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Communications in Computer and Information Science 340

Computer Applications for Software Engineering, Disaster Recovery, and Business Continuity

International Conferences, ASEA and DRBC 2012
Held in Conjunction with GST 2012
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Volume Editors

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Foreword

Advanced software engineering and its applications and disaster recovery and business continuity are areas that attract many academic and industry professionals. The goal of the ASEA and DRBC conferences is to bring together researchers from academia and industry as well as practitioners to share ideas, problems, and solutions relating to this field.

We would like to express our gratitude to all of the authors of submitted papers and to all attendees for their contributions and participation.

We acknowledge the great effort of all the Chairs and the members of the Advisory Boards and Program Committees of the above-listed events. Special thanks go to SERSC (Science & Engineering Research Support soCiety) for supporting this conference.

We are grateful in particular to the following, speakers who kindly accepted our invitation and, in this way, helped to meet the objectives of the conference: Jack Dongarra, Tao Gong and Subramaniam Ganesan.

We wish to express our special thanks to Yvette E. Gelogo for helping to edit this volume.

November 2012

Chairs of ASEA 2012
and DRBC 2012

Preface

We would like to welcome you to the proceedings of the 2012 International Conference on Advanced Software Engineering and Its Applications (ASEA 2012) and the 2012 International Conference on Disaster Recovery and Business Continuity (DRBC 2012), which were held during November 28–December 2, 2012, at Jeju Grand Hotel, Jeju, Korea.

ASEA 2012 and DRBC 2012 are focused on various aspects of advances in advanced software engineering and its applications and disaster recovery and business continuity. They provided a chance for academic and industry professionals to discuss recent progress in the related areas. We expect that the conferences and their publications will be a trigger for further related research and technology improvements in this important subject. We would like to acknowledge the great effort of all the Chairs and members of the Program Committee.

We would like to express our gratitude to all of the authors of submitted papers and to all attendees for their contributions and participation.

Once more, we would like to thank all the organizations and individuals who supported this event and helped in the success of ASEA 2012 and DRBC 2012.

November 2012 Tai-hoon Kim on behalf of the Volume Editors

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Table of Contents

Central Technology Forecasting Using Social Network Analysis 1
Sunghae Jun

Design of Movement Scenarios for Aircraft Ad Hoc Networks 9
Ki-Il Kim and Kyoung Choon Park

STVsm: Similar Structural Code Detection Based on AST and VSM ... 15
Ning Li, Mingda Shen, Sinan Li, Lijun Zhang, and Zhanhuai Li

Impact on Realistic Mobility Model for Aircraft Ad Hoc Networks 22
Ki-Il Kim and Kyoung Choon Park

Technology Network Model Using Bipartite Social Network Analysis.... 28
Sunghae Jun

Museum Guide, a Mobile App 36
Jaegeol Yim and Thanh C. Le

Hybrid Mobile Testing Model..... 42
Haeng-Kon Kim

Mobile Application Development Using Component Features and Inheritance 53
Haeng-Kon Kim

View, Level and Fragment: Commonalities in "Architecture 101" and Software Modelling 63
K.O. Chow

Highly Analysable, Reusable, and Realisable Architectural Designs with XCD..... 72
Mert Ozkaya and Christos Kloukinas

ARSL: A Domain Specific Language for Aircraft Separation Minima Determination 80
Sakon Sinlapalun and Yachai Limpiyakorn

Automated Testing Featuring Prototype Generation from Harvested Requirements Specification 88
Nawin Phuangphoo and Yachai Limpiyakorn

Regression Testing of Object-Oriented Software: A Technique Based on Use Cases and Associated Tool 96
Pierre-Luc Vincent, Linda Badri, and Mourad Badri

Development of an Instant Meeting Android Application Using Wi-Fi Direct APIs 107
Jae Yoon Jung and Dong Kwan Kim

V&V to Use Agile Approach in ES Development: Why RDR Works for Expert System Developments! 113
HeeGuen Yoon, Soyeon Caren Han, Byeong Ho Kang, and Seong-Bae Park

Developer Support for Understanding Preprocessor Macro Expansions 121
László Vidács, Richárd Dévai, Rudolf Ferenc, and Tibor Gyimóthy

Enhancing Smartphone Malware Detection Performance by Applying Machine Learning Hybrid Classifiers 131
Abdelfattah Amamra, Chamseddine Talhi, Jean-Marc Robert, and Martin Hamiche

Myth or Reality? Analyzing the Effect of Design Patterns on Software Maintainability 138
Péter Hegedűs, Dénes Bán, Rudolf Ferenc, and Tibor Gyimóthy

Towards Building Method Level Maintainability Models Based on Expert Evaluations 146
Péter Hegedűs, Gergely Ladányi, István Siket, and Rudolf Ferenc

A Study on the Improved Stability of Inverter through History Management of Semiconductor Elements for Power Supply 155
Young-Choon Kim, Ho-Bin Song, Moon-Taek Cho, Chung-Sik Lee, Ok-Hwan Kim, and Sung-Young Park

CSP Based Relation Structure for Social Network Service 163
HwaYoung Jeong and BongHwa Hong

Service Based Software Fault-Tolerance for Manufacturing System 171
HwaYoung Jeong and BongHwa Hong

A Study on Industry-University Collaboration Schemes for the Improvement of Urban Convergence Contents Industry 179
Hae-Jong Joo and Euy-Soo Lee

Information Security System Using Image Puzzle Type Keycode 187
Seongsoo Cho, Changhoon Choi, Sukjoo Hong, and Youngchoon Kim

Schedulability Analysis Approach for UML-Based Real-Time Models . . . 194
Abdelouahed Gherbi

Correlated Weibull Clutter Generation Procedure for UWB SRR System in Automobile Application 202
Seok-Jun Ko, Purushothaman Surendran, and Chul-Ung Kang

RBAC-Based UAV Control System for Multiple Operator Environments 210
Hyeok-June Jeong and Young-Guk Ha

A Study on the Extraction of Damage Locations Using Twitter Messages 218
Younghak Chun, Hyun Suk Hwang, and Chang Soo Kim

Experiments on the Sensor Space Based Location Estimation System under KS Specified Illumination Intensity Environment 225
Seok-Jun Ko, Sang-Seop Lim, and Chul-Ung Kang

A Study on Damage Spatial Data Generation to Construct Disaster History Information 233
Hyun Suk Hwang and Chang Soo Kim

Analysis of Gaussian Pulse's Bandwidth for Automotive UWB Short Range Radar 239
Seok-Jun Ko and Chul-Ung Kang

Software Test Capability Improvement Method 246
Jihyun Lee and Sunmyung Hwang

Implementation of Improved DES Algorithm in Securing Smart Card Data 252
Ariel M. Sison, Bartolome T. Tanguilig III, Bobby D. Gerardo, and Yung-Cheol Byun

Uniform Random Number Generator Using Leap-Ahead LFSR Architecture 264
Je-Hoon Lee, Min-Jeong Jeon, and Sang Choon Kim

The Effect of Fairy Tale Activities with Multimedia on Preschool Children's Prosocial Behavior 272
Yongsuk Kim, Youngsik Kang, and Seongchul Yun

Strategies for the Improvement of Historic Sites Bike Tour Using Structural Equation Modeling 280
Jangwon Jin and Jeongill Kim

A Case Study on the Effect of Land-Use Characteristics on Damages Caused by Natural Hazards in South Korea 287
Jae Heon Shim, Kwang-Woo Nam, and Sung-Ho Lee

An Analysis of the Relationship between the Flow Experience and the Lesson Persistence Intention of Robot Programming Lesson Participants 293
Seung Young Shin and Mi Ryang Kim

Guitar Application Programming for Smartphone 300
Yoemun Yun and Si-Ho Cha

A Study of Communication Design Strategies Based on Visual Elements in Yeosu Expo Newsletter 306
Jung-Ae Lee, Gwang-Yong Lee, and Hee-Suk Shin

A Study on the Conceptual Design of High Efficiency Induction Motor and the Production of Prototype Motor for Sharing Core (Less than 37kw) 313
Kye-Kwang Choi, Sei-Hwan Kim, and Sae-Jong Lim

Solving Mutual Exclusion Problem in Mobile Cellular Networks 319
Sung-Hoon Park and Seon-Hyong Lee

A Resource Allocation Supporting QoS in Mobile Communication Systems 327
Gi-Sung Lee, Jong-Chan Lee, and Sang-Joon Park

An Effect of Korean Wave on Domestic Cosmetics Industry of Korea Boryeong Mud 334
Moon-Hee Choi, Hyun-Seob Cho, and Jason Lee

A Study on the Introduction of Family Impact Assessment System 341
Seung-Il Moon, Ki-Min Song, Sang-Hyeon Park, and Ho-Young Choi

A Harmony between Point of Parity and Point of Difference for the Improvement of Positioning 348
Hyok-Gun Jo

The Economic Analysis of Feasibility Study on the Food Factories of Egypt 353
Doo Hee Han

Multicriterial Evaluation of Critical Infrastructure Element Protection in Czech Republic 361
Martin Hromada and Ludek Lukas

Integrated Alarm Systems 369
Jan Valouch

Reservoir Risk Dispatching Combining Forecasting Error 380
Yu Song, Linlin Fan, and Hongrui Wang

Investigation Technique of Slope Disaster Using Advanced Technology 387
Young-Karb Song, Jeongrim Oh, Young-Jin Son, and MinSu Jung

A Schematic Approach for GIS Application for Tsunami Disaster Management 395
Asha Nilani Liyanage and Heewon Lee

Application of Disaster Information System for Disaster Management ... 401
Hee-Cheon Yun, Jong-Bai Kim, Kap-Yong Jung, and Min-Gyu Kim

Analysis of Judicial Precedent Tendency in the Tourism Business Field ... 409
Seung-Il Moon, Sang-Hyeon Park, Ho-Young Choi, and Ki-Min Song

A Study on the Efficient Supply Chain Management in the Parts Manufacturers of Nuclear Power Plants ... 416
Lee-Sang Jung, Chang-Seung Ha, and Seok-Yong Lee

An Android Phone Workplace Management System ... 424
Shinhyeong Choi

TOD as a Rail Integrated Urban Regeneration Strategies of Old City through Case Study about Toyama Station and Surroundings Area in Japan ... 429
Shin Yekyeong

Concrete Strength Reduction of DSCT Member by Welding Heat ... 437
Deokhee Won, Taek Hee Han, Seungjun Kim, and Young Jong Kang

Mesoporous Co(III) Bis(tetrazolate) Framework for CO_2 Adsorption ... 445
Pushparaj Hemalatha, Mani Ganesh, Mei Mei Peng, Wang Seog Cha, Muthiahpillai Palanichamy, and Hyun Tae Jang

Towards a Framework for Ubiquitous Computing Technologies: Analyzing Users' Values Using Value Focused Thinking Approach ... 452
Jungwoo Lee and Min Sun Kim

Effort Estimation in Incremental Software Development Projects Using Function Points ... 458
José Antonio Pow-Sang and Ricardo Imbert

Semantic Approach to Verifying Activity Diagrams with a Domain Specific Language ... 466
Chinnapat Kaewchinporn and Yachai Limpiyakorn

Author Index ... 475

Central Technology Forecasting Using Social Network Analysis

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Abstract. In this paper, a central technology is defined as a key technology that is connected to most other technologies and that significantly affects them. Accordingly, we can build an R&D policy effectively if we can forecast central technologies. We propose a central technology forecasting model that uses social network analysis (SNA). A social network is a social structure of diverse items as well as of human beings. In this study, we set each technology as a node in an SNA graph and analyze the linkages between them. Thus, we forecast central technologies from SNA results. To verify the performance of our model, we conducted a case study using patent data related to nanotechnology.

Keywords: Social network analysis, Central technology, Technology forecasting, International patent classification, Patent analysis.

1 Introduction

The objective of technology forecasting (TF) is to predict technological changes according to standard and objective processes in technological development [1]. In other words, TF is intended to find the future trend of a technology using analytical methods [2]. Our central technology forecasting (CTF) model is a TF approach, whose objective is to find the key technology in a given technological field. In this paper, we call this a central technology (CT). A CT has significant effects on the development of most other technologies in a given technological field. For example, a company can plan their R&D effectively by using the CTF results. Therefore, CTF will be an important issue for most companies, as well as governments. In this paper, we propose a CTF model that uses social network analysis (SNA). SNA is an analytical approach for social networks, which are social structures that comprise diverse items as well as human beings [3]. SNA has been used in diverse studies [4-5]. In particular, it has recently been applied to the visualization of patent statistics [6]. In this research, SNA of patent and literature documents was conducted using the words that appear in them for statistics purposes. In this study, we construct a more advanced SNA model of patent analysis for CTF. We propose three SNA graphs and an SNA degree ranking for CTF. In addition, we use the international patent classification (IPC) codes of patent documents as input data for our CTF model. In our previous research [7], we used IPC

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codes as meaningful data for TF by applying data mining techniques to them. In this study, we set each IPC code as a node in an SNA graph and analyzed the linkages between these nodes. Thereby, we forecast CTs from the SNA results. To verify the performance of our model, we conducted a case study using patent data related to nanotechnology.

2 Proposed Model

This paper proposes an SNA model for CTF. We define CT as a key technology in a given technology field. In a technological domain, this key technology is connected to most other technologies and it affects them significantly. With the knowledge of which technology constitutes a CT, we can conduct R&D planning and perform technology management effectively. To construct our model, we use patent data. We extract IPC codes from retrieved patent documents in a given technology field. The IPC code shows its corresponding technology. Thus, according to IPC code data analysis, we can forecast future trends in the target technology field. In our model, we construct a patent–IPC code matrix (PIM), the rows and columns of which represent the patents and the IPCs, respectively. Each element of the PIM comprises the occurrence frequency of an IPC code in a patent document. First, we calculate variance–covariance and correlation coefficient matrices [8] from the PIM to construct our SNA model. Covariance between IPC codes is defined as

$$Cov(IPC_i, IPC_j) = E\left(\left(IPC_i - \mu_{IPC_i}\right)\left(IPC_j - \mu_{IPC_j}\right)\right) \quad (1)$$

where $E(\ )$ is the expectation (mean) function and μ_{IPCi} is the mean value of IPC_i. In this study, if IPC_i and IPC_j are concordant, the variance has a positive value. Conversely, the covariance takes a negative value if two IPC codes are discordant. The larger the absolute value of the covariance, the stronger is the relationship between IPC codes. We then build a variance–covariance matrix of IPC codes as follows.

	IPC_1	IPC_2	…	IPC_m
IPC_1	$Var(IPC_1)$			
IPC_2	$Cov(IPC_2, IPC_1)$	$Var(IPC_2)$		
⋮	⋮	⋮	⋱	
IPC_m	$Cov(IPC_m, IPC_1)$	$Cov(IPC_m, IPC_2)$	…	$Var(IPC_m)$

Fig. 1. Variance–covariance matrix of IPC codes

In Figure 1, $Var(IPC_i)$ is the variance of IPC_i. We know that $Cov(X, X) = Var(X)$. We now build an SNA graph model of IPC codes using this matrix. In general, the covariance measure is dependent on the scale of the given data. Therefore, we consider a second matrix that is built according to the correlation coefficient:

$$Corr(IPC_i, IPC_j) = \frac{Cov(IPC_i, IPC_j)}{\sqrt{Var(IPC_i)}\sqrt{Var(IPC_j)}} \quad (2)$$

The correlation coefficient is a standardized covariance and has a value between –1 and 1. In this paper, we construct another SNA graph model using the correlation matrix shown below.

	IPC_1	IPC_2	…	IPC_m
IPC_1	1			
IPC_2	$Corr(IPC_2, IPC_1)$	1		
⋮	⋮	⋮	⋱	
IPC_m	$Corr(IPC_m, IPC_1)$	$Corr(IPC_m, IPC_2)$	…	1

Fig. 2. Correlation matrix of IPC codes

Using the covariance and correlation matrices, we construct SNA graphs of IPC codes. These matrices are used as an adjacency matrix [9] for the SNA graph model. Fig. 3 shows the SNA graph considered in our study.

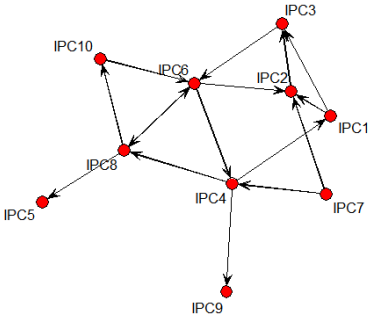

Fig. 3. SNA graph by covariance and correlation matrices

The direction of the arrows shows the direction of the technological impact. Therefore, we can decide that *IPC2* and *IPC6* are more likely to represent CT candidates because they have more connections than all the other IPC codes. Similarly, it is unlikely that IPC5 and IPC9 represent CT candidates. Next, we build a second SNA graph for the mutual relationship, as shown below.

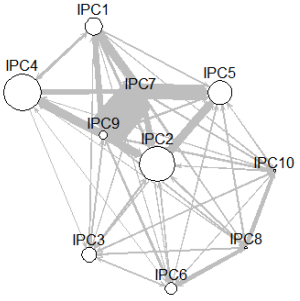

Fig. 4. SNA graph by mutual relationship

In Fig. 4, the thicker the line that links the IPC codes, the stronger is their mutual relationship. We observe that the mutual relationships of *IPC7* and *IPC9* are stronger than those of other IPC codes are. Therefore, these IPCs can represent CT candidates. Next, we consider the degree of SNA in order to find CT candidates. In this study, the degree is an index that represents the local characteristic of IPC codes. The degree of IPC_k is defined as

$$Degree_{IPC_k} = \left|O^{+}_{IPC_k}\right| + \left|I^{-}_{IPC_k}\right| \quad (3)$$

where $|O^{+}|$ and $|I^{-}|$ are respectively the out-degree and in-degree, which are the number of arrows from and to IPC_k. The SNA process for CTF is represented as follows.

SNA Process for Central Technology Forecasting

Step 1. Preparing IPC code data
(1-1) Retrieving patent data of target technology;
(1-2) Extracting IPC codes from patent documents;
(1-3) Constructing patent-IPC code matrix (PIM) using text mining;
Step 2. Building SNA graph
(2-1) Calculating variance-covariance (Σ) and correlation (R) matrices;
(2-2) Building two SNA graphs using Σ and R;
(2-3) Building another SNA graph using mutual relationship;
(2-4) Selecting candidates by connecting states from three SNA graphs;
Step 3. Ranking degrees
(3-1) Computing in-degree and out-degree of IPC codes;
(3-2) Setting [degree] = [in-degree] + [out-degree];
(3-3) Ranking all IPC codes by degree index;
(3-4) Searching central technologies by degree ranks;
Step 4. Deciding central technologies
(4-1) Combining step 2 and step 3 results;
(4-2) Selecting central technologies in combined results;

Fig. 5 shows our proposed model.

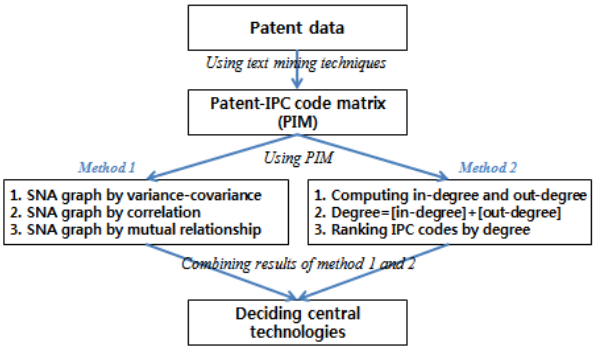

Fig. 5. Process of the proposed model

To verify the performance of our proposed model, we then conducted a case study using patent data related to nanotechnology.

3 Experimental Results

To verify the performance of our approach, we conducted a case study using nanotechnology patent data [10]. In a previous research [10], the emerging technological areas of nanotechnology were forecast by regression analysis and neural networks modeling. In this research, we forecast the CT in the nanotechnology domain using the SNA model. The number of retrieved patent documents was 2482, which yielded 253 IPC codes. Using all the IPC codes is superfluous, because most IPC codes have only a few occurrences in retrieved patent data. For our experiment, we selected the IPC codes with an occurrence frequency over 50. Therefore, we finally used 24 IPC codes, as shown below.

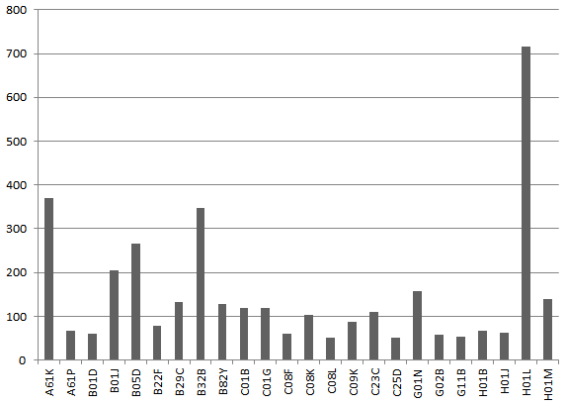

Fig. 6. Occurrence frequency of selected IPC codes

H01L code is the IPC code with the greatest occurrence frequency (717). This code represents the technology of "semiconductor and electric solid state devices" [11]. We can determine that this technology is a basic item in the nanotechnology field; however, we cannot infer whether it is a CT. Therefore, we applied our SNA model for CTF. First, we calculated the covariance and correlation values between IPC codes for the SNA graph. Fig. 7 shows the SNA graphs according to covariance and correlation matrices.

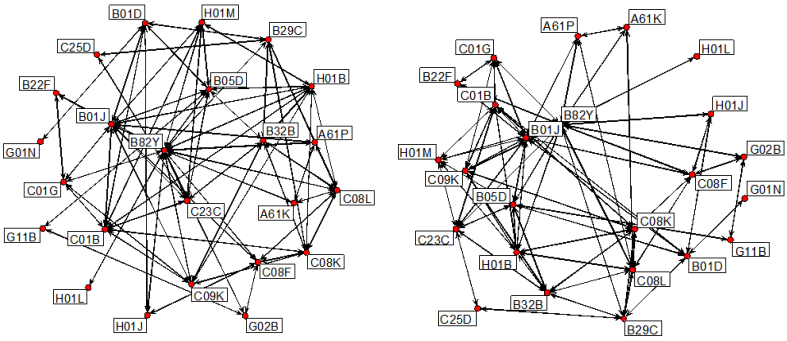

Fig. 7. SNA graph by covariance (left) and correlation (right) matrices

In the SNA graph on the left side of Fig. 7, we can consider the IPC codes *B05D*, *B32D*, *B01J*, *B82Y*, *C01B*, *C23C*, and *C08F* as representing candidates for CTs of nanotechnology, because they are connected to many other codes. Next, on the right side of Fig. 7, we show another SNA graph built according to the correlation coefficient matrix. This graph is the standardized version of the SNA graph according to covariance. As in the covariance case, the IPC codes *B05D*, *B01J*, *B82Y*, *C01B*, *C08K*, *C09K*, *C08L*, and *H01B* were selected as representing CT candidates in the nanotechnology domain. We were aware that *B05D*, *B01J*, *B82Y*, and *C01B* were CT candidates in the two SNA graphs simultaneously. To obtain results that would be more detailed, we computed the degrees of all the IPC codes, and ranked the IPC codes in order of their degree size. Table 1 lists the degrees and rankings of 24 IPC codes according to their covariance and correlation values.

Table 1. Degree and ranking of IPC code data

IPC code	Covariance		Correlation	
	Degree	Ranking	degree	ranking
A61K	-0.09221672	22	-0.17276083	13
A61P	0.13062563	1	0.40443494	5
B01D	-0.02478466	12	-0.29059761	14
B01J	0.07440659	3	0.55477425	4
B05D	0.02029737	7	0.31895373	6
B22F	-0.04828964	17	-0.67921432	21
B29C	-0.04499044	15	-0.37923223	16
B32B	-0.05060019	20	-0.04438418	9
B82Y	0.11522283	2	0.93177823	1
C01B	0.02399607	6	-0.02545989	8
C01G	0.03879476	5	0.30416989	7
C08F	-0.02188624	11	-0.12497927	11
C08K	0.01337222	8	0.71597092	2
C08L	0.03911305	4	0.69775586	3
C09K	-0.03528184	13	-0.42526781	18
C23C	0.00272563	9	-0.07257486	10
C25D	-0.03666284	14	-0.35068658	15
G01N	-0.11143189	23	-0.83993582	23
G02B	-0.04879242	18	-0.66785287	20
G11B	-0.04908603	19	-0.78747679	22
H01B	-0.01447715	10	-0.14071852	12
H01J	-0.04510801	16	-0.50801311	19
H01L	-0.50371867	24	-1.89631037	24
H01M	-0.06816609	21	-0.39054355	17

As mentioned in the previous section, the IPC codes whose degree values are larger than those of others have a high probability of representing a CT. In Table 2, we show the combined total of covariance and correlation rankings according to which we selected CTs candidates.

Table 2. Total degree ranking (Tot. Ranking) of IPC code data

IPC code	Tot. Ranking	IPC code	Tot. Ranking	IPC code	Tot. Ranking
B82Y	1	C23C	9	A61K	17
A61P	2	C08F	10	H01J	17
B01J	3	H01B	10	B22F	19
C08L	3	B01D	12	G02B	19
C08K	5	B32B	13	H01M	19
C01G	6	C25D	13	G11B	22
B05D	7	B29C	15	G01N	23
C01B	8	C09K	15	H01L	24

The IPC code of *B82Y* has the largest degree value. Therefore, we can decide that the technology represented by *B82Y* is the CT of nanotechnology. This technology is described as "specific uses or applications of nano-structures; measurement or analysis of nano-structures; manufacture or treatment of a nano-structure" [11]. The second and third CT candidates are *A61P* and *B01J*, respectively; the remaining IPC codes are ranked in the same way. Finally, we built a mutual related SNA graph as shown below.

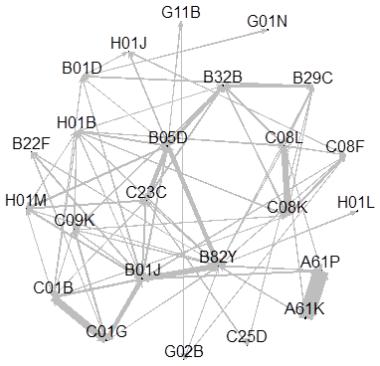

Fig. 8. Mutual relationship SNA graph

From this graph, we found that the IPC codes of *B05D*, *B01J*, and *B82Y* could represent CT candidates in the field of nanotechnology. We also found that the relationship between *A61P* and *A61K* was strong. This means that the technologies represented by *A61P* and *A61K* affect each other strongly in terms of their technological advancement. From the results of all the experiments, we could determine the CTs for nanotechnology. They were represented by IPC codes *B05D*, *B01J*, and *B82Y*, which were included in all the candidate lists of our experiments. Therefore, if we develop nanotechnology, we indirectly develop the strength of the following technologies.

Table 3. Determined central technologies for developing nanotechnology

IPC code	Detailed Technology
B05D	Processes of applying liquids or other fluent materials to surfaces
B01J	Chemical or physical processes
B82Y	Uses, application, measurement, analysis, or manufacture of nano-structures

4 Conclusion

In this paper, we proposed an SNA model for CTF based on an SNA graph and degree ranking approach. We built covariance and correlation matrices for constructing SNA graphs, and we constructed a mutual relationship SNA graph to determine CTs. In addition, we computed the degree ranking of IPC codes to extract a candidate list for CTF. We verified the performance of our approach in a nanotechnology case study, for which we used retrieved patent documents related to nanotechnology. From the experimental results, we decided that the technologies represented by IPC codes *B05D*, *B01J*, and *B82Y* were CTs of nanotechnology. The final utilization of our determined CTs is the role of domain experts. In particular, we recommend that the domain knowledge of nanotechnology be used for deploying the CTs that were found in our experiments.

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Design of Movement Scenarios for Aircraft Ad Hoc Networks

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Abstract. Since current popular simulators do not provide the simulation environments for aircraft ad hoc networks, it is strongly required to extend the current simulators by adding several elements such as mobility model, type of node and so on to conduct research in the area. In this paper, we propose how to design the realistic mobility scenarios for aircraft ad hoc network. Unlike previous approach based on mathematical equation, it relies on the flight simulator which is used to train pilot. By using of flight simulator, it can generate more realistic mobility model because it can describe accurate dynamics of aircraft. Moreover, user interface of the proposed software is also presented.

Keywords: Mobility model, Aircraft ad hoc networks.

1 Introduction

AANET (Aircraft Ad hoc Networks)[1] have been recently proposed to solve faced problem in aviation. AANET can improve areas such as flight safety, schedule predictability, maintenance and operational efficiencies, passenger amenities. Since aircraft ad hoc networks are constructed under basic technology as the same as current mobile ad hoc networks, it can make use of benefits obtained from self organizing networks. On the other hand, there are still too many research challenges not explored yet since the node in this network possesses significantly different properties to MANET (Mobile Ad Hoc Networks)[2] and VANET (Vehicular Ad Hoc Networks)[3]. Among them, mobility model[4-5] is one of the major differences between them. Thus, this difference accelerates the research works for simulator study in AANET since AANET environments is not available in current famous simulators yet. In addition, as proven in previous works for MANET and VANET, simulation studies have precedence of other research works because realistic test-bed and the evaluation would need to be performed. These demands have been observed and demonstrated in many previous research works such as SUMO[6].

For further simulation study, several parameters such as diverse type of aircraft, mobility pattern based on dynamics of aircraft should be included. However, it is not easy task since their behaviors are mostly dependent on external and internal

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environments. This implies that current approach through mathematical model is not sufficient for mobility in AANET. Followed by above needs, in this paper, we propose how to generate realistic mobility scenarios for each simulator. Instead of mathematical model, we propose how to develop software which makes use of commercial flight simulator, Microsoft Flight Simulator[7]. This software provides an artificial re-creation of aircraft flight and various aspects of the flight environment. Under the architecture, a user can place multiple aircrafts at anywhere. And then, the position of this aircraft is converted to corresponding position on Flight Simulator. After configuration for waypoint of aircraft and speed is done, actual movement is achieved on the Flight Simulator in a way automatic aviation. The position information of aircraft on Flight Simulator is traced and then converted to corresponding format for each simulator. As a result, realistic mobility model is achieved by using the actual model for aircraft and environment.

The rest of this paper is organized as follows. In section 2, we explain software component. In section 3, we show design user interface for implementation. Finally, the conclusion and further works will be given in section 4.

2 Software Design

2.1 Software Component

Fig. 1 shows the software component to obtain mobility model. New software has five components and their detail description is shown below.

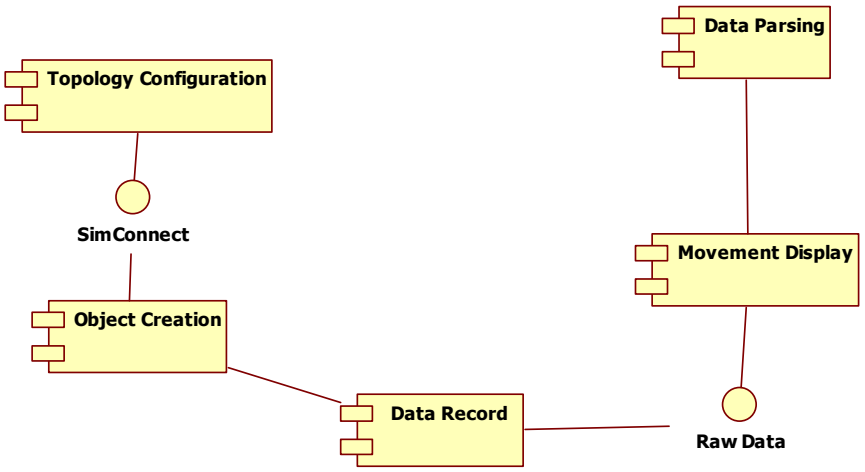

Fig. 1. Component diagram

- Topology Configuration: In this component, a user creates aircraft and sets its type. Also, some information for speed is initiated and the consecutive waypoints are determined. It also includes function to start and stop simulation.

- Object Creation: When the topology configuration events are passed to object creation component, actual aircraft is created in Flight Simulator. Also, passed information form topology configuration is used to set up simulation scenarios in Flight Simulator.
- Data Record: During the aviation in the Flight Simulator, all position information along the waypoint is recorded. The information includes the latitude, longitude, speed, and the simulation time.
- Movement Display: For the validation, new software includes component for displaying movement. For the movement, recording data is converted to corresponding data in a component which uses different system for position and speed.
- Data parsing: According to the networks simulator, this component parses the data file obtained in Data Record component and creates the corresponding formats.

3 Implementation of User Interface

For the topology configuration, we develop new software by .NET. The connection between developed software and Flight Simulator is made by SimConnect which is an API to enable add-on components communicate with Flight Simulator. The main function of this component is to perform the followings such as creating the flight plans and recording or monitoring a flight. In Fig. 2, we make simple interface for software such as Connect, CreateNode, Start Simulation, Stop Simulation, and Create Mobility Model. The details are as followings.

- Connect : connects two software via SimConnect
- CreateNode : makes node in software
- Start and stop simulation : indicates to start aviation in Flight simulator
- Create Mobility File: makes the corresponding mobility file where default is set to NS-2

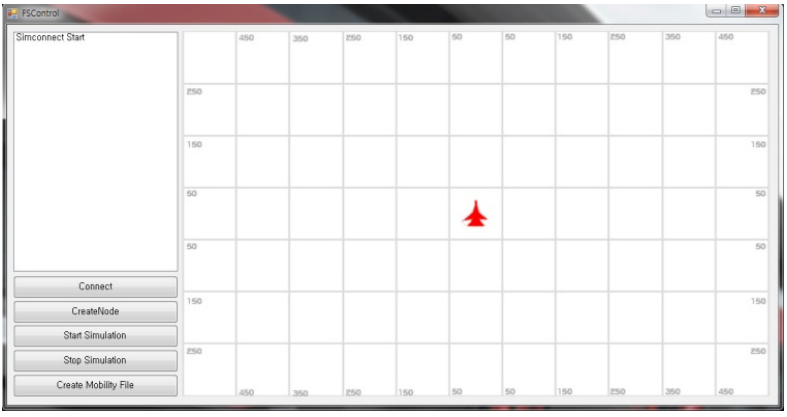

Fig. 2. User interface for software

The user runs the software by connecting respective software. After this job is completed, a message is displayed in Fig. 3 and position information is consecutively display without regard to movement as you can see in Fig. 4.

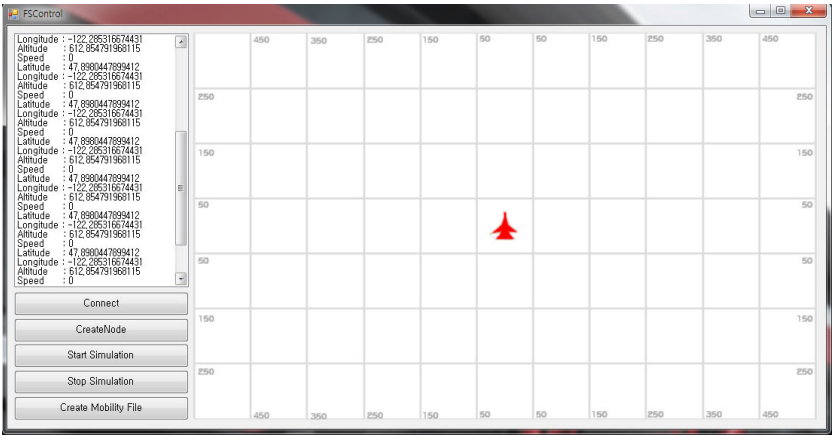

Fig. 3. Receiving data from Flight Simulator upon connecting

In Fig. 4, a user can create a new aircraft on the new software as well select its type. After setting the type of aircraft, related information to the speed is determined. A new position of the aircraft is set by locating a point in software. Node volume indicates the number of aircraft and node type does the type of aircraft.

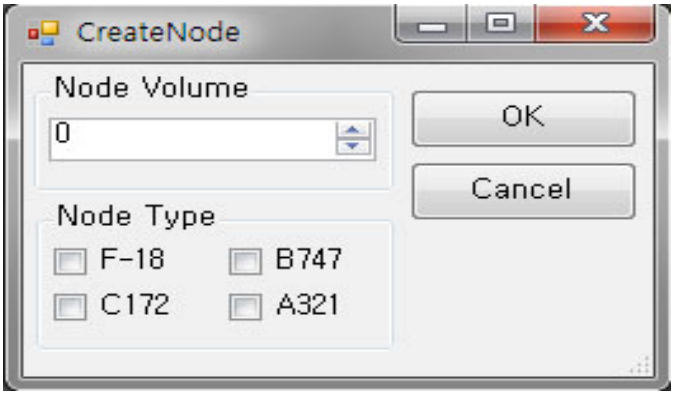

Fig. 4. Creating a new node with type

Next step is to set up waypoint of each aircraft. This is done by pointing a desired location according to user demand. In Fig. 5, user interface is developed through .NET. After deciding the final waypoint, the simulation scenario is completely established. As you can see in Fig. 6, both latitude and longitude are automatically computed by communicating with Flight Simularor. However, altitude and speed information should be configured by the user.

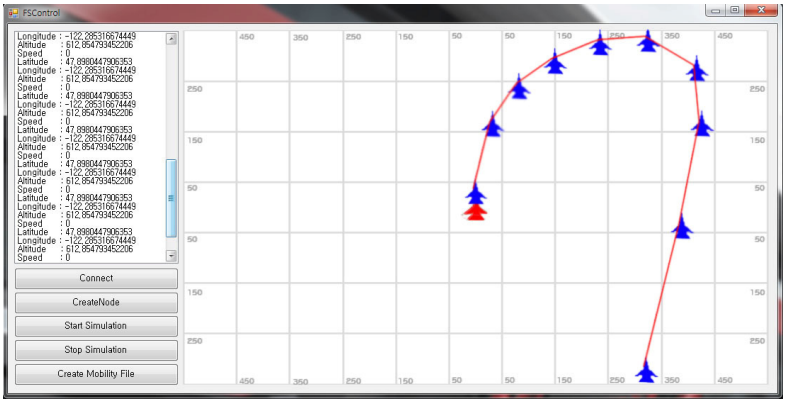

Fig. 5. Pointing multiple waypoints

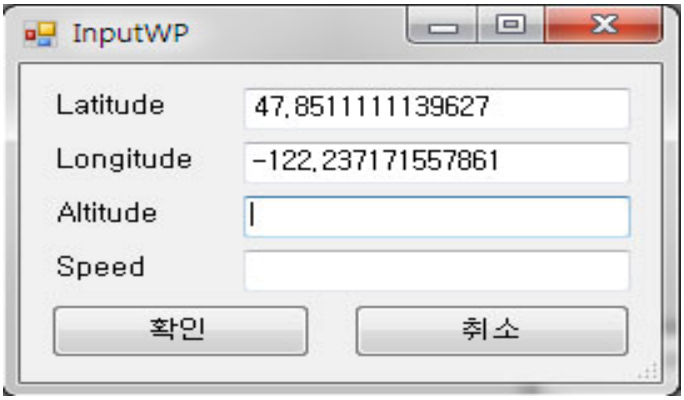

Fig. 6. Input the altitude for one waypoint

4 Conclusion and Further Works

Even though there are many components for entire AANET simulator, mobility model is the most significant component in simulator. Based above needs, we proposed and developed new software to generate realistic mobility model for aircrafts. This is achieved by making use of actual flight simulator. And, the experiment and its interface on the software were introduced. For this work, more components such as generating simulation scenarios automatically and adding the weather conditions will be continued.

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STVsm: Similar Structural Code Detection Based on AST and VSM

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Abstract. The potential software defects are most derived from the frequent changes during the development life cycle. It is very helpful to inform developers of the related codes which are affected by the change they are currently performing. In this paper, we propose a new approach STVsm to detect the similar structural code which related to some software changes. The method of STVsm is based on abstract syntax tree and vector space model. Experimental results show that our STVsm method achieves a significant accurate to detect the similar structural codes in C programming language, including exact clones, change code format, renamed codes, reordered codes and add redundancy codes.

Keywords: Clone Code Detection, Similar Stuctural, Change Related Code, AST, VSM.

1 Introduction

Software defect is one of the determinants of software quality. Many software systems undergo frequent changes during the life cycle, and the potential software defects are most derived from these changes. It is essential to understand the potential impact of a software change as early as possible. It is very helpful to inform developers of the related codes which are affected by the change they are currently performing. These codes may be structural related or semantic related. In this paper, we aim to propose a new approach to detect the similar structural code.

With respect to change related code, there are two close research directions including code clone detection[1] and change impact analysis(CIA)[2]. In the research of code clone detection, a multitude of clone detection approaches have been proposed. They differ in the program representation they operate on and in the search algorithms they employ to identify similar code fragments. Most of them can be classified into: metric-based[3, 4],text-based(including token-based)[5–7],tree-based[8, 9] and graph-based[10]. In metric-based method, the comparison object is the metric of codes. It is simple, but not very accurate since many important logic informations in source code are lost. text-base method is

T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 15–21, 2012.

very efficient not only time but also space, while it is sensitive to the source code order. Tree-based method can do well in structural similarity detection,but it is so time-consuming as well as graph-based method. In order to detect similar structural codes efficiently, we propose a new detection method called STVsm. In this method, we get structural information by tree-based method, and then detect similar code using text-based method. Our experiment shows the STVsm method achieves more accurate code clone detection.

The remainder of this paper is structured as follows. Firstly, background knowledge is introduced in Section 2. Then in Section 3, we describe the STVsm detection method in detail. We report our experiment results in Section 4. Finally Section 5 concludes the paper, discusses the limitations of our approach and outlines further work.

2 Background

2.1 AST and ANTLR

An abstract syntax tree(AST), or just syntax tree, is a tree representation of the abstract syntactic structure of source code written in a programming language. Each node of the tree denotes a construct occurring in the source code. The syntax is 'abstract' in the sense that it does not represent every detail that appears in the real syntax. Since we aim to detect the similar structural code, the syntax tree is essential.

In this paper, we use ANTLR[1] to generate the AST of C language. The ANTLR(ANother Tool for Language Recognition) is a open language tool that provides a framework for constructing recognizers, interpreters, compilers, and translators from grammatical descriptions containing actions in a variety of target languages. We select it as our AST generation since ANTLR provides excellent support for tree construction, tree walking, multi-languages.

For example, a simple C code fragment is listed as Fig.1. The parse result of ANTLR is Fig.2.

```
void mysum(int i)
{
  int sum;
  for(i=1;i<100;i=i+1)
  {
    sum=sum+i;
  }
}
```

Fig. 1. C Code Fragment

```
(FUNC_DEF
(FUNC_HDR void mysum (ARG_DEF int i))
(BLOCK (VAR_DEF int sum)
(for (= i 1) (< i 100) (= i (+ i 1))
(BLOCK (= sum (+ sum i))))))
```

Fig. 2. Parse Result

Fig.3 is the graphical tree corresponding to the result string listed in Fig.2 .

[1] http://www.antlr.org/

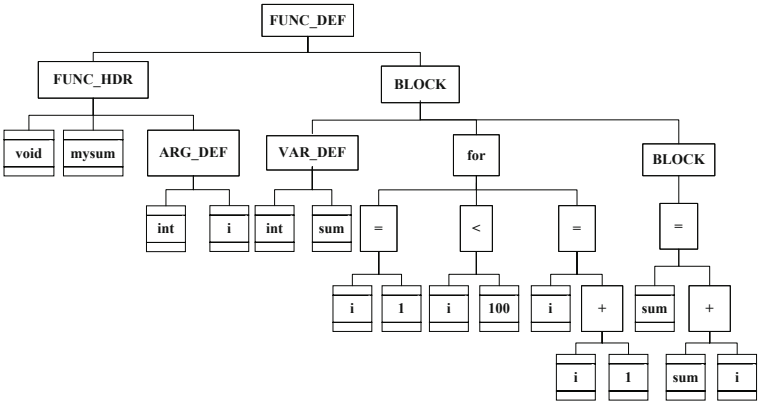

Fig. 3. Abstract Syntax Tree

2.2 VSM

Vector Space Model(VSM) is an algebraic model for representing text documents. It is widely used in information retrieval. Source code is also a kind of text. In this paper, it is used to construct code token vector space mode by traditional tf-idf formula(Formula 1, Formula2, Formula3), and then we compute code similarity using cosine distance as Formula 4.

According to the classic vector space model proposed by Salton, the term specific weights in the code document vectors are products of local and global parameters as Formula 1.

$$w_{ij} = tf_{ij} \times idf_i \tag{1}$$

Where w_{ij} is the weight of the i-th index term and the value fall within the range [0,1], tf_{ij} is the weight of term i in code document j(local weight), and idf_i is the all weight of term i in all code document(global weight).

$$tf_{ij} = \frac{freq_{ij}}{max(tf_j)} \tag{2}$$

$$idf_i = log(\frac{N}{n_i} + offset) \tag{3}$$

Where $freq_{ij}$ is the frequency of term i in code document j. $max(tf_j)$ is the max frequency value of all term in code document j. N is the number of documents. n_i is the number of documents which include the term i. Here, $offset$ is 0.1.

$$Sim - Cos(C1, C2) = cos(\theta) = \frac{C1 \cdot C2}{||C1||||C2||} = \frac{\sum_{i=1}^{n} W_{1i}W_{2i}}{\sqrt{\sum_{i=1}^{n}(W_{1i})^2 \times \sum_{i=1}^{n}(W_{2i})^2}} \tag{4}$$

where C1 and C2 represent two code fragments. In this paper, the code fragment is string parsed by ANTLR instead of original source code.

3 Structural Similarity Detection Method: STVsm

In STVsm method, firstly source codes are transformed to AST by ANTLR, then some leaf nodes of AST are replaced with the same term, and compute the code similarity by VSM lastly.

3.1 AST Generating

There are two steps when generating AST by ANTLR.

- Make the grammar file(.g). The rules of Lexer and Parser are included in this file. For example, the grammar rule of for/while statement in C is described as following.

```
forStat
        : 'for' '('start=assignStat';' e=expr ';' next=assignStat ')' block
            -> ^('for' $start $e $next block)
        | 'while' '(' expr ')' block
            -> ^('while' expr block)
        | 'do' block 'while' '(' expr ')' ';'
            -> ^('do' block 'while' expr)
```

- Generate the AST. ANTLR scans original source code and parses them by Lexer and Parser. Finally, ANTLR output the parsed string as Fig.2

3.2 Variable Name Processing

Renaming function or variable is a common way to plagiarize code. And the identifiers are not very useful in structural similarity detection. Therefore, in order to remove the negative effect, we replace function/variable name and const value using the same term.

In Fig.3, we should replace the leaf nodes which represent function/variable name or const value. After observation, we found all non-leaf nodes are keywords/operators in C or ANTLR, so we can scan the whole AST string, then reserve the words listed in Table1 and replace the other words with the same term.

Table 1. Reserve Keywords

Operator	=, + =, − =, ∗ =, / =, +, −, ∗, /, −−, ++ >, <, <=, >=, ==, ! ==, &&, ||, !, <<, >>, &, |, , ?, :
Keywords in C	if,else,switch,case,for,do,while,return,auto,struct, enum,typedef,const,extern,register,static,volatile, continue,break,default,sizeof,union,goto
Keywords in ANTLR	ARG_DEF,BLOCK,IF,ELSE,EQ,EQEQ,FOR, FUNC_DEF,FUNC_HDR,OPRT,OPLT,PLUS, FUNC_DECL,WS,ID,INT,VAR_DEF,WHILE
bracket in AST	(,)

3.3 Similarity Computing

We use the processed code text as Fig.4 compute the code structural similarity by VSM. Fig.4 shows the processed code text corresponding to the code described in Fig.1.

Firstly, we construct the vector space by Formula1- Formula3, and then we compute the similarity by Formula4.

```
(FUNC_DEF
(FUNC_HDR V V (ARG_DEF V V))
(BLOCK (VAR_DEF V V)
(for (= V V) (< V V) (= V (+ V V))
(BLOCK (= V (+ V V))))))
```

Fig. 4. AST string after replacement

In order to compare with VSM, in this paper we also use LD(Levenshtein distance)[2] and GST(greedy string tiling) method[11] to compute text similarity.

4 Experiment

To parse the code to AST by ANTLR, we modify and extend grammar rules based on official example V3 grammar file for simple C language[3].

4.1 Data

In our first experiment, we use five common code pairs to evaluate the accuracy of the STVsm.

- clone exactly(CE):Two code fragments are the same.
- change format(CF): Change code format by adding/removing some blanks or newlines.
- rename identifier(RI): Rename the name of functions or variables.
- reorder statement(RS): Change the order of the statements.
- add redundancy codes(ARC): Add some redundancy source codes.

Another experiment is designed to evaluate all kinds of program structure. We use three kinds of control structure: sequential control statements, conditional selection statements and loop statements.

To simplify the experiment, we use "if" statement as conditional selection statements, and use "for" statement as loop statements.

[2] http://en.wikipedia.org/wiki/Levenshtein_distance

[3] http://www.antlr.org/download.html: ANTLR v3 sample grammars (C, C#, Java, ActionScript, and Python targets).

4.2 Result

Table 2 and Table 3 show the similarity using different methods and structures. The similarity is within the range of [0,1]. The similarity value is closer to 1, the codes are more similar. The experiments result shows that our STVsm method gets the most accurate similarity.

In Table 2, Compared with the methods based on AST, the first method only using VSM is lower than the other methods. It shows AST which extracts code structural information exactly have a great help for improving the code similarity detection.Due to that LD and GST methods are order sensitive, VSM do better than LD and GST in RS and ARC among of the last three methods based on AST.

Table 3 shows our STVsm get a better similarity in every basic structure.

Table 2. Similarity Comparison of Different Code Clone Ways

Method	CE	CF	RI	RS	ARC
VSM	1	1	0.3847	1	0.3963
LD based on AST	1	1	1	0.9537	0.7322
GST based on AST	1	1	1	0.9957	0.8415
STVsm(VSM based on AST)	**1**	**1**	**1**	**1**	**0.8806**

Table 3. Similarity Comparison of Different Code Structure

Method	sequential	conditional	loop
VSM	0.5203	0.0619	0.0113
LD based on AST	0.9924	0.9321	0.9833
GST based on AST	0.9924	0.9267	0.9833
STVsm(VSM based on AST)	**1.0**	**0.9471**	**1.0**

5 Conclusions

In this paper, we propose a novel method named STVsm for similar structural code detection. In this method, we consider both structure and text information. With respect to structural information, we use abstract syntax tree parsed by ANTLR, and then replace some leaf nodes of AST. For the transformed string, we use classical VSM model and Cosine Distance to compute the code similarity. The Experimental results show that our STVsm has a significant accurate similarity than traditional VSM, and also gets better similarity than LD and GST based on AST.

Although STVsm takes both structure and text information into account, it ignores the semantic information of text. And the experiment code scale is not very large. It needs to be further studied. In the future, we will try to evaluate our method in more large dataset, and try to combine the semantic information into our code similarity detection method.

Acknowledgment. This work is supported by the National Science Foundation of China No.60970070, No.61033007 and the Basic Research Foundation of Northwestern Polytechnical University No.JC20110225.

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Impact on Realistic Mobility Model for Aircraft Ad Hoc Networks

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Abstract. In this paper, we address the impact on realistic mobility model for routing protocol of aircraft ad hoc networks. Since current simulation results are not based on realistic model, impact of mobility model for aircraft ad hoc networks has not been explored very well yet. Thus, this study will provide good simulation results for researcher who is going to develop routing protocol for aircraft ad hoc networks. Moreover, analysis of results shows what is the important factor in design of routing protocol. For the simulation, we introudce three main protocols, AODV, DSDV, and GPRS according to general classification, reactive/proactive as well as geographical protocol.

Keywords: aircraft ad hoc networks, performance evaluation, mobility model, routing protocol.

1 Introduction

Research for typical Mobile Ad Hoc Networks (MANET)[1] where participating nodes are supposed to construct self-organizing networks without any help of centralized point whenever it is needed becomes one of hard challenges. In order to form topology as MANET, a node should collaborate with other nodes to build networks autonomously in a distributed way.

One of the most outstanding features in this kind of networks is mobility support because networks are distinguished by what kind of nodes are used in the networks such as vehicle as well as following fact that each node is allowed to move anywhere and anytime freely in this network. As compared to existing network technology, the need of mobile ad hoc networks increases rapidly because many applications are increasingly demanding it. Example of communication environments for mobile ad hoc networks includes communication in tactical area as well as disaster area where infrastructure network is not available or rapid network deployment is required. Moreover, both telecommunication and teleconference are good examples for application in these environments around the real world.

In addition to previous research works, recently, AANET[2] (Aircraft Ad Hoc Networks) have been proposed. In these networks, aircraft is envisioned to participate

T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 22–27, 2012.

as a self-aware node and communicates with ground infrastructure and other aircrafts. Thus, these networks show different features with typical ad hoc networks in that information becomes available through in-aircraft, aircraft-to-ground and aircraft-to-aircraft communications. With help of these networks, traffic between aircrafts can be distributed and is regarded to have improved reliability as well as scalability. Based on this property, the need of aircraft ad hoc networks increases due to an unprecedented increase in air traffic, fuel costs and environmental pollution. Also, more efficient communication method is supported by AANET.

Since the topology of the network is constantly changing, the issue of routing packets between any pair of nodes becomes a challenging task. Routes between nodes may potentially contain multiple hops, which is more complex than the single hop communication. For the routing protocol, much research has been conducted to establish the path between source and destination. Thus, when it comes to develop routing protocol, performance evaluation of the existing protocols can be good approach to analyze the properties of networks as well as understand the requirement of new protocol. Based on above demand, in this paper, we will conduct simulation study of existing ad hoc routing protocol for aircraft ad hoc networks. For the study, three famous protocols are concerned. They are AODV[3], DSDV[4] and GPSR[5].

To precede the simulation study for AANET, it is strongly recommended to take previous case, evolving from pure ad hoc networks to vehicular ad hoc networks. When research for VANET (Vehicle Ad Hoc Networks) started, first of all, the study for simulator became one of important research challenges[6] because we need to gain insight into the operation of those systems. Even though traditional the formal modeling of systems via a mathematical model that attempts to find analytical solutions to problems as well as enables the prediction of the behaviors of the system from a set of parameters and initial conditions are possible in VANET, however sometimes it is even painful and inaccurate. Thus, it is very important to prepare related components for simulator. But, current networks simulator does not include the corresponding components at all. Among those, the mobility model or movement trace is essential one because each network has the significant different mobility pattern. This indicates that the realistic mobility model for aircraft should be obtained. For the mobility model, we implemented new software which is connected with commercial flight simulator[7]. The detail software architecture will be explained in following section.

By analyzing the suitability of three routing protocols, we can recognize the impact of mobility model in AANET as well as presents design principle for new routing protocol for AANET. The performance of routing protocol is evaluated by varying the number of aircrafts. For the simple study, this paper only includes the results of packet delivery ratio which is the most important performance parameters of routing protocol in ad hoc networks. Since it depends on many parameters such as how soon the path is established or how the protocol can cope with high dynamic mobility, packet delivery ratio is chosen for indicator of routing protocol.

The rest of this paper is organized as follows. The software architecture to get realistic mobility model is presented in section 2. The basic simulation study is explained and analyzed in section 3. Finally, conclusions and further works are given in section 4.

2 Realistic Mobility Model for AANET

In this section, we propose how to generate realistic mobility scenarios for each simulator. Instead of mathematical model, we propose how to develop software which makes use of commercial flight simulator, Microsoft Flight Simulator[8]. This software provides an artificial re-creation of aircraft flight and various aspects of the flight environment. Under the architecture, a user can place multiple aircrafts at anywhere. And then, the position of this aircraft is converted to corresponding position on Flight Simulator. After configuration for waypoint of aircraft and speed is done, actual movement is achieved on the Flight Simulator in a way automatic aviation. The position information of aircraft on Flight Simulator is traced and then converted to corresponding format for each simulator. As a result, realistic mobility model is achieved by using the actual model for aircraft and environment.

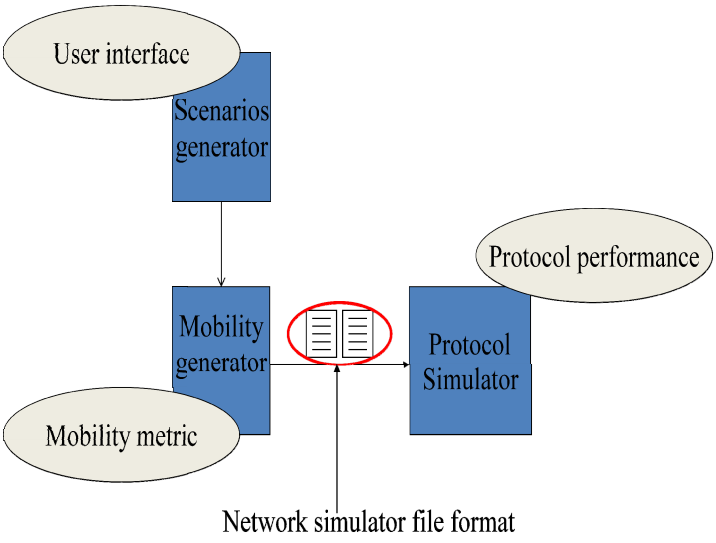

Fig. 1. Software architecture

3 Performance Evaluation of Routing Protocols

In this section, we present the simulation results for three routing protocols with gathered trace file by our new software. The simulation is conducted by ns-2[9] simulator and other parameters for multiple scenarios are described in Table 1.

Since there is not well-known MAC protocol for aircraft ad hoc networks that is implemented in ns-2 now, typical IEEE 802.11 protocol is used in this simulation. However, it is not good example for simulation, the impact of MAC protocol should be concerned while analyzing the performance result. For the traffic pattern, we employ constant bit rate that is usually introduced in the simulation. For the initial

position for the aircraft, they are placed in a way of uniform distribution where all nodes locate at any place in a grid topology.

Table 1. Simulation parameters

Parameters	Value
MAC protocol	IEEE 802.11
Propagation model	Two-ray model
Aircraft type	F-18
Initial position	Uniform distribution
Traffic	CBR over UDP

3.1 Simulation Results

We evaluated the three routing protocol as a function of total nodes. The total number of nodes increases from minimum 10, 20, 50 and maximum 100. We measure the packet delivery ratio with number of nodes and realistic mobility model. Fig. 2 illustrates the packet delivery ratio which is defined the number of packets delivered successfully among the total number of packets sent.

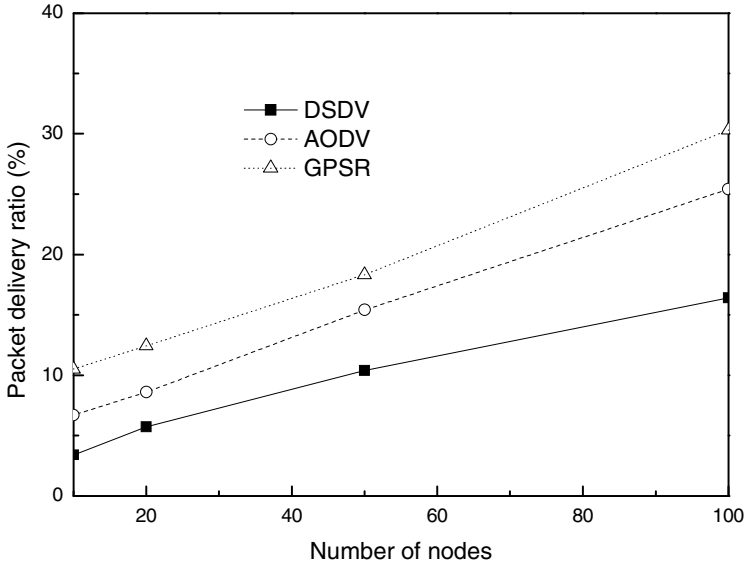

Fig. 2. Packet delivery ratio as a function of number of nodes

In Fig. 2, all protocols show the low packet delivery ratio. The main reason for this result is caused by the following fact that the current routing protocols cannot cope

with such a high mobility. Moreover, sparse deployment is another main source of low packet delivery ratio. More detailed, GPRS shows the better performance than other two protocols. Since the GPRS uses the geographic information to determine the next hop, the effect of dynamic topology is not great as compared to other two protocols. Also, since the waypoints used in our scenarios are not changed significantly, the less impact is considered in the packet delivery ratio. On the other hand, DSDV shows the worst performance in packet delivery ratio. Due to spares deployment, the topology information is not propagated into the whole network adequately. Thus, the routing information based on this topology cannot contain the last information. In a case of AODV, it shows the better performance than DSDV in a usual case. However, due to high mobility speed and sparse deployment, a path established by the RREQ message is not maintained until the RREP message is arrived. This means that different paths between source and destination are established. For all protocols, there are similar pattern for enhanced packet delivery ratio as the density of nodes increases. This fact implies that it is very hard to guarantee packet delivery in sparse environment.

4 Conclusion and Further Works

According to research experiences taken by the example from typical mobile ad hoc networks and recent vehicle ad hoc networks, performance evaluation was the first and important research challenges. To conduct this study, usually simulation study was conducted through well known simulator.

However, a few research works have been conducted to analyze mobility patterns and their impact for aircraft ad hoc network where aircrafts form self-organizing network arbitrary. This is mainly because there is not too much research works for realistic mobility model for aircraft ad hoc networks. Based on above demands, we made the following contributions. First, we explained how to get the realistic mobility mode for aircraft ad hoc network through new approach by using commercial flight simulator. Second, a simulation study for performance evaluation of existing three major routing protocols was conducted to analyze the impact of realistic model over them.

For the further works, more realistic simulation study will be followed by replacing IEEE 802.11 protocol as new one. Also, impact on end-to-end delay and other performance parameter will be demonstrated.

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Technology Network Model Using Bipartite Social Network Analysis

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Abstract. Social network analysis (SNA) is an analysis method with network analytic functionality in the social science domain. SNA is used to analyze nodes and linkages between nodes in social structures. In general, a node represents a person and a linkage is the line that connects that person to others. We can determine the associated structure of a social domain from SNA results. Using an SNA approach, we propose a technology network model for forecasting trends in a target technology. In addition, we construct a bipartite network SNA graph that is composed of technologies and technological clusters. To verify the efficacy of our technique, we carry out a case study using patent data.

Keywords: Technology network, Bipartite-network model, Social network analysis, Patent clustering.

1 Introduction

Most technologies are related to one another [1]. That is, the development of a technology can affect the development of other technologies. Therefore, knowing about the relationship between technologies is essential as this knowledge can help in the management of technology, for example, technology forecasting and R&D planning. In this paper, we propose a technology network model for technological trend-forecasting of a target technology. We use techniques from social network analysis (SNA) to construct the proposed model. SNA is a network analysis model that is based on centrality, multidimensional scaling, distance, covariance structure, and visualization [2]. It provides the linkage structure between nodes in social systems [3]. In this paper, we use nodes to represent technologies and use a SNA graph to construct a technology network model that is based on technologies and their associations (linkages). We also verify the efficacy of our model by means of a case study using software safety and reliability technology as the target technology for the technology network model. In our case study, we conduct experiments using patent documents related to the target technology as this field has a lot of information about developed technology.

T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 28–35, 2012.

2 Proposed Technology Network Model

We propose a technology network model that finds technological relationships and trends for a target technology. In this paper, we use bipartite network SNA (BN-SNA) to construct our technology network model. BN-SNA is a SNA graph that is based on nodes, clusters, and linkages. This study regards a patent document (technology) as a node, and a cluster consists of a group of similar patent documents. The linkages are the connecting lines between patents and clusters. In this way, BN-SNA is well able to explain the networking structure of technologies. Fig. 1 shows an example of our BN-SNA graph.

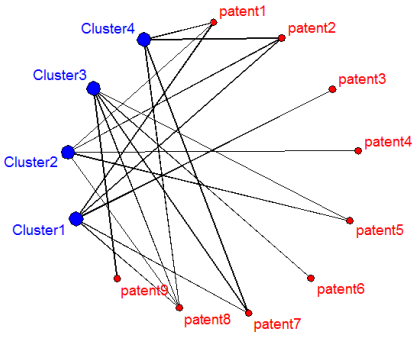

Fig. 1. Example of BN-SNA graph

This graph has a total of thirteen nodes (four cluster nodes and nine patent nodes) and their linkages. If two nodes are connected, they are dependent on each other. The clusters are composed of similar patents. In other words, the four clusters are used t group the nine patents. Using the BN-SNA graph, we can find the relationship between a cluster and a patent as well as a patent and another patent. For example, patent8 is an important technology because it is connected to all the clusters. On the other hand, patent3 is of little import because it is linked only to cluster1. In addition, it can be seen that patent5 and patent6 are associated through cluster3. That is, they share the technology represented by cluster3. Additionally, we use two measures, degree-centrality score (DCS) [4] and between-centrality score (BCS) [4], to effectively construct our proposed model. DCS deals with vertex (node) degree with in-degree and out-degree. In-degree and out-degree are the cardinalities 'into' and 'from' the vertex, respectively. The importance of a technology increases as its DCS increases. BCS gives an indication of the mediative centrality of a node. If the nodes around a particular node are connected by means of that node, its BCS is large. Thus, in this research, we construct our proposed technology network model using BN-SNA graph, DCS, and BCS. To begin the proposed model, we first choose a target technology domain, and retrieve patent documents related to the target technology. We can get patent data from Internet sites (patent databases) such as the United States Patent and Trademark Office (USPTO) [5] and the World Intellectual Property Organization (WIPO) [6]. In general, a patent document has a complicated

data structure that is difficult to analyze using statistical analysis and machine learning. Therefore, we have to preprocess patent data for patent analysis. Text mining techniques are used to preprocess patent data [7]. In our patent analysis method, we cluster similar patents in groups using fuzzy clustering. A patent can be assigned to one or more clusters in fuzzy clustering. In this research, we also use Silhouette measure for optimal selection of the number of clusters [8] because this number is the initial fuzzy clustering value [9]. When the Silhouette value is at its maximum, the optimal number of clusters is determined. Next, we construct an affiliation matrix using the results of preprocessing and fuzzy clustering. In our fuzzy clustering, each patent has a certain probability (fuzzy membership value) of belonging to a cluster. Therefore, a patent can be included in one or more clusters at the same time according to its membership function. The affiliation matrix is the input data for our SNA approaches; i.e., BN-SNA, DCS, and BCS. Using this matrix, our model performs two analytic processes. First, we construct the BN-SNA graph and compute the DCS of all the nodes (patents) in the graph, after which we find meaningful relationship between patents. Next, we calculate the DCS and BCS of all the clusters in the constructed SN-SNA graph. From the results, we extract associated between-clusters information. We then combine the two results to form our technology network model. Our technology network model extracts meaningful association information about clusters and patents. As a result, we can forecast technological trends related to our target technology. Fig. 2 shows the process involved in constructing our model.

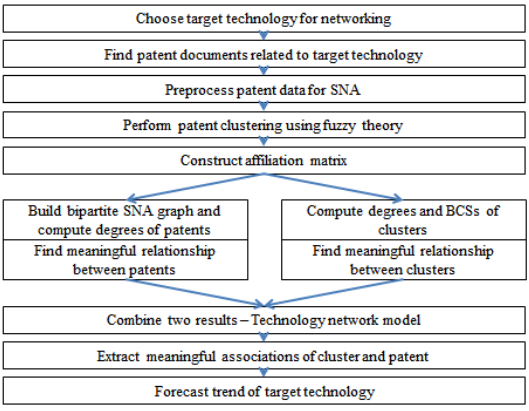

Fig. 2. Technological network model construction process

This paper contributes to the management of technology such as that which takes place in R&D planning and technology forecasting. Our research can also be applied to an approach to patent mapping (a patent visualization model). In the next section, we carry out a case study using patent data related to software engineering to verify the efficacy of our model.

3 Experiment and Results

In this case study, we used patent data related to "software safety and reliability (SSR)" to validate our proposed model. We retrieved patent documents related to SSR from patent databases all over the world. The total number of patents used was 141. Fig. 3 shows the number of patents applied for by year.

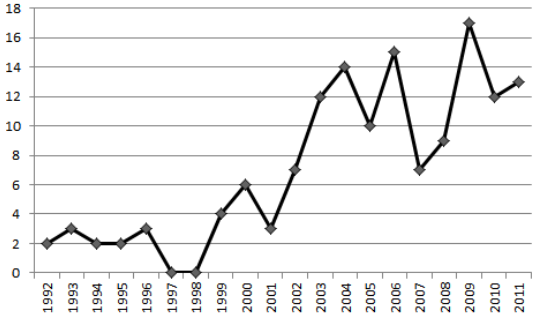

Fig. 3. Number of patents applied for by year

The first SSR patent was applied for in 1992. The number of patents applied for increased after the late 1990s. Next, we constructed a BN-SNA graph to find the relationship between SSR patents, i.e., to predict the association of SSR technologies. To construct the affiliation matrix, we performed fuzzy cluster analysis of the patent data. The first step in clustering is to determine the number of clusters. As a result, we used average Silhouette width for optimal selection of the cluster size as follows:

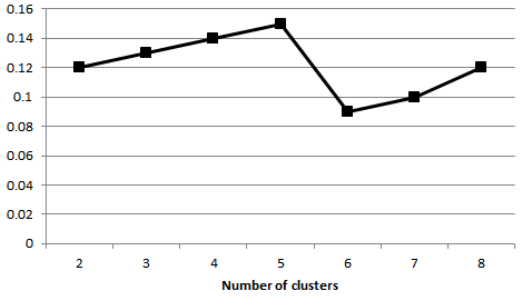

Fig. 4. Average Silhouette width by candidate number of clusters

From Fig. 4, it can be seen that the Silhouette value is largest when the number of clusters is five, so we decided to set the number of clusters for fuzzy clustering at five. In our study, we searched for related patent documents in patent databases throughout the world. Among them, we used WIPO PCT publications (WOPCT),

USPTO (US), and European patents (EP) to construct our technology network model. Fig. 5 shows the BN-SNA graph of the WOPCT patent data.

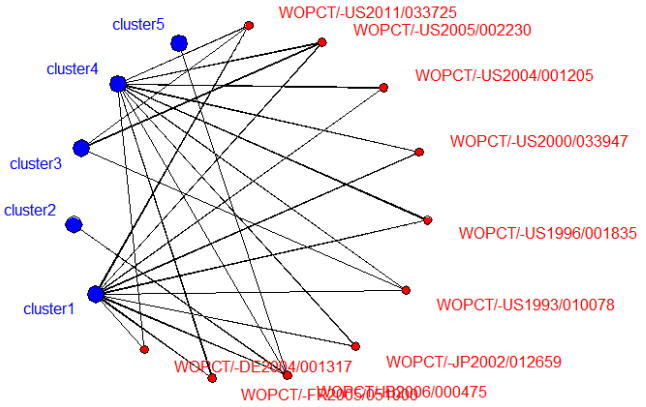

Fig. 5. BN- SNA graph of WOPCT patent data

We found that the patent 'WOPCT/-IB2006/000475' was connected to four clusters, namely, clusters 1, 2, 4, and 5. This means that the technology patented in 'WOPCT/-IB2006/000475' is a widely used technology in SSR technology development. We also know that clusters 1 and 4 are major SSR technology groups because they are linked to many patents. To check the relative importance of all the WOPCT patents, we computed their DCSs in Table 1.

Table 1. DCSs of WOPCT patent data

Patent number	DCS	Patent number	DCS
WOPCT/-US2011/033725	3	WOPCT/-US1993/010078	3
WOPCT/-US2005/002230	3	WOPCT/-JP2002/012659	2
WOPCT/-US2004/001205	2	WOPCT/-IB2006/000475	4
WOPCT/-US2000/033947	2	WOPCT/-FR2005/051000	2
WOPCT/-US1996/001835	2	WOPCT/-DE2004/001317	2

The patent DCS for 'WOPCT/-IB2006/000475' is the largest, so we decided that it is a very important patent for SSR technology. Patents 'WOPCT/-US2011/033725', 'WOPCT/-US2005/002230', and 'WOPCT/-US1993/010078' are also significant technologies because their DCSs are larger than all the other patents except 'WOPCT/-IB2006/000475'. Next, we built a BN-SNA graph for the US. Fig. 6 shows this graph.

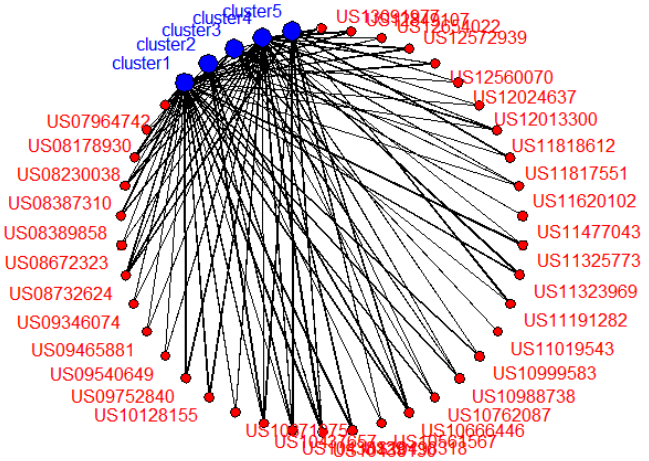

Fig. 6. BN-SNA graph of US

It can be seen that patents 'US10666446', 'US10438130', 'US10438129', 'US10437657, and 'US08732624' are more connected to clusters. Hence, these represent critical SSR technologies. Table 2 shows DCSs for all the US patents.

Table 2. DCSs for US patent data

Patent number	DCS	Patent number	DCS	Patent number	DCS
US13091977	3	US11191282	2	US09752840	2
US12849107	2	US11019543	1	US09540649	2
US12654022	2	US10999583	2	US09465881	2
US12572939	2	US10988738	3	US09346074	2
US12560070	2	US10762087	3	US08732624	4
US12024637	2	US10666446	4	US08672323	2
US12013300	2	US10561567	2	US08389858	2
US11818612	3	US10498318	2	US08387310	3
US11817551	2	US10438130	4	US08230038	3
US11620102	3	US10438129	4	US08178930	2
US11477043	1	US10437657	4	US07964742	3
US11325773	2	US10371975	2		
US11323969	2	US10128155	2		

Patents 'US11477043' and 'US11019543' are isolated technologies because both of them have a DCS of 1. Thus, we surmise that these technologies are of little importance in the SSR domain. We next applied our model to EP patent data. Fig. 7 shows the BN-SNA graph of EP patent documents concerning SSR.

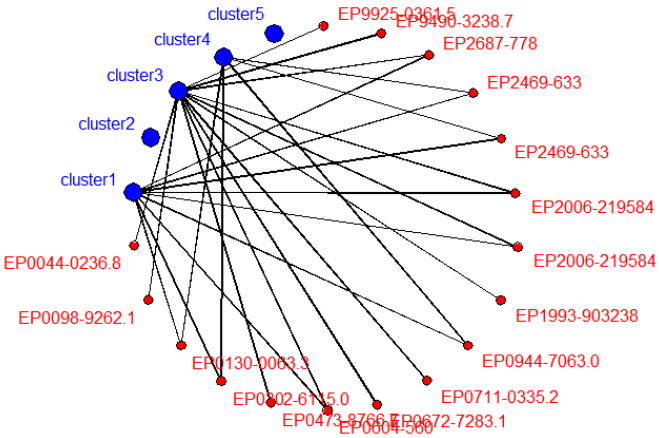

Fig. 7. BN-SNA graph for EP

This graph is different to those for WOPCT and US. In the BN-SNA graph for EP, we cannot find dominant patents for SSR technology. Most patents are connected to one or two clusters. However, clusters 1 and 3 are major technology groups because they are connected to many patents. Table 3 shows the DCS for all the patents of EP.

Table 3. DCSs for EP patent data

Patent number	DCS	Patent number	DCS	Patent number	DCS
EP9925-0361.5	1	EP2006-219584	2	EP0473-8766.7	1
EP9490-3238.7	1	EP1993-903238	1	EP0302-6115.0	2
EP2687-778	2	EP0944-7063.0	2	EP0130-0063.3	2
EP2469-633	2	EP0711-0335.2	1	EP0098-9262.1	1
EP2469-633	2	EP0672-7283.1	1	EP0044-0236.8	1
EP2006-219584	2	EP0604-560	2		

It can be seen that the majority of the EP patents each have a DCS of either 1 or 2. As a result, we concluded that there is no dominant patent for SSR technology in EP. Finally, we computed the DCSs and BCSs for all the clusters.

Table 4. DCSs and BCSs for five clusters

Cluster	WOPCT		US		EP	
	DCS	BCS	DCS	BCS	DCS	BCS
1	10	71	30	683	9	172
2	1	0	10	190	0	0
3	3	2	10	177	12	238
4	10	71	30	683	5	10
5	1	0	10	190	0	0

In the WOPCT and US databases, clusters 1 and 4 are determined to be major technology groups because their DCSs and BCSs are larger than those of other clusters. On the other hand, there is one technology group (cluster 3) in EP. Consequently, we know that the technological trend for (WOPCT and US) and EP is different.

4 Conclusion

In this paper, we proposed a technology network model. This was constructed using a BN-SNA graph, DCS, and BCS. We also clustered all patents into groups of similar patents using fuzzy clustering build an affiliation matrix. Our model used this matrix as input data for constructing a BN-SNA graph. In our case study, we retrieved patent documents related to SSR technology. This case work confirmed the efficacy of our proposed model. In our experiments, we performed fuzzy clustering to get five clusters from all the SSR patents found. Using the results, we constructed a technology network model, and found that there are two dominant clusters in WOPCT and US. In contrast, EP has one dominant technology group in the SSR domain. We also extracted important patents from the constructed technology networking model. This paper contributes to technology management works including R&D policy and technology foresight. In addition, our study can be applied to patent analysis such as patent mapping and technology road-mapping. In our future work, we will develop more advanced network models for technology forecasting using diverse SNA approaches.

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Museum Guide, a Mobile App

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Abstract. As science and technology are advancing, computers become so small and powerful that they are now embedded into mobile telephones. Not only a computer but also so many sensors are installed in a smartphone. Making use of those devices, they have developed so many apps running on smartphones. Museum guide we are introducing in this paper is one of those apps. To the best of our knowledge, Museum Guide is the first indoor-location-based, context-aware, and video-on-demand app.

Keywords: Smart phone, Indoor Location Based, Context Awareness, VoD, App.

1 Introduction

One of the most popular buzzwords is convergence. As science and technology evolve, computers become smaller and smaller while their computing power become stronger and stronger. At the same time, sensor devices also become smaller and smaller while their accuracy become higher and higher. Finally, they all converged into a telephone to become a smartphone which is one of the best examples of successful convergence. Nowadays, a smart phone, convergence of computer, telephone and many sensors, is one of the most common personal belongings.

As a smart phone is equipped with a computer and many sensors, various useful applications running on it have been developed. Since a smart phone is one of the most common personal belongings, it is one of the most appropriate devices which provide location based and context aware services. This paper introduces Museum Guide, an indoor location based, context aware and video on demand mobile application, we have developed.

2 Related Works

Museum Guide is an indoor location based, context aware, and video on demand system. Researches on location based service (LBS) started relatively long ago and practical LBS devices are around people's everyday life, nowadays. Without accurate knowledge of the geographical position of a user, development of LBS system is not possible. The authors of [1] proposed the linear matrix inequality method that computes the optimum value of the range intersection where the user lies. The authors of

T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 36–41, 2012.

[2] proposed an adaptive extended Kalman filter moving target tracking algorithm using the measurement signals of time difference of arrival and the frequency difference of arrival. There are many location based applications. The authors of [3] introduced a network based ticket reservation system which is a location-based smartphone application with augmented reality. The authors of [4] introduced Personalized Location-based Traveler Recommender System that provides personalized tourism information to its users.

As the cities are filled with huge buildings and numerous large stores are open underground, most of the people spend most of their time indoors. Therefore, LBS should be available not only outdoor but also indoor. Developing outdoor LBS is much easier than developing indoor LBS (ILBS) because of GPS (Global Positioning System) and Map providers (Google, for example). Since we cannot use GPS or the map in ILBS development, researches on indoor positioning and floor map (or drawing) provide service [5-8] are actively being performed.

A context ware service determines the situation of the user by investigating sensor values gathered from the sensors equipped on the smart phone (GPS, temperature, humidity, brightness, compass, accelerometer), the history of using the phone (call, SMS, app), personal information (images, scheduler, addresses) and the specification of the device (size of the monitor, speed of the CPU, size of the memory) and inferences the content which seems most likely useful to the user [10-14]. Video on Demand (VoD) are systems that allow users to select and watch video content [15-17].

3 Functional Requirements

As an indoor-location-based, context-aware, and video-on-demand smartphone application, our Museum Guide has to detect whether the user is moving or standing still to watch an exhibit. Once the user is determined to be watching an exhibit, Museum Guide has to identify the exhibit being watched by the user and play the video which is mostly relative to the exhibit.

On top of these functions, it is desired to be able to estimate user's available time, or the time period for which the user is intending to spend in the museum. It is also desired to correctly guess the showcases (exhibits) that the user would like to visit (watch). Once we know the available time and the showcases (exhibits) most likely to be visited (watched), we can make most appropriate recommendations to the user. The following is a list of main functions of our Museum Guide:

- Detects whether the user is moving or not
- Detects whether the user is watching at an exhibit or not
- Recommends showcases which the user most likely wants to visit
- Recommends videos which the user most likely wants to watch
- Plays the video selected by the user
- Records "who and when watches which video" and manages history
- Records "who rated which video what level" and manages rating data

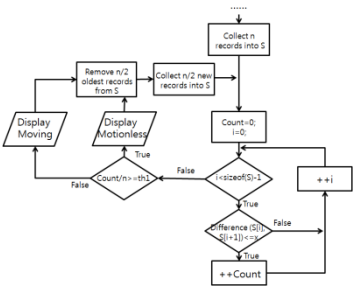

Fig. 1. The process of detecting moving status

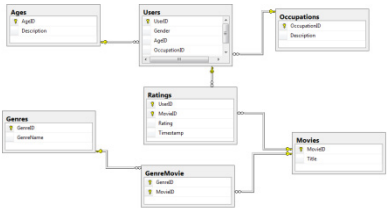

Fig. 2. Structure of our DB system

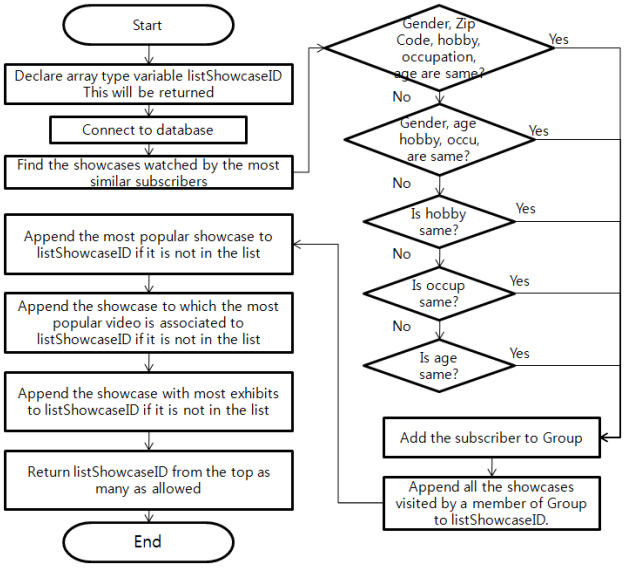

Fig. 3. The process of recommending showcases

4 Design

The first function to be realized is detecting whether the user is moving or not. By investigating 10 recently gathered accelerometer values we determine whether the smart phone is moving or not. Let A[0] to A[9] represent those values. When the phone does not move, accelerometer values do not change much. That is, |A[i]-A[i-1]| is less than a small threshold value, th1. Since we investigate 10 values we can have 9 |A[i]-A[i-1]|. Among them, we count the number of i's that satisfies |A[i]-A[i-1]|<th1. If the number is greater than another threshold, th2, then we conclude that the phone does not move. Our strategy is represented in Fig. 1.

The user aims at the exhibit with his or her phone camera when the user is interested in the exhibit. This situation can be detected by investigating pitch value. When the

phone is in straight portrait orientation, the value of the pitch is about -90. Therefore, if |pitch+90|<30 then we can conclude that the smart phone is in straight portrait orientation. Furthermore, if the phone does not move and |pitch+90|<30 then we conclude that the user is watching an exhibit.

For our recommendation, referring to the Movielens [18] dataset, we designed our database as shown in Fig. 2. It consists of the following tables: Users, Occupations, Ages, Movies, Genres, GenreMovie, and Ratings. These tables are corresponding to the dataset in Movielens. Our recommendation module finds the entries (similar subscribers) which are the most similar to the user (the owner of the smart phone). Then, it returns the videos that have been most frequently watched by the similar subscribers.

As soon as the user selects a video from the list of recommended videos, the smart phone starts playing the video. For more information of VOD system, readers are encouraged to refer to [17]. The design for the remaining requirements is included in the DB system shown in Fig. 2.

5 Implementation and Experiments

Recall that we investigated 10 recently collected accelerometer values and used th1 and th2 in the process of determining moving status. In our implementation we collected accelerometer every 0.5 second and set th1 to 0.2 and th2 to 5.

We have implemented two recommendation modules, one for showcases and the other is for videos. Because of the space limitation, the former only is discussed. The process of it is described in Fig. 3. In Fig. 3, Group represents the subscribers who are similar to the user. We consider two persons are the most similar if all the attribute values are the same. We consider two persons are the second most similar if the values of gender, age, hobby and occupation are the same. We consider two persons are the third most similar if they share the same hobby. We make listShowcaseID with the showcases that have been watched by the members of Group. At this moment, listShowcaseID might be empty or too short. Therefore, we append the most popular showcase to the list if it is not in the list. By this time, the remaining of the process should be clear and we omit explaining it.

Our recommendation module takes the available time into account. That is, by investigating the current time and the scheduler of smart phone, it estimates the available time for which the user may spend in the museum. Based on the available time, it recommends appropriate number of showcases.

Our video player is interactive in that if the user touches an object on the screen then the player pauses playing the current video and starts playing another video that is associated with the touched object.

Fig. 4 is a screenshot of showcase recommendation. From users table, Museum Guide finds subscribers who are most similar to the user. Then, it finds the showcases which have been most frequently visited by the similar users and call them most likely visited showcases. Finally, considering user's available time, it selects appropriate number of showcases from the most likely visited showcases and displays the selected ones. When user's available time is longer than the total time to visit all the most likely visited showcases, it selects most popular showcases.

Fig. 5 shows the behavior of the interactive player. In the middle of playing the video, the user touched the pagoda as shown in the first screenshot. Our player recognized that the pagoda was touched as shown in the second screenshot. It is now supposed to start playing the video associated with the pagoda. The third screenshot shows that there is no video associated with the pagoda.

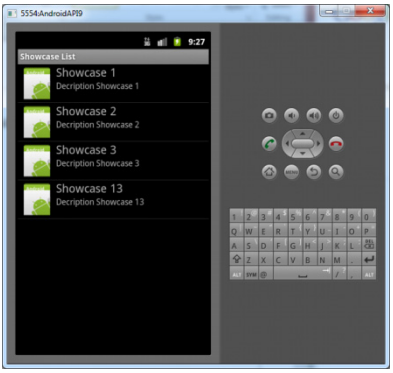

Fig. 4. Showcase recommendation

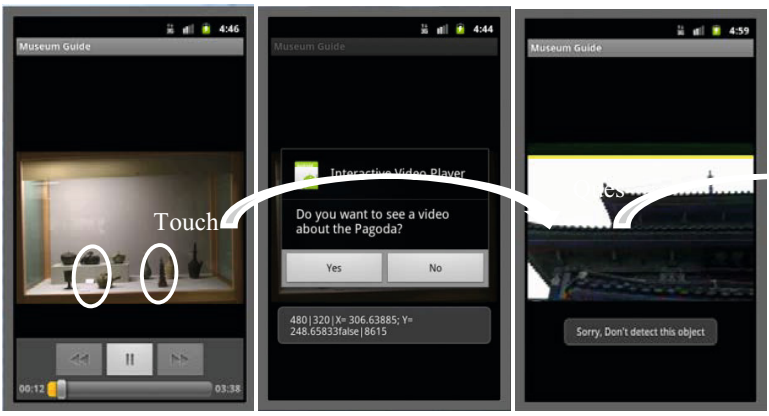

Fig. 5. Screenshots of our interactive player

6 Conclusions

We have designed and implemented a prototype of Museum Guide. To the best knowledge of ours, it is the first indoor-location-based, context-aware, and video-on-demand smartphone app. We are now working on our indoor positioning method in order to improve its accuracy.

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Hybrid Mobile Testing Model

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Abstract. In order to obtain higher quality mobile applications, greater attention should be devoted to the testing activity throughout the development process and effective models, methods, techniques and tools for testing should be available for testers. In particular, cost-effective, rapid, and automated testing processes should be executed when possible, in order to cope with the fundamental necessity of the rapid delivery of these applications. In this paper focuses on the problem of automatic testing of mobile applications developed for the Hybrid platform. We also describe the services as a test idea generator for software testers new to testing mobile applications, and to broaden the risk analysis that guides the testing of this new breed of application. A risk-based software tester can choose the categories of interest from this structured risk profile, explore the mobile application under test, and create more powerful tests designed to detect potential failures.

Keywords: Mobile Applications Testing, Mobile Services, Mobile Testing Architecture and Tools, Dynamic and Static Testing, Quality Assurance, Potential Failures.

1 Introduction

Over the past ten years, there was a trend towards smaller and higher processing power of mobile devices on the market. Advanced technologies have made the mobile devices smaller while increasing their processing power and memory capacity. The technology advances enable also mobile devices to run applications which existed only on a desktop computer before. Another trend is that mobile devices go wireless. Many devices are equipped with a WLAN card to enable the access to resources in the internet or on a central data repository at any time, from anywhere and using any system. According to the equipment, mobile devices can be divided into two main categories: high end, such as Notebooks and Tablet PC and low end, such as PDA and other appliances. All of these devices share the following characteristics up to a certain degree:

- Restricted screen size and, thus, restricted screen resolution makes it difficult to design and develop a complex GUI for mobile applications. The information which can be displayed on the screen at the same time is limited.

T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 42–52, 2012.

- Because of their diversity, mobile devices usually require complex settings for the operating system.
- The communication modules of these devices (such as the WLAN card, Bluetooth, IrDA) normally consume much more energy than the processor itself. In addition, the battery power implies inherent limitations of the device's usage patterns. Consequently, the mobile devices are prevented from being connected to the internet all the time.

Furthermore, due to the nature of the wireless communication, it might make it difficult to connect to the internet or to some other devices.

Test automation often expedites the process of test execution by reducing the manual input required. It is a technique that saves a lot of time by enabling the execution of repetitive tests with the help of computers. In the case of mobile applications, it is difficult to automate even the mundane tests due to the inherent constraints of hardware like less memory and poor processing power on which these applications execute. These tests have to be executed manually. This demands more manual testing resource and time. Test case prioritization based on risk becomes increasingly important, to minimize the number of tests, and isolate the more powerful tests from the weak ones. A risk catalog helps in test case prioritization, by allowing the software tester to focus on the failure categories of interest and map the risks in the application under test from a pre-structured risk profile. Another testing challenge is that, as mobile technology is emerging, the market, including developers and customers, is still figuring out what makes mobile applications great or merely adequate. Quality criteria are in flux and will stay that way until the market matures.

In this paper, we'll give a contribution in this direction by defining an approach to conceive cooperative work that is inspired by the mobile computing paradigm and by proposing a new model as a basic step toward architecture. We also describe the design of Hybrid mobile-computing Testing environments to adequately support for the applications. In our view, the shift from the desktop computer metaphor to the mobile computing one is promising in the aim to support Hybrid testing methodology. In particular, in the paper we focus on Mobile GUI testing techniques already adopted for traditional applications and propose a GUI based technique for Hybrid testing and regression testing of Mobile applications. The technique is supported by a tool for producing test cases that can be automatically executed.

2 Related Works

2.1 Mobile Applications

Definitions of mobile applications vary. In this paper, a mobile application is any application that runs on a handheld device, like a personal digital assistant or a smart phone, and connects to the network wirelessly. H. Kim [1] provided a way to categorize mobile applications on the basis of the connectivity model of the application to the backend system. The following is a model for categorizing mobile applications, inspired by Kim's work, and includes additional categories to account for the recent changes in wireless technology.

• **Applications that are stand-alone**: These applications run on the handheld device itself without connecting to the network. An example of a standalone application is a calculator running on a Windows Pocket PC.

• **Applications that connect to the backend through synchronization software**: These applications use synchronization software like Microsoft Active Synch to connect to a parent computer or network. An example of such an application is Microsoft Outlook for Pocket PC that synchronizes data between the handheld device and the host computer through synchronization software.

• **Applications that connect to the backend through a wide-area wireless network**: These applications use either circuit-switched or packet-switched wide-area wireless networks to connect to a data source or other network

resource. An example of such an application is a stock-ticker application that streams real-time information about the stock rates to handheld devices using cellular data transfer.

• **Applications that connect to the backend using special networks**: These applications connect to the back-end through special networks like Specialized Mobile Radio (SMR) or paging networks.

• **Other Applications**: There applications include those that connect to the back-end using short-range wireless networks, such as Bluetooth or infrared.

Another way to categorize mobile applications could be on the basis of the layering of the system, which is based on the software and hardware infrastructure. Liu [3] proposed a framework for mobile commerce application development to separate the responsibilities and functionalities provided by different entities, and to implement mobile systems. The framework has four layers in the user plane: m-commerce applications, user infrastructure, middleware, and network infrastructure. Each layer has a well-defined responsibility and provides a standard interface to the adjoining layers. For example, the user infrastructure layer shows that the design of new mobile applications should take into consideration the general capabilities of the mobile device, and should not be device-specific. Similarly, the middleware layer hides the details of the underlying wireless network from the application layer. In the developer and provider plane, this framework has separation of responsibilities between the application developer, content providers, and the service providers. A content provider can build its service using applications from multiple application developers. They can also aggregate content from other content providers and can supply the aggregated content to a network operator or service provider. Service providers can also act as content aggregators, but are unlikely to act as either an application or content provider due to their focus on the networking and service aspects of m-commerce. A service provider can also act as a clearing house for content and application providers in advertising and distributing their products to its customers. In any case, the developer and provider plane in our framework is likely to have multiple layers. They are as follows:

• **Mobile application layer**: This layer includes the application software that is responsible for user authentication and privacy, for establishing the communication partners, and for determining the constraints on data and other application services.

• **Client-side devices**: This layer constitutes the hardware on which a mobile application with varying capabilities executes.

• **Mobile content delivery and middleware**: This layer includes mobile middleware that integrates heterogeneous wireless software and the hardware environment, and that hides the disparities to expedite development at the application layer. There are a rich set of content delivery and application programming interfaces available from Microsoft, Sun, and other leading companies in the mobile application domain that developers can use out of the box for rapid application development [4].

• **Wireless networking infrastructure**: Wireless networks could be broadly divided into wide area networks (WANs), local area networks (LANs), and personal area networks (PANs), on the basis of network coverage.

Applications are a natural extension to the current wired infrastructure. In the enterprise, a variety of people including road warriors, sales and service professionals, are being equipped with on-the-go computing capabilities using mobile technologies for the entertainment, education, communication, work, and other Ares. These pieces of information can be recognized by mobile applications technologies able to identify and locate documents and people on the one hand, and by technologies managing the information constituting the logical space of collaboration (competencies, duties, roles, etc.) on the other hand. Irrespective of its current situation, each person has to behave so that the meeting is anyhow mobile applications. Here, the technology has to support different degrees of participation of the community members to the cooperative process going on in the meeting. Moreover, the environment has to support the quiet development of the meeting itself. As for the last aspect, cellular phones have to be turned to the quiet state when participants enter the room apart from the case of the meeting coordinator that could be contacted by the missing members. Other functionalities can be available that are typical of smart environments [5].

2.2 Mobile Applications Testing Environments

The need for testing full and effective implementation of mobile phones has increased dramatically in recent years. Unveiling of the market for cellular devices with advanced versions of different operating systems and platforms functional complexes has led a growing demand for large and infallible mobile application testing tools. Cost effective and faster testing of mobile applications is widely considered a prerequisite for the profitability and sustainability in the face of cut throat market competition in the telecommunications sector [6]. Testing Services enable customers to gain confidence that software applications function as intended with devices and applications other participants in the ecosystem of mobility. Mobile application testing allows developers and aggregators to accelerate time to market their mobile applications. Figure 1 show the testing environment for mobile applications based on software development life cycle. There are several methodologies for mobile application testing attributes as followings;

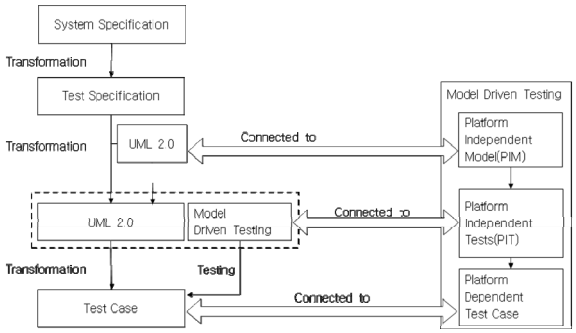

Fig. 1. Testing environment for mobile applications

Compatibility Testing: Compatibility testing ensures that a given application works as expected with the selected devices with different screen sizes, resolutions, and the internal hardware (memory size, processor speed, and button input / differences).

Functionality Testing: Functionality testing of a mobile device with commands, options for media storage, handling and other operational aspects. Functionality testing of a mobile application is a type of black box testing to ensure that the application functions according to business specifications.

Usability Testing: Usability testing includes testing of mobile interface, navigation application testing, and intuitiveness of the application, consistency, and simplicity of the color palette. AppLabs examines conceptions of usability, task analysis and graphics alpha application in connection with the transfer of knowledge products and provides criteria for use of the application are met.

Performance Testing: The objective of load testing is to determine whether the application can support the required number of users with acceptable response times. The objective of the capacity test is to compare the maximum load of concurrent users an application can handle before experiencing a system failure while the objective of the stress tests is to validate the stability of an application and reliability over a long period of time.

Localization and Internationalization Testing: The objective of this test is to ensure that the functions of localization and internationalization are supported by devices and applications according to specifications. Communication tests: The objective of the tests is to verify communication protocols and handshakes in a call flow between multiple users.

3 Method for Mobile Application Hybrid Testing (MASHTE)

3.1 Overviews

The overall purpose of testing is to ensure the mobile application meets all of its technical, functional and business requirements. The approach described in this paper

provides the MASHTE(**Mobile Applications Systems Hybrid Testing Tools and Environments** framework for all testing related to application. Individual test cases will be written for each version of the mobile application that is released. This paper will also be updated as required for each release. The quality objectives of testing the mobile application are to ensure complete validation of the business and software requirements:

- Verify software requirements are complete and accurate
- Perform detailed test planning
- Identify testing standards and procedures that will be used on the project
- Prepare and document test scenarios and test cases
- Regression testing to validate that unchanged functionality has not been affected by changes
- Manage defect tracking process
- Provide test metrics/testing summary reports
- Ensure the application is certified for release into the University of Minnesota production environment
- Schedule Go/No Go meeting
- Require sign-offs from all stakeholders

In Figure 2, the global architecture of our solution is shown. It matches the requirements that we listed above. The component filter we used in this architecture blocks the software components which should not be published by the software component service at all. And the additional software repository is used to increase the performance for our software component service. It stores all available versions of the components.

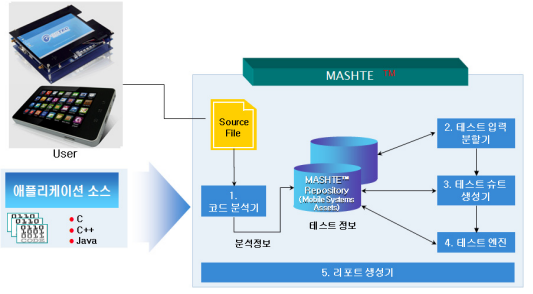

Fig. 2. MASHTE Architecture

3.2 Our MASHTE Goals

The goals in testing this application include validating the quality, usability, reliability and performance of the application. Testing will be performed from a black-box approach, not based on any knowledge of internal design or code. Tests will be designed around requirements and functionality. Another goal is to make the tests repeatable for use in regression testing during the project lifecycle, and for future application upgrades. A part of the approach in testing will be to initially perform a 'Smoke Test' upon delivery of the application for testing. Smoke Testing is typically

an initial testing effort to determine if a new software version is performing well enough to accept it for a major testing effort. For example, if the new software is crashing frequently, or corrupting databases, the software is not in a stable enough condition to warrant further testing in its current state. This testing will be performed first. After acceptance of the build delivered for system testing, functions will be tested based upon the designated priority (critical, high, medium, low). Quality software is reasonably bug-free, meets requirements and/or expectations, and is maintainable. Testing the quality of the application will be a two-step process of independent verification and validation. First, a verification process will be undertaken involving reviews and meetings to evaluate documents, plans, requirements, and specifications to ensure that the end result of the application is testable, and that requirements are covered. The overall goal is to ensure that the requirements are clear, complete, detailed, cohesive, attainable, and testable. In addition, this helps to ensure that requirements are agreed to by all stakeholders. Second, actual testing will be performed to ensure that the requirements are met. The standard by which the application meets quality expectations will be based upon the requirements test matrix, use cases and test cases to ensure test case coverage of the requirements. This testing process will also help to ensure the utility of the application – i.e., the design's functionality and "does the application do what the users need?"

Reliability is both the consistency and repeatability of the application. A large part of testing an application involves validating its reliability in its functions, data, and system availability. To ensure reliability, the test approach will include positive and negative (break-it) functional tests. In addition, to ensure reliability throughout the iterative software development cycle, regression tests will be performed on all iterations of the application.

3.3 MASHTE Methodology

Figure 3 shows the MASHTE model and methodology. It consist of two major sub model as development and test execution environment.

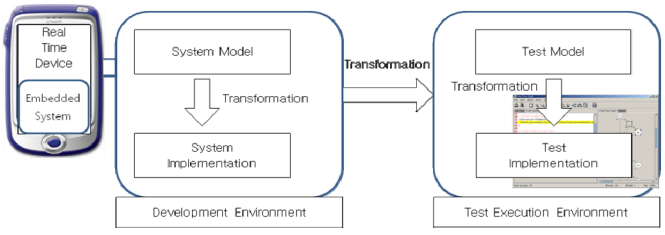

Fig. 3. MASHTE Testing Model

(1) MASHTE Development Criteria

- All business requirements are documented and approved by the business users.
- All design specifications have been reviewed and approved.
- Unit testing has been completed by the development team, including vendors.

- All hardware needed for the test environment is available.
- The application delivered to the test environment is of reliable quality.
- Initial smoke test of the delivered functionality is approved by the testing team.
- Code changes made to the test site will go through a change control process.

(2) Exit Criteria

- All test scenarios have been completed successfully.
- All issues prioritized and priority 1 issues resolved.
- All outstanding defects are documented in a test summary with a priority and severity status.
- Go/No-go meeting is held to determine acceptability of product.

(3) Test Execution Environment

The test execution phase is the process of running test cases against the software build to verify that the actual results meet the expected results. Unit testing is performed by the application developers testing in the development environment. This testing phase will have a "white box" perspective, which means the application developers know, and will be testing the internal logical structure of each software component. Typically, unit testing is performed without written test cases. The project team will share smoke test criteria. Any build failing smoke test will be returned to vendor with the expectation of expedited resolution. Functional testing, or "black box" testing, focuses on the functional requirements of the software. Functional testing is performed to confirm that the application operates accurately according to the documented specifications and requirements, and to ensure that interfaces to external systems are properly working. Regression testing shall be performed to verify that previously tested features and functions do not have any new defects introduced, while correcting other problems or adding and modifying other features. Integration testing is the phase of software testing in which individual software modules are combined and tested as a group. In its simplest form, two units that have already been tested are combined into a component and the interface between them is tested. In a realistic scenario, many units are combined into components, which are in turn aggregated into even larger parts of the program. The idea is to test combinations of pieces and eventually expand the process to test your modules with those of other groups. Eventually all the modules making up a process are tested together. This testing follows a transaction through all of the product processes that interact with it and tests the product in its entirety. Interface testing shall be performed to ensure that the product actually works in the way a typical user would interact with it. Destructive testing focuses on the error detection and error prevention areas of the product. Destructive testing is less structured than other testing phases and is determined by individual testers. User acceptance testing activities will be performed by the business users. The purpose of this testing will be to ensure the application meets the users' expectations. Test case/script design is the central focus of a software quality assurance process. A test case or script is defined as a written specification describing how a single or group of business or system requirement(s) will be tested. The test case or script consists of a set of actions to be performed, data to be used, and the expected results of the test. The actual results of the test are recorded during test execution. Test cases or scripts will also be updated as testing proceeds.

Test Cases/Scripts written for this project include the following:

- Software requirement ID
- Requirement description
- Any dependencies and/or special set-up instructions required for performing the test
- Test description
- Expected results

3.4 MASHTE Test Scenarios

Table 1 shows the high-level scenarios that will be tested. These scenarios are derived from the Requirements Matrix and Use Cases.

Table 1. MASHTE Testing Scenarios

Test Objective
Test Objective #1 – All stated requirements exist and function: • List all functionality to be tested
Test Objective #2 – Security Issues: • List security issues
Test Objective #3 – System availability and performance: • Concurrent users; • Load and volume tests; • Large file migrations/uploads/downloads;
Test Objective #4 – Data Validation: • List data validation specifics
Test Objective #5 – Environment: • Test environment; • Production environment; • Platforms and Browsers; o PC testing only; o Test Remote connection;

Interface Testing will include:

- Interface test
- Interface test

Functionality that will be tested, but not thoroughly tested in the initial testing cycle:

- Interface to …
- Interface to …

Although the mobile application testing process is basically the same we understand mobile devices have different peculiarities that must be kept in mind when deciding which testing types to use for authentication. The testing types used are

predominantly unchanged but we do utilize different testing techniques and tools. Figure 3 shows the MASHTE modeling information as components, scenarios and execution screen for future developments.

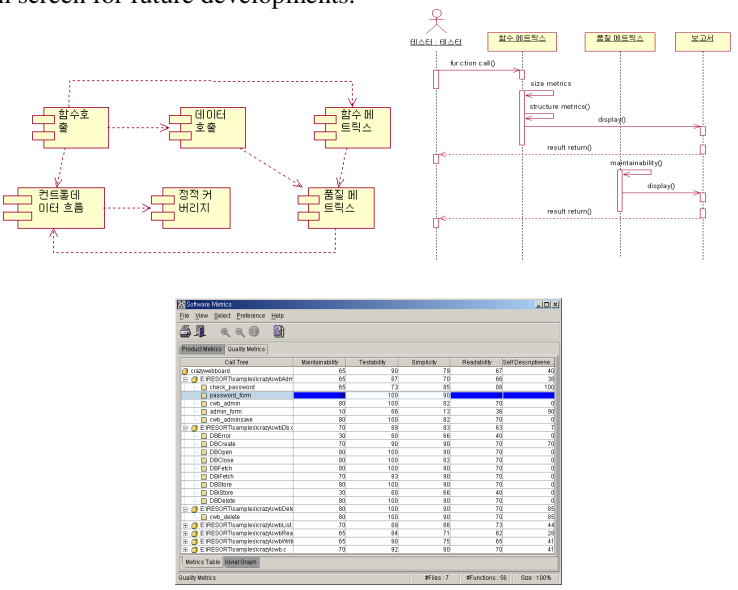

Fig. 4. MASHTE Modeling Information

4 Concluding Remarks

In this paper a technique for hybrid testing of mobile applications has been proposed. The technique is inspired to other mobile applications testing techniques proposed in the literature and relies on specially mobile GUI that is used to obtain test cases that reveal application faults like run-time crashes, or that can be used in regression testing as hybrid manner. Test cases consist of event sequences that can be fired on the application user interface. Also In this paper focuses on the problem of automatic testing of mobile applications developed for the Hybrid platform. We also describe the services as a test idea generator for software testers new to testing mobile applications, and to broaden the risk analysis that guides the testing of this new breed of application. A risk-based software tester can choose the categories of interest from this structured risk profile, explore the mobile application under test, and create more powerful tests designed to detect potential failures. The proposed testing technique aims at finding runtime crashes or user-visible faults on modified versions of the application. In order to detect runtime crashes, at the moment, we instrument the source code of the application under test. In the paper we just discussed an example of using the technique for testing a small size mobile application, and showed the usability and effectiveness of the technique and supporting tool.

In future work, we plan to carry out an empirical validation of the technique by experiments involving several real world applications with larger size and complexity, with the aim of assessing its cost-effectiveness and scalability in a real testing context.

Moreover, in order to increase the effectiveness of the obtained test suites we intend to investigate further and more accurate techniques for the mobile applications.

Acknowledgement. This work (Grants No.C0024433) was supported by Business for Cooperative R&D between Industry, Academy, and Research Institute funded Korea Small and Medium Business Administration in 2012.

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Mobile Application Development Using Component Features and Inheritance

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Abstract. With the ever increasing of personal mobile services in a mobile service group, in which mobile services offer the same functionality with different parameters, Mobile service selection in a Mobile service group is an ongoing research topic. Recognizing and achieving software reuse for mobile applications are fundamental problems in software engineering. The current approaches for component reuse concentrates primarily on the consumer perspective for it. To keep balance between the component producers, the component consumers and end-user perspective for the mobile applications, this paper proposes two orthogonal approaches to reusing existing components: component inheritance and feature composition. Component inheritance provides an effective mechanism for service component refactoring. To meet variability requirements, a new service component object can be derived from an old component object. The base component class defines interface and event message flow, and implements code framework and partial functions. The derived component class for the mobile applications reuses legacy asserts and implements virtual interface method. The event message flow produced by base component object can be intercepted by derived component. we also presents a sound approach to derive a software reuse architecture model from the requirements goal model in systematic way for ubiquitous mobile applications using CBD and UML. To narrow the gap between the user and the developer perspectives, the system's features are decomposed into a set of independent feature component. When a feature component is reused, the consumer only needs to plug it into the prime component to be used by component clients. Mobile telephone projects experiments show that the two approaches contribute to reuse and ease of change.

Keywords: mobile applications, software reuse, inheritance , component based development, QoS, software frameworks, software futures.

1 Introduction

Nowadays, widespread popularization of internet and emergence of many application patterns such as pervasive computing and grid computing need to operate in open, changing and unpredictable environments. To operate reliably, such systems must have the capabilities of robustness, fault tolerance and adaptability. UML(Unified Modeling Language)

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CBD(Component Based Development) and software reuse has been proposed as a good solution for this demand. However, there is a troublesome step in the development process of reusable software system which is transforming what we want the system to do (requirement analysis model) into a framework for how to do it (software architecture design model). Requirements specifications can be viewed as a contract between the customer and the software developers. Hence, they should be not only easy to understand by the software architects and engineers but also by the end-users (customers) [1]. Traditional requirement analysis approaches, such like those used in structured method and object-oriented method just describe the structure and behavior of the system from developers' view, and do not contain the information that is interest to end-users. So, those approaches are inadequate for transforming the requirement model to software architecture. Aiming at this problem, there is growing interest on the topic of mapping stakeholder-oriented requirements to software-architectures. Among all the kinds of requirements specifications, goal model are more near to the way human being thinks and are easy to understand by all the stakeholders. So goal model becomes a hot research topic in requirement engineering domain [2,3,4]. However, these researches have not considered the adaptability of the software system. Specifically, in current goal-based methodologies for developing software systems, requirement-level variability modeling, specifying and analyzing have been well understood and supported. However, their transition to self-adaptive software architecture remains vague, that makes the derivation for this kind of application system hard to achieve on the design level. Aiming at this problem, this paper proposes a promising approach which takes a goal-based requirement specification as the input, and returns a self-adaptive software architecture model to solve the problem existing approaches met. On the other hand, the gap between the end-user and the developer perspectives leads to difficulties in producing successful software systems [5]. Users are focused on the problem domain, where the system's features are the primary concern, while the developers are focused on the solution domain, where the system's life-cycle artifacts are keys. Features act as an important organizing concept within the problem domain and as a communication mechanism between end users and developers. The feature-driven CBD approach works well in many ideal cases, when a particular feature will be implemented in code that is mostly localized to a single module [6]. This occurs when the features are decomposed into a set of almost independent clusters, each cluster implemented by fixed components. Component inheritance provides an effective mechanism for service component refactoring. The system's features are decomposed into a set of independent feature component. A feature component usually is small and lightweight. When a feature component is reused, the consumer only needs to plug it into the prime component to be used by component clients.

In this paper, we proposes a data streaming system that enables device users to get an intelligent recommendation regarding the media content they want based on the user preferences stored on the home server, and that users receiving the data streaming service with a multimedia client on a home network are assured of seamless access to such multimedia content even if they switch devices. We also presents a sound approach to derive a software reuse architecture model from

the requirements goal model in systematic way for ubiquitous mobile applications using CBD and UML. To narrow the gap between the user and the developer perspectives, the system's features are decomposed into a set of independent feature component. When a feature component is reused, the consumer only needs to plug it into the prime component to be used by component clients. Mobile telephone projects experiments show that the two approaches contribute to reuse and ease of change.

2 Related Works

2.1 Reusable Model and Process for Mobile Application Development

The structural model of a UML(Unified Modeling Language), CBD(Component Based Development) and software reuse is presented in figure 1. It is composed of a control center, several internal/external ports and the implementation body. In this paper we extend the component model by adding an adaptation manager component into the control center. In this model, a component has a number of ports. Each port defines a logically separable point of interaction with its environment. A component explicitly states its provisions/requirements by its external provide/request ports. Three kinds of ports 1) External provide ports. They define how the environment can access the functionalities implemented by the component, and they are also the entries for other components to startup the control flow; 2) External request ports. They define how the component can access the functionalities provided by the environment. At the same time, they are the entries for the control flow to involve external service providers; 3) Internal ports: They are internal functional interfaces provided by the implementation body to fulfill external requests. Usually, after an external request is received, one or more internal ports will be involved in an execution of the control flow to complete the whole service process. Control center is separated from the component implementation to enforce component-level coordination on its external and internal ports according to the behavioral protocol. At runtime, usually, the control center will be activated by requests of other components on a provide port, then it will perform a series of interactions on internal ports and external request ports on the runtime control flow. In order to see whether and how well the self-adaptive component achieves its goal, it needs to monitor its managed element, collect the data, analyze it based on its knowledge (in our approach, we use goal model as the knowledge for component's adaptation), plan changes to its behavior if necessary, and execute the plan. The monitor in the adaptation manager senses the environmental components. The analyzer compares event data against patterns in the knowledge base to diagnose symptoms. The planner interprets the symptoms and devises a plan which is a goal-based behavior protocol.

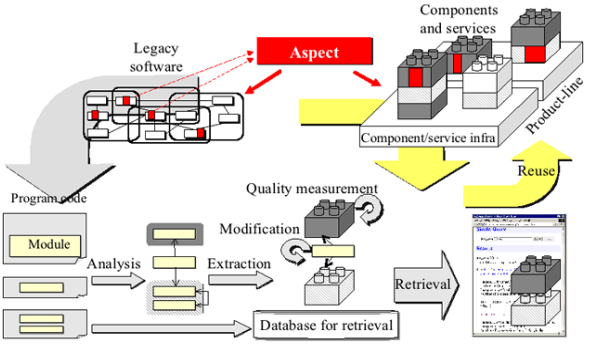

Fig. 1. The Reusable Model for Mobile Application

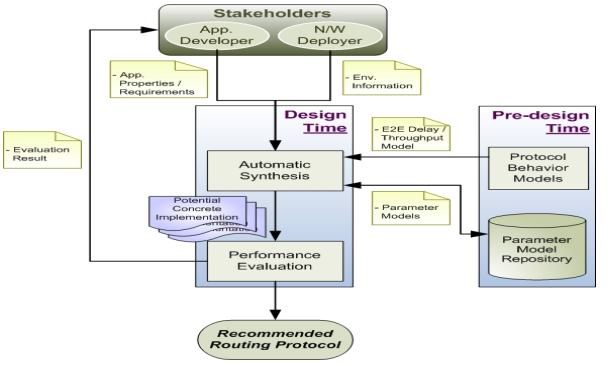

Fig. 2. Method Model Derivation for Mobile Applications

2.2 Method Model Derivation for Mobile Software

Mobile component's method (behavior) model is a separated coordination logic of the component and is described as interacting protocols. We adopt a subset of CSP (Communicating Sequential Processes) notations to describe component's behavior. CSP is a formal method to describe and analyze processes behavior patterns and interactions. Semantically speaking, the architectural components' behaviors model can be modeled as CSP processes. So CSP can be used naturally to formalize the behavioral models of architectural components. Here, we only introduce a portion of CSP elements we used in this paper due to the space limitation. The major elements are described as follows: ***Processes and events***: a process is an execution flow of events, standing for the behavior pattern of objects. Processes are described by a series of communication events and other simpler processes. The basic unit of the processes specification is event. An event represents an atomic interaction on external or internal ports. The set of events with which a process ***P*** can communicate is termed the "alphabet of ***P***". In this paper, we use the symbol "**SKIP**" to represent the successful termination of a process. ***Parallel composition***: Parallel processes may interact by jointly (synchronously) engaging in events that lie within the intersection

of their alphabets. Conversely, if an event ***e*** is in the alphabet of processes ***P1*** and ***P2***, then ***P1*** can only engage in the event if ***P2*** can also do so. That is, the process ***P1*** $\|$ ***P2*** is one whose behavior is permitted by both ***P1*** and ***P2***, and for the events in the intersection of the processes' alphabets, both processes must agree to engage in the event.

3 Modeling for Mobile Application Using CBD and UML

Expectations for mobile applications functionality and quality have grown significantly in recent years. At the same time, the constraints imposed by development costs and delivery times have grown increasingly rigorous. The resulting ratio of success with respect to quality, cost, and delivery of current software development is below 30%. There is growing need to balance these competing goals, along with rising demand for cost-effective development for mobile applications specially.

3.1 Mobile Applications Using UML and Component-Based Systems Modeling

UML can be used for both component and system modeling for mobile applications. Component-driven design concentrates on interfaces definitions and collaboration between the components through the interfaces. The design process continues with the modeling of mobile systems with physical components, which do not necessarily match the logical structure. These may be pre-existing components, with interface already specified and possibly in need of wrappers. One logical component, identified in the first phase of design, may consist of several physical components. Finally, there is a deployment aspect, the components being executed on different computers in a distributed application. The figure 3 shows the different notations and also three aspects of system architecture for mobile applications. The conceptual architecture is a result of a top-down system analysis and design. In the conceptual part the components mobile applications are expressed by UML packages with the <<subsystems>> stereotype. In the implementation architecture part, the physical components mobile applications are represented by UML components and the <<imp>> stereotype.

The mobile developer and architect may choose to merge two or more components into one, if they think their functionalities are too restricted to justify their independent existence.

This can be done by introducing compound components and merging individual external ports into ones that contain the union of the original ports. Conversely, the software architect may introduce new ports and components in order to describe functionality in more detail for mobile applications. The decomposition tree for the goals and the refinement tree for the corresponding software architecture maybe don't have the same shape. It would be a pure coincidence if they did have it.

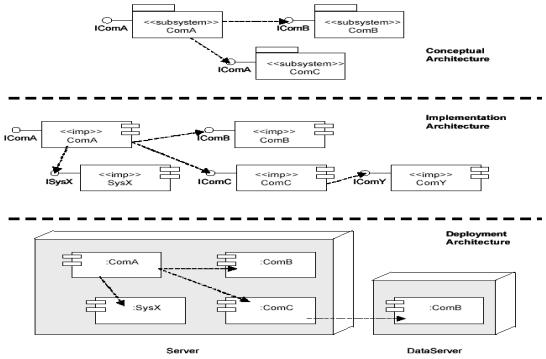

Fig. 3. Mobile with UML notations for CBD process

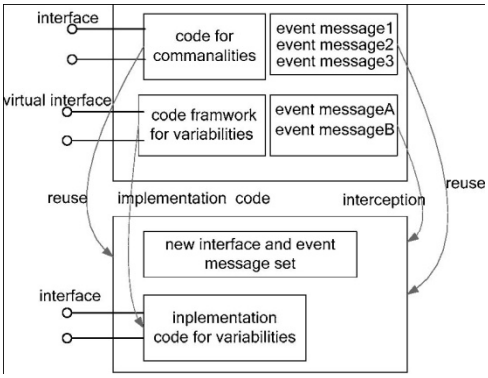

Fig. 4. Example of Model Inheritance

3.2 Mobile Applications with Model Inheritance

Inheritance is an old and fundamental concept in object-oriented programming, while the reuse based on interface and event message flow in different binary component is proposed in this paper. The derived class inherits both attributes and behavior from his base classes in object-oriented programming. However, the class derived from different component module inherits both interface and event message flow defined in base component object in CBD. The common action between base component class and derived component for mobile applications is defined in terms of interface and virtual interface for variability. The base component class defines interface and event message flow, and implements code framework and partial functions for mobile applications. The derived component object inherits base component's interface and event message flow, and maybe extends these legacies. The virtual interface specifies a serial of component's actions and the derived component add implement code for these interface, which we call interface level overriding. We provide interception event flow mechanism for subcomponent component. When a base component object triggers an event, the derived component object can intercept this event and decide his own action

(forwarding or filtering this event for his client, even other actions) for mobile applications. Figure 4 shows the relationship between the base and derived component for mobile applications. Solid lines show derived component object directly reuse the base component's compositions, while the dashed lines show variability.

3.3 Architecture and Composition Model

The behaviors specified in other models or languages for mobile applications can be converted to this model using translators. The integrated behaviors can then be specified in a Control Plan program for remote and runtime behavior reconfiguration. This architecture also separates other non-functional constraints, especially timing and resource constraints, from functionality and behavior integration so that these constraints can be analyzed and verified incrementally and as early as at design phase. Components are pre-implemented software modules and treated as building blocks in integration for mobile applications. The integrated embedded software can be viewed as a collection of communicating reusable components. The component structure for mobile applications defines the required information for components to cooperate with others in a system. The software component is modeled as a set of external interfaces with registration and mapping mechanisms, communication ports, control logic driver and service protocols, as shown in figure 5.

External interfaces define the functionality of the component that can be invoked outside the component. In this model, external interfaces are represented as a set of acceptable events with designated parameters. A component with other forms of external interfaces, such as function calls, can be integrated into the system by mapping each of them to a unique event Communication ports:

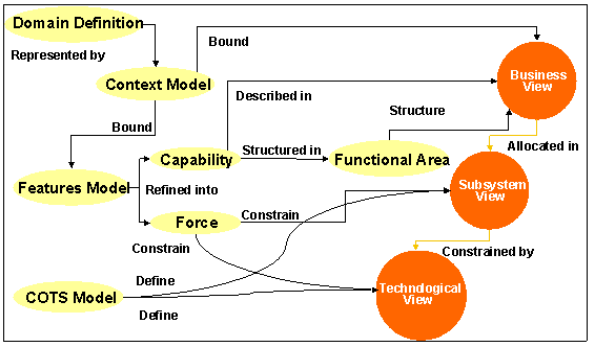

Fig. 5. Component Architecture for mobile applications

Communication ports are used to connect reusable components, i.e., they are physical interfaces of a component. Each reusable component can have one or more communication ports. The control logic driver, also called the FSM driver, is designed to separate function definitions from control logic specifications, and support control logic reconfiguration. The FSM driver can be viewed as an internal interface to access and modify the control logic, which is traditionally hard-coded in software

implementation. Service protocols define the execution environment or infrastructures of a component. Example service protocols include scheduling policies, inter-process communication mechanisms and network protocols. Software integration includes component selection and binding, and control plan construction (both control logic and operation sequence). A runtime system can be generated by mapping the integrated software onto a platform. The composition model defines how software can be integrated with given components. Since each reusable component is implemented with a set of external interfaces that uniquely define its functionality, components can be selected based on the match of their interfaces and design specifications. The integration of reusable components can be viewed as linking the components with their external interfaces. Reusable components in integrated software are organized hierarchically to support integration with different granularities, as illustrated in figure .

The behavior of an integrated component can then be modeled as integration of its member component behaviors. The control logic and operation sequences of each component can be determined individually and specified in a Control Plan. The behavior specifications can further be classified as device-dependent behaviors and device-independent behaviors. The device-independent behaviors depend only on the application level control logic, and can be reused for the same application with different devices. The device-dependent behaviors are dedicated to a device or a configuration, and can be reused for different applications with the same device. With such a composition model, both components for low-level control such as algorithms and drivers and for high- level systems can be constructed and reused. However, additional overhead is introduced as the component level is increased, and may results in associated performance penalties due to excessive communications and code size. The integrated software obtained from the composition model cannot be executed directly on a platform since the composition model only deals with functionality. To obtain executable software, components have to be grouped into tasks, which are basic schedulable units in current operating systems. Each task needs to be assigned to a processor with proper scheduling parameters determined by an appropriate real-time analysis. Also, communications among components should be mapped to the services supported by the platform configuration. After these pieces of information are obtained, the components can be mapped to the platform by customizing their service protocols. Figure 7 sows the mapping from functional integrated software to a runtime system with our architecture.

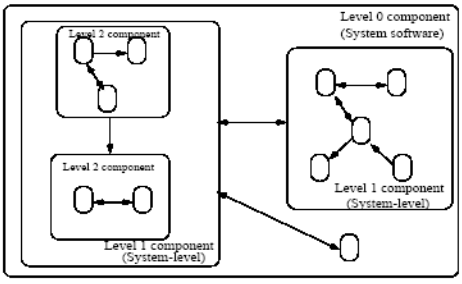

Fig. 6. Component Composition for mobile applications

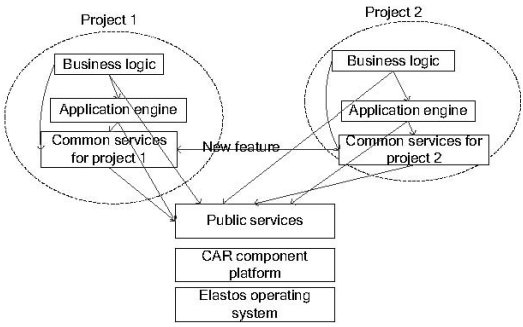

Fig. 7. Overall model for Mobile Applications

4 Conclusion

The goal of this paper is to provide possible implementation mobile framework for mobile services that automatically follow up and predict the maintenance needs of mobile devices. Concept of a "mobile service component" supposes that any component can be executed at any platform from the Service Network, including service requestor side. This allows delivering not only a service results but also a service itself. Mobile service component carrier can move to a field device's local environment and perform its activities locally. Service components improve their performance through online learning and communication with other components. Heterogeneous service components' discovery is based on semantic P2P search. we also presents a sound approach to derive a software reuse architecture model from the requirements goal model in systematic way for ubiquitous mobile applications using CBD and UML. To narrow the gap between the user and the developer perspectives, the system's features are decomposed into a set of independent feature component. When a feature component is reused, the consumer only needs to plug it into the prime component to be used by component clients. Mobile telephone projects experiments show that the two approaches contribute to reuse and ease of change. This paper focuses on the design and implementation method for supporting component object inheritance and feature composition on component platform. We also propose a software development process abstract model based on component object inheritance and feature composition. Our future work involves developing a sound and complete framework for software process engineering.

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View, Level and Fragment: Commonalities in "Architecture 101" and Software Modelling

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Abstract. In software modelling, it is difficult to properly arrange the modelling of system structure and behaviour as the traversal between software models usually lacks a clear progression path. Taking an inter-disciplinary approach, this paper tackles the problem by borrowing ideas from a successful movie "Architecture 101". The commonalities between the movie and modelling are studied. The result is a proposal for multi-modelling. The benefits include more explicit guidance in software development. And the progression from model to code is made more productive.

Keywords: System view, abstraction level, fragmentation, "Architecture 101".

1 Introduction

"Architecture 101" is a recent South Korean film [1, 2] with successful box office ratings [3]. Nowadays software modelling is an important technique in software development. The twos are far apart in terms of the disciplines each belongs. However, there are important commonalities that the two share. And it is hoped that the engineering of software artefacts can borrow useful ideas from the accomplished movie product, in the end improving the software engineering discipline.

As Boyd has stated, the theory of modelling remains incomplete though software modelling is the heart of engineering [4]. Software engineering is awaiting progress. It is not clear how different models can be coordinated during the model construction process. This paper tackles the problem of a suitable use of the multiple system models in the software development process.

This paper is an integration of art and science. It investigates ideas that can be applied into computer science from the filming industry. The similarities and differences between "Architecture 101" and software modelling are identified. The film is analysed to give clues on how to structure the concurrent development of multiple software models.

This paper is organized as follows. Section 2 discusses the key concepts in software modelling. Section 3 describes the "Architecture 101" movie. Section 4 gives a comparison to software development.

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2 Software Modelling

2.1 Multiple System Views

Modelling makes it easier to understand essentials of a system and is a central tool in model-driven software development. Abstraction is closely related to modelling as models are built by abstracting important system elements. Modelling has migrated from a single perspective to multiple ones. Multiple perspectives put software in better context. As such, multi-modelling prevails in current software development, as is shown in UML 1.x [5] and the later UML 2.x [6]. There are different proposals in terms of 2-model, 3-model and others. The more common one is a dual model, comprising structural model and behavioural model. He two models coexist but are opposite and relative to each other. During the development process, these models grow over time and become models with increasing details. However, multiple models shoulder the shortcoming of inconsistencies among system models. Further it is not easy to provide a clear guidance on when and how to construct these models. Although models are part of system, it is not sure how they should be integrated. There is also a lack of clear mapping between model elements.

2.2 Multiple Abstraction Levels

Software methods incorporate the techniques of decomposition and composition in organizing system parts into a vertical hierarchy of abstraction levels. This is common to both the structured and the object-oriented approaches. Abstraction levelling has become an important idea in tackling complexity in software development. Abstraction level is a relative term, with no absolute value. It is not clear what constitutes high and low levels in the absolute scale. These abstracted levels comprise high and low levels, forming a relative hierarchy. A major weakness in the abstraction process is that it is not clear when should abstraction be stopped. This is so because the nature of abstraction implies that the process should be complete when essential features are obtained. However, the task of separating essentials from non-essentials is itself a lengthy iterative process with continuous refinements. Other shortcomings include no relationships exists between the hierarchical levels. Inconsistencies exist between abstraction levels. In addition, inconsistencies may also exist between models and abstraction levels.

3 The “Architecture 101” Movie

This section presents an analysis of the “Architecture 101” movie with a view to give hints to tackling the software modelling problem. The analysis is a personal interpretation of its author and is subjective by nature. The framework of analysis is a based on using cubism in painting art, which will be explained later in the section. This cubic analysis of the movie is done within the context of the avant-garde movement. In previous searches of literature about the movie, no mention of cubism or avant-garde has been found. Most of the listings shown in this section are not intended to be a comprehensive listing of all relevant entities in the movie, but more in giving illustrative examples.

3.1 Movie Description

"Architecture 101" is a romance film about architect and love [1]. It is released in March of 2012 in South Korea and has since received high success in box office rating with millions of admission [3] as well as favourable reviews [2]. The movie tells the story of two university students, namely Lee Seung-min and Yang Seo-yeon, that first meet and fall in love in an Introduction to Architecture course (course code: Architecture 101) in Soeul and re-meet some 17 years later in the office of an architecture firm to design and rebuild a house in the southern Jeju Island. There are two pairs of actor/actress to star the two main characters for the two time periods, college study years in the past and the present house project. The film is set in a way so that the romance story progresses in two parallel paths of past and present, skilfully incorporating a traversal across casts, eras, seasons and places, and subtly transmitting messages at different levels of depth.

3.2 Dual Paths through Fragmentation

The movie is explicitly structured with alternate displays of film fragments for the first love in the past and the hopeless fate for a second chance love in the present time period. In other words, it does not follows a sequential progression of story from past to present or vice versa. In order to achieve this, the romance story is decomposed into numerous fragments, constituting an employment of fragmentation in the movie. As such, part of movie quality will be related to how the love story is fragmented and how the fragments are organized so that film audience can read the romance story, extract messages and enjoy viewing the movie overall.

The film starts at the architecture office and ends in the rebuilt house, with both belonging to the present time path. The main story for the past includes first meet in a university setting, fall in love and eventually separate at the end of semester. The main story for the present portion includes re-meeting again to seek help in building house. The twos spend a lot of time together in Jeju during the house renovation. But eventually Yang stay to care for her dying father and Lee marries his fiancée and flies to US. Some examples of film fragments include meeting in the architecture office but Lee pretends not remembering Yang, eating in a restaurant with Lee's fiancée participating and informing Yang of their coming marriage, first encounter with Yang in the "Architecture 101" course, first kiss in the railway station, coaching by good friend on how to get girls by Lee, sadly leaving the CD and player by Yang in the vacant house when failing to meet Lee in early snow, expressing opinion on life through spicy soup in a waterfront restaurant in Jeju, teaching student to play piano in the renovated house, surprise receipt by post of the CD and player returned by Lee who is already on a flight to US, and others. In sum, there are numerous fragments that form the movie story. They are organised in a skilful way so that eventually the romance story is properly told in the mind of the film writer and director. The audience view the movie story and read the messages by piecing together the different fragments. The dual paths complicate the presentation of the movie story and probably instil to the audience a sense of ambiguity.

The followings are observed with relation to the frequency of alternate display of fragments in both the past and present, and with the pattern of fragment length:

- At the beginning of the movie, there are more fragments shown on the past. The length of these fragments tends to be longer than those at the end of the movie.
- Towards the end of the movie, the switching between past and present are more frequent, and these fragments are shorter compared to those at the beginning of the movie.
- The developments of story are not synchronized in both past and present.

3.3 Similarities and Differences at Three Levels

A number of contrasts are observed. They can be grouped into three levels, representing increasing significance in meanings. Some examples in the movie are:

- Although Yang already has a withering interest in piano, she still plans a piano room in the new housie. These are done to please her father in his remaining years. Yang places high priority on his father's wellbeing, though money is important to her.
- In contrast, Lee keeps his promise from first love to help Yang to build a house, though he is stupid and idiot (in Yang's words).
- Yang's father does not realize that her daughter has less interest in piano. Similarly, Lee's mother has no knowledge of how his son is affected by the low family status among university peers.
- For some 17 years after the first love, Yang still retains the thrown away house model. Similarly Lee also keeps the CD and player collected from the vacant house.

At a higher level of personal value, the following reflections are deduced:

- The retention of the thrown away house model and left-behind CD and players indicates that both Lee and Yang are serious in this first love and are willing to keep these deep and lasting memories.
- In the eyes of Lee, Yang is a bad girl, implying that Lee has a different moral value on the matter. In contrast, Yang does not think that she is bad and Lee is regarded as "stupid, idiot, ruin everything in the love romance" and be responsible for the failure of the first love.
- Yang is willing to stay behind and care for her dying father in his remaining years in the beautifully renovated house. In contrast, Lee flies to USA with his newly married wife, leaving his mother in the old Soeul house. This reflects different orientations for the two persons in terms of personal value.

At an even higher level, the following wisdoms of life are derived:

- There is no such thing as absolutely right or wrong. Even when Yang is bad in sex treatment, she also does good things in caring her father. Lee insists on sex within moral standard, he flies away, leaving his mother behind.
- To Yang life is harsh, just as Yang has expressed through spicy soup in the seaside restaurant in Jeju Island. One does not know the ingredients in the spicy soup, only that it is spicy.
- As a fact of life, both Lee and Yang should not (and cannot) marry together. Though they like each other and are serious in the first love and the second encounter, there are fundamental differences between them in terms of views and value.

3.4 Avant-Garde/Cubism and Movie

Originally used in the French army, avant-garde refers to works that are experimental or innovative, particularly in art and culture. Essentially, the term represents a pushing of boundaries beyond the norm. An example is pushing the movie theory boundary towards using the technique of fragmentation, beyond convention. Cubism is an avant-garde movement. Object in cubic works, such as a movie story, is broken up into fragments, analysed and then re-assembled. Fragments are important parts of the movie, as shown by the frequent flashbacks as the movie story progresses. It is interpreted that the "Architecture 101" has adopted cubism into the movie production, though no substantiation or confirmation has been obtained. The cubic fragments are broadly classified into two groups, namely the first love in the past and the second chance love in the present. These two groups intermix in the movie as the story is unfolded. The overall organization of fragments conforms to a conscious, deliberate dissociation and recombination of fragments into a new artistic entity made sufficient by its movie structure. The "Architecture 101" has made an attempt to stamp out ambiguity and to enforce audience to read the movie through fragments. In summary, the following points are noted from the cubism perspective:

- The film does not choose to take a low-level straight-forward description of the love story.
- The alternate display of past and present fragments is a new concept in the spatial organization of the love story, creating cuttings between past and present.
- The inter-mixing and co-existence of fragments for the past and present symbolizes continuity in time, expressing complexity within the movie.
- Deeper reading of the film message by the viewing audience depends on how the fragments are pieced together, but not on visual experience and emotional feeling.
- The film does not present an explicit judgment on whom or what is right or wrong.

4 Comparison to Software Modelling

4.1 Commonalities

With reference to the software modelling in Section 2, the following cornerstone concepts are re-iterated:

- Dual models co-exist in software development. Model development dictates the need to move back and forth between structure and behaviour.
- Abstraction levelling is an important consideration in software development.
- Progression in software modelling needs to incorporate both switching models and deepening levels.

Summarizing the "Architecture 101" movie in Section 3, it can be observed that:

- There are multiple views within the movie story as represented by the college study years in the past and the present house project.
- The past and present sub-parts intersect randomly. This seems to create ambiguity in the story.
- The two pairs of actors and actresses represent a multitude of viewpoints that broadens a wider context and continuity in life.

- Messages are conveyed at multiple levels, namely the movie story, personal value and wisdom in life.
- Multiple fragments from the movie help to establish story space and movement in space for progressing the story.

Table 1 gives a comparison of the development process for the movie and modelling. It is obvious that the twos share similar development steps. Table 2 shows the three commonalities between the movie and modelling.

Table 1. Similar Development Process

Movie	***Modelling***
Progress to present movie story	Progress to build models
Start at present sub-part	Start at structural model
Flashback to past sub-part	Switch to behavioural model
Add details in movie story	Add details to models
Iterate back to 'Flashback'	Iterate back to 'Switch'
End at present sub-part	End at structural model

Table 2. Shared Similarities

Movie	***Modelling***
Multiple sub-parts of story (past and present)	Multiple views of system (structure and behaviour)
Multiple levels of movie messages	Multiple levels of abstracted details
Movie fragments	Model elements

4.2 Model View and Level

Meaningful modelling results will not be produced with the construction of a structural model alone and with no reference to the behaviour side. In order to suitably develop the multiple models of structure and behaviour, a number of switching between models during the modelling process are needed. This is similar to the alternate display of fragments in the movie. Compared to the movie, the following similarities are observed in modelling:

- For movie: "At the beginning of the movie, there are more fragments shown on the past. The length of these fragments also tends to be longer than those at the end of the movie."
  For modelling, similarly, it normally starts with the class diagram to build system structure. It also takes longer time in drawing the class diagram.
- For movie: "Towards the end of the movie, the switching between past and present are more frequent, and these fragments are shorter compared to those at the beginning of the movie."
  For modelling, similarly, the frequency of switching between structural and behavioural models tends to be higher towards the end of modelling.
- For movie: "The developments of story in both the past and present are not synchronized."
  For modelling, similarly, it usually starts and ends at structural model.

4.3 Model Fragment

Unlike view and level, there exists a bigger difference between fragments in the movie and that in modelling. In the movie, it is the fragments for the past and present that form the building blocks. As we have observed earlier, these fragments vary in display frequency and duration at various stages of the movie. Some movie fragment examples are:

Table 3. Sample Movie Fragments

Casts	Two pairs of actors/actress that star the past and present
Places	Architect office, classroom, vacant house, hospital ward, restaurants in Soeul and Jeju, Lee's home, Yang's rebuilt house, model of dream home
Eras	First love in the past (in 1990s), second chance love in the present (in 2010s)
Seasons	Early winter and others
Others	CD player, Etude of Memory CD

In modelling with UML, the three kinds of building blocks are things, relationships and diagrams [6]. Examples of structural and behavioural things are class, use case, interaction and state machine. Association and generalization are examples of relationship. Using the common diagram groups, a complete listing of model elements is shown below:

Table 4. Sample Model Fragments

Class diagram	Class, attribute, operation, generalization, association, multiplicity, …
Use case diagram	Use case, actor, include, extend, association, system boundary, …
Sequence diagram	Object, message, timeline, lifeline, sequence number, flow, …
Activity diagram	Action state, fork, join, branch, initial state, final state, swimlane, …
State diagram	State, transition, condition, event, initial state, final state, nested state, …

A comparison of Tables 4 and 5 shows apparently few similarities between the movie and modelling. The fragments in the movie are clips which incorporate combination of casts, places, etc. The fragments in model building are units of information which may involve scale and granularity.

5 Discussion

5.1 Multi-modelling Criteria

A set of criteria that can be used to refine modelling is derived from Tables 1 and 2. The similarity in development process and the common entities lend ideas to switching views and deepening levels. In terms of order importance in modelling, it should be frequency of switching views, sequencing of fragments, duration of each fragment, and beginning and ending of modelling.

Just as the movie does not take a straight-forward progression, multi-modelling needs to determine how often to switch from one view to another, what fragments to create, how long to use a fragment in one of the dual model, and finally what model to begin and end the process.

5.2 Fragmentation and Sequencing

Fragmentation is an important key to the success of the movie. But is it as important to modelling is still an open issue. How should fragments be defined in models? Should it be at basic level of primitive or at certain granularity? The answers to these questions may provide result to the balancing question in suitable modelling and levelling. Up to now, the common understanding is that thing and relationship at the basic level are the model building block, whereas diagram is a higher level building block. In sum, there is a need to re-think the nature of important model elements and the ideal organizations of model elements in facilitating progression from multiple models in design to the later stages of programming. We have seen this phenomenon before when the function-decomposition based dataflow diagram is "side-lined" in many object-oriented methods as the next wave of the object technology emerges. But the de-emphasized function property still exists in system, and system complexity still demands decomposition. The model elements of control flow, function, conditions, states, actions, events, and many others form the many facets of a system. They need to be reconciled in terms of which one, or their combination, will contribute to better software development results.

One of the normal sequences of diagram is to use the structural model as the first model to be worked on. Afterwards more detailed works start on sequence diagram to fill the interactions among classes through message passing. Methods defined in a class are expanded to become an activity diagram. This process carries on. At end of modelling, the class diagram will be modified to obtain a finalized diagram.

5.3 Ideal State of Development Order

As Nogueira et al [7] has stated, the edge of chaos may constitute an ideal state in software development. Just as it is difficult to determine the conditions of having too much or too less structure/behaviour, software modelling should aim through a structured variably changing state. This is the same as the movie which has achieved success through varying flashbacks between past and present.

6 Conclusion

In conclusion, this paper has presented an inter-disciplinary work. The "Architecture 101" film and software modelling are studied and compared with a view to derive hints that can overcome the difficult challenges in model-based software development. View, level and fragment are determined as the key commonalities. Among these three, there are more open issues in fragment. The paper proposed a preliminary version that inter-mixes the three and suggests a more practical process for software development with some explicit guidance in switching models. The progression from model to code can be made more productive as a result. It is of the view that fragments take a more important role than view and level in the comparison. This leads to a re-thinking of what is model fragment. There are other outstanding issues, such as deriving a detailed mechanism to facilitate a balance between suitable modelling with levelling. Future works include realistic applications for purpose of further validation and verification.

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Highly Analysable, Reusable, and Realisable Architectural Designs with XCD

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Abstract. Connector-Centric Design (XcD) is a new approach to specifying software architectures. XcD views complex connectors as highly significant in architectural designs, as it is the complex connectors that non-functional quality properties in systems can emanate from. So, XcD promotes in designs a clean separation of connectors (interaction behaviours) from components (functional behaviours). Designers can then specify connectors in detail explicitly thus easing the analysis of system designs for quality properties. Furthermore, XcD separates control behaviour from connectors as control strategies. Architectural designs in XcD thus become highly modular with re-usable components, connectors, and control strategies (representing design solutions for quality properties). The end result is the eased architectural experimentation with different design solutions by re-using components/connectors and formal analysis of these solutions to find out the optimal ones.

1 Introduction

Architectural description of systems is described in terms of two main elements – *components* and *connectors* [1]. However, current design languages (e.g., SysML [2] and AADL [3]) do not support connectors as first-class elements. That is, they only make available simple connector types (e.g., procedure call and event broadcast) and high-level *complex* connectors (i.e., interaction protocols) are not supported. This leads to architectural designs being more like low-level specifications [4]. In such cases, complex connectors would be either not specified or at best integrated into components. However, omitting the specification of complex connectors results in architectural mismatch [5], i.e., the inability to compose independent components to a whole system due to wrong assumptions they make about their interaction. Furthermore, formal analysis of architectural designs w.r.t. quality properties is hindered too; it is the complex connectors from which system-level global issues emanate from. When the behaviour of a complex connector is instead integrated into components, the analysis becomes more difficult as designs become less modular. It is almost as trying to analyse a program where procedures have been replaced by *goto* statements.

Complex Connectors. are essentially *interaction protocols* specifying at a *high-level* how interacting system components are to be composed into an entire

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system. Let us consider n trains, t_1,..., t_n, which operate on a single station (as is the case in London Underground). They interact with each other through a signaling interaction protocol that instructs trains how to behave in particular cases. For instance, trains on their way to a station have to reduce their speed if the present train in the station experiences a delay. Or the trains might have to stop right on the track depending on an issue that might break out on the station. So, the interaction protocol herein is the one that determines how trains can interact properly without resulting in safety issues (e.g. collision) and thereby is the key part for analyses against non-functional quality properties (e.g., safety). On the other hand, the trains themselves are unaware of each other and operate independently. Therefore, if there were no interaction protocols coordinating their behaviour, they would possibly collide leading to safety issues.

In this paper, we introduce our new *connector-centric* approach (XcD) to specifying software architectures. Inspiring from Wright ADL [6], XcD separates *connectors* (representing interaction protocols) from *components* (representing functional behaviour). Thus, architectural designs can be easier to (i) understand, (ii) develop and (iii) more importantly analyse. Indeed, the complex connectors, where system-level quality issues emanate from, now become explicit in designs. Connectors in XcD, unlike Wright connectors enforcing centralised glue, are *decentralised* thus rendering distributed system designs realisable. Furthermore, to maximise modularity XcD separates control behaviour from connectors as *control strategies*. Design solutions for quality properties can then be specified externally to connectors. This eases the architectural experimentation with different alternative design solutions without modifying components/connectors. Thus, architectural design with alternative solutions for quality properties can be formally analysed easily and the optimal solutions can be explored early on.

2 Component Specification in XCD

The functional units in systems, components are specified in XcD with (i) ports ($P^{e,r,s,p}$) representing the points of interaction with their environment, (ii) data (D) representing the component state, and (iii) functional and (minimal) interaction constraints (FC and IC respectively).

Ports are similar to those of CORBA [7] – emitter ports (P^e) and recipient ports (P^r) that emit and receive *events* respectively; socket ports (P^s) and plug ports (P^p) that provide and require *methods* respectively. Here events and methods are grouped into interfaces (e.g., $i_{get,set}$ comprising *get* and *set* events) which are then supported by ports (e.g., $p^{i_{get,set}}_{user\_emits}$).

Functional and interaction constraints represent the functional and the *minimal* interaction behaviours of a component respectively. The former allows for specifying the acceptable arguments for methods/events accessible via ports; the latter, if desired, for specifying (i) the particular manner in which the component wants to behave (i.e., the order of actions), or (ii) the conditions under which it does not know how to behave thus leading to interaction exception. XcD constraints are specified following the well-known Design by Contract (DbC) approach

[8], inspired by JML [9] too. The syntax for XCD constraints is thus: *(port, method-/event, pre-condition, post-condition)*, stating that when a method/event action occurs via a port, if the pre-condition is met, then the post-condition is to be met.

In Fig. 1 and Fig. 2 the *user* and *memory* components interacting via shared-data connector are specified in XCD. The user specification does not have interaction constraints (i.e., $\mathtt{IC_{user}} = \emptyset$), meaning that its instances emit or receive events in any order. Whereas in the memory, $\mathtt{IC_{mem}}$ states that (c_1) upon receiving event *set* via the port $p_{mem\_receives}$, the component state is to be updated, setting $initialised_m$ to $True$, (c_2) upon receiving event *get* from the users, if $initialised_m$ is $True$, then the event is received successfully (i.e., post-condition is $True$), else, as stated in the last constraint (c_3), an *Interaction Exception* (i.e., `Int_EX`) is to be thrown. Thus, the memory does not know what to do in case it receives event *get* before event *set* causing access to uninitialised data. As for the functional constraints, neither component has any (i.e., $\mathtt{FC_{user/mem}} = \emptyset$), as the events (i.e., *get* and *set*) emitted or received via the ports do not have parameters.

$$\begin{bmatrix} \mathtt{P^e} : \{p^{i_{get,set}}_{user\_emits}\}, \mathtt{P^r} : \{p^{i_{get,set}}_{user\_receives}\}, \ \mathtt{D} : \{\mathtt{Bool}\ initialised_u = \mathrm{False}\}, \\ \mathtt{FC_{user}} : \emptyset, \ \mathtt{IC_{user}} = \emptyset \end{bmatrix}$$

Fig. 1. User Component Specification

$$\begin{bmatrix} \mathtt{P^e} : \emptyset, \ \mathtt{P^r} : \{p^{i_{get,set}}_{mem\_receives}\}, \ \mathtt{D} : \{\mathtt{Bool}\ initialised_m = \mathrm{False}\}, \\ \mathtt{FC_{mem}} : \emptyset, \ \mathtt{IC_{mem}} \end{bmatrix}$$

$$IC_{mem} : \left\{ \begin{array}{l} c_1 : (p_{mem\_receives}, set, True, initialised_m) \\ c_2 : (p_{mem\_receives}, get, initialised_m, True) \\ c_3 : (p_{mem\_receives}, get, \neg initialised_m, Int\_EX) \end{array} \right\}$$

Fig. 2. Memory Component Specification

3 Connector Specification in XCD

The *high-level interaction protocols* among components, connectors are specified in XCD with *roles* and *channels*. Depicted in Fig. 3, shared-data connector, coordinating access to a (shared) memory by users, is specified in XCD. Connector roles are described in terms of *data-variables*, *port-variables*, and *interaction constraints*. Roles essentially represent the interaction behaviour of components interacting via the connector. Indeed, the user components specified in Fig. 1 will assume the user and initialiser roles in Fig. 3a and Fig. 3c respectively; the memory components in Fig. 2 assume the memory role in Fig. 3b. Connector channels represent the communication links between interacting roles; each is specified with a *pair of port-variables* and a *communication type*, e.g., synchronous and lossy. In Fig. 3d, the channels specify which recipient port-variable receives events of which emitter port-variable, e.g., ch_3 stating that the recipient port-variable of the memory role receives the events emitted by the emitter port-variable of the initialiser role through synchronisation (i.e., *sync*) of events.

r_{user} :
$\left[\begin{array}{l} \mathtt{P^e} : \{pv^{iget,set}_{user\_emits}\}, \mathtt{P^r} : \{pv^{iget,set}_{user\_receives}\}, \\ \mathtt{D} : \{\mathtt{Bool}\ initialised_u = \mathrm{False}\}, \mathtt{IC_{user}} : \emptyset \end{array}\right]$

(a) User Role specification r_{user}

r_{memory} :
$\left[\begin{array}{l} \mathtt{P^e} : \emptyset, \mathtt{P^r} : \{pv^{iget,set}_{mem\_receives}\}, \mathtt{D} : \{ \\ \mathtt{Bool}\ initialised_m = False\}, \mathtt{IC_{mem}} : \emptyset \end{array}\right]$

(b) Memory Role specification r_{memory}

r_{init} :
$\left[\begin{array}{l} \mathtt{P^e} : \{pv^{iget,set}_{init\_emits}\}, \mathtt{P^r} : \{pv^{iget,set}_{init\_receives}\}, \\ \mathtt{D} : \{\mathtt{Bool}\ initialised_i = \mathrm{False}\}, \mathtt{IC_{init}} \end{array}\right]$

IC_{init} :
$\left\{\begin{array}{l} c_1 : (pv_{init\_emits}, get, \mathrm{True},\ \mathrm{True}) \\ c_2 : (pv_{init\_emits}, set, \mathrm{True}, initialised_i) \end{array}\right\}$

(c) Initialiser Role specification r_{init}

$ch_1 : [sync, (pv_{init\_emits}, pv_{user\_receives})]$ $ch_2 : [sync, (pv_{user\_emits}, pv_{init\_receives})]$
$ch_3 : [sync, (pv_{mem\_receives}, pv_{init\_emits})]$ $ch_4 : [sync, (pv_{mem\_receives}, pv_{user\_emits})]$

(d) Channel Specifications for the Shared-Data

Fig. 3. XcD Connector Specification for Shared-Data Connector

Interaction protocols are imposed through role interaction constraints on the component(s) assuming the roles. The interaction constraints of roles are intended for enforcing components to behave in a particular manner (i.e., through imposition of specific order on action execution). Components can thus be avoided from getting involved in unexpected interactions due mainly to actions (e.g., event listening and receipt) performed in wrong order. The end result is then a set of components interacting with their environments successfully to compose the whole system. IC_{init} in Fig. 3c, for instance, states that (c_1) the emission of event *get* via the port-variable pv_{init_emits} occurs with no pre- and post-condition (i.e., both are $True$), and (c_2) upon emission of the event *set* with no pre-condition, $inititalised_i$ is set to $True$. Effectively, the initialiser role= allows assuming user components to perform actions (i.e., the emission of event *get* or *set*) in any order.

connector $\mathtt{Shared\_Data_2}$ =
role Initializer=**let** A = set→ A ⊓ get→A ⊓ ℘
in set→A
role User = set→User ⊓ get→User ⊓ ℘
glue = **let** Continue=Initializer.set→Continue □ User.set→Continue □
Initializer.get→Continue □ User.get→Continue □ ℘
in Initializer.set→Continue ℘

Fig. 4. Wright Connector Specification for Shared-Data Connector, reprinted from Figure 4 of [6]

Decentralised Connectors are adopted in XcD, distinguishing it from the Wright ADL [6] which also focuses mainly on connectors. Unlike XcD, Wright enforces a *centralised glue* for connector specification which composes the behaviour

of contained roles into a whole system behaviour. Indeed, as depicted in Fig. 4, Wright specification of the shared-data connector includes a glue coordinating the events of the user and initialiser roles. However, the glue, just like SOA choreographies [10], is problematic. As shown in [11, 12], realisation of choreography specifications is not always possible thus leading to systems that are impossible to implement.

4 Control Strategy Specification in XCD

XcD, unlike similar approaches, e.g., Wright [6] and Exogenous Connectors [13], introduces a new architectural abstraction for specifying design solutions.

XcD control strategy is specified by means of *external* interaction constraints that refer to a specific connector *role*. The constraints herein are intended for constraining the role behaviour further so that the assuming components obey an additional order of action execution. The end result is to be the satisfaction of the design solution (e.g., for quality properties) represented by the control strategy. For instance, memory in Fig. 2 might be accessed before its state-data is initialised thus leading to safety issues (e.g., deadlock, as the memory throws interaction exception where users expect successful termination). One can avoid this by specifying a control strategy for the memory role, as in Fig. 5. The $\texttt{IC}_{\texttt{str}}$ in Fig. 5 states that (c_1) event *get* is not allowed to be received by the memory role until *when* pre-condition, $initialised_m$ evaluating to $True$, is met. Thus, interacting with users memory always receives event *set* first to initialise its data which prevents it from throwing exception and thereby causing deadlock.

Unlike other approaches supporting design solutions (e.g., aspects in AO-ADL [14]), control strategies, e.g., in Fig. 5, are specified *externally* to connector specifications. The end result of such highly modular architectural designs is, as shown in the evaluation section, the eased architectural experimentation with different design solutions and their analysis for quality properties.

$$\begin{bmatrix}\texttt{r\_memory},\\ \texttt{IC}_{\texttt{str}}\end{bmatrix} IC_{str} : \left\{ c_1 : \begin{pmatrix} pv_{mem\_receives},\ get,\\ \textbf{when}(initialised_m),\ \text{True}\end{pmatrix}\right\}$$

Fig. 5. XcD Control Strategy Specification for the Memory Role

5 Evaluation

We have developed the first version of a toolset, used as plugin to Eclipse [15], that allows designers (i) to specify their system architectures in XcD and (ii) to *automatically* translate their models into formal specification in FSP formalism [16]. FSP formal specifications can then be automatically analysed through model checkers e.g., LTSA. Through our toolset, we have automatically encoded the architectural specifications, described in Fig. 1, Fig. 2 Fig. 3, and Fig. 5, in FSP. Our goal herein was to show how it helps in design to improve modularity

(i.e., separate functional, interaction, and control behaviours), which is introduced with XCD. For simplicity, herein we considered 2 different configurations of the shared-data system: one (*MemoryInitialised*) with the control strategy specified in Fig. 5 and another (*NoStrategies*) with no strategy. Interestingly, both configurations comprise the same component and connectors; it is only the strategy employed on the former that distinguishes it from the latter.

Table 1 shows the formal analysis results for these 2 configurations with one user [1]. Table 2, Table 3, and Table 4 show the results for 3, 5, and 7 users respectively. Unsurprisingly, the strategy is successful in avoiding deadlocks, resulting from users accessing un-initialised data. Moreover, modelling formal specifications as state-machines, LTSA ends up with the same number of states (i.e., 5) for the shared-data's formal specification, regardless of which configuration is applied. This shows that the design solution represented by the strategy *MemoryInitialised* not only avoids deadlock but also maintains state-space efficiency of the formal model. Hence, designers can better utilise the state space during the formal analysis by, e.g., analysing their systems with more users.

With the external control strategy we easily experimented with a design solution, without modifying components/connectors, and further analysed our system design for safety property (i.e., deadlock freedom). If the experiment results were not satisfactory, we could so easily employ different strategies and analyse the system design with them. Hence, highly modular XCD lets designers easily analyse their designs with alternative solutions for quality properties.

Table 1. Configurations with 1 Users

Strategies	State	Deadlock
NoStrategies	5	Yes
MemoryInitialised	5	No

Table 2. Configurations with 3 Users

Strategies	State	Deadlock
NoStrategies	5	Yes
MemoryInitialised	5	No

Table 3. Configurations with 5 Users

Strategies	State	Deadlock
NoStrategies	5	Yes
MemoryInitialised	5	No

Table 4. Configurations with 7 Users

Strategies	State	Deadlock
NoStrategies	5	Yes
MemoryInitialised	5	No

6 Related Work

Widely used modelling languages, e.g., UML [17] and SysML [2], unlike XCD, neglect connectors and offer mere associations that can expose only wire-like connections between components. ADLs, e.g., Darwin [18] and Rapide [19] suffer from the same problem too; while Darwin views connectors as bindings between

[1] We used LTSA version 2.2. with 2000 MB of RAM.

required and provided service of components, Rapide as connections between input events and output events released by components. Better yet, AADL [3] introduces a set of pre-defined connector types. However, it does not allow specifying any different complex connector types.

The lack of interest to connectors has been spotted earlier by Garlan [5], and subsequently Wright ADL [6] has been developed, which formalises connectors. XcD aims at enhancing Wright by going further and separating also the control behaviours from connectors. Moreover, XcD, unlike Wright, does not enforce (centralised) glue specification for connectors and thus render distributed system designs realisable. Viewing connectors as first-class entities, Plasil et all.'s [20] work is also similar to XcD. However, they allow for compound connectors that can encapsulate components too. This is avoided in XcD to maximise the understandability, re-usability and analysability of architectural designs. Exogenous connectors [13], like XcD, promotes clean separation of components from connectors. However, control behaviour is scattered inside the exogenous connectors, which by contrast in XcD is specified externally as control strategies.

BIP [21], like XcD, separates control behaviours from connectors. However, it neglects connectors, viewed as first-class elements by XcD, and supports only rendezvous and broadcast interaction methods. Similarly, AO-ADL [14] introduces aspect for design solutions, which are, unlike control strategies, specified inside connector specifications and thus the re-usability of connectors and the experimentation with different aspects get hindered.

7 Conclusion and Further Work

Connector-Centric Design (XcD) introduces a new architectural modelling language that aims to revive the complex connectors in architectural designs. To this end, XcD, inspired from Wright ADL, cleanly separates in designs connectors (interaction behaviour) from components (functional behaviour). However, unlike Wright, XcD adopts decentralised connectors that do not allow for glue-like specifications which lead to un-realisable system designs. Furthermore, like BIP language, XcD separates design solutions (control behaviour) from connectors and introduces them as control strategies. Hence, designers can specify realisable system architectures in a highly modular way through re-usable components, connectors, and control strategies. This significantly eases the experimentation with different combination of components/connectors/control-strategies and also the formal analysis w.r.t. quality properties. Indeed, with external control strategies, designers can easily conduct formal analysis of their system with different design solutions by re-using components/connectors, and decide early on the optimal design solutions that best meet quality properties.

Currently, we are working on extending XcD so that it supports channel types and also extending the XcD language too to improve its expressiveness.

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ARSL: A Domain Specific Language for Aircraft Separation Minima Determination

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Abstract. This paper proposes Aeronautical Rules Script Language (ARSL), which is particularly designed for the collaborative determination of a required separation between aircrafts before the tactical phase. ARSL is a domain specific language (DSL) that can be used as a formal language for information sharing and airspace configuration. The advantages of ARSL are that it allows domain specialists to understand, easy to write, reuse, and maintain the program efficiently. In this research, ARSL is implemented and integrated into the collaborative decision making (CDM) project of Aeronautical Radio of Thailand as a case study.

Keywords: Domain Specific Language, Collaborative Decision Support, Aero-nautical.

1 Introduction

Currently, air traffic congestion is massively increasing. To maximize the use of air space in Thailand, Aeronautical Radio of Thailand (AEROTHAI) started a Collaborative Decision Making (CDM) project of which one of the key features is "Able to determine required separation between each aircraft". Required separation is the information provided and alert to stakeholders.

In order to determine required separation between aircrafts, there are a lot of data needed. Many aeronautical data models are defined such as Aeronautical Information Exchange Model (AIXM) [1]. AIXM is designed to enable the management and distribution of Aeronautical Information Service (AIS) data in digital format. The structure of AIXM is defined by FAA (Federal Aviation Administration) and EUROCONTROL. At the current structure level of 5.1, AIXM does not support the complex separation determination rules which are used in BANGKOK FIR (Bangkok Flight Information Region).

Typically, a domain specific language (DSL) is designed to allow domain specialists to understand, easy to write, reuse, and maintain the program efficiently and quickly [2]. These advantages make DSLs very popular and also contribute to safety and reduce software errors [3].

A domain specific language called Aeronautical Rules Script Language (ARSL) has been invented in this research. ARSL is designed for the integration of the major

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elements needed from airplanes or any navaids (navigational aids) to define the re-quired separation between aircrafts.

2 Background

The following subsections briefly introduce the background knowledge of domain specific language, and longitudinal aircraft separation that are related to this research work.

2.1 Domain Specific Languages (DSLs)

In software development engineering and domain specific engineering, domain spe-cific languages are considered as a computer language which aims for help in com-munication among developers and others who are concerned with the system.

Today, DSLs are very popular. They are built by experts in a particular domain and focus only on must-have ability. A domain expert can easily understand and maintain the DSL code without programming ability. The benefit of applying domain specific languages in software development is "Time and time again, the key bottleneck is software development is communication between developers and those for whom they are developing system" [4]. Compared to general-purpose languages like C#, C++ or Java, a domain specific language has capability of providing more advantages that can be summarized as follows [4], [5], [6]:

1. Improve development productivity.
2. Improve software quality, productivity, reliability, maintainability, portability and reusability.
3. Communication with domain experts to express solutions in the level of abstraction of the problem domain, so that the expert can understand, validates software by themselves.
4. Change in execution context, so that some part of software can be programmed by domain experts.

Domain specific languages are divided into three main categories by Martin Fowler [6] as follows:

1. An external DSL is a language separate from the main language and has its custom syntax. Examples of external DSLs are regular expression, SQL and XML configuration.
2. An internal DSL is an extended of a general-purpose language as a subset of that language features. Examples of internal DSLs are Ruby and Lisp.
3. A Language workbench is an IDE for defining and building DSLs.

2.2 Longitudinal Aircraft Separation

Longitudinal aircraft separation is the spacing between aircrafts that can be calculated by estimating the position of each aircraft [7] as shown in Fig. 1.

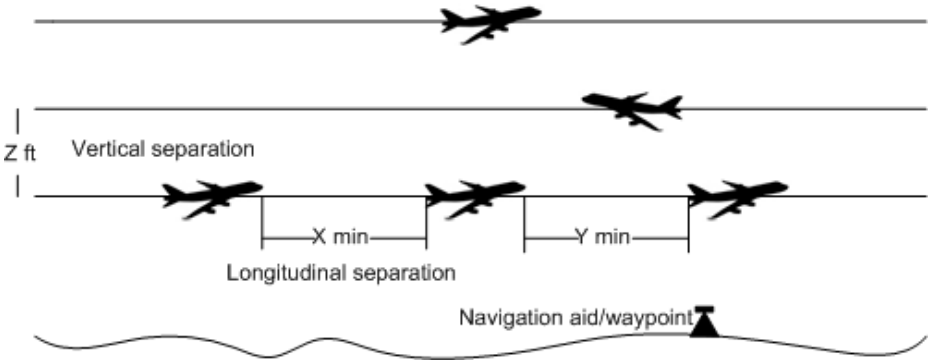

Fig. 1. Longitudinal separation minima based on time

For safety, separation must never less than longitudinal required separation mini-ma. There are various techniques used by the air traffic controller to maintain the required separation of aircrafts during the tactical phase. For example, Mach number technique uses DME (Distance Measuring Equipment) and/or GNSS (Global Naviga-tion Satellite System) or by using RNAV (Area Navigation) where RNP (Required Navigation Performance) is specified [7]. All techniques are used for maintaining the separation which is defined in terms of time-based or distance-based. Unlike the ver-tical separation, the longitudinal separation is af-fected by many variables such as aircraft performance, destination and navigation aids. To optimize the use of airspace, aircraft separation must be known before flight is departed.

3 Aeronautical Rules Script Language (ARSL)

3.1 Requirements

In air traffic management, required separations and calculated aircraft separations are compared for alert and to inform those who are responsible for problem resolution early before flights are departed. Estimated Time Over (ETO) across waypoints (coordinates that define a point in airspace) can be calculated by extracting the routes, departure time, arrival time, and estimated time to cross boundary from the flight plan. Then the flight trajectory (A path that the aircraft will follow) is built by combining the list of waypoints and their ETO.

Next, we have to know what the required separation for each aircraft is. These can be found in Aeronautical Information Package (AIP) and its supplement. Typically, AIP declares the longitudinal separation between aircrafts in unformatted text that

humans can read and understand easily but not by machine, for example, “10 mins longitudinal separation between RNAV- equipped aircraft apply Mach Number Technique; 15 mins longitudinal separation between other aircrafts” [8]. And some waypoints have special implementation examples in AIP supplement [8]. The example from AIP supplement A16/11 is “2.4 flight intending to land within YGN FIR, CPDLC will not require” to achieve RNP 10 navigation requirement. In short term period all rules can be programmed by a general-purpose language, but in long term period, a general-purpose language is too complex for the user. In addition, it has to be recompiled every time it has been changed.

It can be concluded that the main requirements of developing ARSL are: 1) Provide information needed for determining the required separation, 2) ARSL must be the external DSL, 3) ARSL parser can detect syntax error, and 4) Develop integrated development environment (IDE) for the user to edit ARSL.

3.2 ARSL Parser

Parsing a domain specific language is a strongly hierarchical operation [6]. When parsing text, the chunks are arranged into a tree structure. To build the tree structure, we collected information from studying the existing data model, called AIXM, and collected extra information from AIP of Thailand. Basically, ARSL parser reads the script file, builds the parsed tree, translates it to ARSL semantic model, and generates rules and data by using an Irony [9]. Irony is a development kit for implementing languages on .NET platform. Irony’s target language grammar is coded directly in C# using operator overloading to express grammar constructs.

3.3 ARSL Implementation

ARSL is implemented within the Collaborative Decision Making (CDM) project en-vironment. The current scope of CDM is to manage flights in Thailand FIR. In order to manage a plan in CDM, we need to know a longitudinal required separation of the aircraft. Currently, the required separation determined in AIP is simply a constant value, i.e. 10 minutes for RNP10 flights. However, in case of some special exceptions other than RNP10 flights, for example, flights that fly over LIMLA and BETNO can get 7 minutes required separation without CPDLC equipped.

Example ARSL script is shown in Fig. 2. It contains three defined rules. The first rule (RUL1) indicates if flight navigation performance is RNP10 and has CPDLC equipped, then the required separation is 50 nautical miles or 7 minutes. The second rule (RUL2) describes the case when the flight does not have CDPLC but its destination is within YGN FIR, the required separation will be 50 nautical miles or 7 minutes. The last rule (RUL3) indicates the default separation when it does not meet any conditions of the above rules.

```
Rules: RUL1;
EQUIPMENT: R;
NAV: RNP10;
FlightLevel: >270;
CPDLC: YES;
Separation: 50NM, 7mins;
Rules: RUL2;
EQUIPMENT: R;
NAV: RNP10;
FlightLevel: >270;
Destination: VYYY;
CPDLC: NO;
Separation: 50NM, 7mins;
Rules: RUL3;
Separation: 80NM, 10mins;
Applyto: LIMLA;BETNO;
Rules: RUL1, RUL2, RUL3;
```

Fig. 2. Example of Aeronautical Rules Script Language

Fig. 3 illustrates the implementation of ARSL to support the requesting system. Ini-tially, the ARSL template is established and it contains all of the generic rules listed from Procedure of Air Navigation Services Air Traffic Management [7] that are suffi-cient to define longitudinal required separations. A domain specialist can start adding rules to the template to produce ARSL working file. Next, he or she has to submit the completed ARSL file to the server. Rules and Data service will then be generated in order to serve the requesting system that needs the required separation of any aircrafts and the rules used to determine the separation. The requesting system can connect to the RulesAndData service by using SOAP protocol.

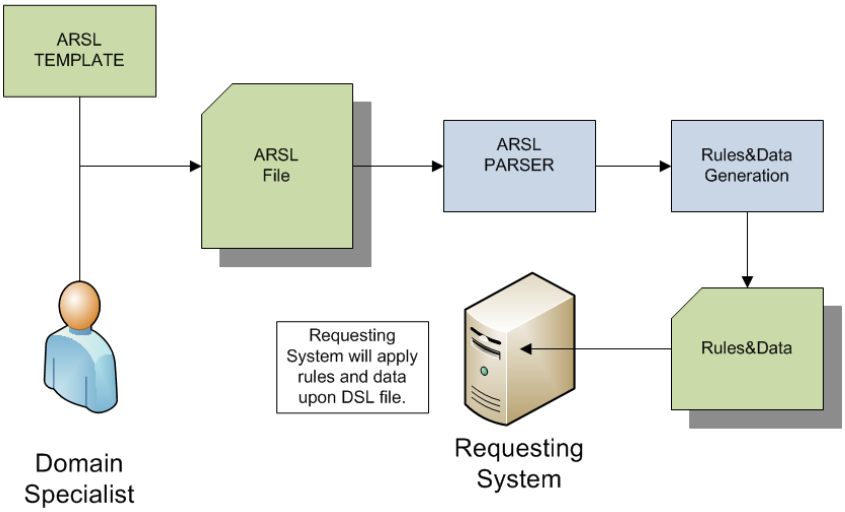

Fig. 3. Aeronautical Rules Script Language Implementation Concept

Fig. 4 illustrates the class diagram of RulesAndData service. The ARSL parser gener-ates the initial semantic model of rules and data. The function of ARSLData-Generator is to prepare the structure of rules in the format suited for the request from RulesRespondent. The RulesRespondent can be considered as the processor that executes the information obtained from ARSLDataGenerator, in addition with data obtained from FlightInformation, and then returns the separation minima to the requesting system. Any systems that want to request for this service have to format its flight information to conform to that of FlightInformation class.

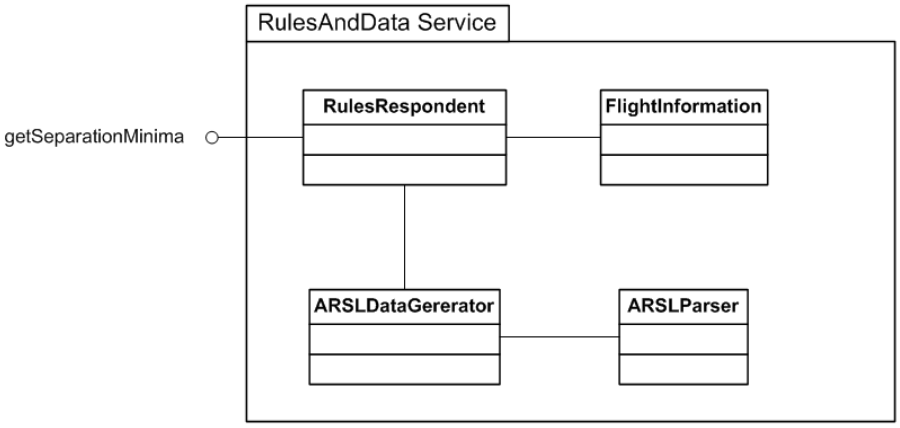

Fig. 4. RulesAndData Service Class Diagram

FL	P_FL	P_ETO	f_p_ETO	b_p_ETO	E
F300	F300	17:45		00:13	
F300	F300	17:58	00:13	00:19	
F300	F300	18:17	00:19		
F320	F320	18:10		00:07	
F320	F320	18:17	00:07	00:06	
F320	F320	18:23	00:06	00:43	
F320	F320	19:06	00:43		
F340	F340	15:06		02:48	
F340	F340	17:54	02:48	00:14	
F340	F340	18:08	00:14		

Fig. 5. Example output of collaboration view

Fig. 5 shows the example output, called collaboration view, resulting from the integration of ARSL into CDM. Focusing on Planned Estimated Time Over (P_ETO) of which the value is calculated from route, Estimated Elapsed Time (EET) contained in the flight plan, in addition with Target Take-Off Time (TTOT) of which the value is obtained from the collaboration of the planner and aerodrome traffic controller. Once the calculation of P_ETO of each flight has been completed, CDM will line up the aircrafts and calculate the separation between the adjacent. However, each flight has individual longitudinal required separation, thus CDM has to ask RulesAndData service implemented in this work for the required separation. Three status will be displayed as the result of the comparison between the value of required separation and that of calculated separation. The red mark signals "alert" status, the yellow mark notifies "warning", and the green mark indicates "normal". For example, given the required separation is 10 minutes, if the calculated separation is less than 7 minutes, the red mark will then be assigned. In case the calculated separation is between 7 and 10 inclusively, the warning mark is then assigned; otherwise, the green mark of normal status is displayed. It is mandatory that the planner must adjust the plan, i.e. change TTOT, change flight level or change route, in case of alert status. For the warning status, the planner may opt to ignore the signal.

4 Conclusion

In this research, Aeronautical Rules Script Language (ARSL), which is a domain specific language for aircraft separation minima determination, is designed to cover all elements sufficient to determine the longitudinal separation between the aircrafts. The basic idea is to collect all elements from International Civil Aviation Organization (ICAO) standard, and AIXM, associated with other extra elements from Bangkok FIR's AIP. Since ARSL is text-based, it is easy to exchange data with other standards such as AIXM. Moreover, ARSL promotes the ease of rule manipulation.

The ARSL presented in this paper is capable for determining the longitudinal separation minima at waypoint only. Future research work could be the enhancement of its

capability to support determining the required separation at airports, and to support determining the vertical separation minima.

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Automated Testing Featuring Prototype Generation from Harvested Requirements Specification

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Abstract. Prototyping is a common technique suggested for requirements validation during the early phase of software project. However, prototype construction is resource consuming. Moreover, the evolving prototype due to requirements change may cause inconsistency among associated artifacts. This paper thus presents an approach to automating the construction of prototypes from harvested requirements specification. The implemented component is part of Requirements Harvester— RH, which is the system to facilitate integrating quality control activities with requirements management ability provided by a traceability matrix. The generated prototype is self-test and capable of maintaining the consistency of related work products. The presented automation approach promotes the working smarter environments that could improve process capability and performance. The findings from the comparisons of the manual and the proposed methods reported the outperformance of the latter.

Keywords: Prototyping, Content harvester, User Interface Testing, and Software Process Improvement.

1 Introduction

Requirements are raw materials for developing software. Throughout the life cycle processes, requirements are transformed into design blueprints and code, respectively. Therefore, the early determination of what the user really wants can result in faster and less expensive software, because changes cost exponentially more to implement if they are detected later in development [1].

For mature software processes, prior to formal hand-off from the phase of requirements analysis, prototyping is one of the methods or techniques typically used to demonstrate the essential features of the system being developed so that the common understanding among the developers, the end users, and other relevant stakeholders could be established. The valid requirements are the basis of the final quality products, as well as faster and less expensive software projects.

Prototyping can be considered as a necessary auxiliary step that can help increase speed, improve quality and cut cost. Moreover, it can be used to test user interface flows or as a means of reducing the risk caused by wrong user interfaces, which are usually a most visible or most risky part. Since users know the problem domain better

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than anyone in the development team, increased user involvement can result in the final product that is more likely to satisfy the users' desire for look, feel and performance [1].

Today, there are many tools to facilitate creating a prototype. For example, screen generators that provide the drag and drop feature to help create prototypes easier. However, the prototype created simply shows users the system that does not function. It merely shows what the screens may look like. Screencast (or video screen capture) is a digital recording of computer screens which may contain audio narration. However, there are no prototyping tools that facilitate creating a prototype directly from the requirements specification, support self-test, and maintain consistency when requirements change. This research thus presents a method to harvest the contents of requirements specification, and to generate the prototype with the features of self-testing and self-adapting to requirements changes.

2 Content Harvester

In literature, the purpose of Content Harvester [2] is to unleash the information in a collection of unstructured, formatted documents that follow a similar pattern, and to make that information available for publishing in any open format. Typically, the process of content harvester starts with: 1) converting the source document into XML format; 2) specifying the regions of content that are of interest in terms of textual markers or tagging based on user-defined names; 3) locating the target tags; and 4) extracting the associated contents. The resulting output is XML contents which can be queried for information exchanges among applications or platforms.

A specification contains some concrete information to link between requirements and programs. User interfaces are one of the information contained in a specification. Based on the notion of content harvester, software requirements can be extracted from the location detected by XML tags. The extracted data will then be processed for the prototype construction.

3 Design and Implementation

Our research group has implemented a system called Requirements Harvester (RH), of which the purpose is to facilitate the integration of quality control activities to requirements management ability provided by a traceability matrix [3], which is used for tracking any change and reflecting it properly from the initiation point to implementation. It can also detect the indirect or transitive relationships as well as indicate the suspect requirements that might be affected if a linked requirement is changed or deleted. Moreover, the input into the traceability matrix [3] is automated that could reduce human errors and resource consumption.

The architecture of RH is illustrated in Fig. 1. The current major components consist of requirements traceability matrix [3], the input preprocessing component [4], the user acceptance tests generator [5], and the prototype generation component which is the focus of this research as the enhancement of RH.

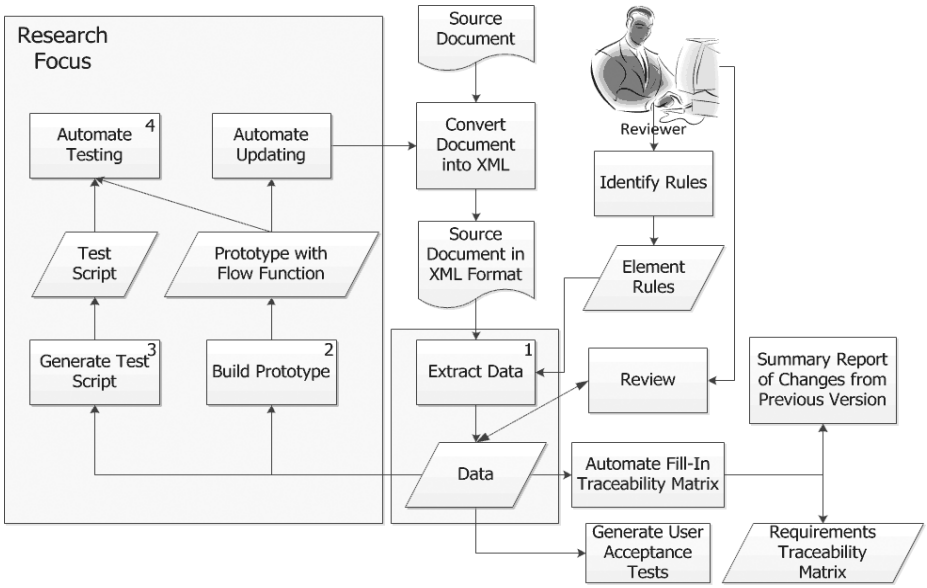

Fig. 1. Architecture of prototype generation component of Requirements Harvester

The prototype generation component is developed as Java application. It comprises four major modules as described in the following subsections.

3.1 Extract Useful Information

It is required that the input requirements specification contains a section of screen design and screen element descriptions, examples as shown in Fig. 2. The screen design can be handwritten, printed, image capture, etc. Screen images are used as the screen templates for generating user interfaces, while each screen element description provides details including list of elements (e.g. button, checkbox, drop-down list, link etc.) associated with properties, and transitions to other screens. The contents harvested from requirements specification are stored in DOM (Document Object Model) tree which enables direct data access and allows data modification. Moreover, it enables automatic updates onto requirements specification when there are minor changes to the associated prototype.

3.2 Build Prototype

A prototype contains two main components: 1) a set of user interfaces, and 2) the control flow. Each user interface (UI) is generated based on the screen image template which guides the developer to locate the screen elements. The step of generating UI requires human intervention. The type and properties of each screen element are known from the SRS analysis and extraction in the prior step. The program will match each element and its properties to the user-specified area. Some input types and

exceptions are pre-defined for text fields. The program can examine these criteria with the event flow type and responds to it correctly. Additional exception handler may be triggered as needed in case of exception flow transition. At this stage, we obtain a set of user interfaces that do not function, but show what the screens may look like.

The prototype generator supports conventional types of UI element and argument. Example types of argument are shown in Table 1. The argument detail can be automatically filled in by the information extracted from requirements specification or manually input by the user on the screen template. Typical UI elements supported include: TextField, TextArea, PasswordField, RadioButton, CheckBox, Button, DropDownList, List, ScrollPane, Label, Panel, Slider, Spinner, ProgressBar, DateChooser, FileChooser, ColorChooser, etc.

Next, the component will match the element, such as button and link, with the control flow or transition analyzed from the source document. As a result, a prototype that does function is obtained. Another feature of the prototype generation component is that it provides automatic updates on requirements specification once the current prototype has been modified due to minor changes. The procedure is presented in Fig. 3. This feature promotes the consistency among work products produced in a project.

Mapping Fields

Field Name	I/O	M/O	Format	Detail
User Name	I	M	Digit	**text:** 510001
Password	I	M	Varchar	**password:** *
Remember Password	I	O	CheckBox	**text:** Remember my password
Logo	O	O	Image	

Notes: I/O denotes Input/Output
M/O denotes Mandatory/Optional

Events / Actions

Field Name	Type	Detail
Login	Button	**normlink:** Main Page
Clear	Button	
Recovery Password	Hyperlink	**text:** Forgot you password? **normlink:** Recovery Page

Fig. 2. Example screen design and screen element description contained in input SRS

3.3 Generate Test Script

The self-test feature is added to the prototypes generated. That is, the user interfaces and their flows can be automatically generated from requirements specification. Walking through the user interfaces to validate a set of requirements could be automated by following the control flow. State machine testing is introduced here. It is assumed that a state is assigned to each page or an element, all of which are then explored. Example state diagram of the screen design in Fig. 2 is shown in Fig. 4.

Applying the algorithm of graph traversal will generate a set of test paths, example as shown in Fig. 4. Each test path represents a test case. A set of test cases comprise a

test script. A test script contains trigger component, trigger method (action), source page and destination page. It is defined based on the deterministic finite state machine, so called Variable Finite State Machines or VFSM [6]. VFSM can be converted to other equally finite state machines and can be applied for user-interface testing. The main component of this state machine is small and natural compared to others. In addition, it is more flexible, much faster, and more accurate because of its design for representing program procedure.

Table 1. Example of supported UI argument types

Type	Detail
Position	User clicks to notify start position
Size of Element	User clicks upper left and lower right co-ordinate to frame the area size
Text of Element	Extract from SRS
Drop Down List Items	Extract from SRS
Regular Expression for Input Validation	Extract from Format column in Mapping Fields Table (Fig. 2)
Date Format in Date-Chooser	Extract from SRS or default format applied
Tool Tip Text	Extract from SRS or specified by human
Input/Output Type	Notified by I/O column in Mapping Fields Table (Fig. 2)
Required	Notified by M/O column in Mapping Fields Table (Fig. 2)
Normal Link	Extract from Detail column in Events/Actions Table (Fig. 2)
Exceptional Link	Extract from Detail column in Events/Actions Table (Fig. 2)
Label Text	Extract from SRS or specified by human
Label Position	Default position determined by the program
Comment	Extract from SRS or specified by human
Icon Image	Extract from SRS or specified by human

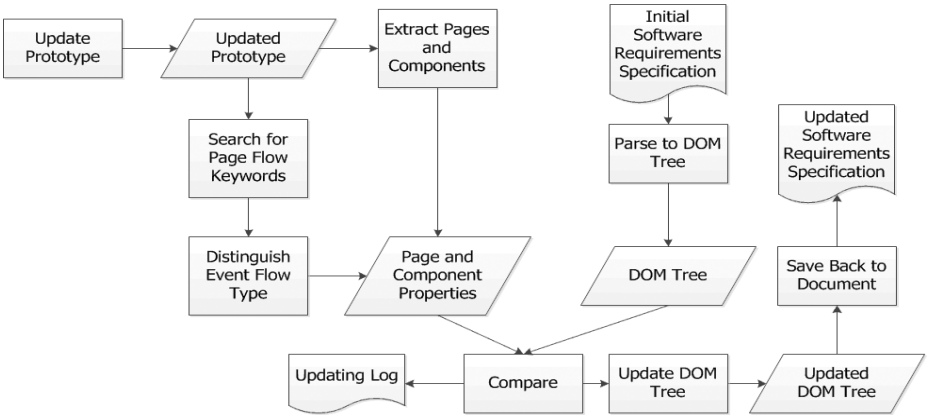

Fig. 3. Steps to update SRS when prototype has been updated due to minor changes

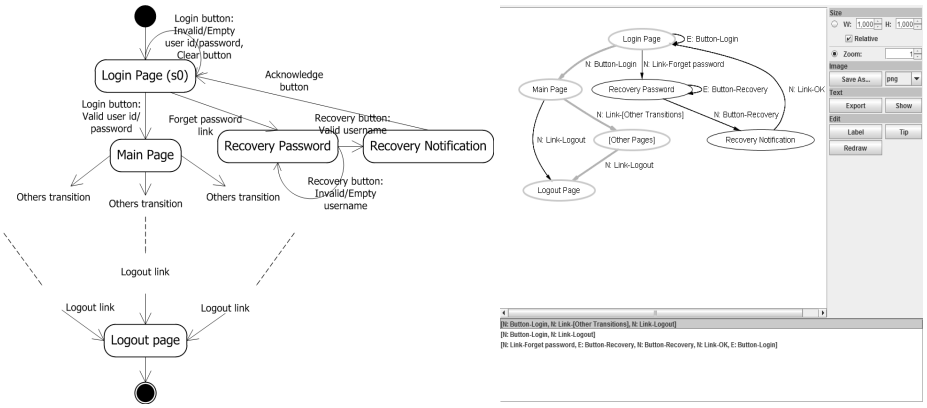

Fig. 4. Example state diagram and its associated graph and test paths

3.4 Automate Testing

This research opts to automate testing with the insertion of native system input events. The reviewer can easily inspect a particular procedure with automated walkthrough. Native system input events consist of Mouse move, Mouse press, Mouse release, and Key code send that emulate human behaviors. A set of operations are defined on individual sequence of events. Each operation can be regarded as human interaction.

3.5 Evaluation

Some experiments were conducted to demonstrate the significant difference of time usage between the manual against the proposed automation approach to prototyping. The results strongly support working smarter strategy or automation approach. Table 2 and 3 summarize the method type of each step comprising the procedure.

Table 2. Tasks of creating prototype and testing (initial)

Procedure	Manual	Automated
Documentation (SRS)	Manual	Manual
Review Document	Manual	Manual
Analyze Data	Manual	Automated
Import Document	-	Automated
Configure Input Specification	-	Manual (or Default)
Input Data into System	Manual	Automated
Define Element Flow	Manual	Manual
Create Prototype	Manual	Automated
Test Prototype	Manual	Automated (+Human observation allowed)

Table 3. Tasks of modifying prototype and retesting

Procedure	Manual	Automated
Review Document	Manual	Automated
Analyze Data	Manual	Automated
Import Document	-	Automated
Input Data into System	Manual	Automated
Define Element Flow	Manual	Automated
Modify Prototype	Manual	Automated
Test Prototype	Manual	Automated (+Human observation allowed)

Each task was performed and the usage of time was recorded. The time usage is compared in the dimensions of manual against automation, various sizes of requirements, and manual change against automated change, as shown in Table 4 (Note that Change2 denotes the second time of requirements change). The findings of Table 4 reported the much less time spent with automation approach for all scenarios. The percentage of differences is about 60%-70%.

Table 4. Comparisons of time usage (minute)

Number of requirements	25	50	100	150	300
a) Manual	397	794	1588	2381	4763
b) Automated	145	273	530	786	1555
c) Manual Change	550	1100	2200	3300	6600
d) Automated Change	174	328	638	947	1875
e) Manual Change2	703	1406	2813	4219	8438
f) Automated Change2	202	384	746	1109	2196
Diff Initial (%)	63	66	67	67	67
Diff Change (%)	68	70	71	71	72
Diff Change2 (%)	71	73	73	74	74

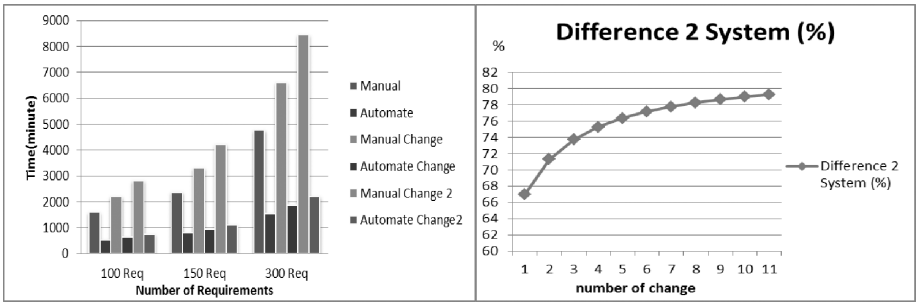

Fig. 5. a). Comparison of time usages between manual and automated prototyping b). Differences of time usages when more changes

The differences of time usages between manual and automation at the sizes of requirements: 100, 150, and 300, is presented with the bar chart in Fig. 5a). The tendency

of the differences of time usages between manual and automated procedure after 10 changes at the size of 150 requirements is also illustrated in Fig. 5b). The result shows that automation is faster than manual around 65-80%. The greater number of change, the more difference of time usages was reported.

4 Conclusion and Future Work

User Interface Prototyping, or horizontal prototype, provides a broad view of an entire system or subsystem, focusing on user interactions rather than low-level system functionality [7]. A prototype is supposed to be developed quickly to explore the system requirements and user interface design early. Based on Content Harvester, the implemented prototype generator could reduce cost and effort by generating prototypes directly from the requirements specification, as well as help manage the consistency between the requirements specification and the prototype system due to requirements changes. This can be considered as the preventive approach to promoting conformance to requirements that will result in quality software product.

Experiments were conducted to demonstrate the efficiency of automation approach to prototyping compared to the manual method. The results showed significant reduction of time when constructing and modifying the prototype automatically.

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Regression Testing of Object-Oriented Software: A Technique Based on Use Cases and Associated Tool

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Abstract. This paper presents a regression testing technique (and associated tool) for object-oriented software based on use cases. The basic models we use to describe use cases are UML statechart and collaboration diagrams. The technique combines, in fact, the analysis of these models to a simple static analysis of the code. The goal is to identify changes that may not be visible in design models (change in a method's body). The developed tool identifies modified (impacted by modifications) use cases and selects the appropriate test cases from an existing test suite. New test cases are generated when necessary. The selected test cases (including the new ones) are automatically executed. A case study is reported to provide evidence of the feasibility of the approach and its benefits (reduction of regression testing effort).

Keywords: Software Maintenance, Regression Testing, Object-Oriented, Test Case Selection, Test Case Generation, Use Cases, UML Diagrams, Static Analysis.

1 Introduction

Regression testing is an important activity to ensure software quality at maintenance phase. It can also be used in the testing release phase of software development. Regression testing is a process that consists of determining if a modified system still verifies its specification and whether new errors were introduced inadvertently (Kung, 1995; Rothermel, 1997; Harrold, 2001). For obvious reasons, the retest-all approach, that consists in rerunning every test case in the initial test suite (generated during initial development), is inefficient, costly and unacceptable in the maintenance phase (Rothermel, 1996). Moreover, it does not consider obsolete (no longer valid) and new test cases. In addition, it is often impractical due to the development cost and delivery schedule constraints (Wu, 1999). An alternative approach, known as a selective retest strategy, assumes that not all parts of a system are affected by changes (Pilskalns, 2006). Regression test selection consists in selecting and running, from an initial test suite, a reduced subset of test cases in order to verify the behavior of modified software and provide confidence that modifications (and parts of the software affected by modifications) are correct (Graves, 2001; Engström, 2008). This leads to a reduction in the cost of (regression testing and) software maintenance.

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Regression testing strategies need to address different important issues (Pilskalns, 2006; Engström, 2009): modification identification (finding where changes occur in a system), test selection (deciding which tests are more likely to reveal faults introduced by modifications), test execution and test suite maintenance (determining where additional tests may be needed). Many researchers have addressed the regression testing problem (and particularly the regression test selection problem) in the literature (Rothermel, 1993; Kung, 1995; Rothermel, 1997; Abdullah, 1998; Von Mayrhauser, 1999; Wu, 1999; Le Traon, 2000; Rothermel, 2000; Harrold, 2001; Briand, 2002; Skoglund, 2005; White, 2005; Pilskalns, 2006; Engström, 2008; Engström, 2009). The selection of adequate test cases can be made in different ways. These techniques attempt to reduce the effort required to test a modified program by selecting a suitable set of test cases from a test suite used during development. The reuse of test cases offers, indeed, major advantages because the creation of new test cases is an expensive activity (Leung 1991; Pilskalns, 2006).

Most of the regression testing techniques proposed in the literature are code-based (Kung, 1995; Rothermel, 1997; Abdullah, 1998; Wu, 1999; Rothermel, 2000; Harrold, 2001; Skoglund, 2005; White, 2005). Engström et al. (Engström, 2009) argue that these techniques can achieve a high degree of precision in the selection of test cases. In addition, they allow, in some cases, to consider different levels of granularity. Code-based techniques have, however, certain shortcomings: usually quite costly (particularly when working with large and complex systems) and prone to comprehension errors since the testers need to access and understand the source code (Mansour, 2011; Engström, 2008). Chen et al. (Chen, 2002) argue that code-based techniques are good for unit testing but have a scalability problem. In addition, some of these techniques are not extensible enough to apply to large components (Skoglund, 2005). Fahad et al. (Fahad, 2008) argue that it is more difficult to identify changes from the code than from the models. Finally, these techniques are dependent on the programming language used and in some cases don't support all of its constructions (Kung, 1995).

A limited number of approaches are based on models, especially for object-oriented software (OOS) (Von Mayrhauser, 1999; Briand, 2002; Pilskalns, 2006). These approaches are independent from programming languages, which gives them more applicability. Model-based regression testing techniques have many advantages over code-based techniques (Fahad, 2008). However, model-based approaches also have some limitations. Particularly, models must be complete and up-to-date. Advances in the field of reverse engineering allow, however, reducing the effects of such a drawback (Briand, 2006). Different models can, actually, be generated automatically from the source code of programs. Moreover, according to Briand et al. (Briand, 2002), techniques based only on models may not be as accurate as code-based techniques (incompatibility between model and code). Some changes in the source code of the programs may not have impact on models. Approaches based solely on models cannot capture this type of change.

In this paper, we present a selective retest approach (and associated tool) supporting the regression testing of OOS. The technique is essentially based on use cases. The basic models we use to describe use cases are UML (Unified Modeling Language) statechart and collaboration diagrams. The technique combines, in fact, the analysis of these models to a simple static analysis of the code. The goal is basically

to identify changes (change in a method's body) that are not visible in design. In this way, the approach combines the advantages of both model-based and code-based approaches (to improve the accuracy in the selection of test cases). The developed tool identifies modified use cases (parts impacted by modifications) and selects the appropriate test cases, from an existing test suite, that must be retested. New test cases are also generated when necessary (scenarios whose structure has been changed and/or new scenarios). This will allow updating the test suite incrementally (test suite maintenance, which is a crucial issue in regression testing). The selected test cases (including the new ones) are automatically executed. A case study is reported to provide evidence of the feasibility of the methodology and its ability to reduce the regression testing effort.

The article is organized as follows: A brief review of the literature on regression testing techniques for OOS is presented in section 2. Section 3 presents the methodology of the proposed approach and associated tool. Section 4 presents the case study, the definition of the evaluation criteria and a discussion of the results. Finally, section 5 concludes the paper.

2 Related Work

Rothermel et al. (Rothermel, 1997) present a regression testing technique using both static and dynamic analysis of programs. The program code is instrumented. Test cases that cover modified code are executed. The execution time varies depending on several factors (for example, cases where the modifications change the control graph's path structure). Harrold et al. (Harrold, 2001) present the first regression testing technique to support the Java language. The technique uses both static and dynamic analysis. The code here also is instrumented. It is, in fact, an extension of Rothermel's DejaVu technique (Rothermel, 1997). This approach selects the test cases that must be retested after a change, but do not address the problem of new test cases generation. Rothermel et al. (Rothermel, 2000) present an extension of the DejaVu technique adapted to the C++ language.

Kung et al. (Kung, 1995) present an algorithm based on the concept of firewalls. The technique isolates modules that need to be re-tested after a change. Static code analysis is used to identify the classes that have been impacted by changes. This work focuses on the identification of the impacted classes and the determination of a test order but does not address the generation and execution of tests. Abdullah et al. (Abdullah, 1998) elaborate the concept of firewall presented by Kung et al. (Kung, 1995). The main novelty of the approach is that a distinction is made between high and low level changes. The generation of new tests is discussed but no tool is mentioned. White et al. (White, 2005) present an extension to Adbullah's approach (Abdullah, 1998). The extended firewall takes into account, in addition to the elements of the standard firewall, global variables, cycles and paths. This work does not cover the generation of new test cases. Skoglund et al. (Skoglund, 2005) evaluate the firewall technique on a large system. The authors conclude that the time required for extraction and analysis of the data is more important than retesting all.

Wu et al. (Wu, 1999) propose a technique based on dependency relationships (Affected Function Dependency Graphs) to identify variables and functions affected

by changes. This technique addresses only the test case selection problem. Chen et al. (Chen, 2002) use an activity diagram (control flow graph) to describe system requirements, behaviors and workflows of underlying system to test. The paths that correspond to the affected graph nodes determine the tests to be rerun. Wu et al. (Wu, 2003) use class, collaboration and statechart UML diagrams for regression component-based software. Pilskalns et al. (Pilskalns, 2006) present a regression test selection technique based on UML class and sequence diagrams. The technique takes into account OCL (Object Constraint Language) expressions. No tool is mentioned to automate the approach.

Briand et al. (Briand, 2002) present an impact analysis and regression test selection technique based on UML designs. The used models are class, sequence and use case diagrams. After a change, the two versions of the different models are compared and the test cases are classified into: obsolete, re-testable, reusable. A tool (RTSTool) is used to automate the approach. The authors mention that it is likely that the approach is not as accurate as if it was based on the code. Mansour et al. (Mansour, 2011) present also a regression test selection technique based on UML. The used models are class, interaction and interaction overview diagrams.

3 Regression Testing Methodology

Use cases are used to describe functional requirements. Informally, a use case is a collection of related success and failure scenarios that describe actors using a system to support a goal (Larman, 2004). A scenario, also called a use case instance, is a specific sequence of actions and interactions between actors and the system. It is one particular story of using the system, or one path through the use case. The development (and testing) process is driven by use cases. Use cases can be described by several UML models. A useful application of statechart diagrams is to describe the legal sequence of external systems events that are recognized and handled by a system in the context of a use case (Larman, 2004). Moreover, in OOS, objects interact in order to implement the behavior. The dynamic interactions between groups of objects may be specified using UML collaboration diagrams. Collaboration defines, in fact, the roles a group of objects play when performing a particular task (a complex operation for example). The specification described in a collaboration diagram must be preserved during the transformation process into an implementation (Offutt, 1999; Badri, 2003).

The proposed approach (Figure 1) covers the important issues that regression testing strategies need to address: change identification, test selection, test execution and test suite maintenance. The technique supports the identification of the use cases affected by changes (scenarios to be tested). Moreover, it allows the selection of the test cases, from an existing test suite, appropriate to cover the modified (impacted) scenarios. It also supports the generation of new test cases. The different test cases selected (or newly created) are executed automatically. We assume that UML models are updated after modifications. Let V_i and V_{i+1} be two versions of a program P (models and code). The version V_{i+1} is obtained following changes instantiated to the version V_i. We focus on the scenarios impacted by changes (and new ones). The approach is organized in several steps.

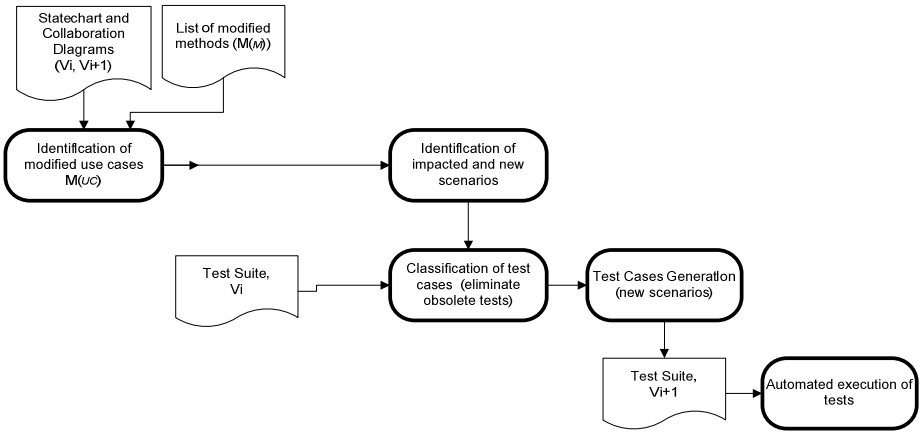

Fig. 1. Iterative methodology

We first determine the set M(*UC*) of use cases that have been affected by one or more modifications to assist in identifying (and classifying) appropriate test cases. Each use case identified as impacted by changes will be marked (marking of the corresponding statechart and collaboration diagrams - version V_{i+1}). The goal is to identify the set M(*S*) of modified (impacted and/or new) scenarios of a use case. In order to ensure that modifications have not adversely affected the system, all these scenarios will be (re-) tested. This step is essentially based on the comparison of the diagrams corresponding to the different use cases (statechart and collaboration diagrams) of the two versions V_i and V_{i+1} (creating a mapping of the changes between the two versions). UML diagrams are described in XML. The comparison uses also the list M(*M*) of modified methods. This list is obtained by a static analysis of the code of the two versions V_i and V_{i+1} of the program. We use an impact analysis tool (Badri, 2005). The list M(*M*) also contains the removed and added methods. This is particularly useful because it allows identifying the changes (change in a method's body) that are made to the code that do not require an update of the models.

For each modified (impacted) use case UC_i, the corresponding statechart diagram (version V_{i+1}) is transformed into a tree T_{SD} (the modified scenarios are marked). Each collaboration diagram corresponding to a modified method is also transformed into a tree T_{CD} (the modified sequences of calls of the methods are marked - collaboration). Each modified method, included in a scenario of the use case, will be replaced by its own tree (sequence of calls). The different (complete) scenarios of the use case (from T_{SD}) that have been modified M(*S*) (impacted scenarios, new scenarios and scenarios whose structure has been changed) must be (re-) tested. We draw, in this process, on the approaches that we have developed in previous work (Badri, 2003; Massicotte, 2007; Badri, 2009).

We focus, in a second step, on the identification (classification and eventually generation) of the test cases corresponding to the impacted scenarios M(*S*). With the set of scenarios M(*S*), this step allows to identify, from the existing test suite, the test cases covering the impacted scenarios (reuse). We perform a static analysis of the XML descriptions of the models combined to a static analysis of the code of the test

cases (JUnit code). We also identify the scenarios that are not covered by the existing suite for which new test cases are generated. The initial test suite is thus updated incrementally. In this step, the various test cases are analyzed and classified into different categories: Obsolete (test cases that are no longer valid - deleted), Retestable (test cases that cover scenarios that have been modified), Reusable (test cases that cover scenarios that have not been modified – kept in the test suite but not used for regression testing) and New (new test cases that cover new scenarios or scenarios whose structure has been modified by changes).

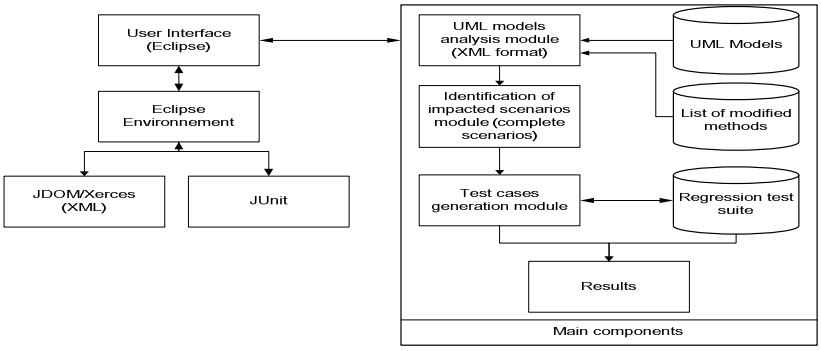

Fig. 2. Architecture of the tool

The approach we propose considers both unit testing (unit test cases - methods) and integration testing (integration test cases - use cases – modified and new scenarios). The (prototype) tool that we developed, based in part on an extension of the JUnit Framework (http://www.junit.org), allows the generation and automatic execution of test cases. All new and re-testable test cases are tested. The architecture of the tool is illustrated in figure 2. It is composed of several modules. It supports all phases of the methodology.

4 Case Study

4.1 The Case Study

In order to provide evidence of the feasibility of the methodology and its benefits in terms of regression testing effort reduction, we used our approach (and associated tool) on a case study. The case study is an ATM (simulator) system (taken from literature), allowing to perform basic banking operations (withdrawal, deposit, transfer, balance, etc.). To evaluate our approach, we have made several changes to the different models (and some methods in the code) of the original application (V_1) to produce two successive versions (V_2 and V_3). Subsequently, the evaluation is performed by applying our technique on each pair of successive versions ((V_1, V_2) and (V_2, V_3)). The evaluation is performed in two iterations. Each iteration includes data collection and analysis and interpretation of results. We compared our methodology with retest-all strategy.

Table 1. Changes made between versions 1 and 2

	Total (V.1)	Added	Changed	Deleted	**Total (V.2)**
Methods	**32**	5	2	3	**34**
Classes	**13**	1	5	0	**14**
Use Cases	**7**	0	3	0	**7**

Table 2. Changes made between versions 2 and 3

	Total (V.2)	Added	Changed	Deleted	**Total (V.3)**
Methods	**34**	3	5	1	**36**
Classes	**14**	0	3	1	**13**
Use Cases	**7**	0	5	0	**7**

The initial specification of the application has 7 use cases, 7 statechart diagrams and 4 collaboration diagrams. The implementation (in Java) has a total of 13 classes and 32 methods. The second version includes changes made on 3 of the 7 use cases. Two methods have been renamed, a method was moved to another class, a transition was added to the statechart diagram describing one use case (*Inquiry*) and a message has been added in the collaboration diagram of one method (*createDeposit*). Table 1 presents the detailed statistics on the differences between version V_1 and version V_2 of the application. The third version of the application includes changes made on 5 of the 7 use cases. A new collaboration diagram is added to keep the credit card after three unsuccessful attempts by the user to enter his password. The statechart diagrams of the 4 possible transactions are modified to no longer to eject the card after a transaction is done to allow more than one transaction per session. Finally, a method is moved to another class and a transition is added to the statechart diagram of one use case (*Session*) to allow users to make more than one transaction per session. Table 2 presents the detailed statistics on the differences between version V_2 and version V_3 of the application.

4.2 Evaluation Criteria

A review of the literature on the evaluation criteria used by different researchers allowed us to identify two major classes of criteria: criteria for the *reduction of the cost of regression testing* and criteria for the *effectiveness of the detection of faults* (Engström, 2008). Although both classes are important, in this paper we concentrate on test suite size reduction criteria. We adapted some criteria defined in the literature to evaluate: the reduction of the number of test cases to re-test both at the integration level (in terms of scenarios) and at the unit level (in terms of methods), and the reuse rate of test cases. Let P be a program.

Definition 1: The reduction of the test suite at the integration testing level is given by: *ReductInteg*(P) = 1 – (STC/TC), where STC represents the selected test cases and TC represents the set of all test cases of the program.

Definition 2: The reduction of the test suite at the unit level is given by: *ReductUnit*(P) = 1 – (M/AM), where M represents the methods that are part of the selected test cases and AM represents the set of all methods.

Definition 3: The reuse rate of the test suite at the integration level is given by: *ReuseInteg*(P) = RITC / ITC, where RITC represents the number of integration test cases (sequences) that are classified reusable or re-testable and ITC represents the total number of integration test cases (sequences).

Definition 4: The reuse rate of the test suite at the unit level is given by: *ReuseUnit*(P) = RUTC / UTC, where RUTC represents the number of unit test cases (methods) that are classified reusable or re-testable and UTC represents the total number of unit test cases (methods).

Table 3. Classification of test cases (iteration 1)

	Total (V.1)	Obsolete	Retestable	Reusable	New	**Total (V.2)**
Unit	**32**	3	12	17	5	**34**
Integration	**15**	4	0	11	6	**17**

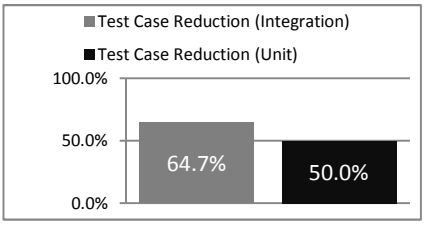

Fig. 3. Test suite reduction

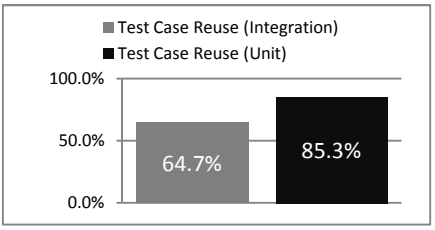

Fig. 4. Test case reuse rate

4.3 Results

Iteration 1: Version V_1 to Version V_2

At this iteration, for integration testing, there are 6 test cases (complete test sequences) selected on a total of 17. The 6 test cases correspond, in fact, to new scenarios. For unit tests, there are 17 unit test cases selected on a total of 34 (see Table 3), including 5 new and 12 re-testable. Figure 3 shows the evaluation results based on the two criteria (*ReductInteg*, *ReductUnit*) for test suite reduction. The reduction of the test suite is significant for both integration (64.7%) and unit (50%) levels when compared to retest-all strategy although the changes we made (from version 1 to version 2) affect the majority of use case scenarios. Figure 4 shows the evaluation results based on the two other criteria (*ReuseInteg*, *ReuseUnit*) for the reuse rate of test cases of our approach.

Iteration 2: Version V_2 to Version V_3

At this iteration, for integration testing, there are 10 test cases (complete test sequences) selected on a total of 20. The 10 test cases correspond to new scenarios. For

unit tests, there are 23 unit test cases selected on a total of 37 cases (see Table 4), including 4 new and 19 re-testable. Figure 5 shows the evaluation results based on the two criteria (*ReductInteg*, *ReductUnit*) for test suite reduction. The reduction of the test suite is here also significant for both integration (50%) and unit (38%) levels when compared to retest-all strategy. Figure 6 shows the evaluation results based on the two other criteria (*ReuseInteg*, *ReuseUnit*) for the reuse rate of test cases of our approach.

Table 4. Classification of test cases (iteration 2)

	Total (V.2)	Obsolete	Retestable	Reusable	New	**Total (V.3)**
Unit	**34**	1	19	14	4	**37**
Integration	**17**	7	0	10	10	**20**

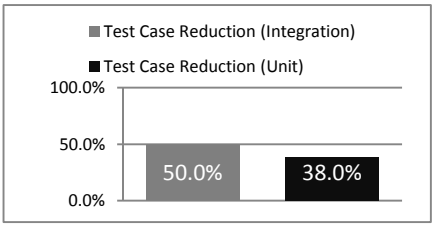

Fig. 5. Test suite reduction

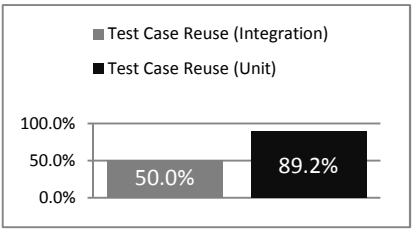

Fig. 6. Test case reuse rate

5 Conclusions and Future Work

We have presented a regression testing technique and associated tool for OOS. The technique is essentially based on use cases described using UML statechart and collaboration diagrams. The technique combines, in fact, the analysis of these models to a static analysis of the code. Indeed, certain changes do not need to update the design models. The technique cover the different important issues that regression testing strategies need to address: change identification, test selection, test execution and test suite maintenance. The developed tool identifies modified use cases (parts impacted by modifications) and selects the appropriate test cases from an existing test suite. New test cases are generated when necessary. This allows updating the test suite incrementally.

In order to evaluate the proposed technique, we used the tool we developed on a case study. We focused on the reduction of the cost of regression testing. Results provide evidence of the feasibility of the methodology and its ability to reduce the regression testing effort (reducing test suite size). The achieved results are, however, based on the data set we collected from only one subject system. The performed study should be replicated using many other OO software systems in order to draw more general conclusions. As future work, we plan to: extend the approach to more UML views, further explore the combination of model-based and code-based techniques in

order to increase the accuracy of test case selection (and generation), use other criteria to improve the evaluation of the approach, and finally replicate the study on other OO software systems to be able to give generalized results.

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Development of an Instant Meeting Android Application Using Wi-Fi Direct APIs

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Abstract. In most cases, Web conferencing requires a meeting place equipped with presentation facilities such as beam projectors, computers, video presentation aids, and Internet connection. Such a Web conferencing may be well suited for formal meetings or presentations rather than small-scale group meetings. In small-scale group meetings, presenters may want to start meetings quickly anywhere at any time even though there is no Internet connection. In this paper, we present the design and implementation of an instant meeting Android application based on Wi-Fi Direct, thus not using 3G, 4G, or Wi-Fi Internet access. The initial version of the proposed application indicates that the Wi-Fi Direct APIs of the Android platform can be effectively applied for file sharing and event exchange.

Keywords: Instant Meeting Application, Wi-Fi Direct, Android Platform.

1 Introduction

The rapid proliferation of mobile devices leads to the development of various mobile applications ranging from entertainment, education, health to business. According to the prediction of Gartner, mobile phones will overtake PCs as the most common Web access device worldwide by 2013 [5]. Mobile apps are offered in application stores in a boundless variety. In particular, mobile devices are used for Web conferencing by allowing a user to control presentation files remotely. In a client/server environment, a presentation file places on a server and a mobile phone is used to control the screen of the shared file at a near distance. Most of Web conferencing products are installed on personal computers directly connected to the Internet. In most cases, the mobile device is not a main tool for Web conferencing.

However, these Web conferencing applications may not be well suited for small-scale group meetings which frequently take place outdoors or at meeting rooms equipped without presentation facilities such as beam projectors, video presentation aids, and Internet connection. For instant and quick meetings, mobile devices can be utilized to minimize complicated and time-consuming

T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 107–112, 2012.

configuration installation. Furthermore, such an application needs to offer easy-to-use interfaces and communication capabilities without Internet connection.

To this end, we propose an online meeting application for the small-scale group meetings or presentation. Our application is based on Wi-Fi Direct [4,1] which makes it possible to conduct meetings without Internet connection. Wi-Fi Direct is a communication standard that allows Wi-Fi devices to connect to each other without the need for a wireless access point or Internet connection. Therefore, with Wi-Fi Direct, informal meetings or presentations can take place anywhere at any time–on campus, outdoor places, etc. The proposed instant meeting application enables presenters to start meetings using mobile phones to invite participants. In addition, it provides screen-sharing functionality which allows presenters to share their screen with their participants during presentations.

The rest of this paper is structured as follows. Section 2 describes the design and implementation of our online remote meeting application. Section 3 compares our approach to existing online meeting applications. Section 4 presents concluding remarks.

2 Instant Meeting Android Application

We have developed an instant meeting application on the Android platform [2] which is one of the major mobile frameworks. Android 4.0 (API level 14) or later provides the Wi-Fi Direct APIs that consist of necessary Java classes and methods. Since our application is based on Wi-Fi Direct, it can be used without Internet connection. It is a useful feature for applications that share presentation files and events among users.

Figure 1 shows a message flow between a presenter and an audience. When the meeting application starts, a presenter create a meeting group where audiences will join. The presenter waits for join requests from audiences. When an audience device enters the range of the Wi-Fi Direct host(i.e., a presenter), they can connect each other using the existing ad-hoc protocol. When a presenter and an audience are connected using the Wi-Fi Direct, the audience can ask the presenter to join a user group.

Once the meeting group has been created, the audience sends its IP address the presenter. For unicast communication, the presenter stores the IP address to an Arraylist. The presenter uses the IP addresses to manage the synchronization issues between presenter and audience such as page and note synchronization.

When the request of the audience is accepted, the presenter can send the audience a presentation file in PDF format. To send the file, the “Send” button is activated at the screen of the presenter. The presenter selects a PDF file using a file browser. After joining the meeting group, the audience is waiting for the data from the presenter in the socket waiting mode. The PDF file opens automatically when it is arrived at the audience and then the audience waits for a page number from the presenter. Our application uses native Android PDF Viewer [3] to manage PDF files. The native Android PDF Viewer is an open source program and provides useful APIs to view PDF files.

The main feature of our application is to control remotely the screen of the audience's mobile device. The presenter and audience share the same page of the presentation file by using the real-time remote control. To change the page number, the presenter scrolls up and down the screen or pushes the volume key. Whenever the page number changes, a current page number is sent to the audience via socket connection. As soon as a new page number arrives, the page of the presentation file at the audience side goes to the new one. All audiences in the meeting group share the same page as that of the presenter. Of course, the audience can move the page of the presentation PDF file. However, the changed page number is not sent to the presenter and the other group members. The remote control of the presenter includes page moving, screen rotation, zoom-in, zoom-out, and comment. To use zoom-in and zoom-out, the presenter enlarges or minimize the specific area of the presentation file. Such events are sent to the all group members and their screens are synchronized with that of the presenter.

The group members can share questions or comments on the presentation file. The audience can ask for authorization to question and then the presenter allows or rejects the request. When the presenter accepts the request of the audience, the audience can give a question. The presenter answers to the question of the audience. The questions and answers are shared with the other group members.

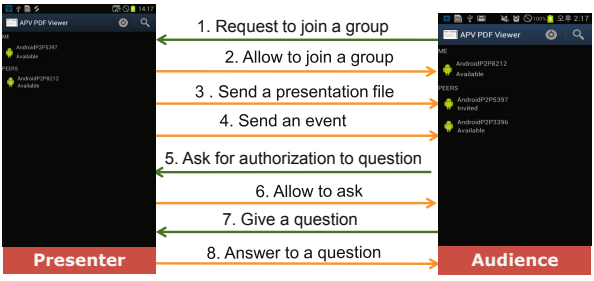

Fig. 1. A message flow between a presenter and an audience

In Figure 3, a presenter shares his or her presentation material with three audiences. The presenter creates one socket for each audience to send a presentation file and screen control data. The presentation file opens immediately when it is downloaded on the audience device. The audience device waits for a page number from the presenter device. The presenter can simultaneously control the screens of three audiences by sending screen control data. For moving a page of the file, the presenter uses the volume key button or screen scrolling. The screen of the audience displays the same page as that of the presentation file on the presenter device.

Figure 3 shows some marks on the slide including circles, stars, arrows, and characters. When the presenter marks some areas of the slide, the screen position of the mark is transferred to the audiences. After screen position mapping, the marks are drawn on the slide of the audience device. Both the presenter and the

audience can transfer their notes on the presentation slide each other. As you see in Figure 3, the notes of the device owner are drawn in red and the others are represented in green.

For the precise note presentation, we should consider the different size of the screen. Our application could run on mobile devices that have different screen size. Even if we use mobile devices with the same model, their screen size would be different. Therefore, the note of the presenter would be represented at the different location on the audience device. To address this issue, the note producer sends note contents, note location, and screen size information. The note receivers map the note location to the proper position of their screen. The screen size can be acquired from the system information provided by the Android platform.

The audience can send questions or comments on the slide to the presenter after obtaining authorization. The authorization procedure is required to avoid miscommunication among audiences. To ask for authorization to question, the audience can select a "To question" menu item in the option menu. When the request arrives at the presenter device, the IP address of the audience pops up on the screen of the presenter. The presenter can allow or reject the request of the audience.

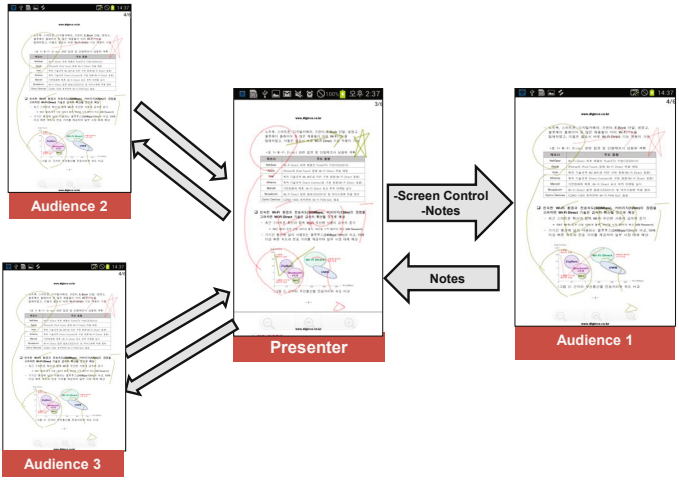

Fig. 2. Sharing a presentation file between a presenter and three audiences

Figure 3 shows the presented meeting application running on three Android mobile devices-two Galaxy S II and one Galaxy Note. A presenter device on the center sends a presentation file, screen control events, and notes. As you see in Figure 3, they display the same page of the presentation material and the same notes.

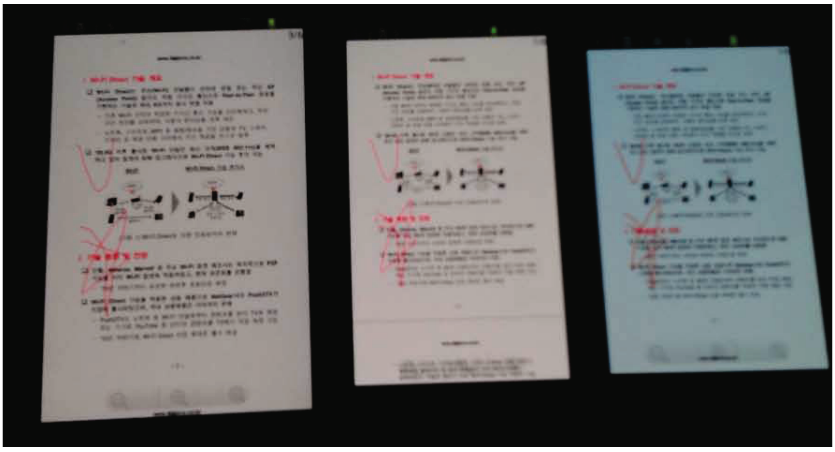

Fig. 3. A screen shot of our meeting application running on three Android mobile devices

3 Related Work

Most of online meeting applications are intended to control remotely presentation materials which place on a desktop computer. Unlike these applications, our application is installed on mobile devices directly connected through Wi-Fi Direct. Each mobile device has a presentation file locally. The AllShare Play of Galaxy S III is similar to our approach in that both applications make it possible to share files among mobile devices. However, our instant meeting application can be used on any Android devices in which the Android platform 4.0 or later is installed.

4 Conclusion and Future Work

We have introduced an instant meeting Android application based on Wi-Fi Direct. Android 4.0 or later includes the Wi-Fi Direct APIs so that Android developers can construct their own applications using Wi-Fi Direct. Our application provides a simple but smart meeting program which can be used without regard to Internet connection. It is applicable for informal and quick group presentations when meeting facilities including beam projectors and computers are not available. In addition, presenters and participants can share presentation files and exchange comments using screen-sharing functionality. Our application supports real-time remote control to enable the presenter to share the same page number and notes with the other members. Thus, the screen of the presenter could be synchronized with those of the other members.

As future work, we plan to improve the remote control functionality by adding new features such as highlighting and word finding. In addition, we are going to develop a new drawing algorithm for the clear note presentation.

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V&V to Use Agile Approach in ES Development: Why RDR Works for Expert System Developments!

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Abstract. In artificial intelligence, many researchers have proposed several expert system development approaches but most of them failed to deal with two issues, maintenance and analysis. It is better to find an alternative solution from other areas, rather than to waste time waiting any longer. We found that researchers in computer software development also have been suffering from the difficulty of maintenance and analysis, just as in the expert system development area. To solve this problem, agile software development is used to overcome the difficulty of analysis, and business rules approach is utilised for removing maintenance issues. We believe that the two approaches are the ideal solutions that are able to formalize the expert system development process. In this paper, we outline this novel approach, Multiple Classification Ripple Down Rule, which is based on agile software development and business rules approach.

Keywords: Agile approach, Business rule approach, MCRDR.

1 Introduction

Expert system is the common systems not only in the artificial intelligence research area, but also in the commercial field. It is a system that uses a knowledge base provided by domain expertise over a wide range of industries. Expert system has a unique structure, which is different from other AI systems. Expert system has three main factors: inference engine, knowledge base and knowledge acquisition. Developing those three components with an ideal method has been a big challenge for many researchers. The inference engine analyses several domain problems. In order to analyse domain problems, it is necessary to store a large amount of domain expertise in the knowledge base. The given problems can be solved by extracting expertise from this knowledge base. This process is called 'knowledge acquisition'. Knowledge engineer (KE) plays an important role in the development approach of the expert

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system. KE assists domain experts in supplying expertise to the knowledge base. This approach has been applied in various domains in expert systems [1].

Researchers in the Software Engineering (SE) area are generally focused on finding how to develop software; however, expert system development was neglected from SE research field. This is because there are several difficulties in acquiring and maintaining knowledge in expert system. Expert knowledge can be divided into two types: explicit knowledge and tacit knowledge. While most SE area deals with explicit knowledge, the type of knowledge in expert system is tacit knowledge. Tacit knowledge is very hard to represent even for domain experts, since it is obtained by experience. There is no appropriate approach to overcome this difficulty in the expert system development area. For this reason, expert system pales into insignificance beside the development of the overall software industry sector.

In recent years, software engineering area had the same knowledge maintenance and analysis issues as the expert system development. This is because the lifecycle of software is becoming shorter and the level of personalization/adaptation services by the computer is getting higher. In order to overcome this issue, agile software development and business rules approach have been widely used in the software engineering area. Agile software development is focused on solving problems in requirement analysis. Business rules approach is concentrated on the software issues in domain rule changes. Two approaches have been applied to some software engineering areas, which is similar to the expert system. Therefore, the approaches are good for formalising the expert system development process. In this paper, we suggest several requirements in using agile software development and business rules approach so as to develop successful expert systems with the Ripple Down Rules.

2 Related Work

In the 1960s, the software crisis led to the failure of software development approaches. To overcome this, the software engineering area was introduced. Various systematic methods in software engineering enables engineers to prevent taking risks in software development by providing clear requirements. SE methods have been applied to software development in various kinds of organisations [2].

CommonKADS [3] is the most widespread expert system development approach. It is similar to traditional software engineering techniques and it supports constructive knowledge engineering. CommonKADS represents various perspectives, such as the task model and knowledge model, in expert system development. It also defines the relationship between the roles of knowledge provider and knowledge engineer. CommonKADS presents the user's requirements and design specifications explicitly, using text or diagram. It provides systematic methodology and enables one to construct the successful expert system by supplying the formal system. However, there are some problems. First, it creates additional overheads. Some overheads are created in specific documentations. Secondly, to operate this method, domain expert needs to learn the way to process terms and all notations for CommonKADS. Thirdly, it does not suggest any solution in the development part of knowledge maintenance.

There are various methods of acquiring such knowledge, including CommonKADS. Typical knowledge acquisition is time-consuming, since it is collected through

interviews and observations. The quality of knowledge is too dependent on the KE's ability. However, Blythe et al. [6] introduced a system where end-users can insert knowledge into the knowledge base so that it is unnecessary to contact with KEs. Although this is the ideal method for knowledge acquisition, verification and validation (V&V) are not considered in this system. V&V is regarded as the performance measure in the acquisition of knowledge. Verification is the efficient measure of how consistency can be achieved in a knowledge base. Validation is regarded as the performance measure of how external behaviour is adopted properly and how the knowledge domain issue can be solved.

Software development processes have changed dramatically over time. In order to adjust to this change, agile software development approach was introduced by publishing 'Agile software development Manifesto' in 2001. Unlike the traditional software engineering method, agile software development does not consider all development processes at once, but divide all processes into separate small stages. It enables to develop tasks in each stage and to prepare risks. Currently, agile software development is widespread as the most appropriate development technique [7].

Business rules approach has focused on different perspectives to overcome current software engineering issues. In the software engineering area, most methods have concentrated on effective development, not on maintenance. On the other hand, in business rules approach, the focus has been on maintenance since it is the most essential component while the system is working. In this approach, the system consists of business rules and the rules-engine, which is the program to run business rules [8]. This approach aims at achieving two main goals. Firstly, it should be flexible, which means the system can be adapted to new strategies, without modifying core modules. Secondly, it should be easy to conserve maintainability, which should be done constantly. In business rules approach, business rules can be created or managed by ordinary business people, not just software engineers.

3 Requirements for Using Agile and Business Rules in Order to Enable the Use of Expert Systems Developments

3.1 Incremental Knowledge Acquisition

Domain experts gain knowledge through experience [9]. They do not obtain the entire knowledge of their field at once but accumulate it incrementally through a variety of activities. This is similar to that of agile software development approach. Agile software development system is developed to implement each module gradually. Because of this, it supports test-driven development and identifies missing requirements in each stage of development. It resembles the typical learning process of human beings so agile approach seems to be novel approach to the usual way of acquiring knowledge. Unfortunately, agile software development is not the ideal solution for the expert system development.

Agile software is developed by a software engineer who has a similar role to the KE in an expert system. In this approach, it is inevitable that KE manages the knowledge base of the expert system. However, it is often impossible for experts to

explain how they arrive to their decisions. This approach is too dependent on KE in the expert system development. This can lead to miscommunication between knowledge engineers and domain experts. This results in a decline in quality.

Another weakness of agile approach is that this does not explicitly support maintenance [10]. In the expert system, knowledge acquisition is characterised by two aspects: breadth and depth of knowledge. Domain experts have a limited knowledge of their field. Therefore, the knowledge base faces the problem of only being able to evolve enough to judge specified problems. Because of this, knowledge acquisition increases only its depth of expertise in the developmental phase. Although it increases only the depth of the high quality of the knowledge base also requires the breadth of knowledge. There is some unrevealed knowledge in the development phase. Most unrevealed knowledge is exposed throughout the life of the system. This is the reason why constant maintenance is required.

3.2 Maintainability

The question is then posed as to how we can overcome the difficulty of maintenance. The expert system should provide a way of handling this constant maintenance issue. Fortunately, this method is provided by business rules approach. Business rules system provides the method for users to design/maintain the logic changes in the program. This approach allows the effect to be applied directly to the expert system since the structure of this approach is almost the same as that of the expert system.

As the key requirement for expert system development is V&V, business rules approach is the best solution for the expert system development. This is because it is able to resolve the maintenance problems that other approaches cannot address. In rule based systems, any small changes of rules could affect the system severely and the prediction of influences is impossible [11]. However, there are some difficulties for domain experts in verifying and validating all knowledge when the new rule is added. This is because domain-experts cannot understand the entire system. Although business rules approach is a competent approach, it is not a precise solution if it does not provide appropriate V&V methods. Therefore, it is crucial to use the knowledge acquisition method that can verify and validate the knowledge automatically.

Ripple Down Rules is regarded as the best knowledge acquisition method for expert systems. This system is able to resolve the verification process when domain users handle the validation themselves [12]. In this paper, we introduce a novel expert system-development-approach, MCRDR, which has also incorporated features of both agile-software-development and business rules approach. In this approach, knowledge is acquired incrementally by direct interaction between experts and the knowledge base via automatic V&V. In the next section, we will explain these incremental knowledge acquisition techniques, MCRDR.

4 Multiple Classification Ripple Down Rules

Multiple Classification Ripple Down Rules (MCRDR) [13] is a novel knowledge acquisition method and it is an extension of the original RDR for the single classification domain. The philosophy of both MCRDR and RDR is defined as

"learning by doing". To explain this, here is the example. If children learn a certain concept, they tend to follow their mentor's behaviour and mend their mistakes. MCRDR is based on this example. This method is an approach to acquisition of knowledge that is based on incremental learning. It is the approach that easily establishes a knowledge base at the stages of both development and maintenance, unlike other knowledge acquisition algorithms.

We look at the process of knowledge acquisition by using RDR, which is the base version of MCRDR. In RDR, knowledge acquisition or collection operates by handling exceptional cases. There is no perfect knowledge base. If errors occur in the knowledge base, new knowledge is required to correct them. The knowledge base, based on RDR, represents knowledge as a rule. These rules are organised into trees or decision lists. Each part of the knowledge domain is covered by only the related rules. When the new context is added to the knowledge base, it draws a conclusion by checking a set of rules from high to low. When a new context arises, it cannot handle the current expertise. In this case, knowledge acquisition in RDR has occurred and a new conclusion is derived. A new rule is added based on the conditions of a new conclusion and its corner stone case. This rule is added as a child of the last evaluating rule. When a new rule is added, conditions are selected from a condition set, excluding conditions of being a cornerstone case of its parent. As a result, new rules refine the existing rules. RDR is a process that makes knowledge more specific by adding new rules. Figure 1 shows the example of structure and coverage of each rule. As shown, lower level rules refine parent rules in detail.

As above, in order to classify error contexts (cases) properly, RDR does not analyse users' entire domain-knowledge in advance, but only requires necessary knowledge. The main advantage of RDR is that the knowledge acquisition can be performed without any knowledge analysis or knowledge engineers' assistance. RDR can acquire expert knowledge incrementally without any further effort. However, it is a very hard task to manage rules. To guarantee that incremental knowledge acquisition by RDR will perform effectively, V&V should be considered [13]. In RDR, new rules do not conflict with existing rules because of restricted selecting conditions for the new rule. Thus, verification is always guaranteed in the knowledge acquisition stage. Knowledge acquisition means adding new rules. It helps solve the new problem properly. Therefore, the system performs better than previous version of knowledge base as new rules are added. This will be discussed in more detail below.

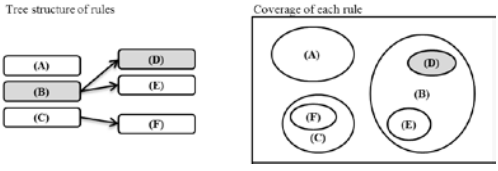

Fig. 1. Example of Rule Structure and Coverage

If the system leads to an incorrect result, domain experts are requested to correct the error by adjusting to the different conditions between the past and current context. The

system does not modify/delete the existing rules but adds new rules that determine the conclusion of the new context. New rules are used only when the existing rules alone will produce an error. However, the new rules will not be considered if the existing rules can function properly. Therefore, the validation is satisfied efficiently. Through this, RDR can increase the depth of investigation.

If the depth increase is achieved, the knowledge base should be capable in increasing in its breadth. Addressing this need is simple. A root node does not have any conditions so that it can be considered as covering all knowledge in the domain of problem. If the current rules cannot cover the new context, a new rule will be added at the highest level. The new rule will cover the new area which is beyond the scope of current rules. Cao et al. [14] have proved convergence of RDR. According to this, RDR performs incremental knowledge acquisition without any other effort and it increases the knowledge base in both breadth and depth. This automatically guarantees that the knowledge acquisition is on the right track.

MCRDR has the basic features of RDR and provides the incremental knowledge acquisition that has V&V [15]. RDR is limited in a context having only one classification as a decision. Nevertheless, each context has multiple decisions in a considerable proportion of cases. Therefore, to determine the multiple classifications in RDR, it is necessary to increase the knowledge acquisition exponentially since a possible solution would be to separate sub-domains and build independent KBs for each sub-domain. The basic idea of MCRDR is each context can have multiple classifications by following numerous rule paths appositionally.

It has been explained above that in RDR, new nodes are added as a child to the last evaluating rule. On the other hand, in MCRDR, the new rule is not always added as a child node. This is where MCRDR is fundamentally different from RDR. There are 3 different knowledge correction strategies in MCRDR. Table 1 shows different situations of wrong classification and the strategy that is used to address this.

Table 1. Knowledge Correct Strategies

Wrong Classification	To correct the Knowledge Base
Wrong classification to be stopped	Add stopping rule at the end of the path
Wrong classification replaced by correct	Add a rule at the end of the path
A new independent classification	Add a rule at the root

Stopping rules does not lead to a conclusion. These rules play a major role in preventing incorrect classifications in MCRDR. As mentioned before, MCRDR can achieve V&V. It provides immediate recovery of new knowledge acquisition by domain experts. This is not only for developing the system but also for maintaining it. MCRDR is the appropriate method for developing high quality expert systems since the knowledge-base can be evolved constantly. Consequently, it plays a huge role in improving the level of performance in the expert system.

5 Successful Applications

RDR (MCRDR) is the most successful approach in the expert system area. Pacific Knowledge Systems (PKS) is a leading provider in pathology and about 100

knowledge bases have been built by 14 chemical pathology laboratories. PKS developed LabWizard, which are used for building interpretations for many domain reports, such as glucose, thyroid anti-bodies and viral panels. According to practical experience [16], LabWizard has delivered valuable results, satisfying clinician-customers. LabWizard has been adopted in pathology laboratories around the world and performs over one million interpretations per month. Tesco, the world's largest on-line grocer is based on RDR. Tesco business analysts have developed countless RDR rules, used mainly for ensuring that appropriate information about products appears on their affiliate sites and also suggests similar products to customers. Park et al. [17] applied MCRDR to web document management. Knowledge for document classification in the web constantly needs to adapt to new domains since the domains of these documents are diverse. The results indicate that MCRDR can achieve the incremental knowledge acquisition for constant use. The incremental acquisition ability does not only refine the coverage of rules but also adds new topics. MCRDR can easily solve problem caused by a multiple domain problem. The experiment indicates that the knowledge base, based on MCRDR, is robust even if an expert is replaced. Bindoff et al. [18] show the efficiency of MCRDR in a multidisciplinary domain empirically. They proved it is sufficient to classify a wide range of Drug Related Problems though MCRDR has several limitations.

6 Conclusion

Expert systems are able to handle new circumstances by using its knowledge base. To develop the system, it is necessary to reflect changes to the knowledge base in the expert system. However, other knowledge engineering approaches could not adequately overcome the maintenance problems. These phenomena can be found in the software engineering area. In SE area, agile and constant maintenance are considered to be the most important factor. Since their introduction of agile software development and business rules approach have attracted public attention.

This paper suggests the requirement of a method based on the relationship between two methodologies and the characteristics of the expert system. It can be helpful to incorporate the fundamentals of these two approaches in developing an expert system. The requirements are summarised as follows: incremental acquisition and maintainability. After considering these requirements, we propose a new approach that does not clearly distinguish between development and maintenance phases. This is feasible by V&V methods. The use of MCRDR will provide the strength of both agile software development and business rules approach, which have achieved commercial success in the past. MCRDR acquires knowledge without any further efforts, such as knowledge analysis or assistance from knowledge engineers through automatic V&V. Through V&V method, MCRDR provides a seamless knowledge acquisition method that can be applied to both development and maintenance phases. This enables expert systems to be agile and to maintain the knowledge base constantly, which consequently increases the quality of the system.

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Developer Support for Understanding Preprocessor Macro Expansions

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Abstract. In the age of advanced integrated development environments there is a lack of support for understanding preprocessor macros. The preprocessor has proven to be a powerful tool for decades, but the developer is still guided poorly when the debugger stops at a source code line containing macros. The main problem is that the developer sees the original code, while the compiler uses the preprocessed code in the background. Investigating the usually nested macro calls can be a labor intensive tasks, which increases the overall effort spent on development and maintenance. There are several possibilities to help the developer in similar situations, but these are rarely employed since the preprocessor has its own, separate language to be analyzed. We implemented a Visual Studio plug-in (AddIn) that provides hand-on information on macros to increase the productivity of developers during debugging or program comprehension tasks. We enhanced the idea of macro folding, a technique to show/hide macro names and values within the source code editor; and defined a graphical view for macro expansions. In the background precise dynamic analysis of directives takes place, so the hint given for the developers considers all kind of preprocessor constructs like macros in conditionals and concatenating operators in the replacement text.

1 Introduction

An empirical study shows that preprocessor directives make up a relatively high 8.4% of source code lines on average [2]. Beyond the fact, that the preprocessor is the only way to define multiple configurations of a C/C++ program, today a large amount of legacy code relies to directives. Although the preprocessor is useful for forward engineering and development, it behaves as an obstacle in case of program understanding and reverse engineering tasks. The fundamental problem about preprocessing from a program comprehension point of view is that the compiler gets the preprocessed code and not the original source code that the developer sees. In many cases the two codes are markedly different. These differences make program understanding harder for developers and analyzers, and they can cause problems with program understanding tools.

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The first point where the software developer is facing problems with macros is when a runtime error occurs at a source code line which contains macros only. The usual debugger stops at the line in question, but there is no information on what is the real code that the compiler used. Besides constant-like macros, many times the macro name is replaced by whole C/C++ loops or complex expressions spreading across several lines – all hidden from the developer. Furthermore, several macros have multiple definition depending on conditional directives, which makes it hard to find the actual definition manually. These labor-intensive activities can increase the overall effort spent on development or maintenance tasks. Unfortunately, widespread integrated development environments today, like the Visual Studio for C++ [11], give fairly limited support for the developer. As the preprocessor language is independent from the C/C++ language, the analysis of directives requires a separate analyzer, extra risk and effort for tool developers. Although the benefits of such extension are clear, developers are still forced to do workarounds when investigate macro calls.

In this paper we present the following contributions for supporting developers' understanding of macros:

- Enhanced macro folding in textual source code view, which helps in situations like debugging.
- Visualization of macro expansions in graphical code view, which gives overall picture of a full macro expansion.
- Both views are integrated as an AddIn (plug-in) in recent versions of Visual Studio.

The implemented AddIn enables step-by-step macro extraction to reveal each internal step that leads to the final macro replacement text. Furthermore, the graphical tree-like view of the expansion gives an overview on what happens during the expansion.

The paper is organized as follows: Section 2 introduces the textual and graphical views of macros and mentions the internal representation of preprocessor directives. Next, the AddIn is introduced through examples and screenshots in Section 3. Related work is discussed in Section 4, while conclusions are drawn in Section 5.

2 Visualizing Macro Expansions

2.1 Textual View – Macro Folding

Folding is an interactive extension of the textual view of the source code. The idea of folding in the context of preprocessing is presented by Kullbach and Riediger [7]. The base idea of folding is to define a textual area in the source code, which is hideable by the user. A fold is associated with a label; when the area is hidden (folded), then the fold label is shown. The folding mechanism may be presented by special characters (▼, ▲, ► and ◄) in the textual view of the program code. These special characters denote folded and unfolded state of the area, where ►`Label`◄ shows the folded and ▼`Content`▲ shows the unfolded state.

The folding mechanism was successfully employed within the GUPRO program understanding environment. Conditional expressions, file inclusions and macro expansions were presented as folds in the GUPRO environment. While the underlying metamodel was rather simple (consisting of nine elements) it was flexible to cover the above mentioned preprocessor constructs. Although the idea is presented several years ago, the modern integrated development environments still lack of folding support for preprocessor constructs.

The folding technique can be most appropriately applied to preprocessor macros. Let us consider a simple example of a macro constant `Z`. The label of the folded view is the name of the macro, which corresponds exactly to the state of the source code before preprocessing (see Listing 1.1). On the other hand, the unfolded view shows the value of the macro constant, which view corresponds to the state of the source code after preprocessing, as shown in Listing 1.2.

```
#define Z 5
int var = ▶Z◀;
```

Listing 1.1. Simple macro folded – initial source code

⟺

```
#define Z 5
int var = ▼5▲;
```

Listing 1.2. Simple macro unfolded – preprocessed source code

Function-like macros can be tracked similarly, except that further macro expansions may take place even in arguments – besides the macro body. As a more complex example let us consider the code shown in Listing 1.3, where macro `A` has two parameters and two macro names are passed as actual arguments. There are 3 macro replacements belonging to the full macro expansion of `A`, so it requires 3 steps to fully unfold the macro call (see Listing 1.4).

```
#define Z 1
#define Y 3
#define A(x,y) x+y
int var = ▶A(▶Z◀,▶Y◀+3)◀
```

Listing 1.3. Function-like macro example

2.2 Graphical View

While the folding mechanism enables to follow macro expansions in a step-by-step manner, it is not so appropriate to give an overall view of the macro expansion as a whole. It is usual to have even 8-10 expansion steps before reaching the fully expanded state in text mode. We propose a graphical notation for presenting full macro expansions as shown in Figure 1. The root of the tree is the actual compilation unit, which contains a macro call. The call is denoted by the root macro name. Each macro name in the graph has two children: the replacement value on the left hand side, and the actual text of the call on the right hand side.

```
Initial: int var = ▶A(▶Z◀,▶Y◀+3)◀
Step 1:  int var = ▶A(▼1▲,▶Y◀+3)◀
Step 2:  int var = ▶A(▼1▲,▼3▲+3)◀
Step 3:  int var = ▼1+3+3▲
```

Listing 1.4. Function-like macro expanded

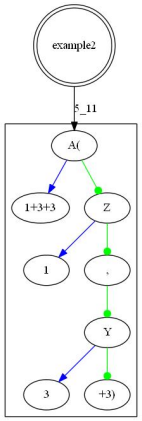

Fig. 1. Graphical hint for the function-like macro example

2.3 Internal Representation

Macro expansions can be tracked at all places of programs, e.g. in conditional expressions as well. Detailed step-by-step macro expansion information is obtained through analysis of the preprocessor language. In our previous work we defined a schema (metamodel) for the preprocessor [18]. The Columbus Schema for C/C++ Preprocessing describes the original source code, the final preprocessed code and all transformation steps in between. Schema instances represent preprocessor constructs of concrete programs. We analyze one configuration at a time (dynamic instances.) Our representation contains all kinds of preprocessor construct, however in current work we use the macro-related part of the schema. Schema instances are produced by a tool, which can be smoothly incorporated into build processes, as it behaves as a usual preprocessor as well. The output of the tool is written out in XML format. Figure 2 presents the dynamic schema instance of the function-like macro example. Macro definitions

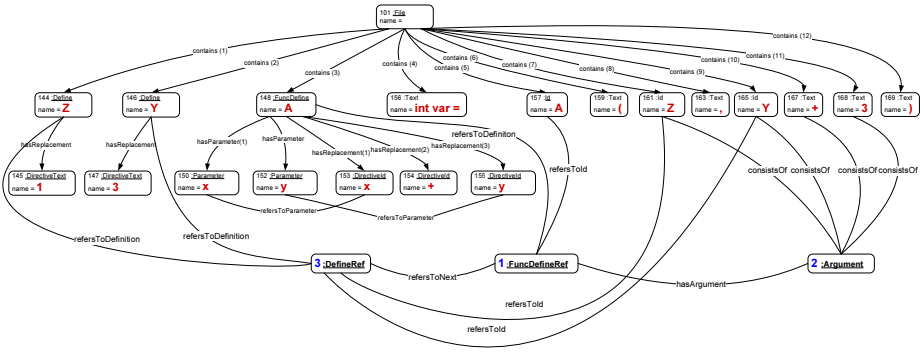

Fig. 2. Schema instance of the function-like macro example

are denoted with `(Func)Define` nodes. Definitions contain replacement text and may contain parameters. Macro calls are linked to active macro definitions via `(Func)DefineRef` reference nodes, which also mark actual arguments of function-like macros. Fold/unfold information can be extracted by traversing the instance graph along these references. For further information we refer to our previous work [18].

3 IDE Plug-in for Understanding Macro Expansions

Surprisingly, modern IDEs lack of support for understanding directives. Visual Studio is a sofisticated development environment for .NET languages, with support for the C/C++ languages. There were enhancements made in recent years related to preprocessing, e.g. conditional directives are analyzed using a fuzzy parser and excluded conditionals are marked in the code editor, but there are still possibilities for improvements. Our goal was to extend the functionality of the Visual Studio by providing enhanced textual and graphical views based on the dynamic analysis of preprocessing directives. The base unit of the analysis is the compilation unit starting from the actual source file open in the editor. The whole compilation unit consists of the source file and all the header files included recursively.

We developed a plug-in for Visual Studio, which is called AddIn in its terminology. The architecture of the AddIn can be seen in Figure 3. The source code is first analyzed using the Columbus reverse engineering toolchain [4,18]. The result is exported to XML (.ppml), which is processed by the AddIn: the node graph and the token trees are computed. At this point the AddIn reached its operating state and listens to user activities.

- Fold/Unfold action – the AddIn changes the source code view of the current file by replacing fold labels with their content and vice-versa.
- Expansion action – the AddIn generates `.dot` file form token trees and invokes the GraphViz tool to produce the layout of the picture. The generated image file, which is the output of the graphViz tool, is passed to the default image viewer tool of the system.

The AddIn has a limited access to the internals of the Visual Studio. The AddIn has to work with the source code editor and has to read the properties of the actual project to access source files with full path and obtain command line defined macros for precise analysis. We have to note that some UI related features could not be implemented because a part of the API is for Microsoft internal use only. The AddIn has a simple but intuitive toolbar interface. The toolbar – with its two states and buttons – can be seen for Visual Studio versions 2005, 2010 and 2012 in Figure 4. The first button starts the `'A'`nalysis of the actual source file. As the analysis results are processed, the toolbar changes to operating state and annotates macros in the source code view. Folding mechanism and special notation of the code can be disabled any time using the `'HIDE'` button. Unfolding and folding buttons change the folding state of macros pointed by the actual

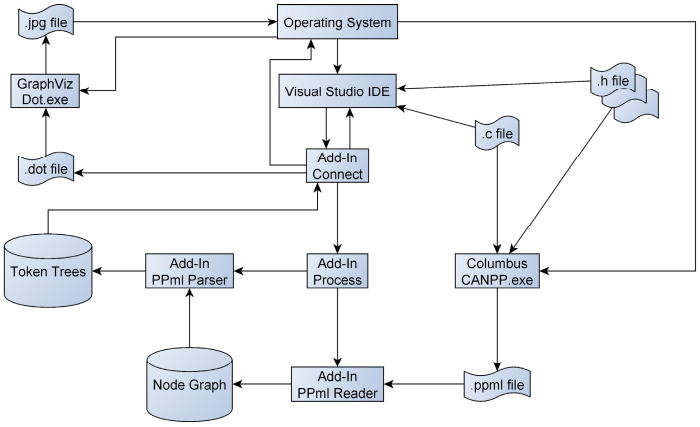

Fig. 3. Visual Studio AddIn architecture

cursor position. The `'EXT'` button decides between the two folding strategies. When a macro is unfolded, the replacement text of the macro is shown. In case of function-like macros, the actual arguments are also substituted. However, during the folding actions the original macro definition is not shown. In extended folding mode the definition of the macro is shown as an intermediate step, where the argument replacements can be followed before the final macro replacement step.

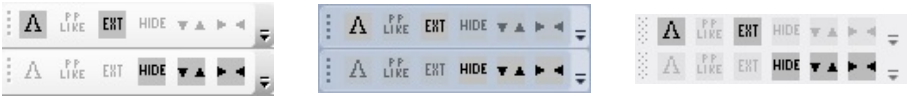

Fig. 4. VisualStudio AddIn Toolbar for versions 2005, 2010 and 2012 respectively

The inserted folding signs can be seen in the text editor of the development environment in Figure 5. Full macro expansions can be followed using a graph-based visualization as well. The notation of the graphical view is as follows. The shape of a node shows its node type: compilation unit (double circle), text (ellipse), conditional directives (hexagon). The edge colors denote the following properties: black edges show initial macro calls, where the macro position in the file is an attribute; green edges denote the chain of a full macro expansion, which gives the final result text of the call; blue edges denote macro evaluation steps; and red edges denote the conditional hierarchy if relevant.

First evaluation is done on test cases which cover most special macro constructs. The tool has proven to expand and fold/unfold macro constructs not only in C/C++ code but also in preprocessor conditional expressions and includes, which validates general usability. On the other hand, the tool is currently a research prototype, there are several points where the user experience of the tool could be greatly improved.

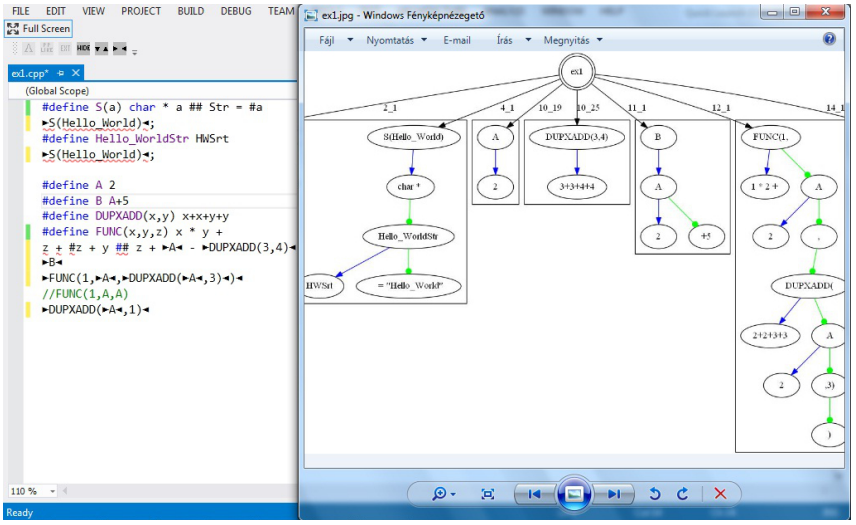

Fig. 5. Folding and macro expansion example in Visual Studio

4 Related Work

Preprocessor directives are still widely used as no real size program with configurations exist without them. Ernst, Badros and Notkin [2] analyzed 26 commonly used Unix software packages and found that preprocessor directives made up the relatively high 8.4% of lines on average.

To overcome the preprocessor as a barrier in program understanding, researchers tackled problems of various areas. Analysis and visualization of include directives is a research topic from the early years, while in a recent work Spinellis [15] proposes a solution for the automatic removal of unnecessary includes, based on computed dependencies of program elements.

Dealing with software configurations is a well studied topic. Krone and Snelting [6] proposed concept lattices to aid reengineering configurations. Latendresse [8] proposed a symbolic evaluation algorithm for finding the conditions required for a particular source line to get through the conditional compilation. CViMe and C-CLR tools are Eclipse plugins, which collect and present configuration-controller macros [13]. Sutton and Maletic implemented analyzer tools on the top of the srcML infrastructure to reveal portability issues based on include files and configuration macros [16]. In the work of Garrido the analysis of preprocessor constructs was integrated into the C refactoring tool, where she implemented a configuration independent solution [5]. Livadas and Small developed a special preprocessor inserting special lines into the preprocessed file to support the source code highlighting methods of the Ghinsu program slicing tool [9].

Those working on C or C++ analyzers are confronted by the problem of preprocessor directives. Therefore, a lot of effort has been made to avoid their usage. Mennie and Clarke proposed a method to transform some macros and

conditionals into C/C++ code [10]. Spinellis tackled the problem of global renaming of variables, preprocessor-aware solutions have been implemented in the CScout tool [14]. Saebjoernsen et al. [12] propose a mapping between the C language and the preprocessor to find inconsistent macro usage. The preprocessor-problem occurs also in the context of aspect mining and aspect-refactoring. Adams et al. worked on the problem of aspect refactoring, and also how to refactor various conditional compilation usage patterns into aspects [1]. In our previous work, we defined the macro dependency graph (MDG) for dependence based slicing of preprocessor macros [20]. Using the MDG C++ slices were extended with macro slices and better precision is achieved in case of more than 75% of backward slices [19]. Despite the wide range of initiations, current software development tools lack of support for the developers. In a recent paper Feigenspan et al. investigate the use of coloring techniques depending on the preprocessor conditionals in the FeatureCommander tool [3].

The initial work of Kullbach and Riediger on folding is already mentioned. The primary difference between the GUPRO environment and our solution is their purpose. While we concentrate on helping the developers with macros in place in the IDE, the GUPRO environment is a separate tool. Our internal structure (preprocessor schema) is capable of detailed analysis of preprocessor constructs, which is utilized also in macro expansion visualization to give an overview on what is happening. The Understand for C++ reverse engineering tool provides cross references between the use and definition of software entities [17]. This includes the step-by-step tracing of macro calls in both directions as well. The tool is appropriate for tracking back the uses of a give macro definition but the information is imprecise in certain situations like macro calls generated by `##` operators. A similar solution to macro folding is implemented in the Emacs editor. In C-mode, the `M-x c-macro-expand` command in Emacs will run the C preprocessor on the actual region and display the results in another buffer. This is similar to unfolding the actual macro. While this is a generic and simple solution, the folding mechanism is much more intuitive for stepwise investigation of a full macro expansion, than working with buffers. In addition, the visualization component is also available in our tool.

5 Conclusions

Developers need tool support when coping with preprocessor macros. Several research tools exist working with the preprocessor for various purposes, but the support for the developer is still limited in most common integrated development environments. We introduced an AddIn for Visual Studio to provide hand-on information on macro calls in the actual source code. We enhanced the idea of folding, a source code annotation technique, and integrated with graphical view of macro expansions. Macro information is obtained by detailed dynamic analysis of preprocessor constructs. The AddIn enables the step-by-step investigation of macro expansions and a quick view of the final form of the code, which is in fact compiled. Thus, developers need less manual effort for tasks related to macros – like debugging.

Future work includes enhancement of the user experience; improved, interactive macro graph that controls the source code view; and on field validation of the usability.

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Enhancing Smartphone Malware Detection Performance by Applying Machine Learning Hybrid Classifiers

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Abstract. Significant increase and serious thread of Smartphone malwares has imposed adopting accurate malware detection solutions. In this paper, we investigate the performance of machine learning individual classifiers and the possibility of enhancing this performance by introducing hybrid classifiers using stacking method. For the purpose of malware detection on Smartphone, the classifiers are evaluated and tested on 100 most download normal free applications and 90 available malicious applications traces. Those applications have been installed and executed on a HTC Dream phone. The metrics used to measure the classifiers performance are classifier accuracy and false positive rate.

Keywords: machine learning, malware detection, Smartphone security, hybrid classifiers.

1 Introduction

In recent years, we attend to an explosive increase in Smartphone sales and Smartphone applications release. IDC (International Data Corporation) expected about 982 million devices will be shipped by the end of 2015[1]. According to IDC forecast, the Smartphone applications market will keep its sharp growth as the number of downloaded applications will increase from 10.9 billion in 2010 to 76.9 billion in 2014[2]. Unfortunately, the increase of Smartphone sales and applications development comes with growing prevalence of Smartphone malwares. Google Android market recently found some applications infected within hidden malicious code DroiDream. They were available for 4 days and between 50,000 and 200,000 copies were download by users.

To protect Smartphone, we need to install anti-malware tools on the device. Signature-based malware detection is the first technique adopted against malware attacks. The main drawback of this technique is that it cannot detect unknown malwares. As a result, anomaly-based malware detection technique has been developed. This technique is usually based on Machine Learning methods, such as classification algorithms. A classification algorithm is trained on sets of benign and/or malicious data in order to classify new unknown data as malicious or benign.

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Various types of Machine Learning classification algorithms such as support vector machine (SVM) [3, 4], decision tree (DT) [5], Self-Organizing Map (SOM) [6], Artificial Neural Network (ANN), and Naïve Bayes (NB) [5] have been investigated and evaluated in Smartphone malware detection problem and yield good classification results. However, anomaly-based technique still suffers from considerable false positive rate which needs more investigations and improvements. In this work, we investigate and evaluate the possibility to enhance the performance of machine learning individual classifiers using hybrid classifiers. A hybrid classifier combines two or more different individual classifiers in order to improve classification process performance and reduce false positive rate. Thereby hybrid classifier is good candidate to make accurate malware detector. We address the problem of detecting malwares on Smartphones. For this purpose we have traced system calls of the 100 most downloaded normal applications and the 90 available real malwares. Those applications are installed and executed on a HTC dream device. As far as we know, all research papers in Smartphone malware detection investigate and evaluate individual classifier on proof-of-concept malwares. This work is the first attempt to study and evaluate hybrid classifiers performance on Smartphone system calls traces.

This paper studies the most known and used machine learning classifiers. We have selected Support Vector Machine (SVM), Artificial Neural Network (ANN), Naïve Bayes (NB) and Logistic Regression (LR). We evaluate their individual performance and the performance of combination of those classifiers in order to understand which of these hybrid classifiers best improves the classification process.

The rest of this paper is organized as follows: we introduce the related work in section 2. Section 3 presents the empirical work and results analysis. We end with conclusion in section 4.

2 Related Work

Recent studies have proposed techniques to detect malwares in Smartphone using machine learning classifiers. Shabtai et al [5] proposed framework that applies machine learning classifiers to detect a new malwares. The authors evaluated the performance of each classifier on a Smartphone running Android OS. These classifiers are: k-means, Logistic Regression, Histograms, Decision Tree, Bayesian Networks and Naïve Bayes. Zhao et al [4] introduced a new framework called AntiMalDroid. AntiMalDroid uses Support Vector machine (SVM) classifier trained by 100 normal applications and Plankton, DroidDream and Geinimi malwares. Bose et al [3] proposed framework to detect mobile malwares. The authors represent the applications behaviors by temporal logic of causal knowledge (TLCK). They discriminate the malicious behavior from normal behavior by training Support Vector Machine (SVM) classifier with both normal malicious behaviors. Schmidt et al [6] proposed a framework to detect malwares in Smartphones running Symbian OS and Windows mobile OS. The proposed framework is based on monitoring client runs in mobile device. Monitoring Clients collects system features, such as free RAM, CPU usage and the number of SMS messages in sent directory. Also monitoring client sends the collected

data to remote server to apply machine learning classifiers, such as Self-Organizing Map (SOM) and Artificial Immune System (AIS) to distinguish between normal and abnormal behaviors.

3 Empirical Study

In this section we describe the used dataset and the applied experiments. Also we provide empirical comparison of different individual classifiers and their hybrid classifiers. All machine learning classifiers used in this study were obtained from the WEKA machine learning visual package [7].

3.1 System Call Representation

Malware detection using system-call datasets generated by various applications can be defined as follow:

Let consider the set of system calls $\sum = \{s_1, s_2, s_3, \ldots, s_m\}$, where m is the number of system calls and $\sum^*$ is set of all possible finite sequences of system calls. Dataset D is a set of finite sequences of system calls generated by different executed applications. The dataset D can be defined formally as: $D = \{<S_i, C_i> \mid S_i \in \sum^*, Ci \in \{normal, malicious\}\}$ where S_i is a finite sequence of system calls generated by an application i and C_i indicates whether this application is normal or malicious. Given the dataset D, the goal of the learning algorithm is to find a classifier F: $\sum^* \rightarrow$ {normal, malicious} that maximizes given criteria.

In our experiments we adopted "Bag of system calls" representation [10]. It is an integer-frequency based representation. In this representation, the ordering information of adjacent system calls in the sequence is lost and only the frequency of each system call is preserved. Formally, the representation can be defined as follow:

The feature X_i is defined as an ordered list $X_i = <n_1, n_2, n_3, \ldots, n_m>$, where $m = |\sum|$ and n_j is the number of occurrence of a system call s_j in the sequence S_i.

3.2 Stacking Method or Combining Classifiers

A stacking method is used in our experiments to combine different types of classifiers. Stacking method combines different classifiers to derive a higher level classifier with greater accuracy performance [11]. The procedure is as follow:

1. Split the training dataset into two disjoint sets.
2. Train first-level learners on the first set.
3. Test the first-level learners on the second set.
4. Use the predictions from first-level as the inputs of higher level, this allows the higher-level to recognize first-level errors and correct them.

We used 2-level method in which the outputs of the first-level classifiers are used as inputs for second-level classifiers [12].

3.3 Performance Metrics

In order to evaluate the performance of individual and hybrid classifiers, we chose the following metrics: accuracy and false positive rate. To visualize those metrics, we present the confusion matrix.

Table 1. Confusion Matrix

		Predicted Class	
		Normal	Malware
Actual Class	Normal	True Positive (TP)	False Positive (FP)
	Malware	False Negative (FN)	True Negative (TN)

From table 1 we infer the following parameters [13]:

- False positive (FP) is the amount of misclassifying normal behaviours as malicious:

$$\text{False Positive Rate} = \frac{FP}{TP + FP}$$

- Classifier accuracy is the rate of correct predictions over dataset:

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN}$$

3.4 Dataset

We collected a large set of system-call traces of benign and malicious applications. We traced the 100 most downloaded benign free applications. We got those applications from Android market (official Android applications store) [8]. Also we traced the 90 available Android real malwares [9]. All applications installed and executed on HTC Dream device runs Android OS 2.2.

Fig 1 illustrates the integer-frequency based representation of a normal application. Each number in the sequence represents the number of times a system call is called. For example, the sequence 3,1,1,1,7,1,0,…. represents the following: fstat64 called 3 times, setgroups32 called 1 time, setgid32 called 1 time, setuid32 called 1 time, getuid32 called 7 times, geteuid32 called 1 time and seteuid32 0 time. The last attribute in figure 1indicates the sequence for normal application.

3,1,1,1,7,1,0,1,1,3,0,0,4,0,0,0,0,203,25,62,58,0,0,0,0,0,0,0,0,0,0,0,0,35,101,0,
,0,0,0,0,0,0,0,0,36,0,0,0,0,0,4,0,10,0,0,0,0,0,0,0,0,0,0,0,513,0,0,0,0,0,0,0,0,
97,6072,1617,142,360,0,1,0,0,0,0,0,0,0,0,90,0,0,0,0,0,0,0,0,0,0,0,108,0,0,0,8,0,
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,10,0,0,0,0,85,353,0,0,0,0,0,0,0,0,0,0,
0,0,2,0,0,25,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,3,0,0,0,0,0,0,0,0,(
0,0,0,0,0,2575,40,0,0,0,0,0,normal

Fig. 1. System calls of a Normal Application

3.5 Empirical Comparison of Classifiers

In this section we evaluate classifiers performance using accuracy and False Positive (FP) rate metrics. We examine individually the performance of two classifiers, and then compare their individual performance with the performance of their hybrid classifier. The results are summarized in below tables. Table 2 shows the accuracy and false positive rate of individual classifiers SVM, ANN and their hybrid classifier (SVM-ANN).

From Table 2, we can see that SVM classifier has better performance than ANN classifier with accuracy rate (92.5%) and FP rate (8%). However, Hybrid SVM-ANN classifier performs better than both individual classifiers. It significantly reduces the lower FP rate (from 8.50% to 4%) and improves the higher accuracy (from 92.50% to 96%).

Table 3 shows the performance of 3 classifiers Naïve Bayes, Logistic Regression and the corresponding hybrid NB-LR. Logistic Regression is little better than Naïve Bayes with higher accuracy (92.30%) and lower FP rate (8%). However hybrid NB-LR classifier performs better than Logistic regression classifier. It enhances accuracy to 94.10% rather than 92.30 and FP rate to 6% rather than 8%.

Table 2. SVM, ANN and hybrid SVM-ANN Classifiers Performance

Classifier	Accuracy	FP Rate
SVM	92.50%	8.50%
ANN	89.60%	11.50%
Hybrid SVM-ANN	**96%**	**4%**

Table 3. NB, LR and Hybrid NB-LR Classifiers Performance

Classifier	Accuracy	FP Rate
Naïve Bayes (NB)	91.30%	9%
Logistic Regression (LR)	92.30%	8%
Hybrid NB-LR	**94.10%**	**6%**

Table 4 shows the good performance of hybrid classifier SVM-NB relative to their individual classifiers SVM and Naïve Bayes. SVM performs little better than Naïve Bayes. It has lower FP rate (8.50%) and higher accuracy (92.50%). However hybrid classifier SVM-NB improves FP rate of SVM by 35% and increases accuracy to 94.10%.

Table 4. SVM, NB and Hybrid SVM-NB Classifiers Performance

Classifier	Accuracy	FP Rate
SVM	92.50%	8.50%
Naïve Bayes (NB)	91.30%	9%
Hybrid SVM-NB	**94.50%**	**5.50%**

Table 5. LR, ANN and Hybrid LR-ANN Classifiers Performance

Classifier	Accuracy	FP Rate
Logistic Regression (LR)	92.30%	8%
ANN	89.60%	11.50%
Hybrid LR-ANN	**95.50%**	**4.50%**

Table 5 illustrates the efficient performance of a new possible hybrid classifier LR-ANN relative to their individual classifier Logistic Regression (LR) and ALN. Logistic Regression is more efficient than ANN. Its FP rate is lower (8%) and its accuracy is higher (92.30%) whereas ANN has FP rate (11.50%) and accuracy (89.60%). Hybrid classifier LR-ANN improves FP rate of ANN by 61% and FP rate of Logistic Regression by 44%. Also, hybrid classifier LR-ANN has better accuracy with 6%.

In summarizing the results of the above tables, we can state that the machine learning individual classifiers have good performance on Smartphone system calls dataset. The best classifier was SVM with 8% FP rate and 92.50% accuracy. The worst classifier was ANN with 11.50% FP rate and 89.60% accuracy. The hybrid classifiers achieved better performance than individual ones. They have lowest FP rate (4%) and highest accuracy (96%). As shown in the above tables, the worst hybrid classifier (LR-NB classifier with 6% of FP rate and 94.10% of accuracy) has better performance than the best individual classifiers (SVM with 8% of FP rate and 92.50% of accuracy). We observed hybrid classifiers have a big influence on FP rate improvement. In most cases, the FP rate is improved by more than 25%, which is significant improvement. Table 6 orders the classifiers (individual and hybrid) according to their FP rate performance.

Table 6. Classifiers Order per FP Rate

Classifier	Accuracy	FP Rate
Hybrid SVM-ANN	96%	4%
Hybrid LR-ANN	95.50%	4.50%
Hybrid SVM-NB	94.50%	5.50%
Hybrid NB-LR	94.10%	6%
Logistic Regression	92.30%	8%
SVM	92.50%	8.5%
Naïve Bayes	91.30%	9%
ANN	89.60%	11.50%

4 Conclusion and Future Work

We evaluated and compared four individual machine learning classifiers for malware detection on Smartphone. The used dataset is system call traces of the 100 most downloaded normal and 90 available malware applications. Each classifier performance is

evaluated by its accuracy and false positive rate. The results showed good performance of individual classifiers. We examined the possibility of enhancing this performance by applying hybrid classifiers instead of individual classifiers. Hybrid classifier is combination of two individual classifiers using stacking method. The results showed enhancement in performance in terms of accuracy and false positive rate with extra computational costs. This work proved hybrid classifiers can be good candidates to implement accurate malware detector. Because Smartphone is limited resource environment and cannot bear extra computational cost and all Smartphones operators offer cloud computing service, then malware detector based on hybrid classifier and cloud service is good solution and we will study this approach in the future work.

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Myth or Reality? Analyzing the Effect of Design Patterns on Software Maintainability

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Abstract. Although the belief of utilizing design patterns to create better quality software is fairly widespread, there is relatively little research objectively indicating that their usage is indeed beneficial.

In this paper we try to reveal the connection between design patterns and software maintainability. We analyzed more than 300 revisions of JHotDraw, a Java GUI framework whose design relies heavily on some well-known design patterns. We used our probabilistic quality model for estimating the maintainability and we parsed the javadoc annotations of the source code for gathering the pattern instances.

We found that every introduced pattern instance caused an improvement in the different quality attributes. Moreover, the average design pattern line density showed a very high, 0.89 Pearson correlation with the estimated maintainability values. Although the amount of available empirical data is still very small, these first results suggest that the usage of design patterns do improve code maintainability.

Keywords: Design patterns, Software maintainability, Empirical validation, OO design.

1 Introduction

Since their introduction by Gamma et al. [7], there has been a growing interest in the use of design patterns. Object-Oriented (OO) design patterns represent well-known solutions to common design problems in a given context. The common belief is that applying design patterns results in a better OO design, therefore they improve software quality as well [7,16].

However, there is a little empirical evidence that design patterns really improve code quality. Moreover, some studies suggest that the use of design patterns not necessarily result in good design [13,20]. The problem of empirical validation is that it is very hard to assess the effect of design patterns to high level quality characteristics e.g.: maintainability, reusability, understandability, etc. There are some approaches that manually evaluate the impact of certain design patterns on different quality attributes [11].

We also try to reveal the connection between design patterns and software quality but we focus on the maintainability of the source code. As many concrete maintainability models exist (e.g. [2,4,8]) we could choose a more direct

T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 138–145, 2012.

approach for the empirical evaluation. To get absolute measure for the maintainability of a system we used our probabilistic quality model [2]. Our subject system was JHotDraw 7, a Java GUI framework for technical and structured Graphics (http://www.jhotdraw.org/). Its design relies heavily on some well-known design patterns. Instead of using different design pattern mining tools we parsed the javadoc entries of the system directly to get all the applied design patterns. We analyzed more than 300 revisions of JHotDraw, calculated the maintainability values and mined the design pattern instances. We gathered this empirical data with the following research questions in mind:

Research Question 1. *Are there any traceable impacts of the application of design patterns on software maintainability?*

Research Question 2. *What kind of relation exists between the design pattern density and the maintainability of the software?*

There are some promising results showing that applying design patterns improve the different quality attributes according to our maintainability model. In addition, the ratio of the source code lines taking part in some design patterns in the system has a very high correlation with the maintainability in case of JHotDraw. However, these results are only a small step towards the empirical analysis of design patterns and software quality.

The rest of our paper is structured as follows. In Section 2 we highlight the related work then in Section 3 we present our approach for analyzing the relationship between design patterns and maintainability. Section 4 summarizes the achieved empirical results. Next, Section 5 lists the possible threats to the validity of our work. Finally, we conclude the paper in Section 6.

2 Related Work

Although the concept of utilizing design patterns in order to create better quality software is fairly widespread, there is relatively little research that would objectively indicate that their usage is indeed beneficial.

Since design patterns and software metrics are both geared towards the same goal - improving quality - Huston [10] attempts to prove their correlation by representing the system's classes in connection matrices and defining algorithms for applying patterns and evaluating metrics. This approach shows promising results but it is purely theoretical.

In an empirical study, - replicated in 2004 [18] and in 2011 [12] - Prechelt et al. [15] gave groups identical maintenance tasks to perform on two different versions - with and without design patterns - of four programs. Here, the impact on maintainability was measured by completion time and correctness while this article uses objective quality metrics and analyzes a more complex software.

In another case study, Vokáč [17] measured the defect frequency of pattern classes versus other classes in an industrial C++ source for three years and concluded that some patterns - Singleton, Observer - tend to indicate more complex parts than others, e.g.: Factory. However, the used pattern mining method could

have introduced false positives or true negatives and the defects are also based on subjective reports. In contrast, we rely on the official pattern documentation of source code and the quality model published in [2].

Khomh and Guéhéneuc [11] used questionnaires to collect the opinions of 20 experts on how each design pattern helps or hinders them during maintenance. They bring evidence that design patterns should be used with caution during development because they may actually impede maintenance and evolution. Another experiment conducted by Ng et al. [14] decomposes maintenance tasks to subtasks and examines the frequency of their use according to the deployed design patterns and whether these patterns are utilized during the change. They statistically conclude that performing whichever task while taking existing patterns into consideration yields less faulty code. Trying to evaluate the effectiveness of patterns in software evolution, Hsueh et al. [9] defined their context and their anticipated changes and then checked whether they held up to the expectations. Their conclusion is that although design patterns can be misused, they are effective to some degree in either short or long term maintenance. Aversano et al. [1] also investigate pattern evolution by tracking their modifications and how many other, possibly unrelated modifications they cause. In this paper we do not use questionnaires or evaluate design patterns manually, but rather measure its impact on maintainability directly. Moreover, we focus on their impact on the maintainability of the system as a whole and not only the evolution of the code implementing design patterns.

3 Approach

For analyzing the relationship between design patterns and maintainability we calculate the following measures for every revision of JHotDraw system:

- M_r - an absolute measure of maintainability for the revision r of the system. We used our probabilistic quality model [2] to get this absolute measure.
- $TLLOC$ - the total number of logical lines of code in the system (computed by the Columbus toolset [6]).
- $TNCL$ - the total number of classes in the system.
- PIn_r - the number of pattern instances in revision r of the system.
- PCl_r - the number of classes playing a role in any pattern instances in revision r of the system.
- PLn_r - the total number of logical lines of classes playing a role in any pattern instances in revision r of the system.
- $PDens_r$ - the pattern line density of the system defined by the following formula: $\frac{PLn_r}{TLLOC}$

To answer our research questions we examine the tendency of M_r in comparison to the pattern related metrics and changes in the number of pattern instances. The pattern related metrics are calculated by our own tool that is able to process the structured *javadoc* comments.

3.1 Probabilistic Software Quality Model

Our probabilistic software quality model is based on the quality characteristics defined by the ISO/IEC 9126 standard. The computation of the high level quality characteristics is based on a directed acyclic graph whose nodes correspond to quality properties that can either be internal (low-level) or external (high-level). Internal quality properties characterize the software product from an internal (developer) view and are usually estimated by using source code metrics. External quality properties characterize the software product from an external (end user) view and are usually aggregated somehow by using internal and other external quality properties. The edges of the graph represent dependencies between an internal and an external or two external properties. The aim is to evaluate all the external quality properties by performing an aggregation along the edges of the graph, called Attribute Dependency Graph (ADG). We used the particular ADG presented in [2] for assesing the maintainability of JHotDraw Java system.

3.2 Mining Design Patterns

Instead of applying one of the design pattern miner tools (e.g. [5,19]) we used a more direct way for extracting pattern instances from different JHotDraw versions. Since every design pattern instance is documented in JHotDraw 7 we could easily build a text parser application to collect all the patterns. This approach guarantees that no false positive instances are included and no true negative instances are left out from the empirical analysis. Finally we ran the parser on all relevant revisions of JHotDraw7 to track the changes.

4 Results

We analyzed all the 779 revisions of the JHotDraw 7 subversion branch[1] and calculated the measures introduced in Section 3. The documentation of design patterns is introduced in revision 522, therefore the empirical evaluation has been performed on 258 revisions (between revision 522 and 779). Some basic properties of the starting and ending revision of the analyzed JHotDraw system can be seen in Table 1.

Table 1. Basic properties of JHotDraw 7 system

Revision (r)	Lines of code	Nr. of packages	Nr. of classes	Nr. of methods	PIn_r	$\frac{PCl_r}{TNCL}$
522	72472	54	630	6117	45	11.58%
779	81686	70	685	6573	54	13.28 %

To be able to answer our first research question we have analyzed those particular revisions where the number of design pattern instances has changed. After

[1] https://jhotdraw.svn.sourceforge.net/svnroot/jhotdraw/trunk/jhotdraw7/

filtering out the changes that does not introduce or remove real pattern instances (e.g.: comments are added to an already existing pattern instance) five revisions have remained. We also checked that these change sets do not contain a lot of source code that is not related to patterns. It is important to be able to clearly distinguish the effect of design pattern changes to maintainability. In all five cases more than 90% of the code changes are related to the pattern implementations. The tendency of different quality attributes in these revisions can be seen in Table 2.

Table 2. The tendency of the quality attributes in case of design pattern changes

Revision (r)	Pattern	Pattern Line Density ($PDens_r$)	Maintainability (M_r)	Testability	Analyzability	Stability	Changeability
531	+3	↗	↗	↗	↗	↗	↗
574	+1	↗	↗	↗	↗	↗	↗
609	−1	↘	—	—	—	—	—
716	+1	↘	↗	↗	↗	↗	↗
758	+1	↗	↗	↗	↗	↗	↗

In four out of five cases there was growth in the pattern instance numbers. In all four cases every ISO/IEC 9126 quality characteristic (including the maintainability) increased compared to the previous revision. This is true even for revision 716 where the pattern line ratio decreased despite the addition of a design pattern. In case of revision 609 a *Framework* pattern has been removed but the quality characteristics have remained unchanged. This is not so surprising since this pattern (which is not part of the GoF patterns) consists of a simple interface. Therefore its removal does not have any effect on the low level source code metrics on what our maintainability model is based on.

As we have shown in one of our previous works [3] a system's maintainability does not improve during development without applying explicit refactorings. Therefore, the application of design patterns can be seen as applying refactorings on the source code. These results support the hypothesis that design patterns do have a traceable impact on maintainability. In addition, our empirical analysis on JHotDraw indicates that this impact is positive.

To shed light on the relationship between design pattern density and maintainability we performed a correlation analysis on pattern line density ($PDens_r$) and maintainability (M_r). We chose pattern line density instead of pattern instance or pattern class density because it is the finest grained measure showing the amount of source code related to any pattern instances. Figure 1 depicts the tendencies of pattern line density and maintainability. It can be seen that the two curves have a similar shape meaning that they move very much together. The Pearson correlation analysis of the entire data set (from revision 522 to 779) shows the same result, the pattern line density and maintainability has a **0.89** correlation. This result may indicate that there is a strong relation between the rate of design patterns in the source code and the maintainability. However, this is still a surmise and we cannot generalize the results without performing a large number of additional empirical evaluations.

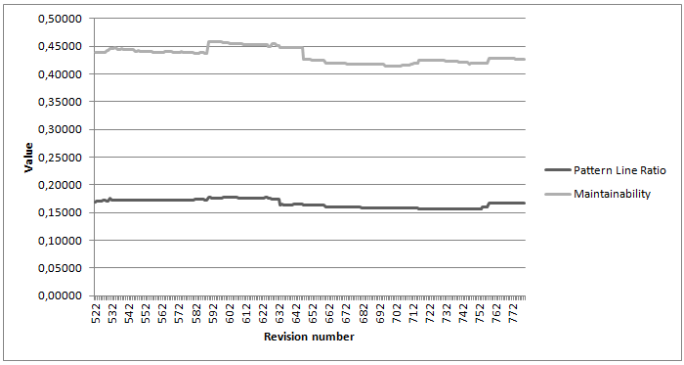

Fig. 1. The tendencies of pattern line density and maintainability

5 Threats to Validity

Similarly to most of the works, our approach also has some threats to validity. First of all, when dealing with design patterns, the accuracy of mining is always a question. As there are no provably perfect pattern miner tools, we chose our subject system to be a special one, having all design pattern instances documented by its authors. This way we can be sure that all (intentionally placed) design patterns are recognized and no false positive instances are introduced. Of course it is still possible that some pattern comments are missing or our text parser introduces false instances. We reduced this effect by manually inspecting the results of our text parser as well as the source code of JHotDraw.

Another threat to validity is using our previously published quality model for calculating maintainability values. Although we have done some empirical validation on our probabilistic quality model in our previous work, we cannot state that the used maintainability model is fully validated. Moreover, as the ISO/IEC 9126 standard is not defining the low-level metrics, the results can vary depending on the quality model's settings (chosen metrics and weights given by professionals). These factors are possible threats to validity, but our first results and continuous empirical validation of the maintainability model proves its applicability and usefulness.

Finally, the small number of design pattern changes and the fact that less than 300 revisions of one system have been evaluated threatens the generality of results. It might be possible that the explored relationship between design patterns and maintainability is just a byproduct of other factors. Our analysis is only a first step towards the empirical analysis of this relation. Nonetheless, these first results are already valuable and support the common belief that design patterns do have a positive impact on maintainability.

6 Conclusions

In this paper we presented an empirical analysis of exploring the connection between design patterns and software maintainability. We analyzed nearly 300

revisions of JHotDraw 7 and calculated the maintainability values with our probabilistic quality model and mined the design pattern instances parsing the comments in the source code. Examining the maintainability values where changes in the number of pattern instances happened and by correlation analysis of design pattern density and maintainability we were able to draw some conclusions.

Every ISO/IEC 9126 quality characteristics (including the maintainability) increased with the number of pattern instances. Since there were no other changes in the code it indicates that the quality attributes increased due to the introduced patterns. Hence, we could observe a traceable positive impact of design patterns to maintainability of the subject system.

Another interesting result is that the pattern line density and maintainability values have a very similar tendency. The Pearson correlation analysis of the data sets showed that there is a strong relation between the rate of design patterns in the source code and its maintainability. These facts strengthen the common assumption that using design patterns improve the maintainability of the source code. However, these results should be handled with caution. We analyzed only one system and a relatively few number of pattern instance changes. We are far from drawing some general conclusions based on this; our work should be considered as a first step towards the empirical validation of the relation between design patterns and software maintainability.

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Towards Building Method Level Maintainability Models Based on Expert Evaluations

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Abstract. The maintainability of software systems is getting more and more attention both from researchers and industrial experts. This is due to its direct impact on development costs and reliability of the software.

Many models exist for estimating maintainability by aggregating low level source code metrics. However, very few of them are able to predict the maintainability on method level; even fewer take subjective human opinions into consideration. In this paper we present a new approach to create method level maintainability prediction models based on human surveys using regression techniques.

We performed three different surveys and compared the derived prediction models. Our regression models were built based on approximately 150 000 answers of 268 persons. These models were able to estimate the maintainability of methods with a 0.72 correlation and a 0.83 mean absolute error on a continuous [0,10].

Keywords: Software maintainability, Regression analysis, ISO/IEC 9126, Comparative study.

1 Introduction

Analyzing the maintainability of software systems is one of the core research topics in the field of software engineering. This is due to its direct impact on development costs and reliability of the software [3]. The development costs of a system with poor maintainability are significantly higher and unexpected errors are more likely to occur. This might be critical in many software domains, e.g. air traffic control, banking systems or energetics.

In our previous work [11] we built a maintainability model based on the ISO/IEC 9126 [13] standard by applying classification algorithms (using source code metrics as predictors) on manually labeled methods. The labeling of 350 Java methods was performed by 35 IT experts in such a way that each expert evaluated 10 different methods. Although the classification models worked well in classifying the maintainability of methods using 3 classes: *good*, *average*, *bad*;

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using a finer scale the precision of the models decreased. We have found out that this is due to the deviation of the experts' votes and the classification performs badly in an unbalanced training set (almost 70% of the labeled methods fell into the *good* category). To overcome this problem we improved our surveys in two different ways: first, only one expert was asked to evaluate lots of methods while in the other case one method was evaluated by more participants and the evaluation score of the methods were calculated as the averages of the votes.

Moreover, instead of using classification we applied regression techniques to assess the tendency of maintainability on a much finer scale. As it defined in [18] predicting the values of numeric or continuous attributes is known as *regression* in the statistical literature. Regression differs from classification in that the output or predicted feature in regression problems is continuous. However, many standard classification techniques (e.g. neural networks, decision trees) can be adapted for regression. In this paper we present and compare the results of the regression models based on the following three surveys:

- **Experts' evaluation.** More experts evaluated the methods; every method was evaluated by only one expert.
- **One person's evaluation.** One expert evaluated all the methods; every method was evaluated by this expert.
- **Students' evaluation.** A large number of students evaluated the methods; every method was evaluated by at least 7 students.

Our regression models were built based on approximately 150 000 answers of 268 persons. These models were able to estimate the maintainability of methods with a 0.72 Pearson-correlation and a 0.83 mean absolute error on a continuous [0,10] scale where 0 means the absolutely not maintainable and 10 means the perfectly maintainable source code. With the improved surveys we tried to answer the following research questions:

Research Question 1: *How effectively can we apply regression techniques to predict maintainability sub-characteristic on a continuous scale?*

Research Question 2: *How is the prediction of regression models affected by the underlying surveys?*

The rest of the paper is structured as follows. In Section 2 we overview the related work. Then, in Section 3 we introduce the improved surveys and technical details about the performed evaluations. Section 4 presents the results of the surveys and the comparison of the different regression models. Afterwards, Section 5 discusses the known threats to the validity of our work. Finally, we conclude the paper and present future work in Section 6.

2 Related Work

The ISO/IEC 9126 model clearly defines the characteristics of software quality but it does not provide sufficient details about how one should calculate them in practice. Using the results of static source code analyzers is one of the most

widespread solutions to calculate an external quality attribute from internal quality attributes [5]. There are several case studies about that the metrics are appropriate indicators for external quality attributes such as code fault proneness [7] [9] [15], maintainability [1] and attractiveness [14].

Dagpinar and Jahnke [8] indicated that size and coupling metrics are significant predictors for measuring maintainability of classes while inheritance, cohesion, and indirect/export coupling measures are not. Contrary to them we investigated the maintainability on method level rather than class or system level. We used the following method level metrics: method coupling, complexity, size, number of coding rule violations and clone metrics.

Wang, et al. [17] compared different machine learning algorithms to predict software defects. They found that multiple classifiers (e.g. Bagging, Boosting, Random trees, Vote) can effectively improve classification performance of the single classifiers like Naive Bayes. The efficiency of the classification algorithms were tested on 14 datasets and the average accuracy of the best algorithm (Vote) was 88.48%. We also used single (Linear Regression, Neural Network) and multiple (Bagging) machine learning algorithms, but our purpose was not to compare the efficiency of these techniques, but to find out how well these algorithms are applicable to predict the maintainability sub-characteristics.

There are several models for calculating maintainability in a direct way [2] [4] [12] [16]. All of them use some kind of aggregation technique based on various metrics. For example Heitlager et al. [12] proposed an extension of the ISO/IEC 9126 model where metric values are split into five categories, from poor (--) to excellent (++). The evaluation in their model means summing the values for each attribute and then aggregating the values for sub-characteristics. Similarly to them we also tried to provide a bridge between source code metrics and the high level ISO/IEC 9126 quality characteristics, but we approximated maintainability on the level of methods and our estimation model is based on subjective opinions of many IT experts.

3 Applied Surveys

As a sequel of our previous work [11] 268 participants took part in the experiment where the three surveys introduced in Section 1 were performed and more than 150 000 questions were answered (for evaluation statistics see Table 1). The participants had to score the sub-characteristics of *maintainability* defined by the ISO/IEC 9126 standard (*analyzability*, *changeability*, *testability*, *stability*) and a new quality attribute, *comprehensibility*, introduced by us [11]. Besides these quality attributes, the students had to evaluate the maintainability of the methods as well. The evaluation has been performed with the help of our online survey system called Metric Evaluation Framework. For details about the application and technical questions refer to our earlier paper [11].

Experts' Evaluation. First, 35 experienced software engineers dealing with software quality at our Software Engineering Department evaluated the 5 sub-characteristics of 350 different methods of jEdit open source text editor

(http://www.jedit.org). One method was evaluated by only one participant and each participant evaluated 10 methods. The results pointed out that there was a large deviation in the judgments of the sub-characteristics which affected the efficiency of the built prediction models [11]. The cause of the large deviation can be that different experts might have different subjective scales and different interpretation of the same quality concepts. We tried to resolve this problem in two different ways: first, only one expert was asked to evaluate lots of methods while in the other case one method was evaluated by more participants and the evaluation scores of the methods were calculated as the averages of the votes.

Table 1. Statistics about the evaluations

	Experts	One person	Students
Evaluators	35	1	232
Questions	13 407	11 901	125 097
Methods	350	250	200
System	jEdit	Industrial	jEdit

Table 2. The deviation of the justifications of the properties

Property	Deviation
Analyzability	1.859
Changeability	2.049
Stability	2.222
Testability	2.019
Comprehensibility	1.880
Maintainability	1.975

One Person's Evaluation. Our first attempt to eliminate the large deviation of the answers was that we asked a software engineer having 2 years experience to evaluate 250 methods of a closed source industrial system. Although we could build a more effective model (see Section 4) this result cannot be treated as a representative one as it might be specific to the given system and evaluator.

Students' Evaluation. The next step was that 232 students having preliminary Java studies evaluated 200 methods. Because of the large number of participants, almost all methods were evaluated at least 7 different students and those methods which had less than 7 evaluations were excluded (about 10%). For each method the averages of the scores were calculated which approximated the student justifications of the given sub-characteristics and the maintainability. Table 2 shows the deviations of the scores given to the different maintainability characteristics. As we can see, the deviation is about 2 in all cases which are surprisingly large taking into account that the scores range from 0 to 10. This points out why it is difficult to build an effective model based on human evaluations. On the other hand, we have to remark that experts usually judge the methods similarly so they would have given more similar scores and the deviation would have been smaller. Unfortunately, we would have to involve lots of experts to prove this hypothesis which would be quite expensive.

4 Results

Applied Regression Techniques. In order to apply machine learning models effectively in practice, appropriate properties have to be chosen that can be calculated fast and automatically at the same time so we chose method level metrics in our experiment and we calculated them for all methods that were evaluated [11].

The list of considered metrics is the following: *lines of code*[1], *logical lines of code*[2], *number of statements*, *number of parameters*, *number of incoming invocations*, *number of outgoing invocations*, *number of foreign methods accessed*, *number of local methods accessed*, *McCabe's cyclomatic complexity*, *nesting level*, *clone coverage*, and *rule violations*[3]. This way we had all necessary information to build models that could predict maintainability and its sub-characteristics based on method level metrics. We used 10-fold cross-validation to evaluate the models. This means that the training data set was split into 10 disjoint parts and 9 of them were used to build the model and its usefulness was tested on the 10th part. Then this process was repeated ten times with different splitting.

In the classical form of machine learning, the unknown value being predicted is nominal, which means that it can have finite possible values and there is neither order nor ratio among them. In our previous work [11] we used three categories (good, average, bad) to classify the methods. In this case, one of the best measures of such learning is the rate of the correctly classified elements. Unfortunately, in that case almost 70% of the methods belonged to the *good* class and therefore the model classified almost all methods into the *good* category so too few bad methods were found what the real purpose of the experiment was.

Regression [18] is another frequently used technique to build models, where the unknown variable can be an arbitrary real number. The Pearson-correlation and the mean absolute error (MAE) are used to measure the usefulness of the model, more precisely, to measure the differences between the expected values and the values given by the model. One of the advantages of regression is that we use continuous scale so we expect more precise results. Furthermore, the correlation tells us how well the model hits the tendency while the MAE indicates how much the model differs from the expected values which are more useful information than those received in the nominal case. This is why we did not use the standard IR measures like precision and recall.

Comparing the Different Algorithms. In this experiment we applied neural networks, linear regression and decision tree techniques. We used the Weka data mining tool [10] to build appropriate models. First, we examined the efficiency of the three techniques on the results of the students' evaluation, then we compared the results of the three different method evaluations. Weka offers only one option for neural networks and linear regression, but in case of decision trees we chose the one that worked the best for us. This was the REPTree algorithm but it was further improved with a bagging technique [6] which builds more trees based on the learning data set and the prediction is combined by the average of their predictions. Besides the correlation and MAE the efficiency of the results can be measured by comparing to the ZeroR algorithm, whose prediction is always the average of the predicted values in the training set. Without using the metrics as predictors this technique gives the prediction with the smallest average error so we can compare how much the result improves when the metrics are used.

[1] The end-line of the method minus its begin-line plus 1.
[2] All nonempty, non-comment lines of the method.
[3] Number of PMD (`http://pmd.sourceforge.net/`) rule violations of the method.

First, we compared the different regression algorithms on the students' evaluation. We calculated the correlation values and the MAEs of all models (see Table 3). As we can see the decision tree has significantly larger average correlation value (0.631) and significantly smaller MAE value (0.87) than the others.

In the following we compared the different evaluations as well. Since the decision tree gave the best results, we applied it in our further investigations.

Comparing the Evaluations. We compared the models trained on the three different survey results to see which gives the best results. The results of the model built by decision tree are presented in Table 4.

Table 3. The MAE and Correlation values of the examined regression techniques

	ZeroR		Neural Network		Linear Reg.		Decision Tree	
	MAE	Corr.	MAE	Corr.	MAE	Corr.	MAE	Corr.
Analyzability	1.201	-0.162	1.076	0.408	1.076	0.466	0.884	0.660
Changeability	1.026	-0.116	1.088	0.362	0.965	0.437	0.861	0.571
Comprehens.	1.574	-0.153	1.387	0.275	1.188	0.491	1.048	0.621
Stability	0.822	-0.239	0.824	0.297	0.833	0.360	0.670	0.572
Testability	1.189	-0.118	1.168	0.427	1.145	0.363	0.926	0.639
Maintainability	1.187	-0.122	1.193	0.587	0.909	0.615	0.831	0.723
Average	**1.166**	**-0.152**	**1.123**	**0.393**	**1.019**	**0.455**	**0.870**	**0.631**

Table 4. Efficency of the decision tree algorithm based on the different surveys

	Experts		One Person		Students	
	MAE	Corr.	MAE	Corr.	MAE	Corr.
Analyzability	1.792	0.479	0.896	0.660	0.884	0.660
Changeability	1.656	0.445	1.011	0.758	0.861	0.571
Comprehensibility	1.867	0.395	1.063	0.712	1.048	0.621
Stability	1.712	0.509	1.154	0.453	0.670	0.572
Testability	1.910	0.520	1.781	0.476	0.926	0.639
Average	**1.787**	**0.469**	**1.181**	**0.612**	**0.878**	**0.612**

The 0.469 average correlation value and the 1.787 average MAE value of the model trained on experts' evaluation show that the decision tree algorithm could not build an effective model. On the other hand, it is interesting that if we consider the correlation only, the model based on experts' evaluation predicts stability and testability better than the model based on the result of the one person's evaluation. The average correlation of the other two models is the same but the average MAE value of the students' evaluation is smaller.

Answering the Research Questions. RQ1: Neural network and linear regression performed poorly in our experiment so we can say that they are not able to predict the maintainability sub-characteristics efficiently. On the other hand the REPTree decision tree method gave good results in all cases therefore it can be considered an effective regression technique.

RQ2: Because of the preliminary results only decision tree was applied to answer this question. On the students' evaluation it performed uniformly well while on

the one person's evaluation it could not predict stability and testability values efficiently. On the other hand, we were not able to predict the results of the experts' evaluation.

5 Threats to Validity

It is common to collect large amount of data with the help of students, but it is always a huge risk as well. The risk in our case is that the opinion of a student is much less reliable than an expert's opinion. To handle this threat we used the averages of lots of student opinions about the quality of the methods. This way we decreased the effect of the unreliable votes.

We compared the efficiency of the regression techniques based on the different surveys, but we left out of consideration that only two of the surveys evaluated the same system. The one person evaluation is based on an industrial system. Although it is possible that the subject systems have an effect on the efficiency of applied regression techniques, our results are mainly based on the experts' and students' surveys, which use the same subject systems.

The used regression algorithms were trained on 350, 250 and 200 methods, but to accept the achieved results in general a larger amount of data might be needed. However, even these survey results are valuable assets considering the huge number of human evaluators involved.

6 Conclusions and Future Work

In this paper we presented a way to build prediction models for maintainability based on human evaluations. We performed three surveys with different set-ups: experts, one person, and students evaluated a large number of Java methods. By comparing the results of the three evaluations we can conclude that the experts' survey provided the hardest predictable opinions due to the high deviation in the different expert votes (each expert evaluated different methods). On the contrary, the one person and student opinions were equally well predictable by the means of correlation but the mean average error is significantly smaller in the case of student evaluations.

Looking at the different regression techniques we can say that on our training data the decision tree algorithm was the best performing one. The model trained on the students' evaluation predicts the quality attributes with 0.61 correlation and 0.88 mean average error on a [0,10] continuous scale. The maintainability itself is predicted by the model with 0.72 correlation and 0.83 average error. Based on these results we can conclude that efficient maintainability prediction models can be built using regression techniques when we have a large amount of reliable subjective evaluations from one person or less reliable but redundant evaluations from multiple persons.

An interesting question is that how the results of existing maintainability models correlate with the opinions of human evaluators. Our future plan is to

improve our probabilistic quality model [2] to enable method level qualifications and compare its results with the human evaluations.

We also plan to extend the questionnaire of the evaluation and apply different kind of predictors for the model building (not just basic metrics).

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A Study on the Improved Stability of Inverter through History Management of Semiconductor Elements for Power Supply

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Abstract. This study suggested the methods to check a proper replacement time, etc. by managing operation data of IGBT used as switching element of inverter for improving the stability of inverter, which was checked through practical experiment. This study accumulated and recorded data such as operation time of IGBT and temperature of radiator for the use in setting, etc. of proper replacement time by checking the data through an indicator. Methods and systems suggested in this study will be also easily used in various sectors using other electric system and semiconductor switching elements for power.

Keywords: Inverter, IGBT, History Management.

1 Introduction

A lot of studies are continued for the expanding of electric braking for the improvement of performance of the car regarding for the inverter recently used in the rail car [1-5]. These studies are for obtaining braking power with electric braking in the high-speed area as well as in stop, and are reported as methods to improve the efficiency and advanced performance, etc. in the use of energy and the ride quality. Technology for the inverter enters into the stable period to some degree.

Most of electric/electronic equipment has devices to stop or interrupt operation against over current, overvoltage, etc. as protective devices against malfunction in the design phase. Even in the design of the inverter for the rail car, the controller is designed to stop or interrupt operation by function of protective circuits due to over current, overvoltage and rise of temperature against malfunction. It is impossible to take proper actions to prevent of failure of power elements in use.

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Prevention and diagnosis against failure for the inverter driving a traction motor are very important. Presently IGBT is mainly used as a power element. It is considered impossible to measure its aging level or deterioration level like general semiconductor elements. It is also considered that analysis of failure against power elements after occurrence of failure in respect of the improvement of reliability of the inverter, redesign of the system and improvement of circuits is impossible but the management, etc. of individual history for the power element as a part is not possible.

Since the use period of semiconductor elements for power is guaranteed through the multitude of temperature change and the repetitive numbers of semiconductor elements, it is determined that maintenance or replacement can be achieved at a proper time only if possible to accumulate, record the operational environment such as operation time of power element and temperature of radiant by controller of the inverter, and check it with an indicating device. Accordingly this study suggested the methods to accumulate, record the operational data such as operation time, temperature, current, voltage for the IGBT of the inverter of the rail car and to check them with an indicating device and verified the feasibility of the suggested methods and the system performed the practical experiment by organizing and establishing the practical system so that data are implemented and checked on a PC.

2 Life and Heat Stress of Power Element

Over current, etc. due to overvoltage or overload and the environment conditions in the use of IGBT are factors to determine the useful life period, and failure of the thermal fatigue phenomena in the wire bond junction part between inner module and chip, and the junction part between insulation plate and base plate (soldering junction) occurs. These thermal fatigue phenomena and the related failure examples are explained as follow [6].

2.1 Thermal Fatigue Phenomena of Power Module

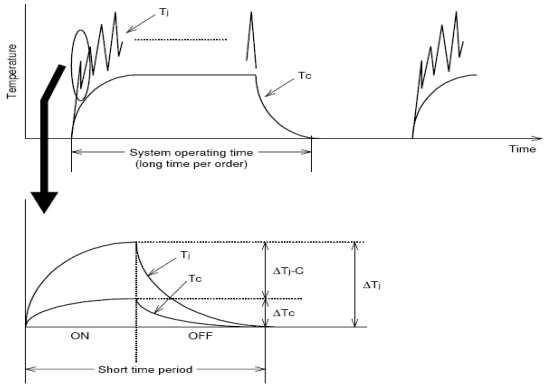

Fig. 1. Change of module temperature

Thermal stress is classified into 2 operational patterns as expressed in Figure 1 when the module operates and it is required to select the module and design a machine considering its effective life.

(A) Operation mode 1
Life (life of power cycle) in the operational pattern where the change of case temperature (temperature of base plate) is small but the junction temperature frequently occurs
(B) Operation mode 2
Life (life of thermal cycle) in the operational pattern where the flat change of temperature occurs in operation or stop of the system

2.2 Failure Mechanism

2.2.1 Failure Mechanism of Power Cycle Life

If the change of junction temperature occurs in the operation of module in the structure of general power module, crack occurs on this junction surface due to stress occurred by difference of linear expansion coefficients between aluminum wire and silicone chip. This crack develops and finally becomes a detachment (separated due to peeling) mode.

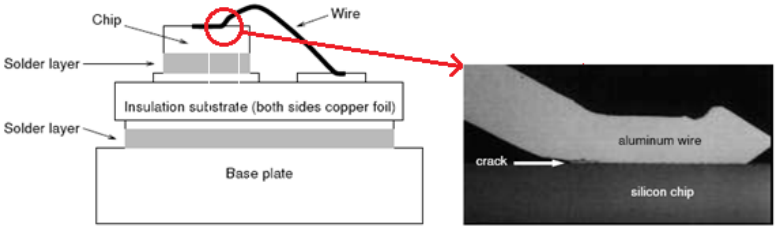

Fig. 2. Example of damage of fire by the power cycle test

In the condition that the change of junction temperature frequently occurs in the event that the case temperature of the module is relatively common in operation of the inverter, it is required to consider the destruction of power cycle in the phase of device design. Figure 2 illustrates the structure of general power module and the peeling photograph of the junction part by power cycle.

2.2.2 Failure Mechanism of Thermal Cycle

In the operation pattern that a large change of temperature occurs due to comparative gentle case temperature (Tc) of the power module by operation and stop of the system, a stress distortion occurs on the layer of soldering by difference of linear expansion coefficient between insulation plate and base plate in the module structure of Figure 2.

Crack occurs in soldering due to repeated stress as shown in Figure 3. If the increase of thermal resistance is resulted by that the crack develops by the bottom part

of power chip, ΔTj increases due to destruction of thermal urge or increase of thermal resistance and makes the inside quantity of power cycle fall down and finally reached to a wire detachment mode similarly with the life of power cycle.

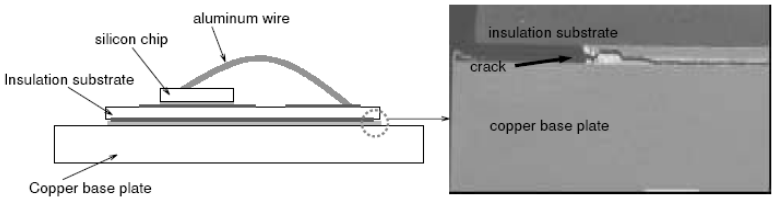

Fig. 3. Example of thermal cycle test

Figure 4 illustrates the test methods of the module suggested by Hitachi. All of them guarantee the use life by the width of change and the number of repetition of the temperature of the junction part. It needs estimation by loss of the junction part and equivalent circuit since temperature of the junction part is not measured.

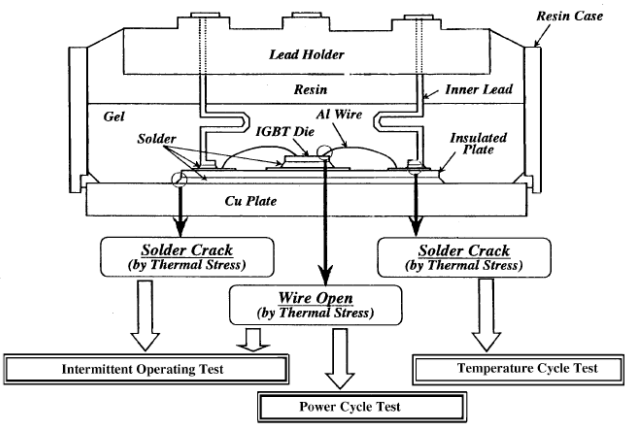

Fig. 4. Thermal stress test(Hitachi)

3 Proposal of Approximate Method

Power cycle is expected as Figure 5 for power semiconductor element regarding retrogression and braking of the inverter operating a traction motor.

3.1 Life of Power Cycle

The power semiconductor elements guarantee the life with the temperature change size and the repetition number of the junction part for the power cycle as shown in

Figure 3. The equation of a straight line in Figure 3 can be indicated as below and arranged as Equation (2).

$$\log N = -a \log (\Delta T_j) + b \tag{1}$$

$$(\Delta T_j)^a N = 10^b \tag{2}$$

If examining Equation (2), the repetition number, which is related with the life even though the temperature change size, ΔT_j of the junction part varies only lightly, largely varies. Since the repetition numbers, N of the temperature change, which is related with the ΔT_j and the life of the junction part in Figure 3, are based on the possibility, the need of accurate calculation is little. It is likely to use it as approximate use history of power element by a simple calculation if assuming that the change of ΔT_j is small through treatment as $\Delta T_{j1} \approx \Delta T_{j2}$ in respect of operation and braking of a traction motor.

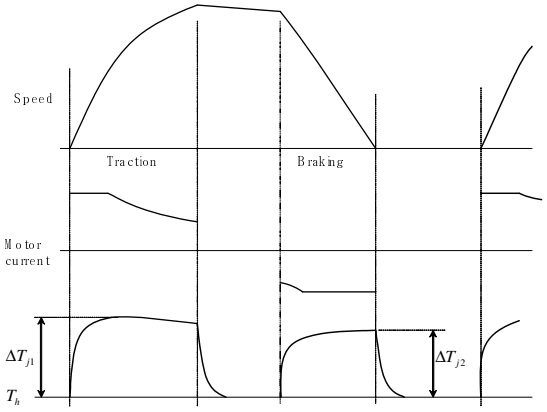

Fig. 5. Estimation of junction temperature in retrogression and braking

3.2 Calculation of Loss and ΔT_j

Figure 6 shows approximate voltage and current of the switching time for a phase composing the inverter.

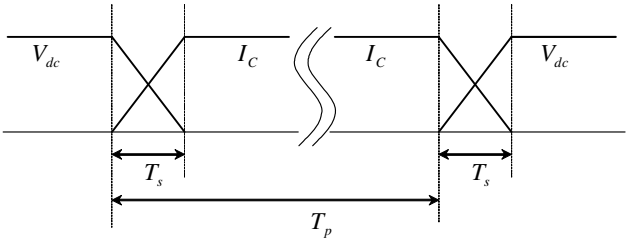

Fig. 6. Voltage and current in switching time

T_s representing that voltage and current changes in the switching moment of power element is shorter than turn-on or turn-off time, and is very shorter than PWM cycle ($2T_s$) for the power inverter used to operate the traction motor. Switching loss is calculated by equation (3) since it occurs in the T_s period in Figure 6.

$$\begin{cases} P_S = \dfrac{V_{dc} I_C}{T_P} \displaystyle\int_0^{T_\theta} at(1-at)\,dt \\ a = \dfrac{1}{T_S} \end{cases} \tag{3}$$

It is assumed that both voltage and current changed straightly in Equation (3), and switching loss becomes as below:

$$P_S = \frac{1}{6}\frac{T_S}{T_P} V_{dc} I_C \tag{4}$$

Since 2 power elements compose the phase, the loss per 1pc and the temperature change size of the junction part becomes as Equation (5) by Equation 3 and Equation (4).

$$\begin{cases} \Delta T_j = P R_{th(j-c)} \\ P = \dfrac{1}{2}(V_{CE(sat)} I_C + P_S) \end{cases} \tag{5}$$

If assuming that the maximum current of the motor is current of q-axis in the rated torque operation area and is a sine wave of current, average current conducting through a power element can be calculated as Equation (6).

$$\begin{cases} I_C = \dfrac{1}{2}\dfrac{1}{\pi}\displaystyle\int_0^{\pi} i_q \sin\theta\, d\theta \\ \quad = \dfrac{1}{\pi}|i_q|_{\max} \end{cases} \tag{6}$$

Since $T_\theta \gg T_s$ where the PWM cycle is sufficiently larger than T_s in Figure 6.,

$$V_{CE(sat)} \gg \frac{1}{6}\frac{T_S}{T_P} V_{dc} \tag{7}$$

if considering the above Equation (7), switching loss becomes smaller than turn-on loss. This condition calculates loss of power element only with turn-on loss in Equation (5).

$$\begin{cases} \sum \Delta T_j = \sum k\, |i_q|_{\max} \\ k = \dfrac{1}{2\pi} V_{CE(sat)} R_{th(j-c)} \end{cases} \tag{8}$$

4 Demonstration Test

Figure 7 shows accumulation results of ΔT_i as per Equation (8) depending on repetition numbers by using the data management program.

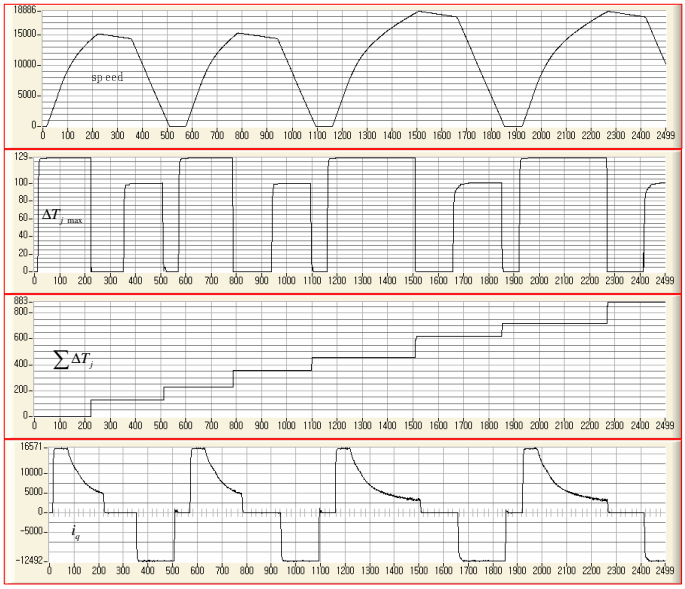

Fig. 7. Management and graphic of data

5 Conclusion

This study suggested the semi-conductor element history management system to previously interrupt the unstability of the system due to defect by managing the data to guarantee the stable operation of IGBS as a important key parts of the inverter and checked the results through the experimental system. The semi-conductor element history management system was designed to give unique ID to several inverters, record the accumulated operation environment to check and review them with graphs.

The management of use history of the inverter suggested in this study will be utilized as the concept to prevent failure if using the inverter in the methods or maintain or replacing it before the inverter is damaged by a fire. In addition, the suggested method will be widely applicable even to other power device or various types of semi-conductor switching elements.

It is thought that a study for a method to estimate and manage the degree of thermal stress along with the method suggested in this study must be performed.

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CSP Based Relation Structure for Social Network Service

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Abstract. Social networking sites (SNS) have infiltrated people's daily life with amazing rapidity to become an important social platform for computer-mediated communication. SNS provides a method of communicating, employing computers as a collaborate process to accelerate group formation and increase group scope and influence. Therefore it is important to identify and design their relation in SNS. In this paper, we make a human relation model for SNS considering each factor's correlation in social environment. The factors were Person, Interesting and Society. We also consider their behavior and interaction that person does to keep their relationship with their interesting and society. For this process, we use CSP that is well known in formal method to process analysis. And finally, we define person's relation and interaction in SNS using CSP.

Keywords: Manufacturing system, Fault tolerance, Reducing system jam, Dual CPU based process.

1 Introduction

"Cloud" computing has been receiving much attention as an alternative to both specialized grids and to owning and managing one's own servers. Currently available articles, blogs, and forums focus on applying clouds to industries outside of biomedical informatics [1].

As the same environment, social networking sites (SNSs) such as Friendster, MySpace, Facebook, Orkut, LinkedIn, and myriad others have attracted hundreds of millions of users, many of whom have integrated SNSs into their daily lives to communicate with friends, send e-mails, solicit opinions or votes, organize events, spread ideas, find jobs, and more. Facebook, an SNS launched in February 2004, now overwhelms numerous aspects of everyday life, and it has become an immensely popular societal obsession. Facebook members can create self-descriptive profiles that include links to the profiles of their "friends", who may or may not be offline friends. Facebook requires that anybody who wants to be added as a friend have the

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T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 163–170, 2012.

relationship confirmed, so Facebook friendships define a network (graph) of reciprocated ties (undirected edges) that connect individual users [2, 13, 14]. SNS is a cyber environment that allows the individual to construct his/her profile, sharing text, images, and photos, and to link other members of the site by applications and groups provided on the Internet. Hence, SNS enables users to present themselves, connect to a social network, and develop and maintain relationships with others. Users who propagate perceived benefit of use to their friends and relatives achieve network externalities, and positive feedback gives rise to larger expansion, which increases platform members. Facebook is an obvious example. Facebook statistics indicate that its global members have rapidly increased from 150 million to about 350 million between January and December 2009. Hence, network externalities not only increase its economic benefits, but also have significant effect on expanding social network potential. SNS service providers need to investigate the correlation between network externalities and individual motives to comprehend the concerns of users to attract them [3].

In this paper, we propose to make the relation structure for SNS. In order to make relation process in social environment, we use CSP (Communicating Sequential Processes). CSP, for instance, is a very attractive formalism to describe concurrent and dynamic aspects of computer systems. One of the fundamental features of CSP is that it can serve as a notation for describing concurrent and communicating processes at different levels of abstraction [4].

The rest of the paper is organized as follows. Section 2 presents related works such as cloud computing, SNS and CSP. Sections 3 propose human relation structure on SNS and Section 4 shows CSP process on SNS. Finally, Section 5 shows the conclusion for this paper.

2 Related Works

2.1 Cloud Computing

Cloud computing is attracting more and more users. In addition to the common customers from industry, researchers out of the scientific fields are also joining the Cloud world. The reason for the success of Cloud computing lies in its easy-to-use computing model and the benefits it brings to the users. We see the following features from Cloud computing:

- Elasticity. Cloud computing provides users with the flexibility in the amount of requested resources, e.g. size of the storage and number of the processors/machines. This feature is rather helpful for scenarios like “Web service operators need to add or remove servers depending on the number of users”.
- Economy. In Cloud computing, customers pay only what they used. For small companies or research groups, the cost for using Cloud resources can be much cheaper than investing and maintaining an own local system.

- Reliability. Cloud systems are fault tolerant and the services on them are highly available.
- On-demand. Cloud computing provides users with customized environments that are tailed to individual requirement. This feature is more user friendly than Grid computing where the application has usually to be adapted to the target architecture.

Over the last years, a number of Cloud infrastructures have been built. Well-known examples include commercial products like Amazon EC2, Google App Engine, Microsoft Azure, salesforce.com, OpSource, Zimory, as well as research systems such as Nymbus, Cumlus, Eucalyptus , and OpenNybula. These Clouds provides different services. Based on the common definition for Cloud and its services, existing Clouds can be categorized into three classes: Infrastructure as a Service (IaaS), Software as a Service (SaaS), and Platform as a Service (PaaS). IaaS-Clouds provide the users with on-demand hardware, normally virtual machines, for them to run their applications. SaaS-Clouds present users' software as Web services so that the software can be shared and the user is released from the task of maintaining a local copy. PaaS-Clouds provide both SaaS and the hardware to run the web services. Independent of the individual service, existing Cloud infrastructures are generally gaining more and more users [5]. Fig. 1 is an example of what is meant by a federated Cloud structure mediated by brokers. The figure shows two independent Clouds, each supporting a vertical stack of service layer offerings from the (SaaS or AaaS) layer at the top, through the middleware or PaaS, to the operating system and infrastructure layer (IaaS). At each layer a choice is made to fulfill a service request through local resources using delegation, or by a partner cloud through federation [6].

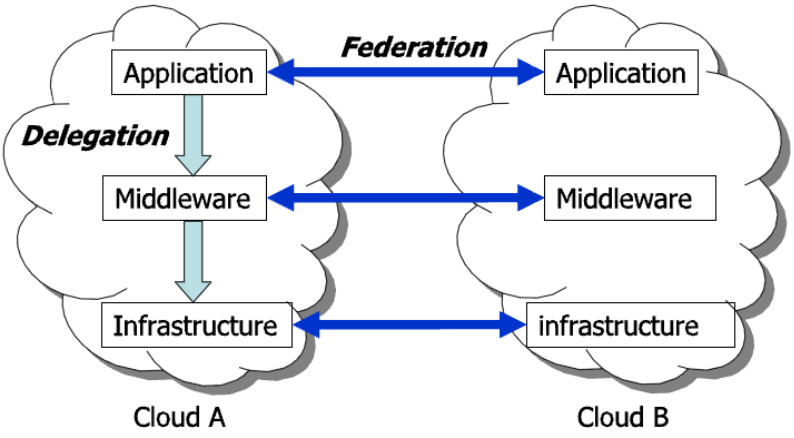

Fig. 1. Federation and delegation in Cloud application

2.2 SNS

Social network services have become tremendously popular in recent years. The popular network services such as Myspace1 and Facebook2 allow users to post useful

information and resources and to share those with their social friends. Millions of users are active daily in these services, creating and sharing rich information online that has not previously been available. As well as finding the most attractive and relevant information, users struggle with a great challenge in determining information sources such as like-minded users, reliable social friends, and communities of the same interests. This challenge has led a substantial number of diverse applications to concentrate on social network analysis in order to achieve the full potential offered by social network services [7].

The notion of social network, coined by Barnes [8], denotes a description of the underlying patterns of social structures. Social network theory models persons as nodes of a graph and their relation-ships as 'ties' connecting the nodes. Two friends who are directly connected are one link away from one another; a friend of a friend is two links away. In this way, all relationships of individuals can be modelled as paths on the graph. It has been found by experiment that anyone can be connected to another one on the planet through a short chain of acquaintances, typically consisting of no more than five intermediaries [9]. Pasquale et al., [10] shows the relationship on the social networking as shown in Fig 2.

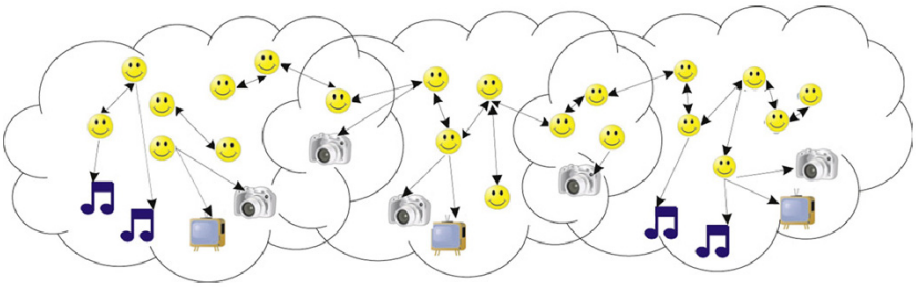

Fig. 2. A Social Internetworking System as a set of "clouds"

2.3 CSP

Most popular formalisms in existence can be divided into two different categories: state-based formalism (e.g. Z, B and VDM) and behavioral formalism (e.g. CSP, CCS and Lotus). State-based formalism explicitly defines data states, leaving temporal ordering of operations implicitly specified. Behavioral formalism elaborates mainly on the temporal ordering of actions with no explicit description of data states [11]. CSP or Communicating Sequential Processes is a well-known process algebra typifying the event-based approach to concurrency, in which a process is characterized entirely by its externally observable possible patterns of interaction with its environment via shared primitive events drawn from a specified alphabet of possible such events. In CSP the observer is deemed to be concerned by safety and liveness properties of his system, so his observations are therefore confined to any or all of the following: [12]

- ***traces***, a trace being any particular sequence of events in which the process is observed successively to engage;

- ***failures***, a failure being a trace leading to *a refusal set, i.e.* a given set of events simultaneously proposed by the environment in each of which the process refuses to engage;
- ***divergences,*** a divergence being a trace after which the process becomes unstable by being as it were *livelocked* in an endless succession of hidden internal events so that no further meaningful observation of trace or refusal behavior is possible.

3 Human Relation Structure for SNS

This research aims to make a relation structure for social network service. Also the research was considered the correlation between human and human, their interesting and behavior. The structure can be depicted as shown in Fig 3.

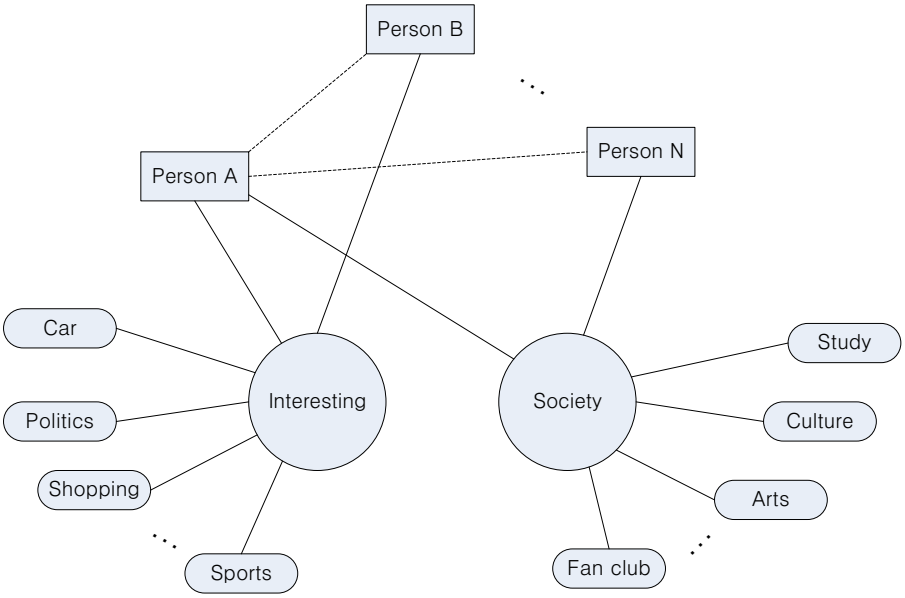

Fig. 3. A human relation model for Social Network

In this structure, the human factor which is described by *Person A* to *Person N* intends to correlation with other person and they have behavior in the relation such as interesting and society. Interesting has many factors such as *Car, Politics, Shopping and Sports.* Also *Society* has same things such as *Fan club* for actor or actress, *Arts, Culture and Study*. The *Person* has the characteristics as shown in Table 1. The *Person* factor consists of 3 items: *Personality, Interesting and Society*. Especially, *Personality* means much closed personal information such as name, gender, address and so on.

Table 1. Person's characteristics

Item	Sub-item
Personality	Name
	Gender
	Address
	Telephone
	Email
	Educational level
Interesting	Hobby
	Politics
	Shopping
	Sports
Society	Fan club
	Hobby club
	Friends

4 CSP Approaches Analysis and Design

The communication behavior can be calculated by formal method. In this paper, we design and analyze the relationship between a person and other person, person and interesting or society. Let's P_1, P_2, …, P_n means *Person* factor. Then we can define the person's relation as below.

Definition 1 (person's relation). *P_1, P_2, …, P_n, is a Person factor. He/she can have relation to other Person.*

$$P1 \parallel P2,\ P2 \parallel P3, \ldots,\ P1 \parallel Pn$$

$$\prod_{i=1}^{n} P_i \,||\, \left\{ \prod_{j=1}^{m} P_j \right\}, i, j = 1..n, i \neq j$$

That is, P_1 is able to have other person $P_{2..n}$.

Definition 2 (interaction). when a_i *and* b_j *are interaction between Person and Interesting (Society), we can describe their interaction as below.*

$(a_i : P_i \rightarrow I(a_j))$ = JOIN from P_i ($Person_i$) to I_j ($Interesting_j$) *if* $i \neq j$
$(a_i : P_i \rightarrow S(b_j))$ = JOIN from P_i ($Person_i$) to S_j ($Society_j$) *if* $i \neq j$

Then interaction with Interesting and Society can be
$(a_i : P_i \rightarrow I(a_i)) \parallel (a_i : P_i \rightarrow S(b_j))$ = INTEACT with Person, Interesting and Society *if* $i \neq j$

By this definition, we make a relation model between *Person* and *Interesting*, *Society*. Fig 4 shows the CSP based human relation model for SNS. Person has correlation to other person according to their interesting or joins the society or a club.

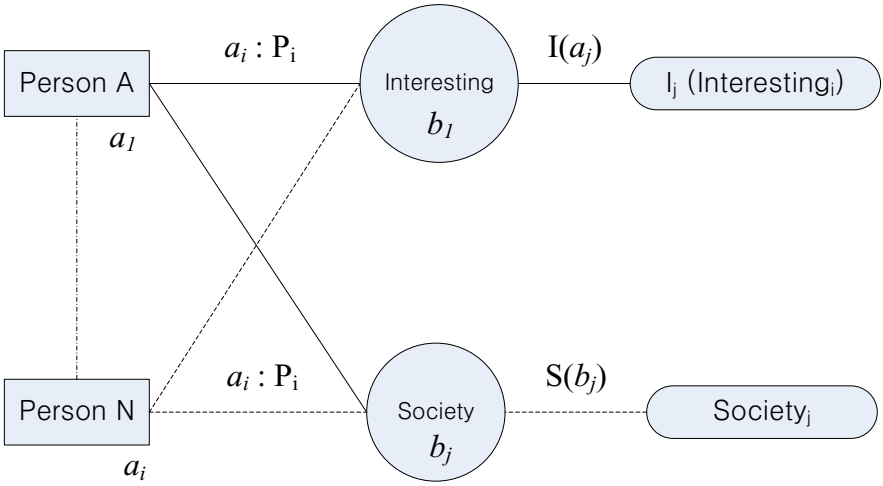

Fig. 4. The CSP based human relation model

5 Conclusion

Social Network Services (SNS) have become popular and have spawned a whole new subculture. In SNS, person is able to have and keep their relationship according to their interesting or society that he/she is in.

In this research, we make a human relation model for SNS. Human, a person has their relationship for their interesting or society in virtual world, social network. In this point, we consider correlation between their behavior to keep their relationship in order to design and analyze our relation model. For this process, we use CSP that is well known in formal method to process analysis. The factors were *Person, Interesting and Society*. And finally, we define *person's relation* and *interaction* in SNS using CSP.

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Service Based Software Fault-Tolerance for Manufacturing System

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Abstract. Manufacturing system consists of many components such as robots, motors, cylinders and sensors. It also operates in poor environment in the factory. Worst thing is, it is difficult to control, manage and repair the system for system engineer when the manufacturing system has jam or error. Because the system engineer stay hard always beside the manufacturing system. Therefore automatic recover system is necessary. In this paper, we propose web based software fault-tolerance for manufacturing system. Due to use the web service, the system use UDDI server. The Manufacturing service system that is to provide system software consists of 4 programs; Operating program, Control program, Management program and Fault-Tolerance program. Especially Fault-Tolerance program provide the system recovery process as a service to the manufacturing system at the distance location. It performs the automatic recover process when the manufacturing system has the jam or error.

Keywords: Manufacturing system, Fault tolerance, Reducing system jam, Dual CPU based process.

1 Introduction

In recent years, an increasing demand for customized products has caused a drastic increase in the number of options and product variations. Traditionally, the product variety demanded by customers has been produced in a job shop or small batch operation. However, because of low productivity and high production cost, job shop facilities usually are not suitable for large-volume production [1]. On the other hand, the actual manufacturing process is carried out, and various software systems have been introduced to support the engineers. But, it is still true that the manufacturing knowledge that is formed and maintained principally among the engineers on the shop floor is still indispensable for their operations. The main reason for this is that programs implemented in the systems do not model the physical manufacturing process with the precision of practical application. The actual manufacturing process is very complex and includes some uncertainty such as unevenness of work-piece

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T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 171–178, 2012.

material [2]. Therefore the operational and control software for manufacturing system should be perform in poor surroundings of the factory. Also it can easily occur something error or unknown system jam during their system running.

The software fault-tolerant can be solution for this problem. From the perspective of software engineering, which strives to build software systems that are free of faults, the architectural consideration of dependability compels the acceptance of faults, rather than their avoidance. Thus the need for novel notations, methods and techniques that provides the necessary support for reasoning about faults at the architectural level. For example, notations should be able to represent non-functional properties and failure assumptions, and techniques should be able to extract from the architectural representations the information that is relevant for evaluating the system architecture from a certain perspective [3]. Fault tolerance (FT) is often discussed as an important consideration in modern high-performance computational science and engineering (CSE). Starting recently, the growth in the computational capabilities of high-end systems now comes almost entirely from increasing the number of processors, and concerns about fault tolerance are exacerbated. Today's largest (petascale) systems report mean times between failures (MTBFs) in the range of a few days. Planning for the first generation of exascale machines suggests that maintaining failure rates at this level will be challenging, requiring significant new efforts on fault tolerance throughout the system [4].

In this paper, we propose fault tolerance of software side for manufacturing system. The main purpose of our software fault tolerance is to provide automatic recovery process to the manufacturing system immediately without system engineer when manufacturing system has jam or something error. Also the fault tolerance process is based on web service over the internet. All the recovery process as a service located in the manufacturing management server and it performs to call recovery service process when the system has error.

In Section 2 of this paper, we describe the related works for manufacturing system, fault tolerance and Web service. Then in Section 3, we present the manufacturing system environment with web service and the fault tolerance architecture. In Section 4, conclusions are drawn.

2 Related Works

2.1 Manufacturing System

Manufacturing is global. In fact, international business activity is not a recent phenomenon. It can be traced as far back as the late 19th century when the onset of the industrial revolution resulted in the need for large-scale operations [6]. Manufacturing systems are classified in terms of the physical machine arrangement. A production job shop is a manufacturing system in which machines are grouped by function (e.g., turning dept, milling dept., etc). Transfer lines, group technology cells and lean, linked cell manufacturing systems are established so that machines are arranged based on product flow. The best known fixed manufacturing system is still the transfer line. A manufacturing system is not unique from a design point of view. It

is a subset of general engineering systems. Therefore, the general methodologies developed for system design should equally apply.

A manufacturing system is also a subset of an entire manufacturing enterprise. Manufacturing enterprises consist of people, “things”, and information. People are deployed to perform various functions such as marketing, design, purchasing, inventory control, inspection, machining, management, safety, service, and security. “Things” range from factories, to machines, materials, transporters, computers, warehouses, vendors of components, and utilities. Information is related to marketing requirements, product design, manufacturing systems and operations, manufacturing processes, human resources, supplier chain systems, and general management. All these elements constitute part of the manufacturing enterprise and thus, the design of manufacturing systems is regarded to be complex.

A manufacturing system - a subset of the production system - is the arrangement and operation of elements (machines, tools, materiel, people and information) to produce a value-added physical, informational or service product whose success and cost is characterized by the measurable parameters of the system design. The specific combination of a manufacturing system's elements is predicated by the functional requirements (FRs) placed on the manufacturing system [5].

Over the years, the nature of these operations has changed significantly. The changes can be attributed mainly to the variations at the level of trade barriers and the development of more efficient modes of transportation and communication that have made possible a higher level of coordination. Moreover, during the last few decades the level of innovation has dramatically grown to such an extent that, in order for firms to be familiar with the best products, processes, materials and technologies, they must have access to international operations in all three major industrial centres of the Triad: Western Europe, North America, and Japan as well as the Far East countries [6].

Fig. 1. Example of manufacturing system

Fig 1 shows an example of manufacturing system. The system composed lots of motors, cylinders and sensors. Monitoring system can help to control the machine from system engineer [7].

2.2 Fault Tolerance

Fault tolerance aims to avoid system failure via error detection and system recovery. Error detection at the architectural level relies on monitoring mechanisms, or probes, for observing the system states to detect those that are erroneous at the components interfaces or in the interactions between these components. On the other hand, the aim of system recovery is twofold. First, eliminate errors that might exist at the architectural state of the system. Second, remove from the system architecture those elements or configurations that might be the cause of erroneous states. From the perspective of fault tolerance, system structuring should ensure that the extra software involved in error detection and system recovery provides effective means for error confinement, does not add to the complexity of the system, and improves the overall system dependability [3].

Gupta et al., [8] proposed a schematic of the architecture of the Fault Tolerance, as shown in Fig 2.

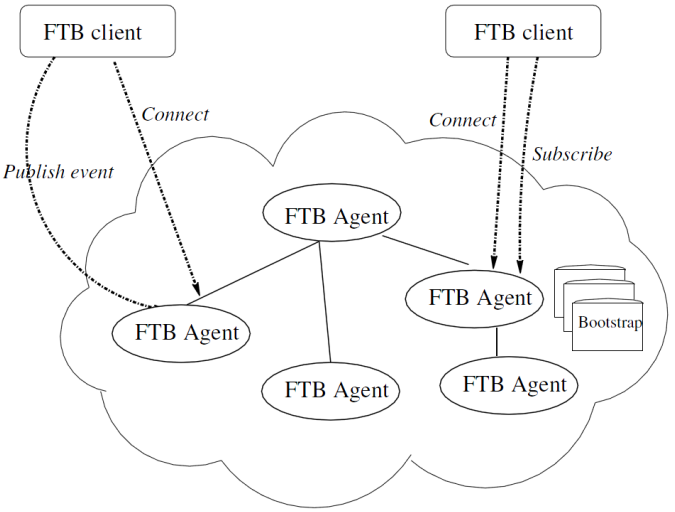

Fig. 2. A schematic of the architecture of the Fault Tolerance. FTB means Fault Tolerance Backplane.

Since fault tolerance has a global system scope, it should be related to both architectural elements (components and connectors) and architectural configurations. However, the incorporation of fault tolerance into systems normally increases their complexity, making their analysis more difficult. One way of handling the inherent complexity of fault-tolerant systems is to adopt architectural abstractions. These are

able to hide system complexity, and provide the means for analysing how errors are propagated, detected and handled, and how faults in the system are handled [3].

2.3 Web Service

Service-oriented architectures (SOAs) provide an architectural paradigm for software development. Systems can be organized in terms of services units of software that provide functionality 'as is' to users. Functionality descriptions and other properties and quality attributes such as security or performance and usage-oriented information such as invocation protocols and locations are advertised by providers and can be looked up by potential users [9]. Web services provide a paradigm for developing Internet-based applications using standard technologies and protocols such XML, SOAP, WSDL and UDDI among others. Web services are used in developing and integrating collaborative applications, business applications, e-government systems. The wider application of Web services in different domains is due to their support for high level of interoperability using widely used protocols and technologies such as HTTP, WSDL, SOAP and UDDI [10]. Claus and Yaoling [9] proposed web service deployment platform as shown in Fig 3.

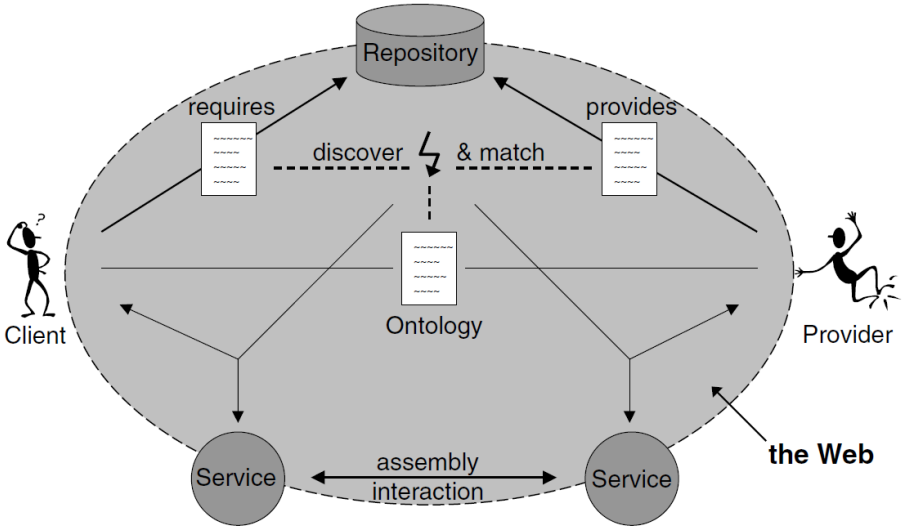

Fig. 3. The Web as a Service-oriented Development and Deployment Platform

3 Service Based Fault Tolerance for Manufacturing System

In this research, we propose software fault tolerance for manufacturing system. The system architecture is as shown in Fig 4. This system has *Manufacturing service system, Manufacturing Hub and Manufacturing management system*. In the factory, there are many *Manufacturing management system* that is to control and manage the manufacturing system practically. This system operates the process which is in web

service. Therefore the *Manufacturing service system* has real business logics to operate, control and manage the manufacturing system in the factory at distance location. The system engineer can access to use whole process as a service after find the manufacturing web service's information in UDDI server. The UDDI server has whole meta data for manufacturing web service.

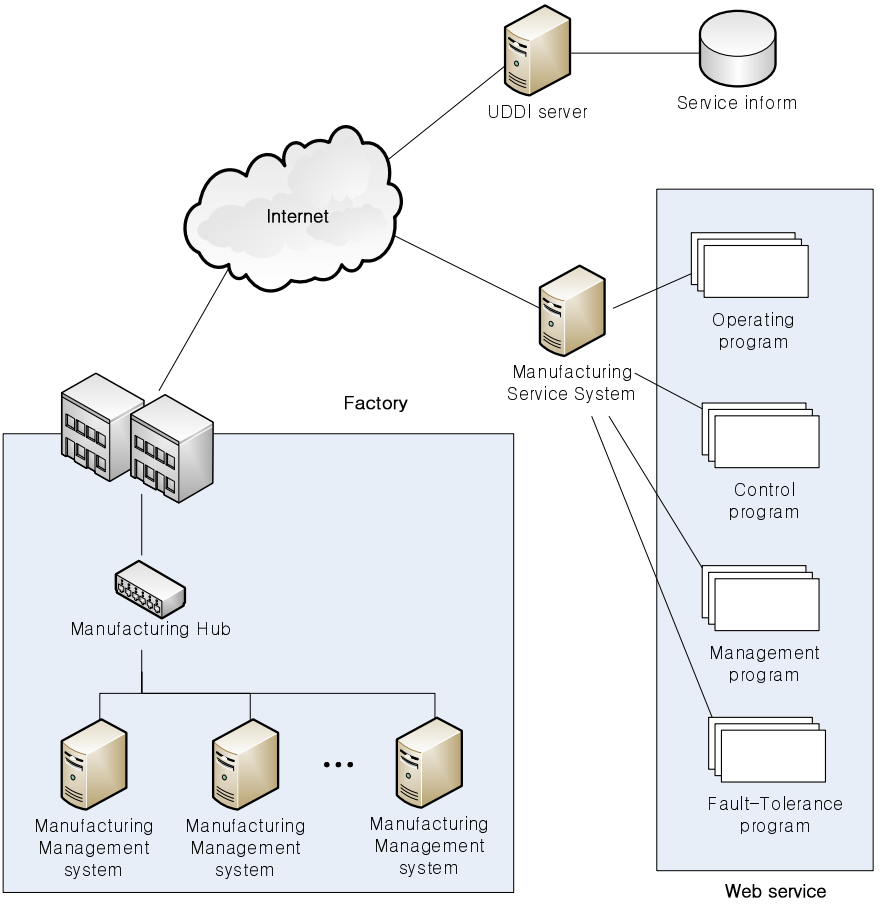

Fig. 4. Proposed system architecture for manufacturing system with web service

Fig 5 shows manufacturing web service's ontology in side of manufacturing service system. The service consists of 4 programs; *Operating program, Control program, Management program and Fault-Tolerance program*. The *Operating program* deals with process to remote control the machine such as Start, Stop, Emergency stop and so on. The *Control program* performs control process to actuators such as robot, sensors, cylinders and motors. In order to calculate Production yield according to good or bad product devices, maintenance time between stop and start the machine, MTTR (Mean Time To Recovery) and, MTTF (Mean Time To Failure), *Management program* was performed. Finally,

Fault-Tolerance program has many processes such as get system error information, Analyze error occurrence that is to search the system jam point in the machine, Repair system jam, System data backup and Load system setting that is to load setting value for the system recovery.

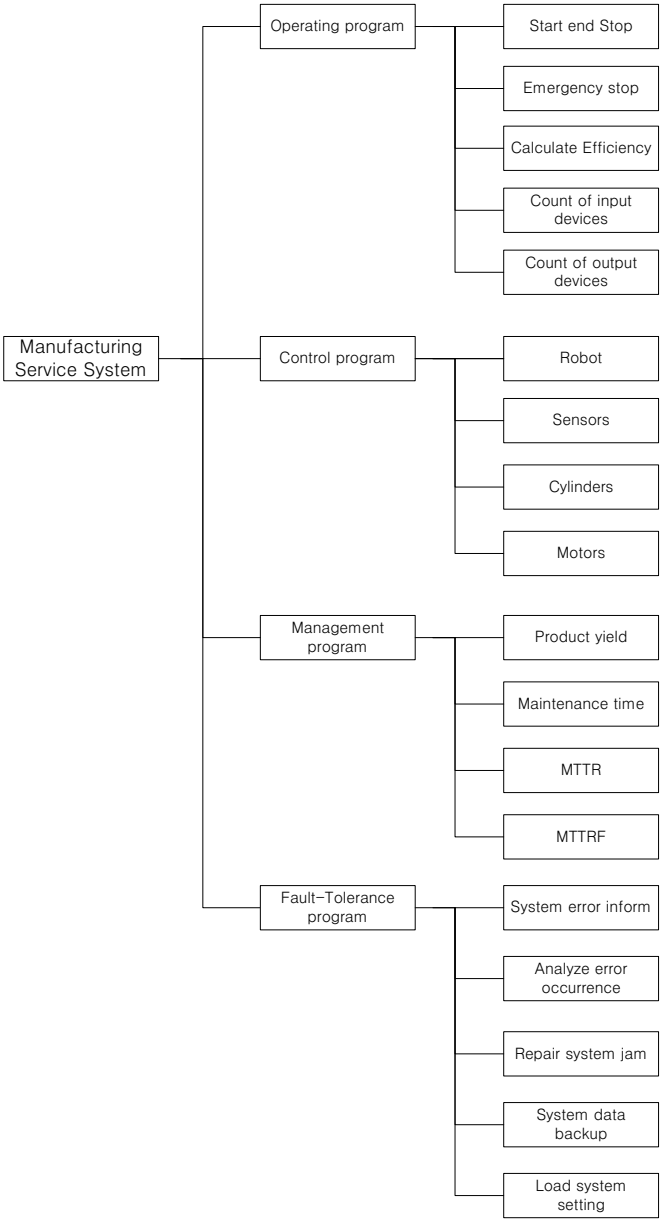

Fig. 5. Proposed system architecture for manufacturing system with web service

4 Conclusion

In this paper, we make web service based software fault-tolerance that is to automatic recover the manufacturing system at the distance location. Due to use the web service, this system use UDDI server. And whole system software is located in *Manufacturing service system*. The *Manufacturing service system* consists of 4 programs; *Operating program, Control program, Management program and Fault-Tolerance program.* Especially *Fault-Tolerance program* that is our proposed service logic provide the system recovery process as a service to the manufacturing system at the distance location. It performs the automatic recover process when the manufacturing system has the jam or error.

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A Study on Industry-University Collaboration Schemes for the Improvement of Urban Convergence Contents Industry

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Abstract. The cultural contents industry is related to the consumers' sensibilities. At the turn of the 21st century, its importance to all industries gradually increased, and each country separated it as cultural technologies and fostered it intensively. The cultural contents industry creates added value in itself, but it can also create value as a new urban industry through convergence and integration in mutual association and exchanges. Thus, the growth potential of the cultural contents industry can be said to be very high.

This research was conducted to examine the current conditions of the cultural contents industry in the Seoul metropolitan area, and to conduct a survey among the related enterprises on the industry-university collaboration program, particularly with regard to their participation in the program, the degree of their satisfaction with it, the demand for it in the industry, and the difficulties they have encountered while participating in the program, and to establish and recommend the effective project performance and direction for the development of the urban convergence contents industry.

Keywords: Industry-University Collaboration, Urban Convergence Contents Industry, CT.

1 Introduction

The contents industry is the core growth engine industry that is expected to lead South Korea's service industry, the future high-growth, high-value-added industry. As its importance is steadily increasing, the Ministry of Culture, Sports, and Tourism established the pan-government Contents Industry Promotion Basic Plan to cope with the rapid development of IT technologies and the changes in the contents industry paradigm [1, 2, 5]. Simultaneously, the government is promoting support policies in diverse fields to reinforce the industry-university collaboration and the industry-university collaboration leading model for the purpose of raising and vitalizing the industry-university outcomes. The importance of industry-university collaboration as a way of cultivating talented persons who will lead the next-generation technological

T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 179–186, 2012.

innovation, who will be responsible for the competitiveness of the country's enterprises and of the country itself, and who will support the development of the regional economy, is increasing [3, 4].

Thus, this research analyzes the policies related to the contents industry as well as the current conditions and trends in such industry in South Korea and abroad, and explores and presents development schemes through which the industry-university collaboration can be further vitalized, by conducting a questionnaire survey among enterprises related to cultural contents located in the Seoul metropolitan area, including Seoul, Gyeonggi, and Incheon, where the enterprises were asked about the effectiveness of the industry-university collaboration, the obstacles to participating in the industry-university collaboration program, and the support needed by the program. Further, this research raised the practicality of the industry-university collaboration development schemes by gathering and presenting the candid views of the cultural-contents-related enterprises regarding such matter.

2 Cultural Contents Industry Policy Trends

2.1 Current Conditions of the Contents Industry Support Policy

The South Korean government recently established a CT (culture technology) R&D basic plan, expanded the CT R&D area, established the pan-government Contents Industry Promotion Basic Plan to cope with the rapid development of IT technologies (e.g., "making things smart") and with the changes in the contents industry paradigm, and is exerting continuous and diverse efforts to establish a digital-convergence-type contents support system and to vitalize digital-friendly CT technological development [2].

The major results of the cultural contents industry promotion policy can be said to be market size expansion and employment and growth foundation creation. First, regarding market size expansion and employment creation, as shown in the following table, the average annual growth rate of the contents industry is 3.7%, and according to the Contents Industry Promotion Basic Plan, despite the overall rise of the unemployment rate, employment was created for 26,000 persons in 2008-2009.

Table 1. Sales Increase Trends of South Korea's Contents Industry

(Unit: billion won, %)

Classification	2006	2007	2008	2009	2010 (p)	Average Annual Growth Rate
Contents industry sales	62,768.5	64,414.4	66,012.6	69,000.4	72,537.8	3.7

Source: Ministry of Culture, Sports, and Tourism, 2010 Contents Industry White Paper, Aug. 2011.

To build the growth foundation for the country's contents industry, the pan-government contents promotion policy was promoted through the selection of the 17 biggest new growth engines (Jan. 2009), the enactment of the Contents Industry Promotion Law (June 2010), the formulation of contents industry nurturing strategies (Apr. 2010), the establishment of the Contents Industry Basic Plan (May 2011), and

the establishment of the foundation for the systematic nurturing of the contents industry. Moreover, to create the environment of vitalizing creation activities, the investments in such areas as financing for contents enterprises, R&D, and story basis were expanded.

2.2 Contents Industry Promotion Basic Plan

The Contents Industry Promotion Basic Plan was established to build the foundation for the development of the next-generation contents industry, including the creation of an industrial ecosystem in which contents, equipment, and services are to coexist, cooperate, and develop based on the country's cultural potentials and the world's highest IT competiveness. The contents industry, amid the 3D- and smart-oriented environment, is becoming globalized.

This plan contains five core promotion strategies that include the vision of the Contents Industry Promotion Basic Plan (a three-year medium- and long-term basic plan related to the promotion of the contents industry in accordance with Article 5 of the Contents Industry Promotion Law), the creation of a pan-national contents industry nurturing system by materializing "Smart Contents Korea," job creation for young people by raising the national creativity, expansion of the advance into the global market, creation of a win-win growth ecosystem, and reinforcement of the core foundations of production, distribution, technologies, and the 15 priority tasks [1, 2].

3 Questionnaire Survey

3.1 Survey Summary

A survey was conducted among enterprises related to cultural contents to investigate their participation in the industry-university collaboration program, their intent to participate in the program, the degree of their satisfaction with the program, the difficulties they have encountered while participating therein, and the demand for manpower, and to establish a more advanced industry-university collaboration system. The subjects of this research were the representative directors and board members of enterprises related to cultural contents, and the valid samples in the survey, which was conducted for three weeks from January 18, 2012, were 125 enterprises.

3.2 Results of the Survey

(1) **Necessity of the industry-university collaboration projects**

With regard to the necessity of the industry-university projects, the responses "very necessary" and "necessary" accounted for 89.8% of all the responses, showing that most enterprises considered the system necessary.

(2) **Intent to participate in the industry-university collaboration program by area, and reasons for the low intent to participate in the program**

The results of the examination of the average response scores (5-point scale) for the intent to participate in the program showed that the score in the case of "internship of the unemployed" was the highest (4.205 points), followed by

"utilization of university equipment" (4.158), "participation in technological development tasks" (3.991), "participation in industry-university collaboration associations" (3,931), "transfer of technologies and contents in possession" (3,921), and "employee education" (3,913). On the other hand, the intent to participate in the "professors working for enterprises" program was found to be low, and 66.7% of all the respondents answered that this is because they fear they might leak the company's confidential information.

(3) **The program considered most effective among the industry-university collaboration programs**

The program considered most effective among the industry-university collaboration programs currently being operated by some universities was found to be "participation in the development of technologies" (R&D task), which accounted for 47.2% of all the responses, and the second and third most effective programs according to the respondents were "technology instruction" and "support for technological difficulties," accounting for 25% of all the responses, respectively. "Utilization of university equipment" was also considered highly effective.

(4) **Reasons for the difficulty of developing technologies**

For the reasons for the difficulty of developing technologies, most of the enterprises cited "R&D manpower shortage" (38.4%), followed by "uncertainty of whether the development was successful" (19.2%) and "shortage of resources for activities" (18.4%), the latter likely referring to the shortage of human and material infrastructure in technology development.

(5) **Reasons for the satisfaction/dissatisfaction with the manpower trained through industry- university collaboration**

The average response score (5-point scale) for the degree of satisfaction felt by the enterprises (n=108), which had their manpower trained through industry-university collaboration (e.g., internship, specialized major), was found to be 2.851, close to dissatisfaction. As the reason for this, most of the enterprises (94%, the absolutely highest percentage) cited "shortage of a positive mindset (entrepreneurship)." Accordingly, there is a need to amend the college educational curricula based on this consideration.

(6) **Contents to be dealt with in the college education for training talented persons**

For the contents (open questions, multiple responses, n=31) that should certainly be dealt with in the college education for training talented persons through industry-university collaboration, most of the respondents cited "character (entrepreneurship)," accounting for 41.9% of all the responses, followed by "specialized (in-depth) technologies in the applicable field" (32.3%).

(7) **Convergence technology fields that need to be nurtured, and curricula that need association with the future expansive industry-university collaboration**

To the questions (multiple responses, n=168) about the convergence technology fields that need to be nurtured, most of the respondents answered "3D cubic

technology" (37.5%) and "CG special effects" (20.8%), and to the questions (multiple responses, n=203) regarding the curricula that need association with the future expansive industry-university collaboration, 30.0% of all the respondents answered "multimedia engineering," followed by "computer engineering" (26.1%) and "information communication engineering" (15.8%).

(8) **Projects that should be promoted to strengthen industry-university collaboration**

To the questions (multiple responses, n=271) about the domain and role of Dongguk University in the intensive promotion of the vitalization of the industry-university collaboration with family companies, 33.2% of the respondents answered "support for R&D capabilities," 26.9% answered "providing information about the government's support projects and joint preparations," and 24.4% answered "strengthening the industry-university association (technology exchanges, vitalizing family companies, etc.).

(9) **The path of enterprises' manpower employment**

To the question about the employment path (multiple responses, n=123), 37.4% of the respondents answered "Internet job listing sites," 21.1% answered "job placement organizations," and 19.5% answered "school or private educational institutes."

4 Development Strategy for Industry-University Collaboration

4.1 Strengthening the HUB Function of Industry-University Collaboration

The government will install an industry-university collaboration group within the university, will reinforce its function as the industry-university collaboration general organ, will reestablish its position as a major organ that is a separate entity within the university, and will raise its professionalism by expanding the employment and nurturing of regular professionals. Accordingly, it is necessary to consider integrating the separate industry-university collaboration organizations within the university so that in the industry-university collaboration group, virtuous circles from the technology development and training manpower for the establishment of technology projects, employment, and startup businesses can be formed. It is also necessary to reinforce the function of the industry-university collaboration group so that it can reinforce the overall adjustment of the industry-university collaboration, startup business education, and support.

4.2 Strategic Management of University Resources

For the university to be reborn as the source of knowledge production and technological innovation, it needs to establish an entrepreneurial university model not only through the traditional role of education and researches but also through industry-university collaboration, and for realistic industry-university collaboration, universities need a strategic technological management system.

It is also necessary to form close relations between researchers and the university, and to prepare and execute long-term research promotion plans based on the principles of choosing and concentration. For the successful operation of Dongguk University Technology Holding Company, an educational foundation, strategic management of the human resources and technologies owned by the university is primarily required.

4.3 Expansion of Opportunities for Industry-University Interchange, and Industry-University Cooperation in and Expansion of the Joint Development of Original Technologies

The need to resolve the country's urgent problems, such as the continuous decline of the country's potential growth rate, the increase in unemployment among young people, and the need to reinforce the country's competitiveness so that the country's economy would become an advanced one, is making open innovation through industry-university collaboration increasingly important. The university should enhance the outcomes of its technology transfer through the expansion of the opportunities for exchange and cooperation among the people in the university and industries, such as expansion of the extensional and qualitative levels of enterprises connected with the university, industry-university cooperation conferences, and industry-university seminars and forums, and should reinforce its demand-oriented R&D and manpower training capabilities.

The most efficient way to achieve the foregoing is considered to be the expansion of the joint development of original technologies. Further, the industry-university collaboration group needs to investigate the enterprises' continuous demand for technology through the reinforcement of the related industry-university collaboration network and the vitalization of the technology transfers to enterprises.

4.4 Customized Manpower Training for Industrial Circles

In the educational and manpower training area, among the various forms of industry-university collaboration of universities and enterprises, the government reflects the establishment and operations of curricula for the university's field-oriented and practical business manpower training as the item related to industry-university collaboration on the public notice of the university information. Moreover, it demands convergence curricula that include the existing research-oriented natural sciences and engineering fields as well as the humanities and arts and sports fields, and explores, develops, and cultivates creative talents through such convergence studies.

In the results of the questionnaire survey conducted in this research, however, the participation rate was low in "employment-linked specialized studies" (0%), "capstone designs" (2.8%), "work experience credit system" (8.2%), and "internship of the unemployed" (10.9%). The degree of satisfaction with the manpower trained through industry-university collaboration was also low, with an average response score (5-point scale) of 2.851 points, showing near dissatisfaction. As such, there is an urgent need to prepare improvement strategies.

Accordingly, it is necessary to reorganize the customized manpower training system for industries within the university into a more practical-business-type system.

Thus, it is necessary to promote the establishment of employment-condition- and reeducation-type contract studies, which are practical-business-type job training courses, by entering into agreements with the government, local autonomous entities, and industries for the procurement of additional funding, the cultivation of good students, and raising the university's employment figures, and it is necessary to urge enterprises to participate in establishing a department for such studies, selecting teaching staff, and even establishing the relevant curricula.

4.5 Increase in the Degree of Technology Development Infrastructure Utilization

According to the results of the questionnaire survey conducted in this research, 16.2% of all the respondents indicated that they participated in "university equipment utilization" in the items of participation in industry-university collaboration, and in the intent to participate, it was highly cited, next to "internship of the unemployed." It also ranked a relatively high third in the investigation of the order of the program items. Accordingly, the university should pursue the development of an efficient system of utilization of the existing technology development infrastructure and of a promotion system for such. In the long run, it should reinforce the R&D capabilities of industry-university collaboration by expanding the degree of utilization, such as expansion of the technology development infrastructure and vitalization of industry-university collaboration laboratories.

5 Conclusion

The results of the questionnaire survey on urban enterprises related to industry-university collaboration showed that most of the respondent enterprises consider industry-university collaboration projects necessary. As such, it is necessary to continue to promote such projects. Further, many industry-university collaboration programs with a high intent to participate were found, such as "internship of the unemployed," "university equipment utilization," and "participation in technology development tasks."

It was found, however, that the degree of satisfaction of the respondent enterprises with the manpower produced through industry-university collaboration programs such as internship and specialized major curricula was low. The enterprises cited "shortage of a positive mindset (entrepreneurship)" as the reason for this. It is thus necessary to supplement the programs by conducting education on the manpower expected to participate in the programs. Also, to narrow the qualitative gap in the demand and supply of manpower between industries and universities, the implication that university educational programs and systems should be improved so that practical-business-type manpower can be cultivated was derived.

It was found that the respondent enterprises' participation rate in "patent and intellectual property rights education" was considerably low, but as it was considered that the government plans to vitalize the reinforcement and use of copyright protection for the steady growth of the contents industry, and to continuously reflect this in its policy direction, it is necessary to raise the participation rate through the

active promotion of technology development and education programs related to the reinforcement of copyright protection.

It was also found that the respondent enterprises' employment path was the use of Internet job listing sites (37.4%) while the use of schools and private educational institutes showed a relatively low degree of utilization (19.5%). These problems should be addressed by introducing a university talent pool system or a work experience registration system. To reinforce the industry-university collaboration capabilities, the reinforcement of the HUB functions of the industry-university collaboration group, the raising of its position and professionalism, the strategic management of university resources, the expansion of the interchange between industries and universities as well as of the cooperation opportunities between them, the expansion of the joint development of original technologies between industries and universities, customized manpower training for industrial circles, and the expansion of the degree of technology development infrastructure utilization are required.

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Information Security System Using Image Puzzle Type Keycode

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Abstract. As the modern society is developing into a multimedia information society, it has become easy to collect, search, process, transmit, and store information. However, damages from illegal system intrusion, personal information leaks, data duplication and forgery are also increasing everyday. Thus, information protection technologies are required to guarantee the confidentiality, integrity, and availability of information by responding to the threats and adverse effects that hinder the information communication environment. This paper proposes an information security system using image puzzle type key-code which divides original images consisting of pictures, figures, texts, numbers, fingerprints, and/or iris into certain sizes and the divided image pieces are arranged in accordance with preset patterns to create an image puzzle type key-code, and the original image is restored to a key-code image by substituting a puzzle type key-code value, thus preventing the leakage of original images.

Keywords: Image puzzle, Key-code, Information Security.

1 Introduction

It is now an era of advanced information technologies that require numerous kinds of information. The use of computers is increasing daily to collect, produce, and process information. As the modern society is gradually developing into a multimedia information society, the demand for multimedia data using the Internet and communication network is explosively increasing [1]. Furthermore, the remarkable development of computer network and database technologies enabled numerous users to collect, search, process, transmit, and store data using computers [2]. In particular,

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with the development of Internet technologies, damages from illegal system intrusions by outsiders, personal information leaks, data duplication and changes, forgery/falsification, and various computer viruses are increasing. At present, various encryption algorithms such as hash algorithm, PKI-based public key authentication, and holography are being developed. These encryption techniques involve complex processing, high cost, and other many problems. This paper proposes an information security system using image puzzle type key-code whereby the original image is contained in a key-code image so that the original information will not be exposed when the key-code is printed or a stored card is used and the original information cannot revealed by encryption code only.

2 Related Research

Information protection refers to technologies to maintain the confidentiality, integrity, and availability of information systems and data so as to prevent the threats and adverse effects that hinder information communication environment such as the paralysis of information and communication network, personal information leaks, and the distribution of unhealthy information [3]. The proposed information security system that uses image puzzle type key-codes divides original images consisting of pictures, figures, texts, numbers, fingerprints, and/or iris into certain sizes and arranges the divided image pieces in accordance with preset patterns to create a key-code image. The image puzzle type key-code and key-code image are then printed for use, and the original image is restored to a key-code image by substituting a puzzle type key-code value, thus preventing the leakage of original images.

2.1 Creation of Image Puzzle Type Key-Code

The key-code creation process consist of acquiring the original image with the image puzzle type key-code that consists of a combination of image pieces that have been divided from the original image, acquiring the multiple image pieces that were divided into certain sizes, specifying the key-code value and key-code image formation pattern, arranging the acquired image pieces in accordance with the key-code image formation pattern, and forming the key-code image to expose the key-code value.

Figure 1 shows the flowchart for creating the key-code. The image puzzle type key-code is created by registering a pre-defined pattern corresponding to the key-code value to transfer the original image to the key-code image in accordance with the predefined pattern. First, the original image is photographed or scanned and processed, or the original image data stored as digital data in a memory device is inputted. The acquired image is divided into multiple image pieces of a certain size (encryption block size 5-10) and the coordinates of each image piece are specified so that the divided images can be identified. In this study, the coordinates of the image pieces do not use the background that does not contain meaningful information. Next, the key-code value to be expressed as key-code image and the pattern for arranging

the divided image pieces are specified, and the specified key-code value and pattern are saved in a database. As this key-code value is a unique code allocated to the original image, it must be different from the key-code value of the original image. The pattern for arranging image pieces is be created through a random number generator so that it would not become a fixed pattern, or multiple patterns are created in advance and a pattern is randomly selected to maintain security. The pattern contains the coordinates of each image piece in the image piece acquisition step and the coordinates on the key-code image corresponding to each image piece. The image pieces acquired in the image piece acquisition step are arranged in accordance with the pattern set in the key-code image formation pattern specification step and form a key-code image to express the key-code value. In other words, each image piece is arranged 1:1 at a location on the key-code image in accordance with the key-code image formation pattern, and the completed key-code image expresses the selected key-code value.

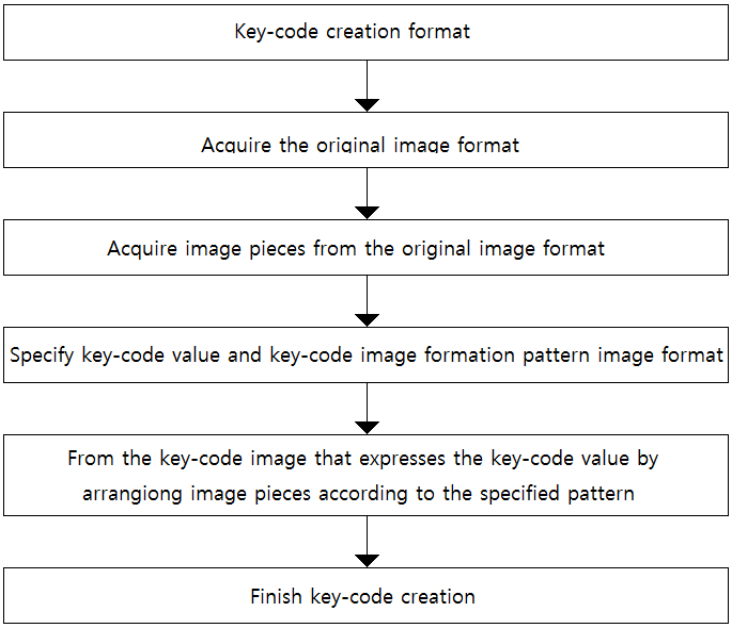

Fig. 1. Key-code creation flowchart

Figure 2 shows the creation process of image puzzle type key-code. The original image of a fingerprint is divided into multiple image pieces with a certain area. These image pieces are arranged to form a key-code image that is expressed as a barcode in accordance with the specified pattern. The final key-code image contains all the image pieces of the fingerprint, and information about the original image including the sequence of the pieces can be known only if the specified pattern values are known. Furthermore, information about the specified pattern is corresponded to the barcode value (key-code) consisting of a key-code image and the pattern is specified

with barcode value to restore the original image. The image pieces in Figure 2 can be also created with a key-code image of a specific password instead of a barcode. In this case, the numbers expressed as a key-code image form a key-code value (8801021402019) that corresponds to a pattern indicating the arrangement sequence of the image pieces.

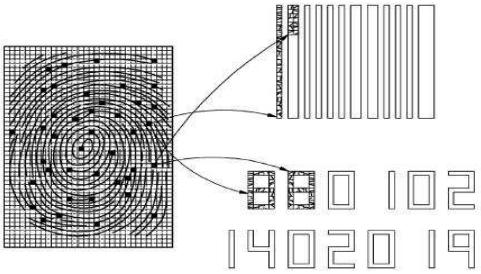

Fig. 2. Example 1 of key-code image creation process

Figure 3 is another example of key-code image creation process. In this figure, the key-code image that is formed as a barcode is created from three original images of a fingerprint, a portrait, and a resident registration number. It is preferable to arrange the divided image pieces of each original image into one key-code image in accordance with the specified pattern of each original image. The reason that the pattern is specified for each original image is to selectively restore the desired original image only from the key-code image. Furthermore, because the original image consisting of a resident registration number can have various forms according to the number font, the number image pieces having the characteristics of the font are arranged in the key-code image corresponding to the number.

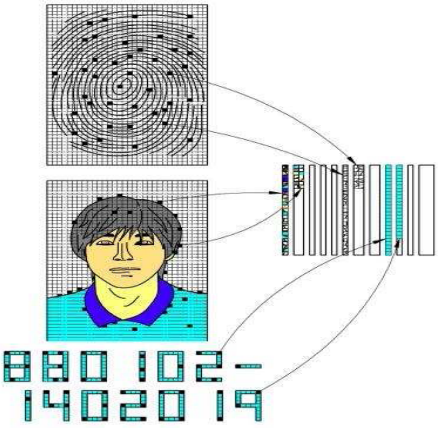

Fig. 3. Example 2 of key-code image creation process

Figure 4 shows a key-code image that is formed as a passport number from two original images consisting of a portrait and a series of numbers indicating the fingerprint characteristics, which generally contains the feature points of the fingerprint and the coordinates and angles of the feature points as shown in Figure 4. For the fingerprint recognition method, the characteristics of a fingerprint image that is actually inputted at the above feature point locations are contrasted with the above characteristics information. Therefore, the restored fingerprint information can be linked with the conventional fingerprint recognition device.

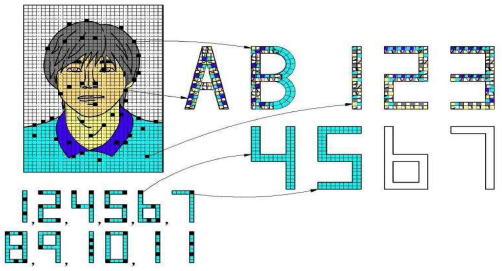

Fig. 4. Example 3 of key-code image creation process

2.2 Restoration of Original Image

The original image restoration process consists of reading the key-code image and acquiring the key-code value, specifying the key-code image formation pattern corresponding to the acquired key-code value, acquiring multiple image pieces by dividing the key-code image, rearranging the image pieces in accordance with the key-code image formation pattern to form the original image.

2.3 Key-Code and Image Restoration Terminal

The key-code registration terminal consists of the original image acquisition unit that acquires the original image as digital data, the original image puzzle unit that forms multiple image pieces by dividing the original image to specific sizes, the key input unit for receiving the key-code value expressed as key-code image, the interface unit that sends the inputted key-code value to the key-code combination server through the communication network and receives the corresponding key-code image formation pattern, the key-code image formation unit that forms the key-code image by arranging the image pieces from the key-code image puzzle unit according to the received key-code image formation pattern to express the key-code value, the key-code image output unit that outputs the key-code image so that it can be used by the user, and the registration terminal control unit that controls the operations of each component, converts the acquired original image into a puzzle of image pieces, forms the key-code image by requesting and receiving the key-code image formation pattern corresponding to the key-code value through the interface unit, and outputs the key-code image through the key-code image output unit. The image restoration terminal consists of the key-code image acquisition unit that acquires the key-code image as digital data, the key-code reading unit that acquires the key-code value from the key-code image photograph data, the

interface unit that requests and receives the key-code image formation pattern for the key-code value from the key-code combination server through the communication network, the key-code image puzzle unit that forms the image pieces by dividing the key-code image, the image restoration unit that restores the original image from the image pieces according to the received key-code image formation pattern, the original image output unit that outputs the restored original image, and the control unit that controls the operations of each component, reads the key-code value from the acquired key-code image through the key-code image acquisition unit, requests and receives the key-code image formation pattern corresponding to the read key-code through the interface unit, converts the key-code image into a puzzle of image pieces and restores the original image according to the key-code image formation pattern, and outputs the original image through the original image output unit.

2.4 System Implementation

The system implemented in this study used a Pentium 4 (2.0 GHz) PC with 512MB memory on the MS Windows XP operating system. The block size for encryption was 5-10, and JPEGgudtlr images with the size of 290*383 pixels were used for this experiment. First, the stored image was opened from the LoadPlainImage menu, the block size was determined from the SetBlockSize menu, and the image was encrypted from the EncryptImage menu. Lastly, the encrypted image was saved (if the image name is test.jpg, the encrypted image is saved as test_enc.jpg). Decryption is impossible if the image is not saved. The result is shown in Figure 5.

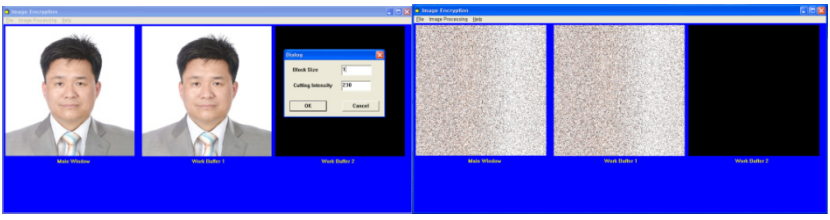

Fig. 5. Original and encrypted image

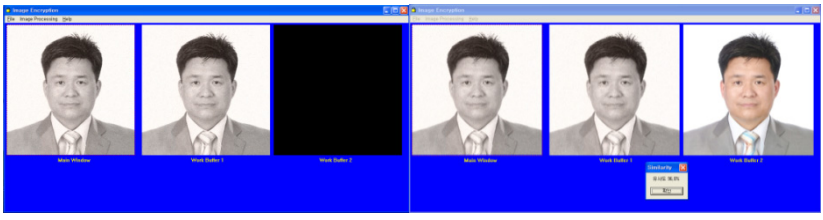

Fig. 6. Decrypted image and similarity measurement images

The decryption process of the encrypted image is the reserve sequence of the encryption. First, the encrypted image is loaded from the LoadEncryptedImage menu. Then it is decrypted from the Decrypt menu. It must be noted that decryption is

impossible if the test_enc.jpg.dat file which was created in the encryption process is lost. The decryption result is shown in Figure 6.

The first of the images is the decrypted image, the second is the image in the buffer, and the third is the original image. When the similarity between the decrypted image and the original image was measured, it was 96.8%. In this experiment, the measurement time for encryption and decryption was less than 1 second. The encryption and decryption times vary by the image size and computer environment.

3 Conclusions

With the development of information and communication technologies, the generalization of computers, and the growth of the high-speed Internet network, the privacy and security issues for digital information have emerged as urgent problems. Digital information is particularly vulnerable to security threats such as illegal duplication, forgery, and falsification due to its easiness of change. Many costs and much time are being invested to cope with such security threats, but security management measures are insufficient. Therefore, this study proposed a safe and reliable information security system for personal information and various other digital data. In the future, we will study various measures to reduce the security risks of personal digital information through the encryption of various kinds of information used in everyday life such as the encryption of USIM chips in smart phones, encryption systems for data and servers that provide various services through the high-speed communication network, and e-mail encryption methods.

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Schedulability Analysis Approach for UML-Based Real-Time Models

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Abstract. Real-time systems cover a large variety of general-purpose and safety critical applications. In addition to their timing constraints, their complexity is continuously increasing. They have in fact evolved to become distributed taking advantages of the ubiquitous real-time networking facilities such as CAN bus, FDDI, TTEhternet, etc. The object-oriented paradigm is well adapted to deal with such complexity. In particular, UML through its proling mechanism can support applying predictive quantitative analysis such as schedulability and performance analysis. In this paper, we present an approach targeting the integration of the design modeling and schedulability analysis for distributed object-oriented real-time systems. In particular, we put the focus on a schedulability analysis technique of a multi-threaded task model derived from an UML model.

1 Introduction

Nowadays embedded real-time systems are ubiquitous. These systems cover a wide spectrum of applications including avionics and automotive. Moreover, these systems are integrating more functionalities and interacting with complex environments. In addition, the correctness of embedded and real-time systems is not limited to functionality but implies also their timing correctness. Hence, it is important to validate the functional and non-functional requirements at a very early stage of the development process. Therefore, there is a need for supporting established quantitative analysis. As a result, the modeling language targeting real-time systems should not support the management of their inherent complexity but also the validation of their non-functional properties using predictive quantitative analysis. This helps the designer to take design decisions having a strong impact on decreasing the cost, speeding up the development and therefore fit the time-to-market requirements. In this paper, we focus on the issue of modeling and schedulability analysis of distributed real-time systems. The design modeling is based on UML. In order to support schedulability analysis, UML profiles such as MARTE and UML/SPT can be used. In particular, we put the focus on a schedulability analysis technique targeting distributed object-oriented real-time models.

The remaining part of this paper is structured as follows: In Section 2 we succinctly introduce the UML profiles for real-time systems supporting schedulability

T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 194–201, 2012.

analysis and we present a model of a real-time systems using such profiles. Section 3 is devoted to present the task model, which is will be derived from an UML/SPT design model. The task model undergos the schedulability analysis for a distributed real-time system presented in Section 4. We present a case study in Section 5. We review the related work in Section 6. Finally we conclude in Section 7.

2 UML Profile for Schedulability Analysis

A UML profile for real-time systems such as MARTE and UML/SPT provide a framework to model the resources, timing constraints and support predictive quantitative analysis of UML models. These profiles provide the designer with a set of stereotypes and tag values in order to annotate the UML models and hence support model quantitative analysis such as schedulability and performance.

We present a UML/SPT model of the elevator controller system. Figure 1 shows a UML collaboration diagram annotated with UML/SPT stereotypes. The periodic external event called arrival sensor is stereotyped *≪SATrigger≫* with tag value *RAT={periodic,25,'ms'}* indicating a period of 25 ms. This event triggers an end-to-end transaction which should be achieved with a deadline of 25 ms. This is specified using the stereotype *≪SAResponse≫* and the tag value *{SAAbsDeadline =(25,'ms')}*.

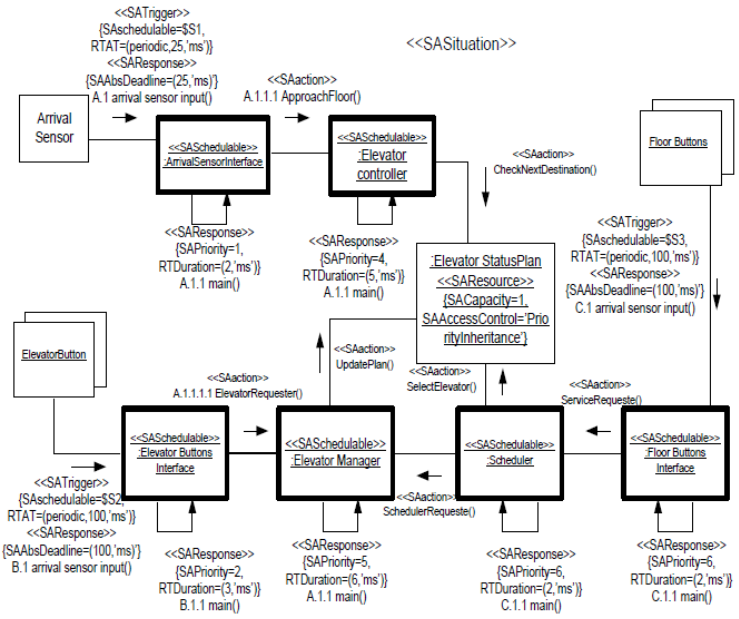

Fig. 1. SPT-Annotated UML Collaboration Diagram of an Elevator Control System

3 Computational Model

We present in this section the computational model that we use to derive realtime task models from a UML design model annotated with UML/SPT. A distributed real-time system consists of a set of nodes connected via a real-time communication network. Each node hosts a multi-threaded run-time sub-system where each thread is assigned a fixed priority. The system is composed of a set of active objects $O = \{O_1, O_2,\ldots,O_n\}$ allocated to these threads. We assume that the threads priority assignment as well as the object to thread allocation is given. The *active objects* have a *run-to-completion* semantics. Therefore, once an action is triggered, it runs completely to its end before processing the next triggered action. This is useful to reduce the race conditions due to active objects participating to many end-to-end transactions. This computational model is depicted in Figure 2.

The system reacts to a set of external events $E = \{e_1, e_2\ldots, e_n\}$ that trigger a set of corresponding end-to-end transactions $\xi = \{\sigma_1, \sigma_{2,}.., \sigma_n\}$. Each end-to end transaction σ_i,

$i = 1,..,n$ is a sequence of actions $\sigma_i = \sigma_{i1}, \sigma_{i2}\ldots,\sigma_{im} >$ carried out by the different active objects and have an end-to-end deadline D_i. Actually, each σ_{ij} is an event-triggered action executed in the context of an active object $O(\sigma_{ij})$. Each action σ_{ij} has a worst case execution time C_{ij} and a priority P_{ij} . Finally, let $P_i = min\{P_{ij}, 1 \leq j \leq i_m\}$ *and*

$C_i = \sum_{j=1}^{mi} C_{ij}$ the computation time of the transaction σ_i.

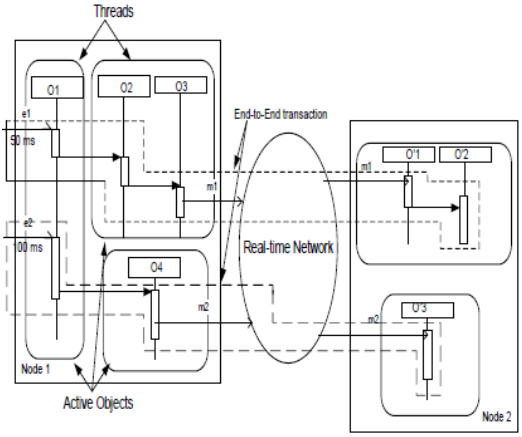

Fig. 2. Distributed Multi-threaded Object Oriented Real-Time Computational Model

4 Proposed Schedulability Analysis Approach

We present in this section a schedulability technique adapted for the distributed object-oriented real-time model described in the previous section. It is a holistic schedulability analysis [7] integrating the computation of the worst-case response

time of the actions composing the different end-to-end transactions at the node level using [2] with the worst case response time of the messages transmitted through the real-time network such as the CAN bus [6], [8]. A node in the system hosts a multi-threaded run-time. This is basically a set of concurrent threads each of which is assigned fixed priority. The active objects in the design are allocated to the different threads. A transaction at the node level, as it is illustrated in Figure 2, is composed of a sequence of actions belonging to the different objects allocated to different threads. This results in each transaction being associated with a set of actions with varying priorities. This corresponds exactly to the task model where each task is composed of subtasks having different priorities and therefore the schedulability analysis technique presented in [2] could be used. This observation has also been pointed out in [1]. We present in the sequel the details of our proposed the schedulability analysis technique based on [2] and that we adapt to the computational model presented in Section 3. This schedulability analysis is used to determine whether the different transactions meet their deadlines. This is achieved by computing the worst-case response time of each action composing the transaction using the following procedure:

Let σ_i be the transaction under analysis. Such a transaction is assumed to be in its canonical form where two consecutive actions do not decrease in priority: $\forall i;\ P_{ij} \leq P_{ij+1}$. The impact of the other transactions on σ_i could be interference from transactions with higher priority or blocking caused by lower priority transactions. The transactions are then classified in five groups based on the priorities of their actions with respect to priority level of σ_i (P_i):

- *Type$_1$ H:* The transactions in this group could preempt σ_i more than once per σ_i-busy period.
- *Type$_2$ (HL) +:* Each transaction in this group could preempt σ_i only once per σ_i-busy period. Only one transaction among the *Type$_2$, Type$_3$* and *Type$_4$* could have a blocking effect.
- *Type$_3$ (HL) +H:* These transactions are treated like *Type$_2$*.
- *Type$_4$ (LH) +L^0:* At most one transaction in this group could have a blocking effect on σ_i.
- *Type$_5$ (L) +L:* The transactions in this group have no effect on σ_i.

In the above, H stands for a sequence of actions, called a segment, where each of which has a higher or equal priority than the priority level P_i of the transaction under analysis while L stands for a segment of actions each of which has a lower priority than P_i.

The schedulability analysis computes the worst-case response time of each action σ_{ij} in the transaction σ_i following the algorithm described below. This algorithm uses the following notations:

- { MP_{ij} is the set of transactions that have more than one preemptive effect on an action σ_{ij} : $MP_{ij} = \{\sigma_k :: k \neq i \wedge P_k \geq P_{ij}\}$

- { SP_{ij} is the set of single time preemptive transactions relative to σ_{ij} : $SP_{ij} = \{\sigma_k :: k \neq i \wedge \exists l :: ((P_{k1}..P_{kl} \geq P_{ij}) \wedge (P_{kl+1}..P_{km} < P_{ij}))\}$. Let C_k^l be defined as follows:

$$C_k^l = \sum_{i=1}^{l} C_{k_i} \quad (1)$$

Table 1. Blocking Factor computation

Algorithm:
MP_{i1} := Tasks of type 1
SP_{i1} := $\{transactions\ of\ type_1\} \cup \{transactions\ of\ type_2\}$
B':=length of the longest H segment of transactions of $type_4$.
for all t $\in Type_2 \cup Type_3$
W:=length of initial H segment
U:=length of the longest inner H segment
V:=length of last H segment if t $\in Type_3$
Let σ_m be the transaction having M:=max(U-W-B', V-B').
if M <0
B_i:=B'
else if U-W>V
B_i:=U
remove σ_m from SP_{i1}
elseB_i:=V

First the blocking factor is computed using the algorithm outlined in Table 1. This is basically caused by the longest inner H segment in the *Type₂, Type₃ and Type₄*. The second step in this procedure determines the length of the σ_i- busy period. The length of the latter includes the blocking factor, the interference factor from all the transactions that could preempt σ_i more than once, i.e. transactions in MP_{i1}, and those which preempt σ_i just once, i.e. transactions in SP_{i1}, and all the instances of σ_i that could occur during this σ_i- busy period. This is computed using the following recurrent equation:

$$W_i^{n+1} = B_i + \sum_{\sigma_k \in MP_{i1}} \lceil \frac{W_i^n}{T_k} \rceil + \sum_{\sigma_k \in SP_{i1}} C_k^l + \lceil \frac{W_i^n}{T_i} \rceil C_i \tag{2}$$

The number of instances of the transaction σ_i in its σ_i-busy period is then:

$$N_i = \lceil \frac{W_i}{T_i} \rceil \tag{3}$$

In the final step, the response times of each of the Ni instances of the transaction σ_i are computed. Equation 4 computes the response time of the first action, σ_{i1}, of the instance q of the transaction σ_i.

$$R_{i_1}^{n+1}(q) = B_i + \sum_{\sigma_k \in MP_{i1}} \lceil \frac{R_i^n}{T_k} \rceil C_k + \sum_{\sigma_k \in SP_{i1}} C_k^l + C_{i_1} \tag{4}$$

The response time of the first action σ_{i1} is used compute the response time of the second action σ_{i2} of the transaction σ_i. The set SP_{i2} should include the elements of MP_{i1} that become singly preemptive.

$$SP_{i2} = \{\sigma_k :: \sigma_k \in (MP_{i1} - MP_{i2}) \wedge (\exists l :: ((P_{k_1}..P_{k_l} \geq P_{i_2}) \wedge (P_{k_{l+1}}..P_{k_m} < P_{i_2})))\}. \quad (5)$$

The response time of the second action σ_{i2} is computed using the recurrent equation:

$$R_{i_2}^{n+1}(q) = R_{i_1}(q) + \sum_{\sigma_k \in MP_{i2}} [\lceil \frac{R_{i_2}^n}{T_k} \rceil - \lceil \frac{R_{i_1}(q)}{T_k} \rceil] C_k + \sum_{\sigma_k \in SP_{i2}} min(1, [\lceil \frac{R_{i_2}^n}{T_k} \rceil - \lceil \frac{R_{i_1}(q)}{T_k} \rceil]) C_k^l + C_{i_2} \quad (6)$$

The response time of the j^{th} action in a transaction is computed using the general recurrent equation 10:

$$SP'_{ij+1} = \{\sigma_k :: \sigma_k \in SP_{ij} \wedge ([\lceil \frac{R_{i_j}(q)}{T_k} \rceil - \lceil \frac{R_{i_{j-1}}(q)}{T_k} \rceil]) = 0 \wedge (\exists l :: ((P_{k_1}..P_{k_l} \geq P_{i_{j+1}}) \wedge (P_{k_{l+1}}..P_{k_m} < P_{i_{j+1}})))\}. \quad (7)$$

$$SP''_{i2} = \{\sigma_k :: \sigma_k \in (MP_{ij} - MP_{ij+1}) \wedge (\exists l :: ((P_{k_1}..P_{k_l} \geq P_{i_{j+1}}) \wedge (P_{k_{l+1}}..P_{k_m} < P_{i_{j+1}})))\}. \quad (8)$$

$$SP_{ij+1} = SP'_{ij+1} \cup SP''_{i2} \quad (9)$$

$$R_{i_{j+1}}^{n+1}(q) = R_{i_j}(q) + \sum_{\sigma_k \in MP_{ij+1}} [\lceil \frac{R_{i_{j+1}}^n}{T_k} \rceil - \lceil \frac{R_{i_j}(q)}{T_k} \rceil] C_k + \sum_{\sigma_k \in SP_{i_{j+1}}} min(1, [\lceil \frac{R_{i_j}^n}{T_k} \rceil - \lceil \frac{R_{i_j}(q)}{T_k} \rceil]) C_k^l + C_{i_{j+1}} \quad (10)$$

The term C_k^l used in the equations 2, 4, 6 and 10 is the one defined previously in Equation 1.

Finally, in contrast with [1], we argue that the run-to-completion semantics has not only a blocking effect but could also have a preemptive effect. Nonetheless, it is already accounted for using our proposed schedulability analysis technique. Indeed, the run-to-completion means once an action in an active object starts executing it runs until its full completion before that any other action in the same active object could be executed. Since an active object containing many other actions could be involved in different transactions, therefore, an action in an active object may suffer a blocking time equal to the longest computation time of the other actions in the same active object. However, since an active object could not be allocated to more than one thread, all the actions in the same active object have the same priority.

5 Case Study

We consider the model of the elevator controller system whose design model is presented in Section 2. The analysis of the transaction σ_2 called *Request Elevator* is as follows:

- $\sigma_2 =< \sigma 2_1 ; \sigma 2_2 >$ having the priorities < 8, 5 > and hence $P_2 = 5$.
- The other transactions are then classified as follows according to their priority sequences with respect to P_2:

• σ_1 has a priority sequence having a pattern H and hence it is of $Type_1$.
• σ_3 has a priority sequence having a pattern HLH and hence it is of $Type_3$.
• σ_4 and σ_5 have a priority sequence having a pattern L and hence are of $Type_5$.

The blocking factor of σ_2, computed using the algorithm outlined in Table 1, is 6 and it is caused by the $\sigma 3_3$ and it is in fact due to run-to-completion semantics since the same action is involved in both transactions σ_2 and σ_3.

- $MP21 = \{\sigma_1\}$ and $SP_{21} = \{\sigma_3\}$.

- The length of the σ_2- busy period is computed according to the Equation 2 and yields: $blocking+2 \cdot C1+C21+C2=6+2 \cdot 7+4+9=33$.

- The worst case response time of the transaction σ_2 is then computed using Equation 4 and Equation 6 yielding the following results:

• The response time of the action σ_{21} computed according to Equation 4 is: $R(\sigma_{21})=blocking+1 \cdot C1+C31+C21=6+1 \cdot 7+4+3=20$

• The response time of the action σ_{22} , which is in turn the worst case response time of the transaction σ_2, is computed according to Equation 6 is: $R(\sigma_{21})+1 \cdot C1+C22=20+1 \cdot 7+6=33$

6 Related Work

The closest research initiatives on the integration of object-oriented design and the schedulability analysis real-time systems to our approach presented in this paper are [1] and [4]. Saksena et al. [3], [4] and [5] addressed the issue of integrating object-oriented design and schedulability analysis. The modelling language used is UML-RT, which is a UML profile for real-time systems capturing the concepts of ROOM. In particular, [4] presents a schedulability analysis of a single-processor multi-threaded implementation of a UML-RT model. Gu presented in [1] an approach aiming at an automatic synthesis of a UMLRT model and its schedulability analysis. The synthesis approach used is called Capsule-based multi-threading, Capsule-based Priority assignment. The schedulability analysis for a non-distributed design is based on the same as the one we use [2] for the node level schedulability analysis. It is claimed that a schedulability analysis for a distributed case of the elevator controller system is possible but was not presented.

7 Conclusion and Perspectives

The increasing complexity of nowadays ubiquitous real-time software systems requires the use of high level modeling languages and supporting methodologies. The object-oriented paradigm proved to be very effective for overcoming software systems complexity. In particular UML, which is a standard object oriented modeling language, provide specific profiles to support real-time modeling and applying predictive quantitative analysis including MARTE and UML/SPT. In this paper, we consider real-time systems models using these UML profiles and the issue of applying a suitable schedulability analysis approach for these models. In particular, we have elaborated on an established schedulability analysis technique targeting task models where a task is composed of a set of subtasks with varying priorities. We target in a future work the integration of this analysis technique with network level to enable a holistic approach for distributed object oriented real-time systems.

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Correlated Weibull Clutter Generation Procedure for UWB SRR System in Automobile Application

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Abstract. In this paper, we propose a model that generates discrete time coherent correlated weibull sequences for Ultra Wide Band Short Range Radar in Automotive applications. First, we generate a coherent correlated Gaussian sequence from coherent white Gaussian noise. Secondly, coherent correlated weibull sequence is obtained from the generated coherent correlated Gaussian sequence by using Zero-memory nonlinear transformation. Finally, the detection performance of UWB SRR detector is analyzed in weibull clutter environment and simulation has been done in order to verify it.

Keywords: UWB SRR, Coherent Integration, Zero-memory nonlinear transformation, Clutter.

1 Introduction

Intelligent Transportation System uses Ultra Wide Band Short Range Radar (UWB-SRR) system for driver's safety and convenience. Ultra wideband (UWB) offers many applications to vehicle such as pre-crash warning system, stop and go operation, spot assist and lane change assist. Clutter is generally distributed in spatial extent in that it is much larger in physical size than the radar resolution cell [1]. The ability to determine range by measuring the time for the radar signal to propagate to the target and back is probably the distinguishing and most important characteristic of radar. In order to suppress the clutter, a pulse integration and Constant False Alarm Rate (CFAR) has been employed. It is therefore important to investigate the more appropriate clutter model to resemble the clutters in automobile applications. In high resolution radars, the log normal and weibull clutters are proved to be better suited for clutter model in automobile applications. The road clutter resembles weibull distribution for 100 MHz bandwidth. Also, the weibull scale and shape parameter for 24 GHz automobile short range radar is 1.6 and 6.9 for traffic road clutter [2].

In this paper, we present the mathematical procedure and corresponding statistical properties to obtain correlated weibull sequence for 24GHz UWB SRR system in automobile applications. Finally, we analyse the detection performance of UWB SRR detector in weibull clutter environment.

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T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 202–209, 2012.

The organization of this paper is as follows. In Section II, the coherent correlated weibull sequence generation model is described. In section III, UWB SRR detector is presented. In Section IV, the simulation results are shown. Finally, conclusion is presented in section V.

2 Coherent Weibull Model

In this section, we present the coherent correlated weibull sequence generation model. They consist of two blocks as shown in Fig.1; the first block is correlator filter, which is used to generate coherent correlated Gaussian sequence by using the covariance matrix and a zero mean and unit variance coherent white Gaussian sequence. The covariance matrix depends on power, the correlation coefficient of the coherent weibull sequence and its Doppler frequency. The correlated weibull sequence is obtained by feeding correlated Gaussian sequence to a zero-mean nonlinear transformation block.

The initial step to achieve our objective is to generate a coherent white Gaussian noise which can be represented as follows

$$\xi'[k] = x'[k] + jy'[k] \tag{1}$$

where k denotes the k-*th* instance of the sequence and the x' and y' are real valued Gaussian sequences with zero mean and unit variance.

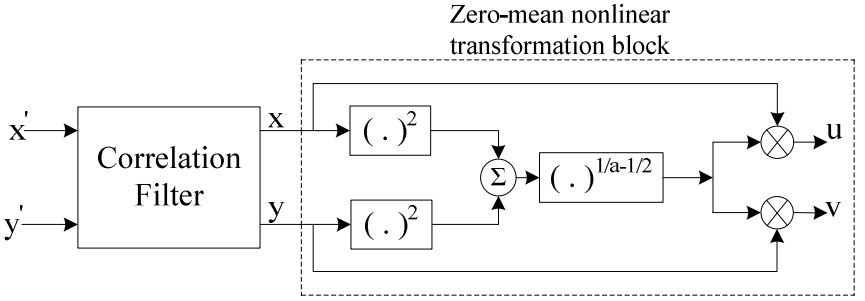

Fig. 1. Coherent weibull generator model

In order to transform the coherent white Gaussian sequence present at the input of the correlation filter to correlated Gaussian sequence, the filter makes a transformation of the input sequence as follows

$$\xi[k] = -\sum_{n=1}^{p} a_{pn} * \xi[k-n] + \xi'[k] \tag{2}$$

where a_{pn} is the filter coefficients obtained by solving $R_g(k)$ using Levinson algorithm for, which can be expressed as follows

$$R_g[k] = \rho_c \cdot e^{j2\pi k f_c t} \tag{3}$$

where, ρ_c is covariance matrix of the desired coherent correlated Gaussian sequence defined as below $R_c(p)$ is the correlation coefficient between two consecutive samples, the clutter Doppler frequency f_c is considered as zero in this paper, t is the sampling time between two consecutive samples.

$$\rho_c = \begin{bmatrix} R_c(0) & R_c(-1) & \cdots & R_c(-p) \\ R_c(1) & R_c(0) & & R_c(-(p-1)) \\ \vdots & \vdots & \vdots & \vdots \\ R_c(p) & R_c(p-1) & \cdots & R_c(0) \end{bmatrix} \tag{4}$$

The relation between the correlation coefficient of coherent correlated weibull clutter and coherent correlated Gaussian sequence is expressed as follows

$$R_u(k) = \frac{R_g(k) \cdot a}{2\Gamma\left(\frac{2}{a}\right)} [1 - R_g(k)^2]^{\left(\frac{2}{a}+1\right)} \Gamma^2\left(\frac{1}{a}+\frac{3}{2}\right) F\left(\frac{1}{a}+\frac{3}{2}, \frac{1}{a}+\frac{3}{2}, 2, R_g(k)^2\right) \tag{5}$$

where Γ () is the gamma function and F ( ) is the Gauss hyper geometric function, a is the shape parameter (i.e., skewness parameter) of the weibull sequence. As a check when $a = 2$, the weibull process becomes Gaussian, the correlation coefficients $R_u(k)$ is same to $R_g(k)$. Fig. 2 shows the covariance mapping between $R_u(k)$ and $R_g(k)$ for a = 6.9, since the weibull skewness parameter for 24 GHz automobile short range radar is 6.9 for traffic road clutter [2]. Finally, we implement correlation filter to generate a AR process with specified $R_g(k)$, and the method to obtain the filter coefficients (a_{pn}) by using levinson algorithm is presented in Fig.3.

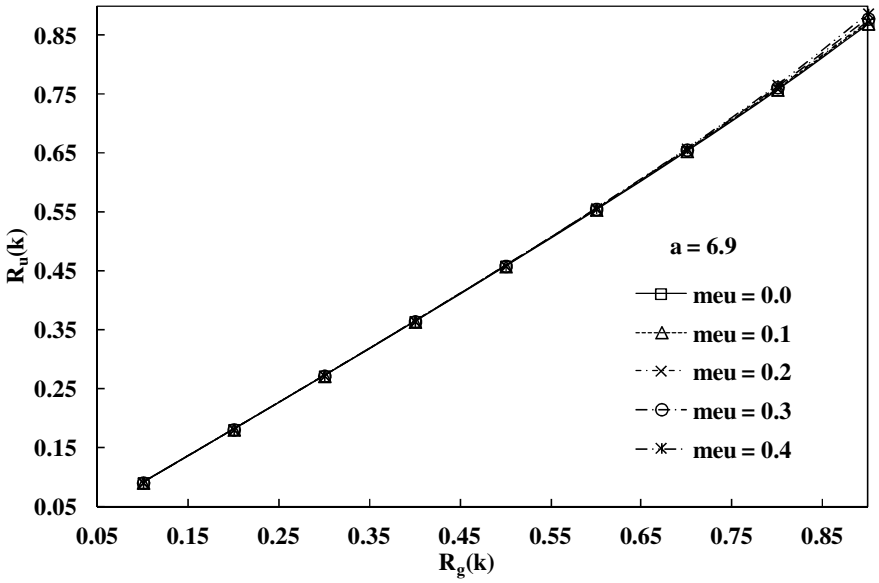

Fig. 2. Covariance mapping between $R_u(k)$ and $R_g(k)$

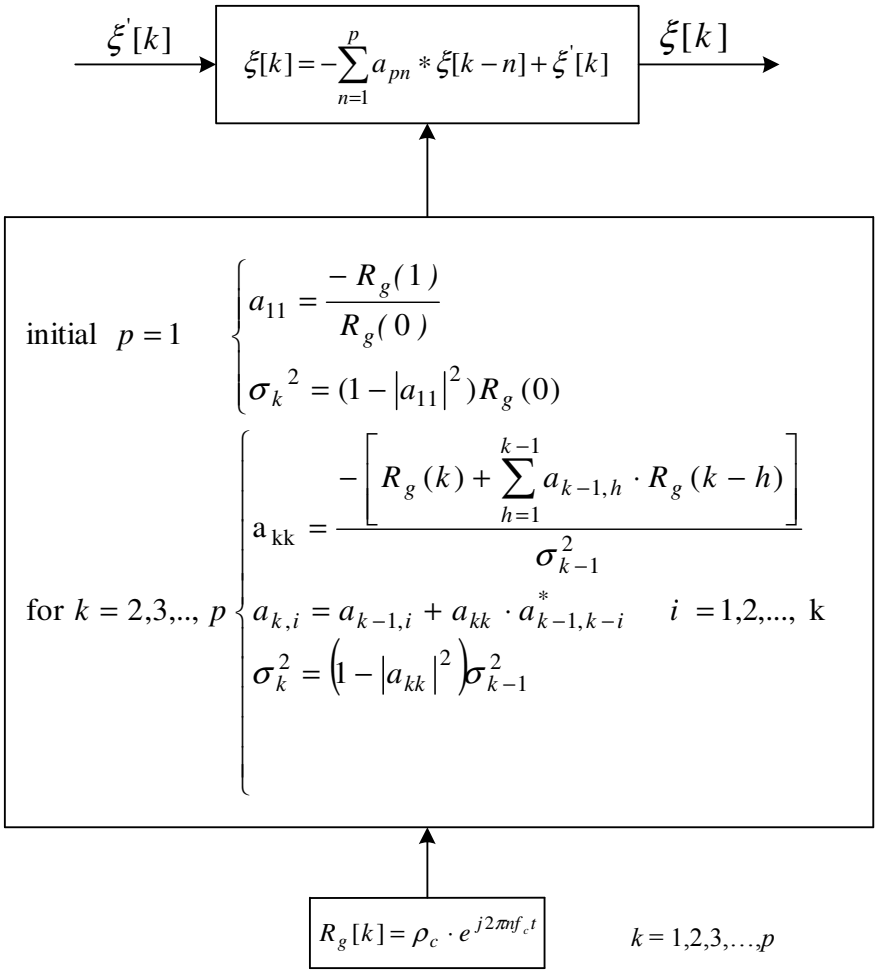

Fig. 3. Levinson algorithm for the calculation of filter coefficients of order p

3 UWB SRR Detector

In this section, we present the non-coherent detector which consists of coherent integrator and non-coherent integrator. The coherent and non-coherent range gate memory size (K) is less than the maximum range and indicates the total number of target range to be tested. These range gates are used as buffer to integrate the values coherently and non-coherently. Therefore, at every T_{PRI}, we use the samples as much as the range gate's memory size (K).

The sampling frequency of ADC is same to the pulse width (T_P). Thus each sampled values of the in-phase (I) and quadrature (Q) channel are shifted at every T_P during one

T_{PRI}. At every T_{PRI}, we use the samples only as much as the range gate's memory size (K). The coherent integrator integrates the sample values at each range gate during $N_c \cdot T_{PRI}$ (where N_c is the number of coherent integration). If the round trip delay (τ) from target is equal to the time position of the k-th range gate ($k \cdot T_P$), then the target maximum range can be expressed as $k \cdot T_P/2 = k \cdot \Delta R$. And then the range resolution is given by $\Delta R = c \cdot T_P/2$.

The transmitted signal can be written as follows

$$s(t) = A_T \cdot \sin(2\pi f_c t + \varphi_0) \cdot \sum_{n=-\infty}^{+\infty} p_n(t) \tag{6}$$

where $p_n(t)$ is the Gaussian pulse train; A_T is the amplitude of single transmit pulse, φ_0 is the phase of the transmit signal, f_c is the carrier frequency [11].

In this paper, we assume one reflected signal from single stationary target against a background of weibull clutter environment, and then the baseband complex received signal can be described as

$$\bar{r}(t) = A_T \sum_{n=-\infty}^{+\infty} \alpha \cdot e^{j(\omega_d t + \theta)} p(t - nT_{PRI} - \tau) + \bar{C}(t), \tag{7}$$

where the amplitude of the scatter α, the time delays of the scatters τ and the arbitrary phase $\theta = -2\pi f_c \tau + \varphi_0$ are all unknown. Also, $\bar{C}(t)$ is the reflected clutter signal from unwanted object. Doppler shift is denoted as $\omega_d = \pm 4\pi v/\lambda = \pm 4\pi v f_c/c$ where the wavelength λ is c/f_c and c is the velocity of light. In the Doppler shift, the positive sign (+) indicates the closing target and the negative sign (-) means the receding target.

The output of the coherent integrator can be distinguished in to two hypotheses,

$$H_1 = \overline{X_k}(m) = \frac{A_T \alpha}{N_c} \sum_{n=mN_c}^{(m+1)N_c - 1} e^{j(\omega_d t + \theta)} p(t - nT_{PRI} - \tau) + \bar{C}(n), \tag{8}$$

$$H_0 = \overline{X_k}(m) = \frac{1}{N_c} \sum_{n=mN_c}^{(m+1)N_c - 1} \bar{C}(n), \tag{9}$$

where m indicates the m-th coherent integration and H_1 is for $\tau = k \cdot T_P$ and H_0 is for $\tau \neq k \cdot T_P$. Also, the sampling rate of the ADC is equal to the pulse width. The baseband received signal is sampled at peak point of $p(t)$. Therefore, we get the coherently integrated values as ($\overline{X_k}(m)$, k=1, 2,…, K). The sample value received from the coherent integration is squared and operates at every $N_c \cdot T_{PRI}$. The squared range gate samples are combined and then both I and Q branch values are summed as shown in Fig. 2(a). The k-th range gate value after squaring can be represented as

$$Y_k(m) = \left\{X_k^I(m)\right\}^2 + \left\{X_k^Q(m)\right\}^2. \tag{10}$$

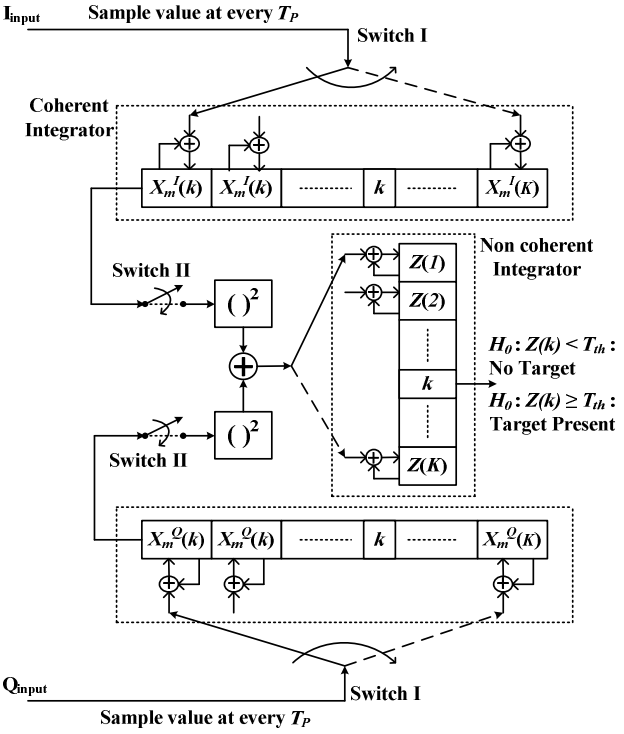

Fig. 4. Block Diagram of UWB SRR detector

The value $Y_k(m)$ is stored in the k-th memory of the non-coherent integration at every $N_c \cdot T_{PRI}$. The output of the non-coherent integration $Z(k)$ can be written as

$$Z(k) = \frac{1}{N_{nc}} \sum_{l=1}^{N_{nc}} Y_k(m), \tag{11}$$

If the above result is greater than the defined threshold, then we can determine that a target is present. And the index k represents the position of the target; the target range indicates $k \cdot 30$ cm. It takes $N_c \cdot N_{nc} \cdot T_{PRI}$ to decide the target range.

4 Simulation Results

The purpose of the simulation is to assess the detection performance of the non-coherent detectors in weibull clutter environment. The various optimized parameters used in the simulation are as follows; the coherent integration number (N_c) and the non-coherent integration number (N_{nc}) [10]. The percentage of total energy reflected from the target is assumed to be 1. The signal-to-clutter ratio (SCR) is defined as $\bar{E}/C_0$, where $\bar{E}$ represents the total average energy reflected from a target.

The weibull distribution can be expressed as follows

$$p(x) = \frac{\alpha}{b}\left(\frac{x}{b}\right)^{\alpha-1} \exp\left[-\left(\frac{x}{b}\right)^{\alpha}\right], \tag{12}$$

where b is the scale parameter ($b > 0$), α is the shape parameter ($\alpha > 0$) and x is the random variable of the weibull distribution.

Fig. 5 shows the detection probability versus weibull skewness parameter at P_{FA} = 0.01. The simulation result shows that the probability of detection is approximately 1 for optimized non-coherent integration number of 8 [9]. Finally, we can predict that the probability of detection is almost 1 for skewness (α) and scale parameter (b) greater than 4 and 2 for uncorrelated weibull clutter.

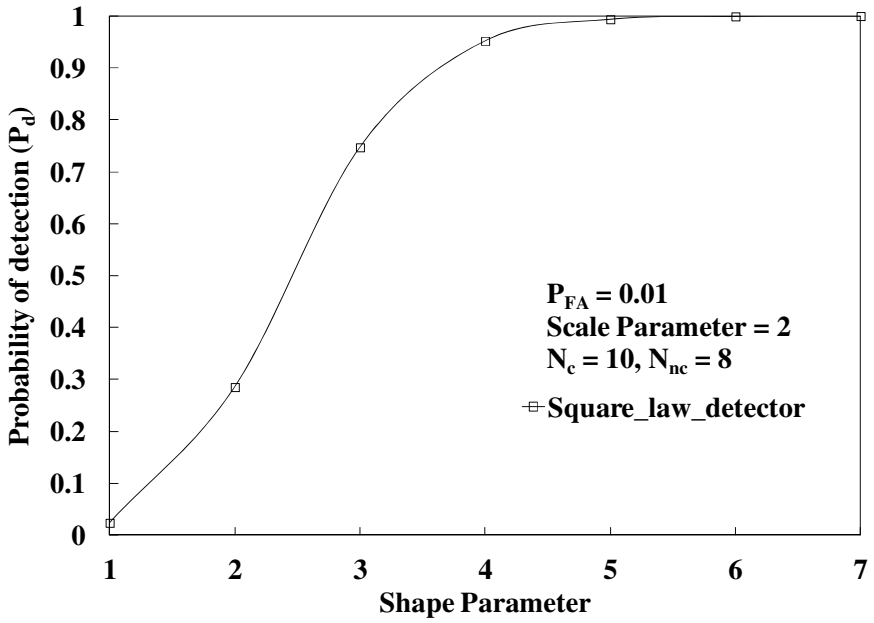

Fig. 5. Probability of detection Vs False alarm probability

5 Conclusion

In this paper, we have presented a mathematical model to generate discrete time coherent correlated weibull sequences for 24GHz Ultra Wide Band Short Range Radar in Automotive applications. Also, we have analyzed the detection performance of UWB-SRR detector in automotive applications. In order to get a detection probability of more than 0.9 for P_{FA}=0.01, the coherent and non-coherent integration number of approximately 10 and 8 is required for weibull clutter environment.

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RBAC-Based UAV Control System for Multiple Operator Environments

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Abstract. Nowadays, there are many researches on UAV (Unmanned Aerial Vehicle) control systems for disaster monitoring, national defense and surveillance applications, which mainly focus on flight performance of UAV or multiple UAV control by single operator. This paper presents design and implementation of an effective system for multiple operators to control UAVs based on RBAC (Role Based Access Control). In the proposed system, a UAV is connected to the UAV control server, and operators remotely access to the UAV by connecting to the server using various devices such as smart phones, desktops, and laptops at the same time. Each operator can control the UAV based on RBAC, in other words, operators are granted with permissions which are corresponding to the given roles. For example, the administrator may have all the permissions defined in the system and a pilot has a role where the flight control and flight status permissions are granted. In addition, operators may have a role with the camera tilt control and video access permissions. The major advantage of RBAC-based approach is to prevent unnecessary operational confusion, conflict and mistake under multi-operator UAV environments. Another advantage is to increase efficiency and accuracy of UAV mission control by allowing a mission to be decomposed into specific roles.

1 Introduction

We know that UAV is widely used in the world. It is useful for military reconnaissance, surveillance purposes, and in the private sector such as aerial photography. Thanks to the excellent technology, we can use UAV safely and conveniently as our purpose. Besides, this technology becomes basic technology so that it can precisely control the vehicle based on a high-precision senor and high-performance algorithm. Furthermore, using these techniques, MAV (Micro Aerial Vehicle) was made with a good performance. In recent years, based on the development of communication technology and image processing technology, research on the swarm flight is gaining popularity more and more. Like this, research on UAV control system is actively in

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progress and it have a common goal. However, this paper approaches come from a slightly different view point. That means the control system makes it possible to do multiple accesses to one UAV and function and share information. So it has an advantage of increasing efficiency due to the sharing of limited resources and it has possibilities of distributed processing control. This is the reason why we choice this subject. The system has several advantages, nevertheless, it also has something to note. For a example, when indiscriminate approach causes the wrong operation, it can even make a accident. Therefore, RBAC theory is applied to system to remove these shortcomings. For this reason system must be designed carefully, of course, many cases have to be considered.

This paper consists of five chapters. In chapter 2 we will discuss the related research and in chapter 3, architecture of the system will be discussed. Chapter 4 has contents about implementation and experiments. Finally in chapter 5, the future research plan will be described.

2 Related Work

For the last decade, UAV control system has received attention from many research. Many systems were designed, for example Grzonka et al. research for indoor quadrotor flight control system that pilot quadrotor in the indoor space that is recognized by real-time image processing [1]. LihuiGu et al. focus on systems which are flying in formation, and each UAV is designed hierarchically depending on UAV's roles like flight leader or wingman [2]. Ly et al. design control system for hierarchical UAV by multi-layer communication to control effectively [3] by extending the concept of [2].

Gancet Ly et al. research about task planning and control for a multi-UAV system. Each UAV carry out missions themselves and it also can make decisions by a particular algorithm [4]. Ferraiolo et al. presents concept of generalized RBAC model [5]. Barkley et al. focused on matching between access control and hierarchical permission [5].

Although there are many researches about the UAV control system, they do not provide control system for Multi-Access. Thus, this system is designed on the basis of previous research about the UAV and it has new concept of control system base on RBAC. If this system works successfully, it can be combined with the existing system. Then we can make batter system by increasing the efficiency of information processing.

3 System Design

3.1 Overall Architecture

This system basically contains the algorithm for processing the data given in the UAV and it has the technology about the sending packet that contains the meaning of the command to the control UAV. And then, different kind of concept is grafted to the system. Because this system is a special case of control system, it has multi-operators.

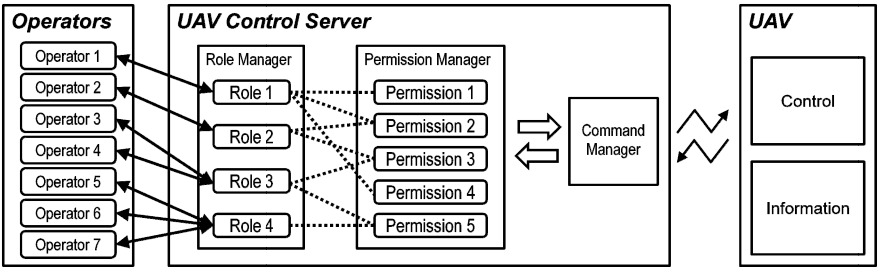

Fig. 1. Architecture: Interactions between UAV, UAV Control Server, and access Operator

This system consists of three functional parts which are Operator, UAV Control Server and UAV. Each part is designed independently in order to effectively perform their functions.

Operators provides interface with which user can access to UAV. It contains some special modules, such as HUD-like UI (User Interface) designed for displaying data from IR sensors, GPS, IMU (Inertial Measurement Unit) and video stream transferred from UAV. UAV Control Server connects the UAV and Operators like bridge. In particular, there are three modules which are implied in UAV Control Server for support RBAC control system named Role Manager, Permission Manager and Command Manager. Finally, the UAV performs the pilot control itself and commands from server. And UAV gets and processes data likes GPS, IMU, etc and transmits it to UAV Control Sever.

3.2 Permission Manager

Permission manager's basic role is the permission defining all of the features that are functions available on this system. Look at the following figure

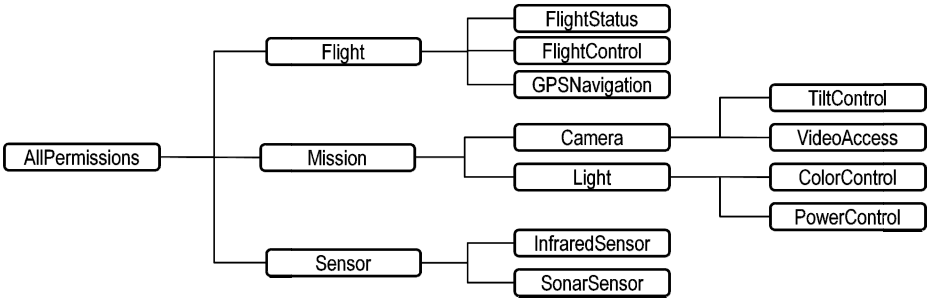

Fig. 2. Permission hierarchy

Permission is designed Hierarchically because it makes simple granting permissions to each role. For example pilot role will be just given permission Flight, then pilot can use the sub-permissions such as Flight Status, Flight Control and GPS Navigation. Suppose another situation, camera man role will be granted Camera permission, then camera man can control tilt and video options. Administrator is granted root

permission named Permission then it can use all functions. Of course it is possible to get receiving many of permissions, pilots can be granted Flight permission and Tilt control.

All of information can be shared, however, it is impossible to multiple control physical control parts at the same time. So permission manager grants exclusive rights to the each role.

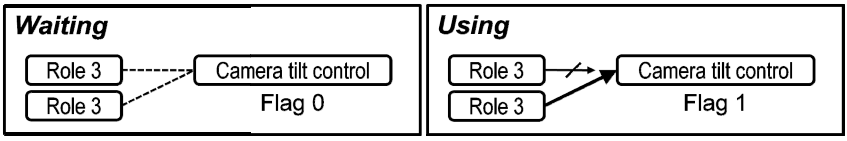

Fig. 3. Semaphore on Permission Manager

Suppose situation that two users were granted same permission 'Role3'. If the Role3 has authority to control Camera tilt, two users control one camera tilt. But it cannot be controlled at the same time, one user who approach first have an exclusive license to control it by assigning flag.

3.3 Role Manager

Roll Manager assign hierarchical permissions to each role. Some roles can be seen in the following table.

Table 1. Assign Permission

Role Name	Permissions
Administrator	AllPermissions
Pilot	Flight, VideoAccess
SensorMonitor	Sensors, FlightStatus
CameraMan	Camera, Light
Observer	VideoAccess

Administrator can do everything because it is assigned AllPermission by Permission Manger and AllPermission is the top level of authority because it can perform all of the lower level of permissions. Pilot assigned Flight and VideoAccess so it can use permission FlightControl, FlightStatus, GPSNavigation and VideoAccess, in other words it shows that one role can be granted various permission. It also means that Role Manager can define the number of Roles

Role Manager directly connects operators to each role and Role Manager can accept more than one operator per each role, of course each role which is connected with Operator will operate independently.

3.4 Command Manager

As mentioned above, there are many permission and they make some command packet and need information packet at the same time. Most of packets are constructed irregularly, so this system needs to design a module that systematize packet.

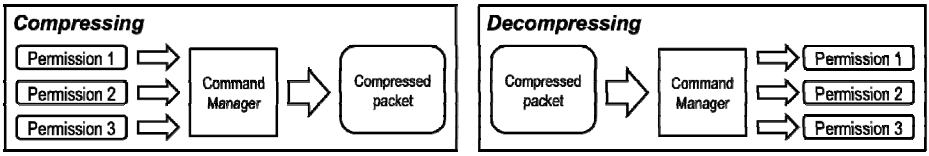

Fig. 4. Command Manger

As shown in the picture above, first role is it create a packet form of compressed from packets which are sent by permissions. Second role is decompression packet which are sent by UAV and it distribute packets to each permissions. Command Manager have another important roles. These are management of RF module by using serial communication port and checking the status of the wireless transmission by using echo message from UAV.

The advantages of using the Command Manager is increasing the reliability of the system by systematize packet. Because it makes easy to maintain, detect of errors, especially it help to use RF module efficiently.

4 Implementation and Experiments

4.1 Implementation

In order to perform the aforementioned functions, each application is designed as shown in the following figure. This system uses optimization solution to operate their functions and run independently. In other words, this system`s modules have low coupling by designing them independently and high cohesion by exchanging packets that comply with protocol.

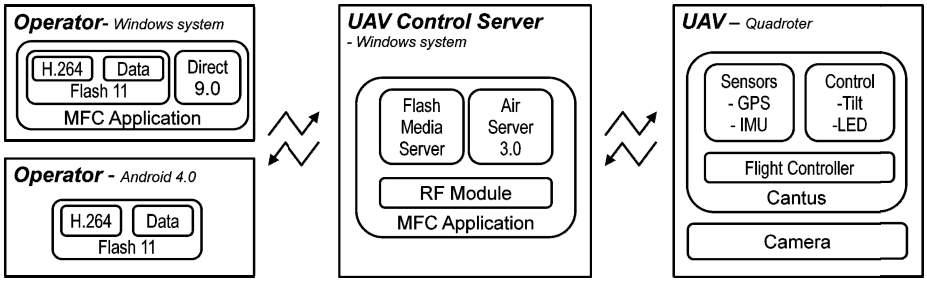

Fig. 5. System implementation

In UAV, there is main CPU called Cantus that is 32bit microprocessor. It is very important in piloting UAV such as hovering by generating PWM signal to control each BLDC motor. Cantus controls LED light and camera tilt. In addition, Cantus's another important role is combining the information obtained from the UAV, transmitting it to server in the form of a packet through the RF module and, interpreting the packets coming from sever and performing the command.

UAV Control Server is a bridge that connects the UAV and client. In order to perform this function, RF-module is mounted on the server and then operating the RF module through serial communication. MFC (C + +) language is used in controlling module because it is very useful in using an external device. Also other programming languages, Flex (Action script3.0), java and C, are used because each language has different strength. Then programs are combined into one executable program with nested programming technology. Flash media server provides an environment that can stream H.264 video in real-time. Air server3.0 technology gives a solution for constructing TCP/IP server simply that provides multi socket. Techniques mentioned above are specialized in operating special function and programs can run as a single executable file on any PC. So this server can be built easily and work lightly by executing applications.

Operator is designed for users to control in real-time. So it needs to access to Air server3.0 through TCP/IP for exchanging packets. Also it should display H.264 video through RTMP protocol. In addition, lots of information should be effectively displayed so that GUI (Graphic User Interface) client application could be adapt. Another important thing is Portability because it is used in many fields such as PC, laptop and smart devices. Flash11 can solve all these problems. Flash11 is specialized in multimedia like video stream and provides optimal environment to make GUI. Especially its compatibility is very good. It can be executed even on the web browser such as Explorer and Chrome.

4.2 Experimental Results

In this system quadrotor platform is used as UAV. The object of first experiment is checking flight controllability because it is most important and basic in this system. As shown in the picture (a) below, the result is satisfying. Controllability is good and reaction time is fast. Also its flight was stable without any error. Thus, first experiment proves integrity of whole system which consists of many modules that are made on different of platforms and written by different programming languages.

Next, the system functionality has been expanded. Figure (b) shows implement of Light function using RGB-LED. Thanks to this function, we can confirm the integrity of Command Manager and Permission manager. Then many functions are added to the system such as camera, servo-motor for camera tilt, GPS and other sensors.

As shown in (c), Operate application is developed to an integrated information control system. It can stream H.264 video in real time (delay within 0.5second) and can pilot quadrotor by using joystick on windows7 system or using G-sensor on Android 4.0 Smart phone. It can also control other parts such as Camera tile, Light. Then HUD-like UI is adopted to display IMU, GPS (with Google Map) and other sensors more effectively.

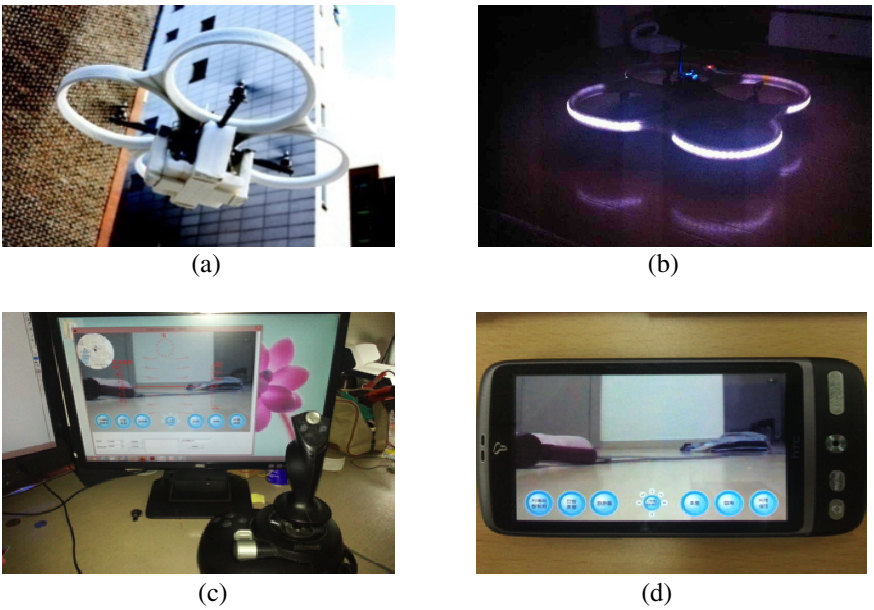

Fig. 6. Experimental result. (a) Piloting Quadroter, (b) Control Light, (c) On windows7, (d) On Android 4.0.

All implementations have been successful until now. So we went to next stage. Multi-access environment is implemented as shown in (c), (d). Operator1 (c) is an Administrator on windows7 system and operator2 (d) is a Camera man on Android 4.0. In this situation operator1 pilots the quadrotor and operator 2 controls camera tilt at the same time. Another situation is applied to the system. It is about granting exclusive right while Operator 2 is controlling camera tilting. Of course, other operators (including Operator 1) should not be able to control the same thing. Thus the integrity of RBAC and semaphore is confirmed with these results.

5 Conclusion

In this work, UAV Control System for Multiple Operator Environment is achieved by new designed architecture, which is based on RBAC. For real-time implementation, we used various programming languages which are specialized in special function. There are needs to pilot UAV without delay while other parts such as light and camera tilting are being controlled by multi operators. (Some physical functions should be granted exclusive rights.) This research's other object is improving the reliability of the system and optimizing wireless communications by Systemizing the packets

Experimental results are successful. However, there is a limitation because this research only targeted the design and implementation of the system. In other words, if many areas such as its performance, its reliability is improved and it will be converged with other technologies to make a powerful control system.

Acknowledgement. This research was supported by the Basic Science Research Program of the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science and Technology (grant number: 2012006817).

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A Study on the Extraction of Damage Locations Using Twitter Messages

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Abstract. In the past, people had to rely on broadcasts and public agencies to receive disaster information when the disaster occurred. More recently, disaster information is shared by means of photos or messages shared by citizens using social network services (SNS). However, SNS is neither reliable nor efficient method of sharing information, due to the fact that SNS messages are not necessarily grammatically correct and the information may not be accurate. In this paper, we suggest the method of extracting information regarding affected locations by means of message analysis, and extracting GPS information from uploaded photographs.

Keywords: SNS, Disaster, Extraction of Damage Location, Twitter Message.

1 Introduction

Recently, a typhoon with strong winds and heavy rain occurred in Korea. It caused a significant amount of flooding in the roads in buildings. The existing method for the public to receive natural disaster-related information is through media broadcasts based on the meteorological agency. However, due to the progress of the present day's IT industry, the methods of relaying natural disaster-related information to the public are increasing. In particular, social network services associated with smart phone technology are utilized by an estimated fifteen million people in South Korea, and 500 million worldwide. In the instance of a natural disaster, SNS activity increases. An example would be when, in 2009, a plane crashed in the Hudson River in New York, information regarding the accident was shared via SNS. To date, there have been several cases in South Korea in which SNS activity allowed for information sharing regarding an emergency situation. One such case was in Korea in 2011 when, during a fire at an apartment building, information taken from SNS played a vital role in disseminating information to the local authorities as well as local residents [1].

In situations such as these, SNS can spread disaster-related information to the public more quickly than other broadcast media. However, most disaster information

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T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 218–224, 2012.

using SNS systems cannot make full use of SNS as the primary means of disaster-related information sharing. The reason for this is that SNS is a public forum for expression of ideas and discussions. Therefore, written posts may not follow grammatical rules or contain accurate information.

The aim of this paper is to suggest the implementation of a method which would allow for verification of reliability of information in SNS posts, as well as a system to extract location data of disasters. In extracting reliable information from SNS, citizens could form a real-time information sharing community regarding disaster-related information.

2 Related Works

2.1 The Information Delivery System Using SNS

In South Korea, Seoul was damaged by heavy rain in July 2011. Daum, an internet portal site, created a 'heavy rain hazard map' during this incident. Citizens could upload SNS messages that included disaster-related information. The managers of the site checked the individual SNS posts and displayed them on their map in order to provide information about the disaster situation. During that time, citizens in Seoul received useful disaster information from this map. Unfortunately, this map is not systematically updated, therefore citizens cannot reference it regarding recent disasters [1].

In foreign countries, research is also being actively done regarding the use of SNS for gathering disaster-related information. In Australia, the 'Emergency 2.0 Australia' system has been implemented to provide disaster-related information to citizens in real-time using Twitter and Facebook. This system serves a similar purpose as using SNS to convey disaster-related information, but it runs only with the exclusive application.

2.2 Semantic Analysis of SNS Messages

Information shared via SNS may contain individuals' personal information, but when a disaster occurs, SNS messages can become a social issue and have an effect on various areas. In such cases, there will be a great amount of messages, therefore we need to extract important information from the SNS messages systematically.

First, Hong C.H et. al., [2] conducted research regarding the extraction of features from Korean text by morpheme analysis using 'n-gram' of each syllable. The results indicated 8% improved performance. Won D.Y et. al., [3] suggested an algorithm to filter useful posts from tweets by using the Naïve Bayesian algorithm and URL analysis. In this research, they used 'spam-index' to select and delete useless tweets. Furthermore Chun Y.H et. al., [4] have researched the method to utilize SNS posts as an input parameter to calculate the flood risk index. Three properties of the input parameter can be set, including the type of disaster, the level and the location.

Related research in foreign countries is also being conducted. First, Rui LI et. al., [5] researched the method of creating a buffer for areas affected by disasters. They analyzed tweets and accumulated them to set the buffer that includes the disaster area. The method was used to make a pattern for disaster occurrence. Furthermore, Hurlock et. al., [6] researched the method of creating a semantic result by analysing statistics

of collected similar tweets. Clodoveu A. Davis Jr. et. al., [7] researched the method of extracting the location of a tweet by referencing the uploader's profile.

3 Analysis of Tweet for Finding Location Information

We can classify tweets by the type of information contained within the text. If the tweet includes a photo, it does not have the photo directly but include a path that stored the photo as text. According to this, we can classify tweets into two categories: text type and GPS type.

3.1 The Method to Extract the Location from Tweets Using GPS

Twitter accesses the GPS sensor when the user uses a smart device. We can extract the GPS value by using the 'Twitter Search API' from the Twitter official. Thus, a program could be implemented which would filter GPS including tweets and extract the GPS values from these using 'TwitterSearchResult'. This function extracts latitude and longitude from the search results. Tweets that contain GPS data provide the necessary information to pinpoint an exact location.

An additional function of 'Twitter Search API', 'SearchGeolocation' provides a method of searching in a spatial area. It searches tweets within a set radius. By inputting the geographical location and radius, all of the tweets within the selected area can be accessed. Related source codes follow figure 1.

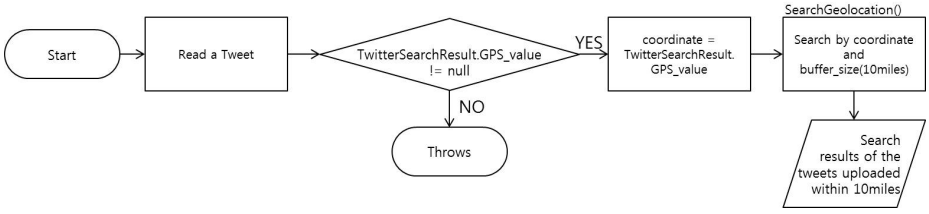

Fig. 1. The Method to Search within Area

3.2 The Method to Extract Location from a Tweet Based on Text

To extract semantic information from tweets, each word within a tweet must be examined. Twitter defined the rule that allows 140 characters in one tweet. In considering the fact that there are spaces between each word, there are twenty-two words in a tweet on average. Useful words and useless words should be separated in order to extract location information. It is important to note that tweets contain Twitter-specific words which are written by the system administrators to indicate such things as account names. These words are not related to the content of the tweet, and should be exempt from the extraction of words regarding location information.

Table 1 displays four tweets which consist of text only. The content of each text is different. The first tweet contains no special features. However, the following three include specific words to be analysed.

Table 1. Classification by Appearance of Specific Vocabulary

Types	Example	Purpose of the special word
Message Only	… what we call a disaster is …	There are no words of particular interest. Each word is examined.
@id	@shadow_S	Account ID
RT	RT @kuyakim_atienza: knee deep flood …	This post has been re-tweeted. If one wants to quote and spread the tweet, this symbol (@) is automatically attached at the beginning of the tweet.
URL Address	http://youtu.be/sND8K_Ys_ig?a	When one follows the link, a YouTube video can be viewed.

Specific words in Twitter have functional meanings. These can be omitted because they are not related to the content of the tweet.

Many tweets include URL links. In clicking on this link, videos or photos of related contents can be viewed. This documentation can be helpful in conveying disaster-related information, therefore URLs in analysed tweets will be stored separately.

Next, the location is set by finding the address in the examined words. The examined words are compared and the address is extracted from the Ministry of Public Administration and Security database. However, addresses in the tweet are generally partial or incorrect making it difficult to inference the full address from one tweet. It is important to consider that tweets posted within the same window of time and from the same region may be related to the same disaster situation. Therefore, the full address could be inferred by comparing tweets posted from the same location and during the same time-slot. The example follows in Table 2.

Table 2. Extraction of Address by Tweets Relation

Account ID	Upload Time	Contents in Korean (Raw Tweets)	Contents in English	Written region name	Confirmed Address
Kimjoo wan	2012-09-17 13:01:55	경남 창원도 '물바다, 트위터로 전해진 현장 사진들 http://i.wik.im/85127 by @TellYouMore @rab_p @cwopenspace @kimdddora 통영에 이어 창원에도 침수피해가 발생되고 있습니다.	Jinhae Yongwon flooded [photo] Hazarded situation by typhoon in Gyungnam	Gyungnam, Changwon, Tongyoung	Gyungsang namdo Changwon-si, Gyungsang namdo Tongyoung-si
Eventka ng	2012-09-17 12:48:02	통영 많은 비가 오고있네요.. #태풍 RT @leeae1827: [현재 통영정량동]침수ㅠㅠ http://pic.twitter.com/Vxat5p41	It is heavy raining in Tongyoung #typhoon RT@leeae1827: [Now] Flooding	Tongyoung, Jungryang-dong	Gyungsang namdo Tongyoung-si Jungryang-dong

3.3 The Method to Extract Location with Photo

Smart devices have several ways of sharing data. One of these is the GPS sensor which includes the geographical location data in photograph form. Photographs can be taken with GPS data in order to display the location of the photograph. The GPS value is stored using the tag 'EXiF'. This tag accompanies all digital photo files and contains a great deal of information about the photo. On occasion, the geographical location data that is stored is not that of where the disaster photo was taken, but rather the location of the individual photographer at the time that the photo is shared via SNS. Therefore, the GPS value must be adjusted to represent the location where the photograph was taken. In order to do so, other variables in the 'EXiF' tag should be referenced. 'GPSImgDirectionRef' and 'GPSImgDirection' are variables which are related with the exact location of the camera. By using these variables, the location of the photographer in relation to the disaster-affected area can be pin-pointed.

4 Realizing the Methods

The Google Map API can be used to receive information regarding a geographical location value by 'geo-coding'. The address can be extracted by several methods, as was demonstrated in the previous paragraph. However, it is necessary for the geographical location value to be displayed on a map. The geographical location value can be set and fixed by following two steps. The first step is the generation of the geographical location value by geo-coding. Geo-coding gives the geographical location value as longitude and latitude from an address. Thus, the location of the disaster can be obtained. The second step is map -searching based on the text. In this step, the location is searched for within the contents of the text, in keeping in consideration the result of the location obtained in the previous step. It is possible that the first and second step may not provide the correct location. It is possible, however,

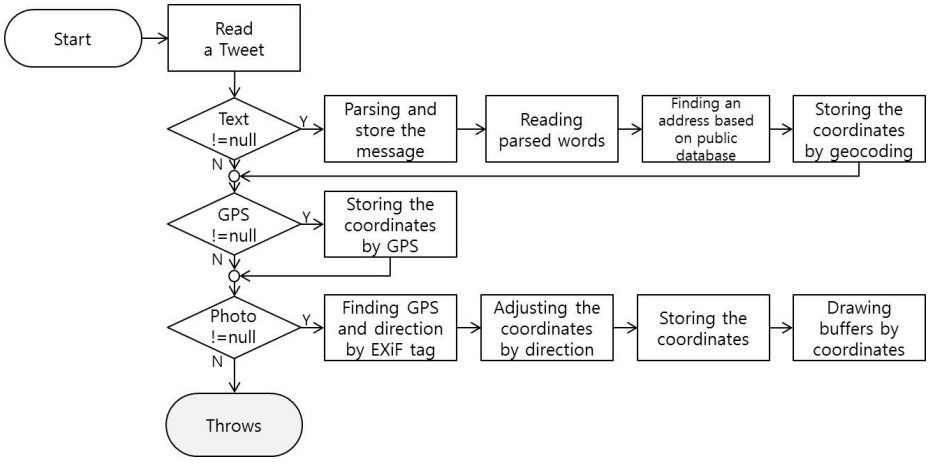

Fig. 2. Process Flow to Realize the Location

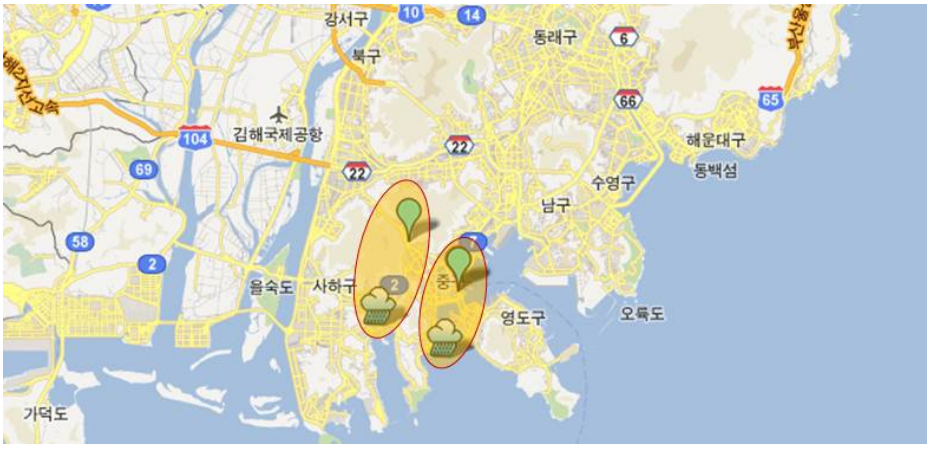

Fig. 3. The Location of GPS and Text based Search

to begin the process again in order to secure the actual location. This process is displayed in Figure 2, with the result in Figure 3. The pin-shaped icons represent the location with GPS, and the rain-shaped icons represent the location of text based searching.

5 Conclusion

The dissemination of disaster-related information to the public is an important area of study. However, at the present time, the only provider of reliable information is the Meteorological Agency of South Korea.

An alternative does exist, in the form of information sharing through SNS. SNS is a faster method of sharing information than any other media, whose speed is vital during disasters. The disaster information should include the properties of the type, the level and the location of the emergency situation. In this paper, it has been suggested that several methods to extract the location of disaster exist to rapidly and correctly categorize and share reliable disaster information. In utilizing these methods, information from SNS messages can be stored to construct new databases related to disaster information. Additionally, real-time disaster-related information can be shared by citizens with access to SNS via electronic devices.

Future studies will consider implementing methods to verify the reliability and grammatical correctness of information found in SNS texts. In addition, a program utilizing a systematized algorithm to extract pertinent data from SNS messages will be implemented.

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Experiments on the Sensor Space Based Location Estimation System under KS Specified Illumination Intensity Environment

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Abstract. A sensor space which is realized in this study was designed as a matrix structure comprised of CDS sensors made to recognize the coordinate of a specific location by sensing light when a robot is positioned on the CDS sensor. However, since CDS sensor is light-specific which sensitively responds according to the amount of light, it is important to understand the characteristic behavior of CDS sensor according to environment changes. Therefore, in this study, by setting various environments in the sensor space, the characteristics of CDS sensor data under different environments were analyzed.

Keywords: sensor space, CDS(cadmium sulfide) sensor, Illumination intensity.

1 Introduction

Recently, with increases in interest about mobile robots such as service robots, entertainment robots, etc., researches have been actively on the way about location estimation by robots which is a key technology in mobile robots. In most of the research, the estimation of relative location by installing encoders and gyro-sensors [1-2], infrared sensors, and vision sensors have resulted to extensive studies on absolute position estimation using GPS [3]. Recent researches that implement location estimation by mobile robots have progressed [6-8] by using RFID tag or barcode as landmark based on a new concept of “smart space” or “sensor network space” [4-5]. However, these methods need the addition of various devices on the robots, and with additional devices, robots would need large amounts of calculation. Also, the situation has a drawback of error accumulation in various sensor values. Therefore, in this study, a system was designed for location estimation without additional devices on the robot by creating a sensor space [9]. Sensor space was designed as a matrix structure of CDS sensor, and CDS sensor was made to estimate the coordinates of specific location when a robot was positioned on the CDS sensor by sensing light. However, since CDS responds sensitively according to the amount of light, it is necessary to understand the characteristics of CDS sensor based on environment changes. Therefore, in this paper, by setting various environments, CDS sensor data were

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T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 225–232, 2012.

analyzed and based on the analyzed data, an algorithm was implemented for accurate location estimation.

For the designing of sensor space based location estimation system, this paper is constructed as follows. In Chapter II, the construction of the CDS sensor space is introduced. In Chapter III, the characteristics of constructed sensor per different conditions are analyzed. In Chapter IV, experiment results are suggested. In Chapter V, the result of this study is concluded.

2 Construction of Sensor Space

The location estimation system in this study judged the robot's position by analyzing the signal from the CDS sensor when the robot was positioned within sensor space which was constructed with CDS sensor. Fig. 1 shows the location estimation system using the sensor space.

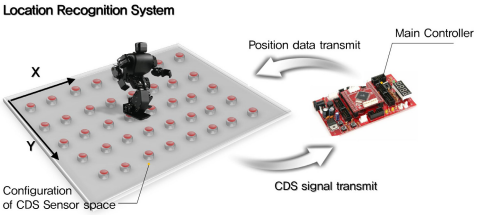

Fig. 1. A location estimation system using the sensor space

A sensor space is constructed as a 24X24 matrix which consists of a total of 576 numbers of CDS sensors. The same lines are connected to a power source, whereas the same rows are connected with signal lines. Therefore, a total of 24 power lines (P1, P2...P23, P24) and 24 signal lines (S1, S2...S23, S24) are connected to a main controller. Figure 2 shows the structure of the sensor space.

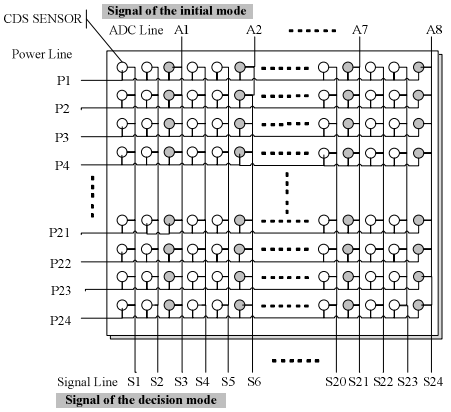

Fig. 2. Construction of sensor matrix

CDS sensors are analogue signal based, and the required time to obtain 576 analogue signals is roughly 1 second per the characteristics of the main controller in the main system. In case of the robot whose movement is instantly changed, its position is changed before the sensor signal is obtained; thus, the system cannot estimate the exact location. Therefore, we need to reduce the signal obtaining time by converting the analogue signal into digital signal. First of all, the main controller selects the initial mode. When power is connected to P1, the main controller obtains the analogue signal of 8 signal lines (A1, A2...A7, A8). After that, the main controller changes power line from P1 to P2 to obtain 8 analogue signals for P2. As a result, the main controller can obtain 196 analogue signals by changing the power line from P1 to P24 sequentially. After that, the characteristics of the analogue signal towards the environment. The reference value can be obtained in the comparator as shown in Fig. 3.

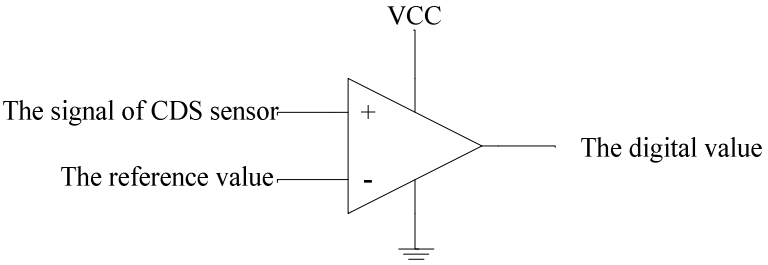

Fig. 3. A comparator to obtain reference value

When reference signal is obtained, the main controller selects decision mode. The main controller, like initial mode, changes power lines from P1 to P24 sequentially while 576 numbers of sensor signal are obtained from sequential 24 signals (S1, S2...S23, S24). The obtained signals are compared with the reference value in the circuit of comparator, and digital signal output 0 and 1 are generated. As a result, the main controller is constructed to execute initial mode once and then repeats the decision mode once the system is started.

3 Characteristic Analysis of Sensor Space in Different Situations

A sensor space which has been designed in the previous chapter is comprised of the matrix structure of CDS sensor. CDS sensor has a characteristic of sensitively responding according to illumination intensity. Therefore, for precise location estimation, the reference value in the comparator has to be set up by analyzing the characteristics toward the different environments.

3.1 Selection of Optimum Resistance Value to which CDS Sensor Responds

CDS sensor can be regarded as a variable resistance whose resistance value is changed according to the intensity of light. Therefore, the circuit in this system to obtain sensor value of CDS sensor is constructed as in Figure 4.

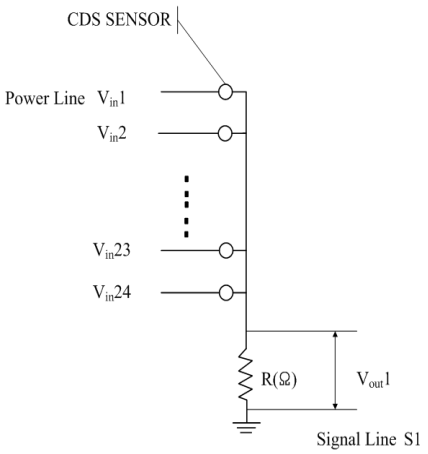

Fig. 4. Circuit construction of system

Figure 4 shows a circuit of S1 signal row in Fig. 1. When 5V V_{in} is input into power line sequentially, output voltage V_{out} is generated into the signal line by voltage distribution rules. At this time, since CDS sensor is a variable resistance, the signal value in CDS sensor can be changed by fixed resistance R. Therefore, we can set the response degree of CDS sensor by selecting the optimum resistance value. Figure 5 shows the response degree of CDS sensor by resistance value.

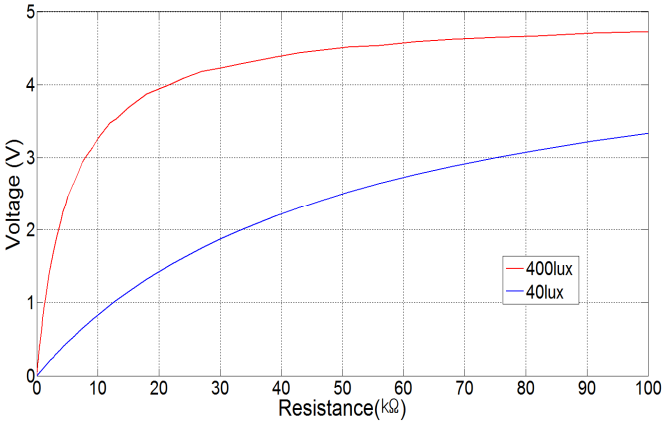

Fig. 5. Resistance changes by input voltage

CDA sensor values were measured by changing the resistance value from 0kΩ to 100kΩ under illumination intensities of 40lux and 400lux, respectively. When resistance was increased more than 50kΩ, the voltage was almost not changed as around 4.7V under input voltage 5V and illumination intensity of 400lux. However, with increases in resistance value of CDS sensor, voltage was kept on changing due to voltage distribution rule. Therefore, 10kΩ which had the largest difference in maximum and minimum output voltage was selected to be implemented in the system.

3.2 Analysis of CDS Sensor Characteristics under Different Illumination Intensity

From the result in Fig. 5, after selecting the optimum resistance value, the characteristics of CDS according to changes in illumination intensity were analyzed. The value of 1 CDS sensor and the value of sensor that was attached at the module were compared while changing the illumination intensity from 0lux to 700lux under the input voltage of 5V. Fig. 6 shows the output voltage values according to illumination intensity changes.

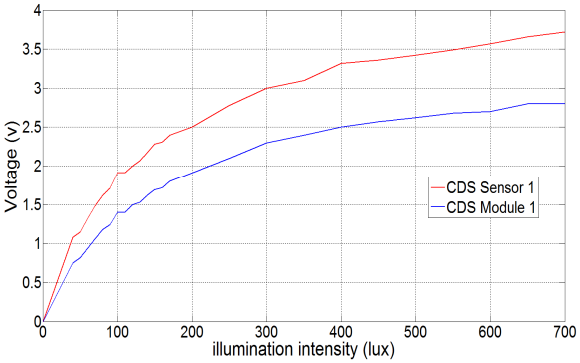

Fig. 6. Output voltage changes with illumination intensity

From Fig. 6, it is clear that with increases in illumination intensity, output voltage value changes is narrowed according to the characteristics of CDS sensor, while with decreases in illumination intensity, voltage value changes in sensor becomes larger. The reason why the voltage value of 1 CDS sensor which is attached at the module is less than that of 1 CDS sensor is that since CDS sensor also possesses resistance, combined resistance values make voltage value less when sensor values are measured from the sensor with multiple CDS resistance connection rather than measuring the voltage value from 1 CDS sensor. Therefore, when CDS sensor space is designed, input voltage and current have to be set considering the combined resistance to be as much as the number of CDS sensor. Fig. 7 shows the output voltage values of 576 CDS sensors in this system according to illumination intensity.

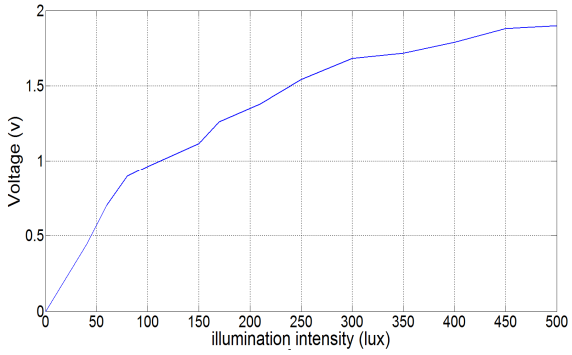

Fig. 7. Output voltage of CDS sensor with a different illumination intensity

In this system, design was made enabling the 576 sensors to be operated normally by lowering the input voltage of CDS sensor from 5V to 3.75V.

4 Results

In the previous chapter, the resistance and input voltage were set by analyzing the characteristics of CDS sensor under a different illumination condition. Therefore, environment was set per the illumination intensity standard specified in KS, and reference value was set by comparing the output data per different environment. Table 1 indicated environment setting with illumination intensity specified in KS standard.

Table 1. Environment setting with illumination intensity specified in KS standard

Illumination	Average of Sensor data	KS standard	Environment Setting
0 lux	0v	A	Existence of Robots
40 lux	0.4409v	D	Shadow
60 lux	0.7019v		
80 lux	0.8961v	E	Passage, conference room
100 lux	0.9619v		
150 lux	1.1156v		
170 lux	1.2617v	F	Lecture room, gym
210 lux	1.3781v		
250 lux	1.5417v		
300 lux	1.6811v		
350 lux	1.7166v	G	Class room, office
400 lux	1.7899v		
450 lux	1.8810v		
500 lux	1.8999v		

Illumination intensity is categorized from ratings A to K in KS standard, but the ratings of A, D, E, F, and G were adopted in this system. Rating A refers to the illumination intensity 0; that is, sensor is completely blocked as robot is positioned on the CDS sensor. Also, rating D is in a condition where most parts of CDS sensor is blocked, which is judged as shadow by light when a robot is positioned. Fig. 8 presents the experiment environment under each illumination rating.

Fig. 9 shows the signal values of CDS sensor by illumination intensity with time elapse. The sensor values changed with rating 0-0.4V under rating D, 0-0.9V under rating E, 0-1.5V under rating E, and 0-1.7V under rating G. At this time, though each reference value selects a median value between the maximum and minimum values, the values in the 40lux-60lux range are recognized as environment which makes shadow. Therefore, if illumination intensity rating is higher than E, the reference value is designed as lower than 40lux, so that the system will not recognize the robot's shadow.

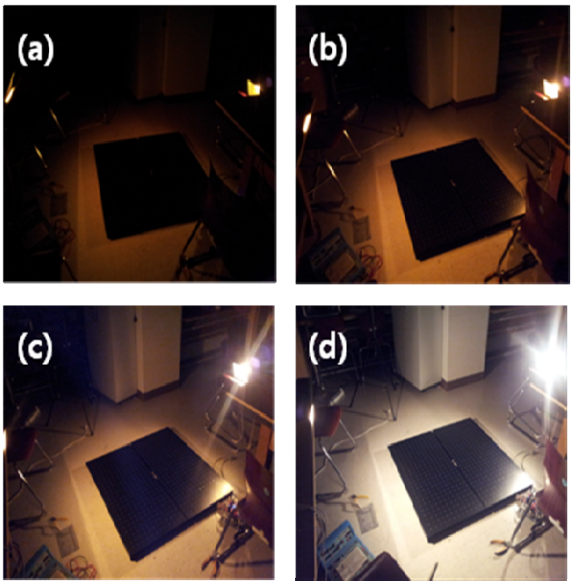

Fig. 8. (a) illumination rating D, (b) illumination rating E, (c) illumination rating F, (d) illumination rating G

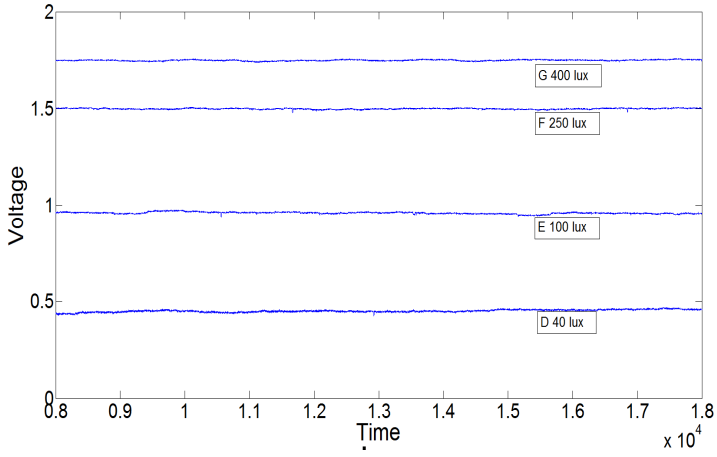

Fig. 9. The signal values of CDS sensor by illumination intensity with time elapse

5 Conclusion

In this study, a sensor space was designed in which location estimation was carried out with a simple communication without changing the structure of the robot. The sensor space comprised of the matrix structure of CDS sensor, and the CDS sensor was made to recognize the coordinates of a location when a robot was positioned on

the specific CDS sensor. However, since CDS sensor responded sensitively according to the amount of light, the characteristics of CDS sensor for the environmental changes needed to be understood. Therefore, the optimum resistance value to which sensor response was searched, and the changed values of the CDS sensor per different illumination intensity was examined with the selected resistance. Also, by setting the standard per different illumination intensity specified in KS, the imaginary environmental data were extracted. With these series of processes, by setting the reference value for each situation, more accurate location estimation was realized. However, resistance was connected either in series or parallel per the characteristics of the system, with increases in the number of sensors, and input voltage as well as current had to be considered. Further, since the reference value was set by judging the sensor characteristics under a different situation only during the initial stage of the initial mode, there was the drawback of not being able to recognize an accurate location estimation if the environment was suddenly changed. The sensor is thus expected to carry out an accurate location estimation by having a new algorithm under changing environment conditions.

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A Study on Damage Spatial Data Generation to Construct Disaster History Information

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Abstract. When disasters occur, data for damage is been collected through media such as the internet, smart-phones, telephones of government-related organizations and some civilians. However, an integrated system to accumulate and to manage the damage data is not completely constructed, and current disaster management systems have disadvantage sin regards to accuracy and cost in constructing spatial databases because of batch input processing with related documentations. We integrate dispersed data into our designed spatial database, such as photos transferred from smart-phones by civilians and other related information. We have developed an integrated damage spatial data management system to generate polygon type of damage areas based on the existing disaster history management system. In this system, managers can conveniently indicate damage areas with three different forms based on maps. General users and managers can provide the collected damage information and can search disaster history information.

Keywords: Disaster Management Systems, Damage Area Generation, Spatial Databases, GIS systems.

1 Introduction

The damage from unpredictable natural disasters such as flooding, wave-storms, landslides, and windstorms has recently increased on a large scale. Research for disaster management and analysis systems has been actively processed to prevent and reduce damage from disaster situations. Rapid and accurate collection and integration of damage information is one of the most important steps to analyze patterns of the spatial data and to provide information regarding hazard areas based on the maps [1].

Systems to collect information regarding location and other related attributes of damage using the applications of smart phones including social network services, such as Facebook and Twitter, and other applications of disaster data collection have been developed in real-time environment [2][3][4].

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T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 233–238, 2012.

On the other hand, methodologies for extraction and analysis of damaged areas with LiDAR data as well as satellite images and aerial photographs have been actively researched in disaster prevention fields as well as in the wide area of forest fire, urban planning, and environmental conservation [5][6]. However, they suggested that essential attributes and spatial data construction based on the real-time environment are required to extract more specific results.

Researchers [6][7] suggested the necessity of a system construction to effectively manage and utilize flood plain maps by constructing spatial databases for government managers and those in charge of planning. The researchers suggested that methods to automatically and easily construct disaster databases with a point type of location data and related attributes collected were required to maximize effectiveness of the disaster management systems.

Therefore, disaster management systems are required for managers to make collected data more reliable and historical. We have developed a GIS system to integrate dispersed damage data and generate polygon type of damage areas.

2 GIS-Based Disaster Management Systems

Disaster management systems based on GIS primarily include text data with additional attributes of time and location, remote sensing data, and satellite imagery data. Hristidis et al. [1] reviewed the data flow process of disaster management with technology such as information extraction, information retrieval, information filtering, data mining, and decision support. They emphasized the needs and requirements for data integration and information extraction, and information retrieval in disaster management. Systems to collect location and related information of occurred damage using the applications of smart phones have been developed in an real-time environment [2][3][4].

Specifically, a flooding information system hazard based on disaster data was earlier constructed in the USA. FEMA constructed National Flood Hazard Layer (NFHL) GIS data and web map services that are integrated with other map data, and provided new option for using FEMA flood hazard information [8]. Flood hazard data can be viewed in Google Earth and FEMA Map Viewer.

In Korea, the National Emergency Management Agency (NEMA) announced a recommendation to construct a hazard map in 2006. The guide includes previous records of flooding, flooding situation surveys and analyses of damage as well as the location, range and depth of the flooding [9]. The data of previous records of flooding has been mostly documented but not systemized based on GIS.

Constructing spatial databases is a basic and important step to analyze disaster patterns. Kim [5] presents a methodology for presenting flooded areas by simulating these with aerial photographs to effectively manage and recover flood records. He suggested the necessity of a system to effectively manage and utilize flood plain maps by constructing spatial databases for government managers and planners. Kim et al. [6] developed a disaster damage investigation system using high resolution satellite images and GIS techniques. They extracted the damaged area by comparing pre-disaster images with post-disaster images, and the results were stored into databases. They suggested the necessity of consistent update works by connecting high resolution spatial images and disaster databases including disaster attributes and spatial data.

In addition, GIS-based disaster management systems have been actively researched based on the existing spatial databases. Abbas et al., [10] proposed a GIS-based earlier response system and an emergency preparedness plan and analyzed the impact of flood disasters with GIS tools. They said the system would provide the opportunity for quick decision-making ability for the rescue and safety of civilians, and in addition would minimize loss of life and property. Jeon et al. [11] developed a search system based on maps to manage previous disaster records and related information using spatial databases. This system can be utilized as a basic framework in developing damage prediction and prevention systems. Kim [12] developed a disaster prevention system by analyzing disaster information using disaster attributes and spatial data such as numerical value video, numerical value topographic maps, land registration maps, and geological maps. This system can calculate the scale of disaster damage, so at to provide information regarding disaster investigation and suggested recovery plans to local government and related institutions.

3 System Architecture for Disaster Data Generation

We propose architecture to illustrate the entire process from data collection to data search as shown in Figure1. The system consists of two parts: data generation including a client-server application and data servers based on client-server environment as well as data collection including a smartphone application, web server, and the Google map server based on the smartphone environment. The former is directly related to this study while the latter has been addressed in our previous research [2]. We now access the collection databases to generate the spatial data of damage.

The data generation is composed of five different stages: data collection, area creation, data edition, data transmission, and map-based search. This system requires managers to validate data for construction of more reliable data after creating damage points and during the process of data edition.

Data Collection. General users through a smartphone application send various kinds of damage information such as location, images, date and time, and description. We have used the method of REST web services to transmit the data. The method is for sharing data by using URI and specific message protocols such as PUT, POST, GET, and DELTE based on a web service protocol platform.

Area Creation. The disaster data gathered from users is stored into the damage collection databases. First, managers must generate point type features of the damage. This work is executed after the values of the x and y coordinates are adjusted to the same coordinates as those of the base-map of the client-server application. Next, this system creates polygon type features of the damage by intersecting generated damage points with an address-related polygon layer based on a coded building identifier field. In addition, managers can directly draw a damage area with editor tools and can create damage areas with an Excel file including the coded building identifier.

Data Edition. Data edition works to update information such as attributes and photos of the generated damage areas. In addition, managers can delete attributes and photos

if some point geometry features associated to a generated area are deemed unreliable. In addition, managers can delete generated points and areas which are also deemed unreliable. This step requires a manager to validate spatial data, collected attributes and photos.

Data Transmission. The transmission step is needed to transmit created damage data into a database constructed to store disaster history data, which is main database in our previous work [11], the damage history expression system. Managers input the attributes of damage such as disaster code, disaster cause, rainfall, damage and recovery amounts, and description.

Map-Based Search. This step supports map operation such as layer management, zooming in and out, and damage area within regions drawn by users on maps as well as general key-word searches such as dates, types of damage, and photos of existing damage areas. Managers can validate data by searching changes of photos on time series.

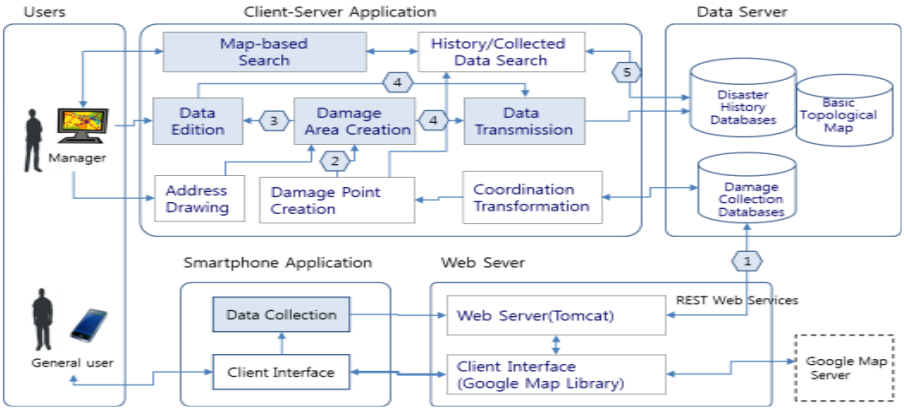

Fig. 1. System Architecture and the Process Diagram

4 System Implementation

We have implemented a proposed system by supposing that civilians send photos and related information of damage, and managers verify the collected data and edit invalid data. We use the the ArcEngine toolkit and the ArcSDE tool by ESRI, and the C# language, oracle database management systems to implement this system. Figure 2 shows a main screen shot with point creation, area creation, and data edition. Specifically, the area creation menu has three sub-menus: address input, drawing, and position uses as to each method to create polygon type of spatial data. In the case of the address input sub-menu, the damage area is created for managers by inputting an address or loading an Excel file. Next, managers can directly draw the damage area with graphic editor tools. Finally, the damage areas are automatically created by using information from collected data locations and an address-related layer.

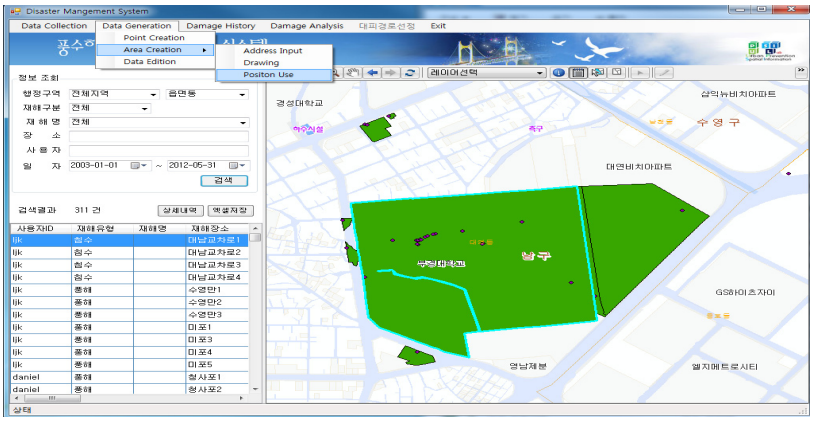

Fig. 2. Main Screen Shot

Figure 3(a) shows the process of area creation using generated points. An area of spatial data for each point is generated depending on each date of occurred damage. The screen shot of Figure 3(b) is displayed after a manger selects the data edition menu. Managers can delete generated points and areas as well as edit and delete photos. In addition, this form has the DB transmission button connected to transfer this area into the history databases.

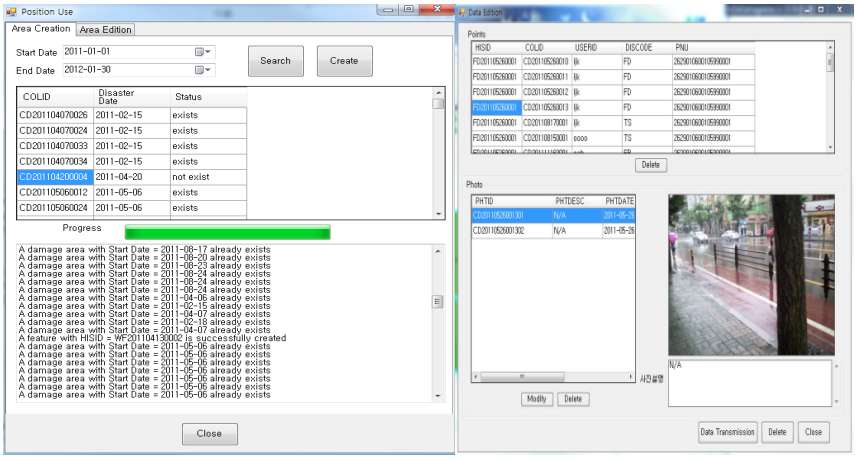

Fig. 3. (a) Area Creation (b) Data Edition

5 Conclusions

We implement a damage data generation system based on GIS to integrate dispersed data transmitted from smart phones into existing disaster history databases. In order to achieve this goal, we propose the five steps of data collection, area creation, data edition, data transmission, and map-based search. In the case of area creation,

managers can create polygon type features of damage areas by accessing address input, an Excel file, and collected points of damage. Our work will be utilized as a basis input data in constructing hazard maps and flood plain maps. In the future, we will create disaster analysis models to provide information regarding characteristics and cause of damage as well as higher intensity flooded areas than others.

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Analysis of Gaussian Pulse's Bandwidth for Automotive UWB Short Range Radar

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Abstract. In this paper, we present the mathematical analysis of the bandwidth and the pulse-width of Gaussian pulse for 24GHz automotive UWB SRR system. Finally, we propose an appropriate value of the time normalization factor in making the Gaussian pulse, which is related with bandwidth satisfying the standards.

Keywords: UWB SRR, Gaussian pulse, Pulsed radar, bandwidth, power spectral density.

1 Introduction

Recent advances in silicon technologies and electronic design methods, make possible the realization of highly-integrated radars with low cost, compact size, and low power consumption. This enables the widespread adoption of radar for new civil such as automotive short-range radars (SRR) for car parking, side-crash warning, collision warning, blind-spot detection, and "stop and go" control in urban scenarios [1].

Such radar systems have some characteristics: radar modulation scheme is pulsed UltraWideBand (UWB) and SRRs operate around 24GHz. Also there are strict limitations in terms of output power spectral density (PSD) [1]. Fig. 1 reports, for ETSI (European Telecommunications Standards Institute) and FCC (Federal Communications Commission) standards, the EIRP (Equivalent Isotropically Radiated Power) spectral density expressed in dBm/MHz [1].

In this paper, we present the mathematical analysis of the bandwidth and the pulse-width of Gaussian pulse for 24GHz automotive UWB SRR system. Finally, we propose an appropriate value of the time normalization factor in making the Gaussian pulse, which is related with bandwidth satisfying the standards.

The organization of this paper is as follows. In Section II, the Gaussian pulse is described. In section III, the bandwidth of the Gaussian pulse is presented. Finally, conclusion is presented in section IV.

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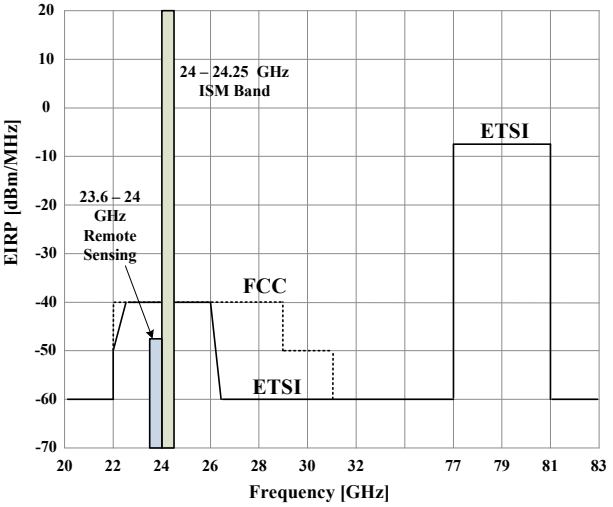


Fig. 1. EIRP Power spectral density in dBm/MHz in ETSI and FCC

2 Ultra-Wideband Gaussian Pulse

UWB automotive Radars take a Gaussian pulse. Gaussian pulse may be defined as follows [2]:

$$p(t) = A \cdot \exp\left[-2\pi\left(\frac{t}{\tau_p}\right)^2\right] \tag{1}$$

where τ_p indicates the time normalization factor that decides the pulse-width of $p(t)$. The energy of Gaussian pulse $p(t)$ defined in the expression above is not normalized. Thus, it may be normalized so that the total energy of the pulse becomes "1" as below

$$\int_{-\infty}^{+\infty} p^2(t)dt = 1 \tag{2}$$

In addition to that, the total energy of signals may be represented as $R(0)$ by using the autocorrelation function $R(x)$, and $R(x)$ may be defined as follows

$$R(x) = \int_{-\infty}^{+\infty} p(t)\,p(t-x)dt = \frac{\tau_p}{2}\exp\left[-\pi\left(\frac{x}{\tau_p}\right)^2\right]. \tag{3}$$

Substituting eq. (1) to eq. (2), the amplitude of Gaussian pulse A in eq. (1) could be calculated as follow

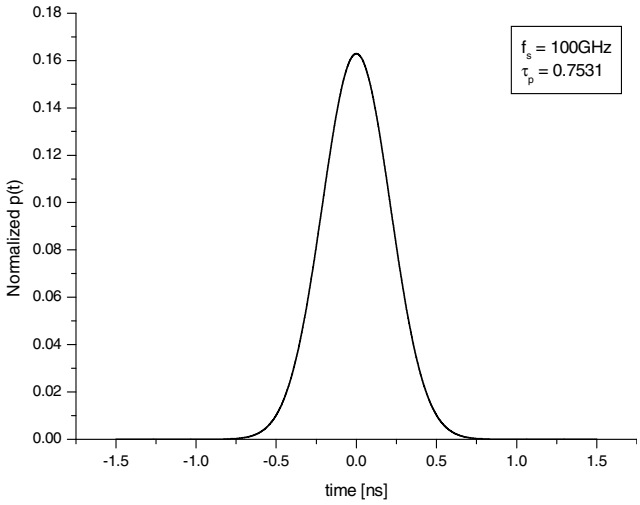
$$A = \sqrt{\frac{2}{\tau_p}}. \tag{4}$$

And the same result could be found when the autocorrelation function in eq. (3) is used. Hence, the normalized Gaussian pulse is as follows

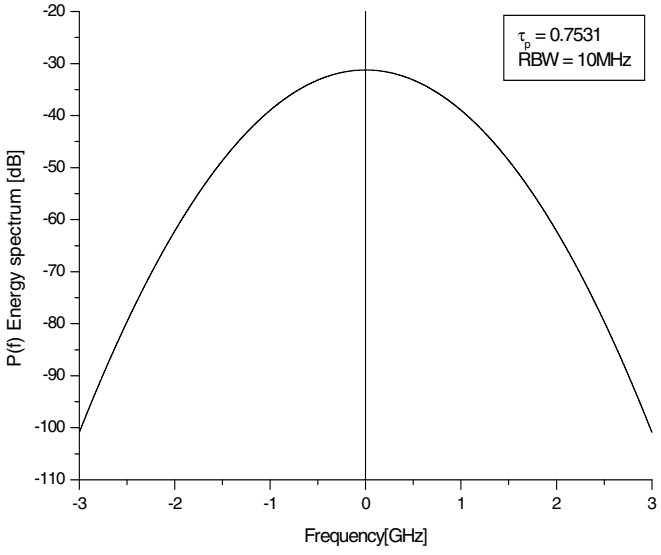
$$p(t) = \sqrt{\frac{2}{\tau_p}} \cdot \exp\left[-2\pi \left(\frac{t}{\tau_p} \right)^2 \right]. \tag{5}$$

The Fourier transform of eq. (5) leads to expression $P(f)$ in the frequency domain:

$$P(f) = \int_{-\infty}^{\infty} p(t) \cdot e^{-j2\pi ft} dt = \sqrt{\tau_p} \cdot \exp\left[-\frac{\pi}{2} (\tau_p \cdot f)^2 \right]. \tag{6}$$



(a) Normalized Gaussian pulse



(b) Energy Spectrum of Normalized Gaussian Pulse

Fig. 2. Gaussian Pulse and Energy Spectrum

Fig. 2 shows the normalized Gaussian pulse and energy spectrum of RBW(Resolution Bandwidth)=10MHz when the sampling frequency of f_s=100GHz(T_s=0.01ns) and the time normalization factor, τ_p=0.7531[ns], are used.

3 Bandwidth of Gaussian Pulse

As shown in eq. (5), Gaussian Pulse is not, in fact, a time-limited signal. Rather, this is a signal astringent to "0" as a time variable, *t*, *approaches* $\pm\infty$. Hence, it is difficult to determine the pulse-width as in Fig. 2. Besides, the energy spectrum of the Gaussian pulse at eq. (6) is not a band-limited signal just as the Gaussian pulse. In general, as for bandwidth of signals, important frequency contents (elements) of the signals are referred to on the frequency, both positive and negative. In particular, it is difficult to define the bandwidth of signals with an unlimited range of frequency. This is because the meaning of the term "important" is not completely mathematical. The commonly used definitions of the bandwidth, therefore, include the following two [3]. First, this is applied to signals with a frequency range that features the mainlobe limited by null(0). As shown in Fig. 2, Gaussian pulse is not a signal whose bandwidth is distinguished by means of a mainlobe, and thus this method cannot be adopted. Second, the frequency of energy spectrum at the point that the peak of energy spectrum reaches -3dB is used as the bandwidth (3dB Bandwidth). To find such 3dB bandwidth, the peak of energy spectrum should be found first. As shown in eq. (6) and Fig. 2, the peak at the point of f=0 is τ_p. When the energy is as much as -3dB of the peak value, the bandwidth $B_{3\text{dB}}$ can be defined as follows:

$$P^2(B_{3dB}) = \tau_p / 2 . \tag{7}$$

Substituting eq. (6) to eq. (7) leads to $B_{3\text{dB}}$ as in the following expression:

$$B_{3dB} = 1/T_p = \frac{1}{\tau_p} \cdot \sqrt{\frac{\ln(0.5)}{-\pi}} . \tag{8}$$

The methods above are commonly used for narrowband or broadband signals while other methods are used for UWB signal.

According to the report of DARPA (Defense Advanced Research Project Agency) in 1990, UWB needs to maintain the extremely low density of energy spectrum, and the bandwidth needs to be at least 25% of the center frequency. The term 'bandwidth' may be replaced here with 'fractional BW' and this is defined as follows:

$$FractionalBW = \frac{f_H - f_L}{(f_H + f_L)/2} \geq 0.25 \tag{9}$$

where $f_{H\ and}$ f_L are defined as the upper and lower frequencies respectively on the energy spectrum which corresponds to 90% or 99% of the entire energy. According to DARPA's definition, the narrowband is to be within 0.01, broadband 0.01~0.25, and UWB 0.25 or higher. Hence, UWB signals have an outstandingly broad bandwidth.

The energy spectrum of Gaussian pulse is expressed with an even function, that is, f_L = -f_H. As Fractional BW cannot be used in this study, f_H - f_L is regarded as the bandwidth of signals. Consequently, the bandwidth of Gaussian pulse in the baseband

is $BW = f_H$. When the energy from the pulse energy spectrum accounts for 99% of the entire energy, this is applied to eq. (6) as below:

$$\int_{-B_L}^{B_L} P^2(f)df = erf\left(B_L\sqrt{\pi}\cdot\tau_p\right) = 0.99. \tag{10}$$

The above equation may be represented by an expression of τ_p as follows:

$$\tau_p = \frac{erf^{INV}(0.99)}{\sqrt{\pi}\cdot B_L} \tag{11}$$

where B_L indicates the bandwidth of the baseband signal, and $erf^{INV}()$ is defined as follows:

$$y = erf(x) \rightarrow x = erf^{INV}(y)$$

If B_L=1/T_P, then based on eq. (11), the pulse-width T_P is as follows:

$$T_p = \frac{\sqrt{\pi}\cdot\tau_p}{erf^{INV}(0.99)}. \tag{12}$$

In February 2002, FCC (Federal Communication Commission) permitted the commercial use of UWB technology, and made public the frequency bandwidth for UWB system. The definition of FCC is divided mainly into two parts, and the first is the system to satisfy the following condition:

$$FractionalBW = \frac{f_H - f_L}{(f_H + f_L)/2} \geq 0.2 \tag{13}$$

where f_H and f_L indicate the upper and lower frequencies respectively on the point of -10dB from the peak of the energy spectrum. The second is the system over 500MHz with f_H - f_L regarded as the bandwidth of signals.

Hereunder, this study states Gaussian pulse with the bandwidth over 500MHz as the standard. The energy spectrum of Gaussian pulse has the peak at the point of 0Hz, and the spectrum is represented as an even function such as $f_L = -f_H$. Consequently, the bandwidth of Gaussian pulse in the baseband is f_H. Just as in the calculation of 3dB bandwidth, the relation between τ_p and the bandwidth (or pulse-width) is as follows:

$$\tau_p = \frac{0.8561}{B_L} = 0.8561\cdot T_p \tag{14}$$

where T_P indicates the pulse-width on the assumption of B_L=1/T_P. Fig. 3 shows the relation between the pulse-width T_P and τ_p.

Fig. 4 shows the energy spectrum and normalized Gaussian pulse according to various bandwidth definitions on the signal with the bandwidth of 500MHz or the pulse-width of 2ns. To determine the pulse-width, the bandwidth is decided based on the definition, and then the time normalization factor, τ_p, is used in the calculation on the assumption of B_L=1/T_P. Consequently, it turned out that the 3dB bandwidth is the broadest, and thus the pulse-width is the smallest. In addition, according to the definition of UWB signal, the bandwidth as much as 99% of the energy and -10dB BW are almost the same. Hereunder, this study states -10dB BW, as defined by FCC, as the bandwidth of the pulse.

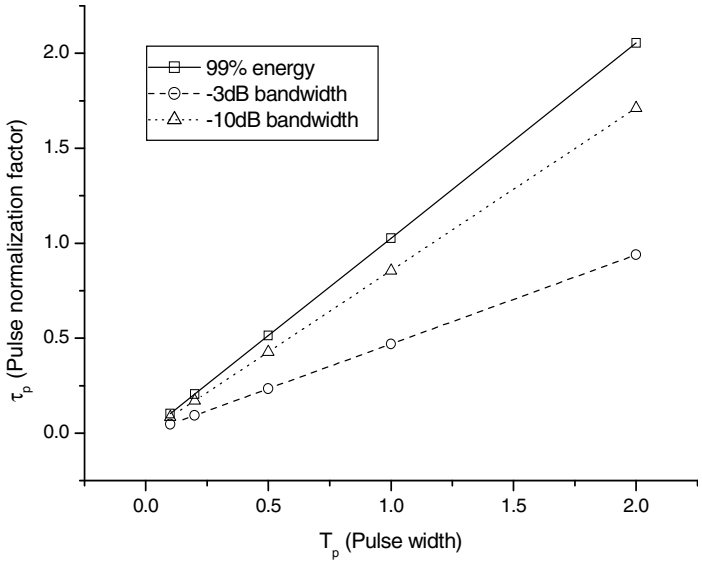
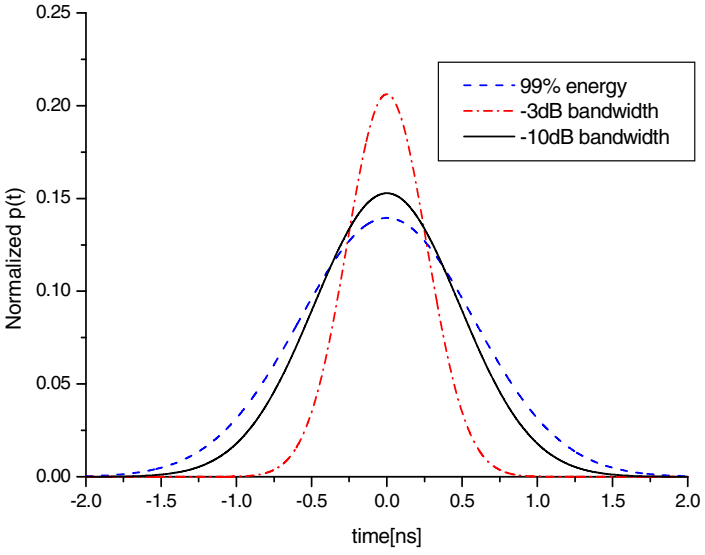
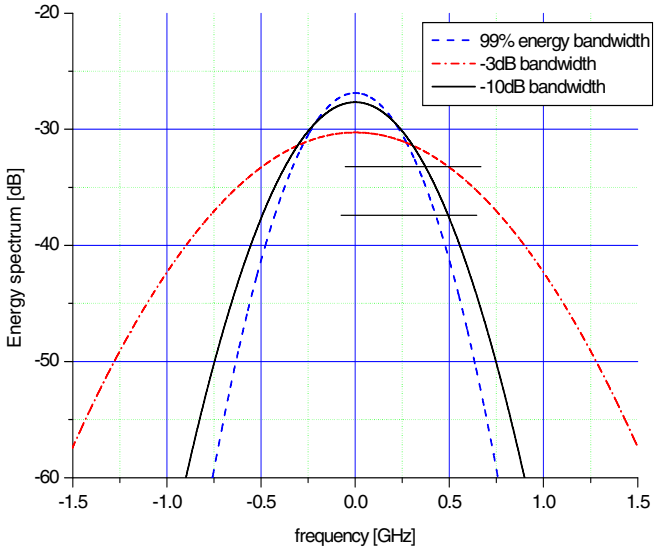


Fig. 3. Relation between T_P and for various BWs



(a) Normalized Gaussian Pulse

Fig. 4. Gaussian pulse and spectrum for various BWs



(b) The Energy Spectrum of Normalized Gaussian Pulse

Fig. 4. (*continued*)

4 Conclusion

In this paper, we present the mathematical analysis of the bandwidth and the pulse-width of Gaussian pulse for 24GHz automotive UWB SRR system. Finally, we propose an appropriate value of the time normalization factor in making the Gaussian pulse, which is related with bandwidth satisfying the standards.

The analysis of this paper helps to decide the Gaussian pulse-width and the bandwidth. Up to now, there is no literature that describes the time normalization factor in order to design the Gaussian pulse exactly.

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Software Test Capability Improvement Method

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Abstract. An Integrated Medical Information System (IMIS) requires continuous customization to cope with periodic government notifications, changes in customer needs, and changing customer preferences. These systems are also modified as part of internationalization efforts. An IMIS should adhere to these situations while retaining its ability to charge medical expenses to patients and to the National Health Insurance Corporation. It should also deal with medical information such as prescriptions, medical images or videos in a manner that avoids minor defects which can lead to legal battles. Thorough testing is therefore very important. However, it is not easy to standardize medical processes, and much tailoring of IMISs has been done as a result. Moreover, new notifications should be reflected in customized IMISs operating in the hospitals within one week. It is known that sufficient testing of these systems has not been carried out. Therefore, this paper describes observations and an examination of the improvements of the test capability of such a system at a SME-level company. The assessments use a lightweight test process based on the test capability level of the company.

Keywords: Software testing, test process, test maturity model, Integrated Medical Information System (IMIS).

1 Introduction and Motivation

The complexity of software is gradually increasing as the functionalities of computer systems become diversified and as software is applied to various fields, such as the medical equipment, aerospace, automobile, and defense fields. As these systems include intelligent and adaptive functionalities that are implemented by software functionalities and considering that the portion of software R&D has increased (from 35% to 65% [1]), their importance has also increased. Accordingly, many organizations recognize the necessity of software quality improvements and have adopted software test processes, test tools, and test methods. Recent surveys of software testing practices also report that the cost of software testing ranges from 20% to 50% of the total software development budget [2, 3, 4, 5]. In addition, there are numerous models for the improvement of test processes , including TMM*i* (Test Maturity Model integration) [8]. However, many software development organizations in Korea experience difficulties due to compressed project schedules, a lack of skills, and a lack of

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T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 246–251, 2012.

knowledge of these test processes [2]. In particular, test process improvement models such as CMM/CMMI [6] are too complex to be used in small and medium enterprises (SMEs), as SMEs do not have the capability to implement such maturity models. Thus, existing test technologies should be adjusted to match the different development environment of each SME, and test processes should be gradually implemented in accordance with the SME's maturity level.

This paper describes test capability improvement measures in a SME. In this study we designed a lightweight test process based on ISO/IEC 29119 [7] considering existing test models and techniques [8, 9] and applied it to improve the test capability. This study was conducted to validate the effectiveness of the lightweight test process, which includes processes and activities that are critical to the SME's domain characteristics as they are defined in ISO/IEC 29119.

This paper is organized as follows: Section 2 introduces the Integrated Medical Information System (IMIS) and as-is test practices of a SME. In Section 3, we present an overview of the domain-dependent designed lightweight test process and rollout results based on the assessment recommendation. And finally in Section 4 concludes the paper.

2 The Domain and As-Is Test Practices

IMISs are operated in different sizes and types of hospitals, from clinics to general hospitals, to support U-health services. IMIS supports an integrated management system for making appointments and payment (PM/PA), issuing prescriptions (OCS), and storing medical records such as images and text (EMR). The functional/non-functional requirements of an IMIS differ depending on the size and type of hospital in which they are used, and they should continuously change in accordance with periodic notifications. Fig. 1 shows the basic IMIS structure, which includes administrative, clinical, and management information systems.

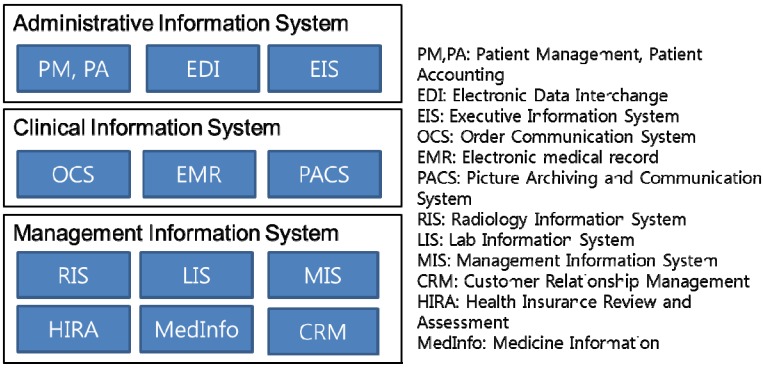

Fig. 1. The structure of IMIS

An IMIS should adhere to the notifications while being able to charge medical expenses to patients and to the National Health Insurance Corporation while also dealing with medical records such as text, images, and videos, exchanging/sharing them

among different departments. Minor defects in such a system can endanger patients or cause the serious financial loss, even leading to legal battles. Despite these concerns, because it is not easy to standardize medical processes and because the preferences of doctors are quite diverse, much tailoring has been done with these systems. In addition, it is not easy to conduct efficient testing because an IMIS should reflect the new notifications rapidly, especially the diverse customized IMIS systems operating in hospitals.

The assessment in this study was conducted on three different IMISs, referred to here as Solution-A, Solution-B, and Solution-C. They operated in different sizes and types of hospitals. The objective was to validate whether it is possible to improve the test capability through the implementation of a lightweight test process. (1) Solution-A is an IMIS operating in a general hospital. It has evolved over 15 years. Recently, the addition of new functionalities is required because the Health Insurance Review and Assessment (HIRA) Service of Korea has implemented new medical regulations. In the case of Solution-A, of which the size is 26,000 KLOC (excluding the GUI relevant codes), the probability of side effects by modifications is high because the modules are highly coupled with each other. (2) In the case of Solution-B, operating in a clinic, its major functionalities are an EMR (electronic medical record) system and an OCS (order communication system). Its size is 2,600 KLOC. Solution-B handles basic functionalities such as receipts, medical treatments, statistics, and payments. Besides these basic functionalities, Solution-B should support patient management, a PACS (picture archiving and communication system) viewer to support the usage of sonogram and endoscope images, real-time drug information inquiries to reduce incorrect prescriptions (druginfo.co.kr), a vaccination EDI for substitute reports to local health centers, a display management system for the patient waiting room, and the issuing of medical treatment records. These support functionalities are similar to those of Solution-A. (3) Solution-C is an underdeveloped system and a common module for supporting HIRA for PM/PA (patient management/patient account), OCS, and EMR. Solution-C will replace the relevant modules of Solution-A and Solution-B.

We measured the as-is test practices of the three selected solutions for 3 months. As a result, in the case of Solution-A, the defect resolution percentage was 76%, and 130 defects were reported per month, where two team members participated out of eight members. In addition, there were numerous defects for which causes were difficult to find or that could not be reproduced. In the case of Solution-B, the defect resolution percentage was 97% and nearly 100 defects were reported per month, where five team members participated out of seven members. However, the defect resolution cost was 63% higher than that of Solution-A. The as-is test measurement for Solution-C was not done because this solution is still under development.

3 Improvement of Test Capability

3.1 Action Plans

A lightweight test process for the SME was defined based on ISO/IEC 29119 [5], the verification and validation practice areas of CMMI, and TMM*i* using the Delphi

method. Four participants who were involved with Delphi have more than 10 years of experience. The lightweight test process includes relevant test methods and tools for each process as well as the basic components of processes, purpose, inputs, tasks, and outcomes. The defined lightweight test process encompasses 30% of ISO/IEC 29119. The principle of the lightweight test process is mutually exclusive and collectively exhaustive while reflecting the TMM*i* maturity level. In addition, reviews/inspections are conducted from the early phase of software development so as to minimize the losses due to the defects found at the late phase of software development in accordance with the principles of agile testing [7]. The SME can determine the priorities of practices that will be implemented and the number of measures and artifacts to be monitored and produced.

Before implementing the lightweight test process, training for ISO/IEC 29119, TMM*i*, and PSP was conducted for the QC team members, the developers who were involved in the testing, and the testers. Three teams prepared a rollout based on the following common action items:

- Formulating the test policy: During the first period of improvement, informally shared policies are collected and documented.
- Establishing the test process: The test process will be gradually set up and improved according to the SME's test maturity level. If it is not easy to formulate a separated test team due to a lack of resources, the developer should conduct testing using well-developed and defined completion criteria and the situation will be complemented by defining different roles and responsibilities among the team members.
- Enhancing the checklist-based test and peer-review process: The checklist must be defined through brainstorming among relevant stakeholders and the rationale for decisions should be documented and the checklist periodically updated.
- Using test tools: Test automation processes will gradually be implemented whenever adding a new module is required and test artifacts should be reused in later maintenance procedures.
- Managing defects: Defect management will be divided into management for defects found while adding new functionalities and those found by customers. Defect statuses, un-reproducible defects, and recurring defects will be managed via a defect management sheet or by defect management software.

The rollout was executed while not invading the current business of each team. The participant team did not conduct system and acceptance testing because establishing a system operation environment in the medical domain is difficult. We therefore conducted more thorough integration testing.

3.2 Rollout Results

Solution-A team developed new modules by adhering to the lightweight test process. The team members implemented the defined action items. As a result, the measurement

results reported that the new process reduced the number of defects by 0.01 per KLOC. The reduced number of defects found before the release will be 260 when we apply the process to the full range of the solution. In particular, the team tried to automate the unit and integration testing for newly added modules using the nUnit tool. This will reduce the effort required for the test as part of the maintenance efforts by promoting the reuse basis of test artifacts.

The defect resolution ratio for the customer reported defects on the Solution-B team was 97%. The lightweight test process was applied to the development of a minor upgrade version (ver. 5.3.1) from version 5.3. As a result, the number of defects was reduced by 0.02 per KLOC; if we apply the process to the full range of the solution, the overall number will be 52. The team conducted a review/reflection meeting with all team members for every test phase, including the reviews and inspections of the requirements, the design, and the codes. However, the results were 30% overall for the lightweight test process. The results were measured over three months.

Modules for Solution-C, with a size of 358 KLOC, are highly correlated due to the sharing of clinical and management information databases. There were as a result difficulties in that many test codes should be added for unit testing. Thus, the team minimized unit testing and focused on integration testing, which was performed by a senior team member who had much domain experiences and who was assigned the roles and responsibilities pertaining to the integration testing processes. As part of this process, the necessity of sharing the uncovered defects and their status in real time was brought up, and the team therefore developed a proprietary defect management tool and used it. As a result, the defect resolution ratio was 95% and the defect density was determined to be 0.7 per KLOC. Solution-C will be integrated into the other two solutions and the customer reported defect density will be traced to monitor the effects of the test process improvement.

Each team performed a formal review which was informally conducted with the senior developers using checklists for every static and dynamic test phase. The checklists were documented, and through this the senior developer's experiences could be utilized as assets.

4 Conclusions and Future Works

This paper described the experience of defining and applying a lightweight test process considered to be the best solution for a SME-level company in their development and use of an IMIS. An IMIS undergoes frequent customization to reflect the various sizes and types of hospitals. Moreover, the IMIS should be continuously upgraded in accordance with changes in government policies and with the new notifications. Thus, systematic testing is very important to cope with these environments. However, it is not easy to adopt existing test processes in a SME attempting to develop an IMIS because too much effort is required to institutionalize these processes.

SMEs often have difficulties in performing the required software engineering processes due to the lack of people, time and skills. Therefore, we adopted an approach that gradually reduces the gap between the current test practices of the

company and proper software testing principles by adjusting the test principles to the current situation of the company. We also adopted a minimally invasive approach, termed here a lightweight test process, to work with the currently operating software. We also confirmed the effect of the defined lightweight test process by applying it to three different solutions of different sizes and types.

As a result, if we use the lightweight test process that includes the adjusted activities, guides, and outcomes in accordance with the test maturity levels of SMEs, we can improve their testing capabilities by implementing only 30% of the standardized test processes despite the fact that SMEs do not typically have efficient software engineering capabilities. This experience showed that the number of defects after release was reduced by as much as 100% in Solution-A and 87% in Solution B. In addition, by reusing test activities and artifacts, they could elevate their test agility.

For the future, we will define lightweight test processes for each TMM*i* maturity level by adding the current lightweight test process defined based on the capability to implement the practice areas of TMM*i* Level 2.

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Implementation of Improved DES Algorithm in Securing Smart Card Data

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Abstract. Although smart cards have already provided secure portable storage device, security is still a major concern to electronic data systems. There is a need to improve data security against accidental or unlawful destruction or alteration during transmission or while in storage. The Odd-Even substitution proved to have provided additional confusion technique to DES and was essential in providing adequate security. The limitation of DES to encrypt large data has also been addressed by this research without intensive processing. Unlike the 3DES or AES, the improved DES has lesser computational load.

1 Introduction

Smart cards have been used in security-sensitive applications from identification and access control to payment systems. Smart cards store confidential information and can deliver secure and accurate identity verification much more difficult to counterfeit than ordinary magnetic stripe cards [2]. These cards can be utilized to provide secure and strong authentication and have been designed to provide greater performance, portability, efficiency, and interoperability. Smart cards enable business establishments to automatically identify, track, and capture information electronically [3].

However, confidential information is vulnerable to potential intruders who may intercept and extract or alter the contents of information during transmission or

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while in storage [4], [14, [37]. Anyone can interpose a computer in all communication paths and thus can alter or copy parts of messages, replay messages, or emit false material [7]. Secure communication channel is difficult to achieve or there is minimal reliance of network-wide services [8]. As data crosses over an unsecured channel, it is already susceptible to eavesdropping, illegal retrieval, and intended modification [5]. A problem confronting security in an open network includes how to identify the individual making the transaction, whether the transaction has been altered during transmission, or how to safeguard the transaction from being redirected or read to some other destination [6]. Criminals use this opportunity to steal identities and commit fraud [2]. Confidential information can be the subject of manipulation and misuse.

Security measures are needed to safeguard data. According to Zibideh & Matalgah [37], encryption is a vital process to assure security. Encryption is necessary before any data is passed between physical vulnerable networks and decrypted back to plaintext when it is read back from the storage. Encryption is any form of coding, ciphering, or secret writing [17], and a practical means to achieve information secrecy [19].

According to Grabbe [8], Data Encryption Standard (DES) is one of the most widely used symmetric encryption algorithm and its design idea is still used in numerous block ciphers. A symmetric encryption uses series of numbers and letters and some shifting of characters (bits) to alter the message. Over the last three decades, DES has played major role in securing data [9] since it was adopted as Federal Information Processing Standard (FIPS) in November 1977 [10]. It has been endorsed by the United States of America as the standard of encryptions [23], [24].

However, all encryption techniques are subject to attacks. Just like any other encryption techniques (e.g. IDEA, RC5, RC6), DES is no exception. Intruders have exploited its weaknesses to bypass secure encryption to steal sensitive information since it has been publicly known as a standard of encryptions. One major concern surrounding DES security is the key length (56 bits). Intruders have devised attacks that can work against it. Attacks known to have successfully broken DES security are Brute Force (exhaustion attack), Differential Cryptanalysis [18], [19], [20], [36], and Linear Cryptanalysis [21], [22], [36].

While smart card is a secure portable storage device used for several applications, there is a need to look into the security aspects of the device as it has introduced an array of security and privacy issues. Information inside the card could potentially be exploited by an undetected modification or unauthorized disclosure caused by poor design or implementation. Data can be stolen without leaving the users wallet or bag through an illegal activity called *card skimming*. Card skimming involves the intruder hiding a device inside a bag close to a victim's card proximity to steal the data without the victim's knowledge [33]. Therefore, appropriate measures to protect and secure data during transmission or while in storage must be implemented.

2 Review of Related Literature

Evolutions of DES

DES has gone through many enhancements and served as basis for later techniques in the field of encryption. One of its successors is the Triple DES (3DES or TDEA), According to Dhanraj et al. [25], 3DES uses 48 rounds to encrypt the data. Using this technique gives the data three levels of security making it highly resistant to differential cryptanalysis and boosting the security. However, since 3DES involves going through DES three times, its performance also takes three times as long to encrypt and decrypt [26]. The 3DES works by forward and inverse encryptions. DES encrypts with K_1, K_2 and K_3. To decrypt data it starts with K_3, then with K_2 and with K_1 [29].

Ammar et al. [27] proposed an extended DES called Random Data Encryption Algorithm (RDEA). New features added to the DES include pseudo randomized cipher key for encryption and protocols for sending cipher key embedded in the ciphertext. Random generator sequence length and its memory capacity have hampered the RDEA's overall efficiency this along with its weakness to linear attacks to the S-Box and its key scheduling.

Fan Jing et al. [25] proposed the idea of TKE (Two Key), which is versatile in the sense that it can perform faster and works easily with hardware. Aside from these advantages, it also has high-level security like the DES. However, TKE requires two keys and its data block has different length. This gives the process a heavier load slowing the encryption.

Blowfish encryption encrypts a 64-bit block of data using a key with lengths ranging from 32 to 448 bits. The encryption itself is a sixteen round encryption revolving around utilizing S-Boxes and complex key schedules [30]. The strength of the Blowfish lies in the fact that in its full round form cryptanalysis techniques have no effect on it. However, anything less than four rounds are susceptible to cryptanalysis and the algorithm is not immune to brute force attacks [31].

DES has also been used in conjunction with other encryption techniques. Hamami et al. [28] proposed fusion of DES and Blowfish encryption. The proposed fusion aimed to strengthen the key generation of the DES. It encrypts a 64-bit data block using two keys by initial permutation followed by sixteen rounds of crossover iterations using two keys and going through a final inversed permutation. Its weaknesses are the same with regular Blowfish although it offers more resistance to Brute Force attacks but the two keys adds to the encryption slowed the process.

AES (Advanced Encryption Standard) is the successor to the DES as a standard for encryptions [32]. AES encrypts data blocks of 128 bits using keys of 128, 192, 256 bits. AES works through phases. First, round keys derived from the main key through key schedules are expanded. In the next rounds or iterations, the plain text is subjected to left shifts as well as column mixing using the derived round keys and S-Boxes, This phase repeats for a final round with the exemption of the column

mixing. Although AES has tighter security compared to DES or 3DES, it also has the longest encryption time and load due to all the variables needed to process encryption. AES key schedule has also come under scrutiny since its key schedule is too simple and can be exploited by cryptographers through newer cryptanalysis techniques [34].

Known Attacks on DES

Among known attacks on DES, the common techniques used were Brute Force and cryptanalysis techniques. Brute Force is the most basic and effective form of attack on any encryption system to date [35]. It attacks the encryption head on by trying every possible key in a turn. Although Brute Force is proven to work successfully, the machine used and time consumed by the method proved non feasible [23]. Differential Cryptanalysis works by presuming the attacker has a piece of the original plaintext using this knowledge. The attacker diminishes the security of the encryption until he deciphers the key. To break the full 16 rounds, differential cryptanalysis requires 2^{47} chosen plaintexts. Linear Cryptanalysis works like differential cryptanalysis although it only needs 2^{43} known plaintexts due to its linear nature. The number of rounds used by the DES defines these types of attacks. The shorter the rounds give higher probabilities of success for such techniques. Analysts gain knowledge on the security margins needed by DES through these attacks.

Both cryptanalysis attacks require the attacker to gain a part of the plaintext, which gives the method tricky prerequisites.

3 Design Architecture of the Modified DES

Key Encryption Process

The encryption process starts by converting a 64-bit key into a binary value. The result is reduced to 56-bit and went through the *Odd-Even* substitution. This process provided additional confusion to DES. Confusion is one of the two basic techniques of cryptography [35] that is achieved through the XOR operations making the relationship between the ciphertext and the key complex as possible. The enhancement was simple that it does not slow down the whole process of encryption.

The *Odd-Even* substitution process substitutes 1 for every even position and 0 for every odd position in the 56-bit block. Afterwards, the 56-bit block is divided into 2 halves. Each half contains 28-bits and performs the left shift. After shifting is applied, the two halves are combined and reduced to 48 bits. The 48-bit produced is now the first key. The combined 56-bit block is used to generate the remaining keys. All results are then converted to hexadecimal. The key generation process is shown in Table 1. After 16 rounds of iterative operation, the keys generated are shown in Table 2.

Table 1. Illustration of the Modified Key Generation Process

Step	Process	Result
1	Convert the key *p@SSWoRD12345TiP* from hexadecimal to binary value	01110000010000000101001101010011010101110110 11110101001001000100001100010011001000110011 00110100001101010101010001101001010100000
2	Reduce the result to 56 bits.	00000000111111110010000101010111110010110000 001000001101
3	Apply Odd-Even substitution to the result.	01010101010101010101010101010101010101010101 010101010101
4	Divide the result into two halves.	C_0: 01010101010101010101 1010101 D_0: 01010101010101010101 01010101
5	Shift left both C_0 and C_1.	10101010101010101010 0101010 10101010101010101010 10101010
6	Assign C_0 to C_1 and D_0 to D_1.	C_1: 10101010101010101010 0101010 D_1: 10101010101010101010 10101010
7	Combine C_1 and D_1 to produce the 56-bits then reduce to 48-bits to generate the first key.	01101110101011000001101010111100111001100100 0010 (6eac1abce642)
8	Combine C_1 and D_1 in Step 6 to generate the next keys (C_2 and D_2, C_3 and D_3 ... C_{16} and D_{16}) and repeat Step 3 to Step 7. Perform this for 16 rounds.	

Table 2. Key Generation Result

Key	Value
1	6eac1abce642
2	6eac1abce642
3	9153e54319bd
4	9153e54319bd
5	9153e54319bd
6	9153e54319bd
7	9153e54319bd
8	9153e54319bd
9	6eac1abce642
10	9153e54319bd
11	9153e54319bd
12	9153e54319bd
13	9153e54319bd
14	9153e54319bd
15	9153e54319bd
16	6eac1abce642

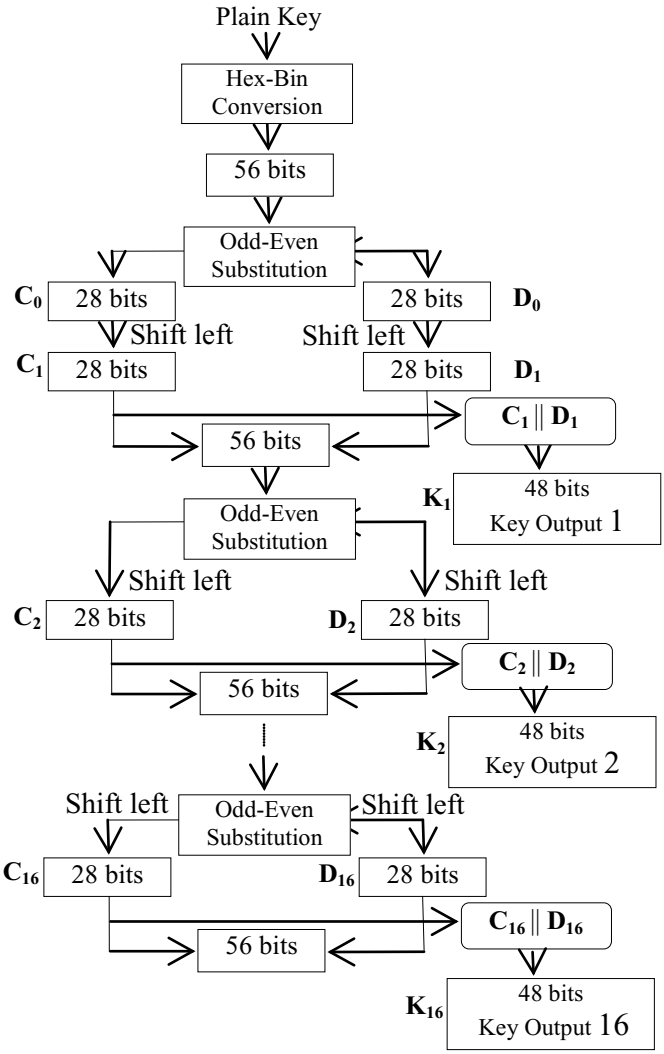

Fig. 1. Modified DES Algorithm

Plaintext Encryption Process

In the plaintext encryption, the input is of any length. This is a significant contribution to DES since any size or length of plaintext could already be encrypted. The plaintext is then subsequently divided into 64-bit block. This is shown in Figure 2. For example, if the given plaintext is *I will meet you at 7:00am today at the park*, this will be grouped into 8 characters per block where each character is 8 bits. The output is shown in Table 3. Take note that at Block 6, the length of the remaining characters is *3* which is less than 8 characters. The system automatically padded 5 spaces to make it 8 characters. Each block is encrypted using the 16 keys generated in Table 2.

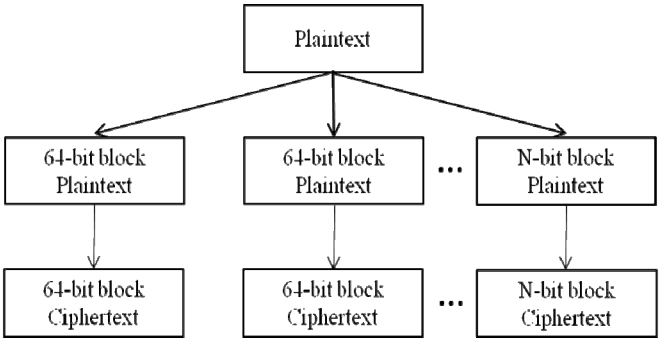

Fig. 2. Division of the Plaintext into 64-Bit Block

Table 3. 64-Bit Block Plaintext

Block	Text
1	I will m
2	eet you
3	at 7:00a
4	m today
5	at the p
6	ark

Below is the simulation result of the plaintext in the first block of Table 3.

Table 4. Illustration of the Encryption Process of the Plaintext per 64-Bit Bock

Step	Process	Result
1	Convert the text *I will m* from hexadecimal to binary value.	01001001001000000111011101101001011011000110110000100000011011101
2	Apply initial permutation to the result then convert to hexadecimal value.	bd04b48d00feb904
3	Divide the result into two halves to form the Left and Right values.	L_0 bd04b48d; R_0 00feb904
4	Apply E-bit selection table to the result of R_0	0017fd5f2808
5	Using the first key in Table 2, perform XOR with R_0	6ebbe7e3ce4a
6	Apply S-Boxes substitution to the result.	5f766bef
7	Apply permutation function to the result.	5c7ffcb7

Table 4. (*coninued*)

Step	Process	Result
8	Perform XOR with L_0 and the result.	e17b483a
9	Assign the value of R_0 to L_1	L_1 00feb904
10	Assign the result of Step 8 to R_1	R_1 e17b483a
11	Repeat Steps 3 to 10 having L_1 and R_1 as input to the next round. Perform this for 16 rounds using the keys in Table 2. This will produce 16 round output block as shown in Table 6 for decryption.	
12	Concatenate the value of R_{16} *(1ba732b1)* and L_{16} *(69bbb462)* from Table 6. Apply inverse on initial permutation (IP^{-1}) to the result. This is now the encrypted value of *I will m*	Encryption Value f17618e06dbf8239
13	Read the next plaintext in Table 3 then perform Steps 1-12 to have the next encrypted value.	

After performing the steps in Table 4, the complete encrypted value of the plaintext from Table 3 is shown in Table 5. Figure 3 also illustrates the steps in Table 4.

Table 5. Encryption Result of the Plaintext Per 64-Bit Block

Plaintext (64-bit block)	Ciphertext
I will m	f17618e06dbf8239
eet you	a0032d56e3fda715
at 7:00a	2460491262022a41
m today	228db1b8c8102503
at the p	7846ab84750c1e3b
ark	f2d0e39d5784b196

Table 6. Encryption Block of the First Ciphertext

Index	L	R
1	00feb904	e17b483a
2	e17b483a	f6960904
3	f6960904	cd843f3f
4	cd843f3f	75853adf
5	75853adf	b62ff04d
6	b62ff04d	727534d3

Table 6. (*continued*)

Index	L	R
7	727534d3	48c03366
8	48c03366	4b5a3d7d
9	4b5a3d7d	8542aa8b
10	8542aa8b	512adb84
11	512adb84	3bbf9555
12	3bbf9555	0d816157
13	0d816157	2bde0e6e
14	2bde0e6e	bd378359
15	bd378359	69bbb462
16	69bbb462	1ba732b1

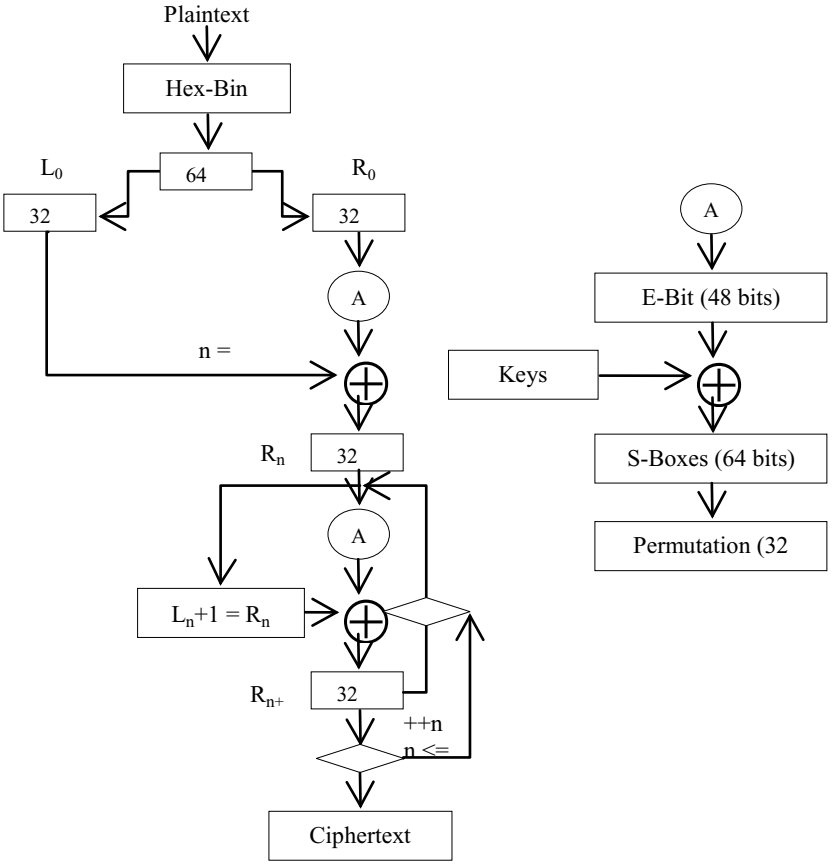

Fig. 3. Plaintext Encryption Process

Decryption Simulation Process

Although encryption and decryption use the same algorithm, the key processing is performed in reverse order during the decryption process and the input is the ciphertext. Development of the decryption process is necessary to make sure that the modified DES algorithm can decrypt the ciphertext back to its original form.

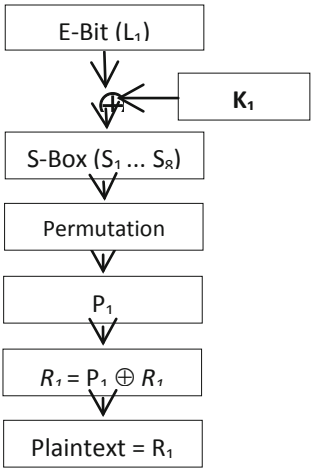

Fig. 4. IV: Decryption Process

After finishing the encryption process illustrated in Table 4, the 16 round output block is also generated for each ciphertext block and is shown in Table 6. The decryption starts by applying E-Bit selection table to L_1 *(00feb904)* and K_1 *(6eac1abce642)* getting the result of *6ebbe7e3ce4a*. S-Boxes substitution is then applied to the XOR result to have *5f766bef* followed by permutation function to obtain *5c7ffcb7*. XOR *5c7ffcb7* and R_1 *(e17b483a)* to get the new value for R_1 = *bd04b48d*. This process is shown in Figure 4.

Finally, by concatenating $R_1 \,||\, L_1$ yields to *bd04b48d00feb904*. Thus, $X = IP^{-1} = (L_1 \,||\, R_1)$ = *492077696c6c206d*. Subsequently convert this hexadecimal to ASCII value. Hence, the plaintext *I will m* is recovered.

4 Conclusion and Recommendation

Smart card is like an *electronic wallet* replacing all of the things we carry around in our wallets, including credit cards, licenses, cash, and even family photographs and is like carrying digital credentials [4]. There is no doubt that smart cards will be the next generation of the highest level of security card technology that will soon replace magnetic stripes, bar code, and some proximity technologies. It will soon play significant role in personal identity verification.

According to Gong-bin et al. [36], improvement and perfection to DES are still very important. Encrypting information ensures that only the intended parties are able to read and access the confidential information inside the smart card. The inclusion of the Odd-Even substitution to DES ensures that even the data is intercepted by other networks or is redirected to other destinations; its integrity and confidentiality will not be compromised. More so, the Odd-Even substitution has provided additional confusion to the complexity of security capable of resisting cryptanalysis whilst having the stability and speed of handling encryption and decryption processes. Aside that this enhancement can be easily implemented to smart card, it can encrypt or decrypt any length of plaintext and does not require intensive processing, memory, and time compare to AES or 3DES.

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Uniform Random Number Generator Using Leap-Ahead LFSR Architecture

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Abstract. The conventional Leap-Ahead LFSR URNG (uniform random number generator) is useful to generate multiple random numbers since it only consumes 10% slices of the multi-LFSR architecture. However, it has significant drawback. The maximum period of the random number generated is dramatically diminished depending on the relationship between the number of the stages in LFSR and the number of the output bits in URNG. This paper presents the new architecture for Leap-Ahead LFSR URNG employing segmentation technique to increase the maximum period of the random numbers. The simulation results show that the proposed architecture can increase the maximum period is increased 2.5 times at the worst cases without significant area overhead.

1 Introduction

Recently, the demand of secure data exchange and manipulation rely mostly on the use of cryptography. The cryptography mechanisms can be categorized into symmetric key cryptography, asymmetric key cryptography and crypto hash function [1]. A symmetric key cryptography uses same secret key, that is, private key, to encrypt and decrypt its data, whereas an asymmetric key cryptography uses both public key and private one. A symmetric key cryptography is widely used in practice since it can encrypt large amount of bulk data efficiently. However, it has crucial problem in the key distribution and management. An asymmetric key cryptography was presented to overcome the key distribution issue in the symmetric key encryption [2]. Nevertheless, the most crucial part in both crypto mechanisms still rely on the cryptographic keys, not the cryptography mechanisms used. If the key value leak out, the original message shall be resolved by the cracker regardless of the cryptography mechanisms. The key value must be secret and irreproducible for the attacker. Thus, it is important to generate cryptographic keys of high randomness quality to ensure the security of the whole data security system.

In spite of growing demand of RNG (random number generator), still there is no algorithm that can produce truly random numbers. All previously presented RNGs are pseudo-random numbers generators. Since most of them are based on linear congruential equations, they perform a number of time consuming arithmetic operations. On the contrary, the use of LFSR (linear feedback

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shift registers) allows very fast generation of binary sequences [3-5] and a random number is drawn from a set of these possible sequences that have same probability of occurrence. In general a LFSR based RNG is implement as hardware design in order to increase its throughput and to use in high-speed security applications. A normal LFSR based RNG generates one random bit per cycle. As the use of multiple random bits at a time, Multi-LFSRs architecture was presented. However, this architecture requires the number of LFSRs equal to the number of random bits. Thus, it suffers from the significant area overhead in proportion to the number of random bits.

In order to solve this area overhead, a Leaf-Ahead architecture was presented since it can generate one multi-bits random number per cycle using only one LFSR. X. Gu and M. Zhang presented URNG (uniform RNG) using this Leap-Ahead LFSR architecture [6]. However, it has two significant drawbacks. The one is small number of binary sequence and the other is the period of the generated random numbers. It acquires the best quality when 2^{n-1} is divided by m, where, n is the number of the stages of the LFSR and m is the number of the output bits of the URNG. To overcome these drawbacks of the previously presented URNG, we present the new transform matrix for the proposed Galois type URNG.

2 The Conventional LFSR Based Galois Type URNG

This section describes Galois type LFSR URNG in detail. An LFSR is particular model of PRNG that is able to generate a sequence of pseudo-random binary digits for random key-stream which can be used in stream ciphers. The structure of conventional Galois type LFSR is presented in Figure 1. It can only generate one random bit per cycle. An LFSR is a shift register whose input bit is a linear function of its previous state. The registers in LFRS have a finite number of possible states. The security key, that is, the seed is loaded as initial value of the LFSR. A feedback vector is carefully chosen which corresponds to a primitive polynomial to generate a sequence of binary digits. The arrangement of taps for feedback in an LFSR can be expressed in finite field arithmetic as a polynomial mod 2. Thus, the coefficient of the feedback polynomial must be 1's or 0's.

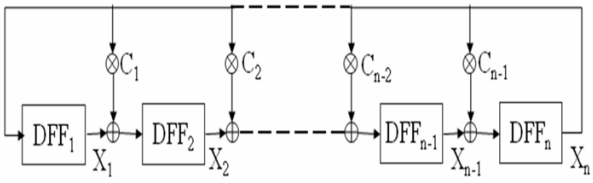

Fig. 1. Basic architecture of Galois type LFSR

In Figure 1, DFFi is a register set with taps from C_1 to $Cn-1$. X_i is the output of the *i-th* DFF. Here, X_n only is active output per cycle and it becomes the random number. The operation of this Galois type LFSR is iterated through all

2^{n-1} possible linear states, where n is the number of stages. X. Gu and M. Zhang presented URNG (uniform RNG) using this Leap-Ahead LFSR architecture [X. Gu] by exploiting the transform matrix to eliminate the very close correlation between the consecutive random numbers generated. First, two consecutive random numbers can be described as X(t+1) = AX(t), where X(t) and X(t+1) is the current output and the next output of all the DFFs, respectively. A is the transform matrix. Then, m-cycle-late outputs of all the DFFs can be expressed as X(t+m) = AX(t+m-1) = A(AX(t+m-2)) = ... $= A^m X(t)$. Consequently, this could also be represented as Eq. (1).

$$X'(t+1) = A^m X'(t) \tag{1}$$

If the output from $\mathrm{DFF}_{n-(m-1)}$ to DFF_n in Figure 1 operates as shift registers, then, in Leaf-Ahead architecture, the m-bit outputs from $\mathrm{X'}_{n-(m-1)}$ to $\mathrm{X'}_n$ per cycle is same with the m-cycle outputs from $\mathrm{X'}_{n-(m-1)}$ to $\mathrm{X'}_n$ as an m-bit random number since they have no longer close correlation between two consecutive random number outputs. The period of the generated random numbers, T can be obtained as $[2^{n-1}, m]/m$. Here, 2^n-1, m] is the LCM (lease common multiple) of 2^n-1 and m; n and m are the number of the stages of the LFSR and the output bits of the URNG. Also, the transform matrix A in Eq. (1) can be obtained from Eq. (2).

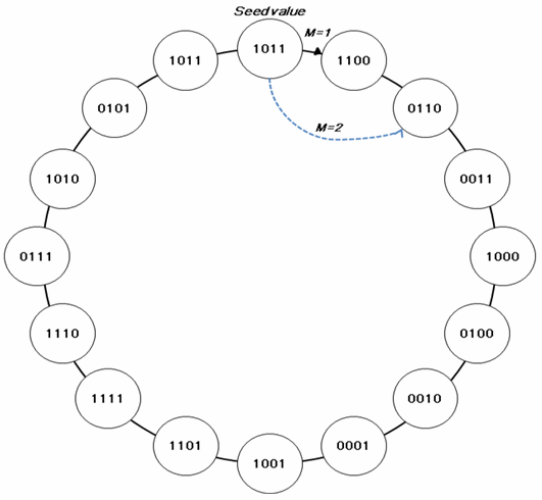

Fig. 2. Basic sequence set of Galois type LFSR (m=1)

$$A^m = \begin{pmatrix} 0_{m\times(n-m)} & C_{n\times 1} A x C_{n\times 1} \ldots A^{m-2} x C_{n\times 1} A^{m-1} x C_{n\times 1} \\ 1_{(n-m)\times(n-m)} & \end{pmatrix}_{n\times n} \tag{2}$$

Here, the taps have the following relationships: $C_{n-1} = C_{n-2} = ... = C_{n-(m-1)} = 0$ and $A^m - 1$ X $C_n x1$ can be obtained from Eq. (3).

$$A^{m-1} \times C_{n\times 1} = \left(\underbrace{0 \;\; 0 ... 0}_{(m-1)} \;\; 1 \;\; C_1 \;\; C_2 ... C_{n-(m+1)} C_{n-m} \right)^T_{1\times n} \tag{3}$$

Consequently, a conventional Leap-Ahead LFSR architecture generates the sequence set consists of 2^n*-1* random numbers. For example, the number of one-bit stream generated is 2^n*-1*=15 when Leap-Ahead LFSR having 4 stages outputs 4-bit random numbers. The sequence set is shown in Fig. 2.

This URNG can generate m-bit random number that eliminates the significantly closed correlation with each other. However, the maximum period of the generated random number is achieved when 2^n*-1* is divided by the number of output bits, m. Thus, the best quality of the generated random numbers is only obtained when 2^n*-1* is divided by m. This fact is the crucial drawback of the conventional Leap-Ahead architecture.

3 The Proposed Segmented LFSR Based URNG

Even though many URNG designs have been proposed until now, there are still many problems in sequence-generating technology. In particular, how to generate all the feedback sequences are still puzzled. If it is impossible, we should concentrate on how to improve states utilization ratio of the pseudo-random sequences generated by URNG. In order to increase period of generated random number without significant area overhead is another important design issue.

In this paper, we present new LFSR based Galois type URNG. The proposed one has similar architecture and mechanism of the conventional LFSR based Galois type URNG. However, the proposed URNG allows the segmentation of LFSR to improve states utilization ratio of the pseudo-random sequences. The coefficient of taps should be carefully chosen to make sure that the one-bit stream generated has a maximum period of 2^n*-1*. If not, we divide the URNG as two segments that have maximum period. Obviously, the period for the latter case should be shortening than 2^n*-1*-1 but the period is significantly longer than the period for the conventional LFSR based URNG. In this section, we describe the proposed LFSR based URNG in detail.

First, we use Galois type Leap-Ahead LFSR architecture to improve the state utilization ratio. Thus, we also generate transform matrix using the same way of the previously presented by X. Gu [X.Gu]. Two consecutive random numbers *X(t+1)* and *X(t)* can be represented as *X(t+1)=AX(t)*, here *A* is the transform matrix. Thus, this relationship between two more consecutive random numbers is also represented *X(t+m)=AmX(t)* as shown in Eq. 1. The number of random numbers generated is 2^n*-1* and the sequence is equal to the conventional Leaf-Ahead LFSR architecture as shown in Fig. 2. However, the proposed Leap-Ahead

architecture employs the segmentation technique for LFSR architecture as shown in Fig. 3. The proposed architecture divides entire LFSR as two segments having same architecture of Leap-Ahead LFSR architecture. The number of stages in each segment is less than half of total stages in Leap-Ahead architecture. Control signals, *sel0* and *sel1* choose the output to each segmented Leap-Ahead LFSR.

If the number of random numbers generated, 2^n*-1* is not divided by m, the number of outputs, the proposed LFSR is not divided into two parts. Thus, the output of Segment2 is inputted into Segment1 and the output of Segment1 is propagated as input of Segemnt2. The period of generated random numbers for this case is equal to that of the conventional Leaf-Ahead LASER. However, the proposed LFSR is divided into two segments when the number of random numbers generated, 2^n*-1* is divided by m. Then, the output of Segment2 is fed into the Segment2, not Segment1. In addition, the output of Segment1 is also inputted into Segment1. Thus, both segments work independently and the period of generated random numbers.

There are four cases are produced depending the number of stages, n and the number of outputs, m are even or odd when the number of random numbers generated, 2^n*-1* is divided by m as shown in Figure 4. For example, the segment1 and segment2 operate independently when the number of random numbers generated, 2^n*-1* is divided by m. In case 1, both the number of stages in LFSR, n and the number of output bits, m are even numbers. In this case, Segment1 contains $n/2$ stages in LFSR and it outputs $m/2$ output bits. In addition, Segment2 contains $n/2$ stages in LFSR and it outputs $m/2$ output bits. Maximum period of random numbers generated becomes

$$\frac{[2^{n/2-1}, m/2]}{m/2} * \frac{[2^{n/2-1}, m/2]}{m/2}$$

Consequently, the proposed segmented Leap-Ahead LFSR can increase maximum period of random numbers generated even though 2^n*-1* is divided by m. Furthermore, the proposed architecture does not require the significant area overhead compared to the conventional Leap-Ahead LFSR URNG. Only the circuit for controlling two multiplexes in Fig. 3 is added. Thus, it can enhance the efficiency of the proposed.

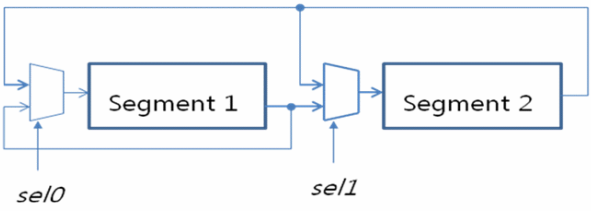

Fig. 3. Proposed segmented Leap-Ahead LFSR architecture

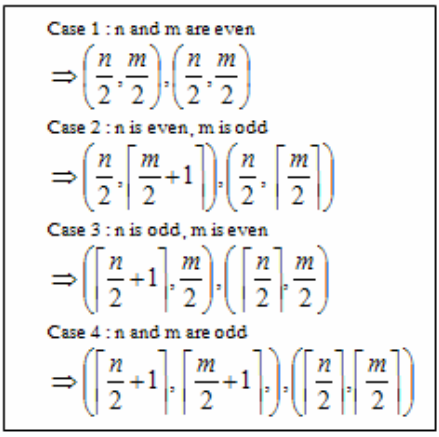

Fig. 4. Four cases the operation of two segmented LFSR architecture

4 Simulation Results

In this section, we show the simulation results of the proposed Leap-Ahead LFSR URNG compared to the other counterparts such as multi-LFSRs and Leap-Ahead LFSR URNGs. The proposed URNG is synthesized using VHDL and it is implemented on the Xilinx ISE 10.1, Virtex II PRO with a device XC2VP30. Figure 5 shows the simulation waveform of the design example having 4 stages in LFSR and outputs 4 bits random numbers. The random numbers generated is equal to the conventional Leap-Ahead LFSR URNG [6]. Figure 6 shows the comparison results in respect to maximum period of random numbers generated between the conventional and the proposed Leap-Ahead URNGs. As shown in Fig. 6, the maximum period of the proposed architecture is same with that of the conventional architecture when 2^n*-1* and m could not divide by each other. However, the maximum period of the random numbers generated is greater when

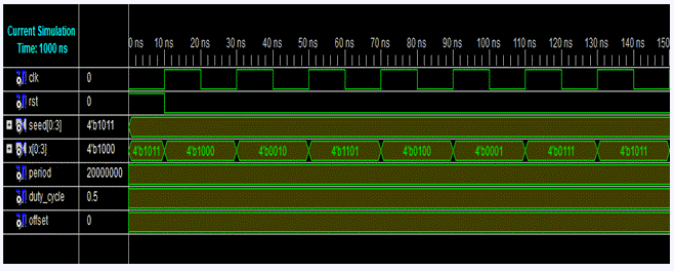

Fig. 5. Simulation results of the proposed segmented Leap-Ahead LFSR URNG

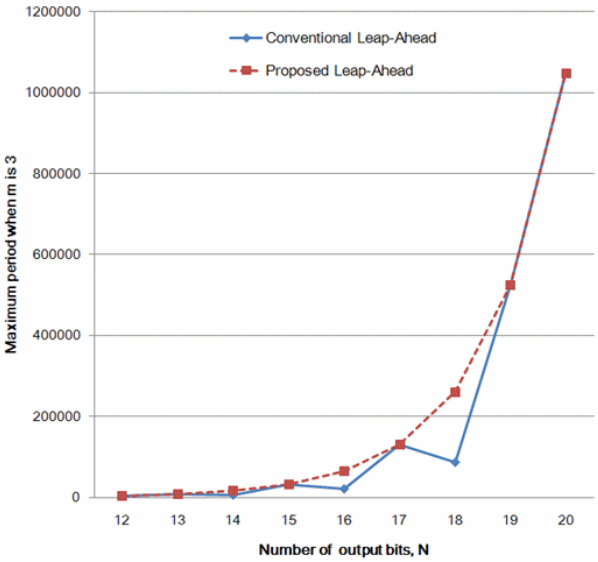

Fig. 6. Comparison results of maximum period between the conventional and the proposed Leap-Ahead LFSR URNGs (m=3)

Table 1. Area and throughput comparison with the other counterparts

	Area Time slices	Throughput Bits
Conventional Leap-Ahead [6]	2.18	17.87
Multi-LFSR (Galois)	19.05	20.63
Proposed segmented Leap-Ahead	2.36	17.56

2^n*-1* and m could divide by each other. The difference of maximum period is up to 2.5 times compared to the conventional Leap-Ahead LFSR architecture.

Finally, we show the comparison results with respect to the area and throughput between the proposed architecture and its counterparts in Table 1. As shown in Table 1, the area time performance of the proposed segmented Leap-Ahead URNG is 2.36 slices x sec per is 2.36 and it is similar that of the conventional Leap-Ahead architecture. In addition, the throughput is also similar with that of the conventional Leap-Ahead URNG. This result shows that the proposed segmented Leap-Ahead URNG has similar area and performance with the conventional Leap-Ahead architecture even though the maximum period of the generated random number is dramatically increased. Consequently, the proposed architecture is more profitable for the data security system.

5 Conclusion

A conventional Galois LFSR random number generator is small and fast to generate random number. However, it generates only one random bit per cycle. As the use of multiple random bits at a time, Multi-LFSRs architecture was presented. However, this Multi-LFSRs architecture requires the number of LFSRs equal to the number of random bits. On the contrary, a conventional Leap-Ahead LFSR is more useful since it occupies small circuit area that is almost 10% of multi-LFSR and it has similar throughput. However, it has significant drawback that is the serious decrease in maximum period of the random numbers generated when 2^n*-1* and m could divide by each other. The proposed segmented Leap-Ahead LFSR can preserve the maximum period for all conditions. The simulation results show that the proposed architecture has similar throughput with almost same circuit size. In addition, it can increase the maximum period up to 2.5 times when 2^n*-1* and m could divide by each other. Consequently, the proposed architecture is more profitable for the data.

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The Effect of Fairy Tale Activities with Multimedia on Preschool Children's Prosocial Behavior

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Abstract. The purpose of this study was to find a teaching-learning method to improve preschool children's prosocial behavior, comparing educational effectiveness of fairy tale activity with picture book and with multimedia, which contained the context of helping and sharing. The results of this study were as follows: First, fairy tale activity with multimedia turned out to have a statistically significant difference in improving preschool children's prosocial behavior. That is, it had a positive effect on preschool children's helping and sharing behavior. Second, activity with multimedia showed a significant interaction effect of age and gender only by age. As a result, it suggested that fairy tale activity with multimedia was an educationally effective activity in improving preschool children's prosocial behavior.

Keywords: Fairy tale, Multimedia, Picture book, Prosocial behavior.

1 Introduction

In early childhood teaching field are many electronic media and audiovisual materials being used such as newspaper, radio, TV, movies, magazines, DVD, CD, E-books, E-mail and Internet.

So far much of education has been done in the purpose of accumulating a lot of information and knowledge by using multimedia. But during the time, learners are more likely to be exposed to electronic media, accustomed to passive information acquirement, and more frequently in contact with information inappropriate to their development.

In spite of the fact, it isn't reasonable to apply the extreme protectionism education asking to be alienated from the media to preschool children living in this multimedia age. That's because multimedia have two sides. They can be advantageous or harmful according to their use.

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Therefore, it is most important to develop the ability to express their own thoughts and opinions as well as to use multimedia and to analyze and evaluate the information using it, based on the basic understanding of media.

Like that, the role of media in modern world is increasingly being emphasized, visual media of which are having many impacts on many different areas.

Especially for the fast growing preschool children, visual media are more effective in that they make up for the weakness of print media.

From the trend of recent studies, it is considered more effective to reinforce positive behaviors rather than to eliminate negative behaviors.

While it has been proved that VTR and dramatic activities are effective for improving prosocial behaviors, there are few studies that prove the effect of improving prosocial behaviors by multimedia fairy tale.

Therefore, this study was designed to find a teaching-learning method to improve preschool children's prosocial behavior, comparing the educational effect of fairy tale activity with picture book and with multimedia, which contained the context of helping and sharing.

Research questions for the study are as follows:

First, Does fairy tale activity with picture book and with multimedia make a difference by group - helping and sharing - in preschool children's prosocial behavior?

Second, Does fairy tale activity with picture book and with multimedia make a difference by age and gender in preschool children's prosocial behavior - helping, sharing?

2 Research Method and Procedure

2.1 Research Subjects

The experiments in this study were conducted on four classes - 62 preschool children from 4 to 5 years - , half of whom belonged to a experimental group and the others a comparative group. They were at similar social-economic level and were selected at U kindergarten in J city, South Korea. Each average age of the experimental group was 4.19 and 5.21, and that of the comparative groups was 4.14 and 5.22. There was no significant difference(t=.518 p=.474). The educational career of each homeroom teacher in each group ranged from 6 to 8 years.

2.2 Research Tools

Helping and Sharing Behavior Measures. For 'helping behavior' measures was changed and chosen helping behavior six items of Radke-Yarrow and Zahn-Waxier[7], and research questionnaires[8]. And for 'sharing behavior' measures was used 5-stage measures for sharing behavior[2].

Fairy Tale Selection. All the fairy tales were selected in 2006 suggested books by Korea Children's Reading Institute[6]. Half of them were 8 creative fairy tales and the

others were traditional fairy tales. To estimate on the criteria of fairy tale suitability and superiority, 17 preschool teachers were presented a fairy tale list and scored by three-point rating scale. The list is as follows: *The Enormous Turnip, Faithful Toad, Fart Contest, Brotherly Love, Half Boy, The Ants and The Grasshopper, Mud Shell Bride, Doggy Poo, The Three Little Pigs, The Crow and The Pitcher***.**

2.3 Research Procedure

The research procedure sequently went on preparatory experiment, pretest, control, and post test, as shown in Table 1.

Table 1. Research Procedure

	Preparatory experiment	Pretest	Treatment	Posttest
Period	2011.10.4~10.7	2011.10.13~10.19	once a week (10 times)	2011.12.18~12.29
Subjects	10 preschool children	scorer : 2 graduate students majoring in early childhood	development process : introduction, development, finishing	preschool children
Time	15`17 (inter-observer reliability : .87)	place : empty classroom in free play time		2 days

2.4 Data Processing

The data collected after pretest and post test were processed by SPSS Ver. 15.0 and applied to T-test, to figure out the difference of preschool children's prosocial behavior effect by group, age, and gender.

3 Results and Analysis

3.1 Analysis of Difference by Group in Improving Preschool Children's Prosocial Behavior Using Fairy Tale Activity with Multimedia and That with Picture Book

The result of analyzing whether fairy tale activity with multimedia and with picture book have a difference by group in improving preschool children's prosocial behavior is seen in Table 2 and Table 3.

Analysis of Difference by Group in Improving Helping Behavior. The result of analyzing whether fairy tale activity with multimedia and with picture book have a difference by group in improving helping behavior is seen in Table 2.

Table 2. Difference by Group in Improving Helping Behavior

	Group	N	M	SD	t
Pre	Experimental group	32	2.18	.820	.433
	Comparative group	32	2.28	.728	
Post	Experimental group	32	3.03	.646	7.799**
	Comparative group	32	2.78	.941	

** $p < .01$

Shown as Table 2, the post test of helping behavior, lower area of prosocial behavior, showed a statistically significant difference(t=7.799, p<.010) between experimental group(M=3.03, SD=0.6460) and comparative group(M=2.78, SD=0.941).

This result showed that in helping behavior, preschool children's score in fairy tale activity with multimedia significantly improved more than that in fairy tale activity with picture book. In short, it can be considered that fairy tale activity with multimedia has an influence on helping behavior, lower area of preschool children's prosocial behavior.

Analysis of Difference by Group in Improving Sharing Behavior. The results of analyzing whether fairy tale activity with multimedia(experimental group) and with picture book(comparative group) have a difference by group in improving sharing behavior is seen in Table 3.

Table 3. Difference by Group in Improving Sharing Behavior

	Group	N	M	SD	T
Pre	Experimental group	32	2.16	.766	1.532
	Comparative group	32	2.28	.634	
Post	Experimental group	32	3.25	.718	4.691*
	Comparative group	32	3.00	.622	

* $p < .05$

Shown as Table 3, the post test of sharing behavior showed a statistically significant difference(t=4.691, p<.05) between experimental group(M=3.25, SD=0.718) and comparative group(M=3.00, SD=0.622).

This result showed that in sharing behavior, preschool children's score in fairy tale activity with multimedia significantly improved more than that in fairy tale activity with picture book. In short, it can be considered that fairy tale activity with multimedia has an influence on sharing behavior, lower area of preschool children's prosocial behavior.

3.2 Analysis of Variance of Preschool Children's Prosocial Behavior by Age and Gender

Analysis of Variance of Preschool Children's helping Behavior by Age and Gender. The result of analyzing effect of interaction by age and gender is seen in Table 4 and Table 5.

Table 4. Mean and Variance of Helping Behavior by Age and Gender

	Group	N	M	SD
4 years	male	16	2.31	.704
	female	16	2.56	.727
	total	32	2.43	.715
5 years	male	16	3.18	.655
	female	16	3.56	.512
	total	32	3.37	.609
total	male	32	2.75	.803
	female	32	3.06	.800
	total	64	2.90	.811

$^{*}p < .05$

Helping behavior of 4 years preschool children appeared like these; male(M=2.31, SD=.704), femail(M=2.56, SD=.727). And helping behavior of 4 years appeared like these; male(M=3.18, SD=.655), femail(M=3.56, SD=.512).

The score by age appeared like these; 4 years(M=2.43, SD=.715), 5 years(M=3.37, SD=.609). It showed that helping behavior improved by age. Also, in helping behavior, female showed higher mean than male in both ages.

Table 5. Analysis of Variance of Helping Behavior by Age and Gender

group	R-squared	Degree of freedom	Mean square	Standard deviation
age	14.063	1	14.063	32.767***
gender	1.563	1	1.563	3.641
age×gender	.063	1	.063	.146
error	25.750	60	.429	
sum	582.000	64		

$^{***}p < .001$

Preschool children's helping behavior had a significant difference by age(F=32.767, p<.001) and had no difference by gender. Also, there was no interaction effect of age and gender. In other words, preschool children's helping behavior increased as their age increased.

Analysis of Variance of Preschool Children's Sharing Behavior by Age and Gender. Regarding preschool children's sharing behavior, interaction effect by age and gender is seen Table 6 and Table 7.

Sharing behavior of 4 years male was M=2.87, SD=.500 and female's one was M=2.68, SD=.704. Sharing behavior of 5 years male was M=3.50, SD=.516 and female's one was M=3.43, SD=.629. Regarding age, 4 years' score was M=2.78, SD=.608 and 5 years' one was M=3.46, SD=.567, which showed that sharing behavior improves as age increases. And male children showed higher mean than female in sharing behavior of both gender.

Table 6. Mean and Variance of Sharing Behavior by Age and Gender

	Group	N	M	SD
4 years	male	16	2.87	.500
	female	16	2.68	.704
	total	32	2.78	.608
5 years	male	16	3.50	.516
	female	16	3.43	.629
	total	32	3.46	.567
total	male	32	3.18	.592
	female	32	3.06	.759
	total	64	3.12	.678

$^{*}p < .05$

Table 7. Analysis of Variance of Sharing Behavior by Age and Gender

group	R-squared	Degree of freedom	Mean square	Standard deviation
age	7.563	1	7.563	21.479***
gender	.250	1	.250	.710
age×gender	.063	1	.063	.178
error	21.125	60	.352	
sum	654.000	64		

$^{***}p < .001$

Preschool children's sharing behavior had a significant difference by age($F=21.479$, $p<.001$) and had no difference by gender. There was no interaction effect of age and gender. In brief, preschool children's sharing behavior increased as their age increased.

4 Discussion and Conclusion

4.1 Discussion

Supposing to improve helping behavior and sharing behavior among prosocial behaviors, the consequences of comparing the educational effect of fairy tale activity with multimedia with picture book can lead to the following discussions :

First, preschool children of experimental group taking part in fairy tale activity with multimedia showed more significant rise in helping behavior score than ones of comparative group taking part in fairy tale activity with picture book, which contained the context of prosocial behaviors.

That is, it revealed that fairy tale activity with multimedia has an impact on helping behavior, lower area of preschool children's prosocial behavior. And the experimental group and the comparative group made statistically significant difference as a result of post test score of sharing behavior, lower area of prosocial behavior. As a result, it

inferred that fairy tale activity with multimedia influences sharing behavior, lower area of preschool children's prosocial behavior.

The result coincided in one study[3] proving that preschool children of group watching VTR programs, which contained the context of prosocial behavior. remarkably improve in learning helping and sharing behavior by imitating and recalling behaviors of the programs. And another study[5] showed that performing dramatic activity after presented visual media is more effective in enhancing prosocial behavior than only when presented visual media. So based on the result, it is assumed to be able to raise the educational effect if information media activity are accompanied .

Second, after fairy tale activity with multimedia and with picture book, it turned out to disclose a significant difference by age of each group. But a correlation between age and gender meant nothing. That's because preschool children of 5 years group relatively showed higher mean than ones of 4 years group, which revealed that prosocial behavior develops as age rises.

Compared with advanced researches, these results partly coincide one study[4] that dramatic activity in linguistic helping behavior is more advantageous to 6 years preschool children than 5 years, and another study[1] that 6 years preschool children are more effective than 5 years in interaction activity and role-playing activity.

Judging from these results, fairy tale itself has much educational merit. But because each presentation way of fairy tale differently stimulates preschool children, different teaching methods by different media must be developed. In this study, fairy tale activity with multimedia has a significant educational merit in itself. More importantly, this study is another research material available for developing teaching method to improve prosocial behavior in early childhood field.

4.2 Conclusion and Suggestion

Based on the result of this experiment, it can come to the conclusion as follows :

First, when analyzing the difference by group in preschool children's helping and sharing with fairy tale activity with multimedia and with picture book, prosocial behavior appeared more apparently for preschool children participating in fairy tale activity with multimedia.

Second, in fairy tale activity with and with picture book, preschool children's prosocial behavior of helping and sharing showed a statistically significant difference by age, and it didn't show any significant difference by gender.

On the basis of findings above and conclusion, some suggestion needs to be made for further study:

First, while the effect of multimedia on prosocial behavior proved in this study, subsequent studies are required for comparing with other different media.

Second, because examples of prosocial behavior would vary regarding whether the experimental context is natural or not, more in-depth comparative researches are required.

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Strategies for the Improvement of Historic Sites Bike Tour Using Structural Equation Modeling

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Abstract. Structural equation modeling was used to evaluate components within safety, amenity, information, convenience and amusement among 198 participants who joined to Gyeongju historic sites tour by bike. As results of a SEM, the component of amusement primarily affects the degree of satisfaction (DS) (0.61). Second significant component influencing the DS is the convenience (0.22) followed by safety (0.16) and information (0.07). Four variables denoting the amusement component are as follows: "Playing in rest time (e.g., game)" (0.82), "How about course? Not detour?" (0.81), "Human relationship among team members" (0.76). This means that participants consider amusement as the most important factor. Second important component is the convenience. It consists of such variables as "Fee - expensive or cheap" (0.88), "Easy to resister for participant" (0.75) and "Quality of rental bike" (0.47). For the component of safety, participants of Gyeongju Bike Tour Program (GBTP) put little importance since they recognized the program itself to be safely run. In this paper, we suggest that the local government needs to play a core role in improving the bike infrastructure such "Safety of shared bike road" and "Obstructions on bike road", although an amusement is the most important component for improving the program running.

Keywords: Degree of satisfaction, Structural equations model, Bike tour, Historic sites tour, Gyeongju.

1 Introduction

1.1 Background and Purpose of Research

Our transport system has become heavily dependent upon motorized transport in the last three decades. This has led to a number of unexpected consequences in terms of congestion, greenhouse gas emissions, air and noise pollution. Walking and cycling

T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 280–286, 2012.

for transport offer many public policy benefits such as public health, greenhouse gas emission reduction, congestion relief and urban livability improvement. Creating the conditions in which healthy city become embedded in our social and physical infrastructure is widely acknowledged as a key method. (Queensland Government, 2011) Meanwhile after the 2000s due to improvement of people's living standard and increase of leisure time caused by enforcement of a five-day work, touring styles changes in such a way that they consider the environment and the amusement.

Gyeongju is a small city of which population size is about 300,000, and the extent of downtown area is good to tour on foot or by bicycle. Cultural assets are concentrated in the 'Downtown Area' in the city. An NGO in Gyeongju has run the Gyeongju bike tour program (GBTP) every weekend for several years. The program plays a significant role in making sustainable city linking green transport and eco-tourism.

This research presents a methodology in which participants' evaluations are systematically incorporated for developing strategies of GBTP. The methodology is based on a Structural Equations Model (SEM) which explains the complex relationships among variables for explaining various characteristics of bike tourists for developing strategies of GBTP.

1.2 Research Method

Questionnaire survey was carried out for tourists who joined GBTP in between April and August 2010. The research consists of three consecutive steps. Firstly, evaluation categories and detailed measurement index were selected based on previous research review. When they were selected, existing evaluation categories and measurement index that will be added in the future were generally regarded. Secondly, factor analysis was made using survey data to validate the selection of variables comprising categories and the associated measurements. Thirdly, an evaluation model regarding tourist characteristics was developed, and SEM, which can conceptualize complex ideas of human beings, was also developed. To analyze structural equation, a model was run using AMOS 15.0[1].

2 Previous Research

As a result of reviewing previous research related to tourist service in bike tour, it was shown that there are few researches. Mainly those studies discussed general issues as sightseeing merchandises (Yu, 2001) and Yu (2008) introduced about GBTP those are for example how to operate program or history of NGO etc. They have a common denominator of historic site tour, but it is obvious that satisfaction levels are different according to conditions of safety, amenity, information etc. Kim (2010) studied on GBTP, however he did not introduce SEM. This study is different from other researches in that it used SEM in field of bike tour, providing some scientific improvements on bike tourist in consideration of behavior and characteristics of GBTP.

[1] AMOS is a widely used statistical package for survey data analysis in a field of social science with LISREL, EQS, etc.

3 Method

3.1 Participants

This research employed the questionnaire survey to analyze tourists' satisfaction factors with the historic site tour by bike. A questionnaire sheet was given to tourists who joined the program from April to August 2010. One investigator who joined together in every program explained about objective of the survey for 10 – 15 minutes in finish time of program.

3.2 Characteristics of Data

Table 1 shows the socioeconomic characteristics of respondents. It is difficult to verify whether the surveyed data represent the population of the respondents. There is not much data worth comparing the socioeconomic characteristics of the Gyeongju bike tourists because there are no studies about socioeconomic characteristics. However, it does not seem that the data be biased in terms of value of average income when compared with Korean's average income. According to the data, 65.1% of tourists take private cars, and only 34.9% take public transportations for transportation.

Table 1. Socio-economic Characteristics of Interviewees

Category	Classification	The Number (Persons, %)
Sex	Male	97(49.0)
	Female	101(51.0)
Age	Below elementary school	48(24.1)
	14~19	32(16.1)
	20~30	26(13.1)
	31~40	27(13.6)
	41~50	60(30.2)
	51~60	4(2.0)
	Above 61	2(1.0)
Monthly Average House-hold Income (won)	Less than 1.0 million	17(8.4)
	1.0~2.0 million	19(9.4)
	2.0 ~ 3.0 million	19(9.4)
	3.0 ~ 4.0 million	22(10.9)
	4.0 ~ 5.0 million	11(5.4)
	More than 5.0	34(16.8)
	No answer	80(39.6)
Staying dates	One day	111(55.0)
	Two days	32(15.8)
	Three days	11(5.4)
	More than four days	13(6.4)
	No answer	35(17.3)
Transportation modes	Private car	127(65.1)
	Bus	24(12.3)
	Train	28(14.4)
	Bike	2(1.0)
	Others	14(7.3)

3.3 Measures

We discussed the degree of satisfaction and preference properties of the measures of safety, amenity, information, convenience and amusement about tour activation in earlier studies (Yu et al., 2001; Yu et al., 2008). The measures used in this study all conformed to unidimensional models that were invariant across groups and time. The measure of attitude included nineteen items that consists of satisfaction and corresponding value statements. The measures of latent variables and expectations included four and three items, respectively. The items were rated on a 7-point scale with anchors of 1 (*Dissatisfy a lot*) and 7 (*Satisfy a lot*). The items were suggested by Yu (2008). The measures of intention and expectation have not been tested for factorial validity or multi-group invariance. Hence, the factorial validity and invariance of unidimensional models to those measures were established based on the results of the covariance modeling. Examples are shown in Table 2 as below.

Table 2. Sample Items from the Questionnaires Measuring the Latent Variables of Safety, Amenity, Information, Convenience and Amusement (Fun)

Questionnaire	Sample Items
Safety	- Safety of exclusive bike road - Safety of shared bike road - Guide way of safety guide - Obstructions on bike road for example on street parking or stuffs
Amenity	- Bumpiness of bike road - Road edge that not completely get rid - Troublesome because of stopping by signal or cross section - Inconvenience because of narrow width of bike road
Information	- Getting new knowledge about historic sites through this program - History introduction by guide - Sign board for bike rider on the course - More information for local products or good restaurant
Convenience	- Easy to resister for participant? - How about fee? Not expensive? - Quality of rental bike
Amusement(Fun)	- Provided food's quality - Relation among team members - Playing in rest time i.e. game - How about course? Not detour?

4 Results

4.1 Confirmatory Factor Analysis

The nineteen-factor measurement model displayed in Fig. 1 represented a good fit, χ^2(Kaiser Meyer Olkon = 0.826, N = 171) = 1624.833, $p < 0.0001$, RMSEA = 0.005, RNI = 0.94, NNFI = 0.94. All of the interfactor correlations were statistically significant.

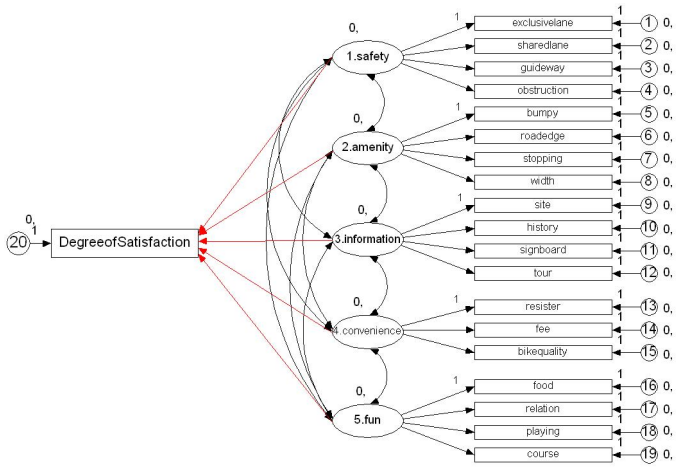

Fig. 1. It shows postulation of path diagram of a SEM for GBTP tourists' service quality. It is postulated that comprehensive satisfaction level will be influenced + direction by five categories namely, safety, amenity, information, convenience and amusement (fun).

4.2 Structural Equation Modeling

The structural model presented in Figure 3 represented a good fit to the data, $\chi^2(N = 198) = 469.319$, $p = 0.001$, RMSEA = 0.101, NFI= 0.772, CFI=0.830, but GFI did not come out because of absent. (Table 3.)

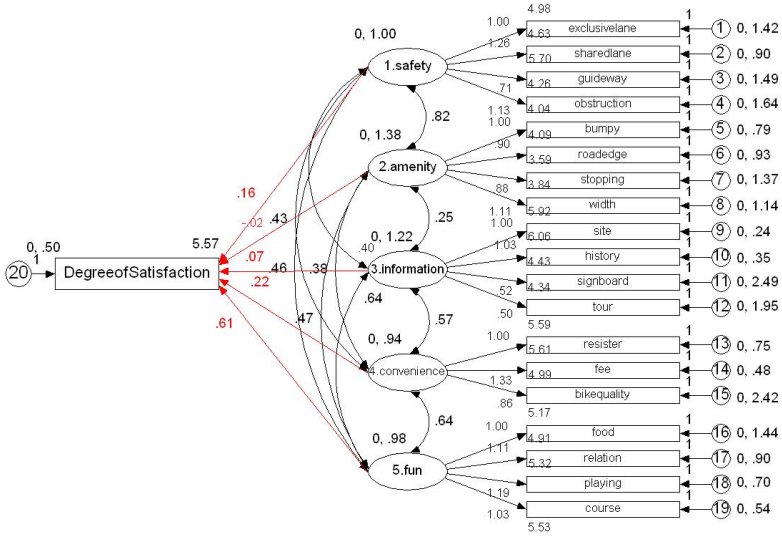

Fig. 2. Model illustrates the theoretical relationships among the latent test variables using structural equation modeling (SEM). To help to clarify the figure above, the items and uniqueness were not included. A solid line in the figure represents the statistically significant relationship based on the SEM analysis results. Only statistically significant path coefficients are provided in the model.

Table 3. Verification Results

Representative fit index	Encouragement accommodation level	Results
χ^2-value	Critical value of χ^2 table	469.319 (p = 0.00)
NFI (Normed fit index)	Between 0 ~ 1 (If it is over 0.9, then good)	0.772
RMSEA	If it p < 0.05, then good	0.101
GFI(Goodness of fit index)	Between 0 ~ 1, If it is over 0.9, then good	-
CFI(Comparative fit index)	Between 0 ~ 1, If it is over 0.9, then good	0.830

5 Discussion

As results of a SEM, the component of amusement (fun) primarily affects the degree of satisfaction (DS) (0.61). Second significant component influencing the DS is the convenience (0.22) followed by safety (0.16) and information (0.07). Four variables denoting the amusement component are as follows: "Playing in rest time (e.g., game)" (0.82), "How about course? Not detour?" (0.81), "Human relationship among team members" (0.76). This means that participants consider amusement as the most important factor. Second important component is the convenience. It consists of such variables as "Fee - expensive or cheap" (0.88), "Easy to resister for participant" (0.75) and "Quality of rental bike" (0.47). For the component of safety, participants of Gyeongju Bike Tour Program (GBTP) put little importance since they recognized the

Table 4. Results of Verification of a SEM

Latent Variable	Measurement Variable	Path Coefficient		t - value	p	Satisfaction Rate
		Unstandardi-zation	Standardi-zation			
Safety	Exclusive lane	1.00*	0.64	-	-	4.98
	Shared lane	1.26	0.80	8.254	***	4.63
	Guide way	0.71	0.50	5.873	***	5.70
	Obstruction	1.13	0.66	7.349	***	4.26
Amenity	Bumpy	1.00	0.80	-	-	4.04
	Road edge	0.90	0.74	10.11	***	4.09
	Stopping	0.88	0.66	9.04	***	3.59
	Width of lane	1.11	0.77	10.64	***	3.84
Information	Site	1.00*	0.91	-	-	5.92
	History	1.03	0.89	13.95	***	6.06
	Sign board	0.52	0.34	4.68	***	4.43
	Tour	0.50	0.37	5.07	***	4.34
Convenience	Register way	1.00*	0.75	-	-	5.59
	Fee	1.33	0.88	9.98	***	5.61
	Quality of bike	0.86	0.47	6.12	***	4.99
Amusement (Fun)	Food	1.00*	0.64	-	-	5.17
	Relation with each other	1.11	0.76	8.67	***	4.91
	Playing	1.19	0.82	9.15	***	5.32
	Course	1.03	0.81	9.09	***	5.53

*** is indicated that significance probability is lower than 0.001.

program itself to be safely run. In this paper, we suggest that the local government needs to play a core role in improving the bike infrastructure such "Safety of shared bike road" and "Obstructions on bike road", although an amusement is the most important component for improving the program running.

In summary, this study helps clarify the independence and the primacy of components of degree of satisfaction for the GBTP; our main findings based on the experimental study here may aid to activate the GBTP and promote the use of bike for citizens.

Acknowledgments. The research was supported by a grant from the Academic Research Program of Korea National University of Transportation in 2012.

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A Case Study on the Effect of Land-Use Characteristics on Damages Caused by Natural Hazards in South Korea

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Abstract. This paper examines the effect of land-use characteristics on the total sum of damages caused by natural hazards in South Korea. The results show that the size of urbanized area, population density, industrial district area, bare land area and so on are positively related to damages, and that the area of levee has a strongly negative influence on them. Lastly, this paper proposes some measures for natural hazard mitigation, based on our empirical findings.

Keywords: Land-use Characteristics, Damages, Natural Hazards, Urbanized Area, Natural Hazard Mitigation.

1 Introduction

Natural hazards such as floods and typhoon have recently increased, which cause huge losses of life and property. In particular, cities in South Korea have rapidly been urbanized, and they are not well-prepared for climate change and natural hazards. And hence not a few studies regarding such natural disasters have been carried out in South Korea lately. These studies have mainly identified various factors which had an important influence on damages caused by natural hazards, and proposed some proper measures for natural hazard mitigation.

For example, Choi (2003) focused on the relationship between the size of urbanized area and vulnerability to natural hazards. They found that the size of urbanized area and population were positively related to damages caused by natural hazards. Jang and Kim (2009) conducted a similar study employing regional regression analysis. Their results showed that population and the area of urban forest had a significant impact on damages. A survey carried out by Park et al. (2010) indicated that the average annual rainfall, stream density, population density, the size of levee and so on had an important influence on flood losses. More recently, Kang et al. (2011) identified green infrastructures, including parks, urban forests, green roofs and so on, as a critical strategy for adapting to climate change. Their empirical results showed that a 1% increase in green infrastructures area was expected to reduce property damages by 6.4%.

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T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 287–292, 2012.

However, in contrast to many studies on natural hazards carried out in South Korea, there is still a lack of research on the relationship between land-use characteristics and damages. Therefore, this paper strives to identify the effect of land-use characteristics on damages by natural hazards, employing multiple regression analysis, a geographic information system (GIS), and a land cover map based on remotely sensed data.

2 Data Description

The data consists of details on a total of 64 administrative districts within the Seoul National Capital Area (SNCA) as of 2010. The SNCA is located in the north-west of South Korea, and comprises three major regions: Seoul Metropolitan City, Incheon Metropolitan City and Gyeonggi province. The SNCA has a population of 24.5 million (as of 2007), and it forms the cultural, commercial, financial and industrial center of South Korea.

Many previous studies empirically showed that the damages were influenced by various factors such as climatic characteristics, topographic characteristics, land-use characteristics, socio-economic characteristics, and preventive characteristics. This study focuses largely on the effect of land-use characteristics on damages by natural hazards. Therefore, we consider the following explanatory variables: population density, levee area, size of urbanized area, residential district area, commercial district area, industrial district area, stream area, agricultural district area, grassland area, wetland area, and bare land area. These explanatory variables can be grouped into three broad categories: demographic characteristic, preventive characteristic, and land-use characteristics. The dependent variable is the total sum of damages caused by natural hazards in 2010.

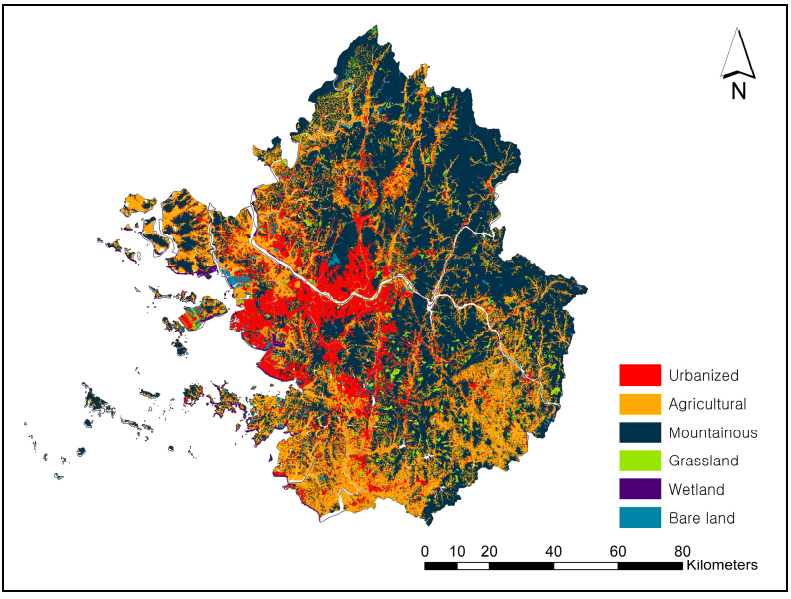

Fig. 1. Land-use patterns of the SNCA (Source: Ministry of Environment, South Korea)

The data regarding land-use characteristics is measured using a GIS and a land cover map based on remotely sensed data (Figure 1). Other data is extracted from the disaster annual report of the National Emergency Management Agency (NEMA) and the database of the Korean Statistical Information Service (KOSIS). Descriptive statistics for the data set are shown in Table 1.

Table 1. Descriptive statistics for the data set

Variable	Mean	Std. Dev.	Min.	Max.
Dependent variable				
Regional damages (1,000 USD)	1,713.44	2,069.40	15.60	11,660.56
Demographic characteristic				
Population density (1,000 people/㎢)	16.93	10.78	1.52	41.28
Preventive characteristic				
Levee area (㎢)	0.42	0.58	0.00	2.53
Land-use characteristics				
Size of urbanized area(㎢)	27.94	21.72	5.51	102.87
Residential district area (㎢)	12.50	10.03	1.92	42.97
Commercial district area (㎢)	2.38	1.99	0.01	9.88
Industrial district area(㎢)	4.45	7.01	0.00	36.86
Stream area (㎢)	7.13	11.05	0.00	46.97
Agricultural district area (㎢)	46.88	77.95	0.00	317.02
Park area (㎢)	2.48	2.20	0.00	9.51
Grassland area (㎢)	1.03	1.89	0.00	8.90
Wetland area (㎢)	1.38	2.34	0.00	10.55
Bare land area (㎢)	5.01	8.05	0.17	53.89

*1USD ($) = 1,000 Korean won (₩).

3 Empirical Results

There are no definite theoretical guidelines on the choice of an appropriate functional form for the multiple regression analysis, though the Box-Cox transformation has been adopted in many previous studies. Cassel and Mendelsohn (1985) stated that it was reasonable to try several functional forms and utilize the multiple regression equation with the best performance.

We empirically considered simple function forms such as linear, semi-log, inverse semi-log, double-log forms, and concluded that the linear form was suitable for the data set in terms of the coefficient of determination and the statistical significance of regression coefficients. Therefore, the linear form is specified for the rest of our analysis. And the estimated coefficients show the increase in regional damages caused by natural hazards when there is a marginal increment in a specific variable, ceteris paribus.

Our empirical results are given in Table 2[1]. The problem of multicollinearity is checked in estimating the model, and none of the variance inflation factors (VIFs) for any of the parameter estimates is more than 10. Therefore, we conclude that multicollinearity is not a serious problem, based on the suggestion by Neter et al. (1996). In addition, Breusch-Pagan statistics are calculated to test for the presence of heteroscedasticity. The test statistics indicate that the null hypothesis of constant residual variance is rejected at the .05 level[2]. Thus, heteroscedastic robust forms are used in our final analysis.

$$Breusch-Pagan\ test\ statistics = (SSR \div 2) \div (SSE \div n)^2 \quad (1)$$

The adjusted coefficient of determination in Model 1, which has only two independent variables, i.e. URBANIZED and STREAM, is .277, and the variables are significant at the level of .05. The size of urbanized area variable (URBANIZED) shows the positive sign as expected, which means that there is a positive relationship between the size of urbanized area and damages.

We break down the URBANIZED into its key elements, that is, the residential district area (RESIDENTIAL), the commercial district area (COMMERCIAL), and the industrial district area (INDUSTRIAL) in Model 2. Contrary to our expectations, the result indicates that RESIDENTIAL and COMMERCIAL are not statistically significant.

We consider more diverse land-use variables in Model 3, excluding insignificant variables in Model 2. The adjusted coefficient of determination is .525 and the F statistic obtained indicates an overall significance of the model estimated. All the variables are significant at least at the .05 level, except PARK, GRASSLAND, and WETLAND.

The estimate of the variable INDUSTRIAL is positive. Specifically, a 1 km^2 increase in the industrial district area is expected to increase damages by 114,587 USD. We think that the result can be explained by the fact that about fifty percent of the total manufacturing companies in South Korea are concentrated in the SNCA.

Similarly, the estimates of STREAM and AGRICULTURAL variables show that there is a positive relationship between their sizes and damages. They indicate that each 1 km^2 increase in the stream area and the agricultural district area would lead to an increase in damages by 59,598 USD and 18,213 USD respectively.

None of three variables, namely PARK, GRASSLAND, and WETLAND reach statistical significance unexpectedly. The result does not correspond to the views of Kang et al. (2011), though their study area was the entire region of South Korea. They found that green infrastructures such as parks and urban forests made a significant

[1] We actually considered regional climatic characteristics such as the annual rainfall, the rainfall intensity, the maximum instantaneous wind velocity, and the average wind velocity, based on the data from the automatic weather system (AWS) of the Korea Meteorological Administration (KMA). However, the variables did not reach statistical significance in our cross-sectional analysis.

[2] Model 1: BP LM statistic = 92.3041, Chi-sq(3), p-value = 7.0e-20.
Model 2: BP LM statistic = 52.6897, Chi-sq(5), p-value = 3.9e-10.
Model 3: BP LM statistic = 39.2175, Chi-sq(10), p-value = 2.3e-05.

Table 2. Empirical results (Dependent variable: regional damages by natural hazards)

Variable	Model 1		Model 2		Model 3	
	Coef.	VIF	Coef.	VIF	Coef.	VIF
Constant	130.517 (449.189)		484.416 (342.740)		-263.386 (647.767)	
URBANIZED (km^2)	46.158** (21.047)	1.01				
RESIDENTIAL (km^2)			37.668 (43.082)	2.48		
COMMERCIAL (km^2)			-50.142 (148.802)	1.67		
INDUSTRIAL (km^2)			133.548* (66.747)	1.69	114.587** (53.692)	1.95
STREAM (km^2)	41.169** (20.249)	1.01	39.620* (20.321)	1.01	59.598*** (20.152)	2.01
AGRICULTURAL (km^2)					18.213** (7.137)	5.67
PARK (km^2)					-110.954 (94.992)	1.17
GRASSLAND (km^2)					-181.292 (270.882)	3.98
WETLAND (km^2)					-192.927 (214.880)	3.95
BARELAND (km^2)					65.098*** (21.337)	2.03
DENSITY (1,000 people/km^2)					57.786** (22.466)	2.31
LEVEE (km^2)					-921.869** (402.559)	1.57
Goodness of fit	N = 64 Adj. R^2 = 0.277 F(2,61) = 6.71 Prob>F = 0.000		N = 64 Adj. R^2 = 0.343 F(4,59) = 3.79 Prob>F = 0.000		N = 64 Adj. R^2 = 0.525 F(9,54) = 11.87 Prob>F = 0.000	

*** p<0.01, ** p<0.05, * p<0.10 Robust standard errors in parentheses.

impact in mitigating flood losses. However, our result can be explained by the fact that the local governments in the SNCA have handled green spaces as sites for leisure activities and recreation, landscape only, and the role of green spaces such as flood mitigation through water management has been overlooked.

With regard to the bare land area variable (BARELAND), a 1 km^2 increase in the area of bare land is expected to increase damages by 65,098 USD. The result means that the unstructured and unkept bare land in our study area has potential danger for natural hazards.

The sign of the population density variable (DENSITY) is positive as expected, which is consistent with the results of previous studies (Park et al., 2010; Jang and Kim, 2009; Choi, 2003). A 1,000 people/ km^2 increase in the population density is

expected to increase damages by 57,786 USD, and this result means that urbanized and crowded areas have vulnerability to natural hazards.

The estimate of the levee area variable (LEVEE) is negative, and a 1 km^2 increase in the area of levee is expected to reduce damages by 921,869 USD. This shows that the levee area has a strongly negative influence on damages.

4 Conclusion

This paper explores the effect of land-use characteristics on damages caused by natural hazards in South Korea. The empirical findings show that the size of urbanized area, population density, industrial district area, bare land area and so on are positively related to damages, and that the area of levee has a strongly negative influence on them.

We can propose some measures for natural hazard mitigation based on our empirical findings. First, structural facilities such as dams and levees should be fully equipped in industrial districts within the SNCA. Second, systematic management is required for the bare land which has potential danger for natural disasters. Lastly, local governments in the SNCA need to take into account the wider role of green spaces including mitigating flood losses when planning land use and development.

Further research for other regions and time periods is required to identify clearly the relationship between land-use characteristics and damages by natural hazards.

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An Analysis of the Relationship between the Flow Experience and the Lesson Persistence Intention of Robot Programming Lesson Participants

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Abstract. The purpose of this study was to objectively analyze the active and persistent lesson participation attitude and the lesson flow phenomenon of students that are participating in robot programming lesson. The analysis information was used to identify the factors that could affect the lesson participation & flow of learners in order to identify the areas of improvement in programming lesson that is regarded as difficult by students in general. Accordingly, Technology Acceptance Model (TAM) and the Theory of Flow were examined based on which structural equation model was established and analyzed. Consequently, it was found that Perceived Ease of Use and Perceived Usefulness were factors that could affect the lesson persistence intention of learner, among which the Perceived Ease of Use factor affected the flow of learner. Meanwhile, it was also found that the factor of Balance between Challenges and Skills affected the Concentration on the task at Hand factor as well as the Perceived Usefulness factor in the flow of learner. In addition, this study also dealt with information on the relation between TAM and flow.

Keywords: TAM, Flow, Robot in Education, Robot Programming Lesson.

1 Introduction

Since robot comprehensively includes the characteristics of various studies from math, science and computer engineering to electronics, teaching students about robot could become an activity of teaching various areas of studies. Particularly, there are many cases in which robot education is provided for the primary goal of providing computer programming education in universities or high schools, as well as the goal of providing basic programming education or education for enhancing problem-solving skills for elementary & middle school students (Fagin et al., 2001; McNally et al., 2006; Apiola et al., 2010).

As mentioned above, however, it is easy to assume that robot education is difficult for both instructor to teach and students to learn because of its complex academic characteristics of combining various studies, but various results show that programming education that utilizes robot or other types of education with the main

T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 293–299, 2012.

objective of enhancing problem-solving skills is being effective. Based on the findings from studies that showed the flow phenomenon of students actively participating in learning activities (Nonnon et al., 1990; Edwards et al., 1997; Fagin et al., 2001; Stefanie & Markham, 2010), it can be said that there is a need for school education that can draw out the active and persistent lesson participation of students, in addition to a need for taking interest in the factors and the process of drawing out the learning flow of students. Particularly, the main interest and focus of this study is to examine the factors that allow students participating in robot education to have the attitude of actively and persistently participating in lesson activities, as well as the relationship between such factors and the flow of students in their learning activities.

2 Theoretical Background

2.1 TAM (Technology Acceptance Model)

The studies on identifying the factors that affect students' attitude of persistently taking interest and participating in school education activities are being conducted in relation to the attitude of teacher or students to accept technical new medium in learning activities

Primary examples are the studies on identifying factors that could affect the attitude of trying to accept and continuously use ICT (Information & Communication Technology) by teacher or students in their teaching/learning process (Yeun & Ma, 2008; Teo, 2010). These studies applied TAM to explain the persistent learning participation intention of learners. TAM is a model that was further developed by Davis et al. (1989) based on the Theory of Reasoned Action (TRA) by Ajzen & Fishbein (1980) that tried to explain the relationship between the belief and attitude of new technology users and their intention of implementation, and TAM has been effectively used in other studies that tried to explain the user intention of new technology.

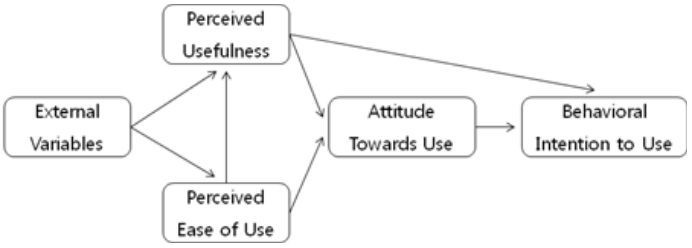

Fig. 1. Technology Acceptance Model (Davis et al., 1989)

2.2 The Theory of Flow

The term 'flow' was first used by Csikszentmihalyi (1990) who expressed the 'natural state of flowing water' or 'feeling of being drifted away by wave' to describe situation

when people become completely focused on a certain task even without their intention (Csikszentmihalyi,1975).

Meanwhile, there are studies that show that these components of flow can lead to a deeper flow experience as the affect one another in order (Ghani, 1995; Hoffman & Novak, 1996; Chen et al., 1999; Shin Namin, 2006). According to these studies, flow experience consists of the three stages of Flow Antecedents, Flow Experience and Flow Consequences. In the Flow Antecedent stage, the phenomenon of Balance between Challenges and Skills appears and affects the next stage of Flow Experience. In the Flow Experience stage, the phenomenon of Concentration on the Task at Hand appears. Finally, the Flow Consequences stage is known for continuously concentrating on the learning process (Ghani, 1995), having positive effects on the learning experience (Chen et al., 1999), or having effects on the learning accomplishment or satisfaction (Shin Namin, 2006). In this study, the experience in the Flow Consequences stage will be considered as 'Learning Satisfaction' a diagram of flow experience is as follows.

Fig. 2. Stages of Flow Experience

2.3 Relation between TAM and Flow

Based on the results of studies that state that flow experience can increase the exploratory behavior or the positive and subjective experience of learner, as well as the studies that state that flow experience can have more effects on the learning intention of learner than Perceived Usefulness or Ease of Use (Hsu & Lu, 2003), it was found that flow experience can affect the Behavioral Intention to Use that is the final stage of TAM.

Meanwhile, it was also found that flow is affected by Perceived Ease of Use in the sense that learner can easily experience flow experience because of ease of use, as well as that it can affect the Perceived Ease of Use factor in the sense that the value of the learning activity can be identified through flow experience (Webster et al., 1993; Ghanin & Deshpande, 1994; Csikzentmihalyi, 1997; Sánchez-Franco et al., 2005).

3 Study Model and Hypotheses

The study model of this study based on the above theoretical background is as follows.

Based on the study model, the following hypotheses can be established according to TAM presented by Davis et al. (1989).

H1: Perceived Usefulness has positive effects on Behavioral Intention to Use

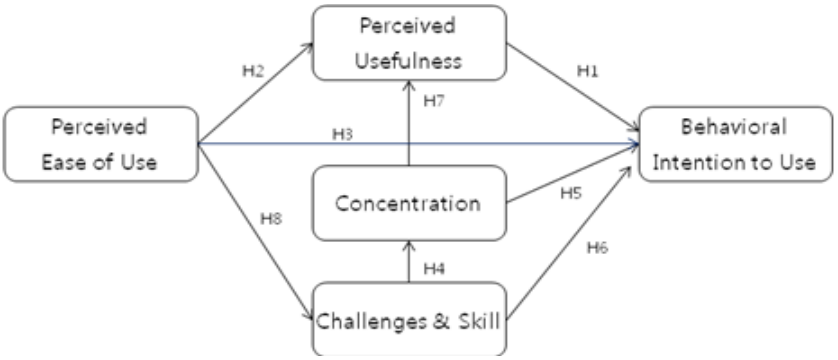

Fig. 3. Study Model

H2: Perceived Ease of Use has positive effects on Perceived Usefulness
H3: Perceived Ease of Use has positive effects on Behavioral Intention to Use

H4: Balance between Challenges and Skills has positive effects on Concentration on the Task at Hand (based on the results of studies conducted by Ghani (1995), Hoffman & Novak (1996), Chen et al. (1999) and Shin Namin (2006) that examined flow)

H5: Concentration on the Task at Hand can have positive effects on Behavioral Intention to Use (since the flow experience of learner can have more effects on the learning intention of the learner (Hsu & Lu, 2003))

H6: Balance between Challenges and Skills can have positive effects on Behavioral Intention to Use

H7: Concentration on the Task at Hand has positive effects on Perceived Usefulness

H8: Perceived Ease of Use has positive effects on Concentration on the Task at Hand (since flow is affected by Perceived Ease of Use and it can affect Perceived Usefulness (Webster et al., 1993; Ghanin & Deshpande, 1994; Csikzentmihalyi, 1997; Sánchez-Franco et al., 2005)

4 Study Content

The robot used in the robot lesson for this study was LEGO MINDSTORMS, and the programming tool used was NXT2.0. The lesson was conducted for 1 month for 182 elementary school student participants and the lesson content is as shown in the following table.

After the completion of the lesson, they were presented with questionnaires that consisted of the 5 point Likert scale and structural equation was used to analyze the questionnaires that were collected.

Table 1. Education Content

Order	Subject	Program Element
1	Controlling sub motor	Controlling motor according to variable value
2	Controlling touch sensor	Controlling motor according to touch value
3	Avoiding obstacle	Infinite conditional statement, conditional branching statement
4	Controlling light sensor	Conditional statement
5	Detecting line	Reiterated conditional statement
6	Detecting line	Controlling conditional statement according to function value

5 Study Result

The analysis showed the result of Chi-square = 139.692, Degrees of freedom = 82 and Probability level = .000, as well as 1.899 for Chall&Skill-> Bi value and 0.051 for Concent-> B value of the critical ratio values of Regression Weights, thereby showing that only these two path values were inappropriate. In addition, the minimum values of the Construct Reliability and the Average Variance Extracted of the factors used in the study model found to be respectively 0.9 and 0.75, thereby showing Convergent Validity and Internal Consistency. Additionally, as shown in Table 2, Discriminant Validity was also ensured since the square value of coefficient of correlation does not exceed the AVE value.

The CMIN/DF value of this study model is 1.704 and the other major model validity values are as shown in Table 3. The final analysis values of the study model are as shown in Figure 4.

Table 2. Correlation Coefficient and AVE

	Bi	Useful	Easy	Chall&Skill	Concent
Bi	0.09*				
Useful	0.75	0.81*			
Easy	0.78	0.85	0.89*		
Chall&Skill	0.69	0.69	0.77	0.92*	
Concent	0.56	0.60	0.61	0.75	0.75*

Table 3. Major Model Validity

GFI	AGFI	RMR	RMSEA
0.908	0.865	0.027	0.064

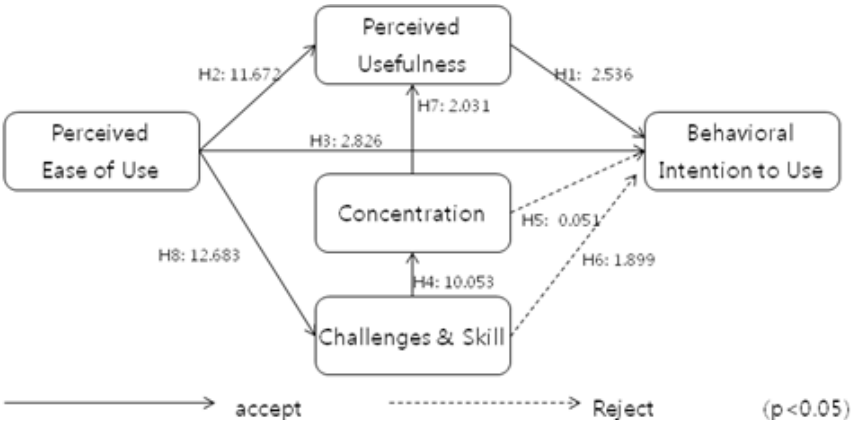

Fig. 4. Study Model Analysis Result

6 Conclusion

The result of analyzing the study model revealed that every hypothesis was accepted except for H5 and H6. In specific, students that participated in robot programming lesson based on TAM thought that it was easy to control the robot in regards to the learning content, and they also thought that the lesson using robot is important in terms of its value. In addition, it was confirmed once again that the Concentration on the Task at Hand factor was being affected by the Balance between Challenges and Skills factor.

Meanwhile, the result of existing studies that stated that flow can be affected by Perceived Ease of Use and affect Perceived Usefulness (Webster et al., 1993; Ghanin & Deshpande, 1994; Csikzentmihalyi, 1997; Sánchez-Franco et al., 2005) were confirmed once again, but it was found in this study that the Concentration on the Task at Hand factor and the Balance between Challenges and Skills factor do not have meaning effects on Behavioral Intention to Use.

Consequently, it was revealed that the lesson persistence intention of robot programming learner was being affected by Perceived Ease of Use and Perceived Usefulness factors, and it was not being directly affected by Flow factor.

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Guitar Application Programming for Smartphone

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Abstract. Groundbreaking ideas or developing products can innovatively change our lifestyles. The ideas and products can be combined together and rapidly evolve by themselves. The smart phone that was developed just a few years ago has capabilities that are too many to list. It is not only a phone, but also has computer functions, such as games, music, and the Internet that are a must for modern people. The guitar application named, 'The First Guitar' which we developed, improves performance and has a realistic touch compared to other musical applications that have been released. This study is about serious consideration of musical applications for smart phones such as sound, design, a variety of functions, and User-Oriented interface in the process. This paper has two different subjects; one is how to produce the best guitar sound source and the other is how to provide an easy and convenient application for users using a previously recorded guitar sound source.

Keywords: Optical Trackpad, Equalization, Compression.

1 Introduction

The First Guitar is an easy and convenient guitar application that a user can play as a lead guitar with a rhythm guitar that is auto played by adding chords as a user in a band. It allows a player to use vibratos and hand cutting just like a user would play a real guitar.

The First Guitar is not based on smart-phone touch screen, but optical trackpad (OTP) which is an optic based navigation module for small handheld devices such as mobile phones and smart phones. Optical trackpad introduces the concept of a cursor to the mobile platform and acts identical to a regular mouse in on a PC system. It can move, navigate, click, scroll, drag and select with the cursor [1]. Using the optical trackpad gives a new experience through which a user can play open position chords by picking on the optical trackpad while touching a string on the nut. Shaking the device after picking on the optical trackpad makes sound vibrate and clicking the optical trackpad stops its echoing. It was designed for a real guitar experience so that

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T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 300–305, 2012.

the sound vibrates when shaking a smartphone device and the fingering and picking areas are separated from each other. This application has 3 Play Modes; Melody mode, Chord mode for solo playing, and Chord mode for fingering practices. It provides easy controls and real sound and graphics.

2 Making Guitar Sound Source

2.1 Understanding Room to Record

To record guitars, understanding un-amplified recording space's behavior must be priority, factors have to be taken into consideration, such as clarity, uniformity, envelopment, freedom from echo, reverberation, performer satisfaction, and freedom from noise [2][3].

Clarity in terms of reverberation is basically meaning how clearly people hear the original sound of the instruments and how the reverberation affects the sound. In the studio where the guitar was recorded, the early reflection is about 15ms in the center of the room. Because of that we could hear initial attacks of instruments fairly well and the reverberation of the studio helps instrument to blend well. However, the frequency response of the studio has more mid and low frequencies. Sometimes, in lower register notes and fast passages, we got unclear definitions of the instruments. The reverberation of the room smears the intelligential frequencies around 1kHz to 5kHz. Obviously, the dynamics of the instruments drive the loudness of the reverberation.

In pink noise analysis, we received more frequency responses from 600Hz to 1.3kHz. During loud performances, for example distortion guitar or any amplified performances, we had to be very careful about the guitar levels and cut off those frequencies, so that I could expect a flatter response of the studio.

2.2 Recording Guitar

There were several ways to record guitar sound in this experiment. Close miking within 20cm of a speaker (Line 6) and ambient miking about 50cm away from the speaker. We put a condenser microphone up against the grill of the speaker as the close microphone and natural ambience can add a lot of character to a guitar sound.

Placing a condenser microphone half of a meter back from the speaker gives a detailed recording of the amp sound interacting with the room ambience. The last method to record the guitar sound was using a direct box (DI) that plugged into the guitar line input to provide the most noise-free input signal and zero leakage [4][5]. DI transforms line input signal into mic-level signal which is delivered to the mic-preamp. Blending this distant microphone with the close microphone produces a fuller overall guitar sound after using equalization on each track.

2.3 Equalization and Compression

The guitar has a very wide range of frequencies. I cut a chunk of very low frequencies (below 100Hz) because of bass boost and it makes the overall sound appear noisy and muddy. I boosted 100Hz a little to warm up and make the sound more powerful and also boosted 125Hz and 200Hz to add warmth. The most important area to make the proper electric guitar sound is the upper mid range. I cut some of the guitar between 1-4kHz and boosted the 4-5kHz to add more presence to the sound. 3kHz is a good point to give guitar more bite, so I boosted 3kHz to give more clarity. Then, I boosted the high frequencies (8-10kHz) for guitar brightness.

Fig. 1. Equalization on guitar track

The guitar is a versatile instrument that forces people to think about what sound they are looking for before deciding on the compressor settings [6][7][8]. To make a sustained sound, the compressor may be used as an artificial sustain device by compressing the input heavily, and using a fast attack time and a release time of 250ms. The ratio was around 4:1. Also, I increased gain compensation to create the guitar sustain effect.

3 Designing Guitar Application

3.1 Concept and Important Functions

The goal of The First Guitar is to help users study guitar without an instructor. The application uses carefully chosen pre-produced audio sources and provides almost every guitar technique that guitarists often use in reality. Also, the optical trackpad gives an advantage by allowing one to stroke the guitar strings compared to other smart phones that do not have an optical trackpad such as the iPhone. The Optical trackpad gives an impression that a user plays real guitar.

Rubbing the optical trackpad up to down performs (plays) the guitar strings. Rubbing the optical trackpad left to right (or right to left), moves 4 guitar fret boards at once. The First Guitar has a total of 8 frets, the basic screen is the first 4 frets. Rubbing the optical trackpad left to right shows the 5th ~ 8th frets, and rubbing the optical trackpad right to left shows the 1st ~ 4th fret.

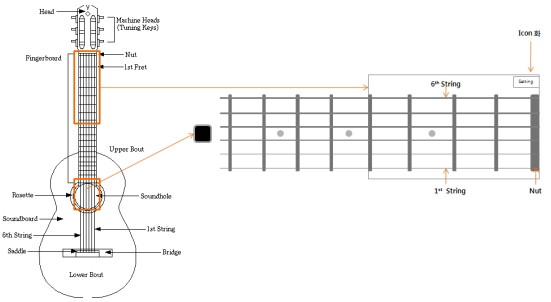

Fig. 2. Basic Concept of The First Guitar

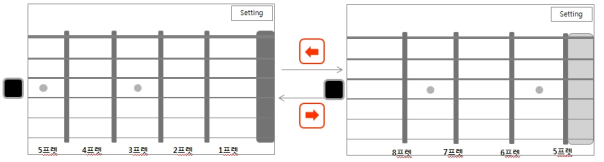

Fig. 3. Moving Display by optical trackpad

To make the guitar feel real, open strings are always placed at the very left of the frets. Besides the basic operation, shaking the phone up and down gently represents vibrato sound. Moreover, different length of musical vibrato can be controlled by the shaking speed. Also, a hand cutting sound to make more clear sound can be made by clicking the optical trackpad.

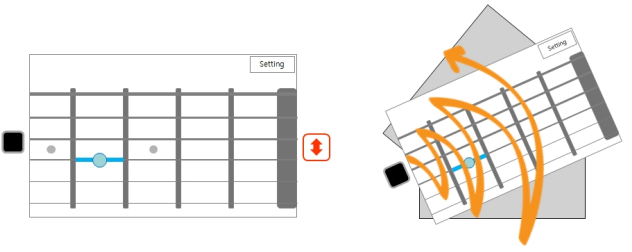

Fig. 4. Vibration

3.2 Settings

There are 6 major setting menus to perform a detailed play, such as Play Mode, Tone Mode, Music Style, Tempo, Sound Balance, and Picking Sensitivity.

Play Mode is classified by Chord, Melody, and Melody (Base chord). Chord menu is to input chord progressions that the user would play. Each guitar chord shape is shown while the chord is playing automatically. Melody is mostly about guitar solo without accompaniment and Melody (Base chord) has the user play solo with accompaniment based on the chord progression that the user already typed in. The idea of Melody and Melody (Base Chord) is derived from the concept of lead guitar

and rhythm guitar as a twin-guitar system in a real band. The First Guitar enables single user to play multiple guitars with a single smart phone.

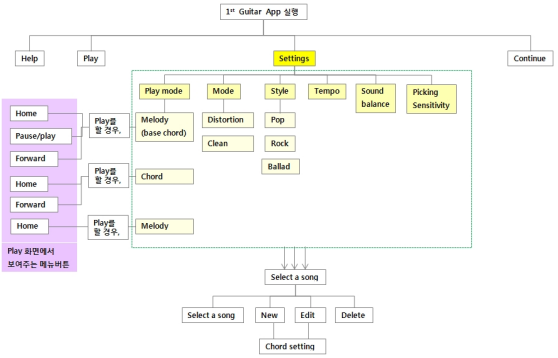

Fig. 5. Main organization chart

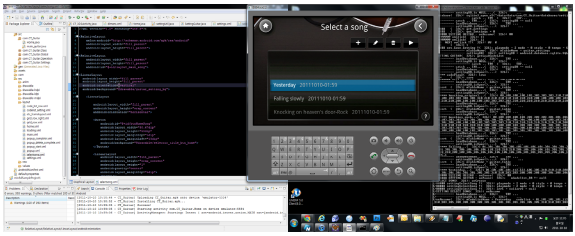

Fig. 6. Select a song

In Melody (Base chord) and Chord mode, it also enables users to use 12 music keys and it provides all the diatonic chords, such as Major, Minor, M7b5, Dominant, Diminished, Augmented, and Sus4. Moreover, users can add an unlimited amount of chords and edit then save.

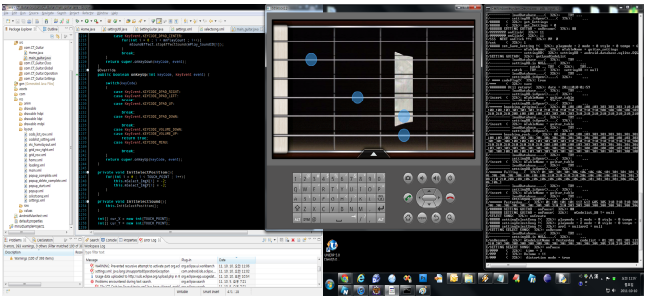

Fig. 7. Play mode

In Tone Mode, there are 2 different guitar tones (Clean Tone and Distortion Tone). Users can change the music style (Pop, Rock, Ballad) of what users already typed chords progression in. When a user chooses the Rock music style, the chord

progression is played with distortion power chords by itself. The First Guitar provides 5 different tempos (60BPM, 80BPM, 100BPM, 120BPM, 140BPM). Also, the user can adjust the sound balance by using a slide bar when it is in Melody (Base chord) Mode.

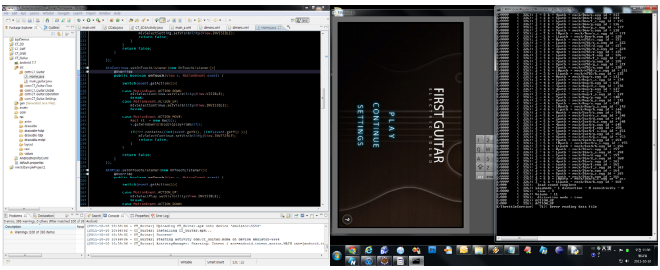

Fig. 8. Front Display of The First Guitar

4 Conclusion

First, when the user strokes the optical trackpad to pluck the strings, the sound does not generate on time; which means that synchronization is not matching tiny delayed. Second, many smart phones of different manufacturers have a different screen size and resolution, so that it is not easy to standardize The First Guitar in terms of string size and fret size. It means that the user needs to pay attention when they play. Third, there are some important guitar techniques missing which real guitar players often use; such as sliding, hammering-on, and pulling-off. Fourth, this application is restricted to smart phones that have an optical trackpad. So, it is recommended to develop different version to be used in other platforms and OS, such as iPhone.

The last, The First Guitar uses real a guitar sound source (audio format such as .wav or .mp3) that was pre-recorded and mixed which means size of the application is very big and heavy to download. Therefore, it is recommended to transform or digitize audio files to a lighter format such as the MIDI (Musical Instrument Digital Interface) format [9].

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A Study of Communication Design Strategies Based on Visual Elements in Yeosu Expo Newsletter

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Abstract. The newsletter in this study provides news and information of the company. And Consumers get necessary information from the newsletter and respond, so quick, precise, and effective information sending to customers is important. Information is delivered from Source to receiver through Channel. Source has to change its purpose into right sign for Channel to use it. The main contents 2012 Yeosu Expo newsletter try to deliver is about link to previous file, the Expo site, BIE site, ticket reservation site, participating nations status, Youtube video, Namdo shortcut, inform, and Naver blog event.In visual aspect of the newsletter, unity of link, prediction for path, and linguistic accessibility are analyzed in harmony of trend of image, arrangement of layout, illustration, photograph, and copy and informational aspect.

Keywords: Newsletter, Yeosu Expo, Visual Element.

1 Introduction

The rapid development of technology and the changes in the mobile industry since 2000 leads to a need of more diversified marketing activities. Among them, newsletters are established as important tools for communication strategies and powerful means for online marketing, changing in many respects with social network. Owing to the mobile development, diverse communication channels are complexly utilized in marketing and a role to group and transfer immense information scattered on web to suit the marketing themes in organization becomes important. Newsletters lie in an important part of that link. Non-profit organizations reduce their marketing expenditure and overcome the constraint of sending, utilizing cost and effort-effective newsletters on a regular basis and newsletters paly an role in improving brand awareness and customer royalty. Thus newsletters are used as an important media to activating communities. This study aims to analyze newsletters relating to the operation of international events by visual element through 2012 Yeosu World Expo and investigate the effect of its communicability in terms of the information of the contents.

T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 306–312, 2012.

2 Understanding of Newsletters

2.1 Understanding for Newsletter

Newsletters refers to a service in which newsletters containing information helpful for members who subscribed the internet site of companies are made and sent via e-mail (Naver: Encyclopedia). Newsletters provide news and information of a company. Customers' agreeing to the receipt of newsletters from an organization means they can be closely associated with people participating in the brands and the missions of an organization on a long-term basis. Sending information effectively and accurately to customers is essential for an organization to deliver the mission of its brand and encourage immediate responses. Thus, newsletters are included in information design when expressed in terms of design. Information design shows the characteristics of the organic interaction in the overlapping areas with the adjacent areas such as the Interface Design, Interaction Design, and Experience Design. As generating easy-to-use information and incorporating information into artificial objects facilitates user-centeredness and effective delivery. Thus, the visual element strategies facilitating them is highlighted in newsletters.

2.2 Communication and Emotional Perception

The origin of communication is communis in Latin having a meaning of 'common' or 'sharing'. Literally, it expresses the behavior of sharing and understanding one's own or others' knowledge, information, opinions, beliefs, emotions, etc. Communication accompanied by objects can not be independent. It can be interpreted as the process or the behaviors of organism transferring and receiving information or messages through symbols to establish common, which in turn affects the behaviors. (Lee Won Jae, 1994).

According to recent scientific research, the emotion is known to play an important role in human knowledge. From a long time ago, knowledge is recognized as objective, yet in fact is very subjective and interdependent. However, it is inevitable that the efficiency of information should rely on the form of the information in which the exchange of the information generated in two different systems are transferred through symbols. Information is transferred from a source to a receiver through channels. To use channels, the source needs to change its intention with the symbols suiting the channels. This process is referred to as Encoding. The symbols transferred through channels need to be converted into the forms which can be understood by receivers before the delivery. This process is referred to as recording. (Yoon, Woo Jung, 2000). Access to newsletters become available through e-mail link by users with interests. Thus, the amount of information needs to be adequate and the design elements need to be constructed in unity. In general, harmony is needed to minimize the noise in the precess of the delivery and the perception of information.

3 Research Findings and Analysis

3.1 Visual Component of Newsletters

Choi, Mi Sun and Whang, Jae Hyeon categorized the visual components of interface design, into layout, color, visual effects, and metaphor as examined in the previous studies; and Cho, Won Gyun and Paek, Jin Gyeong categorized the visual components of interface design into form, space and margin, and color elements, and layout. This study categorized them into navigation, title, layout, color, pictures and illustrations, and typography for the detailed analysis of newsletter design.

2012 Yeosu World Expo newsletter layout was intended to deliver the following information. Screen construction is shown in [Figure 1]. The messages it was intended to deliver included a link to the last issue, relevant Community Expo site links, BIE site links, ticket reservation site links, participants status link, YouTube video link, Namdo shortcut link, shortcut links, Naver Blog Events links etc.

Fig. 1. 2012 Yeosu World Expo screen configuration

In [Figure 2], the top of the newsletters shows the period of Expo as well as community links and provides Archive View function, actively utilizing newsletters as tools to activate the community of operating organizations.

In [Figure 3], the main image of newsletter carries out PR in a full range, focusing on the images which might be the main issues. In the early stage, it focused on the explanation of Expo and hard ware main images encouraging ticket reservation, and displayed the event PR-oriented software program images in front from the mid-stage until the opening of the event.

Fig. 2. 2012 Yeosu World Expo newsletter at the top. Before and after the opening

Fig. 3. 2012 Yeosu World Expo newsletter main image

In [Figure 4], newsletter video link linked to YouTube video facilitated real time communication through smartphones and tablets.

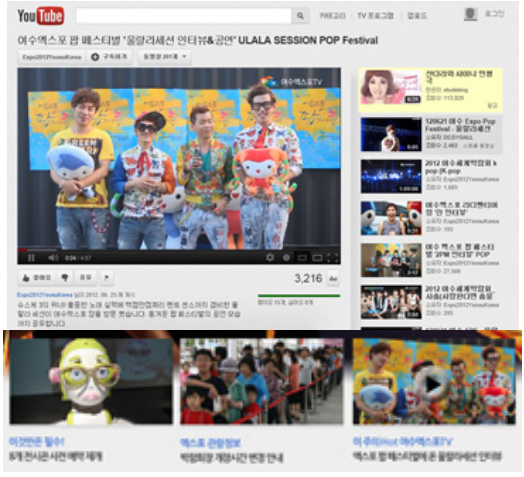

Fig. 4. 2012 Yeosu World Expo newsletter YouTube video link

In the aspect of community, the newsletter in [Figure 5] encouraged the involvement, directly utilizing the photos, the content, and the titles in the communities, such as Naver, Daum, Twitter, Expo official site, Facebook, and Me2day, with designated activities. The newsletter event link in [Figure 7] provided the official sponsor ads at the bottom.

Fig. 5. 2012 Yeosu World Expo Community Site Links

Fig. 6. 2012 Yeosu World Expo Newsletter Event Links

Fig. 7. 2012 Yeosu World Expo Ads at the bottom of newsletters advertising

3.2 An Analysis of Research Findings

Visual components, in the visual aspect, created the image of a tourism festival, effectively utilizing the big images matching the trend. In layout, the grids was aligned vertically in sequence according to the importance, in the marketing aspect, to

improve the readability. Portrait photos were used mostly for illustrations and pictures to match captions and copies, which in turn played a role in extracting and highlighting the key issues from the community posts dealt with the same gravity and encouraged active involvement of customers in the community.

In the information aspect, as the pages linked through each banner base on the link unity are designated as multiple community sites such as Expo Official Site, bogs, blogs, and empathy Korea, they satisfy the intention of the operating organization to encourage the involvement in the delivery of various information and event missions. The official site acting as a hub for all the information primarily handles and encourages the link to other sites, and the identical icons and texts included in newsletter banners facilitate the prediction of links for the visitors of home page. However, it was not easy to search information despite high communicability in the use of media because all the tests were processed in images, which in turn lead to poor accessibility because of not using alternative texts due to the problem of accessibility despite its nature as an national event.

Table 1. 2012 Yeosu World Expo visual component analysis

Information structure and Navigation	Constructed in lists, Intro and 8 categories provide community network link function and archive view function.
Title	Unique emblem is positioned at the upper left corner. It deals the title of newsletters and the information about the opening significantly and uses multiple columns.
Colors	Mainly use a large photo as a background. Main color and coloration structure using mainly pictures.
Photos and Illustrations	Intuitive composition of photos. Uses real time video still cuts and the main illustrations of relevant even posters.
Typography	Basic typeface: Gothic Title typeface: Uses the difference in font size and color.
Layout and Structure	Frame structure. Central alignment method using large background images of the issues at the time of publication.

4 Conclusion

As examined as above, the newsletters of non-profit organizations nowadays evolves from colorful graphics-intensive content to community-driven medium encouraging aggressive involvement of communities, inducing traffic, and confirming posting. This shows the newsletters delivering information also keep the order of the social network era, and newsletters, in the aspect of visual components expressing contents and delivering information and of information, have the characteristics as follows.

1. Improved the reality using photos and video included in communities rather than using colorful graphic images.
2. Encouraged aggressive involvement in the missions during the period through direct links to specific posts rather than the link to community itself through icons.

3. Delivered various information using vertical sub-grid systems based on customers' behavioral pattern accustomed to mobile despite rather long scrolling and dealt with the access path to communities in various ways.
4. Used the unified link as the official web site, and used the same phrases and the copies in community posts to facilitate the easy prediction of access path. However, its linguistic accessibility was not satisfactory enough because of not using alternative texts despite its nature as an national event. An analysis of the content operation cases using newsletters in non-profit organizations and the continued studies on the effective application of visual components expressing communication dealt with in this study will be needed.

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A Study on the Conceptual Design of High Efficiency Induction Motor and the Production of Prototype Motor for Sharing Core (Less than 37kw)

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Abstract. This paper is about the conceptual design and trial production of high efficiency induction motors with a sharing core capacity less than 37kw. For the preparation of a prototype induction motor set, motor design and analysis are required. The methods involved in the design and analysis for the high efficiency induction motor include basic design of motors, design of experiment, equivalent circuit method, and finite element method. Among these, design of experiment can be analyzed by dividing it into optimum design, key parameters, optimum areas, etc. Through the results and analysis of the design, motor characteristics are analyzed and their efficiencies are compared. Based on the analysis results, prototype high efficiency induction motors with a sharing core capacity less than 37kw (5.5kw, 7.5kw, 11kw, four 15kw poles, and six 11kw poles) are produced.

Keywords: Optimal design, high-efficiency induction motor, sharing core, strip layout, prototype.

1 Introduction

A necessity for die development for high efficiency induction motor can be considered at electromagnetic design and analysis technique, materials technology, and production technology [Fig. 1]. Electromagnetic design analysis is further divided into electromagnetic field analysis, selection of optimum combination of slot/bar, and optimum design of winding and slot. Mechanical design technology can be divided into noise, vibration reduction technology (fan noise, bearing noise), lower torque of cooling fan, and high wind speed. Material technology includes steel core materials (hysteresis loss and eddy current loss), conductive materials (aluminum/copper die casting), and insulation materials (increases degradation life, withstanding voltage, and occupying ratio). Production technology is further divided into die casting technology & winding automation, heat treatment (electromagnetic loss, mechanical strength), machining and assembly (improvement in completeness of motor), and bearing press fit technology (stray load loss, durability, and life).

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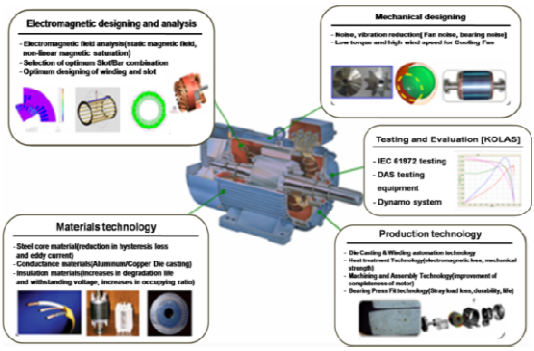

Fig. 1. Relevant technology analysis for the high efficiency induction motor

The small and medium industries for motor production have difficulties carrying the development of high efficiency electric motors by themselves. The major reasons are lack of research and development infrastructure, huge initial investment, and lack of high quality die fabrication technology. Hence, POSCO TMC has come out with the concept of high efficiency induction motor and its commercialization in collaboration with Korea Electrotechnology Research Institute based on the experiences obtained to date. Keeping these trends in view, this study is carried out for high efficiency induction motors concept and the production of commercialized high efficiency induction motors of capacity less than 37kW.

2 Main Points

2.1 Design and Analysis of Electric Motor

2.1.1 Basic Design of Electric Motor

The basic design of electric motor starts from design data input, consideration of rotor deep-bar effect, re-calculation of stator and rotor leak reactants considering saturation condition, ending with motor output characteristic calculation. The detailed activities involved in motor design are illustrated in Fig. 2.

2.1.2 Design of Experiment

The detailed contents about optimum design, selection of key parameters, and checking the optimization area using design of experiment are presented in Fig. 3. The key parameters for the optimum design include objective function, constraints, and design parameters among others.

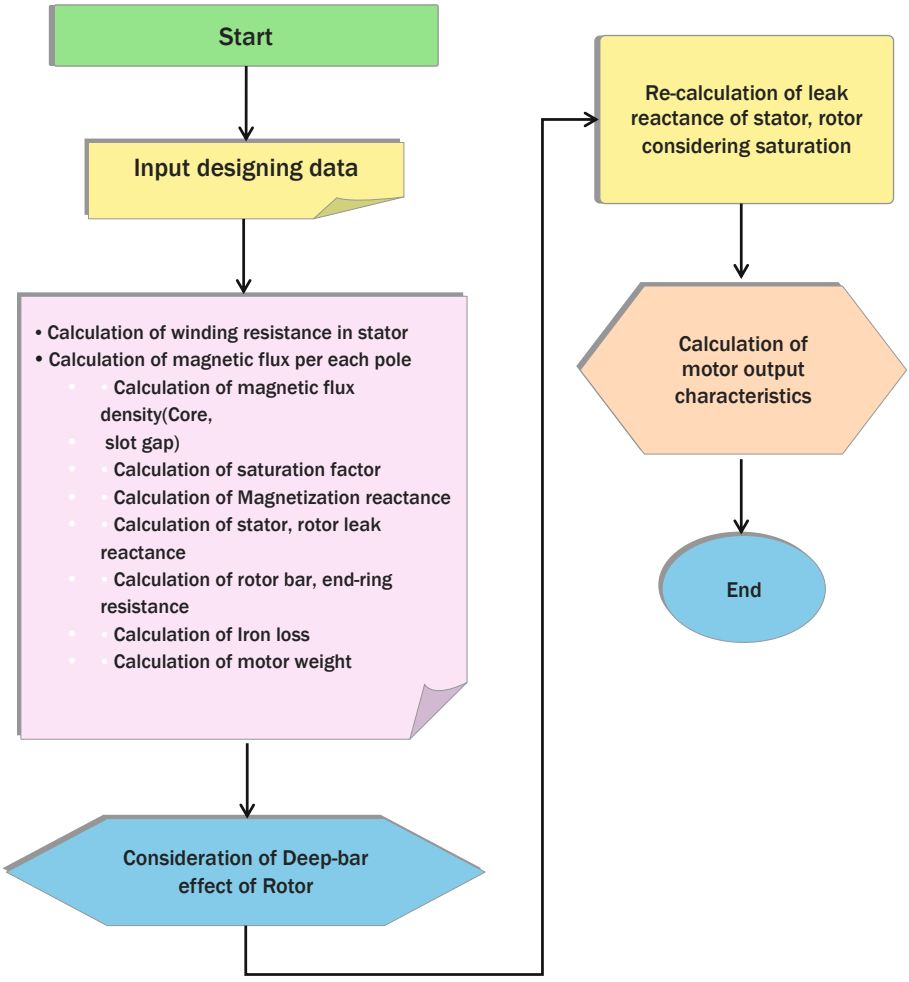

Fig. 2. Flow chart for basic motor design

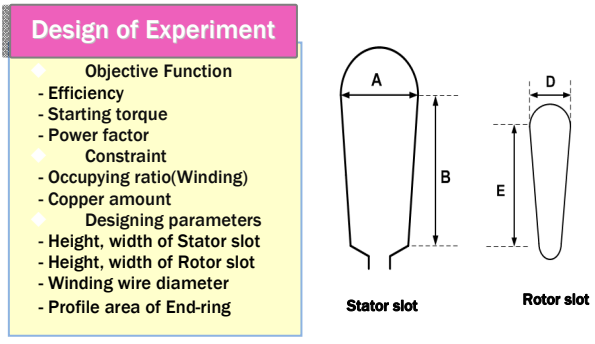

Fig. 3. Optimum design components by the design of the experiment

2.2 Characteristics Analysis Result

The analysis results of characteristics such as optimum design, key parameters, and optimization area are presented in Table 1. As can be seen from Fig. 1, the target for motor efficiency for the motors of four 5.5kw poles, four 7.5kw poles, and six 7.5kw poles is set to 89.5%, but analysis results show an improvement by 0.5%.

Table 1. Characteristic analysis result of proposed motor

Model	Four 5.5kW_poles			Four 7.5kW_poles			Six 7.5kW_poles		
	Efficiency (%)	Power factor (%)	Starting torque (%)	Efficiency (%)	Power factor (%)	Starting torque (%)	Efficiency (%)	Power factor (%)	Starting torque (%)
Result	90.0	83.1	243	90.0	83.1	252	90.1	81.2	265
Target	89.5 (89.0)	77.0	160	89.5 (89.0)	78.0	160	89.5 (89.0)	73.0	150

2.3 Comparison of Material Cost and Motor Efficiency

The comparison results of materials cost, volume, and efficiency of prototype induction motors currently developed by Baldor Electric Company are presented in Fig. 10 and Fig. 11. As can be seen from Fig. 11, when the efficiency of motors for four 5.5kw poles and six 11kw poles are compared, efficiency is better in the motors from Baldor by a range between 0.4% to 1.9%, while material cost increased in the motors from Baldor at a minimum of 5% up to 47% against 100% of the material cost in the proposed motor.

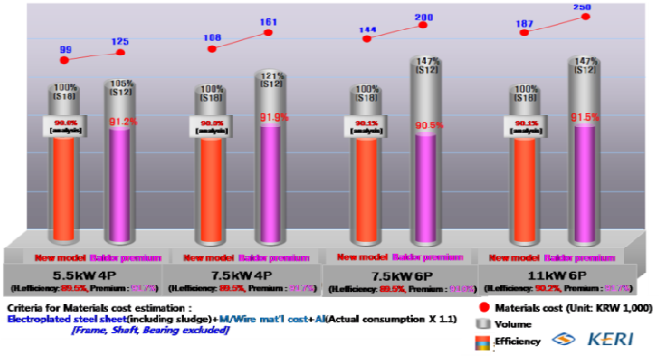

Fig. 4. Comparison between new motors and premium motors from Baldor

3 Die Design and Fabrication

3.1 Die Design

The die design and fabrication process, as can be seen in Fig. 5, goes from receiving purchase order from customer to die design to project completion after finishing die

validation. The entire process includes a stage-wise detailed development and design, process design and machining, assembly and testing the die subjected for reviewing, and assembly of all the components before the project is completed.

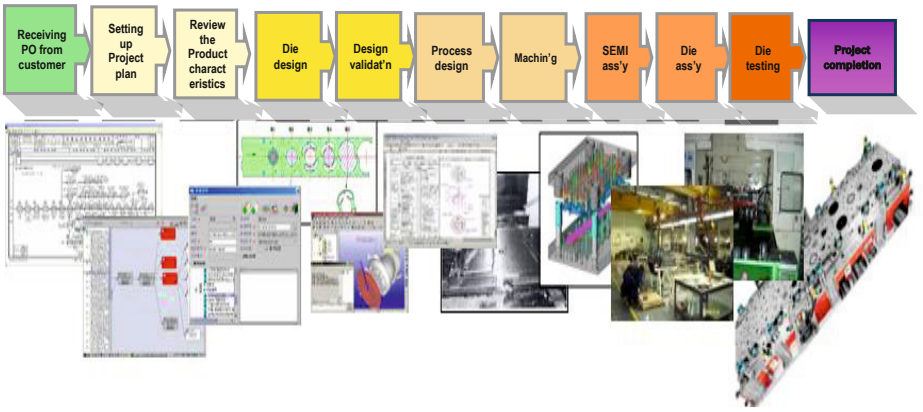

Fig. 5. Die development process

3.2 Die Fabrication

3.2.1 Analysis and Improvement of Die for Productivity Improvement

For productivity improvement, abrasion needs to be improved. Given this, the abrasion mechanism is analyzed, and the resulting outcome is the implementation of lubricating oil supply device in the die [Fig. 6]. To supplement the equipment and accessory devices, press measurement system is established, embossing cut shape is changed, embossing type is set up, and bottom dead end control system is improved [Fig. 17]. The guide of shaft punch is also improved for better motor quality, and the merit point in the mechanical type and motor type of die category is utilized for the improvement.

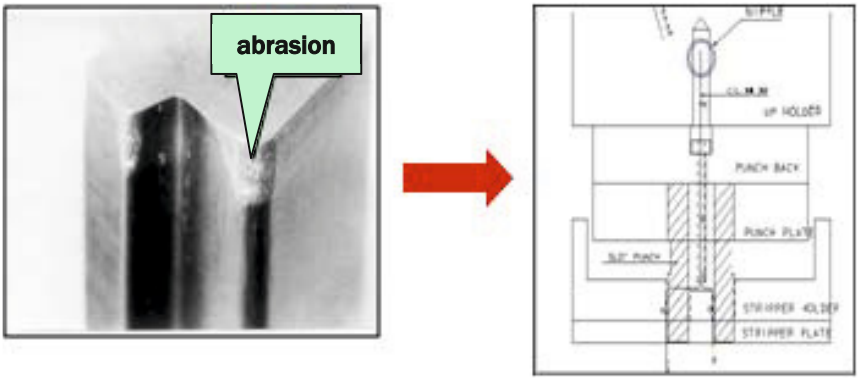

Fig. 6. Improvement of punch abrasion

3.2.2 Improvement of Die Durability

For the improvement of die durability, a cooling device is implemented at index portion [Fig. 7], sub-die plate is adopted, knockout pin structure is improved, post structure is also enhanced, and shearing load distribution is analyzed.

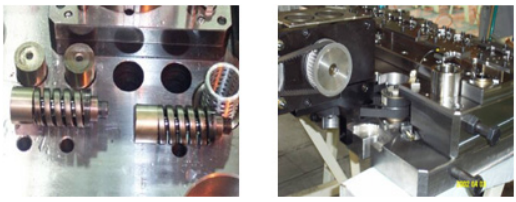

Fig. 7. Improvement of die quality

4 Conclusion

The following results are obtained for the concept and prototype production of high efficiency induction motor for a common core with a capacity of less than 37kw.

1) This improvement is expected to benefit related industries activated by nurturing die research manpower for high efficiency induction motors and by securing relevant technologies.
2) To secure die fabrication technology for automobiles such as hybrid motor, the die technology that can be directly implemented on the high efficiency motors such as those for the robots should be improved.
3) The market size in association with high efficiency motors among novel technologies in the year 2020 is expected to touch USD 720 billion. If high efficiency induction motor occupies 10% of the world market, a market segment of USD 72 billion could be achieved.
4) Besides these, energy saving equivalent to 3.9 atomic power generation plants of 500MW capacity, yearly energy saving effect of USD 455.6 million, and greenhouse gas emission reduction of 746,624TC could be additionally achieved.

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Solving Mutual Exclusion Problem in Mobile Cellular Networks

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Abstract. The mutual exclusion (MX) paradigm can be used as a building block in many practical problems such as group communication, atomic commitment and replicated data management where the exclusive use of an object might be useful. The problem has been widely studied in the research community since one reason for this wide interest is that many distributed protocols need a mutual exclusion protocol. However, despite its usefulness, to our knowledge there is no work that has been devoted to this problem in a mobile computing environment. In this paper, we describe a solution to the mutual exclusion problem from mobile computing systems. This solution is based on the token-based mutual exclusion algorithm.

1 Introduction

The wide use of small portable computers and the advances in wireless networking technologies have made mobile computing today a reality. There are different types of wireless media: cellar (analog and digital phones), wireless LAN, and unused portions of FM radio or satellite services. A mobile host can interact with the three different types of wireless networks at different point of time. Mobile systems are more often subject to environmental adversities which can cause loss of messages or data [8]. In particular, a mobile host can fail or disconnect from the rest of the network. Designing fault-tolerant distributed applications in such an environment is a complex endeavor. In recent years, several paradigms have been identified to simplify the design of fault-tolerant distributed applications in a conventional static system. Mutual exclusion, simply MX, is among the most noticeable, particularly since it is closely related to accessing shared resource called the critical section (CS) [7], which (among other uses) provides an exclusive access basis for implementing the critical section.

The mutual exclusion problem [1] requires two properties, safety and liveness, from a given set of processes. The problem has been widely studied in the research community [2,3,4,5,6] since one reason for this wide interest is that many distributed protocols need an mutual exclusion protocol. However, despite its usefulness, to our knowledge there is no work that has been devoted to this problem in a mobile computing environment.

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The aim of this paper is to propose a solution to the mutual exclusion problem in a specific mobile computing environment. This solution is based on the token-based mutual exclusion algorithm that is a classical one for distributed systems. The rest of this paper is organized as follows: in Section 2, a solution to the mutual exclusion problem in a conventional synchronous system is presented. Section 3 describes the mobile system model we use. A protocol to solve the mutual exclusion problem in a mobile computing system is presented in Section 4. We conclude in Section 5.

2 Mutual Exclusion in a Static System

2.1 Model and Definitions

We consider a synchronous distributed system composed of a finite set of process $\Pi = \{p_1, p_2,., p_n\}$ connected by a logical ring. Communication is by message passing, synchronous and reliable. A process fails by simply stopping the execution (*crashing*), and the failed process does not recover. A correct process is the one that does not crash. Synchrony means that there is a bound on communication delays or process relative speeds. Between any two processes there exist two unidirectional channels. Processes communicate by sending and receiving messages over these channels.

The mutual exclusion problem is specified as following two properties. One is for *safety* and the other is for *liveness*. The *safety* requirement asserts that any two processes connected the system should not have permission to use the critical section simultaneously. The *liveness* requirement asserts that every request for critical section is eventually granted. A mutual exclusion protocol is a protocol that generates runs that satisfy the mutual exclusion specification.

2.2 Token-Based Mutual Exclusion Algorithm

As a classic paper, the token-based mutual exclusion algorithm, which was published by M. Raynal, specifies the mutual exclusion problem for synchronous distributed systems with crash failures and gives an elegant algorithm for the system; this algorithm is called the token-based MX Algorithm [2]. The basic idea in the token-based MX algorithm is that the any process holding the token can use the critical section exclusively. The token-based MX algorithm is described as follows.

- A distributed system is connected by a logical ring. Each process has a unique ID that is known by its neighborhood processes.
- The CS is exclusively used by the process holding the token.
- The token is circulated on the logical ring. If a process wants to use the CS, then it just waits until receiving a token from its neighborhood. Only when it has received the token, it has a right to use the CS exclusively.

3 Mobile System Model

A distributed mobile system consists of two set of entities: a large number of mobile hosts (*MH*) and a set of fixed hosts, some of which act as mobile support stations (MSS_s) or base stations. The non *MSS* fixed hosts can be viewed as MSS_s whose cells are never visited by any mobile host. All fixed hosts and all communication paths connect them from the static network. Each *MSS* is able to communicate directly with mobile hosts located within its cell via a wireless medium. A cell is the geographical area covered by a *MSS*. A *MH* can directly communicate with a *MSS* (and vice versa) only if the *MH* is physically located within the cell serviced by the *MSS*. At any given instant of time, a *MH* can belong to one and only one cell. In order to send message to another *MH* that is not in the same cell, the source *MH* must contact its local *MSS* which forwards the messages to the local *MSS* of the target *MH* over the wireless network. The receiving *MSS*, in its turn, forwards the messages over the wireless network to the target *MH*. When a *MH* moves from one cell to another, a *Handoff procedure* is executed by the MSS_s of the two cells.

4 Mutual Exclusion in a Mobile System

In the following, we consider a broadcast group $G = (G\_MSS, G\_MH)$ of communicating mobile hosts, where *G_MH* and *G_MSS* are respectively a set of m mobile hosts roaming in a geographical area (like a campus area) covered by a fixed set of n MSS_s. In so far, local mobile hosts of base station MSS_i, which currently residing in MSS_i cell, will refer to mobile hosts that belong to group G.

A mobile host can move from one cell to another. If its current base station fails, the connection between the mobile host and the rest of system is broken. To recover its connection, a mobile host must move into another cell covered by an operational or correct base station. So, unless it crashes, a mobile host can always reconnect to the network. A mobile host may fail or voluntarily disconnect from the system. When a mobile host fails, its volatile state is lost. In this environment, the mutual exclusion problem is defined over the set *G_MH* of mobile hosts. When a mobile host h_k wants to use the *CS*, it sends the request message to a *MSS*. In this case, the mobile host eventually should get the permission from the *MSS* and use the *CS*.

4.1 Principle

The mutual exclusion protocol proposed in this paper is based on the solution described by Raynal in Token-based MX algorithm [2]. The outlines of their protocol have been described in Section 2. In this section, we give an overview of our protocol and identify the major differences compared with the original token-based MX algorithm. We assume that the mutual exclusion is initiated by a mobile host which requests its current base station a token to use the CS. The contacted base station saves the request into the queue until it receives the token from its neighborhood.

During the mutual exclusion, each base station on one hand interacts with the mobile hosts located in its cell to gather the request of each mobile host for CS and on the other hand interacts with the other neighboring base stations to send and receive a token. In our approach, a base station *MSS* which participates in the mutual exclusion protocol, always acts on behalf of a subset of mobile hosts. More precisely, the initial value of $Token\_\ Holdek_k$ is false but the value of it is changed true as a mobile host h_k that resides in MSS_i receives the token from its MSS_i. After returning the token to its base station, the mobile host h_k changes the value of its $Token\_Holder_k$ into false again. The mutual exclusion protocol in such an environment consists of two cases depending on who the token holder is. As the first case, that is when a base station received a token from its neighboring base station or its mobile hosts. When it received the token from its neighboring base station, then it just sends the token to a mobile host with highest priority among the mobile hosts connected to the base station. In case of returning the token from its mobile hosts, it just sends the token to the next base station.

4.2 Protocol

The protocol is composed of three parts and each part contains a defined set of actions. Part A (figure 1) describes the role of an arbitrary mobile host h_k. Part B (figure 2) presents the protocol executed by a base station MSS_i. Part B is related to the interactions between a base station and its local mobile hosts on one hand and the other base station on the other hand. Thus, Part B is based on the traditional Token-based MX protocol adapted to our environment.

```
% Mobile host h_k is located in MSS_i cell %
(1) Upon receipt of the request for CS from the application
        Send Req_Token to MSS_i
(2) Upon receipt of Token from MSS_i
% The mobile host (h_k) gets into CS %
        CS (h_k)
(3) Upon receipt of the release for CS from the application
    Send Release_Token to MSS_i
```

Fig. 1. Protocol Executed by a Mobile Host h_k (Part A)

Finally, the part C of the protocol is the handoff protocol destined to handle mobility of hosts between different cells. In figure 1, the three actions performed by an arbitrary mobile host are:

(1) A mobile host executes this action when it receives a request from an upper application program to initiate a mutual exclusion.
(2) Token message is sent to a mobile host h_k by the mobile support systems MSS_i when it had requested a token from the local base station where it resides. Upon receipt of such a message, the mobile host gets into the *Critical Section*.

(3) When the application program terminates the mutual exclusion protocol, the Token is released to the mobile support system, MSS_i.

```
My_Staus_i := 0;
My_Queue_i := ∅;
Cobegin
(4) || Upon receipt of Req_Token( h_k )
        insert Req_Token(h_k) to rear (My_Queue_i);
(5) || Upon receipt of Token (MSS_i-1)
    if My_Queue_i ≠ ∅ then
          My_Status_i := 1;
             send Token to front (My_Queue_i);
             delete front (My_Queue_i);
        else
            send Token to MSS_i+1;
         end-if
(6) || Upon receipt of Token ( h_k )
       if ( Phase_i = 0 ∧ My_Queue_i ≠ ∅ ) then
          My_Status_i:= 1;
             send Token to front (My_Queue_i);
             delete front (My_Queue_i);
       else
             My_Status_i:= 0;
             send Token to MSS_i+1;
        end-if
(7) || Upon receipt of Req_Token ( MSS_j )
         insert Req_Token(h_k) to Rear(My_Queue_i);
```

Fig. 2. Protocol Executed by a mobile support station MSS_i (Part B)

Actions of the protocol in figure 2 numbered from (4) to (7) are executed a mobile support system, i.e., a base station MSS_i. They have the following meaning:

(4) When a base station is asked by a mobile host to send a Token, it inserts the request into the rear of its queue.

(5) In case of receiving a Token from other base station, the base station checks its queue $My\_\ Queue_i$ to confirm whether the queue is empty or not. If the queue is not empty, then the base station sends the Token to the mobile host that is positioned at the front of the queue. And it deletes the element from the queue and sets its status to true that means it holding Token, i.e., $My\_Status_i := 1$. But if the queue is empty, then the base station just passes the Token to the next base station.

(6) When a base station receives a Token from a mobile host h_k, it checks its queue and status. If both ($Phase_i = 0 \wedge My\_Queue_i \neq \varnothing$) are true, which means that it does not hold the token and at the same time the queue is not empty, then the base station sends the Token to the mobile host that is the front element of the queue. And it deletes the element from the queue and sets its status to true. Otherwise it sends the Token to the next base station and sets its status to false.

(7) On receiving the Token request message from other mobile support system, the MSS_i insert the request message into its queue.
As shown in Figure 3, the handoff protocol is described.

(8) When a mobile host h_k moves from MSS_j cell to MSS_i cell, the handoff protocol execution is triggered. Mobile host h_k has to identify itself to its base station by sending a message GUEST(h_k, MSS_j).

(9) Upon receiving this message, MSS_i learns that a new mobile host h_k, coming from MSS_j cell has entered in its cell. With BEGIN_ HANDOFF(h_k, MSS_i) message, MSS_i informs MSS_j that it removes h_k from the set of mobile hosts that reside in its cell.

(10) Upon receiving such a message, MSS_j checks its queue to confirm that the token request of h_k is in the queue. If it is in its queue, then it transfers the token request to MSS_i and deletes the token request from the queue.

```
Cobegin
% Role of h_k %
(8) || Upon entry in MSS_i cell
       send Guest(h_k, MSS_j) to MSS_i
% Role of MSS_i
(9) || Upon receipt of GUEST(h_k, MSS_j)
       Local_MH_i := Local_MH_i ∪{h_k};
        send BEGIN_HANDOFF(h_k, MSS_i) to MSS_j;
% Role of MSS_j
(10)||Upon receipt of BEGIN_HANFOFF(h_k, MSS_i)
       Local_MH_j := Loacl_MH_j – {h_k};
       If (Req_Token(h_k) ∈ My_Queue_i ) then
         send Req_Token(h_k) to MSS_i;
          delete Req_Token(h_k) from My_Queue_i;
       end-if
```

Fig. 3. Handoff Procedure (Part C)

4.3 Correctness Proof

As our protocol is based on the Token-based logical ring algorithm proposed by M. Raynal, some statements of lemmas and theorems that follow are similar to the ones encountered in [2].

Theorem 1. No two different processes can have permission to use the critical section simultaneously (safety property).

Proof (proof by contradiction). Let assume that there exist two mobile hosts to get a permission to use the critical section. A mobile host can use the *CS* only if it received a permission token from the *MSS* of the cell to which it belonging (action 2). In this case, the assumption means that there exist two *MSS*s holding the token or one *MSS* sends the token twice to two different mobile hosts each. The first case is false since there is only one token circulating under the logical ring. The second case is also false

since the *MSS* holding the token sends it to mobile host h_k only once (action 5). So it is a contradiction. □*Theorem* 1

Theorem 2. Every request for the critical section is eventually granted (liveliness property).

Proof If a mobile host sends a message to request a token (action 1), at least one *MSS* eventually receives it and inserts it into the queue (action 4). After that, there are two cases. In first case, if the mobile host h_k sent the message does not move to other cell, then the message Req_Token eventually will be positioned at the front of the queue and the *MSS* received the message sends the token. Thus, the mobile host sent the message eventually receives the token and uses the *CS*. In a second case, when the mobile host h_k sent a message Req_Token moves from MSS_j cell to another MSS_i cell before receiving the token, then the handoff protocol execution is triggered (action 8-10). Mobile host h_k has to identify itself to its base station by sending a message GUEST(h_k, MSS_j). In this case, by (action 10) the request message will be transferred to the MSS of the cell to which the mobile host has moved. Consequently, the mobile host will receive the Token and use the CS when the *MSS* sends the Token. □*Theorem* 2

5 Conclusion

The communication over wireless links are limited to a few messages (in the best case, three messages: one to request a token and the others to get the token and release the token respectively) and the consumption of mobile hosts CPU time is low since the actual mutual exclusion is run by the base stations. The protocol is then more energy efficient. The protocol is also independent from the overall number of mobile hosts and all needed data structures are managed by the base stations. Therefore, the protocol is scalable and can not be affected by mobile host failures.

In addition, other interesting characteristics of the protocol are as follows. 1) During the mutual exclusion period, a base station should keep track of every mobile host within its cell to manage the request messages and the token. 2) In such a mobile computing environment, a handoff algorithm is needed to perform mutual exclusions efficiently and correctly, but it is not needed in static distributed systems.

The mutual exclusion algorithm in a mobile computing environment consists of two important phases. One is a local mutual exclusion phase in which a mobile host holds and uses the CS. The other phase is a global mutual exclusion phase in which each *MSS* takes part in the mutual exclusion by passing the token to another *MSS*.

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A Resource Allocation Supporting QoS in Mobile Communication Systems*

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Abstract. We propose channel management schemes applied to both macrocell and microcell, and we develop algorithms for a new call, handoff request and overflow call through a traffic model. For a new call, a new channel assignment scheme is achieved by modifying a DDCA scheme, using co-channel interference principle. For a handoff call, we suggest a novel channel reservation scheme to adjust the number of guard channels in macrocell, depending on the number of saturated microcells. The proposed schemes are able to accommodate much more mobile calls in the microcell and significantly reduce the blocking probability in the macrocell at the expense of the small increment of a forced termination in the microcell.

Keywords: Channel Management, LTE-Advanced, Hand-over.

1 Introduction

As WCDMA networks develops to R6, high-speed data of downlink 14.4Mbps, uplink 5.8Mbps could be supported. But for progressing to future fourth-generation mobile communication, the need to increase the structure and efficiency of network was suggested. According to this, ITU regulates 4G mobile technique as IMT-Advanced, and defines high data rate, network convergence, ubiquitous & seamless connection as characteristics. As a technique which satisfies above conditions, LTE(Long Term Evolution)-Advanced is in the spotlight now. 3G LTE uses backbone based on ALL-IP, interworking with various networks seamlessly [1-3].

The service offered from 3GPP LTE-Advanced is always connected with data rate of over maximum 100Mbps and minimum delay; it is possible to seamlessly interwork with existing services in WCDMA and HSDPA networks. In case of selecting 3GPP LTE-Advanced, it is possible to link existing 3G and 4G networks, so all the media and communication could be used with only one mobile terminal. The most remarkable technique for this is service continuity technique through Seamless Connection [4-5].

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Handoff is a significantly important aspect for a seamless service in the wireless environment that should accommodate frequent moves throughout the microcell/macrocell system. In systems where the cell size is relatively small, handoff can be made more often. Since handoff usually requires a couple of procedures such as a release of a channel, a new channel acquisition and re-routing, the duplication and loss of packets could happen. The handoff procedure has an important effect on the performance of the system. Hence, an important issue is to limit the probability of forced call termination because forced termination of an ongoing call is less desirable than blocking a new call attempt from the point of view of a mobile user. To reduce forced termination of a call in progress, handoff calls are normally given priority access to channels in both microcell and macrocell. In our system, several channels are reserved in macrocell explicitly for unsuccessful handoff calls at the subordinate microcell.

In this paper, we propose a new scheme that manages a whole life of a call from the beginning to the end by modeling the procedure of an initial call, a handoff procedure to another cell, and an overflow call from microcell to macrocell when the handoff fails. The wireless network structure consists of small cells, which make frequent handoff. If the system cannot provide properly a new service channel to a mobile subscriber, it occurs a significant falling-off in the quality of service. Therefore, in a hierarchically overlaid network architecture, new channel allocation scheme and new handoff schemes are needed. This paper is aimed to develop suitable protocols for the wireless network structure.

2 System Model

2.1 Traffic Management

In this section, we describe the cell structure presented in the paper and its traffic management. A mobile user with the high speed is handled by macrocell to reduce the frequency of handoffs and a mobile user with the low speed gets access to the microcell. A mobile can generate either an initial call or a handoff call to the adjacent cell. Microcell can handle both of the low-speed mobile user's initial call and handoff call. However, only an unsuccessful handoff call can overflow to the macrocell. That is, if the ongoing mobile user's call needs a handoff, a free channel in the destination cell is first checked. If no channel is available, the handoff call overflows to macrocell. Once a call overflows to the macrocell, the microcell will never get the control back, even if a lot of channels get free in the microcell. Therefore the direction of overflow is unidirectional from the microcell to the macrocell.

We propose an efficient channel assignment algorithm suitable to this macrocell/microcell. A mobile user makes a new call and once the call succeeded in getting a service channel, it is termed a service call. The ongoing service call might be a handoff call in some point of time. However if there are no free channels in the target cell, the call becomes an overflow call. We can manage all phases of a call from the beginning to the end by developing each algorithm for a new call, a handoff call and an overflow call.

The access overhead increases when an overflow call is trying to occupy a reserved bandwidth in the macrocell which has no more reserved channels. To eliminate this overhead in advance, macrocell broadcasts its availability of reserved channels to the overlaid microcells. Based on this information, microcell makes a decision to overflow the handoff call to the macrocell. In other words, a microcell first checks broadcasted information before it overflows the call. If there are reserved channels in macrocell, then the call overflows. Otherwise, the call is blocked.

Once camped in a macrocell, a call of mobile will be served in the macrocell until the end of the call. This is due to the hierarchical control that we envision. Once a call is served at a given level of the hierarchy, the call will not be served at a lower level.

2.2 Channel Management

Channel management schemes for mobiles in the proposed macrocell/microcell system are different according to the mobile speed. Channel allocation for a mobile at low speed is performed by MiBSs. Channel allocation for a mobile at high speed is performed by MaBSs. In the macrocell system, FCA scheme is used. Cell *0* is allocated C_0 number of channels of which C_{0h} channels are occupied by priority access of handoff calls.

A new call that originates in a microcell, say the *i*th microcell, (i = 1, 2,…, N), will be served by the *i*th microcell if the number of channels in use in the *i*th microcell is fewer than C_i at the time of origination; otherwise, it will overflow to its overlaying macrocell, cell 0. The overflowed new call will be accommodated by the macrocell if the channels in use in the macrocell are fewer than C_0-C_{0h} at the time of overflow; otherwise, it will be blocked and cleared from the system.

In the microcell system, conventional CDCA is not appropriate because the number of cells becomes incomparably higher than that in the macrocell system. DDCA is more appropriate. In DDCA, the channel allocation or handoff decision is based on local status information. Compared to centralized schemes such as CDCA, it is more flexible and can accommodate higher traffic density. However, the DDCA may cause unpredictable interference. To overcome this problem, a new method is proposed in this paper. This is called ITO (Interference Overlap Allocation) scheme.

Signaling Control Channel (SCCH) is considered for control of radio channels. Mobile Assisted Handoff (MAHO) is necessary to minimize the cell site control load. That is, the MiBSs must be able to decide the destination cell for handoff or set-up. The MiBSs must therefore be able to send information about the destination cell to the source cell, and this means that a SCCH should be assigned to each cell.

3 Proposed Schemes

3.1 IOA Scheme

Distributed DCA schemes produce optimum channel allocation by using either local information about the current available channels in the cell's vicinity or signal strength measurements, which may lead to introduce the unacceptable interference to

the adjacent cell in turn, resulting in premature handoff within its cell. In addition, by the consideration of only local information, it is probable that the frequency utilization could be much lower in the overall of the system. Therefore in this paper, we propose a new modified DDCA, called IOA (Interference Overlap Allocation) which avoids the premature handoff and increases the frequency utilization.

The BSs exchange information about current available channels each other to prevent adjacent cells from using channels which are already in use in the interference region. Interference region is the area that a channel may create interference if it is reallocated in another cell. Based on this information, a channel with the maximum co-channel interference in a reuse cluster is assigned to a call.

Each interference channel may have several interference times which are the time span between the start and the end of the interference. When a new call is generated in cell K_i, the following equation is calculated for every channel in K_i, where n and C_{jh} are the number of BSs within reuse cluster of cell K_i and the channel number of the BSs, respectively. The h is the available channel number in cell K_i.

$$IC_i = \sum_{j=1}^{n} C_{jh}, \quad \text{If } (C_{jh} = \textit{Interferen ce Channel}) \text{ then } C_{jh} = 1, \text{ otherwise } C_{jh} = 0 \tag{1}$$

If more than one channel has the same IC_i, then the first channel encountered is assigned to the call. $IC_i = 0$ for some channels means that there are no interference channels within reuse cluster of cell K_i. After that, the call is allocated to the channel which has the maximum number of IC_i.

This scheme takes advantage of preserving the maximum number of the available channels in reuse cluster by the means of making the interfered channels keep going on its states. Therefore, the system can acquire the minimum values of the average interference time and the number of interference channels on the whole.

3.2 DCR Scheme

When a user moves from the coverage area of one cell to another during a call in progress, a handoff to a new cell is required to maintain the call quality. It is common to give the priority to a handoff call when a new call and a handoff call take place simultaneously in a cell which has only one free channel. It is to prevent the disconnection of ongoing calls to maintain QoS (Quality of Service). In the handoff area, the mobile continues to use the existing channel until a new channel becomes available. If an idle channel is not available until the mobile moves out of the handoff area, the call is blocked. The call duration is the same regardless of the cell structure. However, compared with a macrocell structure, the size of handoff area in microcell structure is smaller. Consequently, the probability that a free channel is created in the target cell during handoff duration time is notably smaller. The performance of QPS of the microcell system is lower because the performance of QPS totally depends on the handoff duration time.

GCS is similar to NPS except that a number of channels are reserved for handoff calls. The reserved channels serve only handoff calls. If a fixed number of channels are reserved for handoff calls, it effectively reduces forced termination of handoff call

but may significantly increase blocking of new call attempts even if there are unused channels in the reserved channels. Thus, we propose a new scheme, called DCR (Dynamic Channel Reservation) that reserved channels can be assigned to both initial calls and handoff calls in order to reduce blocking of new call attempts and reduce forced termination of handoff calls in the microcell. The number of reserved channels are varied according to the ratio of occupied channels over the total channels.

The proposed algorithm is described as follows.

1. Check the state of a call in the cell K_i. If the state is handoff call, then go to step 2 (the decrement of the number of occupied channels). If the state is new call, then go to step 3 (the increment of the number of occupied channels).
2. Check the number of free channels of target cell (TFC_i). If a free channel is available, then go to step 3. Otherwise, check the set of reserved channels of target cell ($TRCS_i$). If $TRCS_i$ is empty, then the call is blocked. Otherwise allocates firstly reserved channel ($TRCS_{i1}$). Go to step 4.
3. Allocate the best channel selected by the ITO-DDCA scheme.
4. Check the number of occupied channels channels (OC_i). $OC_i = TC_i - IC_i - FC_i - RC_i$, where TC_i is the total number of channels and IC_i is the number of interference channels.
5. Check the new threshold level ($H_{i,\ new}$) of reserved channels, which matches the number of OC_i in the table. The predefined table indicates the threshold value corresponding to the number of occupied channls.
6. If $H_{i,\ new}$ is not different from H_i, old then stop. Otherwise, set H_i to $H_{i,\ new}$ and stop.

4 Performance Analysis

The performance of the proposed scheme is examined by computer simulation using C language. By means of computer simulation, system performance creteria such as the blocking probability (P_b, the probability that a new call is blocked), and the forced termination probability (P_f, the probability that a handoff call is blocked) have been used to analyze and evaluate the performance of various channel allocation and handoff schemes.

The simulation is continued until the number of calls goes up to 100,000. The calls in a cell consist of new calls and handoff calls, which are trying to access a control channel to request some wireless bandwidth. If it succeeds, the reservation information is sent and the corresponding bandwidth is allocated. In our simulation, a procedure to access the control channel is not considered, but a procedure to access to the corresponding bandwidth is examined. In the following, the performance parameters for the simulation are listed.

- The radius of a hexagonal microcell is 150 m.
- A single macrocell is overlaid with 37 microcells.
- A call arrival rate and a handoff arrival rate follow Poisson distribution.
- A call duration time and channel holding time follow exponential distribution.

- Reuse distance of 3 cells.
- It is assumed that mobile users can move about randomly at first, but once a direction of vehicle is determined, the direction and the speed of the mobile will not change within a single cell.
- When crossing a boarder of a cell, its direction and speed may be changed.
- The maximum ratio of the reserved channels over the total channels is denote as ϕ.
- A number of channels are reserved exclusively for handoffs. The remaining channels (c-ϕ) can be shared between handoffs and new calls, but the handoff calls have higher priority than new calls.
- The new call arrival ratio from slow moving users is R_f, and the new call arrival ratio from fast moving users is 1- R_f.

Fig. 1 shows the comparison of DCR with other handoff schemes. The value of Nth in DCR and the amount of reserved channels are 5 each. It is seen that DCR shows the better performance than a scheme with a finite queue, and DCR shows the similar performance to a scheme with static reserved channels.

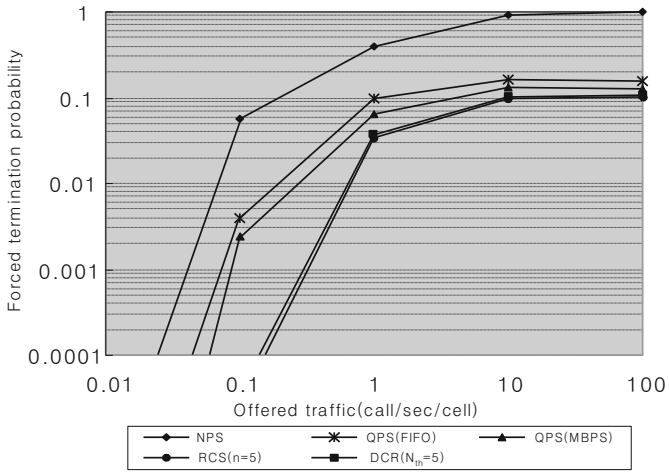

Fig. 1. Comparison of P_f

Fig. 2 shows the comparison between the existing schemes and our proposed IOA. IOA is vastly superior to FCA, FA, and MSQ scheme. When the offered traffic load is more than 0.08, IOA shows lower blocking rate than that of NN.

To sum up the results of all simulations above, P_f is slightly increased, but P_b is remarkably decreased, as a result of changing dynamically the number of the reserved channels, when compared with the schemes having the fixed number of the reserved channels. This is because the reserved channels are used exclusively for handoff calls and the channels are dynamically allocated in a priority manner.

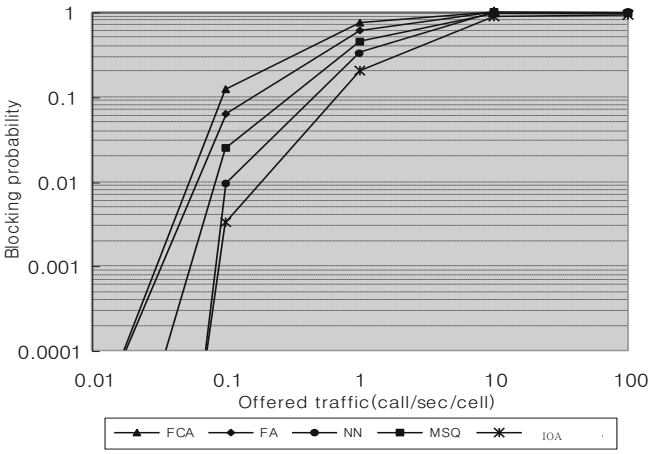

Fig. 2. Comparison of P_b

5 Conclusion

We have achieved a significantly low blocking probability by means of calculating the number of the interference channels for each free channels within the reuse cluster, then select the free channel which has the maximum number of the interference channels. In addition, we improve the probability of the forced termination by dynamically adjusting the number of the reserved channels for handoffs. To reduce blocking probability of new calls in the macrocell, our system is adjusting dynamically the number of reserved channels, according to the number of cells which have no available channels left. Compared with a scheme with a fixed number of reserved channels, our new channel reservation scheme makes a remarkable decrease in the blocking probability of new calls, at the expense of the slight increase of forced termination probability.

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An Effect of Korean Wave on Domestic Cosmetics Industry of Korea Boryeong Mud

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Abstract. Korean wave is intangible cultural product for foreigners visiting Korea and continuous development of Korean wave products are required to foreign accepters who want new stimulation. This study started because of the intention to examine the process cosmetics industry accepted cultural phenomenon of Korean wave positively, reinterpreted it industrially and settled in overseas field successfully as well as diagnose the directivity. Through the effects Korean wave makes on cosmetics industry and actual examples of embodiment, we can realize that Korean wave model shows influences as one axis of brand expansion and cultivates brand property. Cosmetics industry shows that the process that industry is introduced without any effort in the place where culture was introduced successfully at the front.

Keywords: Boryeongmud Cosmetics, Korea-Wave, Domestic Cosmetics Industry.

1 Introduction

Korean wave is evolved to worldwide cultural code beyond the cultural stream. Korean wave is intangible cultural product for foreigners visiting Korea and continuous development of Korean wave products are required to foreign accepters who want new stimulation. The energy of Korean wave which was encountered without any preparation at the early stage was passive cultural product, but Korean wave is perceived as a tourism resource at present. So, effective and continuous development of cultural product is necessary now. This study started because of the intention to examine the process cosmetics industry accepted cultural phenomenon of Korean wave positively, reinterpreted it industrially and settled in overseas field successfully as well as diagnose the directivity.

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2 Korean Wave

2.1 Korean Wave's Banding

Korean wave means cultural phenomenon which intends to yearn for, follow and learn popular culture such as Korean music, drama, fashion, game, food, hair style, etc. and Korean popular entertainers. Especially, after 2000, there was abnormal preference of not only popular culture such as drama, popular song, movie, etc. but also products related to Korea, such as kimchi, gochujang, ramen, home applinace, etc. For comprehensive meaning, all of the phenomena is called as 'Korean wave'. (Cha, Dong Young, 2004)

[Figure 1] is one scene of A Winter Love Song and Daejanggeum which can be representative dramas of Korean wave. Popular entertainers of drama became the representative image symbolizing Korea and under the base, it's passed from cultural code to industrial code. Thus, by starting from tourism product representatively, Korean wave is producing the value of industrial brand in the whole industry.

Fig. 1. Dramas of Korean wave

This picture is K-pop fever which was appeared with the popularity of Korean popular idol groups after Korean wave of dramas. Korean songs of attractive Korean idol groups are showing positive aspect that the object of Korean wave is becoming the generation younger than the past naturally [Figure 2].

The picture is the tendency of cosmetics' retailing sales in Korea. The sales of cosmetics are increased in spite of domestic recession. And, under the base, overseas tourists' consumption of Korean cosmetics focusing on Myeong-dong makes a great effect on the market.

Fig. 2. K-pop fever-Material: Park, Ae Kyung

If seeing , the export of cosmetics is increased by Korean wave's fever. If considering the total of Korea Customs Service, the amount of cosmetics' export was 861.04 million dollars in last year and it was increased by 4.3% in comparison with 2010 (824.9 million dollars). A person in charge of Korean Cosmetic Association is supposed that China and Japan share more than the half of cosmetics export. (Hangyere Feb. 13, 2012, Jo, Ki Won)

2.2 Actual Condition of Korean Wave's Branding

Korean cosmetics were very popular tourism product for Southeast Asians who are interested in whitening so much. And, those are exported to there and showing the brand power of Korean cosmetics industry [Figure 3].

Fig. 3. Korean cosmetics were

Amore Pacific entered the market of high-price cosmetics market successfully thanks to the success of Seolhwasoo in Korea. By providing high-quality cosmetics service to top minority in American field based on the confidence, it is showing the signal that Korean cosmetics are entering the period of gentrification and professionalism beyond the base expansion [Figure 4].

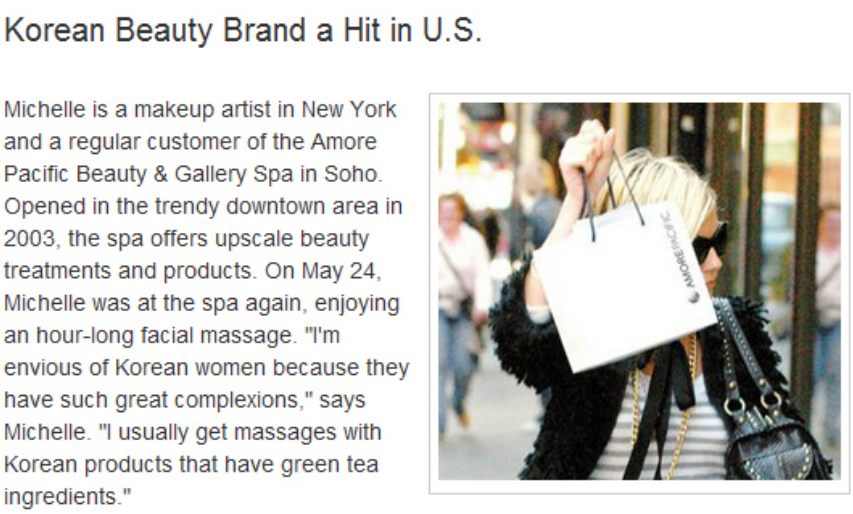

Fig. 4. Sienna Miller who is a maniac of Amore Pacific cosmetics-Material

3 Studying Research and Results Analysis

The tendency of Korean wave in Korean cosmetics industry was investigated and analyzed. As the result of studying, entertainer fandom is naturally expanded to cosmetics brand fandom by utilizing idol groups as the advertisement models. If seeing the picture, The Face Shop implements brand policy focusing on naturalism concept under the model of Kim, Hyun Joong, a singer and talent of SS501 who is a popular idol group [Figure 5].

Fig. 5. A model of The Face Shop, 'Kim, Hyun Joong'

Nature Republic adopted members of Kara who is a popular idol group as the model and is expanding cosmetics concept, nature [Figure 6].

Fig. 6. The model of Nature Republic, 'Kara'

Like the picture, Tonymoly is expanding oriental, young and beautiful image by utilizing popular idol dramas actor, Song, Jun-gi [Figure 7].

Fig. 7. The model of Tonymoly, Drama Actor 'Song, Jun-gi'

In Vietnam exhibit of Boryeong mud cosmetics, national broadcasting station went out to cover the story of occupation. So, they have high expectation on Korean cosmetics [Figure 8].

Fig. 8. Participation in Vietnam exhibit of Boryeong mud cosmetics

Through the prepared knowhow, it showed the result Korean wave is connected to sales directly by locating drugstore, health market, etc. It showed the lesson that industry is introduced without effort in the place culture was introduced successfully and the result was created by Boryeong mud's efforts.

Korean Wave became more and more fervent. This will improve the image of our Boryeong mud cosmetics [Figure 9].

Fig. 9. Boryeong mud festival, Girls' Generation

4 Conclusion

This study implies that models of Korean wave show influence with an axis of brand expansion and cultivate brand property through the effects Korean wave makes on cosmetics industry and actual examples of embodiment. Especially, there is natural phenomenon to adopt advertisement model, apply Korean wave actively and change cultural code to industrial code.

Cosmetics industry shows that the process that industry is introduced without any effort in the place where culture was introduced successfully at the front.

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A Study on the Introduction of Family Impact Assessment System

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Abstract. Even though our nation entered 20-50 club, the seriousness of low birth and aging become deepened than any other nations in the world, and the speed is fast, there is no research and future vision on the population such as population policy. Furthermore, keeping or fortifying policy which cannot diagnose diverse social ills occurring by the family breakup and even worsen them is considered to have the seriousness. Through the experience and know-how of advanced countries, systematical devices which can analyze the effect of population family policy and evaluate should be introduced urgently. Even though the Family Impact Assessment is composed narrowly in the traditional way on the scope and applications and limited, it also has advantage to find what to be learn from those who have suggested or practiced this on studying the characteristics of the Family Impact Assessment in spite of this.

Keywords: family influencing evaluation, family influence statement, legislation influence evaluation, low birth and aging society.

1 Introduction

1.1 Necessity and Meaning

With aging population, the number of ages of house holders over 65years old, living alone is rapidly growing. The rate of senior citizens living alone among the whole senior citizens was growing rapidly from 13.3% 1995 to 32% 2005. Also, combining the ratio of poverty of senior citizens, it stands out as a social problem. The problems of the aged has a big seriousness by combining rapid progress of aging, high rate of the aged living alone and poverty of the aged, and nuclear family. The thoughts that gloomy old age can be my future cause social unrest and can hinder integration.

While preparing living support measures on the sole senior citizen family, government should improve system promoting family breakup and the system able to recover family functions. As the family function becomes stronger, it is investigated as weakening suicidal urge. Hence recovering family functions are important. However, there are many laws and systems promoting family breakup even reversing this among current systems. Urgent improvement is needed on this(Lee & Moon, 2012).

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Regardless of west and east, in the traditional society or even modern society, the importance of family and duties which family should take charge of have tremendous responsibilities.

Family policy is the most economical, effective alternative on solving social issues as well as family issues.

The influence of population factors on public policy is well recognized but the effect of policy besides population policy on population form is ignored generally(Ermaich, 1986). Public policy gives deniable effects on the family. Above all, public policy regulates terms of employment, defines rights of welfare payment, provides education and health medical services, and defines rights and responsibilities of parents. Therefore, public policy builds family life as defining opportunity and management(Gautheir, 2001).

As the rate of divorce increases rapidly and family issues become diverse, Family Impact Assessment started in 1970 America where family policies surged corresponding to this. (Jang & Yu, 2006). Regarding what influence the contents of laws or policies introduced on education, employment, welfare, health medical treatment, etc give to the family, by rediscovering family value and establishing and maintaining healthy family especially, at the current point with high anxiety of family breakup by low birth, aging, suicide, etc which were mentioned before, evaluation on the nation's or local governments' policies(including laws or ordinances) to rich people' living, that is, Family Impact Assessment or Family Impact Analysis, or Family Impact Statement need to be introduced(Nye & Gerald, 1979).

It tries to analyze cases that policies, programs, or laws encourage the family breakup, investigate what the Family Impact Assessment is to enact Family Impact Assessment law and how and what the advanced countries do, and suggest the methods.

2 Situation Analysis

2.1 Situation of Family Breakup

The cases living 3 generations together in today our nation is about 2%. It is because of the becoming nuclear family rapidly since 1980. From two years ago, 1~2 people families have passed 3~4 people families. It is because of the result of family composition becomes nuclear division by no marriage, divorce, etc. As the nuclear family form living parents and children together has become disintegrated gradually, from this year it is prospected that the weight of single person family becomes the biggest. With aging, avoiding marriage, late marriage, etc, in 2035 34 households among 100 is prospected to live alone.

2.2 Situation of Senior Citizens' Suicide

Situation of our nation's senior citizens' suicide over 65 years old is that over 3,000 people commit suicide every year after 2004, of which the seriousness goes too far. The ratio of senior citizens occupying the whole population is 15% but the ratio of senior citizens occupying suicide is over 30% and the suicide rate over 60 years old

goes beyond 60 people per 100,000(Ha, 2011). Characteristics of Korean senior citizens' suicide is that men outnumber women. Senior citizens' suicide directly shows the seriousness of the problems of the aged which the society has and at the same time sends a sign demanding urgent improvement. The problems of the aged have the seriousness by combined with rapid aging process, and high ratio of the aged living alone and the aged's poverty. Rapid increase of the aged's suicide becomes serious social problem beyond a personal issue. The aged's suicide will become more serious with aging and nuclear family. With entering the aging society ahead, if it isn't improved urgently, it will face irrevocable situation.

2.3 Situation of the Aged Living Alone

Ratio of over 65 years old senior citizens among total population of today 2010 is 11.5% and the households of the aged living alone among them is estimated a million. Isolation, alienation, etc of the aged living alone are standing out as social problems and especially system which can prevent 'solitary death' of them is urgently needed.

3 Case Analysis

3.1 Tax System Promoting Family Breakup

In the case of combining households to support parents, it is 2 houses for a household, which are laws and systems encouraging current family community breakup. Taxes are fair when charged based on burden ability such as property, income, and so on. Therefore if fortifying taxes based on some standards which are not related to tax burden ability such as marriage·same family, etc, taxpayers will be encouraged expedients and evasion of the law such as a sham marriage, family breakup, etc to avoid this.

3.2 Family Care System in Act on Long-Term Care Insurance for the Aged

Current payment system of Long-Term Care Insurance for the Aged has poor indemnification system on the aged protected in the family. Hence, the family care system of current Long-Term Care Insurance for the Aged can be seen as very limited. Users of dependents support expenses(150,000won per month) is about 0.8% level. But, the rate of providing service by the family member qualified as care helpers is increasing rapidly and in the case of protection by the family care helper living together, it recognizes up to 90 minutes a day as care hours(360,000won level a month). Change of indemnification by status of principal agent providing payment on the same service is not fair or equal but discriminative. Also, it encourages weakening family function beyond inequality.

4 Family Impact Assessment System

4.1 Overview

Since policy evaluation often is the method by which policies are organized, it often is a synonym along with program evaluation(Bogenschneider, 2002). However, most

program evaluations measure on person than family. It needs to consider if policies, systems, or laws satisfy explicit results on family beyond performance on person and furthermore to approach based on the grounds what effects they have before introducing a program or policy. Family evaluation research refers to evaluate if the program or policy satisfies the explicit results for family. On the other hand, Family Impact Assessment or Family Impact Statement is to evaluate 'likely' or 'potential' on family of proposed change before actual enforcement or fulfillment of new legislation or regulation(Edgar, 2005). That is, Family Impact Assessment has national policies analyzed and evaluated in the view point of family in order to establish and maintain family so that marriage and family living are established and maintained based on individual dignity and both genders' equality regarding if policies or enacted or revised legislation are needed to establish and maintain family in accordance with constitution, if they have intended positive effects. Introduction of Family Impact Assessment system is to rich people's living by rediscovering the family value and establishing and maintaining healthy family at this point in time with high anxiety of family breakup and collapse by low birth, aging, suicide, etc. In light of humanities literature, Family Impact Assessment is describe to have the same basic goal in the aspect of evaluating effect or results of family policies on family well-being and quality of family life as humanities and social sciences(McDonald, 1979).

4.2 Cases of Advanced Countries

Europe is fulfilling family allowance, housing allowance, income tax policy, etc as part of income redistribution policy among family policies. Also, characteristics of Europe family policy are approaching at the level of population policy and long-term population planning, appearing as public policy for the supportive and vicarious protection of the dependents and proper family members such as the disabled, the elderly, the poor, and the homeless. Like this, characteristics of European family policy are to recognize social meaning of family function, inseparate relation between family and local society, and the interdependence of all social systems.

Also in the academic way, they have fulfilled Family Impact Evaluation. Anderson and Lynch fulfilled Family Impact Assessment on 1963 and 1980 community mental health legislation reducing dependency on hospitals and improving foundation and use of alternative community basis system relating to chronic mental illness in America(Anderson, 1984). Wisensale and Waldron(1991) analyzed hearings of assembly held between June 1982 and May 1987 through method of family impact statement in order to determine scope of families' desire and concern for consideration before diagnosis-related groups(DRG) is introduced and fulfilled, and also found features of family impact statement(Wisensale, 1991). Overseas Family Impact Assessment is fulfilled in America, Canada, New Zealand, and so on. Looking into situation of fulfilling Family Impact Assessment in main countries, it is like following.

4.2.1 Family Impact Analysis of America

Historically, public policy in U.S.A has devised, applied, and fulfilled without any or no effort to predict or measure effect on family. However, 2005 American government adopted HMI(Healthy Marriage Initiative. The background of promoting HMI

policy was following clinical, actual research results of the last 40~50 years in America. In light of research contents and the result of analyzing several problems occurring across the society such as diverse social crimes, addiction, suicide, sex problems, teenagers problems, children problems, the problems of the aged, etc, in the end the most direct and basic problems come from family risk and breakup. To conclude, 'family centered' paradigm shift is being sought at the approach that without recovering marital relations and fortifying family function by recovering and curing healthy function of 'family' itself, other problems will be repeated again.

Assessment items are 34 items in 6 areas. The principle of preparing assessment items, first, is to provide guidelines which can evaluate effect of policy by concrete area on family, second, use as the useful instrument which can evaluate policy's positive effect and limits, and dead zone, third, by applying open qualitative assessment method, concern that evaluator's subjective value intervenes, and for the last the possibility of taking much time and cost.

According to principle by 6 areas by concrete item, policy is providing guideline which can evaluate effect on family.

4.2.2 Australia

Australia is fulfilling Family Impact Statement at the level of federation unlike America or Canada. Ahead of federation government, 1998 New South Wales state government introduced Family Impact Assessment as requirement of Cabinet Minutes.

Office of Work and Family under Department of Prime Minister and Cabinet in the level of federation publishes family impact assessment guideline and related resources and advises and takes responsibility of revision. Family Impact Statement Guidelines, revised on 30 Jun 2009, including inspection lists, introduced in 2005 was adopted in 2009. The guideline is divided into two chapters and the first chapter is Identify and assess the family impacts and the second is Provide a Family Impact Statement.

5 Operation and Fulfillment Method of Family Impact Assessment

Institutional strategies able to analyze and evaluate effect of population family policy properly should be introduced urgently through researches on advanced countries' experience and know-how.

5.1 Operation Method

5.1.1 Evaluation Target

Head of central administrative agency and head of local government agency fulfill analysis assessment on legislation promoting enactment and revision(refer to ordinance·Presidential decree·Ordinance of the Prime Minister·departmental ordinance and regulations·rules) and plans and projects which can give significant effect on family (hereinafter referred to as "target policy"), etc.

5.1.2 Operation Method

Operation of Family Impact Assessment can be considered two plans. First is the plan to expand gender impact analysis assessment to the family impact analysis assessment. That is, both genders equality is not confined in the family but fulfills constitutional marriage and family protection duties synthetically. But, in the state of both genders equality is not firm, both genders equality policy can be waned. The second plan is going with impact analysis assessment by gender and family impact analysis assessment together, which has advantage of faithful fulfillment of family protection duty and on the other hand, due to new establishment of regulations, can have burden such as corporation activities as well as nation and local government.

5.1.3 Legislation Form

The first plan is to enact tentatively named 「family impact assessment law」 and the second plan is to newly establish regulation at 「law on building and promoting family friendly social environment」. In the case of plan 2, on introducing as trial operation, it has advantage of relieving burden and soft landing but has concern of getting out of 'social environment' of law purpose.

5.2 Fulfillment Plan

5.2.1 Preparing Standards of Policy Weakening Functions of Population and Family Community

Standards on systems such as laws, budget, etc breaking up or encouraging breakup of family community and family system assured by the Constitution are prepared. Impact assessment on family community promoting divorce or not marriage or giving disadvantage to maintain family community and furthermore assessment on population problem, population policy, aging society are fulfilled.

5.2.2 Establishing Deliberation and Consultative Body

Preparing standards, and with the prepared standard, a consultative body fulfilling review or advice, 'family deliberation committee' is established. The family deliberation committee reviews on laws and regulations for family system protection ensured in legislation. Policy institute supporting tentatively named 'family deliberation committee' and playing a role on population policy like below is needed.

6 Conclusion

Current advanced countries approach family policy in the long-term level along with population policy. It is because of the reflective experience that support policy on individual family member brings results of breaking up family community. Family Impact Assessment began in 1970 America where family policies rapidly increased consistent with surged divorce rate and diverse family problems. Regarding what influence the contents of laws or policies introduced on education, employment, welfare, health medical treatment, etc give to the family, by rediscovering family value and establishing and maintaining healthy family especially, at the current point with high anxiety of family breakup by low birth, aging, suicide, etc which were

mentioned before, evaluation on the nation's or local governments' policies(including laws or ordinances) to rich people' living, that is, Family Impact Assessment or Family Impact Analysis, or Family Impact Statement need to be introduced.

Family evaluation research refers to evaluate if the program or policy satisfies the explicit results for family. On the other hand, Family Impact Assessment or Family Impact Statement is to evaluate 'likely' or 'potential' on family of proposed change before actual enforcement or fulfillment of new legislation or regulation.

That is, Family Impact Assessment has national policies analyzed and evaluated in the view point of family in order to establish and maintain family so that marriage and family living are established and maintained based on individual dignity and both genders' equality regarding if policies or enacted or revised legislation are needed to establish and maintain family in accordance with constitution, if they have intended positive effects. Introduction of Family Impact Assessment system is to rich people's living by rediscovering the family value and establishing and maintaining healthy family at this point in time with high anxiety of family breakup and collapse by low birth, aging, suicide, etc.

Even though our nation entered 20-50 club, the seriousness of low birth and aging become deepened than any other nations in the world, and the speed is fast, there is no research and future vision on the population such as population policy. Furthermore, keeping or fortifying policy which cannot diagnose diverse social ills occurring by the family breakup and even worsen them is considered to have the seriousness. Through the experience and know-how of advanced countries, systematical devices which can analyze the effect of population family policy and evaluate should be introduced urgently.

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A Harmony between Point of Parity and Point of Difference for the Improvement of Positioning

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Abstract. There are many cases that branding or brand marketing is understood as the process to differentiate the brand from other brands. Two axes of positioning are point of parity and point of difference. Based on the point of parity, the point of difference should be inculcated to customers. Both of the point of parity and the point of difference are important and they should be properly harmonized.

Keywords: Point of Parity, Point of Difference, Positioning Improving.

1 Introduction

There are many cases that understand brand as a measure of differentiation. In other words, there are many cases that branding or brand marketing is understood as the process to differentiate the brand from other brands. Ultimately, it's right. But, that understanding may draw incorrect perception only emphasizing on differentiation. However, it's not true that only differentiation is important. With differentiation, point of parity should be considered. Without solving problems about point of parity, it cannot be enter the differentiation. Based on the point of parity, point of difference is defined.

2 Paper Preparation

2.1 Definition of Positioning

Two axes of positioning are point of parity and point of difference. In fact, the problem of differentiation is connected to the concept of brand positioning.

Brand positioning means that brand is positioned in the mind of customer as it is. In relation to the concept of positioning, there are many cases that differentiation is emphasized. Its ground is that customers will purchase the product after it is differentiated from other brands.

2.2 Failure Examples of Point of Parity

Doosan released Mi Soju (米 Soju). 米 is the Chinese character that means rice and the pronunciation is “Mi” in Korea. And the Soju is a kind of alcohol very popular in Korea.

T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 348–352, 2012.

They used a transparent bottle and arranged the letters, “米 xozu, Mi Soju” on it. The letters are on the label of red brown, which symbolizes rice. In addition, on the advertisement, the letters, “米 xozu, Mi Soju” are arranged under the background of rice paddy possessing lots of rice and there used the sentences of “美 味 米 米”, “sound to call good rice”, “birth of 美 味 米 soju!”, “美 味 米 soju with beautiful taste”. “美” means beauty and “味” means taste and their pronunciations are “Mi”.

Fig. 1. Mi Soju

Doosan wanted to appeal to customers that this is made of rice. It is to try strong differentiation because generally Soju is known to be made from chemical alcohol.

However, “米 soju” received a frosty reception in market and Doosan should withdraw “米 soju” from market. Why did “米 soju” be failed? There will be several reasons, but one of the problems is that it failed to announce point of parity as a soju. In other words, Doosan failed to let customers accept “米 soju” as one of soju.

Generally the bottle of the soju is green, and although it's diluted from alcohol, it was perceived to enjoy without any burden. But, Doosan used “xozu”, not “soju” which is the general name of the alcohol and the transparent bottle with background of red brown. That resulted in that the product category of “米 soju” became unclear. In other words, customers don’t know whether it is soju or other things. Differentiated information were provided, but the information why it is soju was not provided.

Another problem is that although it strongly expressed raw material of rice, it did not expressed why it is good. As a result, “米 soju” became something strange to consumers. In conclusion, 米 soju made an effort to give strong point of difference, but it failed to let customers know the basic fact that it's soju. Therefore, 米 soju failed to attract consumers who enjoy soju.

2.3 Success Examples of Point of Parity and Point of Differentiation

OB beer developed the campaign with the slogan, “beer whose swallowing is good because of the 3.56g rice". It maintained OB brand that has old tradition in the beer market and the package generally used in the beer market to keep the identity as a beer. Then it appealed the attribute of rice added on it. By this way, it could maintain

Fig. 2. OB beer

its identity as a beer and successfully deliver the point of difference of raw material and the benefit of “good swallowing”.

As the result, OB beer succeeded to safely arrive on the category of beer in consumers' mind and, at the same time, successfully appealed the point, “good swallowing because of the rice.”

3 Strategies to Increase the Point of Parity

For brand, point of parity must be defined at the first stage. It is the work to announce to customers what brand it is and which goals it satisfies. Consumers must know what the brand is before knowing what is superior to other brands. The following is the brand strategies to have succeeded in the market.

3.1 Emphasis of Attributes

Among the products of Baskinrobbins, there is an ice-cream cake. In fact, it's not a cake (it’s an ice-cream). But, Baskinrobbins gives several attributes from cake (for examples, shape, candle, wearing chocolate or cream, etc.) and settles in customers' mind as a category of cake.

Fig. 3. Baskin robbins ice-cream cake

3.2 Showing the Situation of Use

The advertisement of sports beverage shows rough sports activity, sweat, or scene showing users who drinks beverage. By this way, it informs that this brand is directed to the beverage drunken after sports. There is a brand, T-Smile. It is a gum including xylitol. The advertisement directs that people greet xylitol and then, face T-smile. By showing the people greeting xylitol, it shows the point of parity that the gum includes xylitol.

Fig. 4. T-smile

3.3 Suggestion with Representative Brand

When Tommy Hikfiger was not famous, he talks about himself in relation to Calvin Kelin and Geiffery Beene and suggest that he is in the ranks of those famous designers. Subaru implied that it is safe vehicle like Volvo through the advertisement comparing with Volvo.

3.4 Brand Naming

"Hauzen" implies that it's related to home electronic appliance with prefix of "Hau-". The original meaning of "Pulmuwon" was the place blowing with the bellows. It intended the prosperity of business like blazing fiercely by blowing with the bellows. However, regardless of it, consumers associate grass and daikon and it gives the point of parity for the eco-friendly category.

Pulmuone

Fig. 5. Pulmuwon

4 Lack of Point of Parity

If the point of parity is insufficient, customers cannot know what the brand is. or it is considered something insufficient. The customer could not know what category the "米 xozu" belonged to and it resulted in the failure of the attraction of the customers to soju. Accordingly, the point of parity should be considered firstly. That means, in the customer's mind, the point of parity should be perceived firstly. After that, it is possible to build the point of difference.

5 Conclusion

It is true that the differentiation will bring the ultimate success of brand. In this sense, it's correct that brand is a measure of differentiation. However, the differentiation is not only important. The point of parity is also important. They must be harmonized properly. They must be harmonized each other and let customers know what the brand is.

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The Economic Analysis of Feasibility Study on the Food Factories of Egypt

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Abstract. This paper is based on the feasibility study on the food factories of Egypt. In economical analysis of present project, IRR (Internal rate of Return), PBP (Payback Period) and NPV (Net Present Value) were introduced. Sensitivity analysis is performed by setting all variables at their nominal value and varying each at its upper and lower bound values such as total investment cost, sales price (steam & power) and fuel cost to investigate the impact on internal rate of return.

Keywords: feasibility, economic analysis, recycling.

1 Introduction

Lots of rice, soy, fruits and vegetables are brought up around the Nile river. Egypt Government need to develop food factories in order to trade these rural materials to europe. AYR Co. Ltd., business proprietor, made a contract of three factories(starch, soy milk power, fruits powder) with Egypt Government in March, 2008. Also AYR Co. Ltd. wanted to development by-product management factory. On the other hand, In November 2006, the first Korea-Egypt Environment Ministers' Meeting was held in Cairo, and the topics of discussions ranged from the transfer of CNG bus-related technology, improvements in the water quality of the Nile, hazardous waste management to the exchanges of environmental industry. The two countries completed an MOU on environmental cooperation. JA Environment Co. Ltd. has been worked for food waste recycling, and has many patients of environmental skill. So, AYR Co. Ltd. wanted to work with JA in order to make food factories and by-products management.

In economical analysis of present project, IRR (Internal rate of Return), PBP (Payback Period) and NPV (Net Present Value) were introduced. Sensitivity analysis is performed by setting all variables at their nominal value and varying each at its upper and lower bound values such as total investment cost, sales price (steam & power) and fuel cost to investigate the impact on internal rate of return.

T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 353–360, 2012.

Fig. 1. Site Map

2 Methodology of Economic Analysis

2.1 Internal Rate of Return (IRR)

The Internal Rate of Return (IRR) is defined as discount rate equaling the amount summing in current price of all earnings and all amount converted into present price among expenditure during endurance years of plant

In other words, it is the discount rate equaling zero in the difference between income and expenditure converted into the present price during endurance years.

$$\sum_{t=1}^{n} \frac{I_t}{(1+r)^n} = \sum_{t=1}^{n} \frac{Q_t}{(1+r)^t}$$

Where,

It: Expected amount earning in the year

Qt: Expected expenditure in the year

n: Period

r: Internal Rate of Return (EIRR or FIRR)

The IRR can be calculated by numerical analysis method using a computer.

The internal rate of return is divided into Financial Internal Rate of Return(FIRR) and Economic Internal Rate of Return(EIRR). And that is a corporate view and this is a national view.

1) Financial Internal Rate of Return (FIRR)

The annual net revenue is calculated by subtracting costs such as fuel, O & M, sales and administration, insurance, property tax, income tax, and investments from annual gross revenue. The annual gross revenue is calculated from net energy sales (MWh) and selling price.

2) Economic Internal Rate of Return (EIRR)

The EIRR calculation is very similar to the calculation of the FIRR. The only difference between EIRR and FIRR is the exclusion of insurance, property tax and income tax, which are imposed by government economic policy. Therefore, the EIRR is always higher than the FIRR.

2.2 Payback Period (PBP)

The payback, also called pay-off period, is defined as the period required to recover the original investment outlay through the accumulated net cash flows earned by the project. When making decision of investment, the investment is evaluated as there exists the worth of investment within the investment if the period to collect the investment calculated by the flowing of the cash invested is shorter than the period to collect set.

2.3 NPV (Net Present Value)

As it is the method to decide an investment by obtaining the *NPV* (Net Present Value) calculated by discounting all cash flow with the expense for capital, the Net Present Value is the present value of cash inflow minus outflow of cash.

$$NPV = \sum_{t=1}^{n} \frac{NCF_t}{(1+K)^t}$$

Where *NPV*:Net present value of Net cash flow

NCFt : Net Cash Flow

K : Expense for capital (%)

n : Business term

t : Frequency

If the *NPV* is greater than 0 (zero), the income rate is higher than the income demanded and the project can be judged as feasible.

(4) Sensitivity analysis

Sensitivity analysis is to compute the impact into the IRR by varying the upper limit value and lower limit value of each parameter (Amount invested, waste fee, heat sale's price) after set the proper values of major parameters. Sensitivity analysis is designed to provide a decision-maker with an answer to question about variables.

3 Criteria for Economic Analysis

3.1 Basic Criteria

(1) Basic date: July 1, 2009

(2) Life of power plant: 15 years

(3) Capacity of facility: Rice starch 50ton/day,

Soy milk powder 24 ton/day
Tomoto powder 2 ton/day
Mango Powder 2.7 ton/day
(4) Production efficience : 90%
(5) Depreciation: Fixed rate method (15year, 3% amount of survival value)
(6) Income tax rate: 25 % (Apply with 15% over first five years)

3.2 Construction Cost and Period

(1) Site grading: Jan.1, 2010
(2) Commercial operation:Jan 1 , 2012
(3) Investment cost

unit : 1,000usd

Item	1'st year	2'nd year	Sum
Civil/Architecture	10,000	15,000	25,000
Mechanical	26,000	39,000	65,000
Electric	8,000	12,000	20,000
Design	1,000	1,500	2,500
C M	1,200	1,800	3,000
Test run	800	1,200	2,000
Indirect cost	3,400	5,100	8,500
total	50,400	75,600	126,000
I.D.C	2,680	4,020	6,700
Total investment	53,080	79,620	132,700

3.3 Financing

The financing method of an investment cost is divided into equity financing and long term debt financing from financial institution.

Equity financing can be taken as two forms such as use of retained earnings and issuance of stock. Normally Debt financing includes both long term loan from foreign, local commercial bank and the sale of long term bonds where money is borrowed from investors for fixed period.

In analysis of economical analysis, it was assumed that 75% of whole investment is secured with the borrowed capital.

The loaning condition of borrowed capital during operation period was estimated with interest rate 5.3% in annual, repaying in ten years with KRW(Korean Won) or USD.

3.4 Annual Operational and Maintenance Cost

Item		Cost	Remarks
Materials	Rice	23,990 kusd	800₩/kg(egypt)
	Soy Bean	79,200 kusd	4,400₩/kg(egypt)
	Tomato etc.	1,728 kusd	2,400₩/kg(egypt)
	Mango etc.	1,944 kusd	2,000₩/kg(egypt)
Labor Cost		525 kusd	Anual Salrary 15 kusd
Ordinary Expenditure		105 kusd	20% of Labor Cost
Insurances		630 kusd	0.5% of Construction Fee
Maintanance		756 kusd	0.6% of Construction Fee
Electricity		2,718 kusd	Include basic fee 4,140₩/㎾h
Fuel		648 kusd	Lamp Oil 300₩/L(egypt)
Water		108 kusd	Water Supply 400₩/㎥
Depreciation		6,700 kusd	20% after 15 years
Total		119,052 kusd	

3.5 Income from the Sales of Product Is Total 161,208 kusd

(1) Rice Starch : 50t/d×2,500₩/kg×360d = 45,000 kusd (Applied 90%)

(2) Soy Milk Powder : 24t/d×8,700₩/kg×360d = 75,168 kusd (Applied 90%)

(3) Tomato Powder etc. : 2t/d×30,000₩/kg×360d = 21,600 kusd (Applied 90%)

(4) Mango Powder etc : 2.7t/d×20,000₩/kg×360d = 19,440 kusd (Applied 90%)

4 Result of Economic Analysis

4.1 Economic Analysis

The method of cash flow was used for the analysis of economic efficiency. In other words, earnings by sale of electricity and steam, amount invested, operational

expense, repair & maintenance expenses were computed by converting into current price.

As the index of analysis of economical efficiency, PBP (Pay Back Period), NPV (Net Present Value) and IRR (Internal Rate of Return) were analyzed to decide the economical feasibility. Annual selling of electric power was computed by balancing the electricity power used within power plant from total power produced.

The results analyzed of economical efficient are as follows.

(1) NPV: 89,521,000USD

(2) FIRR: 17.65%

Accordingly, the present project is judged to be feasible.

Table 1. Result of economic analysis

(Unit: 1,000 USD)

Items		Index	Unit price
Amount of production	Rice Starch	50ton/day	
	Soy Milk Powder	24ton/day	
	Tomato Powder	2 ton/day	
	Mango Powder	2.7 ton/day	
Annual income from the sale	Rice Starch	40,500	0.08USD/kWh
	Soy Milk Powder	67,651	10USD/tCO_2e
	Tomato Powder	19,440	
	Mango Powder	17,496	
	Subtotal	145,078	
Investment cost		132,700	
Number of Operator (persons)		35	
Operation cost(USD/year)		112,352	
Result of economic analysis	PBP(year)	4.8	
	NPV(kUSD)	89,521	
	IRR(%)	17.65	

4.2 Sensitivity Analysis

Sensitivity analysis was carried out to test the effect on IRR, NPV and PBP through variation of input variables such as investment cost, electric sales revenues, fuel cost used to estimate cash flow.

(1) Sensitivity analysis for variations of investment cost

(Unit: 1,000USD)

Variation rate	IRR(%)	NPV	PBP(year)
120%	16.06%	80,242	5.1
110%	16.82%	84,882	5.0
100%	17.65%	89,521	4.8
90%	18.54%	94,161	4.6
80%	19.51%	98,800	4.4

(2) Sensitivity analysis for variations of product price

(Unit : 1,000 USD)

Variation rate	IRR(%)	NPV	PBP(year)
120%	32.47%	262,003	2.7
110%	25.42%	175,762	3.4
100%	17.65%	89,521	4.8
90%	8.40%	3,280	8.0
80%		-97,337	

(3) Sensitivity analysis for variation of material cost

(Unit: 1,000 USD)

Variation rate	IRR(%)	NPV	PBP(year)
120%	1.55%	-46,669	13.1
110%	10.70%	22,738	6.9
100%	17.65%	89,521	4.8
90%	23.75%	156,304	3.7
80%	29.36%	223,087	3.0

5 Conclusion

When Productprice vary up to 80~120%, the variation of earning rates is the most sensitive as 0 ~32.47 %. When Material costs vary up to 80~120%, the earning rate fluctuates comparatively largely as 1.55 29.36 %. When the purchase expense of total investment cost varies up to 80~120%, the variation of earning rate is 16.06 19.51%.

Accordingly, product price &material costs are impacting onthe business feasibility of this project most significantly. So, when sales of product are confirmed and material are supplied by stable price, this project is judged feasible to push ahead with.

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Appendix

INCOME STATEMENT AND CASH FLOW

The Feasibility Study on the 3 Food Facility in Port Said City

Project Year	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Initial Investment	53,080	79,620	0														
Equity	13,270	19,905	0														
Debt																	
Domestic (Korea)	39,810	59,715	0														
Revenue			145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087
Rice Starch			40,500	40,500	40,500	40,500	40,500	40,500	40,500	40,500	40,500	40,500	40,500	40,500	40,500	40,500	40,500
Soy Milk Powder			67,651	67,651	67,651	67,651	67,651	67,651	67,651	67,651	67,651	67,651	67,651	67,651	67,651	67,651	67,651
Tomato Powder			19,440	19,440	19,440	19,440	19,440	19,440	19,440	19,440	19,440	19,440	19,440	19,440	19,440	19,440	19,440
Mango Powder			17,496	17,496	17,496	17,496	17,496	17,496	17,496	17,496	17,496	17,496	17,496	17,496	17,496	17,496	17,496
Operation Cost			89,882	89,882	89,882	89,882	89,882	89,882	89,882	89,882	89,882	89,882	89,882	89,882	89,882	89,882	89,882
Rice material			19,192	19,192	19,192	19,192	19,192	19,192	19,192	19,192	19,192	19,192	19,192	19,192	19,192	19,192	19,192
Soy material			63,360	63,360	63,360	63,360	63,360	63,360	63,360	63,360	63,360	63,360	63,360	63,360	63,360	63,360	63,360
Tomato material			1,382	1,382	1,382	1,382	1,382	1,382	1,382	1,382	1,382	1,382	1,382	1,382	1,382	1,382	1,382
Mango Material			1,555	1,555	1,555	1,555	1,555	1,555	1,555	1,555	1,555	1,555	1,555	1,555	1,555	1,555	1,555
Electriccity			2,174	2,174	2,174	2,174	2,174	2,174	2,174	2,174	2,174	2,174	2,174	2,174	2,174	2,174	2,174
Fuel			518	518	518	518	518	518	518	518	518	518	518	518	518	518	518
Water			86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
O & M Expense			605	605	605	605	605	605	605	605	605	605	605	605	605	605	605
Labor Cost			420	420	420	420	420	420	420	420	420	420	420	420	420	420	420
Insurance			504	504	504	504	504	504	504	504	504	504	504	504	504	504	504
General Expense			84	84	84	84	84	84	84	84	84	84	84	84	84	84	84
Interest of Debts			5,285	4,756	4,228	3,699	3,171	2,642	2,114	1,585	1,057	528	0	0	0	0	0
Domestic(Korea) Debt			5,285	4,756	4,228	3,699	3,171	2,642	2,114	1,585	1,057	528	0	0	0	0	0
Annual Depreciation			8,581	8,581	8,581	8,581	8,581	8,581	8,581	8,581	8,581	8,581	8,581	8,581	8,581	8,581	8,581
Salvage value																	3,981
Net Income before tax	-53,080	-79,620	41,340	41,868	42,397	42,925	43,453	43,982	44,510	45,039	45,567	46,096	46,624	46,624	46,624	46,624	50,605
Corporation Tax			10,335	10,467	10,599	10,731	10,863	10,995	11,128	11,260	11,392	11,524	11,656	11,656	11,656	11,656	12,651
Net Income after tax	-53,080	-79,620	31,005	31,401	31,797	32,194	32,590	32,986	33,383	33,779	34,176	34,572	34,968	34,968	34,968	34,968	37,954
Financial Economic Analysis																	
Cash Inflow			145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087
Revenue			145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087	145,087
Salvage value																	
Cash Outflow	53,080	79,620	100,216	100,349	100,481	100,613	100,745	100,877	101,009	101,141	101,273	101,406	101,538	101,538	101,538	101,538	102,533
Initial investment	53,080	79,620	0														
Operation Cost			89,882	89,882	89,882	89,882	89,882	89,882	89,882	89,882	89,882	89,882	89,882	89,882	89,882	89,882	89,882
Tax			10,335	10,467	10,599	10,731	10,863	10,995	11,128	11,260	11,392	11,524	11,656	11,656	11,656	11,656	12,651
Net Cash Flow	-53,080	-79,620	44,871	44,739	44,606	44,474	44,342	44,210	44,078	43,946	43,814	43,682	43,550	43,550	43,550	43,550	42,554
Accumulated Net Cash Flow	-53,080	-132,700	-87,829	-43,091	1,516	45,990	90,332	134,542	178,620	222,566	266,380	310,062	353,611	397,161	440,710	484,260	526,814

Multicriterial Evaluation of Critical Infrastructure Element Protection in Czech Republic

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Abstract. The importance of Critical Infrastructure is seen through its potential to enable the functional continuity of vital societal functions from economic and social perspective. Present state of Critical Infrastructure Protection is related to creation of relevant security and protection management system, where the effectiveness of this system should be important also in relation to business continuity and disaster recovery. The article will discuss about potential approach to multicriterial evaluation of Critical Infrastructure and Its security and Protection management system in the context of security research project in the Czech Republic - "VG20112014067 - Resilience evaluation system of Critical Infrastructure elements and networks in selected areas."

Keywords: Critical Infrastructure Protection, Physical Protection System, Business Continuity, Information security, Resilience.

1 Introduction

The complexity of critical infrastructure as a system created a framework to formulate an approach which would unify the identification and designation process of the European critical infrastructure and consequently national infrastructure in an adequate way. Critical Infrastructure Protection in the Czech Republic is established by the Act 430/2010 Coll., which is accepted as the implementation of Council Directive 2008/114/EC on the identification and designation of European Critical Infrastructures and the assessment of the need to improve their protection.[1] This fact provides a framework and environment for creating a unified European access to Critical Infrastructure Protection. The European perspective is near to national, so this article will discuss about Critical Infrastructure element protection in Czech Republic mostly in relation to multicriterial evaluation.

2 Critical Infrastructure Protection Management System Expression and Evaluation

The main aim of Critical Infrastructure protection process is to reach the desired degree of relevant security and protection aspects in relation to critical infrastructure elements. Another goal is to ensure the recovery process in case of the elements

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function degradation. Identified and designated elements must withstand the effects of all threats and risks, that is seen as a principle of All Risk approach.

In relation to this fact and also in relation to actual state of security research, we are able to say that the main aspect for optimal Critical Infrastructure protection level is combination of:

- Physical protection systems,
- Information security,
- Business continuity planning/management,
- Administrative and personal security,

2.1 Physical Protection System

In connection with the use of a comprehensive physical protection system of the critical infrastructure component, the three main system functions are considered:

- Detection - intruder detection, using technical protection devices (AIR, PIR, MW Bistatic, MW Monostatic, dual sensor etc.), verification of alarm information (CCTV),
- Delay – slowing of an intruder, using a mechanical barrier systems (fences, gates, barriers , grilles, security doors, windows and other),
- Response - reaction and activity of response team - preventing, suspension or detention of an intruder - the regime measures should contribute to that [2].

The standard object of a critical infrastructure element is in relation to the needs of our research and in accordance with existing expert opinion is divided into 8 security zones Fig.1:

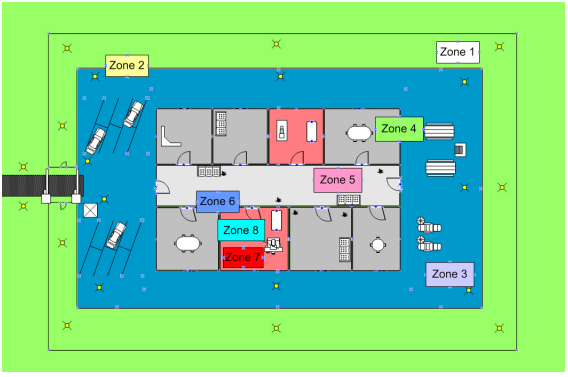


Fig. 1. Critical infrastructure object divided to 8 security zones

Each zone has its specific functional and structural parameters that affect the success of the intruder in achieving his aims. From the functionality point of view, we are talking about probability of detection, breakthrough resistance and time availability of response team.

Based on this approach the structure of the physical protection system was required, which is then subjected to the evaluation process, see Fig. 2.

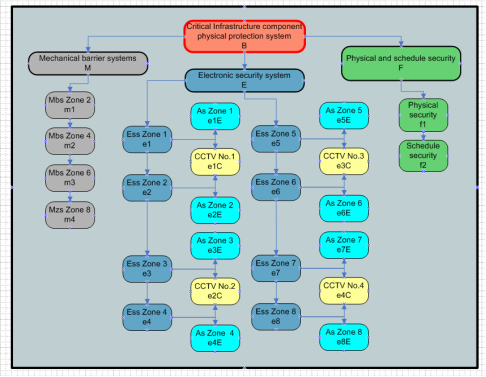


Fig. 2. Critical infrastructure element physical protection system structure

2.2 Information Security

Establishment and formulation process of information risk assessment system or information security management system is an important aspect of setting uniform standards to ensure the critical infrastructure entities information systems functionality. Information systems complexity and current trends in ICT increased emphasis on building security standards. Information (ICT) security is one of the cornerstones of the critical assets protection whether through the provision of security systems connectivity, or providing information protection maintained within the databases and information systems.[3]

Following text identifies areas of information security management system, that are able to assess wide range of information risks and are relevant for critical infrastructure protection and security management system.

Table 1. Information security areas

Information security	
Identification and authentication,	Management control system,
Management of logical access	The security of routing tables,
Audit,	Operational control,
The integrity of the software,	Public key infrastructure,
Backing up data,	Check for software changes ,
The resilience of the network,	Customer authorization,
System posting,	Analysis of vulnerabilities,
Testing of the system,	Document/media
Protection against malicious programs,	Control users,

2.3 Business Continuity

Business continuity is another important aspect of security and protection in terms of identifying needs and requirements to ensure functional continuity and system

recovery of Critical Infrastructure in the event of disruption or interruption. The requirements formulation is crucial in relation to ensure the essential functions in the event of an emergency, area restoration and time intervals definition that are shorter or equal length than a specified maximum function acceptable time failure.[4]

In relation to protection and security management system evaluation, we defined specific areas, for better business continuity implementation:

Table 2. Business continuity

Business continuity	
Business continuity management system (BCMS) structural requirements definition	Crisis situation response team management level
Personal structure of BCMS	Crisis situation level
Personal structure of crisis response team	Crisis situation management and recovery
Structural requirement of business continuity planning	

2.4 Administrative Security

The major part of protection and security management system related to selected area of Critical Infrastructure includes administrative aspects of security that addresses the process of ensuring adequate protection of documents in paper and electronic form and their creation, receipt, recording, processing, transmission, transportation, transfer, storage, shredding, and so on.[5]

The main selected areas of administrative security are presented in table 3:

Table 3. Administrative security

Administrative security	
Responsibilities and duties	Loss of documents and storage media
The labeling and classification of documents	Administrative security of personal changes
Manipulation with documents	

2.5 Personnel Security

On the basis of previous project activities and consultations with the responsible authorities in selected area of Critical Infrastructure was like another part of comprehensive security and protection management system selected the area of personnel security, This area is perceived as a system of individuals selection in relation to access to information assets of Critical Iinfrastructure element, verification conditions for information access, protection and relevant education. The requirements focus on minimizing the impact of human errors, potential theft, fraud or abuse of information resources of the organization.[6] In relation to this fact, the main areas of personnel security were defined:

Table 4. Personnel security

***Personnel* security**	
Responsibilities and duties	Staff training
Employee screening	Responding to security incidents and failures
Agreements on the information security	The disciplinary process
Conditions for work activities	Termination of employment relationship

3 Critical Infrastructure Element Protection

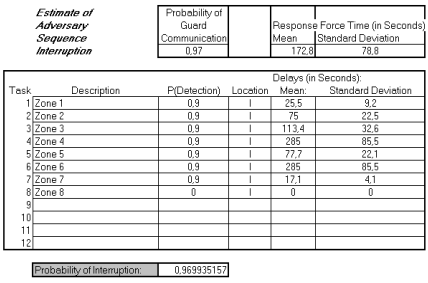
This chapter will discuss about approaches which should be used in relation to Critical Infrastructure protection management system evaluation where the structural properties in selected areas of each security or protection aspects should be seen as comparative criteria for process of multicriterial evaluation of Critical Infrastructure element protection management system. Each area should be for the process of evaluation concretized and compared by checklists.

3.1 Physical Protection System

Evaluation of functionality of these systems will be based on breakthrough resilience, detection probabilities, the probability of response team communication interconnection and temporal accessibility of the response team in respect of specific objects, that were defined for each security level and for the each security zones of Critical Infrastructure element on the basis of presented actual approaches to designing the physical protection systems.

For purposes of this process the model EASI was used (Estimate of Adversary Sequence Interruption - Garcia M.L., The Design and Evaluation of Physical Protection Systems, 2007)[7], the output of which is the probability of successful interruption of an adversary activity (see Fig. 3).

The probability of interruption we will consider as Pss index for further evaluation process.



Estimate of Adversary Sequence Interruption

Probability of Guard Communication		Response Force Time (in Seconds) Mean	Standard Deviation
0.97		172.8	78.8

Task	Description	P(Detection)	Location	Delays (in Seconds): Mean:	Standard Deviation
1	Zone 1	0.9	I	25.5	9.2
2	Zone 2	0.9	I	75	22.5
3	Zone 3	0.9	I	113.4	32.6
4	Zone 4	0.9	I	285	85.5
5	Zone 5	0.9	I	77.7	22.1
6	Zone 6	0.9	I	285	85.5
7	Zone 7	0.9	I	17.1	4.1
8	Zone 8	0	I	0	0
9					
10					
11					
12					

Probability of Interruption: 0.969935157

Fig. 3. EASI model

3.2 Information Security

Each defined area of information security should be in the next evaluation process divided and concretized for better understanding and for evaluation process optimization by creating relevant checklist. Each positive answer is in the process of information security system evaluation considered as a point and the value (sum of the points) of selected information security system is divided by defined maximal value of information security system.

$$Iss = \frac{\sum IP_i}{IP_{\max}} \tag{2}$$

Iss - information security system quality index,

$\sum IsP_i$ - the sum of positive answers,

$IsP_{\max}$ - defined maximal value of information security system

Formulation of the basic requirements for information security is another area of optimal security management system and Critical Infrastructure protection. For the purpose of Critical Infrastructure protection evaluation system will be this approach considered as an entry approach.

3.3 Business Continuity

Each defined area of business continuity should be in the next evaluation process also divided and concretized for better understanding and for evaluation process optimization by creating relevant checklist. Each positive answer is in the process of business continuity evaluation considered as a point and the value (sum of the points) of business continuity area is divided by defined maximal value of business continuity.

$$Bc = \frac{\sum Bc_i}{Bc_{\max}} \tag{3}$$

Bc - business continuity system quality index,

$\sum Bc_i$ - the sum of positive answers,

$Bc_{\max}$ - defined maximal value of business continuity

3.4 Administrative and Personnel Security

Also in the process of administrative and personnel security aspects evaluation each defined area of these security aspects should be in the next evaluation process divided and concretized by creating relevant checklist. Each positive answer is in the process of administrative and personnel security aspects considered as a point and the value (sum of the points) of administrative and personnel security aspects area is divided by defined maximal value of business continuity.

$$As = \frac{\sum As_i}{As_{\max}} \qquad Ps = \frac{\sum Ps_i}{Ps_{\max}} \tag{4}$$

$As; Ps$ - Administrative and Personal security quality index,

$\sum As; Ps_i$ - the sum of positive answers,

$As; Ps_{\max}$ - defined maximal value of Administrative and Personal security

4 Multicriterial Evaluation of Critical Infrastructure Element Protection

For the purpose of multicriterial evaluation of Critical Infrastructure element protection it is necessary to define and establish relevant mathematical approach. In relation to previous text chapters, it is crucial to define optimal mathematical interconnections between these indexes.

Pss - physical protection system quality index,
Iss - information security system quality index,
Bc - business continuity system quality index,
$As; Ps$ - Administrative and Personal security quality index,

The first acceptable mathematical explanation of the Critical Infrastructure element protection level evaluation (CIP) is the basic multiplication by equation:

$$CIP = Pss * Iss * Bc * As * Ps \tag{5}$$

We assume that in the case of probabilistic approach, the multiplication cumulating the probabilities which reduces the total probability and distorts the perception of the overall critical infrastructure protection level.

The second possible approach that is based on the current state of the knowledge is the expression of an average value of defined indexes:

$$CIP = \frac{Ps_S + Iss + Bc + As + Bs}{x} \tag{6}$$

x – number of defined indexes

It necessary to say, that there are a variety of possible mathematical approaches which can be used for Critical Infrastructure element protection level evaluation process, but it is not easy to select those that reflect the requirements of critical infrastructure owners/operators and their need for simplicity the evaluation process.

The relevant selection of the objective mathematical model will be based on practical verification of mathematical models in real objects (Critical Infrastructure element) and further discussions with responsible entities.

5 Conclusion

Article "Multicriterial Evaluation of Critical Infrastructure Element Protection in Czech Republic" discusses about the problematic of Critical Infrastructure element protection evaluation mostly in relation to increasing the resilience of its functional continuity.

In the context of security research project oriented to the area of resilience evaluation we identified and established the security and protection measures areas that could be seen as relevant in present state of knowledge and based on actual requirements of Critical Infrastructure owners and operators. Last part of the text discusses about possible way how to evaluate protection and security management system where the mathematical models were presented. We expect that all approaches would be confronted with real conditions and environment to reach optimal project results and outcomes.

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Integrated Alarm Systems

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Abstract. Alarm systems represent part of the technical resources to provide support for business continuity. Integration of the alarm systems is a modern way of using the current technological capability elements of intruder alarm system, CCTV, access control and hold-up alarm systems. These applications can be integrated with each other or to supplement the non-alarm systems and thereby provide simplify the automation processes in commercial and residential buildings. This article deals with problem of technical solutions of interconnection alarm and non - alarm systems. The key output of the article is classification of techniques of integration these systems.

Keywords: Integrated alarm system, Integration, Intruder alarm system, Automation System, non - alarm application.

Introduction

Integrated Alarm Systems are defined according to relevant technical regulation ČSN CLC / TS 50398 as systems having a one or more common devices at least one of which is an alarm application (ČSN, 2009). Alarm application designed to protect life, property or environment:

- intruder and hold-up alarm system (I&HAS),
- intruder alarm system (IAS),
- hold-up alarm system (HAS),
- social alarm system (SAS),
- closed circuit television used for security and surveillance (CCTV),
- access control system (ACS),
- fire detection and fire alarm systems (FDAS),
- environmental alarm systems and lift alarm systems.

The above systems can be integrated with each other or with non- alarm applications:

- lighting, heating, air- conditioning, ventilation,
- irrigation, building management, energy management.

Integration of alarm and non- alarm applications is solved by various technical solutions, starting with a simple connection of input / output contacts to sophisticated software solutions. In terms of needs of formulation and the subsequent drafting of an

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integrated alarm system (an example IAS Intruder alarm system complete with camera system, control systems for lighting and heating) is an important factor of the selection of appropriate elements- method of technical solutions interconnection systems. Therefore it is necessary to categorize - to classify the different techniques of integration and to create a basic guide the preparation of implementation IAS.

Selection of appropriate components is an important point of the system design as the first phase of the setting up the IAS, especially because of its feasibility, requirements for operation, adequacy of financing costs and particularly the possibility of any further expansion of the system. In other parts of the article author presents the proposal for a possible classification of technical forms of integration alarm and non- alarm systems.

Materials and Methods

Drafting of classification of technical methods of integration alarm and non- alarm applications based on an analysis of these document types:

- technical standards- I&HAS, CCTV, ACCESS, SAS,
- technical product specifications,
- installation manuals of relevant systems and their elements,
- legislation- definition of technical requirements for the components IAS (Act, 1997).

The basic document in integrated alarm systems is a technical standard ČSN CLC / TS 50398 Alarm systems - Combined and integrated systems - General requirements.

Although the CSN issued as early as 2005 and then 2009, not many interested companies (distributors, installation companies) this fact is not known or have only general information about the issue of the CEN / CENELEC, which has the status of technical specifications and its acceptance by the national standards of members of the CEN / CENELEC is not required (only an obligation to ensure notification of the existence and availability of CLC / TS 50398). The standard solves the issue of definitions of basic terms, describe basic types of IAS configuration, system requirements, requirements for documentation and training.

Integrated alarm system has been considered with respect to document title as a synonym term a combined and integrated alarm system, which can be misleading, because the current understanding of the term combination we mean a clustering as opposed to term of integration, which expresses the unification or jointing process to higher arrangement.

In practice, associated with the alarm systems can be the difference quite clearly illustrated by looking at installing an intruder alarm system, supplemented by a camera system, where these systems are independent of each other (combined) in contrast to the same systems that are interconnected - for example, outputs IAS initializes through the alarm inputs start of individual elements of CCTV - cameras, recording devices (integration). However, with respect to in legislative texts we will continue to speak summary on the integrated alarm systems.

An important requirement for the integration of systems, the application of relevant standards relating to individual applications. Each application must primarily comply

with its own standards (I&HAS, CCTV, ACCESS, SAS, see ČSN 5013x series) and must meet specific requirements for system integration. Common components used under integration must then comply with all application standards, which meet in a specific configuration is required and must be used with the strictest requirements of each of the standards related to the function of the system. The key sources of draft techniques of integration alarm systems are primarily the technical documentation (specifications, installation manuals) of components of alarm systems and automation systems, focusing on the features, modules, accessories and equipment relating to the implementation of integration with other applications (Jablotron 2011; Variant 2012; ABB 2012).

Results

Problems of combination and integration of alarm and non- alarm applications can generally be included in the field of system integration (although this is mainly associated with information systems), which is understood as the delivery of services based on connecting heterogeneous subsystems into one functioning whole. Basic forms of system integration are shown in Fig. 1.

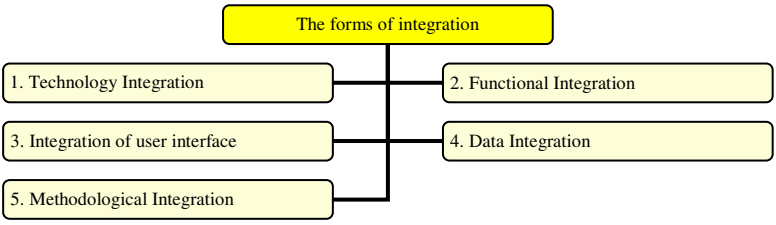

Fig. 1. The basic forms of System Integration

Integrated alarm systems can support the fulfillment of all the above types of system integration. The following Tab.1 gives examples of applications Integrated alarm system, classified in terms of the aforementioned forms.

Table 1. Examples of applications of Integrated alarm systems

Form	Application
Technology Integration	Integration I&HAS, CCTV, ACS, SAS + control of lighting, heating, blinds, air conditioning...
Functional Integration	Integration of Access card functions: Entry – Exit Registration / Registration of manufacturing operations.
Integration of user interface	Combined control of alarm and non-alarm systems – control panels, applications for mobile phones, technology "smart home".
Data Integration	SW products for the personal identification, evidence of entry, attendance, export to the wage systems.
Methodological Integration	Implementation methodology of registration and movement of visitors, registration of persons and vehicles, escorts, the presence of visitors, blocking entry of undesirable persons.

The basis of each form of integration is always a technological solution of interconnection systems. With respect to quantity and difference of currently available electronic devices, there are always several variants of project for a specific object (residential or commercial), which is possible to design based on the requirements of the investor. The following part of Article describes classification of individual technical ways of integrating alarm and non alarm applications, which is processed by analyzing the provisions of the relevant technical regulations and particularly the possibility of currently used technologies. Technical ways of interconnecting the individual applications can be divided into the following basic groups:

- hardware methods of integration,
- software methods of integration.

Hardware (HW) methods of integration are based on the interconnection of systems through their inputs and outputs and on the technical parameters of alarm systems, which may include, in addition to the basic security functions also specific-expanding elements (modules) to control alarm or non alarm applications (lighting control, heating, access control, etc.). The hardware integration methods also include the use of automation systems (eg intelligent wiring system), which in addition to standard control of technologies for buildings (lighting, heating, air conditioning, blinds, irrigation, sound, etc.) offers the ability to connect security devices (detectors, hold-up devices, control and indicating equipment IAS etc.). Hardware integration methods can be divided into the types listed in Fig. 2.

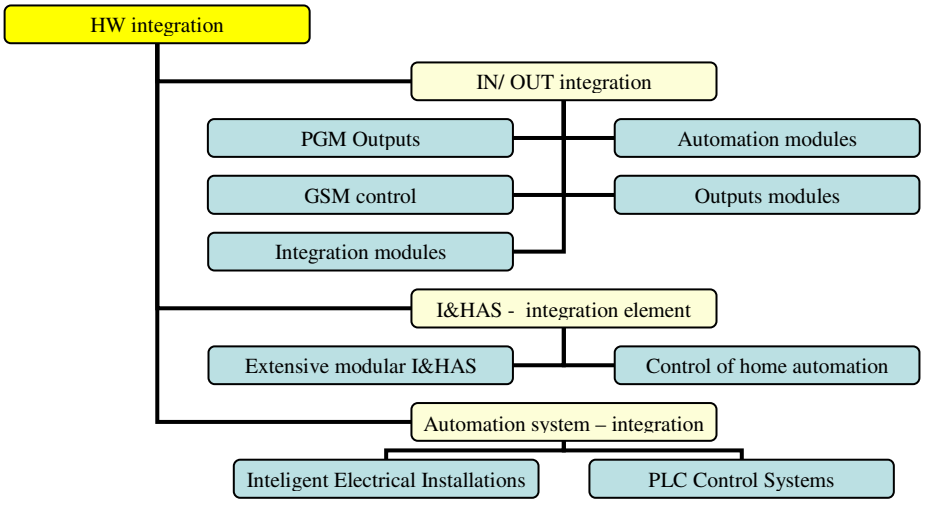

Fig. 2. Hardware methods of Integration of alarm systems

1 Integration IN / OUT

Technical systems integration solutions labeled as IN / OUT is a way of interconnection systems through their inputs and outputs. The parameters of individual components of alarm systems (eg control and indicating equipment, control units, access

control systems, CCTV recording devices, cameras, etc.) allow you to realize the integration of heterogeneous systems to ensure mutual transfer and sharing of information of the sub-systems (I&HAS, CCTV, ACCESS, control of lighting, heating etc.). This information is then used to control (change state) connected systems in accordance with preset configurations. IN / OUT integration is especially useful for small applications, but it is realizable also in larger projects. Such solutions, however, are technically demanding and limited as the maximum number of programmable outputs or the number of connectable modules. In terms of overall system design with respect to its management, control and visualization capabilities is IN/OUT the weakest variant of integration, but due to wide possibilities of creating a concrete implementation of customer-requested features (such as turn off selected power circuits in the building after arming IAS) is a frequently used solutions (Lukas, 2011). The advantages of IN / OUT integration:

- systems are not negatively affected by each other,
- failure of one application does not have an impact on other applications,
- interconnection of the systems is feasible regardless of the manufacturer and communication protocols.

Other hand, the disadvantages of this solution can include:

- hardware requirements on the number of inputs / outputs,
- decentralized management system,
- problematic central visualization in real time.

1.1 PGM Outputs

Basic way of IN / OUT integration is the use of programmable outputs - PGM of components of alarm systems, most of control and indicating equipment IAS. PGM outputs allows implementation of specific activities in objects turn on/off and control - lights, heating, locks, pumps, etc.) using a programmed response to a trigger (arming, disarming, tampering, intrusion, failure, activation of hold-up device etc.). PGM outputs can be activated also by keyswitch zones or by standard buttons involved in NC / NO input control equipments, expanders, card readers, etc.

Programmable outputs allow the transmission binary information or control of power supply for other devices and are usually implemented as modules card of motherboards of control equipments or as individual modules. Number of separate PGM outputs of control panels IAS is usually 2 to 16, using the expansion modules then 8 to several hundred outputs. PGM outputs are technically implemented as a transistor open collector outputs (approx. 12V/150 mA), or closed-emitter (about 5 V / 1 mA), or as potential less outputs relay (contacts for low voltage 30V/1A or power voltage 250V/5A) or as a relay voltage outputs. Peripheral devices are connected to the PGM outputs directly or via additional relay modules for the purpose of strengthening (voltage levels, current consumption) and for galvanic separation from the controlled device.

1.2 GSM Controller

The integration of alarm and non- alarm applications is feasible with selected functions of GSM controllers, which are independent to control panel IAS. Among the standard features of these products includes:

- automatic SMS sending depending on the initialization events (on / off system - in connection with IAS, alarm, fault, the set level - temperature, the liquid level),
- remote control circuit output GSM controller by SMS messages or ringing,
- setting of time windows (time switch),
- control of non- alarm systems (heating, lighting, pumps, irrigation, locks ...).

GSM controllers usually have a lower number (approximately 4 + 4) inputs (NC / NO) and outputs (relays). Outputs can be controlled remotely (GSM messages) or locally through mutual setting of bindings depending on the status of inputs. The controlled devices can be connected by wire or wirelessly, using radio modules.

1.3 Automation Modules

Simple and less extensive installation of integrated alarm systems can be realized using general-purpose automation modules. The standard application possibilities of these modules include:

- remote management, monitoring and control of connected technologies in buildings,
- creating of schedules activities of integrated systems,
- integration with I&HAS - status monitoring and control of basic functions (on / off),
- checking, monitoring and control building technologies (the level of liquids, pumps, air humidity, flue gas, control of the limit position, drying, irrigation),
- monitoring and control of unattended operation facilities (pumping stations, transformer stations),
- home automation (temperature, lighting, wells, irrigation, blinds),
- agriculture (heating, ventilation, air conditioning, feeding),
- control of entry elements (gates, doors).

Modules can be installed directly in controlled facilities and their control is usually implemented using TCP / IP traffic from any PC connected via Ethernet / Internet. Other features of automation modules includes also possibility to set up links between status of inputs and outputs or monitoring of history events.

1.4 Output Modules

The installation of alarm systems can include output modules, which are located directly in box of control panel IAS. These modules are equipped with a fixed programmable outputs (usually semiconductors) whose state corresponds to a defined events (copies triggers - such as arming, disarming, intrusion, panic, fire, failure, power failure, the state PGM). Output module to cooperates with communicators (GSM, LAN, PSTN).

1.5 Integration Modules

Integration modules provide for selected types of control units of alarm systems such as control panel, their integration with other systems or their connection to the additional software product. Module reads conditions of control panel and allow its control while still maintaining the integrity and closure of alarm system. Usually includes parallel, serial and USB port.

2 Intrusion and Hold-Up Alarm Systems as the Integration Element

Extensive alarm systems are based on the groups of modules that are connected on the bus. These groups include alarm components (motion detectors, opening, glassbreak etc.) and also can include elements of access control system and elements of automation, allowing control of connected non- alarm technology of buildings. Control panel is the central element of the system in which can be implemented functions of access control system or other alarm and non-alarm applications. This control panel in conjunction with SW product ensures communication with the system operator and the central control and visualization technology building. All elements of the systems - modules are technologically identical, and therefore there is no compatibility issue. Central control and administration here may seem as an advantage and disadvantages at the same time. Failure of the control panel has resulted in malfunctions of most of the of connected technologies. Smaller applications can be realized using control panel of IHAS, which generating signals for home automation systems (such as X -10 ... control of electrical equipment signals transmitted by power lead 230 V).

3 Automation System as an Integration Element

Automation systems used to control technology in buildings (lighting, heating, blinds, irrigation, etc.) contain a central control with PLC (Programmable Logic Controller) controllers and can be used also to security object. Modern automation systems use technology systems of intelligent wiring. These are built on the platform of the wire bus to which they are connected sensor (temperature, humidity, buttons, microphone, detectors ...) and action elements (switches, relays, warning device ...). Individual elements of technology of building (lighting, air conditioning, blinds, heating, boiler ...) can then be controlled locally, remotely (GSM, web) or can centrally set timetable for their activation and reciprocal links.

IAS can be connected to the systems of intelligent wiring through a transducer, which ensures two-way transmission of signals between the control panel IAS and the control unit of wiring system, which further ensures links with other technologies in the building. When arming the system after the departure of persons from an object such as might occur to turn off lights, locking doors, turning off selected socket circuits. In the case of intrusion can be programmed central unit for turn on lights in the building, pull blinds etc. In another variant is possible to create a security system on

the platform of the system of intelligent wiring without the use of control panels IAS. In this case, the detectors (motion, open, glass break, vibration, etc.) are connected to other sensors to the bus and based on an assessment of their condition control unit run the program - the transmission of messages on alarm receiving centre, activation of warning devices, etc. Such a method of security cannot be certified in accordance with the line of technical standards EN 50131.

Smaller applications can be realized with the use of PLC control systems, which are primarily designed to monitor and control of technologies of building, but their inputs / outputs can be connected to the relevant elements of alarm systems.

4 Software Integration

Software (SW) integration methods are based on linking separate applications via a communication bus, and their control, management, visualization are providing software products, which are installed on an external computer (server, client PC) or at unattended control centers equipped with the necessary software. Individual alarm / non- alarm applications can also be connected to the server via the network (LAN, WAN). For simple applications, the PC client is connected to application using a serial interface or USB port. The common element is the user access to particular functions via PC or through mobile devices.

Software products can be classified by function, which provide for the needs of installation companies but especially to ensure the needs of users with regard to the connected systems. These functions involve integration of selected activities or technology, for example by creating a central database for user management, central visualization or the central setting of automatic links between connected systems. Overview of functions is listed on Fig. 3.

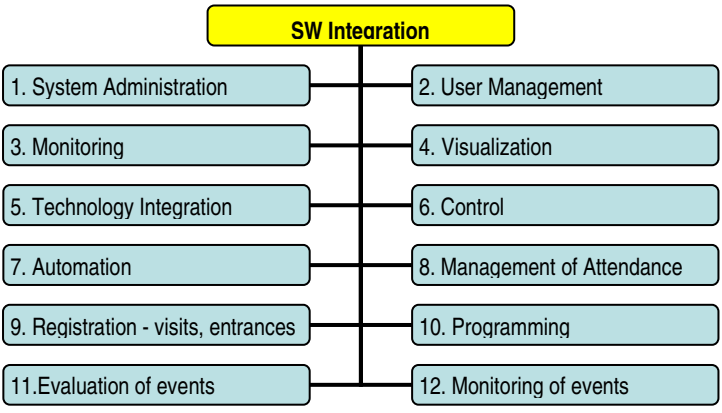

Fig. 3. Software possibilities of integration of alarm systems

Available software products in many cases combine the above functions. The following part of article describes the possibilities of software in accordance with the designation under which it is currently on the market offered.

4.1 Software of Control Panels of Alarm Systems

Additional programs delivered to the various types or line of control panel IAS providing local or remote connection panel (control unit) with a PC in order to realize the basic functions - programming, monitoring, evaluation and event logger. These programs serve the need for installation and service companies. Here we talk about integration from the perspective of a central evaluation and event activation of control panels, that can be hardware linked to other systems.

4.2 Software for User Administration

These programs allow to realized custom settings control units (control panel) connected systems. In the area of security it is usually control panels IAS with access control system. The user has, in addition to basic functions (evaluation, monitoring, archiving events), especially possibility:

- setting up user profiles, create descriptions of subsystems zones, terminals,
- creating time schedules of access,
- allocation and registration of identifiers (cards, fingerprints)
- filtering of event history (type, time, place, person).

4.3 Visualization Software

Visualization programs provide in contrast to programs for user management other comfort function- transparent visualization of system status in real time. Based on the plans, ground plan o f objects (buildings or outdoor space - there are also software for visualization of perimeter protection) with a graphical showing the locations of individual components (detectors, cameras, card readers, terminals, etc.), the operator can monitor system status and controls selected functions - on / off surveillance subsystem or zone, opening doors, turning on the camera or control PGM outputs.

4.4 Integration Software of Systems of Buildings

Interconnection of security systems and other technology of building is implemented through software product, which is installed on the server and these systems are controlled by the client PC through a web browser. The individual systems are connected in a LAN. Integration software is an additional service, allowing for example:

- setting the automatic links between systems, visualization of systems,
- local and remote control, systems management and users
- control activities of operator,

- management of attendance in continuity to payroll system,
- definition of roles and rights of users (employee, operator, manager, receptionist, etc.).

Failure of activities of integration SW may adversely affect the functionality of the connected systems. It is therefore for appropriate ensure integration of important system bindings by the hardware level. Integration software usually consists of separate modules that can be combined according to customer requirements (IAS, HAS, CCTV, ACCESS, FDAS, attendance, the map interface etc.)

4.5 The Partial Conclusion Software Integration

The main advantages of deploying of SW integration products include:

- ability to integrate products from different manufacturers, the implementation of on-line service,
- central control of events and alerts in the system, the central management of user data,
- obtaining before-alarm information,
- better overview of the situation in the building,
- faster response to emergency events, reducing false alarms,
- user control and operators, operative changes of system,
- standard (graphical) user interface, reducing the cost of supervision in the building, maintenance, training, human resources, expansion the possibilities of connected devices.

Conclusion

Development of technological capabilities of systems and higher customer requirements are the basis for a wider deployment of integrated systems, containing alarm systems and other technology of buildings (non- alarm application). The interconnection of systems provides users with many benefits in the form of increased security of buildings, comfort control or potential savings in energy costs and human resources. The aim of the article was to present the proposed classification of technical ways of integrating various systems to support the convergence of perspectives and approaches of professionals in this field and especially in phase the design of integrated systems. The proposal builds on the basic dividing on hardware and software methods of connection. Hardware methods are divided into: IN / OUT Integration (PGM outputs, automation modules, integration modules, output modules, GSM controller), the integration using the superior IHAS or integration using the automation system. SW integration methods are classified according to their basic functions, which SW products can provide (integration of technology - automation of bindings, visualization, user management, supervision, evaluation and archiving of events).

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Reservoir Risk Dispatching Combining Forecasting Error*

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Abstract. Based on statistic forecasting error of different flood discharge magnitude, this paper considers the forecasting errors have relationship with flood discharge magnitude. Using interval estimation principle, a probable error magnitude bound on different risk level α is estimated. To consider safety preference, the upper limit of the probable error magnitude bound is called maximal probable error. On the same risk level, the correlativity function between different flood discharge magnitude and its maximal probable error is called forecasting error risk function. Then the text establishes reservoir forecasting error risk function which puts scientific basis for rational making use of forecasting production. According to reservoir scheduling discipline, probing into Feng Shuba reservoir risk forecasting dispatching combining forecasting error risk, it puts application for real time forecasting and dispatching.

Keywords: Reservoir, flood, dispatching, risk.

1 Introduction

Flood forecasting technique is an important non-structure measure for flood hazard mitigation. But errors always exist in the result of the flood forecasting for the influence of various sources of uncertainties. And the errors will decrease the efficiency of the forecasting result in the application of the flood control. So while aiming to improve the veracity of the flood forecasting, we should analyze the uncertainties sources and estimate the probability of the error range.

2 Risk Function of Flood Forecasting Errors

2.1 Analysis on Flood Forecasting Errors

Although the result of the inflow forecasting with real-time adjustment is acceptable, the error is avoidless. And the stability of the model needs to be tested. So the error must be taken into account in the application of the forecasting result.

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The errors include: (1) input data errors from the measure errors and computing errors of the precipitation, the evaporation and the flow. (2) model frame errors from the hypothesis of Xin'anjiang linear time invariable lumped model; (3) parameter errors from the model calibration for the effect of local optimization.

2.2 The Error Risk Function

All the error components can not be specified. But the combined error of flood forecasting result reflects the integrative effects of all various uncertainties. And the error sequence presents a stochastic series. In this application case, we consider there is a correlation between the forecasting errors and the forecasting discharge magnitude. By principle of the confidence intervals estimate, the probable error range of some magnitude discharge is estimated under a certain confidence level. To consider towards security, the maximum probable error is adopted. On the same confidence level, the correlativity function between different discharge magnitude and the maximal probable error is called forecasting error risk function. The calculation step is as follows:

(1) Calculate the errors $DQ_{(t)}$ between the forecasting discharge $Q_{F(t)}$ and the theoretically true discharge $Q_{T(t)}$:

$$DQ_{(t)} = Q_{T(t)} - Q_{F(t)} \tag{1}$$

Here the sign "t" expresses the time variable.

(2) According to the magnitude of forecasting discharge, the error sequence is partitioned into ten samples for the limited data. And the sign "$\overline{Q}_F$" expresses the average value of the error sequence of forecasting discharge of a certain magnitude.

(3) Some research articles mention that the forecasting error sequence generally presents normal distribution or normal logarithm distribution. In this paper we consider that the forecasting error sequence presents normal distribution. By principle of the confidence intervals estimate, the maximum probable error is estimated under a certain risk. Here we adopt 4 risk percents of 20%, 15%, 10% and 5%. And the corresponding maximum probable errors are $DQ_{20\%}$, $DQ_{15\%}$, $DQ_{10\%}$ and $DQ_{5\%}$.

(4) The error risk function is attained through formulating the recursive correlation of the maximum probable error series and the average value series under various risk percents. The forecasting error risk function of Feng Shuba reservoir presents rectilinear correlation. The correlation equation is expressed as follows:

$$DQ_{\alpha} = b\overline{Q}_F + a \tag{2}$$

Here the coefficient "a" and "b" can be calculated by recursive least mean square algorithm.

2.3 Feng Shuba Reservoir Error Risk Function

Feng Shuba reservoir error risk functions are presented in formula 3 to formula 6, Fig.1 to Fig.4. The regression coefficients of the maximum probable error series and

the average value series under a certain risk percent are beyond 0.95. So we consider it is reasonable that the error risk functions present rectilinear correlation.

$$DQ_{20\%} = 0.1833Q_F + 48.404 \tag{3}$$

$$DQ_{15\%} = 0.2605Q_F + 40.319 \tag{4}$$

$$DQ_{10\%} = 0.3033Q_F + 59.371 \tag{5}$$

$$DQ_{5\%} = 0.3921Q_F + 77.201 \tag{6}$$

Where, $DQ_{20\%}$, $DQ_{15\%}$, $DQ_{10\%}$ and $DQ_{5\%}$ is maximum probable errors of 20%, 15%, 10%, 5% risk, Q_F is forecasting reservoir flow after real time adjustment.

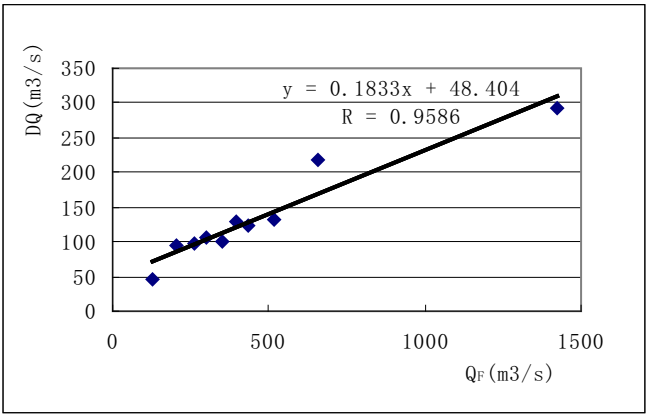

Fig. 1. The correlation between discharge and errors when risk is 20%

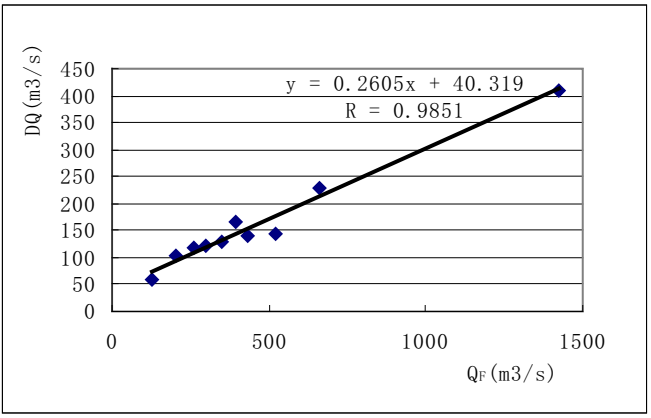

Fig. 2. The correlation between discharge and errors when risk is 15%

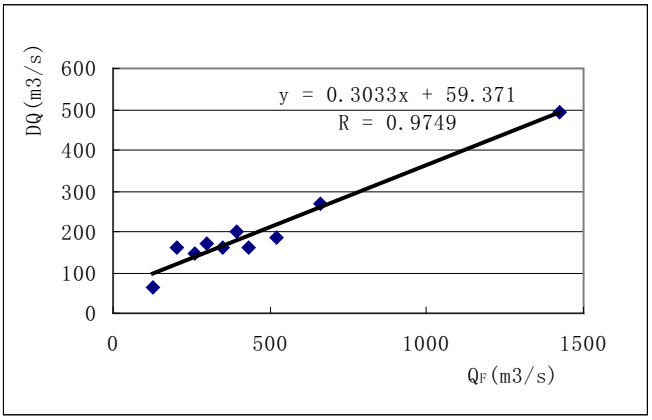

Fig. 3. The correlation between discharge and errors when risk is 10%

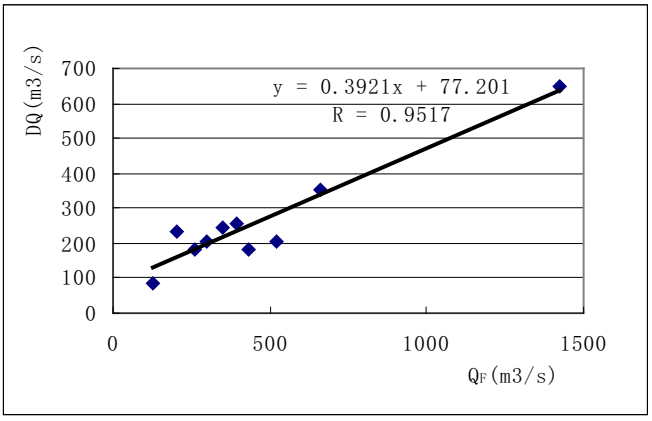

Fig. 4. The correlation between discharge and errors when risk is 5%

3 Risk Regulation of Flood Control

The main idea of the risk regulation of flood control is that: the forecasting error may not be taken into account when the water level of the reservoir is much lower than the flood control level. But when the water level of the reservoir is higher than the flood control level of the reservoir, the flood forecasting error must not be ignored in respect of the safety of the reservoir. The risk of flood control is higher when the water level of the reservoir is higher. For example, when the water level of the reservoir is near flood control level, the hazard level of 20 percent may be adopted to calculate $DQ_{20\%}$; when the water level of the reservoir is near the design flood level, the hazard level of 10 percent may be adopted to calculate $DQ_{10\%}$, and when the water level

of the reservoir is near spillway design flood level, the hazard level of 5 percent may be adopted to calculate $DQ_{5\%}$.

The hazard level of 10 percent and 5 percent are adopted to calculate $DQ_{10\%}$ and $DQ_{5\%}$ when the water level of the reservoir is near spillway design flood level. Comparing with normal dispatching, the results are as Fig.5, Fig.6 and Fig.7.

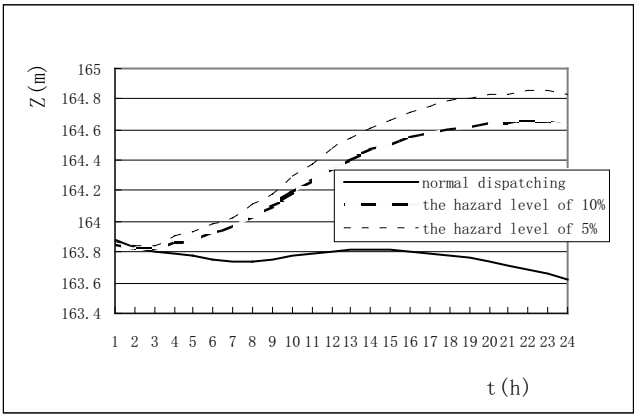

Fig. 5. Feng Shuba reservoir water level in 24 hours

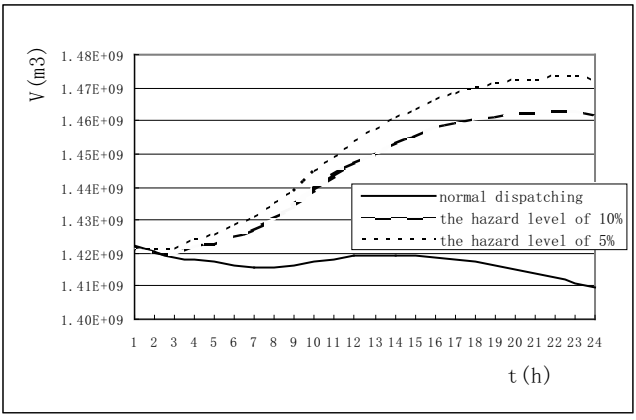

Fig. 6. Feng Shuba reservoir capacity in 24 hours

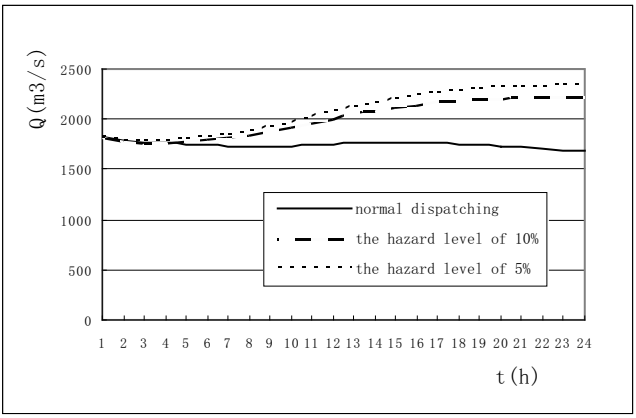

Fig. 7. Feng Shuba reservoir flux in 24 hours

Comparing with Fig.5 to Fig.7:

1. Because of considering risk regulation of flood control, the water level, the capacity and the flux of Feng Shuba reservoir are higher than normal dispatching.
2. Comparing with the hazard level of 5 percent and the hazard level of 10 percent, for the water level, the capacity and the flux of Feng Shuba reservoir, the former is higher than the latter, so the former is safer for Feng Shuba reservoir.
3. But because the reservoir flux is more, dispatching will more conservative and waste some water resources.

4 Conclusion

The inflow forecasting error risk functions of Feng Shuba reservoir are formulated for the application of the flood risk control. The flood forecasting model and the flood forecasting error risk function are reasonable and acceptable, it puts application for real time forecasting and dispatching.

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Investigation Technique of Slope Disaster Using Advanced Technology

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Abstract. Recently the frequency and impact of disasters due to the climate change have been increased and it is a usual trend in Korea. The steep slope failures, which are the representative natural disasters in Korea, generate 18 casualties every year. In order to response this disaster it is imperative to implement the scientific site investigation on potential slope areas and evaluate their vulnerability quantitatively. The efficient maintenance and management of steep slopes often require excessive professional resources and quantitative investigations. Therefore, it is important to develop a technology for the objective scientific site investigation and quantitative evaluation for steep slopes. In this study the 'Field Investigation System' for steep slopes is proposed in order to improve the effectiveness of site investigation rather than conventional methods using the evaluation table. Verification for the applicability of the system is also performed by applying to the steep slope area which was affected by debris flows. It is, therefore, expected that the efficiency of maintaining steep slope is improved while time and resources are decreased by this Field Investigation System.

Keywords: Slope Disaster, Steep Slope, Field Investigation System.

1 Introduction

Recently the frequency and impact of disasters due to the climate change have been increased and it is usual trend in Korea. The steep slope failures, which are the representative natural disasters in Korea, generate 18 casualties every year (NDMI, 2011). In order to response this disaster it is imperative to implement the scientific site investigation on potential slope areas and evaluate their vulnerability quantitatively.

Studies on the investigation methodology and the device development, which are combined with the IT technology in the fields of investigation and management of steep slopes were carried out by Koo et al. (2007), Lee (2005), Jang et al. (2010), Park and Park (2011), and Shim et al. (2006). Most of them, however, have focused on the investigation for artificial slopes and studies on same issues for natural slopes such as vulnerability assessment, identification of the extent and impact due to the landslides are not fully satisfactory. In this study, therefore, a system which reducing time and

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T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 387–394, 2012.

workload compared to the existing methodologies by delineating analyzing, acquiring, and storing data, and evaluating vulnerability and collapse of natural as well as artificial slopes is developed.

2 Development of Field Investigation System

2.1 Field Information Input System

The Field Investigation System consists 1) Field Information Input System which helps to add investigated data for steep slope failure areas; 2) Field Information Analysis System which examines acquired data. Fig. 1 shows the main window of the Input System. It shows Index Window, Map Display Window, Attribute Window, and Data Input and Analysis Window. The Data Input and Analysis Window have various analysis tabs such as data input, vulnerability evaluation, and stability assessment, etc. and enables to import basic information on steep slopes including the geometry of steep slopes, geological and hydrologic conditions, geologic and geotechnical information, and finally site pictures.

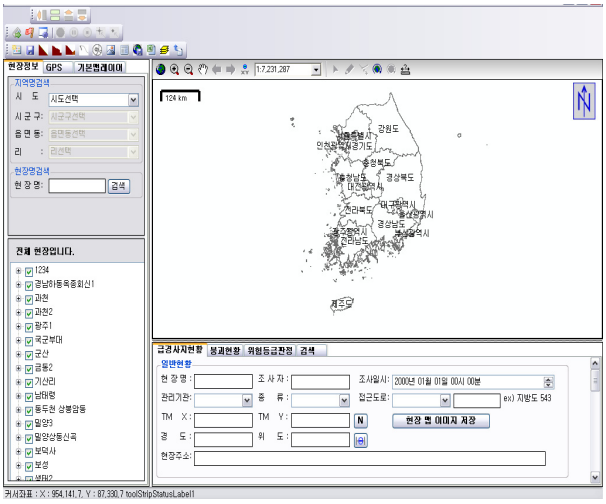


Fig. 1. Input screens of the Field Investigation System

Data for steep slope failure includes failure type and area, depth, length, and height. Generating area information of each polygon from GPS coordinates and digital maps is beneficial especially in case of unstable state of landslide areas where measuring them is quite difficult to calculate. Real time GPS coordinates also enable to determine landslide locations, distance between landslides, tracking of displaced materials, and extent of landslides. Various Digital maps such as geologic, topographical, and index maps can be used to overlap over disaster areas, which easily identify the cause of landslides based on information inherent to them (Fig. 2).

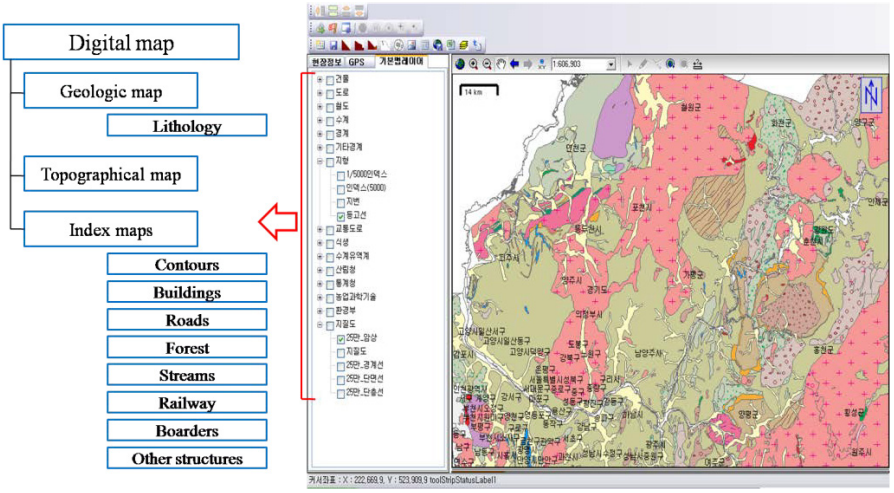


Fig. 2. Geologic information using digital map

2.2 Field Information Analysis System

In this system, users can search relevant information, determine the vulnerability level, implement stability analysis, and make the results, all of which are based on the observed data in the field (Fig. 3). It also displays field information such as GPS coordinates, distances, spatial attributes (Rock type, vegetation, soil depth) on the base map window, and makes effective steep slope maintenance, cause and impact analysis depending on the different views of field personnel.

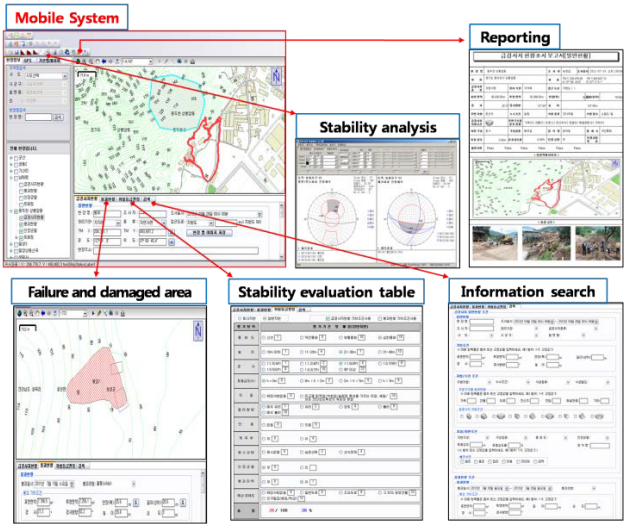
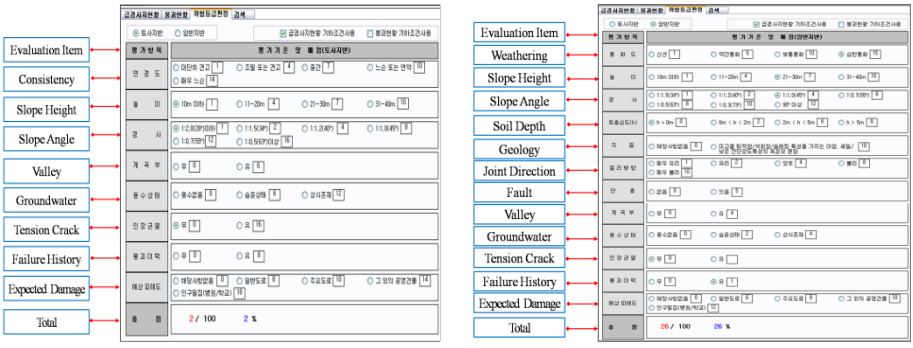


Fig. 3. Overview of the analysis system

The analyzed vulnerability level can be easily determined by the data obtained from site investigation using the Input System of the Field Investigation System. The checklist for vulnerability level proposed by NIDP (2009) is applied to evaluate steep slopes for this system depending on their origin (Soil or Rock slopes). For acquired data during the site investigation, comparing processes to select an appropriate division which related to the evolution of landslide disasters and corresponding values are implemented (Fig. 4).



(a) Soil slope (b) Rock slope

Fig. 4. Stability evaluation table

It also shows the results obtained from analyzing the vulnerability level and input data, which are augmented by the Input System. This enables to manage relevant data in forms of electronic format, which were previously stored as a paper format, and increases the effectiveness and applicability such as searching, reading, printing, and reproducing.

3 Site Study Using Field Investigation System

Circumstances around steep slope, its cause of failure, failure region, and risk level were evaluated using the developed Field Investigation System based on the case history of steep slope failure. The investigated steep slope is a natural slope which was failed on July 28th, 2011 due to the torrential rain (398.0mm/day, 44.0mm/hr). The initial slope failure induced by debris flow and the spreading displaced materials resulted in 4 casualties and destruction of hermitage and houses (Fig. 5).

Site investigation using Field Investigation System is conducted as follows:

1) The Field Investigation System is installed to the hazard area and base map and GPS of the system are activated,

2) Location information of hazard area is available by obtaining real-time location coordinates from the connected GPS.

(a) Location of the study area (b) Steep slope failure

Fig. 5. Overview of the study area

3) From the obtained GPS location information, slope polygon is generated in the map interface of Field Investigation System.

4) For the natural slopes, circumstances and failure situation of steep slope, hazard area estimation can be estimated from the aforementioned GPS tracking information by generating analysis polygon. In other words, site investigator reconstitutes the distribution zone of steep slope in different ways from tracking by performing DEM and by completing surface model using triangular meshes. As a result, slope inclinations with directions and area can be estimated. Typically, the GPS location information is possible if the site investigation is conducted by walking, however, the site of this study was dangerous to assess due to the possibility of additional failure and the spread of displaced materials. Therefore, the generation of slope polygon is done using GPS coordinate information and automatically-generated multiple points.

Following the process, location of steep slope (GPS coordinates), length (143.3m), height (54.8m), inclination angle (35°), inclined direction (135°) were automatically calculated and only the drainage condition and site pictures were manually imported.

The height and inclination angle of steep slope were calculated from the averages of the information of upper and lower locations of the generated steep slope while the length were obtained from two locations randomly selected or from the direct measurement of distance in the site.

5) Geographic and geological information of steep slope and the hazard area are inputted from the basic maps (layers of topographic map, geological map, structures, and roads, etc.) in the Field Investigation System. From the topographic map of the Field Investigation System, failure initiation location can be clearly identified. By inputting the site information of the failure location to the interface of the Field Investigation System, it was concluded that the failure region had alluvial layer. Considering that the failure region mainly consisted of alluvial zone which was formed from

sedimentation during water flows, it is determined that the Field Investigation System successfully predicted the geological characteristics.

6) Using the GPS location information obtained by walking or remote-sensing techniques, hazard area (spread area of debris flow) was calculated (Fig. 6). Hazard area is obtained from the generation of polygon in digital map and calculation of area information of the polygon. The result of hazard area was calculated as follows: From the failure information of steep slope, the maximum spread distance was 351 m, maximum width was 219 m, total failure area was 22,770 ㎡. These results well match with the results of ArcGIS from real field measurements. In addition, the distribution of destroyed structures are possible on the layers with the houses and the layers representing roads, therefore, automatically calculation of structure failures (Damaged houses and buildings) was possible.

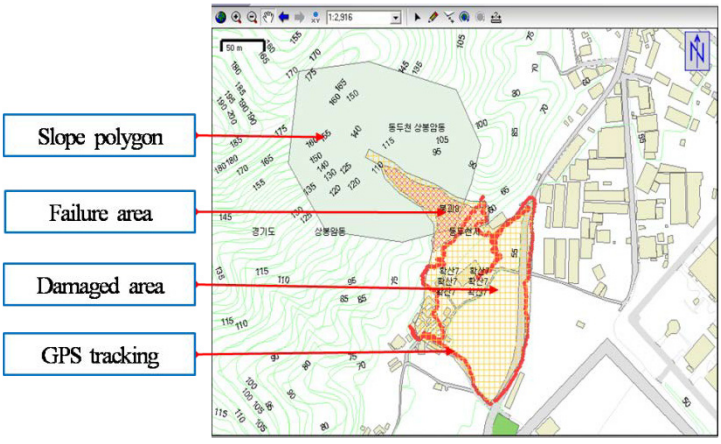


Fig. 6. Measurement of damaged area by using Field Investigation System

7) Final step is the generation of the report for site investigation using the Field Investigation System (Fig. 7). The site investigation report automatically consolidates all the pre-mentioned information (situation of failed steep slope, destroyed area, risk level evaluation and so on) and generates a report on 'General Information' and 'Vulnerability Evaluation.'

Therefore, a standardized technical report can be electrically made. From the conventional evaluation method of damaged site, due to its limitation of assess ability of the failed sites, only limited information can be obtained. However, the site investigation using the Field Investigation System enables to providing reasonable user-defined measures of the failure region by consolidating basic inputs of location-wise information as well as the comprehensive site eye-observations. Therefore, it could be a reliable and effective method of examination of failure information. Furthermore, the Field Investigation System is fast in estimation of losses due to slope failure and could be used as a disaster mitigation tool, which selects a optimized countermeasure.

(a) General information (b) Vulnerability evaluation

Fig. 7. Report on Analysis results

4 Conclusions

Despite of increasing steep slope failures due to climate changes, effective management of slope failures is not possible because of the short of specialists in slope investigation and analysis, and lack of effective maintenance based on quantitive measures. Therefore, the development of scientific and technical evaluation system for potentially dangerous slope is required. In this study, for the replacement of the conventional site investigation, which is based on manual recording of information by hand writing near the failure spot, effective Field Investigation System for steep slope is developed.

In this study we proposed two subsystem: 1) Field Information Input System, which enables to write steep slope information automatically; 2) Field Information Analysis System, which evaluates the stability analysis of steep slopes and provides a vulnerability level. All of these are integrated into the Investigation System for steep slopes. The developed Field Investigation System is more effective than the existing methods in terms of time due to the efficient process of consolidating diverse information and to the possible evaluation of quantitive measures of risks. In addition, the Field Investigation System can be also utilized in fields of management, analysis, hazard mitigation of Steep slope.

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A Schematic Approach for GIS Application for Tsunami Disaster Management

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Abstract. Natural disasters like Tsunami are inevitable and it is almost impossible to fully recoup damages caused by the disasters. However, it is possible to minimize the potential risk by developing early warning strategies. GIS modeling with its geoprocessing and analysis capability can play a crucial role in efficient mitigation and management of disaster. This research aims at developing a spatial information system supporting tsunami evacuation action planning using geo-information technology. The main effort in minimizing casualties in tsunami disaster is to evacuate people from the hazard area before tsunami strikes by means of either horizontal or vertical evacuation.

Keywords: Tsunami, GIS modeling, Emergency action plans.

1 Introduction: What Is Tsunami?

Tsunami mean "harbor wave" in Japanese term. Underwater earthquakes, landslides, or other major deformations that cause large vertical displacements of water generate tsunamis.[1] Tsunamis are most common in the Pacific Ocean, with small, nearly undetectable tsunamis occurring regularly. Although wave height is relatively small in open seas, when the tsunami hits the coastline, it may rise to several meters and can cause loss of lives and property damage when it comes to shores. Major tsunami events are extremely rare, though the Indian Ocean tsunami of December 2004 showed that major tsunami events can have devastating effects over very large areas.[2]

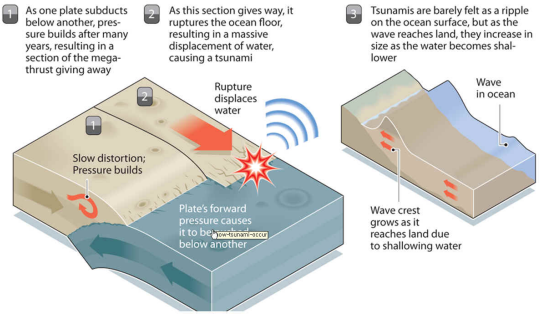

Fig. 1. How tsunami occur (Source -http://fritzboyle.com/how-tsunamis-occur-infographic/)

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On December 26, 2004, with an epicenter off the west coast of Sumatra, Indonesia, The Sumatra-Andaman earthquake resulted in Tsunami, a huge wall of water waves. With a magnitude of between 9.1 and 9.3, it is the third largest earthquake ever recorded on a seismograph was caused by seduction and triggered a series of devastating tsunamis along the coasts of most landmasses bordering the Indian Ocean, killing over 230,000 people in fourteen countries, and inundating coastal communities with waves up to 30 meters (100 feet) high. It was one of the deadliest natural disasters in recorded history. Indonesia was the hardest hit, followed by Sri Lanka, India, and Thailand.[3]

Fig. 2. 2004 Indian Ocean tsunami wave traveling (Source -http://www.rediff.com/news/2004/dec/26kbk.htm/)

Humans cannot stop tsunamis, as it is a natural occurrence. However, humans can predict and minimize the tsunami damages.

1.1 Tsunami Disaster Management and GIS Response

The Tsunami disaster management can be classified into two parts: pre-disaster management and post- disaster management.

GIS technology can be effectively used to both pre-disaster and post-disaster planning. Planning for pre-disaster management involves predicting the area and time of a possible disaster and the impacts on human life, property, and environment. Pre-disaster management concerns with the measures to prevent negative impacts from hazard events and to be better prepared for those that are not prevented whereas post-disaster relief and recovery measures. Pre-disaster management is risk management that has three components: risk identification, risk reduction, and risk transfer and preparedness, the post-disaster phase is devoted to emergency response, rehabilitation and reconstruction.[4]

GIS allows quickly accessing and visually displaying critical information by location that helps in developing action plans.[5] Emergency disaster management requires response, incident mapping, establishing priorities, developing action plans, and implementing the plan to protect lives, property, and the environment. Effective disaster management requires assimilation and dissemination of preplanned, historical and real-time information to many sources.

1.2 Goals and Objectives

This paper will discuss the areas which we can apply GIS applications to minimize the damages occurred by Tsunami, and to make "Run-Up[1]" plans with use of GIS model builder modeling system at schematic stage. By this system, people can integrate Tsunami analysis tools into a GIS workplace. Further, this provides concepts to identify the implementation of technology and the data implementing ideas for calculations that needed in an emergency situation.

1.3 Extent and Methodology

To fulfill above objectives this project mainly focused on how to make "Run-Up" plans, widely means as an evacuation plans. This mainly focuses with the flow or the model building function in GIS. It will discuss about the phases and flows for building up the "Run-up" plans, for further study of how to build a "Run-Up" model in ArcMap and create a geoprocessing[2] model that can be used to automate, run, and re-run a GIS process. This is especially useful for complex data processing flows that need to be executed rapidly during an emergency situation.

2 GIS Model Building: Phases and Flows for "Run-Up" Plans

The project is divided into four main phases, which is interrelated to one phase to another. Since GIS model builder contains mainly three flows, namely input, process and output, following four phases will be described according to those three flows.

Mapping and Analysis Task List:

- Phase one : Build up evacuation zone map
- Phase two : Build up emergency evacuation routes map
- Phase three : Build up emergency resources location map
- Phase four : Build up at-risk population map

2.1 Phase One – Build Up Evacuation Zone Map

Purpose of the first phase is mainly defining the warning areas in post disaster time. It shows the areas which can be damaged due to Tsunami.

(1) Input: As the first phase of the modeling, size of Tsunami should be input to the system. This is done after the earthquake happened. The size of tsunami depends with

[1] Run-Up plans: The maps and methods that used for evacuation in case of emergency.

[2] Geoprocessing is a GIS term used to describe any of the various processes in which specialized software tools are used to compare, analyze, or manipulate map layers and their underlying geographic data to create new sets of data. Geoprocessing yields relationships about geographic information that would otherwise be difficult to visualize or interpret in a geographic context. (http://wiki.gis.com/wiki/index.php/Geoprocessing)

the several factors as follows; The magnitude of the earthquake / Energy released by earthquake / Distance between earthquake happen place and causing area / Other factors (Depth of the sea earthquake happen, current weather conditions, etc.)

(2) Process: Classify the evacuation zone areas according to the height from the sea level; (00-10m) Elevation height / (10-20m) Elevation height / (20-30m) Elevation height. This leads to make results of phase one according to the size of tsunami waves and its height given by input of phase one.

(3) Output: The zoning of risk zone map is the output of phase one. These zones will be used to prioritize evacuation efforts and allocate guard and rescue personnel and emergency resources and supplies.

2.2 Phase Two – Build Up Emergency Evacuation Routes Map

Transportation facilities can itself suffer from both artificial and natural disaster. Transportation system can play crucial role in disaster response if it monitored well and assessed properly. An effective transportation system provides much help to take the affected peoples to safer places and rescue and relief material to the disaster hit areas within very short time. Therefore, as the second phase model build emergency evacuation route map mainly for; Evacuate the population in the area of the event / Provide emergency access to the site of the incident / Allow the public to bypass the affected area / Respond to the impacts of restrictions to access in the affected area.

(1) Input: The output of phase one will be the main input for phase two. Further it will basically overlap with base map of the area and detailed routes maps.

(2) Process: With the results that found in phase one and the road maps, the process should be gone through the processing of; Finding the Safest routes, to reach safer locations / Achieving minimum traffic congestions / Showing more than one optional route and several usages of routes for different areas while it should consume minimum time, allocating maximum speed.

(3) Output: Shows the emergency routes map to reach safer zones. This map is massively helpful for the peoples who are in the dangerous areas, and also people who are going to aid for the risk areas.

2.3 Phase Three –Build Up Emergency Resources Location Map

With optimal utilization for relief and evacuation purposes, a reliable map portraying the location of the emergency resources like water, service units, food warehouses, transport and communication networks and other utilities is very crucial in disaster management with acquisition of real-time (RT) information about the status of the recourses. Purpose of this third phase is aware people about necessity places, and resources.

(1) Input: The result of phase two will be the main input for phase three. Further it will overlap with base map of the area, resource location maps.

(2) Process: This will process important location such as schools, hospital, fire stations, emergency shelters, etc. and rescue resources with the emergency route maps.

(3) Output: Resource location map is the output of this phase, a map which can highly be used in an emergency situation.

2.4 Phase Four – Build Up At-Risk Population Map

The main purpose of this is to determine the at-risk population in an emergency situation. Identifying most risky areas and high population dense areas this can be used mostly by those as aid organization to reach those sites by vertical transportations[3].

(1) Input: With the output of phase three, population maps is overlapping as the input of phase four.

(2) Process: Estimate the at-risk population within each zone as well as the base map calculated and process the at - risk population map.

(3) Output: As the output of the final phase can determine the at risk population, emergency evacuation helping can be patched according to the results shown at-risk population map.

3 Conclusion: Further Discussion

By overlapping four phases, the final detailed evacuation map can be made. The main outcomes of the study elaborate several uses of GIS that can help to evacuate from risk, in determining the inundated buildings and roads and calculating the optimum routes to the closest facilities in case of emergency, based on the source data gathered.

It is also vital that human should have learnt from the experience of previous disasters, by capturing and archiving the GIS methods that worked, by documenting lessons learned, and by iterating designs and plans.

This study will help to improve preparation of the evacuation plan which can be organized by the government in case of a tsunami disaster. Inundation map generated for the study by the result of a tsunami simulation is a guide for areas to be protected and evacuation map and network analysis conducted for the case of emergency is a guide map for the hot points which should be evaluated for the rescue operation at the first place.

By using GIS in this sense, the risk maps and evacuation plans can be arranged for disaster management and those outputs can be used in the emergency action plans, for making emergency decisions and future decisions for new planning implementations.

[3] Transport devices which primary use is to transport in a vertical direction.

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Application of Disaster Information System for Disaster Management

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Abstract. The policy for the recent maintenance of natural disaster is operating the disaster system from preliminary expectation, forecasting and respond, and for this it is necessary to raise the efficient work related to disaster through the scientific analysis and quick investigation of past disaster history. This research used spatial information of disaster attribute, digital image, digital topographic map, cadastral map and geological map for the efficient maintenance of disaster through scientific analysis and quick investigation to construct the disaster information system and evaluated the application of disaster management system. Disaster information system used the spatial information and disaster attribute information to make an efficient performance of functions necessary for disaster management such as disaster zone management, geological analysis and automatized calculation of damage area, and made the efficient disaster management through the extraction of cadastral information and damage area more than certain scale by damage area. In the future, this system can be used for the objective and quick recovery plan of disaster damage investigation and disaster related decision making.

Keywords: Disaster Information System, Disaster Management, Open Source, Disaster System, Damage Investigation.

1 Introduction

Recently the planet warming and abnormal climate cause regularly the yearly damage by natural disaster such as typhoon or localized torrential downpour, and its damage scale is being gradually bigger. It is impossible to make an exact expectation, and it is necessary to make a systematic management of existing disaster for responding to the repeated natural disaster, and to construct the systematic and scientific information system. Korea, based on the National Geographic Information System project over1, 2, 3 times and its related GIS technology developed, is making an active progress of researches related to system development for the efficient management of urban service and the quick and precise damage investigation and its response when natural disaster. The recent wireless communication and IT technology were used to study on

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the real time disaster damage information management system development based on web GIS that can provide the user quick and efficiently with various damage information and data[1]. Satellite image, airline image and earth image were used to develop the automatized technique of various scale of damage investigation, and to perform the practical study of damage investigation system[2]. u-GIS function was developed that treats in spatial information all kinds of data obtained in GeoFOSS based USN sensor. GeoFOSS was used to waste almost no payment for buying software for possible construction of economic system, and a system was developed that is easy for future maintenance or system spreading, and that guaranteed the maneuverability with other system[3]. Open source GIS was used to study that presented how to construct the high resolution image of Tile Map Service system[4]. A study was performed on GIS data used disaster preventive analysis, and virtual reality technology used multi-objective model based disaster preventive simulation system[5]. For the Yoshino river in Japan, a study was performed on the simple development of inundation analysis system that is composed by interface not only for earth but also for satellite inundation data, GIS function for construction of inundation model, initial inundation analysis model, and visualization of result[6]. Based on GIS and intellectual development platform, intellectual simulation system was presented of earthquake disaster evaluation system[7]. However, most of researches had no variety of applying the geological information data that is important for system construction.

Accordingly, this research tries to construct the disaster information system based on open source that used the disaster related attribute information for the scientific analysis and quick investigation and spatial information of result image, result topographical map, cadastral map and geological map. For the disaster related attribute information, we try to use inundation simulated result and the data of existing inundation and of landslide. Also, for the use of disaster information system constructed by disaster information we try to test some function necessary for disaster management such as generating Vector data and Shape file, calculating distance and area using measuring tool, generating DEM with geological contour data, using the existing disaster information to select the dangerous zone, using the damage zone extracted to analyze the disaster zone, adding photographs of damaged zone.

2 Constructing Disaster Information System

For constructing disaster information system, we used VB.net as a development language and an open source GIS program of Mapwindow GIS. Mapwindow GIS is mostly used of various open source GIS system, and having high efficiency and stability it has discovered bug in constructing system, and detected the high possession of system memory. This research increased the module's stability by correcting the bug and same library link problem, corrected the sentence error and source code for the stable execution in the system, and deleted unnecessary modules for the less possession of system memory.

2.1 System Design

Disaster Information System uses inundation simulated result, result image, geological map, result topographic map and cadastral map as basic data, and made possible insertion and edition of text data. Fig. 1 shows the structure of disaster information system.

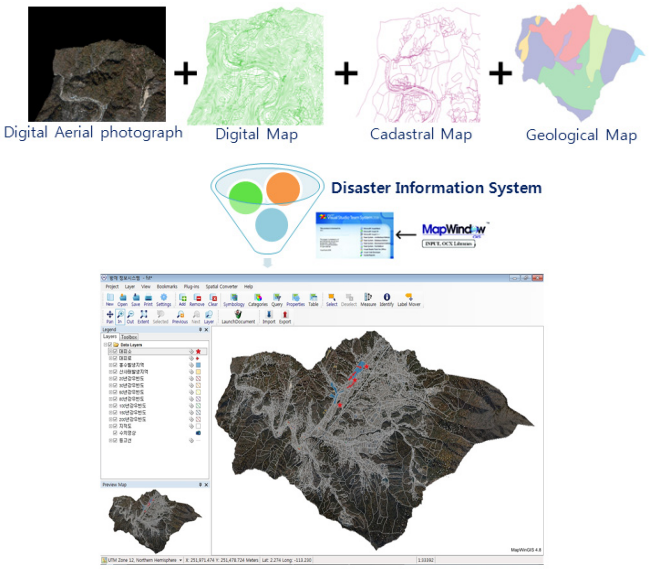

Fig. 1. Structure of disaster information system

2.2 System Construction

Data used in this system are of Vector, Raster, Text type, and the inserted data are used for various data processing. Disaster information system for analyzing disaster and disaster damage investigation used Raster image file and Vector file to make a possible data input and output. Also, we made possible to convert Text and Shape data, and Shape data and Grid data.

In addition, we realized the function of generating point, line and side shape and of generating the additional image file, and made possible calculation of line and polygon area and distance selected by user. Fig. 2 shows the system architecture of disaster information system.

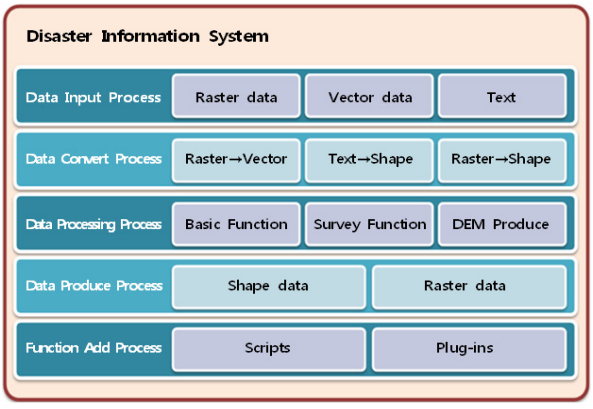

Fig. 2. System architecture of disaster information system

3 Application of Disaster Information System

For the evaluation of disaster information system used, we selected the research subject and operated the system. Geollabukdo, Jangsu gun, Kyebukmyeon Ilwon as research subject is located at a longitude of 127°35‘~ 127°42’, at the north latitude of 35°45‘~ 35°49’, and with its area of 91.12㎢. It is in the boundary line between Geongsangnamdo Geochanggun for east, Jinangun and Jangsugun Cheoncheonmyeon for west, Jangsugun Janggyemyeon for south, and Mujugun for north, which is traditional mountain.

3.1 Data Generation

This system can generate and edit additional Vector data except the constructed data. Also, Shape file Edit is used to edit Shape file, and to add and delete new layer. Table 1 resumed the edit function of Shape file.

Table 1. Edit function of shape file

Icon	Description
	Generating new Shape file
	Adding new Shape file
	Deleting it from the actual Shape file
	Moving vertex from the actual Shape file
	Adding vertex from Shape
	Deleting vertex from Shape

3.2 Distance and Area Calculation

We made for distance and area calculation function to calculate the line length and polygon area. It is possible calculate the distance or area of desired zone, and use the measure tool to calculate the specific area of polygon. Measure tool, which is added by Plug-ins, calculates the specific line or layer length and area from the constructed data. Also, area and length are measured to be saved as additional information. Converting the specific information of layer length and area to text file would be used in the other program.

3.3 Calculation of Dangerous Zone

The existing disaster information such as a landslide and inundation to calculate the dangerous zone from disaster zone. Exhibiting the selected dangerous zone on the image would be easily read of disaster zone, and extract cadastral information of dangerous zone. Fig. 3 shows the cadastral information of disaster zone.

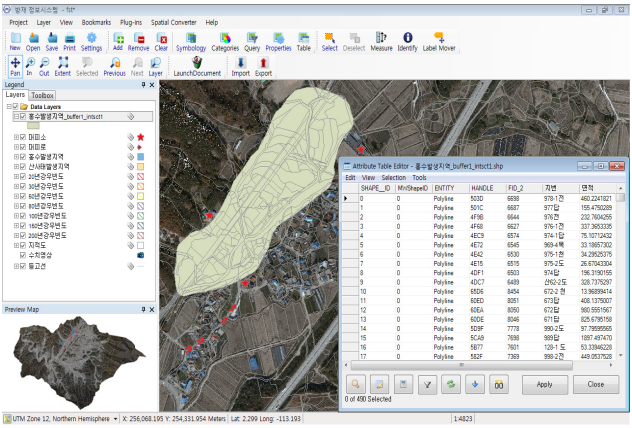

Fig. 3. Cadastral information of disaster zone

3.4 Disaster Analysis

This system can add and analyze the disaster information. Fig. 4 shows added the virtual inundation zone to the system.

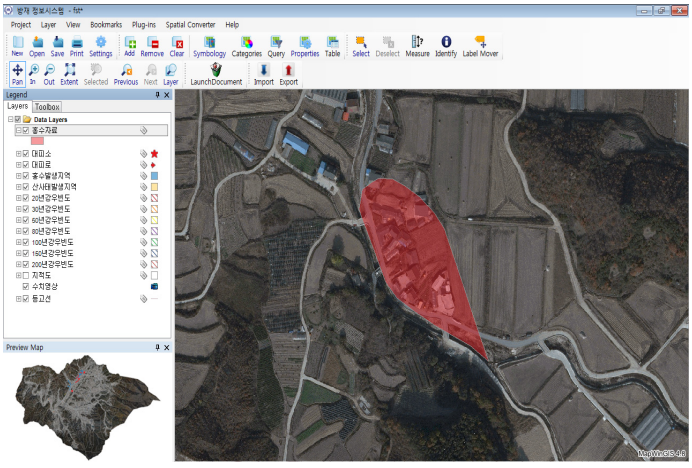

Fig. 4. Virtual inundation zone

The cadastral information of inundation zone added is extracted, damage area of zone is calculated, and classification of damage area and extraction of damage zone is made. Fig. 5 shows the extraction result of damage zone.

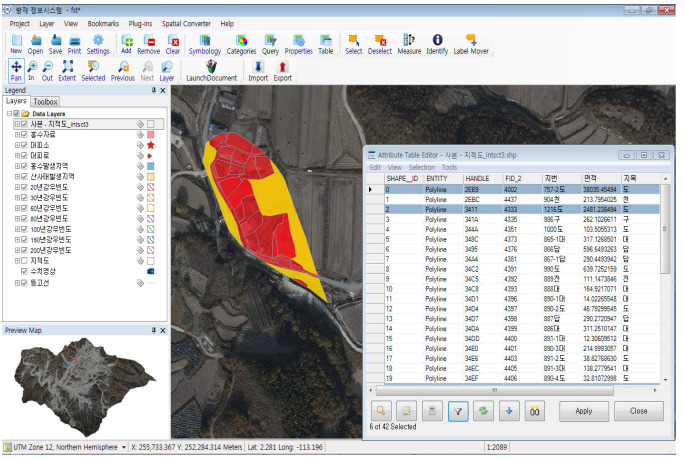

Fig. 5. Extraction result of damage zone

The extracted disaster data is saved as type of Vector, Raster and of Text, and this data is used to analyze the disaster zone. Fig. 6 shows text type data saved CSV format and damage area analysis result in graphic.

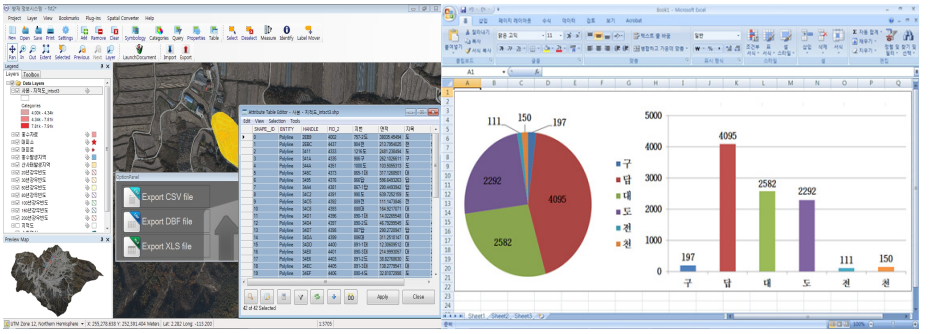

Fig. 6. Text type data saved CSV format and damage area analysis result

3.5 Adding Disaster Zone Photo for Disaster Management

This system can add the disaster zone photos for disaster management, and the added photo is shown in the system. Fig. 7 shows added the damage zone photo.

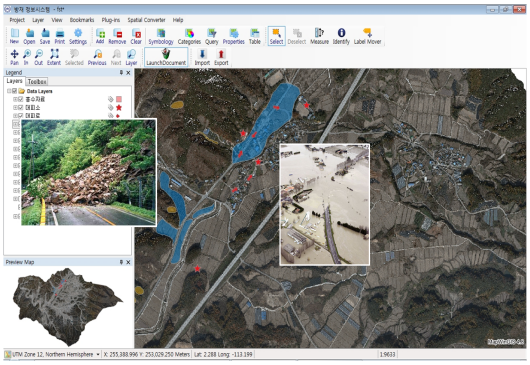

Fig. 7. System added the damage zone photo

4 Conclusion

This research constructed disaster information system that used the disaster attribute information for the scientific analysis of disaster and efficient investigation of disaster, and spatial information of result image, result topographic map and geological map, and evaluated its application, obtaining the following conclusion.

First, this system made possible addition and management of topographoc information of new zone in the program for disaster management, and Script execution and module addition, and realized the processing and generation for spatial information by system in itself.

Second, spatial information and disaster attribute information are used to make a efficient performance of functions necessary for disaster management such as disaster zone management, topographic analysis, automatized calculation of damage area, extraction of damage zone, and made possible efficient disaster analysis of extracting cadastral information of disaster damage, classification of damage area and extracting damage.

Third, maintenance and convenient spreading development were considered to construct system based on open source GIS with simple interface and to guarantee the systematic management and operation of disaster information, and add various types of data of damage zone photo, script and module.

The disaster information system developed in this research can be used not only for quick calculation of disaster damage scale but also for the basic data of disaster investigation and recovery plan, and the objective investigation of disaster damage is maintained to make an efficient business of disaster, and contribute highly to quick recovery plan and disaster related decision making.

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Analysis of Judicial Precedent Tendency in the Tourism Business Field

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Abstract. Recently complaints of tourists and consumers on tourism increase rapidly. According to this, many conflicts are occurring and so law interpretation relating to tourism is increasing. However, there is no tourism law and civil code on contracts relating to tourism, only handling law relations among contracting parties by domestic travel standardized agreement and domestic and overseas travel standardized agreement and so tourism consumers cannot be protected. The research analyzed 36 cases of precedents from 1992 to now, for recent 20 years, based on 8 theme words relating to tourism. In the result, the analysis results of 36 cases could be divided into three in large: 22 cases of concept of tourism business and classification of business types, 8 cases of problems of related law interpretation, 3 cases related to taxation, 3 cases related to others, etc. Problems of tourism filed appearing through tourism precedent analysis showed two in large and the first is that tourism business defined by the Framework Act on Tourism is not clear. The second is that judgement standard of additional facilities is vague. Based on results, regarding defining types of tourism business at Tourism Promotion Act and registration, permission, or designation, etc by this, it should be defined more clearly, not entangled and have good people not charged taxes accidentally or punished.

Keywords: Judical Precedent Tendency, Tourism Business.

1 Introduction

Framework Act on Tourism can be said to have the status of a method of guidance providing grounds on the enforcement policy of related tourism laws and setting up basic direction of our nation's tourism policy(Shin & Jang , 2007), and the background of enacting Framework Act on Tourism is that after 1960s speed of domestic and overseas tourism development became fast and tourism stood out as a significant method of obtaining foreign money and national development, and in the neighboring country, Japan enacted Framework Act on Tourism to enforce more effective tourism policy and so also Korea enacted and proclaim in 1975 to promote tourism administration and suggest direction of tourism policy. That is, Framework Act of Tourism is the uppermost law like constitution on the tourism and can be said what stipulates

T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 409–415, 2012.

the fundamental direction of tourism policy(Lee, 1995). However, in spite of passing through several revisions, it contains the tourism environment as it was enacted in 1970s, nothing but a law composition in a declaratory form as the upper law of tourism related law system.

Due to the incompleteness of the laws, in the situation that conflicts between contracting bodies of tourism surging every year cannot be solved properly by the tourism law, tourism administrative authority doesn't only enact individual and concrete laws regarding conflicts occurring tourism field such as tourists, tourism corporations, etc but also defines government policy's basic direction on tourism and laws such as civil code, commercial law, etc as the form of fundamental law.

Mutual relations in reality are set up by mostly explicit or tacit contract relations, which should be fulfilling faithfully following mutual trust. However, in the reality, even though diverse, complicated conflicts are increasing due to the increase of tourists, expansion of tourism areas, and complicated tourism business structure, with the incompleteness of legal regulation, tourism field cannot solve the conflicts between related parties surging every year properly.

Hence, the study analyze conflicts occurring between related parties of tourism activities with the precedents having effect of sentence, that advanced precedents influence following precedents, even though not recognized as the fundamental legal source in our nation which belongs to the continental legal system and looks into problems of tourism through analysis. Also, by looking into precedent tendency through analysis of precedents in the tourism field, fundamental principle of tourism is reflected and lying to enact and revise tourism related laws.

The study limits the main theme words to 8, relating to tourism to analyze main precedents relating to tourism business in order to achieve the purpose of the study. the eight theme words are "travel business", "tourism accommodation business", "hotel business", "(leisure) condominium business", "tourist use facility business", "international conference business", "casino business", "amusement park facility business", and "tourism convenience facility business". By searching Supreme Court's general legal information(http://glaw.scourt.go.kr/jbsonw/jbson.do) with these theme words, total 36 cases of precedent were analyzed.

2 Theoretical Background

2.1 Tourism Business

According to the regulation of article 2, clause 1 of Tourism Promotion Act, tourism business is defined to refer to the business of providing transportation · accommodation · food · exercise · amusement · leisure or services to tourists of by equipped with additional facilities relating to other tourism, having them use. The types of this are travel business, tourism accommodation business, tourists use facility business, international conference business, casino business, amusement facility business, tourism convenience facility business, etc(Kim, 2001). Similar terms of tourism business are tourism industry, tourism corporation, etc and tourism industry started to be used as comprehensive term at the classification method for 17C Clark's

industry classification or understanding of industry structure, and tourism corporation can be said term in the view of business management weighing economical effect(Lee, 2006). That is, when using as tourism corporation, it refers to private tourism business for the purpose of profits and tourism industry is used to express the whole business relating to tourism(Lee et. al., 1998). Therefore, the study considers eight fields by the Tourism Promotion Act as the tourism industry to avoid confusion of terms.

2.2 Tourism Related Laws

Seeing the tourism laws in large, it can be seen a sort of special law made for the realization of diverse political purposes. Tourism related laws handle overall matters about tourism business, matters relating to preservation and development relating to tourism resources which are objects of tourism, and matters relating to nation's governmental power exercise to ensure main agents of tourism, tourists' tourism activities. In the aspect of tourism business, tourism laws take charge of regulations to ensure profits through normal investments and reasonable business of tourism corporations and prevent indiscriminate overlapping investment, excess advertisement, false advertising, lowering service quality, etc. Also, they take charge of role to promote long-term development of tourism business by keeping tourism order, ensuring mutual safety of tourists, and protecting tourists' rights from providers. Tourism laws have their own characteristics of tourism law and personality as administrative law. Characteristics of tourism laws as the administrative law appear in the point of having discretion at first, superiority of administrative agent, technique, command, and guidance. Also, tourism law's own personality can be found at the point of having characteristics of assignment law, order law, profit assurance law, public disclosure principle, and trust assurance law.

3 Selecting Analysis Target and Analysis Method

3.1 Selecting Analysis Precedent and Analysis Process

To select precedents of analysis target, 9 tourism businesses suggested at the Tourism Promotion Act were selected as the analysis target and standard year of the precedent are the precedent of last 20 years from 1992 to today. In the result of precedent analysis, total 36 precedents were selected and used for analysis. The selected precedents were excluded from lower instance, local courts' precedents to exercise effect of excluding further litigation having legal influence afterwards.

3.2 Analysis Method

Analysis method used content analysis and the content analysis is an observation research method of describing content appeared through media about action or list methodologically. Analysis targets are mostly words, themes, concerns, etc, not only observation, including analysis(Lee, 2005). For the content analysis, content elements such as words, proposition, people, items, papers, number of time, etc should be

Table 1. Classification of precedents relating to tourism business by type

Number of cases	Number of cases	rate (%)/	note
concept of tourism business and classification of business type	22	61	
problem of interpretation of related laws	8	23	
related taxation	3	8	
others	3	8	

quantified. The thesis selected key words for the tendency analysis of precedents in the tourism business field as unit of content analysis.

4 Tendency through Precedent Analysis and Problem of Tourism Field

4.1 Tendency Analysis of Precedent

Precedent relating to tourism can be divided three in large: 'concept and type of tourism business', 'problem of interpretation of related laws', 'taxation', etc.

4.1.1 Concept of Tourism Business and Classification of Business Type

At first, relating to concept of tourism business and classification of business type such as 'tourism accommodation business', etc, they are the precedents relating to whether a certain business is relevant. When total precedents of tourism related field are 50 cases, 52% of them, 26 cases are related to whether they are type of tourism business or additional facilities relating to acquisition tax charge. Those are Supreme Court 2000.Nov. 28. sentence 99du5368 verdict whether slot-machine is speculation business on the Income Tax Law and Supreme Court 1998. Sep. 4 sentence 97do2621 verdict, when a management corporation of leisure condominium business has an annex to a hotel used, whether to unlawful method use behavior on law article 10, clause 1.

4.1.2 Problem of Interpretation of Related Laws

Precedents on interpretation of related law's provisions account for 20%, total 10 cases. 10 cases are the interpretation on contents of related law provisions such as whether to confirm to 'the person buying' of article 12, clause1, provision 1 of former Tourism Promotion Act except whether to type of tourism business or additional facility, etc and can be said conflict by obscurity of legal concept.

4.1.3 Related Taxation

There are 8 cases relating to taxation such as Supreme Court 2003. Jul. 22. sentence 2001du10585 verdict, the case that regarding a corporate body established with the

purpose of tourism facility business, etc doesn't use woods and fields acquired with the purpose of new building and parceling out condominium directly for its own work within a year from the acquisition date, it cannot be recognized as legal reason.

4.2 Problems at Tourism Field

4.2.1 Obscurity of Types of Tourism Business

One among the problems appearing through precedent analysis is the obscurity of types of tourism business and types of additional business(additional facility) of tourism business on the Tourism Promotion Act.

There are many types of laws relating to tourism fields and even「Tourism Promotion Act」itself cannot easily classify as the type of tourism business are divided diversly. Supreme Court says that as current laws relating to tourism define the types of business and define penality in the case of violation, according to what related laws defines on each business, by equipping with the permission terms, the additional business permission should be obtained from each relevant administrative agency: Supreme Court 1995. Jun. 29. sentence 92nu14483 verdict, Supreme Court 1992. Dec. 8. sentence 92nu13813 verdict, etc.

At first, it is obscure how the type of tourism business is. For example,「Tourism Promotion Act」is the tourism accommodation business among types of tourism business, classifying two of 'hotel business' and 'leisure condominium business' but which isn't distinguished clearly on interpreting lines of legal provisions(Choi, et. al., 2012). According to the same law, "the business by equipped with proper facilities for the accommodation of tourists providing this to tourists or by equipped with proper facilities suitable to food·exercise·amusement·leisure·performance or training in addition to the accommodation together having them used" is 'hotel business'(article 3, clause 1, provision 2 gamok) and "the business by equipped with facilities suitable to tourists' accommodation and cooking providing this to tourists or by equipped with facilities suitable to food·exercise·amusement·leisure·performance or training in addition to the accommodation together having them used" is 'leisure condominium business'(the same clause, namok). These two businesses aren't distinguished easily even though there are some difference in words such as 'cooking', 'member', 'sharer', etc.

4.2.2 Absence of Judgment Standard of Additional Facility

Also, additional facility of tourism business defined by the Tourism Promotion Act is unclear. By this the Supreme Court judges "by the objective relation" regardless of whether to business plan approval(or registration) on whether additional facility or additional business such as hotel or leisure condominium, etc are included to hotel business(Supreme Court 1986. Aug. 19. sentence 85nu702 verdict).

For example, only fact that a gambling corporation place is being used as additional facility of current tourism hotel cannot be considered the ground that the use of "amusement place" defined at the building permit on the tourism hotel building indicates the gambling corporate place(Supreme Court 1992. Sep. 22. sentence 92nu7689 verdict).

Therefore, by defining types of tourism business on the Tourism Promotion Act and registration · permission or designation, etc by this more clearly, not occurring confusion, good people should not be charged taxes or penality accidentally.

5 Conclusion

Recently complaints of tourists and consumers of tourism are increasing rapidly. By this many conflicts are occurring and so the legal interpretation related to the tourism are increasing. However, there is no tourism law and civil code on contracts relating to tourism, only handling law relations among contracting parties by domestic travel standardized agreement and domestic and overseas travel standardized agreement and so tourism consumers cannot be protected. The research analyzed 36 cases of precedents from 1992 to now, for recent 20 years, based on 8 theme words relating to tourism. In the result, the analysis results of 36 cases could be divided into three in large: 22 cases of concept of tourism business and classification of business types, 8 cases of problems of related law interpretation, 3 cases related to taxation, 3 cases related to others, etc.

Problems of tourism filed appearing through tourism precedent analysis showed two in large and the first is that tourism business defined by the Framework Act on Tourism is not clear. On this, Supreme Court sees the main difference of two businesses whether to "collect members with the method of parcel-out and operate mainly for them". The second is that the judgment standard of additional facility is vague. By this the Supreme Court judges "by the objective relation" regardless of whether to business plan approval(or registration) on whether additional facility or additional business such as hotel or leisure condominium, etc are included to hotel business (Supreme Court 1986. Aug. 19. sentence 85nu702 verdict).

Based on results, regarding defining types of tourism business at Tourism Promotion Act and registration, permission, or designation, etc by this, it should be defined more clearly, not entangled and have good people not charged taxes accidentally or punished.

The study has limitation of not analyzing all precedents of tourism field by analyzing limiting to 8 theme words for the precedent relating to tourism but by analyzing precedents of 8 businesses defined at the Framework Act on Tourism, it is judged to represent somehow. Future study will suggest reasonable problem solving method and legal standard based on more many precedents and cases.

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A Study on the Efficient Supply Chain Management in the Parts Manufacturers of Nuclear Power Plants*

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Abstract. This study aims to propose an improved trading environment for purchasing low material and alternatives to reform supply chain management among firms which are the parts manufacturers of nuclear power plants. To do this, we deliberate issues to be improved by analyze the purchase and acquisition process between suppliers and purchasers, interview, and survey among those firms in considering specific environment around those firms.

Keywords: Nuclear Power Plants, Manufacturers of Nuclear Power Plants, Supply Chain Management, Procurement.

1 Introduction

Korea, as the world's 10 largest energy consumer, is the seventh largest oil consumer depending on 97% energy consumption of all energy resources imported from overseas [5]. Korea, which has relatively smaller country is needed to obtain enough resources to keep up with 10th largest economy in the world, is essential to be provided resources by suppliers. Nuclear power plant technology is highly intensive, takes long operating time after construction, during time, only an accident could bring a huge disaster. In particular, fault of nuclear power plant component manufacturing may cause that all nuclear power plant management goes wrong. Due to specialty of nuclear power plant, supply chain management been only little known, furthermore, nuclear component manufacturing companies face to structural limitation to produce high quality components for few nuclear power plants that require an exacting standard. In this study, supply chain process of the domestic nuclear power plant component manufacturers has been studied and drawn for pending issue between suppliers and users. Moreover, key alternative has been proposed for efficient supply chain management.

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2 Literature Review

2.1 Introduction of Domestic Nuclear Power Plants

Until recently, nuclear power as an environmentally friendly alternative energy sources has gained confidence. On the other hand, the public's wariness about the safety of nuclear power plants exists and always has maintained ambivalence. The economics of nuclear power plants is an absolute waste contrary to the corresponding anxiety about conflicts that can be a prime example [1][10]. Since the introduction of nuclear power in developed countries, this adoption Korea quickly pursued the following three aspects are in the background. Firstly cost effective and reliable secure energy resources secondly, due to the global warming trend for environmentally friendly energy thirdly, energy security aspects. Report in accordance with the framework convention on climate change and the advent of the oil era, the government considers the issue a national security dimension of energy around.

2.2 Manufacture of Parts of the Domestic Nuclear Power Status

So far, based on new reactor domestic product is about 80%, but in the early stages of construction equipment and facilities required in most of the parts as a turnkey based system has been imported from abroad. Importantly, since the introduction of the management, economics of nuclear power as an energy source in preference to built in order to guarantee the safety of nuclear power's important to keep it safe, for when we need to receive timely supply system components must equip. Nuclear component manufacturers that supply parts to optimize the quality and supply chain is directly linked to performance and safety.

Table 1. Import substitution effect of Nuclear Power Plant

	Import substitution (million won)	*Fuel reductions (thousand ton)*	*Fuel consumption (kg/kWh)*
Coal(flaming coal)	6,785,400	54,970	0.372
Oil(heavy oil)	19,272,600	(barrel)215,620	(L/kWh)0.232
Gas(LNG)	13,792,400	20,100	0.136

Source: Nuclear Power Note, 2010.

Ministry of Knowledge Economy (2008) according to the need for nuclear power plants each year, companies that produce metal parts show a gradual increase, which by December 2008 compared to same month last year were higher than 1.2%. However, the majority of nuclear power is equal to 10 employees as the poor parts manufacturer 28.7% survey, nuclear components to produce a single-party management is serious difficulty [6][9].

3 Nuclear Parts Manufacturing Supply Chain Management Issues

3.1 Nuclear Component Manufacturers Secure Raw Materials

KHNP for nuclear component manufacturers and government support for a variety of policies, despite the common issues faced by the field to the difficulty of securing the raw materials were investigated. We are manufacturers of domestic nuclear power plant to visit three companies with production experts interviewed five kinds of raw material procurement and related issues were confirmed. Firstly, the maintenance of nuclear power plants in operation in parts of the reactor core components also apply to new construction standards to be enforced by, the reality of the production costs will have to pay more than necessary. Secondly, the raw materials of production parts American Society for Testing Materials (ASTM) or Stands for American Society of Mechanical Engineers (ASME) applies, does the broker to deal with the monopoly of raw materials supply is that the unit price increases. Third, the demand appeared out of nowhere due to the nature of the nuclear market in a timely manner the required amount of raw materials to supply there is no middleman. Therefore, buying in bulk in advanced as there is an additional inventory cost. Fourth, the brokerage firm handling the raw materials prior information about the brokerage firms do not have substantial resources are consumed in the search. Finally, the parts ordered and parts inspection department, the department is different, because of delays in receiving final approval and payment practices will occur.

3.2 Nuclear Provider Registration and Procurement

Nuclear power is a safe operation and management of nuclear power plant components manufacturer parts manufacturing for KHNP to register the provider prior to supply nuclear and buy procedure to follow. The procedure is shown in Fig. 1.

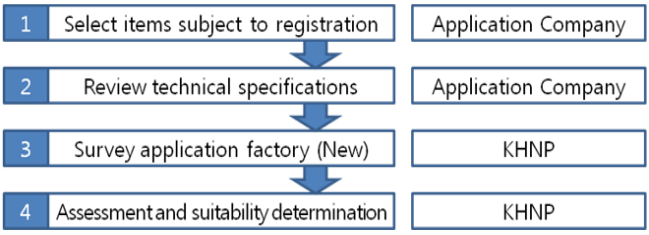

Fig. 1. Supplier registration process

Price research team, equipment materials team, construction materials team, small business support organization comprised of strategic purchasing department of the nuclear power of the existing registered providers through quality control is derived and the smooth procurement. Firstly, regardless of the nuclear component manufacturers multiple departments, to respond because the competitive bidding, or optional contract of purchase to request the department concluded, parts inspection and

purchase process. Secondly, competitive bidding or optional contract, regardless of domestic or foreign goods is signed but, since the purchase process purchase request departments and a department in charge of the business office can check the part argument, thereby the relative departments and nuclear parts manufacturer. Thirdly, domestic purchasing department rather than the headquarters offices of the purchase request department through a competitive bidding or optional contract procurement is to perform two different types. Fourthly, the provider registration system for foreign purchases overseas trading companies often do not have to repeat the opening and closure cases difficult to manage transactions and consistent every time the search is repeated on the opportunity cost supplier may be drained.

3.3 Nuclear Component Manufacturers and the Nuclear Power Plant's Supply Chain

Nuclear power industry is involved in the supply chain, this is definitely, but also demand-based supply and the importance of the safety of nuclear power plant components, when you consider the relationship between nuclear power and nuclear power component manufacturers, risks, rewards, and share the information complement strategic partnerships is defined [2]. Strategic partnership successfully in order to maintain the provider and demand between the partner-ship is important, this partnership to successfully maintain and evolve for mutual strategic coherence, purpose of consistency, compatibility, seamless communication and information sharing is more important than ever [3-4]. In this study, nuclear power plant manufacturers and KHNP interviews with the purchasing process derived from the analysis of those issues as the foundation for a successful partnership composed of elements of the survey items were conducted. In particular, the partnership has been pointed out as success factors of strategic coherence and consistency of purpose to assess the competence of the provider itself, delivery and collaboration, and interoperability with line-of-business standards for evaluating a business level, communication and information sharing utilizing information technology for assessing, satisfaction of the supply chain management, etc. were asked. First domestic manufacturer of nuclear components in order to investigate the status of Nuclear Power and Nuclear Cultural Foundation of the recently-listed companies actively trading the 30 places selected at random, last April, 3 weeks researched by performing the survey results of surveys of 12 companies were analyzed. First and foremost, companies need to manufacture nuclear components of securing raw materials related to ease of response results are summarized as follows. Purchasing raw materials and ease of securing a positive answer for the information companies was 41.7%, raw materials purchase and whether there is enough information on the relationship with your dealer 33.3% answered positively. Ease of securing raw materials only 25% answering positively as a whole, the ratio was negative. Delivery office for the nuclear power plant manufacturers the confidence to ask the Chief Executive Officer, technology, staff, facilities and capabilities were questions about the trust. Response results show that, generally, chief executive, technology, staff, facilities, capacity, etc. Vendor to have the trust was aware. Nuclear component manufacturers and suppliers for seamless supply chain management in preparation for cross-business collaboration are important to standardize the parts ordering, purchasing, contracts, etc. The process of commissioning work on the cross was a question about whether or not

standardized. Business standardization question of order, purchase, inspections and supply chain contract signed and positive half answered on the standardization of the process and positive rate of 58.3%. KHNP provider registration and electronic bidding of the site, purchasing procedures, and standards required to be performed as part of integrated document format, and it is considered that understanding. Supply chain management through standardized business is ultimately a business-to-business-oriented collaboration. Nuclear component manufacturers and the degree of collaboration between the suppliers to assess their goals, demand, inventory management, order planning whether it was a question. Suppliers and establish shared goals and demands adjustments were 50% positive response. However, inventory management, and turn-key plan by 33.3% responded positively. Demand that occurs from time to time, depending on the nature production demand adjustments can be difficult to adjust a prior turn-key, inventory management, nuclear power solely the responsibility of manufacturers seem to reflect the limits. In order to implement supply chain management is essential to take advantage of information technology. Supply and related information about technology use behavior Inter-organizational Information Systems, order planning and processing, and education, etc. were asked. Utilize information technology as a whole the prevailing opinion was negative about. KHNP are currently operated by the electronic bidding system after the conclusion of the contract while performing the actual supply chain management, information sharing and business collaboration is required and has not supported. In the next inter-organizational information systems need to reflect these limitations. Finally, the overall nuclear power plant component manufacturers involved in the procurement and delivery-up trunk supply chain management satisfaction were asked. Nuclear power plant parts procurement business conduct with respect to satisfaction about 50% or more was answered positively also referred to as positive about 58.3% of order processing. On the other hand, the standardization and ease of business ratios against negative. 41.7% answered that these results make it through an interview with the manufacturers specifically the difficulty seems to be indicated.

4 Nuclear Components Manufacturing Supply Chain Improvement

Through a survey conducted earlier results, derived supply chain management related issues can be summarized as a matter of these curing raw materials and the procurement and supply management.

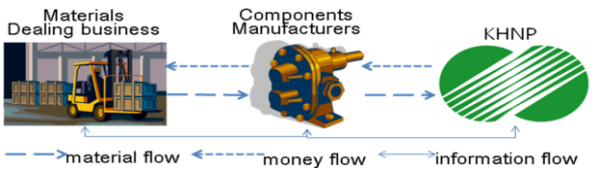

Fig. 2. Supply chains in part manufacturing of nuclear power plant

In order to resolve this, purchasing process needs to be improved with more improved procure environment to smoothly secure raw materials of nuclear component manufacturers and efficient supply chain management.

4.1 Nuclear Power Plant Parts Comprising Procurement Environment Improvement

Part payment paid by KHNP influences production costs of the nuclear component manufacturers and that production costs are included in the cost of buying raw materials. The issue of the securing raw materials in the end related to reliable information on the supply chain, finance, flow of materials that was not settled well, from raw materials suppliers through nuclear component manufacturers to the KHNP.

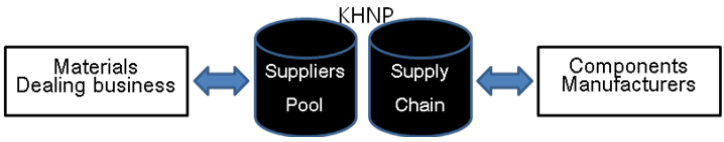

Fig. 3. Building DB for Material Suppliers

To solve this, as shown in Fig. 3, information about raw materials suppliers and by filing and managing supply unit and the raw materials into 'Suppliers POOL' database, nuclear component manufacturers can participate in a bid, or prior to a private contract, query ' Suppliers POOL' or able to determine viewing by requesting whether raw materials secured or not in advance. Therefore, manufacturers of nuclear raw materials becomes easy to be navigated, raw materials supplier sales will be becoming easier to keep units marketable and stable management possibly. Moreover, it is not only raw materials suppliers simply determined but also advanced supply chain management as continuous replenishment will be accomplished.

4.2 Manufacture of Parts of Nuclear Power Plants to Improve the Purchasing Process

4.2.1 Foreign Investment to Improve the Purchasing Process

For foreign trading, after a purchasing although information on these companies to be recorded and managed for the period of time due to having difficulty to update the information in regard to closed companies, limitation may be applied for management or company's history, in addition to ex post facto management on the supplied parts which can be limited. In order to solve these problems, first, provider registering system equivalent domestic purchasing needed to apply about going out on competitive bidding companies. Second, the bidding companies and all the information of companies private contracted is needed to record and managed in the supplier's database. Third, in case of auctioned off or private contracted company, occurring all information needs to be saved 'Contract Execution' database by managing as one project for delivery and inspection procedure. Fourth, later on, as well as purchase requests

departments, departments of business place as needed, will be available a series of information involved in supplying of individual components by performing continual history management inter working 'Suppliers' database and 'Contract' database. Therefore, as shown in Fig. 4, manufacturers of nuclear components for efficient supply chain management and improvement of processes as procurement supply are summarized as approaching setting up through 'Suppliers', 'Contract Execution' and two databases.

4.2.2 Domestic Purchasing Process Improvement

Domestic procurement activities are Separated by a competitive bidding and optional contract with the purchasing department and the Office department purchase request for a parallel in this case, information about contracts and supplier often not shared, or, optional contract, the purchasing department requests Department and the Office of Inter contract requirements, priorities or details of the contract differ consistency could have hurt the cause.

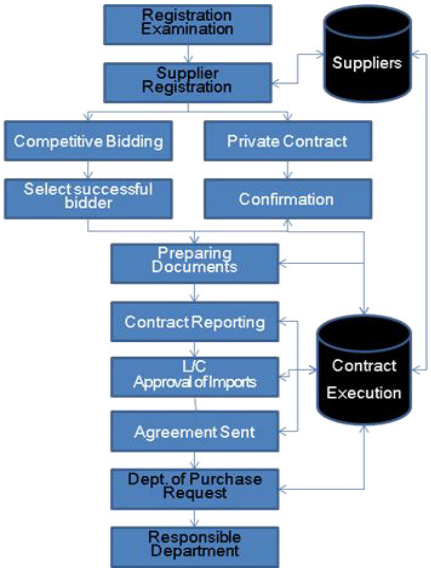

Fig. 4. Improved Foreign Purchase Process

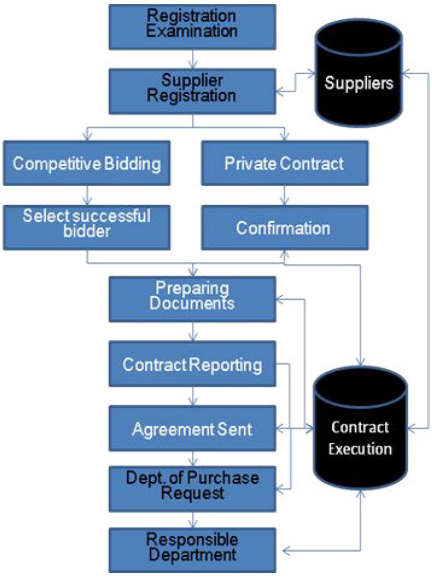

Fig. 5. Improved Domestic Purchase Process

These problems improved purchasing process Fig. 5 include: domestic purchase also purchase foreign commodities supply chain as well as registration screening respondents about this company ' Suppliers ' and ' Contract ' databases, in conjunction bids from vendors delivery to complete that arise in the course of information integration can be managed by should allow.

5 Results

The subjects of this study has already commenced operation until the stop safely operate and maintain nuclear power plants to be 21 and to maintain it for the supply of production parts, is a manufacturer of nuclear components. KHNP first suppliers of raw materials for provider registration and inventory information to management measures proposed to integrate. Nuclear component manufacturers through the nuclear power plant according to the specifications of the parts ordered and handling companies, as well as the necessary raw materials, handling stock companies will be able to check in advance. Nuclear component manufacturers and ultimately the cost of procurement of raw materials and production cost savings are expected in the near future. The next nuclear power plant component manufacturers and NHNP between supply chain management and related foreign purchases domestic purchase the same as the provider registration introduced, and procurement contracts relating to 'Suppliers' database, and since the contract and delivery processes ranging from the information generated from to manage the 'Contract' is proposed to build a database. They interact with the database from the bidding and contract providers through screening after delivery to complete acceptance by managing the entire process by integrating surveillance systems that can be proposed. In addition, since the import of products associated with contract insurance and customs clearance and the argument has been divided into functional departments to integrate the proposed purchase request. This study component suppliers to maintain a safe nuclear power as an energy source by considering the impact on supply chain management issues through a variety of approaches to derive meaningful improvement but the two can provide.

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An Android Phone Workplace Management System

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Abstract. Power plants need quite a wide area of the site. In the power plants, various types of machinery and equipment are distributed throughout the workplace, to manage them checking the operation is necessary on a regular time interval. In general, the workplace inspector writes error data by hand and then inputs them to information system. In this paper, we present an Android platform's workplace management application design, which makes it possible to manage failure or error data of the workplace.

Keywords: Power Plant, Android, Management System.

1 Introduction

Since the last earthquake in Japan, the safety of nuclear power plant is a huge issue around the world. In the countries which produce electricity by nuclear power, many people are much opposed to the construction of new nuclear power plants. However, nuclear power has been used in a variety of aspects of life as well as medical, industrial, research, education, etc. For power supply, there are various types of power plant. These plants need quite a wide area of the plant. In a large business or land plants, a wide various types of task and work are performed. In addition, various types of machinery and equipment is distributed throughout the workplace, to manage them checking the operation is necessary on a regular time interval. In other words, in the large-scale workplace, regular inspection should be performed. This inspection is to check whether the performance of the first time is maintained. This test is also very long period and has many inspection items, on-site inspection is made mandatory. Due to the nature of tasks in the workplace, access control to the internal network is blocking the connection to prevent problem or accident by intrusion from the outside.

In general, the workplace inspection writes error data by hand and then inputs them to information system. In this paper, we present an Android platform's workplace management application design, which makes it possible to manage failure or error data of the workplace.

The remaining paper is divided as follows. Section 2 discusses workplace environment and task process. Section 3 discusses the architecture of the Android phone workplace management system. Section 4 concludes.

T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 424–428, 2012.

2 Related Work

In the literature we can find some works that adopt Android based smart phone to support our lives.

To develop the workplace management system, first of all we analyzed work tasks and processes in the power plant. In the power plant, every day, every time there are various errors and failures, it can be verified through workplace inspection, these errors and failures are described in the handbook. After the workplace inspection, come back to the office and access to the information system through login. And then enter information such as the errors and edit a report using word processor and finally print a report. This task's process can be separated into four parts:

- Check the workplace: Power plant consists of a myriad of electrical appliances. Machinery, instrumentation and many other devices are operating 24 hours, and large and small problems occur. How to find the problem is to check workplace first.
- Record the handbook: If the error or failure is found, inspector writes these error data on the handbook.
- Input error data to the information system: After inspector come back to the office, he accesses to the information and inputs error data.
- Analyze error data: Manager analyzes error data and writes a report.

In this task's process, we can't immediately enter error data in the workplace. In order to solve the shortcomings of the existing workplace management, this paper proposes a workplace management scheme based on Android smart phone.

Android is a mobile platform based on the Linux kernel and open-source [1]. Therefore, Android is called an operating system, but usually referred to as mobile platforms because Android uses Linux kernel as a key of operating system. In other words, Android platform is open, complete, free mobile platform. Android is a software stack for mobile devices that includes an operating system, middleware and key applications. Development of Android application is done in the Java programming language using Android SDK which provides the tools and APIs necessary for development. Android is open source, custom applications for users can be developed and deployed easily [2, 3, 4].

3 System Architecture

There are many types of equipment in the power plant, these equipments are in operation 24 hours and a large or small problem is occurring. Therefore, these problems are discovered through workplace inspection, and by solving these problems the power plant can operate safely.

In this paper, we present an Android platform's workplace management application design. System architecture is shown in Figure 1. First, Inspector checks several different types of instruments and devices which are scattered in other workplace.

If some problems occur, an inspector enters error data using a workplace management application that is installed to smart phone. Workplace management application consists of three modules: information manage module, error data input module and analysis module.

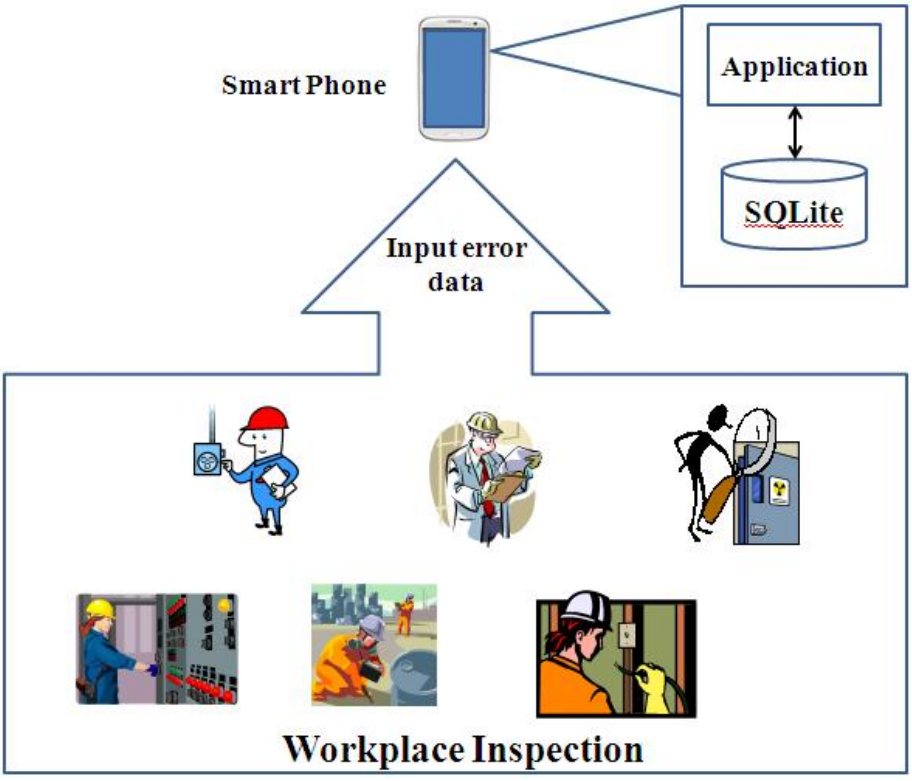

Fig. 1. System architecture

4 The Software Design of the System

The overall performance of smart phone is poor compared to that of a PC. In addition, unlike PC operating system, smart phone operating systems are constrained by their hardware, storage space, power dissipation and mobility conditions. But, Smart phone is becoming a major platform for the execution of Internet services as more powerful and less expensive devices are becoming available. Android smart phone is the most popular among others. As we mentioned earlier our application is designed on the Android software stack produced by Google. The advantages of the design it is easy to use and easy to debug the program errors.

The steps and the process followed in designing the system have been summarized in Figure 2. The function modules of the system contains information manage module, error data input module and analysis module.

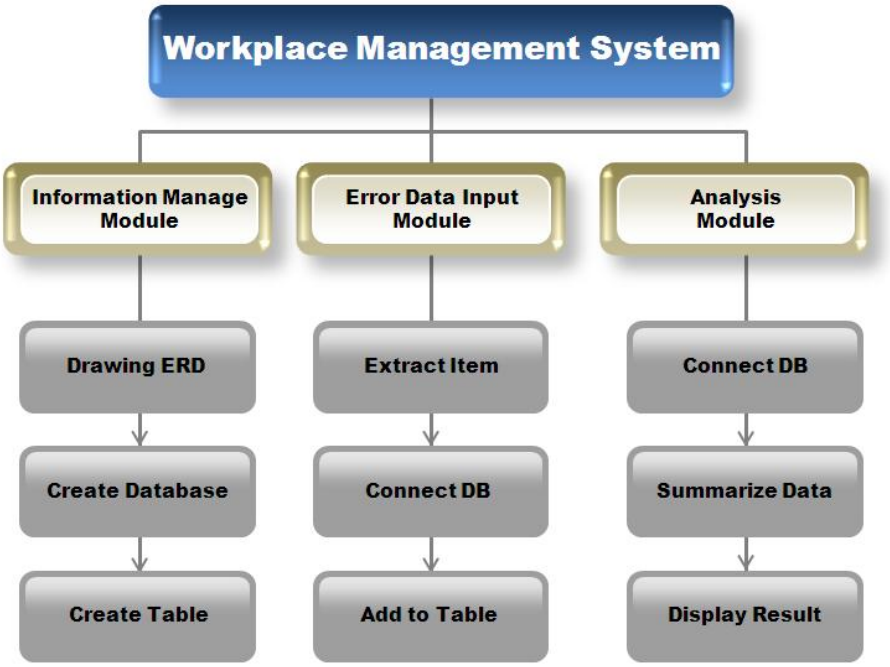

Fig. 2. The function modules of the system

Information Management Module

This module manages effectively information gathered from the workplace. To achieve this, we create a database file to store state information. In this paper, we use a SQLite, which is a lightweight database system specially designed for less power and memory consumption, the common characteristics of mobile devices. In other words, SQLite is installed to store and manage status and error data as DBMS [3, 5]. Through analysis of tasks in the workplace, building the database consists of three: drawing ERD (Entity Relational Diagram), creating table, constructing database.

One of the most used diagram types in computer science are Entity Relationship Diagrams. In relational databases, an entity refers to a record structure, i.e. table. An entity relationship diagram can be used to describe the entities inside a system and their relationships with each other; the entity relationship diagram is also known as a data model [6]. In this paper, our ERD consists of six attributes such as error number, workplace number and etc. After drawing ERD, creates table using SQL statement and constructs a database.

Error Data Input Module

This module consists of some widgets, such as TextView, EditText, Button, Spinner and etc., that is to say user interface members. Inspector can enter error data through application running on the touch screen of smart phone. Through a variety of linear layouts, an inspector selects an appropriate layout and enters error data. This process

is conducted in the following order: SaveActivity class outputs a layout for entering error items and an inspector enters error data in this layout and then clicks a save button. These data are added to a table in a database which is created in the section 3.1. This step works based on the ERD. That is, convert the entity into a table and set up relationship to the reference key and then set the data type for each field in a table. Error data table consists of six fields such as error type, location position and etc.

Analysis Module
This module shows analysis result about the condition of workplace after workplace inspection. Managers order to process work in accordance with the priority of urgency based on the results of this analysis.

5 Conclusion

In a large business or land plants, a wide various types of task and work are performed. In the large-scale workplace, regular inspection should be performed. This test is also very long period and has many inspection items, on-site inspection is made mandatory. In this paper, we presented an Android platform's workplace management application design. One advantage of using a smart phone is that the user is more likely to carry the phone throughout the day. A smart phone is also very familiar to inspectors and this portability of smart phone is useful to the inspector working in the workplace. In addition it is possible to manage immediately failure or error data of the workplace on the spot.

In future, we are planning to implement workplace management application based on Android smart phone. We are also planning to add some connection function to the main server and conduct more experiments in the various workplaces.

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TOD as a Rail Integrated Urban Regeneration Strategies of Old City through Case Study about Toyama Station and Surroundings Area in Japan

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Abstract. Considering national greenhouse gas emissions extract from buildings(25%) and transportation(17%), it is important to construct environmentally friendly city that is for modern human life. Urban planning method using TOD as an element of city planning scheme that is proposing sustainable built environment is a key element of low carbon and green city by interconnecting public transit and land use plan to cause high density development around station influence area. The purpose of this study is to explore TOD city revitalization method focusing on Toyama railway station & Surroundings area in Japan in order to find applicable measures in Korea. In Toyama, there are some projects like a revitalization plan of new city center, activation of public transportation, and downtown inhabitation warning project which are developed by effective transportation link with Toyama Railway Station. From this on, it's an important compound to be recognized as an element of urban facilities.

Keywords: Rail Integrated Urban Regeneration Strategies, TOD (Transit Oriented Development, Toyama Railway Station.

1 Introduction

While 'low carbon green growth' suggested as new national vision of the country recently, all fields have recognized 'green technology' to main axes.[1] Specially, forming the city where is modern environment-friendly human livelihoods could be said as an important task if taking a fact into consideration that 42% of national greenhouse emissions are composed of architectures (25%) and traffics (17%).

In this regard, TOD (Transit Oriented Development) urban planning techniques can be a core planning factor of Low carbon & Green City by linking public transport and land uses centered on railway station areas and then inducing high-density developments as a concept of urban developing method that presents sustainable urban environments. Particularly, railway traffics with lower carbon emission and higher efficiency such as high-speed rails etc than car traffics relatively is newly getting

[1] Cho, Hoon-hee, For Composing Technical Developments of High-Tech Zero-Carbon City Securing Economical Efficiency, Architecture, 2011.04, p.30.

T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 429–436, 2012.

attentions nowadays. So, activating environments of underdeveloped areas is being recognized as a new alternative for revitalizing local small-medium cities through transit oriented development centered on railway station areas together with expanding wide-range railway networks.

Under such backgrounds, this study analyzes railway-linking urban regeneration strategies of Toyama City, Japan that tries to do urban regeneration of old downtown centered on Toyama Station, and intends to find out applying methods of regional activation of domestic small-medium cities that have not been highlighted largely to research scopes till now.

2 Theoretical Reviews on Urban Regeneration and TOD

2.1 TOD Concept

The compact city that raised developmental density lately has been recognized as sustainable, eco-friendly urban types, and thus various researches and discussions have been processed for making detailed implementations. Especially, the concept of TOD (Transit Oriented Development) which has same veins with compact city's concept, high-density complex land uses centered on public transport interchanges, and pedestrian-friendly residential environment has appeared in the US at early 1980 for resolving traffic problems by land-using patterns focused on cars. TOD concept was suggested first from 《The Next American Metropolis, 1993》 authored by Peter Calthorpe, and has been progressed to detailed developing techniques. This concept based on recognitions that suburban sprawl phenomena of the US cities characterizing city's planar diffusion and car-centered urban structures brought deterioration of environmental and social substantiality. Therefore they tried to overcome such problems by liking public works, retail sales, service function with wide-range public transport systems. TOD concept is more focusing on human scale rather than traditional neighborhood unit development, and aiming at urban planning having placeness that fit to regional characteristics after considering various traffics such as walking, bicycle, public transport.

In Europe, such TOD concept has been started from environmental protections such as prevention from traffic increases from long-distance commuting and environmental pollutions in case of making people use surrounding convenience facilities without using separate transports after intensifying skyscrapers in the center of the city, and thus could be reached by walking. In contrast, it was started for preventing from de-urbanization and aging countermeasure. That is, they realized job-housing proximity by integrating urban facilities, and making the aged who were hard to use cars approach to shops or public facilities by walking.

2.2 Railway Station as a Core Element of TOD Development in Japan

Luca Bertilini and Tejo Spit(1998)[2] defined railway station as the main places of the city where roles of interchanges and activity, function were operated integrally at the

[2] Luca Bertilini and Tejo Spit, Cities on Rails: The redevelopment of railway station aras, Utrecht University, The Netherlands, 1998, pp.09-20.

same time, even though classified it into two kinds. In the railway station as interchanging place, urban roles have been expanded gradually such as taking charge of passages by cars and pedestrians together with main function of traffics through regional linkage, linkage in the city, transfer types, approaching forms, using objective, and traffic expenses etc. The density of land uses around railway stations will raised naturally owing to special structures of the city, and the stations where unspecified individuals have accessibility from public transports can become a core element of TOD development by playing roles of the center functions during city activities.[3]

Meanwhile, Japan railway was made in 1872, and is putting down roots in operational and social influencing aspects such like investing over 1 trillion yen annually together with running distance of current 27,106km after Shinkansen (JR)'s opening at 1964, 8.64 billion passengers, and 182 railway operators etc.[4]

Specially, as railway operators become privatized in 1986, developmental figures of railway history and rail station area developments have been changed largely. In addition, it has been evolved to urban developments of TOD type integrated with urban-dimensional railways inducing regional growth from high-density developments having simple architectural scales, based on needs of floating populations. Therefore, cases of additionally constructing high-speed railway stations at existing ones have been occurred frequently according to expansion of metropolitan high-speed railway networks in addition to reconstructing complex high-density stations. So, activations on urban regeneration centered on regions such as restructuring region's structures into TOD based on re-development while reflecting unique urban characteristics of the place at the same time.

3 Toyama City and Urban Regeneration Strategies

3.1 Characteristics of Existing City Structures in Toyama Prefecture and Changes of Toyama Station

Regarding to the railway station area, this study selected Toyama City and its station, and it was regenerating case of Japan's small-medium cities where urban regeneration focused on Toyama Station affected to city's overall aspects largely. Toyama City is the center of Japanese archipelago and located in central northern part of Honshu, and also near Nagano Prefecture to the east, Gifu Prefecture to the south, and Ishikawa Prefecture to the west. Toyama Prefecture is prefectural government, and located in Hokuriku area, middle part of Honshu Island. The Prefecture's scale is about 50km radius centering on Toyama City, and the place has been developed as a post town from mountaineers of Tateyama belief originally, and also the downtown enjoyed its growth centering on Toyama Station.[5]

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[3] Kim, Do-Nyun et al, A Study on the Design Guidelines of Railway Station Areas through the Comparative Analysis of High-Speed Railway Station Development in Foreign Cities, Journal of Architectural Institute of Korea, v.21 n.8, 2005, p.170.

[4] Korea Railroad Research Institute, Japan railroad's history and development, Book Gallery, 2005.

[5] Official Homepage of Toyama City Hall (`http://www.city.toyama.toyama.jp/`) and "Toyama City Manual".

Table 1. Toyama Railway Station Outline and Locations of Each Railway Route

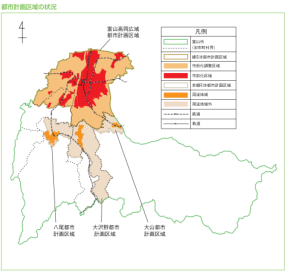
Railway Company	Lines	Map
JR West Japan - belonged lines	Hokuriku Main Line Takayama Main Line Hokuriku Shinkansen (open in 2014)	
Toyama Light Rail	Toyama Chiho Railway Main Line Toyama City Tram Line	
`Toyama Local Railway-belonged lines	Toyama Chiho Railway Main Line	

Table 2. Transformation of Toyama city centering on Toyama Station

1946 1970 2007

Remark 1. The illustrations are cited from Japan Ministry of Land, Infrastructure and Transport, Geographical Survey Institute & Aerial photo viewing system (http:// archive.gsi.go.jp/airphoto/)

Toyama Station was established first by extending Hokuriku Line at 1899, and promoted to Toyama City in the same period. The station at that time was temporary at that time, and moved to current site during 907~1908, and Hokuriku Main Line was opened completely at 1913, and then Takayama Main Line in 1934. At present, railway routes passing through Toyama City are composed of 5 ones totally, and JR western Japan routes had bases in JR Toyama Station, main line of Toyama local railway in subway Toyama Station right next to Toyama Station, Toyama Light Rail Toyama Line in northern station of Toyama Station, and main line of city orbiter of Toyama local railway in front station of Toyama Station. Shinkansen that will pass through Hokuriku is scheduled to be opened at 2014, and high-speed railway has not operated till now.

Above all, three-dimensional cross projects is being processed for doing basic improvements around the station by being linked with Shinkansen's opening, and Table 2 is showing a fact that rear parts of Toyama Station have been expanded gradually even though downtown was developed in front parts of the station initially when looking into urban landscape centering on the Toyama Station. That is, a fact was confirmed that Toyama City was started from front parts of Toyama village centering on Toyama station after constructing railway, even though it was a post village originally and urbanization was processed, and then many public traffics were concentrated there.

3.2 TOD Centering on Toyama Village as Rail Integrated Urban Regeneration Strategies

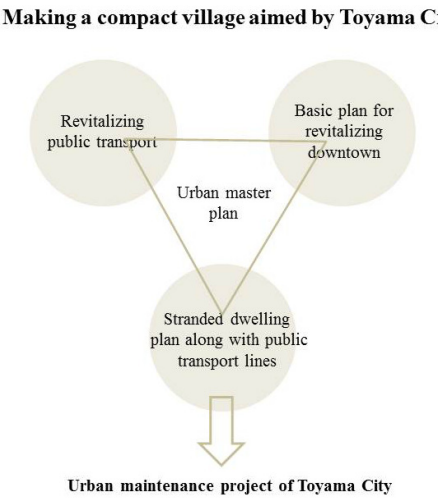


Fig. 1. Concept drawing of Toyama City's urban maintenance project

Urban regeneration strategies centering on Toyama Station is defined as 'making base-concentrated compact village where public transports become the axis by activating it and integrating city functions such as dwelling, commercials, jobs, and culture etc., If looking through total city's master plan, it is composed of 3 axes largely such as acting plans for downtown and public transports together with adjustments of urban population density.

(1) Acting plans for downtown

Acting plans for downtown is planned to do downtown maintenance, grand plaza maintenance project, and land subdivision surrounding Toyama Station. Downtown maintenance are made to extend staying time in downtown by composing job & commercial districts around the station where was front parts of existing railway

station, resetting new central downtown that comprehends back parts of the station, and then letting commercials and dwellings mixed.

(2) Activating plans for public transports
A foresaid acting plans for downtown was to raise conveniences of public transports and make bases complimentary mutually by public transports. First, this plan constructs new orbit of trolly car to Nichimachi at Marunouchi interchange and makes it operated to downtown circularly by connecting with Toyama local railway. Second, it enables to link northern and southern downtown having been divided with the railway up to now by maintaining front square of the station together with continuous three-dimensional cross-project between Hokuriku Shinkansen and existing routes scheduled to be opened at 2014, and then connecting Toyama light rail with trolly car under the high-road after finishing elevations.

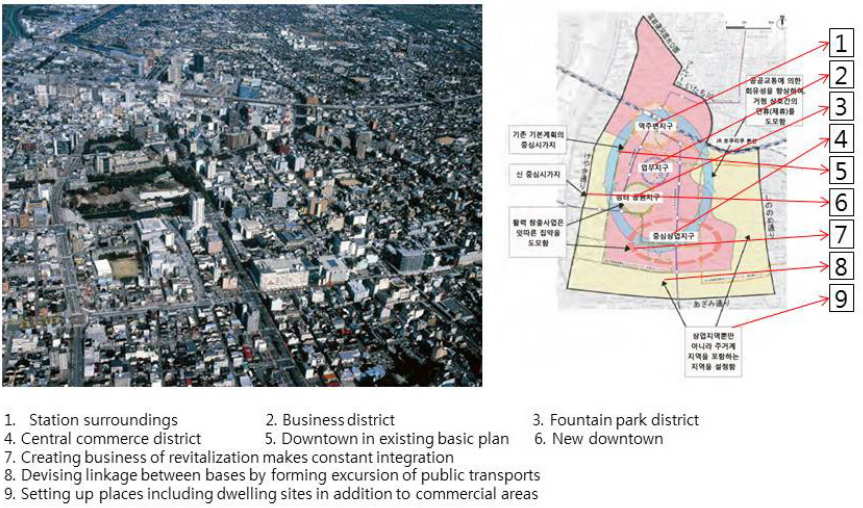


Fig. 2. Front view of central downtown district and Basic concept drawing

Remark 2. The illustrations are cited from Official Homepage of Toyama City Hall

(3)Adjustments of urban population density
Two projects stated above are plans for raising settlement population of the city, and enforcing effectiveness of urban master plans. That is, it set up 13 routes that were operating over 60 per day among downtown 5 railways and route buses, and then designated all zoning like 500m from each railway station and 300m from the bus stop to 'Public transport axises' after exempting exclusive industrial complex and areas. Through this procedure, the project aims at increasing population ratio of stranded residence-propelling district vs. total city one.

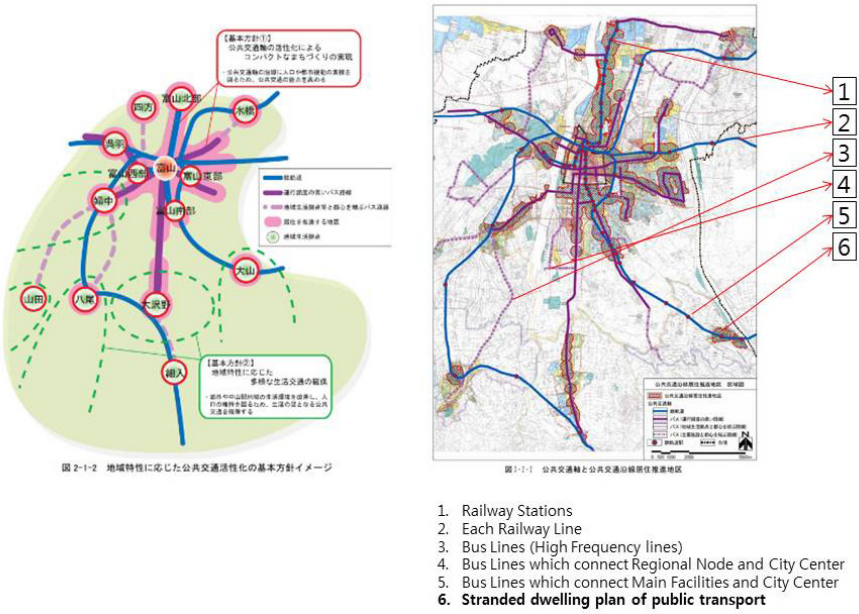


Fig. 3. TOD development plan centered on the railway

Remark 3. The illustrations are cited from 'Linking plans of regional public transports in Toyama City'(2012), p.36

4 Conclusion

Japan's railway Station is recognized as an important complex urban facility that lead regeneration of Japan's urban environment and reconstruction such as establishing effective linkage traffic systems after grasping needs of floating population in addition to developments of railway station, and trying to propel urban reconstruction and overall projects etc. Specially, urban regeneration centered on Toyama Station, this study's object, could be seen as a representative case of TOD development on provincial cities in terms of stressing relevance between land uses and traffics, inducing pedestrian-friendly traffic system together with complex land uses focusing on public transport by making high-density and complex urban developments.

As research results, this study can find out characteristics of TOD developments same as followings.

First, a fact could be confirmed that methods of activating various public transports are being settled mainly as total city plans.

Second, three-dimensional complex developments were propelled so that land uses of total railway station areas together with traffic environment, road improvement could be connected closely centered on the railway station.

Lastly, maintenance and improvement of public traffic environment, redeveloping projects of land maintenance etc. are confirmed as being connected closely with adjustments of settling population in the city together with city residence-propelling plan and stranded dwelling plans of public transport. That is, redevelopment of Toyama Station is a case of affecting large influences to total city's structure, and propels rail integrated urban regeneration in that it tries to reorganize the city structure itself into public traffic-oriented one by locating city functions like LRT etc.s to surrounding various traffics.

Acknowledgement. Funding for this paper was provided by Namseoul university.

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Concrete Strength Reduction of DSCT Member by Welding Heat

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Abstract. Strength reduction was investigated when a double-skinned composite tubular (DSCT) member was exposed to welding heat. And a method for a DSCT member to maintain its original strength against the welding heat when modular DSCT members are composed. Welding causes the heat of 20,000 °C on the weld zone and the heat of 1,300°C around the weld zone. The strength of concrete nearby the weld zone decreases by high temperature. In this study, the concrete strength cases were investigated when arc welding and electro slag welding were used as the welding methods. Through heat transferring analysis of welded DSCT members, a preventing method preventing concrete strength reduction was proposed. The proposed method showed it prevented concrete strength reduction and it was verified by finite element analysis (FEA).

Keywords: concrete, strength reduction, heat, weld, DSCT.

1 Introduction

Recently, the construction of modular columns is increased to reduce construction cost. There are many types of modular columns such as reinforced concrete (RC) columns, concrete filled tubular (CFT) columns, and DSCT columns. A CFT column has superior strength to a RC column. However, a CFT column is inapplicable as a modular column because of its heavyweight. To overcome this advantage, Won et al. [1] suggested a new-type modular column using a DSCT column. A DSCT column was proposed in the late 1980s by Shakir-Khalil and Illouli [2]. Fig. 1 shows the cross section of a DSCT column. Coaxial double steel tubes are arranged, and concrete is filled between them. This column has superior bending strength and shows good seismic performance.

A modular DSCT column has the connection of column module, the bent cap to column module, and a column module to foundation. The connecting method suggested by Won et al. [1] is as shown in Fig. 2. A column resists lateral and axial forces. Therefore, the connection of a modular column must have equal or superior

T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 437–444, 2012.

strength to the original column. And the connecting part should bond the column modules perfectly. Welding is known as the best method to connect column modules. Welding guarantees high reliability of steel connection. The suggested welding method to connect DSCT column modules is fillet welding of steel stiffener and steel tubes as shown in Fig. 2.

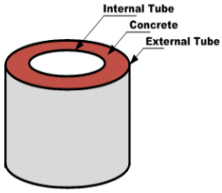

Fig. 1. Constitution of a DSCT column

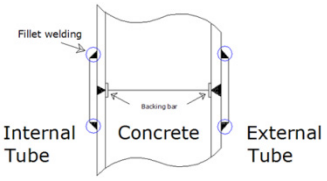

Fig. 2. Welding connection and effect of welding heat

When a modular DSCT column is connected by welding, welding heat reaches 20,000 °C on the weld zone and 1,300 °C around the weld zone. The strength of concrete nearby the weld zone is reduced by high temperature. A localized reduction of concrete strength might affect the entire behavior characteristic of a DSCT column. Welding heat travels to the concrete through the external and internal tubes. This study has suggested a preventive method of concrete strength reduction through finite element (FE) analysis results. This study considered two types of welding methods, which were arc welding and electro slag welding. The effect of concrete strength reduction by the two welding methods were investigated. Heat transfer analysis was verified by comparison of analysis results from Yang et al. [3]. And a method reducing welding heat effect, which makes concrete strength lower, was suggested.

2 Finite Element Model and Verification

For a DSCT column, welding heat transfer analysis was carried out by using a commercial FEA program, ABAQUS [4]. Zicherman [5] proposed the reduced strengths of steel and concrete by the increase of temperature. The proposed material properties of steel and concrete for heat transfer analysis are shown in Table 1 and Table 2, respectively.

Table 1. Properties of steel by temperature (Zicherman [5])

Temperature (^oC)	Specific heat ($J/kg \cdot {}^oC$)	Thermal conductivity ($J/kg \cdot mm \cdot {}^oC$)	Density (mg/mm^3)
0.00	449.91	197.97	7.85
93.58	484.64	185.89	7.82
105.04	488.88	184.41	7.81
114.59	492.42	183.18	7.81
197.35	523.11	172.51	7.78
398.55	597.74	146.55	7.7
700.57	872.51	107.59	7.59
750.39	1046.05	101.16	7.57
827.59	687.49	91.25	7.54
850.03	583.28	92.23	7.53

Table 2. Properties of concrete by temperature (Zicherman [5])

Temperature (^oC)	Specific heat ($J/kg \cdot {}^oC$)	Thermal conductivity ($J/kg \cdot mm \cdot {}^oC$)	Density (mg/mm^3)
0.00	1260.12	8.46	2.35
93.58	1314.12	6.44	2.33
105.04	5256.5	6.19	2.33
114.59	3036.52	5.98	2.32
197.35	954.09	5.84	2.3
398.55	983.25	5.51	2.26
700.57	1207.07	5.00	2.18
750.39	1232.11	4.92	2.17
827.59	1270.92	4.79	2.15
850.03	1282.22	4.75	2.15

Solid element(DC2D4) and transient analysis were adopted for heat transfer analysis. Thermal loads were applied to the surface of the external tube. The applied thermal load accords with the standard temperature time (STT) curve, ISO-834 [6]. This STT curve is given as Eq. (1). T is heating temperature (°C), t is time (minute).

$$T = 345 \cdot Log_{10}(8t + 1) \tag{1}$$

For verification of the analytic method, a column was modeled by using the section properties which were previously used in Yang et al.'s research [5]. Diameter of model is 400mm, diameter of hollow is 200mm, thickness of external tube is 4mm, and thickness of internal tube is 2.87mm. Fig. 3 shows the distribution of temperature by time, where thermal load is conducted up to the internal tube. The thermal load was applied for 120 minutes. Fig. 4 shows that the used FEA model was reasonable when it is compared with the Yang et al.'s research [3]. Therefore, this analytic method was adopted for heat transfer analysis of a DSCT column.

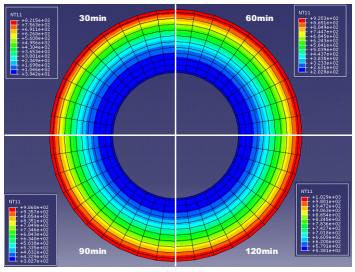

Fig. 3. Distribution of temperature by time

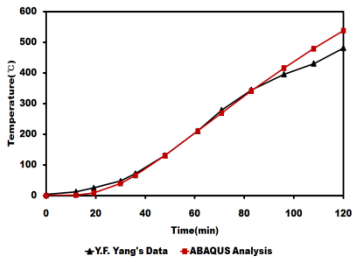

Fig. 4. Distribution of temperature by time on internal tube

3 Effect of Welding Heat on DSCT Column

A common welding heat source is to transfer the heat source by electro arc. Distribution of temperature around the heat source could not change, because of steady-state transfer. Heat by heat source is calculated by Eq. (2) [7]. HE is calories by unit length (joules), E is arc voltage (volts), I is welding current (amperes), and S is transfer distance by minute (mm/min)

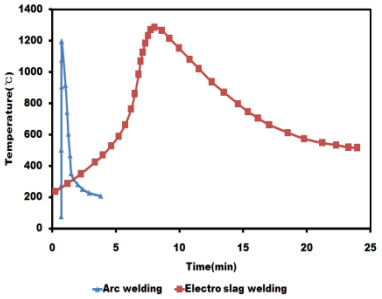

Fig. 5. Time-temperature curve by method of welding(Howard[8])

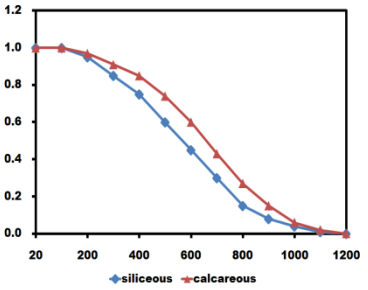

Fig. 6. Variation of concrete strength by temperature (Eurocode 2 [9])

$$HE = \frac{E \times I}{S} \times 60 \tag{2}$$

Eq. (2) is for calculation of the heat by arc and for the comparison of the welding method. The time-temperature curves of arc welding and electro slag welding are shown as Fig. 5 (Howard [8]). Fig. 6 shows variation of the concrete strength by temperature [9].

The time-temperature interaction of the two welding methods has many differences; heat velocity, the highest temperature, and cooling velocity, as in Fig. 5. The arc welding time-temperature curve swings upward rapidly and downwards rapidly. On the contrary, electro slag welding has a slow temperature rise and slow cooling velocity. The thermal load used the time-temperature curve in Fig. 5 that is applied to the surface of the tube with a point load.

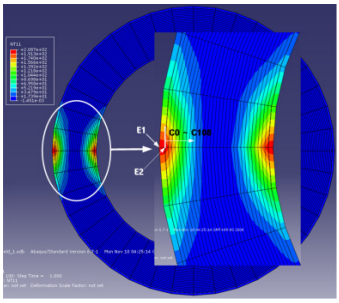

Fig. 7. Temperature distribution by arc welding heat

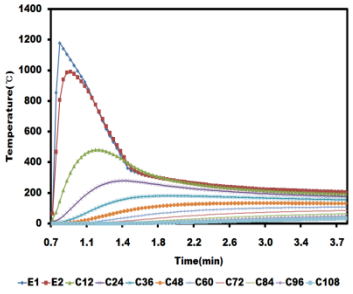

Fig. 8. Temperature-time curve by arc welding heat

Fig 7 shows the temperature distribution by arc welding of welding of the exterior and interior surfaces of a DSCT column. The location legends of each part in Fig. 7 means the exterior of external tube (E1), interior of external tube (E2), and concrete (C0~C108) with 12mm intervals. Fig. 8 shows the temperature-time curves by arc welding. The temperatures on the two tubes are higher than those on the concrete because steel has higher conductivity than concrete. The temperature of the concrete passes 100 °C on the distance of 12~48mm from the concrete surface.

Table 3 shows the decreasing rate of concrete strength by location from the analysis results. The decreasing rates of concrete strength are 37.36% and 24.07% for siliceous

Table 3. Decreasing rate of concrete strength by arc welding

Location	Temp. (°C)	Decreasing rate of concrete strength	
		siliceous	calcareous
C12	482.43	37.36%	24.07%
C24	280.67	13.07%	7.84%
C36	181.55	4.08%	2.45%
C48	134.26	1.71%	1.03%
C60	107.56	0.38%	0.23%
C72	84.4	0.00%	0.00%
C84	64.03	0.00%	0.00%

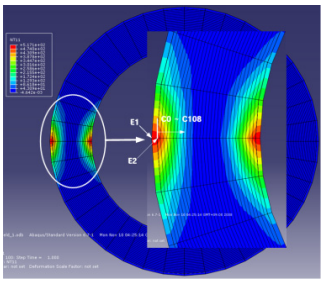

Fig. 9. Temperature distribution by electro slag welding heat

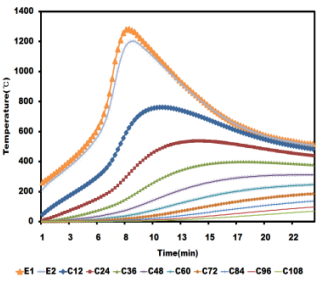

Fig. 10. Temperature-time curve by electro slag welding heat

concrete and calcareous concrete, respectively, at 12mm-distance from the concrete surface Therefore, large thermal load could make the concrete strength extremely lower.

The strength reduction of the concrete by electro slag welding heat as also investigated. Figs. 9~10 show the temperature distribution by electro slag welding. The temperature is distributed in the range of 245.17°C to 761.95°C to as the distances of 60mm to 12mm from the concrete surface. These are very high temperatures, compared with arc welding.

Table 4. Decreasing rate of concrete strength by electro slag welding

Location	Temp. (°C)	Decreasing rate of concrete strength	
		siliceous	calcareous
C12	761.95	79.29%	66.91%
C24	536.7	45.51%	31.14%
C36	399.47	24.95%	14.97%
C48	311.44	16.14%	9.69%
C60	245.17	9.52%	5.71%
C72	185.82	4.29%	2.57%
C84	136.25	1.81%	1.09%

At the distance of 12mm from the concrete surface, the siliceous concrete lost 79.29% of its original strength and calcareous concrete lost 66.91% of its original strength. The entire temperature distribution of electro slag welding is very high, when it is compared with arc welding, as in Tables 3 and 4. When electro slag welding is applied, the concrete lose much more strength. The strength decreasing region of concrete could be estimated 60mm-distance from the inner and outer surfaces of concrete. Therefore, a method to prevent the decrease of concrete strength is required.

4 Welding Heat Mitigating Method

To reduce the conductivity, to block out the conduction of welding heat, to prevent decrease of concrete strength, a new and simple method was proposed. Glass or ceramic fiber pad has very thin thickness, small density, low conductivity. Thus, it can be used for high temperature insulation. If ceramic fiber is inserted between the concrete and the tube, the conductivity of welding heat would be reduced.

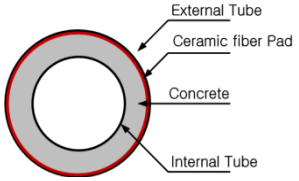

Fig. 11. Insertion of ceramic fiber in space between tubes and concrete

For the case when ceramic fiber is inserted between the concrete and tubes, heat transfer analysis was performed to investigate the decrease of heat conduction. Table 5 shows the geometric and material properties of the used ceramic fiber. These properties were applied to the heat transfer analysis model.

Table 5. Geometric and material properties of ceramic fiber

Article	Properties
Continuous service temperature (°C)	1050
Maximum service temperature (°C)	1260
Melting temperature (°C)	1760
Density (kg/m^3)	600
Conductivity (W/m °C)	0.17
Width (mm)	10～150
Thickness (mm)	0.8～10
Length (m)	30 / 50 / 100

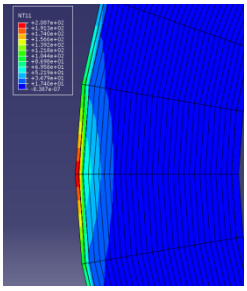

Fig. 12. Temperature distribution when ceramic fiber is inserted

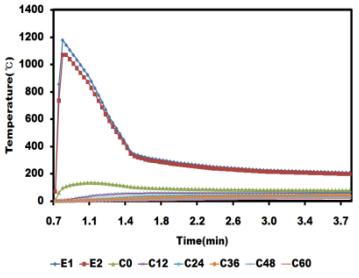

Fig. 13. Time-temperature curve when ceramic fiber is inserted under arc welding heat

Figs. 12 and 13 show temperature distribution when the ceramic fiber is inserted. The temperature of concrete decreased as shown in Fig. 13, compared with Fig.7.

Table 6 shows the variation of temperature at each location. After insulation of ceramic fiber, the temperature on the concrete surface was down to 135.207°C. It means the concrete strength decrease rate was suppressed within 2%. Therefore, decreasing of concrete strength by arc welding heat could be mitigated by insulation of ceramic fiber.

Table 6. Comparison of the temperature before and after insulation of ceramic fiber

Location	Before insulation (°C)	After insulation (°C)
C0	992.044	135.207
C12	482.426	58.8307
C24	280.665	48.1957
C36	181.548	38.25
C48	134.256	29.391
C60	107.559	21.881

The performance of ceramic fiber in electro slag welding was investigated. The geometric and material properties of the ceramic fiber used are as in Table 5.

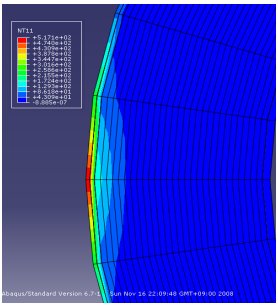

Fig. 14. Temperature distribution when ceramic fiber is inserted

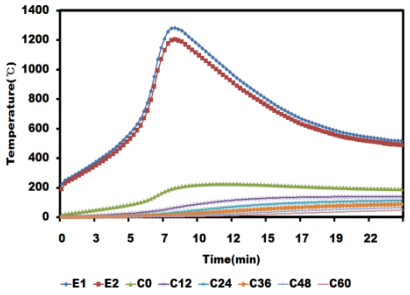

Fig. 15. Time-temperature curve when ceramic fiber is inserted under electro slag welding heat

Figs. 14 and 15 show temperature distribution by electro slag welding when the ceramic fiber is inserted. After insulation of ceramic fiber, the temperature on the concrete surface was down to 225.61°C. . It means the concrete strength decrease rate was suppressed within 10%.

Table 7. Comparison of the temperature before and after the reinforcement of ceramic fiber on electro slag welding

Location	Before reinforcement (°C)	After reinforcement (°C)
C0	1201.63	225.60
C12	761.95	138.15
C24	536.7	110.85
C36	399.47	85.68
C48	311.44	63.92
C60	245.17	46.16

Table 7 shows the decrease of concrete strength was controlled within 7.56% and 4.45% for siliceous concrete and calcareous concrete, respectively, on the concrete

surface. By inserting a thicker ceramic fiber, decrease of concrete strength could be much more reduced in electro slag welding.

5 Summary and Conclusions

This study investigated the effect of welding heat on concrete strength. The cases of arc welding and electro slag welding were considered as the welding methods. As a countermeasure to mitigate the strength reduction of concrete, an insulation of ceramic fiber between concrete and steel tube was suggested. And the welding heat mitigating amount by ceramic fiber was shown.

(1) The decreasing rate of concrete strength is a maximum of 37.36% by arc welding. Inserting ceramic fiber between concrete and steel tubes suppressed concrete strength reduction within 2%.
(2) The decreasing rate of concrete strength is a maximum of 79.26% by arc welding. Inserting ceramic fiber between concrete and steel tubes suppressed concrete strength reduction within 7.56%.
(3) The analysis results show that ceramic fiber efficiently blocks out conduction of the arc welding heat. By increasing the thickness of ceramic fiber, the heat blocking efficiency can be enhanced.
(4) The electro slag welding makes concrete strength much lower than the arc welding because electro slag welding heat is much higher than that of the arc welding.

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Mesoporous Co(III) bis(tetrazolate) Framework for CO_2 Adsorption

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Abstract. Mesoporous Co(III) bis(tetrazolate) metal organic framework was prepared by the reaction of cobalt (III) nitrate and tetrazole in water. The crystalline nature of the material was verified by its X-ray diffraction pattern. Its Fourier transform-infrared spectrum showed absence of N-H stretching vibration proving nitrogen coordination with cobalt. Its non-electrolytic nature was verified by its insolubility in water. Its surface area, pore size and pore volume were 543 m^2/g, 4.9 nm and 0.67 cm^3/g respectively. Its thermogravimetric analysis showed stability up to 250 °C. Its mesopore provided an opportunity to examine its CO_2 uptake, and it was nearer to 6 wt%. This study revealed potential for other metal based tetrazolate derivatives for CO_2 sorption.

1 Introduction

Research on designing materials for CO_2 adsorption in response to controlling global warming has been important worldwide. Many materials have been developed and documented in this context but the search is still continuing. Metal organic frameworks (MOF's) [1,2], covalent organic frameworks (COF's) [3,4], porous organic polymers (POP's) [5,6] etc. are some of the porous materials that inspired much the researchers for some period. Now the research reveals reduced interest for them typified the number of publications which have seen a dramatic decrease. Some of the requirements for materials for CO_2 sorption that have been derived from the previous reports are importance of material porosity, periodic arrangement of pores, nitrogen and acid enrichment of porous materials, presence of both micro and mesopores together. Carbon was also reported as a good sorbent, though it carries only pores without any functional groups [7]. But it does not mean the adsorbent need not have acid groups and nitrogen sites. Presence of such functional groups and sites could boost CO_2 sorption capacity of materials. Tetrazole derivatives carry many nitrogen sites with coordination capability [8]. Hence, in this present study it was planned to synthesize transition metal complexes with a tetrazole derived from

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1,4-dicyanobenzene and sodium azide. Its synthesis, characterization and CO_2 adsorption are discussed in the following sections.

2 Experimental

2.1 Materials and Methods

1,4-dicyano benzene (1,4-DCB, TCI, Japan), sodium azide, ammonium chloride, N,N'-dimethylformamide (DMF), sodium bicarbonate were obtained from Daejung chemicals (Korea) and cobalt(III)nitrate hexahydrate was obtained from Aldrich and used. All the chemicals were used as received without further purification.

2.2 Synthesis of 1,4-di(1H-tetrazol-5-yl)benzene

In the typical preparation, 1,4-DCB (2 mmol), sodium azide (4 mmol), ammonium chloride (4 mmol) were dispersed in 50 mL DMF and refluxed at 125 °C for 8 h. The obtained Na-form of tetrazole was filtered and dissolved in water. To this solution, 0.5 N HCl was added resulting a white precipitate of H-form of 1,4-di(1H-tetrazol-5-yl)benzene. The product was filtered and washed with water and dried.

2.3 Synthesis of Co(III) bis(tetrazolate) Framework

The H-form of 1,4-di(1H-tetrazol-5-yl)benzene (1 mmol) was dispersed in 50 mL of water. Sodium bicarbonate (2 mmol) was added and stirred until the solution becomes clear. Cobalt(III) nitrate (1mmol) dissolved in 10 mL of water was added dropwise to the above solution under constant stirring. The obtained precipitate formed after 1 h was filtered and washed with water and dried to constant weight at 100 °C.

2.4 Characterization

The Fourier transform infrared (FT-IR) spectra were recorded at room temperature with 4 cm^{-1} resolution between 4000 and 400 cm^{-1} in a FT-IR spectrometer (Nicolet IR 200). The thermogravimetric analysis (TGA) was carried out in a N_2 atmosphere at a flow rate of 20 mL/min on a Scinco N-1000 thermo gravimetric analyzer, by heating *ca.* 10 mg of the sample from 25 to 600 °C at a ramp of 10 °C/min The nitrogen adsorption-desorption isotherms were measured at -196 °C with a Belsorp mini II sorption analyzer. Prior to each adsorption measurement the samples were evacuated at 200 °C under vacuum ($p<10^{-5}$ mbar) in the degas port. The surface area was determined from the linear part of the Brunauer-Emmett-Teller (BET) equation. The pore volume was calculated using the BET plot from the amount of nitrogen gas adsorbed at the last adsorption point ($p/p_0 = 0.99$).

2.5 CO_2 Adsorption-Desorption

CO_2 adsorption-desorption measurements using high purity CO_2 (99.999%) and N_2 for the samples were performed using TGA. A sample weight of ca. 10 mg was loaded into an alumina sample pan in a TG unit and the initial activation was carried out at 200 °C for 1 h under a N_2 atmosphere. Then the temperature of sample was brought

down to 30 or 50 °C for CO_2 adsorption. The desorption was conducted by gradually raising the temperature from 30 or 50 °C to 200 °C by passing N_2. CO_2 and N_2 were passed through an automatic valve, assisted with a timer for continuous adsorption or desorption profile respectively.

3 Results and Discussion

3.1 FT-IR

The FT-IR spectrum of 1,4-di(1H-tetrazol-5-yl)benzene is shown in Fig. 1. The N-H stretching vibration occurred at 3386 cm^{-1}. The aromatic C-H stretching vibration showed a peak at 3011 and 3065 cm^{-1}. The group of peaks between 3000 and 2200 cm^{-1} were due to intermolecular hydrogen bonding of N-H group. The broad peak at 1890 cm^{-1} was due to combination of peaks at 852 and 1030 cm^{-1}. The ring vibrations yielded peaks at 1582, 1504 and 1458 cm^{-1}. The group of peaks between 1000 and 1280 cm^{-1} was due to C-H bending vibrations. The peak at 832 cm^{-1} is the characteristic one to confirm 1,4-disubstitution in the aromatic ring.

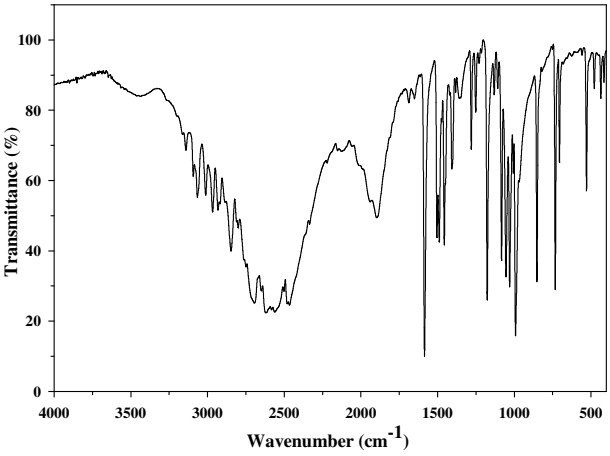

Fig. 1. FT-IR spectrum of 1,4-di(1H-tetrazol-5-yl)benzene

The FT-IR spectrum of Co(III) bis(tetrazolate) framework is shown in Fig. 2. The intense broad band at 3434 cm^{-1} was due to O-H stretching vibration of water coordinated to cobalt. Since transition metal ions can raise their coordination number to six, in addition to three tetrazole nitrogen coordination, three water molecules might also be present in the coordination sphere of cobalt. It was to be verified from TGA. Presence of water was also confirmed by its bending vibration at 1634 cm^{-1}. Absence of group of peaks between 3000 and 2200 cm^{-1} also confirmed N-H ionization and its coordination to cobalt. Most of the ring vibrations and C-H bending modes were absent, hence tetrazole rings might have center of symmetry after coordination to metal. Even then the intense peak at 1439 cm^{-1} was due to its ring vibration, but it was shifted to lower value than that of the free tetrazole.

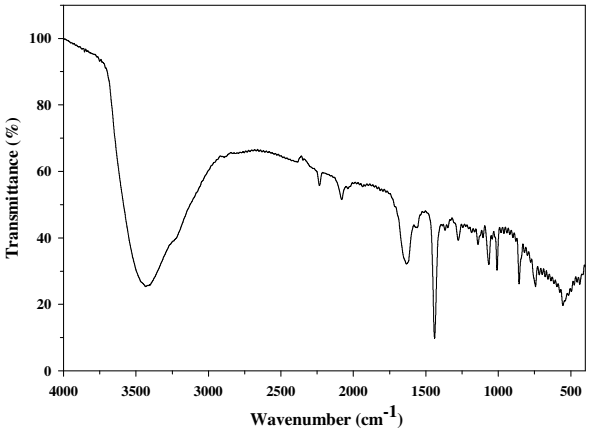

Fig. 2. FT-IR spectrum of Co(III) bis(tetrazolate) framework

3.2 TGA

The results of the TGA of Co(III) bis(tetrazolate) are shown in Fig. 3. The thermogram of 1,4-di(1H-tetrazol-5-yl)benzene is also shown in the same Fig. 1,4-di(1H-tetrazol-5-yl)benzene showed a weight loss close to 300 °C but the complex at 250 °C. Hence the thermal stability of the complex was lowered as a result of complexation. The initial low temperature weight loss was due to desorption of water from the complex. As the weight loss started even below 50 °C, water might not be in the coordination sphere. So cobalt is verified to have a maximum of three coordination.

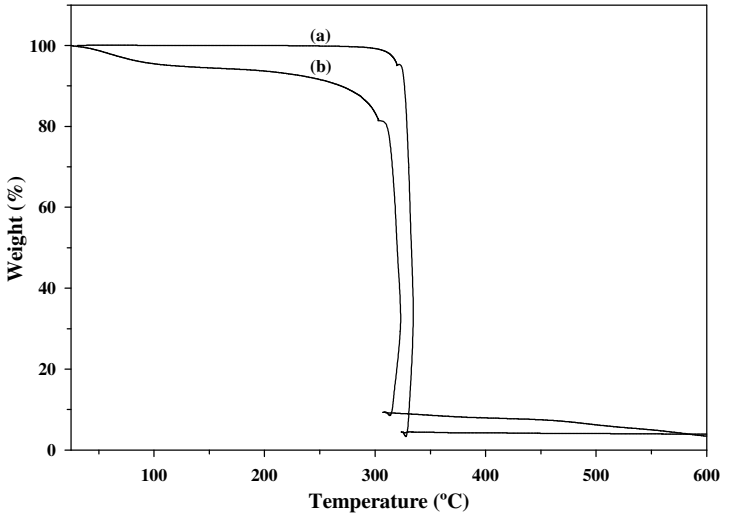

Fig. 3. Thermograms of (a) 1,4-di(1H-tetrazol-5-yl)benzene and (b) Co(III) bis(tetrazolate)

3.3 BET

The nitrogen adsorption-desorption isotherms of the complex are shown in Fig. 4. It showed Type-IV isotherm. Presence of both the meso and macropores were evident. The pore size distribution curve is shown as an inset figure. The meso pore size, BET surface area, pore diameter and pore volume are presented in Table 1. Mesopores were dominating over the macropores. Both are important for CO_2 sorption.

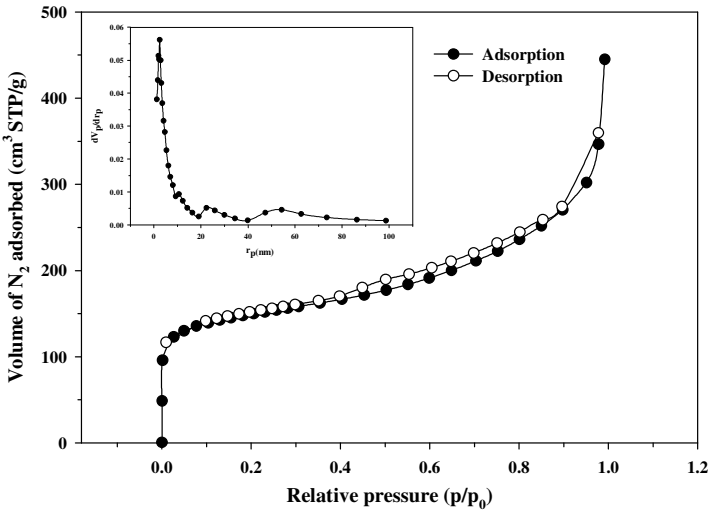

Fig. 4. N_2 adsorption-desorption isotherm of Co(III) bis(tetrazolate). Inset-Pore size distribution

3.4 CO_2 Adsorption

The CO_2 adsorption-desorption of the complex is depicted in Fig. 5. An increase in weight of about 6 wt% was observed when CO_2 was passed at 30 °C but a decrease was observed at 50 °C. The adsorption decreased with increase in temperature (50 °C). It is attributed to decrease of adsorbent-adsorbate interactions (site-adsorbate) induced by an increase of the mobility of adsorbed molecules into the sorbent as the result of rise of thermal agitation. The nature of adsorption (physisorption or chemisorption) is to be studied. This results proved that the Co(III) bis(tetrazolate) frame work prepared here is more potent CO_2 sorbent than the Co (II) thiazolidine framework reported previously [9].

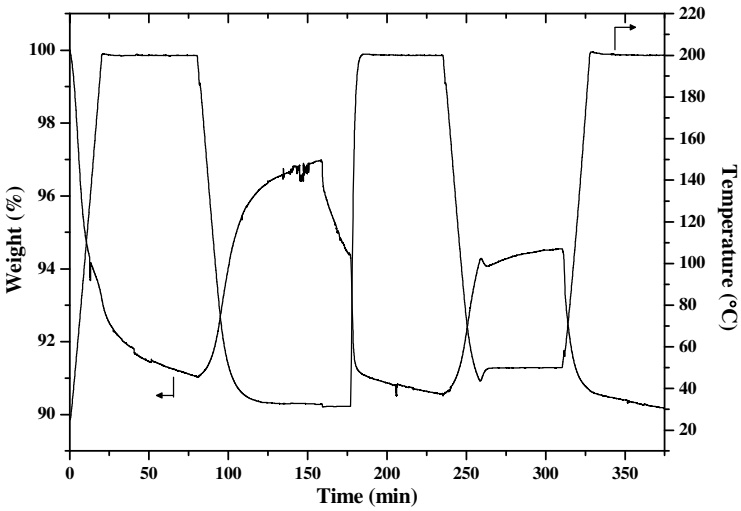

Fig. 5. CO_2 adsorption-desorption profile of Co(III) bis(tetrazolate) at 30 and 50 °C (adsorption) and 200 °C (desorption)

4 Conclusions

Cobalt (III) based bis(tetrazolate) MOF was successfully synthesized for the first time and studied for its CO_2 adsorption property. Results of the analysis proved that about 6 wt% of CO_2 was adsorbed by the MOF at 30° C. It can adsorb CO_2 of about 5 wt% even at 50°C which is the desired temperature for CO_2 from the flue gas. Hence it is proved that, this newly synthesized MOF sorbent is a better choice of sorbent for CO_2. This preliminary research needs to be further explored inorder to study its crystal structure and pressure swing CO_2 adsorption to make it an effective sorbent for the intended purpose.

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Towards a Framework for Ubiquitous Computing Technologies: Analyzing Users' Values Using Value Focused Thinking Approach

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Abstract. Using the value focused thinking(VFT) approach, twenty two in-depth interviews were conducted eliciting the interviewees' underlying values in using ubiquitous computing technologies. Nineteen values/objectives were successfully elicited: five fundamental objectives that users fundamentally value in ubiquitous computing and fourteen means and objectives leading to these fundamental objectives. The findings suggest that research frameworks currently cited in ubiquitous computing literature may largely fit with users' value structure while current technological developments are focused more on the supply side perspective. Technological development may need some course corrections linking towards the demand side perspective of ubiquitous computing technologies. A means-end network of value objectives in ubiquitous computing is presented at the end. This value network may be useful as a guideline for technological development and provide a basis for appropriate business service model development for ubiquitous computing.

Keywords: Framework, Ubiquitous Computing Technologies, Users' Values, Value Focused Thinking (VFT) Approach.

1 Introduction

Ubiquitous computing proposes 'invisible, calm' technology embedded in our environment with increased mobility [1]. In terms of its actual implementation, ubiquitous computing literature suggest 'five any' as a framework that may guide technological development: anybody, anywhere, anytime, any service, and any device [2]. Examples of ubiquitous environment suggest people move around the environment where miniature information processing machines are embedded and constantly communicating with each other sensing the context and provide appropriate information for actions [3].

Ubiquitous computing is emerging as a new computing paradigm with a strong appeal to the information technology community as well as other related fields, for the possibilities and opportunities of industrial and technological convergence. The

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T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 452–457, 2012.

idea of such an environment emerged decades ago and its development has recently been accelerated by improved communications capabilities, open and standardized networks, exponential increases of computing power, and emergence of adaptable hardware and software architectures. Especially during the last decade, it seems that ubiquitous computing has moved from a vision to a reality in terms of its component technologies [4]. As devices continues to become more portable and less expensive with increased computing power, computers seems to becoming more invisible and technologies calm and silent [5], so that computing power can be accessed and used anywhere, anytime, for any service, through any device, by anybody [2].

In ubiquitous computing, as computing power continues to increase and hardware becomes more compact, computers are expected to become part of our work and social life with increased mobility and environmental embeddedness of computing power [1]. Ubiquitous computing seems to have potentials to fundamentally alter the way we use computing including our interaction with the environment in maintaining daily life as well as prospering novel business opportunities. Proliferated infiltration of computing into the physical environment not only promises ubiquity of computing infrastructure, but also presents a new paradigm of human computer interaction via constant access to information and computing power. Ubiquitous computing may push the computing away from desktop and turn the computing from a localized task-specific tool to a daily companion [6].

However, many aspects of Weiser's vision of ubiquitous computing appear as futuristic, even today, as they did in 1991, despite the advance of technologies. For example, though semantically rich databases are being built as a basis for ubiquitous processing and identification technologies are being developed, general public can see partial implementation of these possibilities only in a limited scope. Intelligent home linked to cell-phone monitoring services are being advertised, but not being adopted or sold on a commercial scale yet. Though smart home technologies seems to offer a new opportunity to augment people's lives with ubiquitous computing technology via increased communications, awareness and functionality in our daily life, a number of challenges are still there to be overcome. These challenges are social and pragmatic as well as technological [7].

In other words, this limited public acceptance of ubiquitous computing are attributable to not only technological reasons but also social and business related ones [8]. Though public enjoyably responds to the exciting ubiquitous computing technologies in imaginary movies and futuristic forecasts, they would not accept, in their real life, technological savvy artifacts without appropriate business and social reasons.

In this regards, questions are still remained unanswered about real and practical values that may be provided by ubiquitous computing to the real world users: What is the value proposition the ubiquitous technologies offer to users, business, and society, and more fundamentally, what are the expectations from real-world users about the ubiquitous technologies? How much the actual and potential users of ubiquitous computing value ubiquitous technologies.

This study is designed and conducted with these questions in mind. The objective of this research is to elicit users' values concerning how ubiquitous computing technology would benefit their life and work. Technology should not be taken as a sole deterministic force driving the coming ubiquitous society in terms of its features and

designs, but technology is socially constructed via interactions of critical stakeholders during its development and advancement. Values of ubiquitous computing identified in this study, clustered and related to each other in a framework, may provide insightful guidance for further technological and business development with respect to ubiquitous computing. Knowing what users fundamentally value in using ubiquitous environment is critical in making informed decisions about directions of future technological development. Relatively little prior empirical research exists on how users perceive ubiquitous computing in terms of their own value system.

2 Method: Value Focused Thinking (VFT)

Values and value system occupy a focal position in directing human behavior. Values are fundamental to what people do, and thus, values are the driving force for decision making, leading to actual behavior, and the basis for thinking. Traditional decisions analysis methods are mostly emphasizing the exploration of alternatives. Focusing on alternatives is limited in that it is a reactive and backward process where identification of alternative precedes the articulation of value. Within alternative based thinking, one is not controlling the decision situations because one is restricted by choice of alternatives identified. Alternatives are only relevant for the situation because they help us to achieve what we value. Thus, decision analysis would better focus initially on values and later on alternatives which may be a means to achieve the value identified [9].

According to Keeney [10], alternative based thinking may not work in decision making situation because the attention is limited to available alternatives which may not reflect what the decision maker really wants: what he/she values. Values in any decision context mean what the decision maker wants to achieve via the decision. As alternatives are sought and defined for achieving the objectives of decision maker, when the objectives are clear, the decision context could be scoped appropriately. When the objectives are not clear, alternatives can be misleading the decision. Keeney proposes "value-focused thinking" (VFT), beyond the traditional approach called "alternative-focused thinking" (AFT) in any decision context. VFT would provide (1) alternatives with more innovative characteristics, (2) wider range of alternatives, and (3) preemptive analysis of future consequences of decision in view of inherent.

It is suggested that the best way to identify the values is to ask the concerned people [10]. The purpose and thought processes of VFT are different from those of alternative-focused thinking(AFT). VFT targets to identify desirable decision opportunities and create alternatives, while AFT is geared towards solving decision problems with given constraints. Therefore, the value-focused paradigm for addressing decisions is different from the standard alternative-focused paradigm in three important ways. First, significant effort is allocated to make values explicit. Logical and systematic concepts are used to qualitatively identify and structure the values appropriate for a decision situation. Second, this articulation of values in decision situations comes before other activities. Third, the articulated values are explicitly used to identify decision opportunities and to create alternatives.

We used the four-step process, as described in table 1, to identify and organize the values that an individual might have [9], concerning the use of ubiquitous computing. First, interviews were conducted to elicit values that individuals might have within a decision context. The output of the interviews would generally result in a long list of individual wishes. Second, the individual values and statements were converted into a common format. This is generally in the form of an objective (i.e. object and a preference). Third, these (sub-) objectives are clustered together to form a group of similar objectives, leading to higher level objectives. Fourth, these higher level objectives were classified as either being fundamental with respect to the decision context or merely a means to achieve the fundamental objectives. Keeney's differentiation of means objective from fundamental objective resembles the differentiation of instrumental values and intrinsic values, first discussed by Plato in the "Republic". An instrumental value is a means towards achieve something else that is good (e.g., a radio is instrumentally valued in order to hear music – intrinsic value). An intrinsic value is the one that is worth having for itself, not as a means to something else. As a result, relations were established among these means and ends objectives, leading to a 'means-ends' network of values in using ubiquitous computing.

Table 1. Research methodology

Steps	Processes
Step 1	Eliciting and identifying values - Develop wish lists from interviews asking for what they wish concerning the situation - Probe further with in-depth questions identifying underlying values
Step 2	Construct and compile a list of objectives - Convert statements into an objective form consisting of preferential direction of action and action objects - Remove duplicates
Step 3	Cluster sub-objectives forming higher level objectives - Cluster analogous objectives forming a group of sub-objectives - Generate simpler set of meaningful objectives representing subjects values
Step 4	Construct means-ends network of objectives - Classify these higher level objectives, by analyzing the sequence, into fundamental (end) values and instrumental (means) values - Draw a relationship diagram of these objectives

Table 2. Higher level objectives

Serve my desire	Lower device cost
Ensure freedom of choice	Lower service cost
Assure effective decision making	Assure personal preference
Increase the value of individual	Provide personalized service
Provide beneficial opportunities	Recommend services
Secure privacy of my life and work	Provide invisible help
Ensure anonymity	Provide context-sensitive information
Authenticate appropriate users	Increase convenience
Support my mobility	Minimize search cost and time
Ensure service portability	

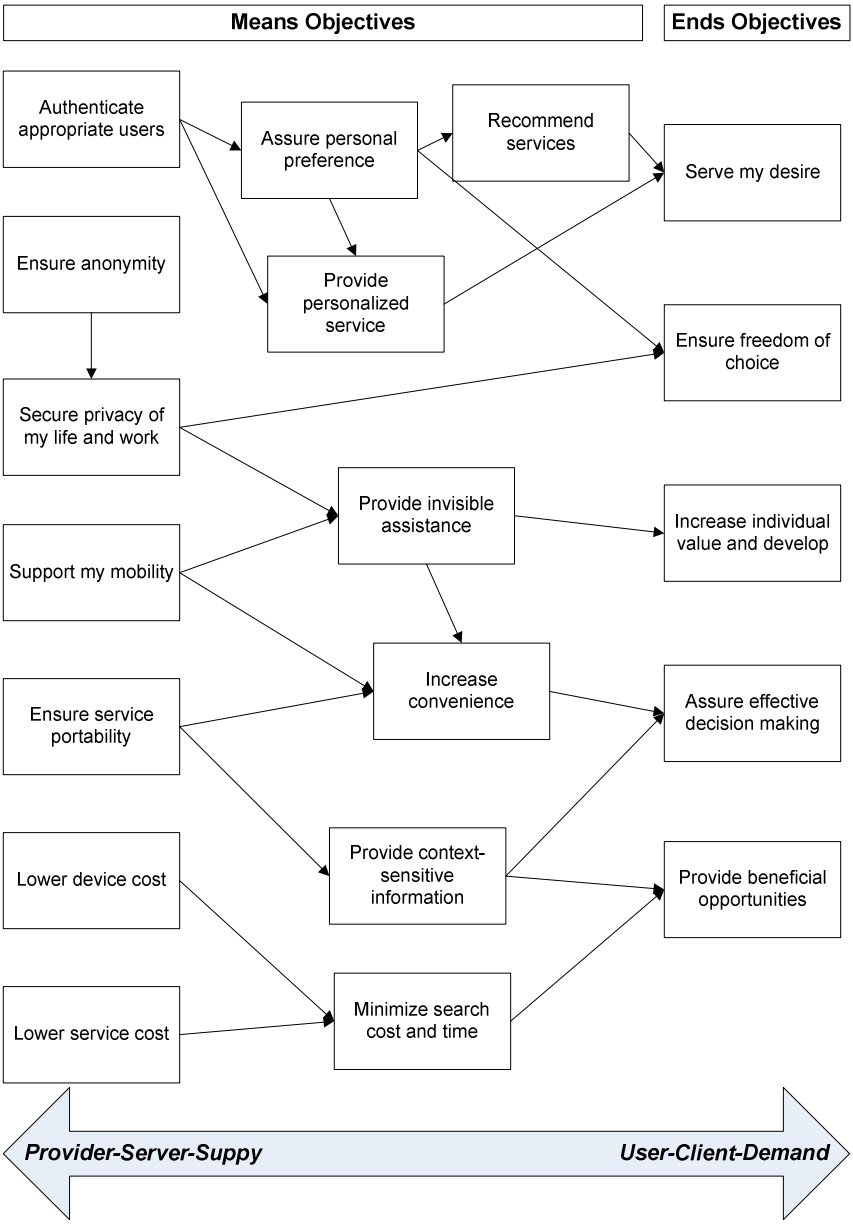

Fig. 1. Means-Ends Network of Users' Values concerning the Ubiquitous Computing

3 Discussion

To understand how users value the technological environment is important for the user-acceptable development of ubiquitous computing technologies. Knowing the

underlying objectives that users are striving to achieve is critical in making informed decisions about directions and scope of future technological development. It seems that users perceive that ubiquitous computing technology would (1)serve their personal desires, by (2)ensuring freedom of choice for him/herself, (3)assuring effective decision making, (4)providing beneficial opportunities, and (5)increasing their individual value for further development. In serving these fundamental values, the technologies need to resolve following means objectives: (1)authenticate appropriate users, (2)assure personal preference, (3)recommend services, (4)ensure anonymity, (5)provide personalized services (6)secure privacy of life and work, (7)support mobility, (8)provide invisible assistance, (9)ensure service portability, (10)increase convenience, (11)lower device cost, (12)provide context-sensitive information, (13)lower service cost, and (14)minimize search cost and time.

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Effort Estimation in Incremental Software Development Projects Using Function Points

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Abstract. Nowadays, software development methodologies, such as Rational Unified Process or agile methodologies, recommend developing software by increments instead of following a waterfall lifecycle model. Although Function Points is one of the most known techniques to estimate effort and cost in software projects, there is little work that indicates how to adapt it in non-waterfall lifecycles, such as incremental ones.

This paper presents an approach called Incremental-FP that allows estimating effort for each increment using unadjusted function points (UFP) and COCOMO's effort adjustment factor (EAF). This approach could be complemented with the Use Case Precedence Diagram to determine use case prioritization, and the rules proposed in a previous work to count UFP with UML class diagrams.

We also present the results by applying our approach in projects with undergraduate students. We obtained good results, because the difference between estimated effort and real effort was lower than 20% for the second increment. Moreover, the results obtained with Incremental-FP were better than the ones obtained with adjusted function points.

Keywords: function points, incremental software development, object oriented, cocomo.

1 Introduction

Nowadays, incremental software development is recommended by many software development methodologies, such as Rational Unified Process or agile methodologies, instead of waterfall lifecycle model [16]. In incremental development, we break up the work into smaller pieces, schedule them to be developed over time, and integrated as they get completed [3]

Function Point (FP) [9] is a software measurement technique created by Allan Albrecht at IBM and it is widely known and utilized. FP considers five basic parameters to measure a software system: External Input (EI), External Output (EO), External Inquiry (EQ), Internal Logic File (ILF), and External Interface File (EIF).

T.-h. Kim et al. (Eds.): ASEA/DRBC 2012, CCIS 340, pp. 458–465, 2012.

COCOMO II, proposed and developed by Barry Boehm [2], is one of the best documented and utilized models for cost estimation. The model proposes a set of cost drivers which indicates the context in which the project is currently set. These drivers are used to determine the Effort Adjustment Factor (EAF), which is utilized to adjust the effort required to develop a software system.

This paper presents an approach called Incremental-FP that allows estimating effort for each increment using unadjusted function points (UFP) and Cocomo's EAF. This approach could be complemented with the Use Case Precedence Diagram to determine the sequence of construction use cases (or use case prioritization) [14] and the rules proposed in a previous work [15] to determine UFP of ILF or EIF with UML class diagrams.

The rest of the paper is organized as follows: Section 2 describes the related work in the area, Section 3 details our proposed technique called Incremental-FP, and Section 4 shows the obtained results in projects with undergraduate students. Finally, a summary and our plans for future research will conclude our paper.

2 Related Work

We conducted a systematic review to find similar techniques to Incremental-FP. We could find three techniques that define procedures to estimate the effort in incremental lifecycles or similar lifecycles, such as the iterative [3]. The techniques are proposed by Orr et. al [11], Kang et. al [10], and Hericko et al. [6].

Only two of the techniques [10,6] define rules to estimate effort between increments or iterations. However, none of the techniques defines how to divide the number of function points between iterations or increments. Besides, none of them considered that the productivity of the team may change due to several factors such as staff turnover, software development experience, knowledge of the tools and languages, etc. throughout the entire project.

None of the techniques considered how to prioritize the construction of use cases or requirements. Additionally, it was observed that the technique proposed by Hericko et.al indicates how to calculate FP using object-oriented models.

3 Incremental FP

The first task of Incremental-FP is to determine the unadjusted function points (UFP) for each increment. The criterion followed to adapt this technique for incremental lifecycles is to consider that the result of the computation of the UFP for the complete project must be equal to the sum of the UFP counted separately for each increment. One of the contributions of this proposal is to determine the UFP of the Internal Logic Files (ILF) and the External Interface Files (EIF) for each use case. First, the number of UFP of each FP file (ILF or EIF) must be distributed proportionally among all FP transactions (EI, EO and EQ) using the formula 1 (*UFP_File_Tr(j)* = UFP for a FP transaction "j" due to FP files, *TTrUFP(i)* = total of transactions that uses a ILF/EIF

"i", *UFP_File(i)* = UFP of FP file "i", *i* = ILF/EIF used in the FP transaction "j", and *j* = FP transaction).

$$UFP\_File\_Tr(j) = \sum_{i=1}^{n}\left[\frac{1}{TTrUFP(i)} \times UFP\_File(i)\right] \quad (1)$$

In a previous work [13], the distribution of UFP due to FP files was made between use cases and not between FP transactions. Unfortunately, developers could identify the use cases for the same software in different ways, because there is no consensus among the authors to define what a use case is. For example, Fig. 1 shows two diagrams: A and B, and both represent the same functionalities of a software system. Diagram A corresponds to the style proposed by Pender [12], and Diagram B is proposed by Bittner [1].

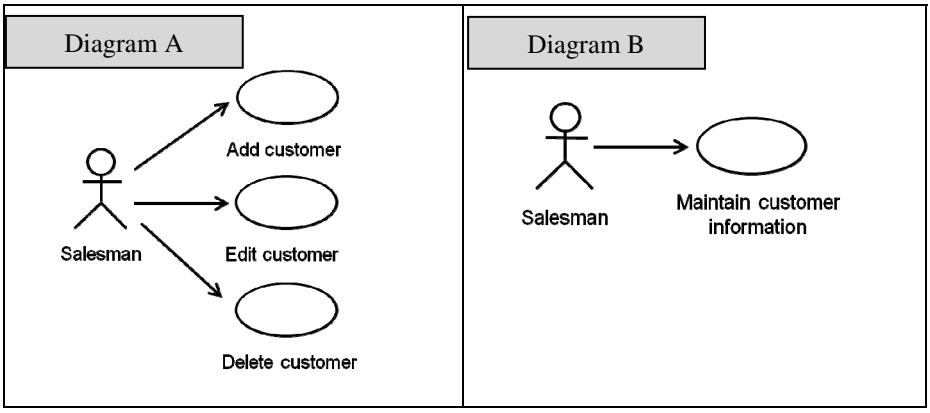

Fig. 1. Different styles to represent the same software with use cases

By making the distribution of the number UFP for each FP file between use cases, the calculation would be affected by the style of identifying use cases. For instance, we have three use cases in Diagram A and only one use case in Diagram B. This is avoided by making the division between FP transactions, since in both cases (diagram A or B) we can identify three FP transactions.

Using the results obtained from de formula 1, we can calculate the UFP for each use case. To accomplish this task, the formula 2 should be used (*UFP_UC(k)* = UFP for the use case "k", *UFP_Tr(j)* = UFP for a FP transaction "j", *UFP_FileTr(j)*= UFP for a FP transaction "j" due to FP files, and *j*= FP transaction identified for the use case "k").

$$UFP\_UC(k) = \sum_{j=1}^{n}[UFP\_Tr(j) + UFP\_FileTr(j)] \quad (2)$$

The next task is to define the software increments that will be developed along the entire project, and the effort required to construct each increment. We can use the Use

Case Precedence Diagram [14] to select which use case could be developed in each increment. In order to calculate the estimated effort for the first increment, we must calculate the estimated productivity. This productivity is calculated using historical productivity of previous projects, which is measured in men-hours/UFP, and historical COCOMO's EAF. The formula 3 shows how to calculate the estimated productivity (*EstProd_Incr1* = estimated productivity for the first increment measured in men-hours/UFP; *EAF_Incr1* = EAF calculated for the first increment, *HistoricProd* = historical productivity of a previous project; and *EAF_Historic* = EAF related to the historical productivity of the previous project)

$$EstProd\_Incr1 = \frac{EAF\_Incr1 \times HistoricProd}{EAF\_Historic} \tag{3}$$

Formula 4 was adapted from formula 3 in order to calculate next increments (*EstProd_Incr(i)* = estimated productivity for increment "i"; *EAF(i)* = EAF calculated for increment "i" or increment "i-1", *RealProd_Incr(i-1)* = real productivity in the increment "i-1", and *i* = number of increment).

$$EstProd\_Incr(i) = \frac{EAF(i) \times RealProd\_hcr(i-1)}{EAF(i-1)} \tag{4}$$

In formula 4, estimated productivity is calculated using the information obtained in the previous increment. However, it also could be used the average of the real productivities obtained in previous increments, as it is presented in formula 5 (*j* = number of the previous increment to "i")

$$EstProd\_Incr(i) = EAF(i) \times \frac{\sum_{j=1}^{i-1} \frac{RealProd\_Incr(j)}{EAF(j)}}{i-1} \tag{5}$$

The next task is to determine the number of UFP for each increment using the formula 6 (*UFP_Incr(i)* = number of UFP for increment "i", *UFP_UC(k)* = number of UFP for the use case "k" that is obtained using formula 2, and *k* = use cases that will be developed in the increment "i").

$$UFP\_Incr(i) = \sum_{k=1}^{n} UFP\_UC(k) \tag{6}$$

Finally, the effort required to developed the next increment is calculated using formula 7 (*EstEffort_Incr(i)* = estimated effort for increment "i", *UFP_Incr(i)*= number of UFP for increment "i" obtained with formula 6, and *EstProd_Incr(i)* = estimated productivity for "i" obtained with formula 4 or formula 5).

$$EstEffort\_Incr(i) = UFP\_Incr(i) \times EstProd\_Incr(i) \tag{7}$$

It could happen that the estimated effort for one increment could be greater or less than the development capacity of the team. In such cases, the team may change the number of use cases to be develop in each increment.

4 Obtained Results

The projects, for which results are shown in this Section, were developed for undergraduate students of the Informatics Engineering Program that were enrolled in the Software Engineering course in 2008 at Pontificia Universidad Católica del Perú. In this course, the students had to develop a software project.

The project teams were divided in groups of 11 or 12 students. The topics of the projects were different in every academic semester to avoid plagiarism. Although the projects were different in each academic semester, both of them corresponds a kind of information system in which its input/output process are similar. Therefore, results obtained from the two different academic semesters (2008-1 and 2008-2) are comparable. The methodology used by every team was an adaptation of RUP [7]. Before beginning of the construction phase, each team had to complete the Software Requirements Specifications document (SRS) [8] with use cases. Client/server 2-tiered architecture [17] was used and validated through a prototype.

The students utilized the Use Case Precedence Diagram (UCPD) [14] to determine the sequences of construction of the use cases, and the rules defined in a previous work [15] to determine ILF/EIF unadjusted function points using analysis class diagrams. Table 1 shows the information obtained for each team. For each increment, the first column shows the real effort of each team in men-hours (m-h), and the second column shows the number of UFP calculated.

Table 1. Real Effort and UFP per increment for each team

Semester	Team	Increment 1		Increment 2	
		Real Effort (m-h)	UFP	Real Effort (m-h)	UFP
2008-1	A	365	116.52	229	130.00
	B	398	107.63	340	173.00
2008-2	A	205	247.55	256	485.17
	B	404	197.89	488	472.11

The teams distributed the workload among its member considering the number of UFP for each use case. In a weekly basis, students had to fill a report of the hours needed to work in a task of the project per day. The students were informed that the final grade was not influenced by the number of hours invested in the project. This was specified to ensure the honesty in the effort recorded by each team member. Table 1 only shows the results obtained in the first two increments for all teams; although, all the projects had three increments. Unfortunately, some students did not record the hours invested in the third increment.

Real effort showed in Table 1 does not consider effort of internal and control meetings because we only wanted to consider effective work utilized in software

construction (detailed design, programming and testing). A magnitude of relative error (MRE) was utilized to show results in tables 2 and 3 of this Section. The MRE compare the estimated effort versus real effort [4]. Hastings et. al [5] indicates that a technique may be considered predictive and may be used with confidence, when the MRE is less than or equal to 20%.

Team members had worked in small projects in previous semesters (with 4 team members) developing small applications. The students had not utilized the programming tool before the construction of the first increment. At the beginning of the second increment, the students knew how to program with the tool (Visual Basic .Net). The change in the context between the first and the second increment can be represented with the Cocomo's effort multipliers LEXP (language experience) and AEXP (application experience). Both multipliers were considered "very low" in the first increment and "very high" in the second increment. Therefore, EAF of the first increment was 1.46 and EAF of the second increment was 0.8.

Table 2 shows the results obtained by applying the formula 4 to calculate the estimated productivity (third column) and estimated effort (fourth column). The last column shows the MRE.

Table 2. Productivity, Effort Estimated, and MRE for the second increment

Semester	Team	Estimated Productivity (m-h/UFP)	Estimated Effort (m-h)	Real Effort (m-h)	MRE
2008-1	A	1.72	223.14	229.00	2.56%
	B	2.03	350.54	340.00	3.10%
2008-2	A	0.45	220.15	256.00	14.00%
	B	1.12	528.12	488.00	8.22%

Regarding the differences between estimated and real effort, measured with the MRE, it can be observed in Table 2 that all are below 20%. This means, according Hastings et a. [5], Incremental-FP can be considered as a predictive technique that could be used with confidence for planning purposes. Table 2 also shows that estimated productivities are different between teams, this means it is not advisable to use the data recorded from another team in order to estimate effort and it is better to use their own data.

The Function Points technique and many authors who work with this technique suggest having historical information with the number of person-hours or person-months required to develop a number of adjusted function points. Adjusted function points (or simply "function points") are calculated when we multiply UFP with a Value Adjustment Factor (VAF). VAF considers factors such as ratio of transaction or reusability. However, it does not consider factors such as experience in application development or experience in the programming tool and language; factors that are considered by COCOMO's effort multipliers. This means that the estimated VAF for the undergraduate students included in this Section would be the same for all increments. Formula 8 shows the estimated effort for the second increment based on the first increment productivity with adjusted function points. In formula 8, adjusted function points is represented as UFP x VAF

$$EstimatedEffort\_Incr2 = \frac{RealEffort\_Incr1}{UFP\_Incr1 \times VAF} \times UFP\_Incr2 \times VAF \quad (8)$$

It can be observed in formula 8, productivity of the first increment is calculated with the real effort of the first increment (RealEffort_Incr1), and with the adjusted function points for the first increment (UFP_Incr1 x VAF). The estimated effort of the second increment (EstimatedEffort_Incr2) is calculated when we multiply real productivity of the first increment with the adjusted function points of the second increment (UFP_Incr2 x VAF). We can delete VAFs of both increments because they are the same. Finally, formula 9 shows how to calculate the estimated effort for the second increment in the projects included in this Section.

$$EstimatedEffort\_Incr2 = \frac{RealEffort\_Incr1}{UFP\_Incr1} \times UFP\_Incr2 \quad (9)$$

The third column of the Table 3 shows the results obtained when applying formula 9 to estimated effort needed to develop the second increment.

Table 3. Comparison between Incremental-FP and adjusted function points for the second increment

Semester	Team	Real Effort (m-h)	Adjusted FP-Est. Effort (m-h)	Incremental-FP Est. Effort (h-p)	MRE for Adjusted FP	MRE for Incremental-FP
2008-1	A	229.00	407.23	223.14	77.83%	2.56%
	B	340.00	639.73	350.54	88.16%	3.10%
2008-2	A	256.00	401.77	220.15	56.94%	14.00%
	B	488.00	963.82	528.12	97.50%	8.22%

As it can be observed in Table 3, the MRE of the adjusted FP is greater than the MRE of Incremental-FP. According Hastings et. al [5] adjusted FP would not be reliable for planning purposes for the second increment in the projects with undergraduate students, because the results obtained are greater than 56%. Furthermore, we can say that the VAF does not reflect changes in the context of a project and it is unnecessary to use it.

5 Conclusions and Future Work

This paper presents a technique that is based on Function Points to estimate the effort in projects that follows an incremental lifecycle. This technique can be complemented with the Use Case Precedence Diagram in order to prioritize use cases.

We also show the results obtained by applying the formulas proposed by our technique in projects with undergraduate students. The relative error between the estimated effort and real effort in the second increment was less than 20%. The results

obtained suggest us that it is unnecessary to use the VAF proposed by the FP technique, and it is enough to use UFP. Although the results obtained are very encouraging, we are aware that more experiments are needed to confirm them.

As future work, we are developing a software tool called Tupux that will easily allow the calculations of the estimated effort using Incremental-FP.

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Semantic Approach to Verifying Activity Diagrams with a Domain Specific Language

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Abstract. The Unified Modeling Language is widely used as a design tool for modeling a software system via a set of diagrams providing both static and dynamic views of the system. However, the applications of UML have many problems, namely model inconsistent behaviors, model misconception, and mistake interpretation. The notations are used in different definitions that may not conform to the UML specification. This paper thus present a semantic approach to verifying UML activity diagrams with a domain specific language called Action Description Language (ADL). The method would facilitate the inspection of activity diagrams for the conformance to UML specification, resulting in better quality of design blueprints that would lead to quality software systems.

Keywords: Domain Specific Language, Activity Diagram, Verification, Process Improvement.

1 Introduction

The Unified Modeling Language (UML) is widely used as a design tool for describing the system behaviors via a set of diagrams, which carry out the interpretation of the various components within the system, describe the behavior and functionality of objects within the system, and indicate the relationships between objects and other objects within or outside the system [1]. For quality and standardization in the design, the UML Specification has been defined by Object Management Group (OMG) for controlling the semantics and notation of UML. OMG is a consortium, which originally aimed at setting standards for distributed object-oriented systems, and is now focusing on modeling programs, systems and business processes, as well as model-based standards [2].

The applications of UML have many problems though, for example, model inconsistent behaviors, model misconception, and mistake interpretation [3]. The mistake interpretation means the diagram is interpreted in various semantics that mostly are mistake semantics departing from the owner intention. This results in the incomplete system, reengineering, or project failure.

Kotb and Katayama [4] proposed a novel XML semantics approach for checking the semantic consistency of XML document using attribute grammar techniques. Shen et al. [5] implemented a toolset which could validate both static and dynamic aspects

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of a model. The toolset was based on the semantic model using Abstract State Machines presented in [6], [7]. Flater et al. [8] proposed human-readable Activity Diagram Linear Form (ADLF) for describing activity diagrams in text format. Narkngam and Limpiyakorn [9], [10] introduced a preventive approach to rendering valid activity diagrams with a domain specific language called Action Description Language (ADL).

This paper presents a semantic approach to verifying existing UML activity diagrams as an application of Action Description Language [9]. The inspection will be carried out to examine the conformance to UML Specification version 2.4.1 [2], resulting in better quality of design blueprints that would lead to quality software systems.

2 Background

The following subsections briefly describe UML activity diagrams, and Action Description Language that are related to this research.

2.1 UML Activity Diagram

The UML diagrams represent two views of a software system model: 1) static view, and 2) dynamic view. The static view describes the static structure of the system, whereas the dynamic view describes the behavior of the system. Class diagrams, Component diagrams, Composite structure diagrams, Deployment diagrams, Object diagrams, Package diagrams, and Profile diagrams provide the static view of system modeling. While Activity diagrams, Communication diagrams, Interaction overview diagrams, Sequence diagrams, State diagrams, and Timing diagrams visualize the dynamic view of a system [1], [2].

Activity diagrams are the blueprints used for describing procedural logic, business processes and workflows. An activity diagram consists of nodes and flows with controls such as decision, fork, join, merge. A node represents an action, and flows denote sequences of actions or behaviors of a system. The current ADL covers the generation of intermediate activity diagrams as shown in Fig. 1.

2.2 Action Description Language (ADL)

Action Description Language [9] is a domain specific language used for creating activity diagrams that conforms to UML specification. The tailored activity diagram metamodel (Fig. 2) is the target model constructed from the source of ADL metamodel (Fig. 3), which consists of Element, Object, Relation, Guard and Action. The syntax of ADL is defined for an action, a sequence of actions, and a decision. The grammar of iteration is not defined as a loop can be directly derived from object relations. The controls can be automatically detected from its individual pattern as described in [10].

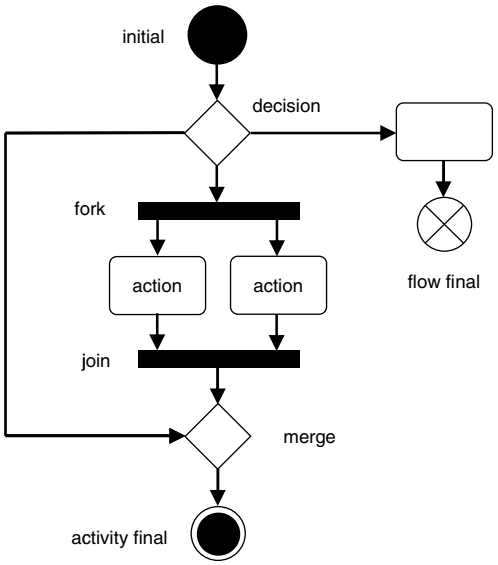

Fig. 1. Components of intermediate activity diagram [9]

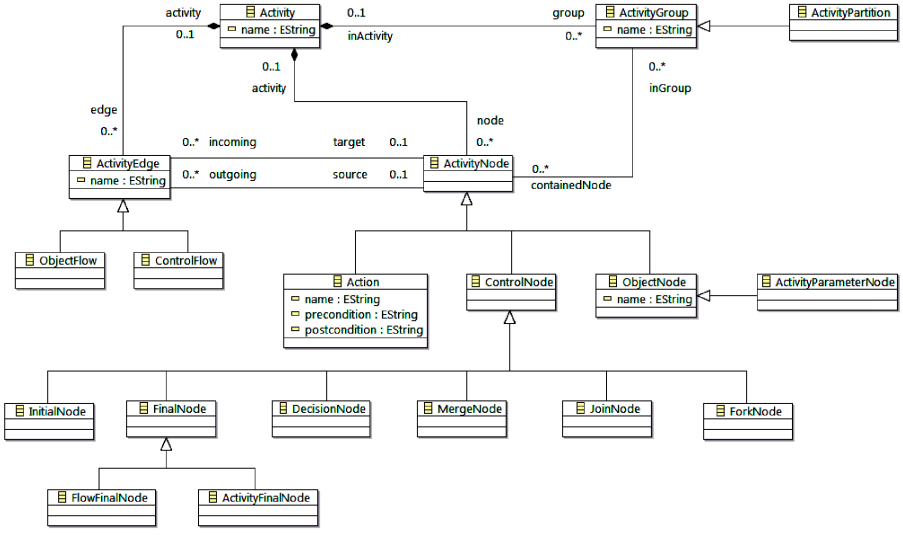

Fig. 2. Tailored activity diagram metamodel

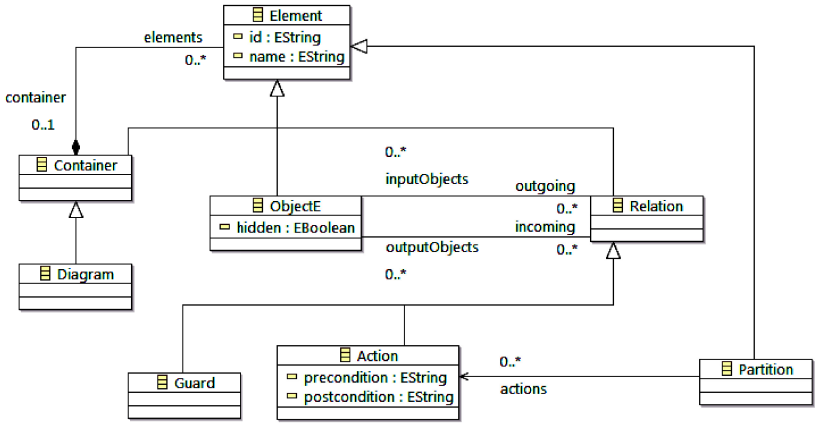

Fig. 3. ADL metamodel

3 Research Methodology

The process of activity diagram verification consists of four main steps (Fig 4) as briefly explained in the following subsections.

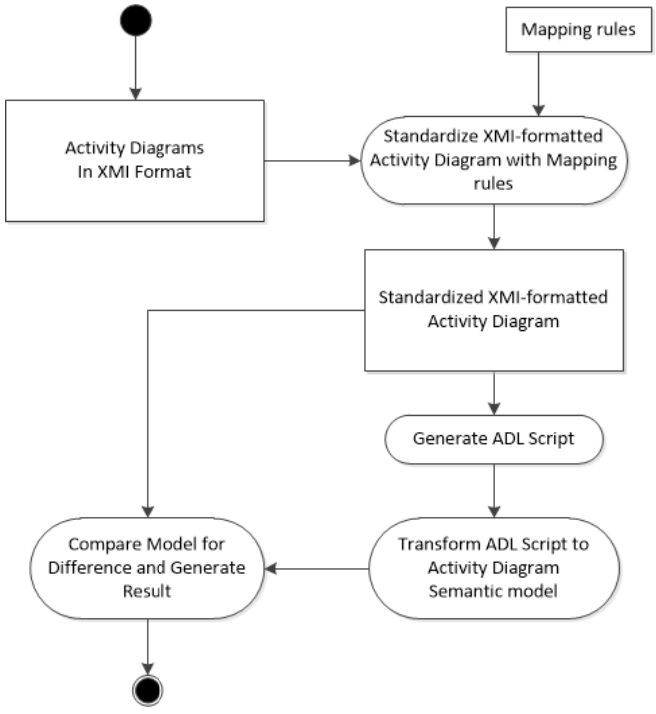

Fig. 4. Process of activity diagram verification

3.1 Standardize XMI-Formatted Activity Diagram with Mapping Rules

Initially, the XMI standard converter, which is developed based on QVTO [11], will be invoked to transform the source activity diagram in XMI format into the defined standard XMI format using mapping rules. The mapping rules contained in the individual XMI standard converter is particularly defined for a certain UML CASE Tool. Currently, the mapping rules only support ArgoUML, Modelio and Jbuilder.

3.2 Generate ADL Script

The second step is to transform the XMI standard document obtained from the previous step into the ADL script. The method is to reverse the approach presented in [9]. If the resulting ADL script fails during the verification in the next step, it can be accessed and revised.

3.3 Transform ADL Script to Activity Diagram Semantic Model

The third step is to generate activity diagram semantic model using transformation technique by adapting the approach of generating activity diagrams semantic model from ADL scripts presented in [9]. The resulting activity diagram semantic model consists of nodes, object evidence, guard condition objects, and relationship.

3.4 Compare Model for Difference and Generate Result

The final step is to verify the standardized XMI-formatted activity diagram against the activity diagram semantic model. The output of inspection result and error report will be generated.

4 A Prototype Tool

To support the automation of activity diagram verification with a domain specific language, a tool has been developed based on Eclipse Modeling Tools [12]. The tool facilitates the transformation of the source activity diagram in the XMI format into the ADL script, the inspection of the ADL script against the activity diagram metamodel, and the generation of the inspection result with corrective suggestion.

The example activity diagram created with ArgoUML v0.34 as shown in Fig. 5 was used as a case for verification with the methodology proposed in this paper. The diagram consists of six actions, a fork node, a join node, and a decision. It was converted into the XMI format by select the export XMI menu in application.

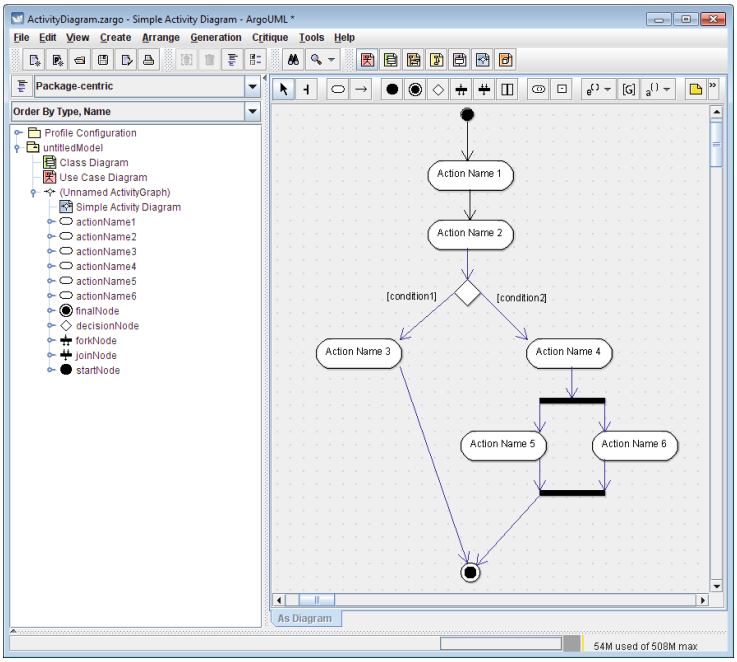

Fig. 5. Example activity diagram as a source for verification

The prototype tool would then invoke the XMI standard converter to convert the XMI-formatted activity diagram into the XMI standard document using mapping rules. Example of mapping rules is shown in Fig. 6. The result of the XMI standard document associated with the activity diagram in Fig. 5 is shown in Fig. 7.

```
### Action Rule ###
if tag.name is ActionState then
        node[ref] = hash(this[xmi.id]);
        node[ref][type] = "basicad:Action";
        node[ref][name] = this -> State.extry -> UninterpretedAction ->
                          Action.script -> ActionExpression[body];
        node[ref][incoming] = "//@edge." . node[this -> StateVertex.incoming ->
                              Transition.idef];
        node[ref][outgoing] = "//@edge." . node[this -> StateVertex.outcoming ->
                              Transition.idef];
end
### ControlFlow Join Rule ###
if tag.name is Pseudostate & tag.kind = "join" then
        foreach (StateVertex.incoming as incomingRow)
                node[ref] = hash(this[xmi.id]);
                node[ref][type] = "basicad:ControlFlow";
                node[ref][name] = null;
                node[ref][source] = "//@edge." . node[incomingRow -> Transition.idef];
                node[ref][target] = "//@edge." . node[this -> StateVertex.outcoming ->
                                    Transition.idef];
        end
end
```

Fig. 6. Mapping rules of Action Rule and ControlFlow Join Rule

diagram_name.stardard.xmi

```
<?xml version="1.0" encoding="ASCII"?>
<basicad:Activity xmi:version="2.0" xmlns:xmi="http://www.omg.org/XMI"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:basicad="http://project.adl.emf/basicad/1.0" name="diagram name">
  <edge xsi:type="basicad:ControlFlow" source="//@node.6" target="//@node.0" name=""/>
  <edge xsi:type="basicad:ControlFlow" source="//@node.0" target="//@node.1" name="condition1"/>
  <edge xsi:type="basicad:ControlFlow" source="//@node.1" target="//@node.2" name="condition2"/>
  <edge xsi:type="basicad:ControlFlow" source="//@node.2" target="//@node.7" name=""/>
  <edge xsi:type="basicad:ControlFlow" source="//@node.1" target="//@node.3" name="condition3"/>
  <edge xsi:type="basicad:ControlFlow" source="//@node.3" target="//@node.4" name=""/>
  <edge xsi:type="basicad:ControlFlow" source="//@node.4" target="//@node.7" name=""/>
  <edge xsi:type="basicad:ControlFlow" source="//@node.3" target="//@node.5" name=""/>
  <edge xsi:type="basicad:ControlFlow" source="//@node.5" target="//@node.7" name=""/>
  <node xsi:type="basicad:Action" incoming="//@edge.0" outgoing="//@edge.1" name="Action Name 1"/>
  <node xsi:type="basicad:Action" incoming="//@edge.1" outgoing="//@edge.2 //@edge.4" name="Action Name 2"/>
  <node xsi:type="basicad:Action" incoming="//@edge.2" outgoing="//@edge.3" name="Action Name 3"/>
  <node xsi:type="basicad:Action" incoming="//@edge.4" outgoing="//@edge.5 //@edge.7" name="Action Name 4"/>
  <node xsi:type="basicad:Action" incoming="//@edge.5" outgoing="//@edge.6" name="Action Name 5"/>
  <node xsi:type="basicad:Action" incoming="//@edge.7" outgoing="//@edge.8" name="Action Name 6"/>
  <node xsi:type="basicad:InitialNode" outgoing="//@edge.0"/>
  <node xsi:type="basicad:ActivityFinalNode" incoming="//@edge.3 //@edge.6 //@edge.8"/>
</basicad:Activity>
```

Fig. 7. XMI standard document of example activity diagram

Next, the processes of Generate ADL script, and Transform ADL script to activity diagram semantic model were carried out, respectively. The resulting ADL script generated from the source activity diagram (Fig. 5) is shown in Fig. 8. Finally, the tool compare model for difference and generate result. The result of inspection is shown in Fig. 9.

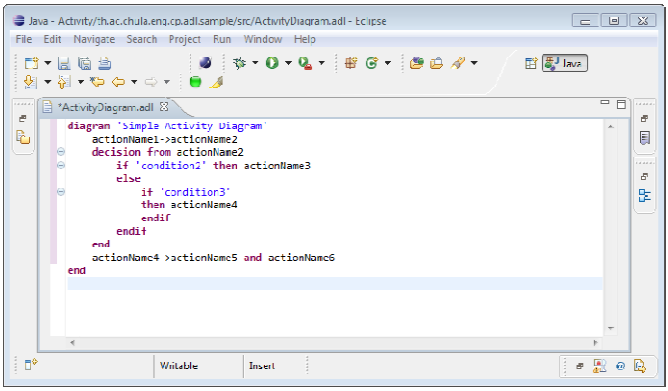

Fig. 8. ADL script of example activity diagram

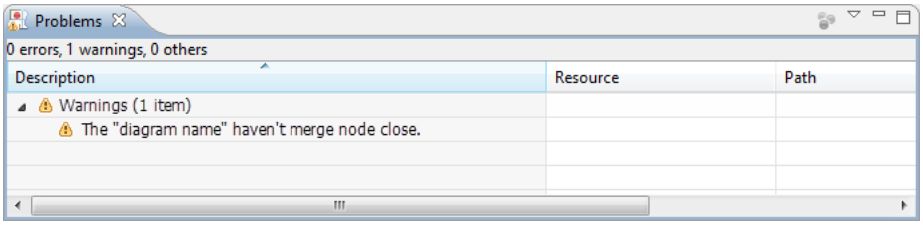

Fig. 9. Inspection result and error report of example activity diagram

5 Conclusion

In mature software development processes, it is suggested to detect and remove defects at the phase they were injected in order to reduce the cost of rework and promote the quality of product. Verification and validation play the role of quality control here. This paper presents an approach to automating the inspection of a design blueprint, activity diagram, for the conformance to UML specification v.2.4.1. The proposed method is the reverse of the process of generating UML activity diagrams from a domain specific language called ADL [9], [10]. The prototype tool has been implemented to facilitate the proposed methodology. The presented approach would promote process improvement, particularly for the design review activity to remove the defects caused by model inconsistent behaviors, model misconception, and mistake interpretation.

Future research work could be the enhancement of mapping rules to the framework that supports the standardization of various XMI formats.

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Author Index

Amamra, Abdelfattah 131

Badri, Linda 96
Badri, Mourad 96
Bán, Dénes 138
Byun, Yung-Cheol 252

Cha, Si-Ho 300
Cha, Wang Seog 445
Cho, Hyun-Seob 334
Cho, Moon-Taek 155
Cho, Seongsoo 187
Choi, Changhoon 187
Choi, Ho-Young 341, 409
Choi, Kye-Kwang 313
Choi, Moon-Hee 334
Choi, Shinhyeong 424
Chow, K.O. 63
Chun, Younghak 218

Dévai, Richárd 121

Fan, Linlin 380
Ferenc, Rudolf 121, 138, 146

Ganesh, Mani 445
Gerardo, Bobby D. 252
Gherbi, Abdelouahed 194
Gyimóthy, Tibor 121, 138

Ha, Chang-Seung 416
Ha, Young-Guk 210
Hamiche, Martin 131
Han, Doo Hee 353
Han, Soyeon Caren 113
Han, Taek Hee 437
Hegedűs, Péter 138, 146
Hemalatha, Pushparaj 445
Hong, BongHwa 163, 171
Hong, Sukjoo 187
Hromada, Martin 361
Hwang, Hyun Suk 218, 233
Hwang, Sunmyung 246

Imbert, Ricardo 458

Jang, Hyun Tae 445
Jeon, Min-Jeong 264
Jeong, HwaYoung 163, 171
Jeong, Hyeok-June 210
Jin, Jangwon 280
Jo, Hyok-Gun 348
Joo, Hae-Jong 179
Jun, Sunghae 1, 28
Jung, Jae Yoon 107
Jung, Kap-Yong 401
Jung, Lee-Sang 416
Jung, MinSu 387

Kaewchinporn, Chinnapat 466
Kang, Byeong Ho 113
Kang, Chul-Ung 202, 225, 239
Kang, Young Jong 437
Kang, Youngsik 272
Kim, Chang Soo 218, 233
Kim, Dong Kwan 107
Kim, Haeng-Kon 42, 53
Kim, Jeongill 280
Kim, Jong-Bai 401
Kim, Ki-Il 9, 22
Kim, Min-Gyu 401
Kim, Min Sun 452
Kim, Mi Ryang 293
Kim, Ok-Hwan 155
Kim, Sang Choon 264
Kim, Sei-Hwan 313
Kim, Seungjun 437
Kim, Yongsuk 272
Kim, Young-Choon 155, 187
Kloukinas, Christos 72
Ko, Seok-Jun 202, 225, 239

Ladányi, Gergely 146
Le, Thanh C. 36
Lee, Chung-Sik 155
Lee, Euy-Soo 179
Lee, Gi-Sung 327
Lee, Gwang-Yong 306
Lee, Heewon 395
Lee, Jason 334

Lee, Je-Hoon 264
Lee, Jihyun 246
Lee, Jong-Chan 327
Lee, Jung-Ae 306
Lee, Jungwoo 452
Lee, Seok-Yong 416
Lee, Seon-Hyong 319
Lee, Sung-Ho 287
Li, Ning 15
Li, Sinan 15
Li, Zhanhuai 15
Lim, Sae-Jong 313
Lim, Sang-Seop 225
Limpiyakorn, Yachai 80, 88, 466
Liyanage, Asha Nilani 395
Lukas, Ludek 361

Moon, Seung-Il 341, 409

Nam, Kwang-Woo 287

Oh, Jeongrim 387
Ozkaya, Mert 72

Palanichamy, Muthiahpillai 445
Park, Kyoung Choon 9, 22
Park, Sang-Hyeon 341, 409
Park, Sang-Joon 327
Park, Seong-Bae 113
Park, Sung-Hoon 319
Park, Sung-Young 155
Peng, Mei Mei 445
Phuangphoo, Nawin 88
Pow-Sang, José Antonio 458

Robert, Jean-Marc 131

Shen, Mingda 15
Shim, Jae Heon 287
Shin, Hee-Suk 306
Shin, Seung Young 293
Shin, Yekyeong 429
Siket, István 146
Sinlapalun, Sakon 80
Sison, Ariel M. 252
Son, Young-Jin 387
Song, Ho-Bin 155
Song, Ki-Min 341, 409
Song, Young-Karb 387
Song, Yu 380
Surendran, Purushothaman 202

Talhi, Chamseddine 131
Tanguilig III, Bartolome T. 252

Valouch, Jan 369
Vidács, László 121
Vincent, Pierre-Luc 96

Wang, Hongrui 380
Won, Deokhee 437

Yim, Jaegeol 36
Yoon, HeeGuen 113
Yun, Hee-Cheon 401
Yun, Seongchul 272
Yun, Yoemun 300

Zhang, Lijun 15