العنوان:	Web-Based Semi-Automated Marking and Feedback
المؤلف الرئيسي:	Al Nuaim, Abeer
مؤلفين آخرين:	Holyer, Ian(Super)
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Chapter 1 : Introduction

As technology develops, it is providing new dimensions for teaching and learning. The number of students seeking higher education is growing year by year. Many courses have more than 80 students enrolled. Having this large number of students makes it harder for a lecturer to mark each student's assignment and give a feedback individually.

E-learning has been an important element in the learning process, new tools and services should be developed to cover the needs of the e-learning environment. However, many tools and methods are provided for students to access materials online regardless of their location, discussion forums has become a popular place for learners to share ideas and find information, and online submission systems gave e-learning a special feature allowing students to submit their assignments online rather than by hand, saving them time and hassle . Yet, assessment and feedback, which are key aspects of education, were not given a priority in this environment.

1.1 Motivation

This project was chosen due to the time and effort spent by markers in the marking process. The project intends to reduce these issues for busy markers by letting them only manage the subjective parts leaving the calculations to the system to deal with.

1.2 Aims and Objectives

The main aim of this project is to (1) investigate the e-marking systems developed and based on that (2) develop a web-based interactive semi-automated marking application for markers. Here are some specific objectives that will help reach the primary aim:

- Review the literature on education in general then marking and feedback in particular.
- Investigate some marking systems both computer-based and web-based. Knowing how their system works and what languages were used.
- Learn about the tools that will be used to build the project. What might be the best options.
- Configure the developed system with the server and the database.
- Design an initial state of the application to start with.
- Develop the application gradually and test it.
- Integrate the entire application.

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Chapter 2: Background

2.1 E-Learning

Distance learning was a method of learning, where postal service , or what is now known as "snail mail", was the medium used to deliver education (Moore, et al., 2001). The Internet has been the dominant technology for of distance learning today in what is known now as E-learning.

E-learning can be defined in a number of ways depending on who uses it. It can be known as a way of delivering knowledge or education electronically. Where a computer is used side by side to the World Wide Web as the medium to deliver learning. E-learning can be a way of self-studying or involve both face-to-face teaching and web-based learning. Cloete and Kotzé (2002) defined E-learning as "a combination of learning services, technologies and products that provides a coherent institutional environment for instruction on the Internet".

2.1.1 E-Learning Benefits

There are many reasons that makes e-learning a convenient learning method for learners (WorldWideLearn, 2008):

- Students can speed up or slow down learning whenever this is needed.
- Students can choose their what, how, and when they want to learn.
- E-learning does not have geographical boundaries.
- Encourages student to interact and collaborate with each other and to get in touch with instructors.
- Materials can be read online or downloaded to be read whenever it is convenient.

There are also many reasons that makes e-learning a convenient teaching method for instructors such as (E-learning system & Technology, 2002):

- Instructors can access resources whenever it is convenient despite their physical location.
- It allows them to develop their teaching materials using Internet resources.
- Instructors can provide information to be accessed by all students.

2.2 Learning Management Systems

Learning Management Systems (LMS) are systems which offers tools and features designed to support learning: distant (online) and traditional (in-class). It allows lecturers to monitor and report students profiles, grades, and participation within the class. It also allows students to manage their progress, download lectures, submit their

assignments, answers tests and participate in discussion with other students. This is done through a ‚collaborative learning environment'.

Administrators also benefit, it gives them the opportunity to give students and staff various privileges to access the system depending on their needs and roles. In addition, they can assign students and lecturers to courses.

Nowadays, many Learning Management Systems have been adopted by universities and schools. Either it was an open source LMS such as Moodle and eFront or a commercial LMS such as Blackboard.

Figure 1 LMS (Nichani, 2001)

2.3 Assessment and Marking

Assessment is the only way where a teacher or a lecturer can measure students' performance and determine whether a student had satisfactory accomplished the required assignments or clearly understood the subject. Moreover, assessment is the way to feedback. An assignment or a task must be assessed or marked first in order to for the instructor to give a feedback. However, to have a good practice of assessment, a number of principles should be met (Barrs, 1990):

- The purpose of learning as well as the product should be included in assessment;

- When assessing competencies and skills, how students execute complex processes should be considered;

- Assessing students in a day-to-day manner is probably known to be valid and reliable;

- A teacher or lecturer should share the assessment criteria with students;

- Student should be able to assess their learning.

Assessment must reflect the criteria set out in a learning sequence, if it was meant to guide student's learning in the duration of the course.

When an instructor decides to assess his or her students, a number of steps must be taken (Wells, 2005):

- Creating a task or an assignment to be given to students to solve;

- Setting a deadline in which the students must submit their work;

- Marking and evaluating each student's submission;

- Grading each assignment and recording the mark;

- Generating a feedback for each student and maybe a general feedback for the entire group; and

- Sending the results in conjunction with the feedback to the students.

As we can see assessment is not only about evaluation, it is more than that. The instructor has to go through a set of steps to complete an assessment task. He or she should manage and develop their own methods. Nowadays, where classes are increasing year by year, the assessment task is getting harder and harder for instructors. They face difficulties to make sure that their assessment and feedback is constant and is completed within a specific time (Thomson, 2001). Students, on the other hand, need to see comments and feedback on their work in order complete their learning and promote understanding (Stephens et al., 1999).

2.4 Feedback

Feedback is a term used in many fields in which each field uses it under its own perspective. The history of feedback is as early as Thorndike (1912) when he wrote ‚the law of effect' which stated that any behaviour that produces a pleasing reaction will more possibly be repeated in the future. Pressey (1926) tried to produce a machine that enables a students to progress at their own speed. He was believed to be the first to accentuate the significance of giving feedback immediately.

Mory (2003) stated that the three definitions of feedback that goes back to the early 1900s are amazingly alike to the ones used nowadays. Kulhavy and Wager (1993) introduced "feedback triad" which was about motivation, reinforcement, and information. Firstly," feedback as a motivator for increasing response rate and/or accuracy". Secondly, "feedback reinforcing a message that would automatically

connect responses to prior stimuli – the focus being on correct responses". Thirdly and lastly, "feedback providing information that learners could use to validate or change a previous response – the focus being on error responses".

According to Vasilyeva, et al. (2007) feedback must have the ability to work simultaneously and be analysable at three levels: on the emotional level as a motivator, on the cognitive level as a provider of information, and on the behavioural level as reinforcement. They also stated that these levels are of a significant importance in the e-learning systems.

Feedback can be categorised in different ways. Kulhavy and Stock (1989) divided feedback into two labels: verification and elaboration. Verification is about simply stating whether an answer is right or wrong. On the other hand, elaboration is the information contained in a feedback message besides correct or incorrect, in other words, it is hints given to guide the student to the right answer. Elaborative feedback definitely consumes the instructor's time more than its counterparts.

Feedback can also be classified depending on the level of verification and elaboration. According to Mason and Bruning (2001):

- No feedback: this is the minimal level where no verification and elaboration is provided. The learner only gets a performance overall score.
- Knowledge of response feedback: here the learner gets a simple response of whether his/her answers were correct or not.
- Answer until correct feedback: modifies knowledge of response which makes the learner stay in one item while he/she is giving incorrect answer until the correct answer is figured out.
- knowledge of correct response or correct response feedback: gives the correct answer for each individual item.
- Elaborated feedback: provides the learner with the correct answers as well as information such as why the answer is incorrect.

Gregory (1993) gives us another way to categories feedback, where he discusses that there is a difference between adapted feedback and adaptive feedback. Adapted feedback is about giving a general feedback to the group as a whole regardless of the individual. Whereas adaptive feedback is about giving each individual a separate special feedback depending on their own work.

Another classification of feedback can be encountered. Either immediate or delayed feedback. Immediate feedback where the learner gets feedback as soon he/she gives an answer. In contrast, delayed feedback is where the feedback is not presented immediately after an answer is given but is delayed to be given after a period of time, before the next task or after couple of tasks (Vasilyeva, et al., 2007).

When it comes to grading, feedback can be either formative or summative. Formative feedback is more about feedback information rather than grades. That does not mean it does not consist of grades but emphasises on comments. Summative feedback, on

the other hand, is about the learner's final grade and final report showing the level of knowledge a learner has gained (Dirks, 1997).

2.4.1 Feedback in Web-Based Systems

Feedback plays a significant role in learning in general and in web-based learning in particular. In higher education, feedback is not well exploited. This is due to the large number of students in each class, or because of having a single assignment moving towards the end of the course. Where the feedback loses many of its benefits such as its motivational purpose. Moreover, many instructors are not willing to spend a lot of time and effort on feedback.

Students need periodic feedback to know that their work was assessed, how they can prevent mistakes in the future, how they can improve their performance, and how their marks are going to be calculated (Bischoff , 2000).

Using a web-environment to give learners the feedback they need to the series of assignments they have throughout a course would be a good solution to some of the problems stated above. A web-based system does not restrict the instructor. But it gives him or her the flexibility he/she needs. An instructor can log into the web whenever it is suitable and generate feedback to the students without needing to go to the office. The learner gain from this benefit too, as he or she does not have to go to the instructor's office or wait for the lecture to know the feedback on his or her performance (Collis et al., 2001).

According to Schwartz and White (2000) and Mory (2003) web-based feedback has to be " a) multidimensional, b) nonevaluative, c) supportive, d) student controlled, e) timely, and f) specific". They also argued that students expect some qualities and features from feedback in a web-environment. These include:

- "Prompt, timely, and thorough on-line feedback
- Ongoing formative feedback about on-line group discussions
- Ongoing summative feedback about grades
- Constructive, supportive, and substantive on-line feedback
- Specific, objective, and individual on-line feedback
- Consistent on-line feedback."

Feedback in a web-environment can be in different forms making use of many technologies. It can be written presented as text like in e-mails, forms, documents or chats. It also can be spoken using multimedia. Moreover, it can use model comments or a database for comments that occurs frequently (Collis et al., 2001).

However, this does not make feedback in a web-based system free of problems. A couple of problems may occur. The presentation of the feedback can be one of the problems. How it should be presented, what should be included and how it should be structured. Well, generally speaking, feedback should be mainly about the assignment and the learner. Another problem is the timing of the feedback; should it be immediate or delayed. Mathan (2003) discussed the tradeoff between both types feedback. He argued that researchers happen to believe that immediate feedback is

more efficient during training periods, whereas delayed feedback might be a better supporter to transfer and retention. Nevertheless, different aims can always change the benefits and drawbacks of the immediate and delayed feedback.

Mandernach (2005), on the other hand, studied the influence and the impact of presenting different levels of computer-based feedback (no feedback, knowledge of response, knowledge of correct response, topic contingent and response contingent ‚elaborated feedback'). His study showed that level of feedback did not have any effect on increasing students' learning. There were no significant differences in learning between students who received more elaborative forms of feedback and those who received less elaborative forms of feedback. This was mainly because of the timing of the feedback. It seems that students were more concerned about their marks, whether they passed or not, at that time rather than learning the information. Hence, providing feedback with the results will more likely to reduce its potential benefits.

2.5 Computer-Based Marking Tools

Many of the marking tools found on the Internet are run on windows. Stephens et al. (1999) stated that the majority of these products were created to be used in an American High School environment. They were designed to record students' grades and then generate a report based on them. These tools were also able to store data about the student such as attendance and class plan. Stephens et al. (1999) illustrates that by giving ‚Blackboard' as an example that focuses on students' progress(Figure 2).
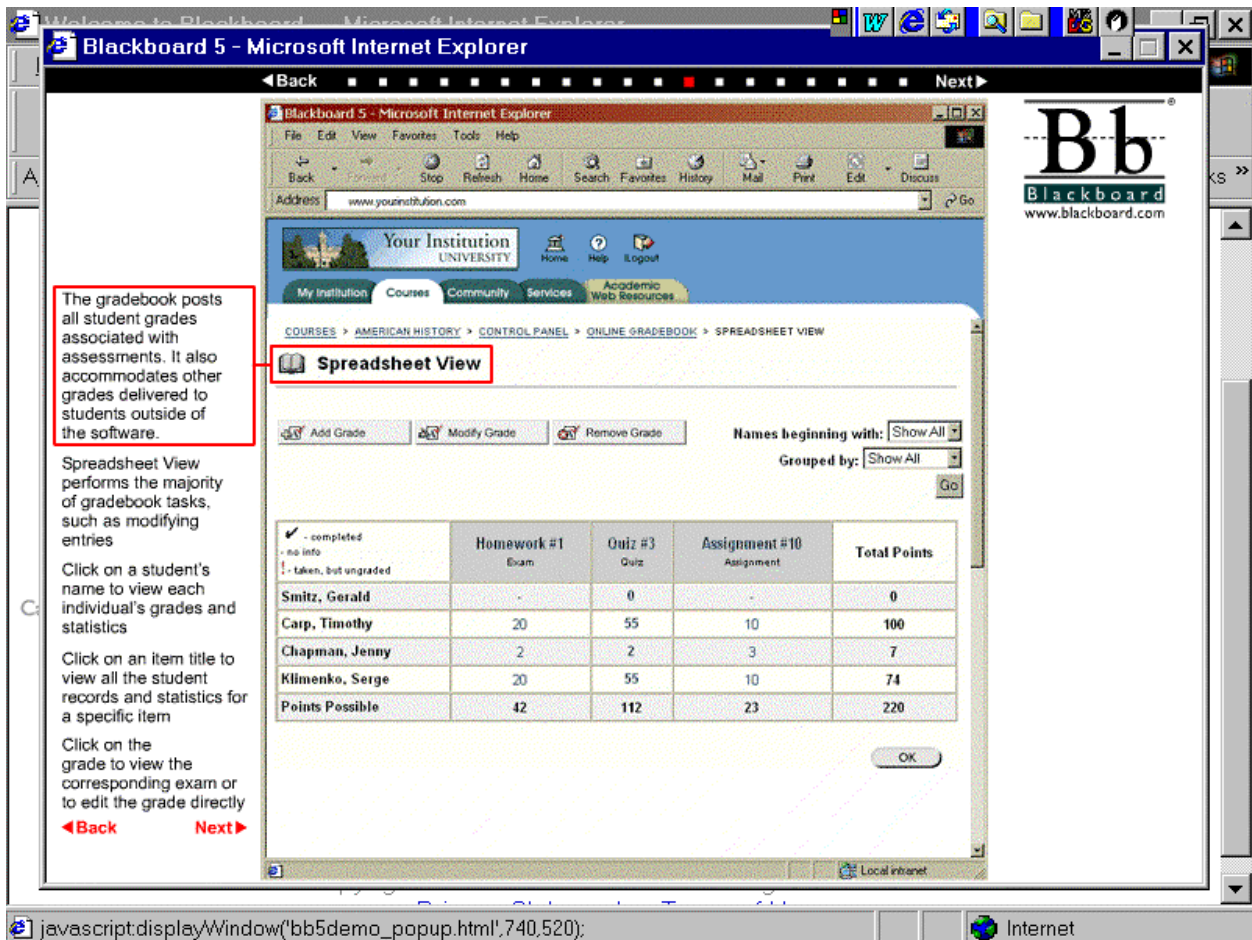
Figure 2 Blackboard software as displayed on the Web (Stephens et al., 1999)

Markin

Another windows-based software is ‚Markin' . This software from Creative Technology can be downloaded on the teacher's computer. It can import students essays or texts either as a RTF (Rich Text Format) or text file. The teacher can annotate and mark the assignment and after marking is completed the teacher can export the marked assignment either as a web page or as a RTF file (Creative Technology, 2007) (See figure 3).
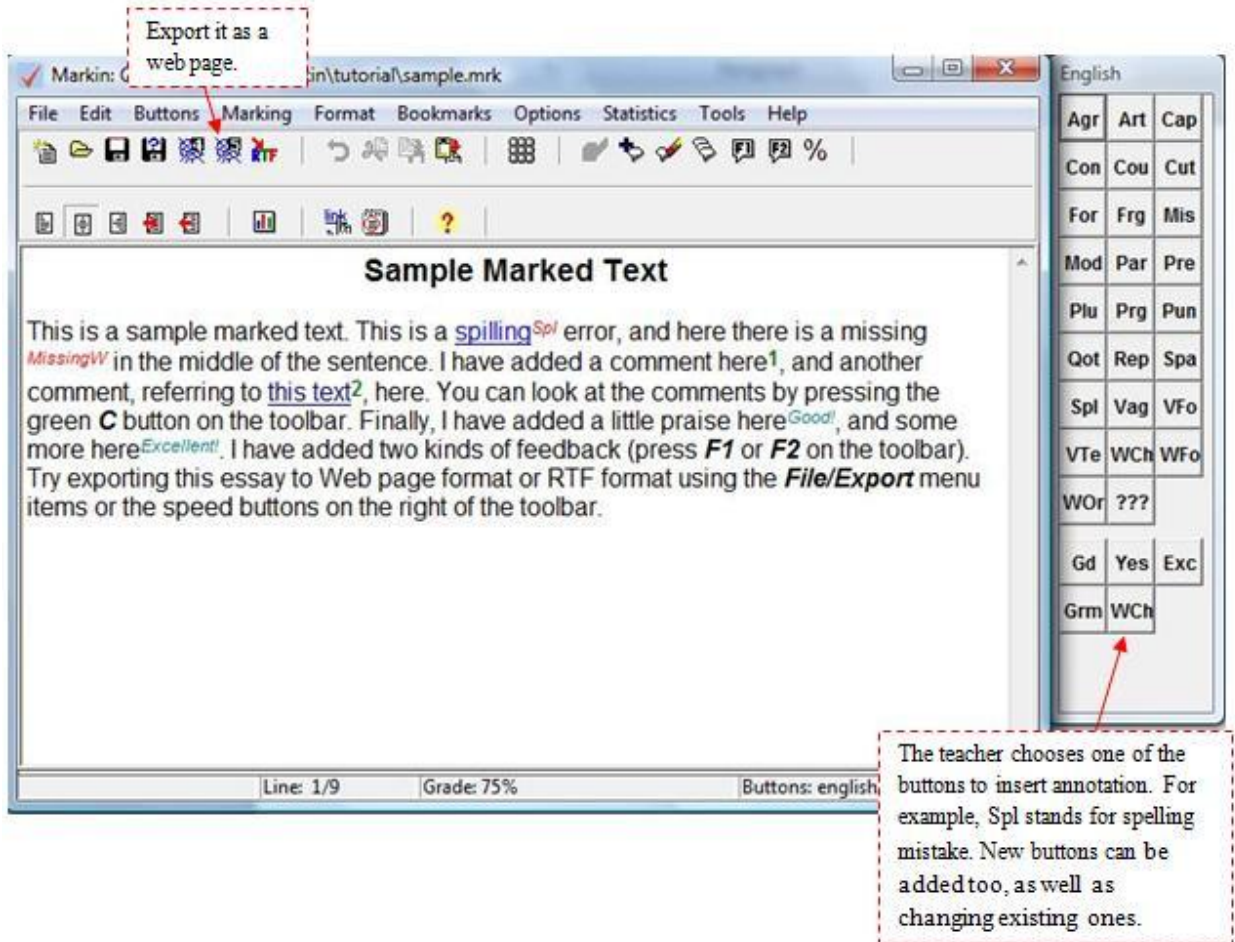
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Figure 3 Markin software

Marking Assistant

Markers Assistant is a software that was developed over a four year period in Deakin University, Australia. It was designed to be able to assess a variety of tasks such as essays, short answer assignments, reports, programming assignments, databases, to name but a few. The application has many features such as creating a marking guide to suit the assignment that is going to be marked and adding feedback either generally to all students or individually. The software also supports sending e-mails to the students with the results as well as saving them as text or HTML files (wells, 2005).

Automatic Marking of MS Word and Excel Files

The Sapporo Gakuin University developed two software written in VBA (Visual BASIC for applications) with a second version is written in VB.NET (Visual Basic 2005) to make it a stand-alone program not depending on specific clients running in a LAN environment.

One was to automatically mark MS Word files and the other to automatically mark MS Excel files. The need for this development was very important to the university

since they made computer literacy a compulsory course to be taken by all students, and since the university is Japanese, the programs' interface is written in the Japanese language.

The MS Word marking program is given an answer file containing the criteria to mark. Since the course is about mastering MS Office applications, the program evaluates the students' ability to use MS Word. For example, it checks page settings, fonts, colours, paragraphs, and so on. However, the students have the ability to download the software from the course's page to check their performance before submitting their work (see figure 3). This allows the students to get immediate feedback about their assignment. One thing must be pointed out, the program does not have the ability to read the text in the submitted file which does not give it the ability to mark reports (Koike et al., 2006).

The MS Excel marking program is similar to the MS Word marking program the only difference that it marks excel files.

Figure 4 Automatic Marking System for MS Word (Koike et al., 2006)

Koike et al. (2006) stated that the problem they faced was that many students preferred to choose their own computers rather than the Department of Social Information's specified computers. This often raised problems regarding the need of extra installations in order for the system to work. The students were notified about such issues but still there were several students who preferred to get their own computers (Koike et al., 2006).

This issue made the developers decide to develop a web-based version of the systems.

Mark

Mark is a automatic marking program, written in Java, used in the Department of Computer Science at University of Bristol by running a group of tests. For example, different input will be tested to see whether the program deals with it in a desired way or not. The program then produces a text file named feedback.txt which has the summary results and feedback of the marking. The program can be used on a number of programming languages such as C and Java. Mark works by writing a test script in a text file containing the command line for the compiler, the name of the program, the wanted output that the program should produce and the word total.

For example, in a C language program the test script should look something like this:

```
SETUP gcc -o myprogramme myprogramme.c
TEST myprogramme
OUT First C programme
TOTAL
```

The main drawback of Mark is that the output produced by the tested program must be identical to the output written in the test script otherwise the result will fail and the total is zero. To overcome this disadvantage the instructor must clearly notify the students about the desired output tested by Mark. Yet many students may likely mistype a character or two which will result in failing the assignment.

Mark is mainly useful to mark for first year beginners simple not complex programmes.

2.6 Web-Based Marking Systems

Web-based systems have some advantages over computer-based systems. One of these benefits is that a web-based system does not require a specific machine.

Vula Marking System

The Vula marking system is a web-based marking system developed by the University of Cape Town. It was developed by three students as a project. It was aimed to be used in all the departments of the university to mark as well as comment on students' assignments. The need of this system came as an enhanced version to the original Vula system which did not have a marking tool.

Every user of the system is allowed to access only the courses they are members of. The user can view the assignments of each course and all students

enrolled in that course. The instructor of a course has the ability to create a marking guide for the assignments, as well as editing it, whereas the tutors can only view the marking guide and mark students' assignments.

The system automatically sums the marks as well as the bonus marks. It also generates a marking guide for the students to view in a HTML format.

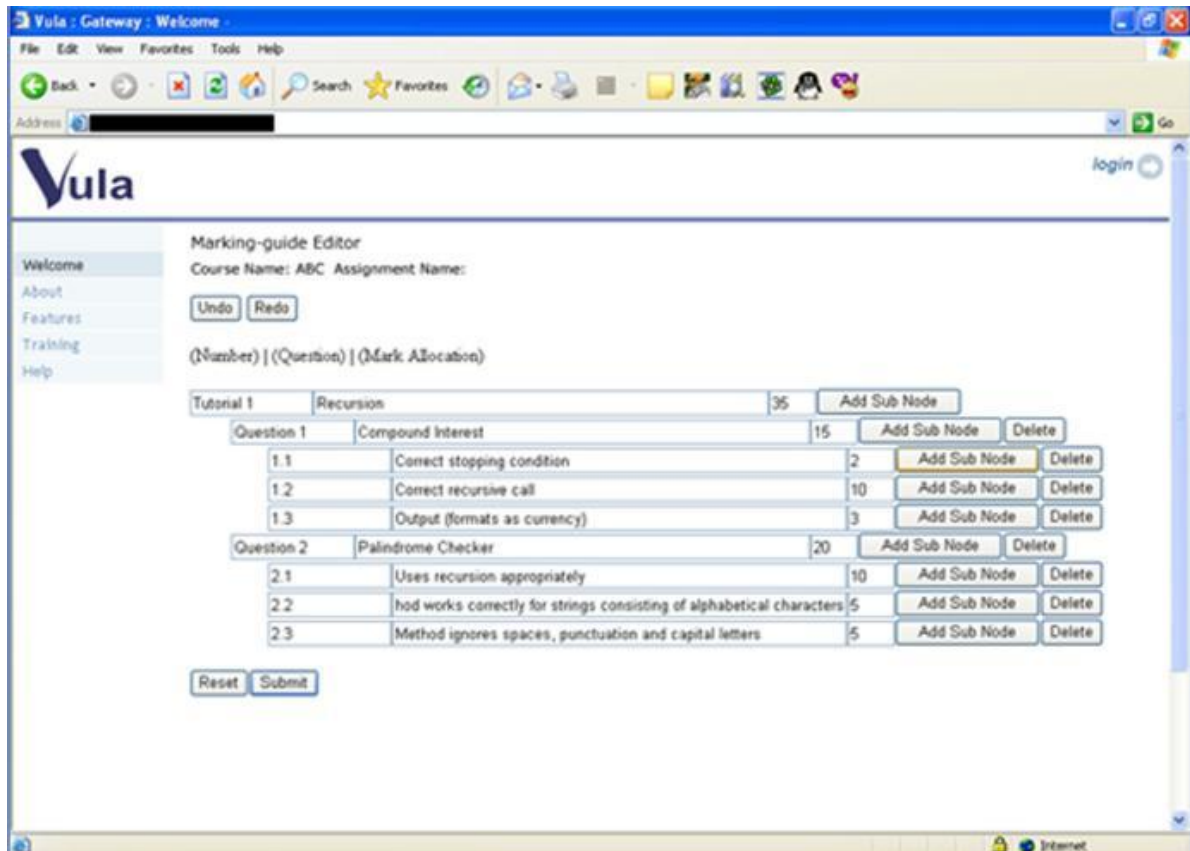The marking guide creates a tree like structure in which each node has a certain value (See figure 5)(Rammutla, et al., 2006).

Figure 5 Vula's Marking-Guide Editor

Online Assignment Marking System in Simon Fraser University

The School of Computing Science at Simon Fraser University developed an online marking system as a solution to the previous system in which the marker had to annotate on the submitted paper that is then returned to the student. Leaving the instructor without the comments and marks unless he or she copied them.

The system is web-based created with Perl and MySQL database. The system allows more than one marker to mark a certain assignment as long as they were

assigned to mark this course. Each assignment has a number of criteria that students must meet. These criteria are set by the instructor or the markers. The marker has to enter the student user id their student number and email address. Then he or she can write comments which can be up to 64k characters. The system deals with the repeated comments that many students share, it allows the marker to predefine a mark and a comment to a particular problem. This then appears as a button, when the marker clicks that button the comment is inserted and the mark is deducted according to the mark specified (see figure 6).

When the marking is completed an email is sent to the students as a report or a feedback containing the comments and mark for each criteria (Baker, 2003).

Figure 6 Online Marking System in SFU (Baker, 2003)

Automated Feedback for "Fill in the Gap" Programming Exercises

The "Fill in the Gap" programming analysis framework was developed at Queensland University of Technology (QUT) to test students' programming solutions to programs with gaps. Students fill in these gaps and submit their solution to get an immediate feedback either positive or negative. Gaps can be for beginners which are small such as an expression or for more advanced programmers such as a complete class. The framework is used with the Environment for Learning to Programming (ELP) at the university.

The students download the exercise and run it on their own computer. The student must compile the program before submitting it. If no syntax errors were found the system now can analyse the program. The analysis framework contains two components: static analysis and dynamic analysis. The static analysis is to check the quality of student's code, it does not execute it but only analyses it whereas dynamic

analysis executes the student's code using a set of test data to test the correctness of the code (Truong, et al., 2005).
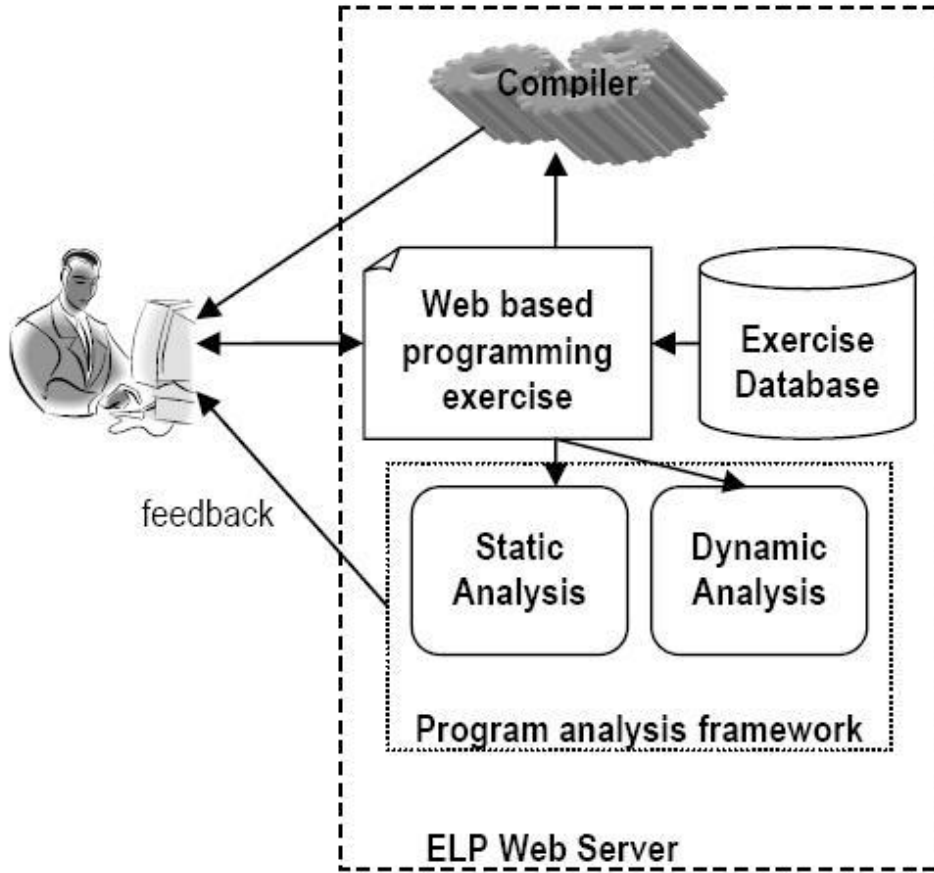

Figure 7 The ELP and the Program Analysis Framework Integration (Truong, et al., 2005)

2.7 Summary

The systems discussed above were categorised either to be a computer-based application or a web-based application. In general, the computer-based applications have one major drawback. To make a computer-based application beneficial, it must be cross-platform. This is not the case for many computer-based systems such as 'Markin' and 'Markers Assistant', which are windows-based applications. Another disadvantage, is the demand of installation. We can never be able to use a computer-based application before installing it on our PCs. That might be an issue when a marker wants to access the application then realises that it is not installed in this computer and maybe cannot be installed due to the different specifications. This was the reason that made the developers of the MS Word and Excel Files automatic marking system in Sapporo Gakuin University decide to develop a web-based version of the application to override this problem.

As far as Web-based systems, and as mentioned above the Web-based application overrides some of the drawbacks of the computer-based systems. A web-based application is known to be cross-platform, which can work on any computer no matter what operating system it is running on. It does not need to be installed on the computer in order to access it as long as there is a browser. However, this does not make it work perfectly on all computers. Some computer still use old versions of browsers which do not support new web technologies such as Ajax.

The Online Assignment Marking System in Simon Fraser University is a good example of marking and feedback. The only drawback that occurs is that the marker needs to enter the marker student's user id, student's number and email address. Which means that the marker must have all these details ready when marking each student's assignment. A better approach is, what is done currently in the Department of Computer Science in the University of Bristol, when an assignment is chosen a list of all students, by their user name, in that course and assignment is presented. The marker then starts marking by selecting the user name of each student.

The "Fill in the Gap" programming exercise framework was an example of a good web-based feedback application. Such an application can be very useful for programming courses especially for first-year programming units. However, this application is limited to programming only and not useful for any other course.

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Chapter 3: Specification

As the aim of the project is to provide markers with a web-based marking and feedback tool to ease the process of marking, reduce time spent on it, and to provide students with an accurate feedback that will help them understand their strength and weakness in particular unit or assignment. It was essential to know what features a marker would like this tool to have. What features would aid in reducing the time consuming of marking. Having surveyed a number of marking systems gave a rough idea of what the application should look like and it should behave.

3.1 Initial Meeting with the Supervisor

The very first meetings with the supervisor helped understanding basic specification of the project. It was understood that creating a system that would assist the lecturers / markers in setting up a marking guide for each assignment and use this guide in marking student's assignment would improve and accelerate the marking process.

These initial meetings helped determine the scope of this project, identify use case and analyse user scenarios.

3.2 Requirements Analysis

To aid markers in their marking, the application must:

- Allow markers to create a marking guide for each assignment. This is done by anticipating what kind of comments and marks would be needed in each assignment. Thus, creating a marking guide which has the most common comments each of which has an assigned mark would help reduce time and effort for the marker when marking a large number of assignments.

- Allow markers to edit a previously created guide either by modifying, deleting an existing comment or adding new ones. The marker can start marking whenever the guide is ready. The application should allow him/her to edit a previously marked student's assignment.

- However, the system must not allow him/her to modify or delete comments and marks from the marking guide since he/she has started marking already but should allow adding more comments. Allowing the ability to edit the marking guide even after assignment had been marked would compromise fairness. The lecturer/marker should be of a great knowledge of the particular assignment that the marking guide will be created for. The assignment's criteria should be clear enough to be able to know what to assess students on and thus create an accurate marking guide.

- Show the marker which students are registered in the unit and which students' assignments have not been marked yet.

- Allow marking students' assignments whenever the guide is ready.

- The system will be responsible for summing the marks with any extra mark given automatically.

- Allow the marker to release marks and feedback to students when marking is finished for all students.

- The system will be responsible for producing a JSP page for each student containing the feedback and the total mark that were given by the marker.

For the purpose of demonstration and to have a standalone application, the system includes a part of the student role which contributes to clarify the way feedback works.

A student in this system can:

- Submit their assignment via the Online Submission System.

- Check what mark they got for a particular assignment and what feedback was given by the marker when the marks are released.
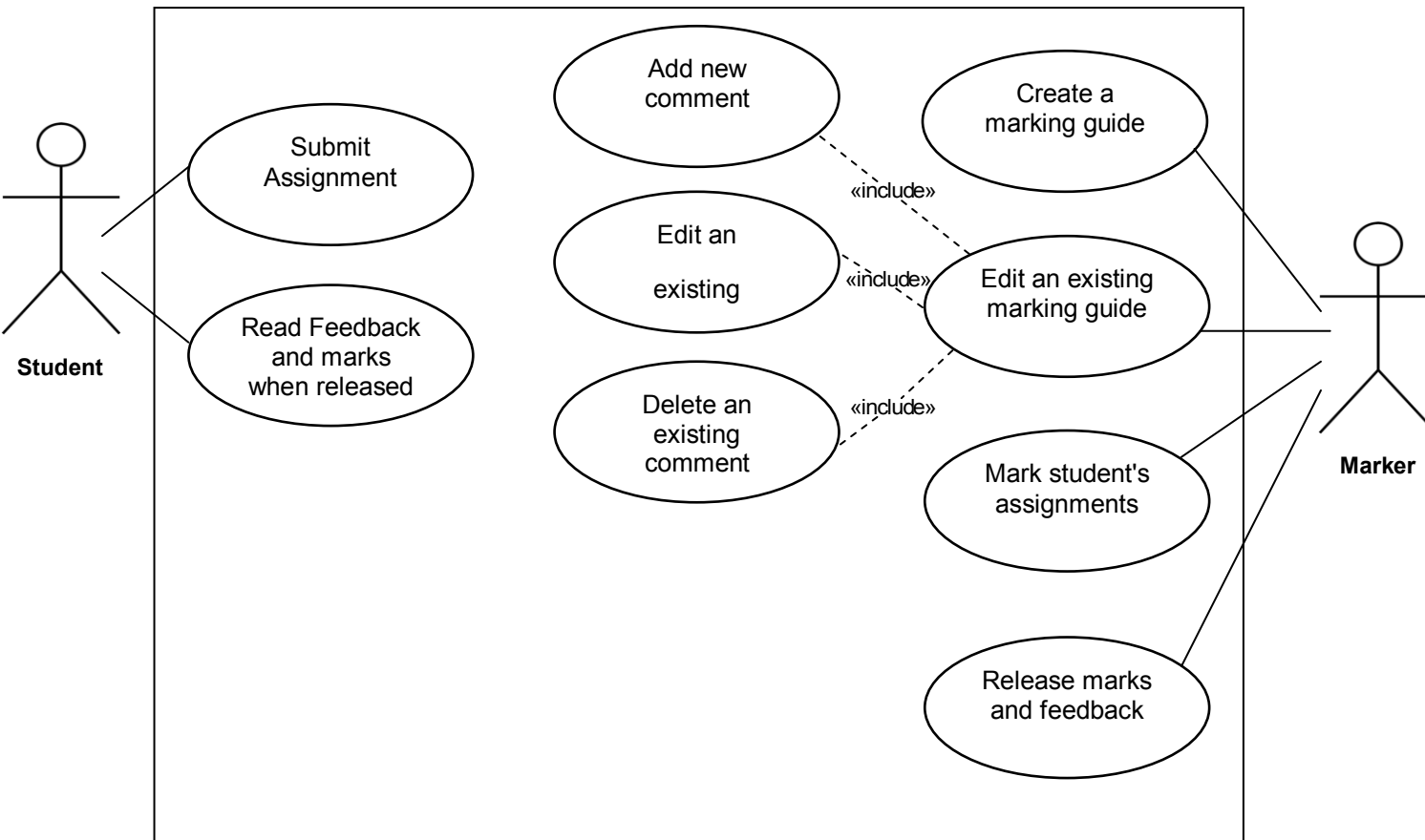
Figure 8 Use Case Diagram of the Application

User Stories:

Table 1: Initial User Stories

Feature Name	Description
Create a marking guide for an assignment	The creation of the marking guide start as soon as the marker chooses so by clicking a button.
Adding a Comment and marks	The marker should be able to add up to 8 comments of the same type in one go with their marks.
Storing the marking guide	As soon as a comment has been added it is automatically stored and can be retrieved even if the guide is not complete.
Adding more comments and marks	This should be done easily with a click of a button.
Editing an existing marking guide	This can be done soon as the marker chooses so by clicking a button. It includes modifying or deleting existing comments or adding new ones.
Retrieving the marking guide to mark each student individually	This should be easy by clicking on the username of the student which the marker wants to mark his/her assignment.
Storing the comments and marks given to a student	Saving what the marker gave to a student is done by clicking a button
Retrieving the marking guide for a particular student to edit what has been marked previously	Editing a student's feedback should be the same as marking a new one but the difference would be that the marker would be able to see what was given previously.
Summing the marks	This is done automatically as soon as a feedback was given to a student.
Releasing Marks	This should be done by a click of a button. By choosing release marks and submitting the choice

Appendix A provides details of other use cases and their description.

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Chapter 4 : Design and Architecture

4.1 System Architecture

Having chosen the technologies that will be utilised for the development of the project. We can now know how the system's architecture would look like (See Figure 8).

Marking Application
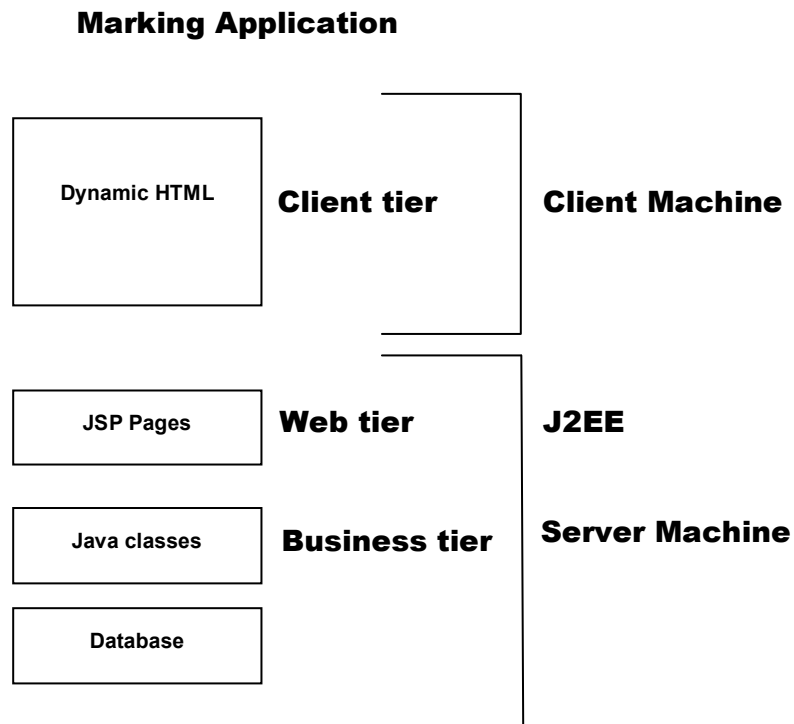
Figure 9 System's Architecture

The application will be divided prior to the development. The division is based on the system's architecture shown earlier. The application is mainly divided into three parts. The JavaScript and/or AJAX, which is the frontend of the system, allow the user to interactively create, edit and use the marking guide. The web services and database, which is the backend of the application, will provide access to the database ,Java classes, and the functionalities of the web server. Finally, binding those two components and making use of them in the "User Interface" or the JSP pages (see Figure 9).
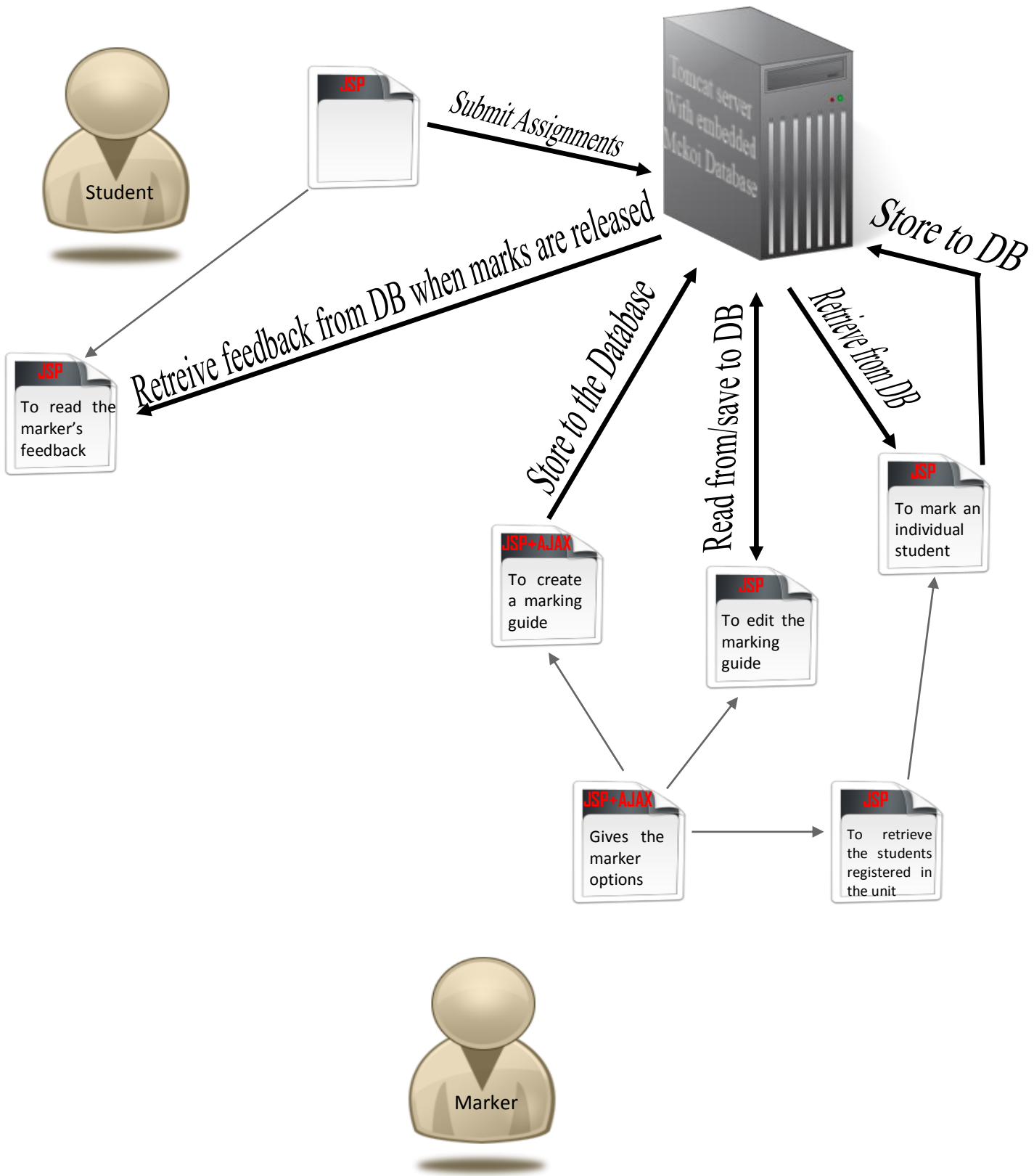
Figure 10 System Architecture 2

Figure 11 The Application's Architecture
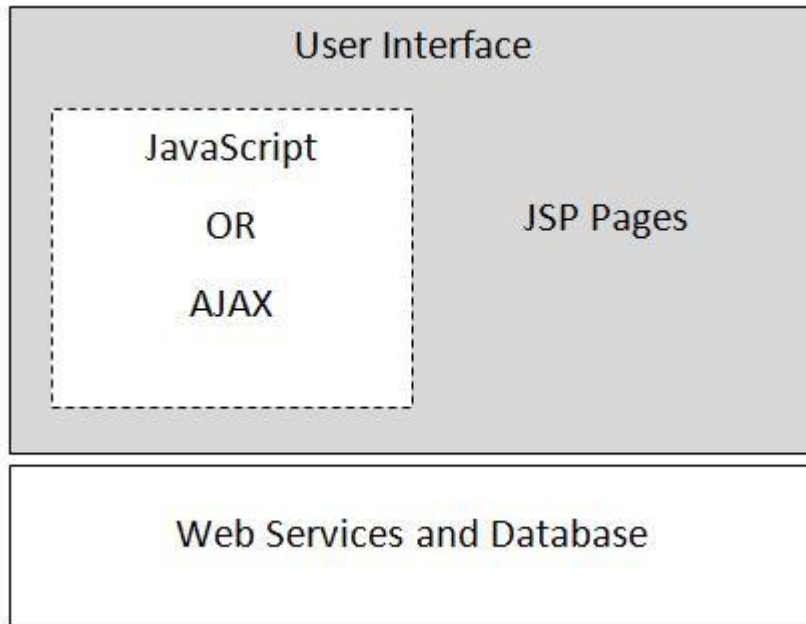
Figure 11 The Application's Three Parts.

4.2 Database Design

The database plays an important role in the project. A lot thought was put into designing it to perform its task in an accurate way. A number of steps were carried out to have a better understanding of what the database should consist of.

- Determining the data that will be stored.

- Determining the relationships between the data.

- Determining the grouping of data in object.

- Determining the relationships between these objects or groups of data.

First of all the data that would be needed in the marking guide was analysed, then the data that would be needed in the system to help create a marking guide for each assignment.

The tables which will be important to the system are:

Student(StudID,number,Fname,Lname,DOB,email,pw).

Marker(MarkerID,Fname,Lname,email,pw)

Unit(unitCode,name,CP)

Components(CID,name,deadline,display,unitCode)

Comment(SEQ,comment,type,mark,id,CID,unitCode)

Feedback(ticks,specialComment,extraMark,totalMark,CID,unitCode,studID)

Registration(StudID,unitCode)

Mark(MarkerID,unitCode,CID)
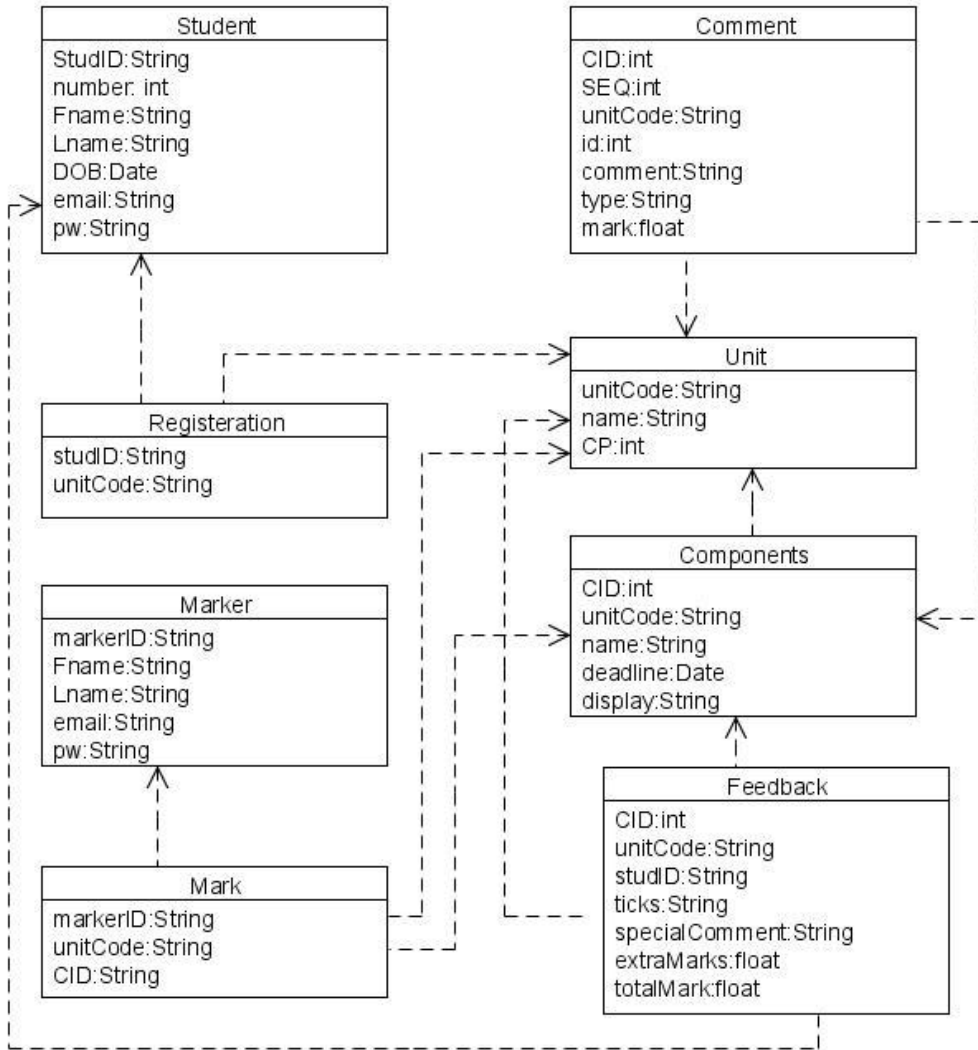
Figure 12 UML Diagram of the DB Tables

4.3 User Interface Design

To have an idea of how the application would look like, an initial design of parts of the user interface was done to set the functional requirements for the rest of the application. This will also give a roadmap of the application. The initial design of the user interface was targeted to the design of the first page the marker would go to and to the marking guide builder. The design of the rest of the user interface came along when implementing those page to have a better understanding of the needs of the user in each page. Below are some sketches of the user interface.
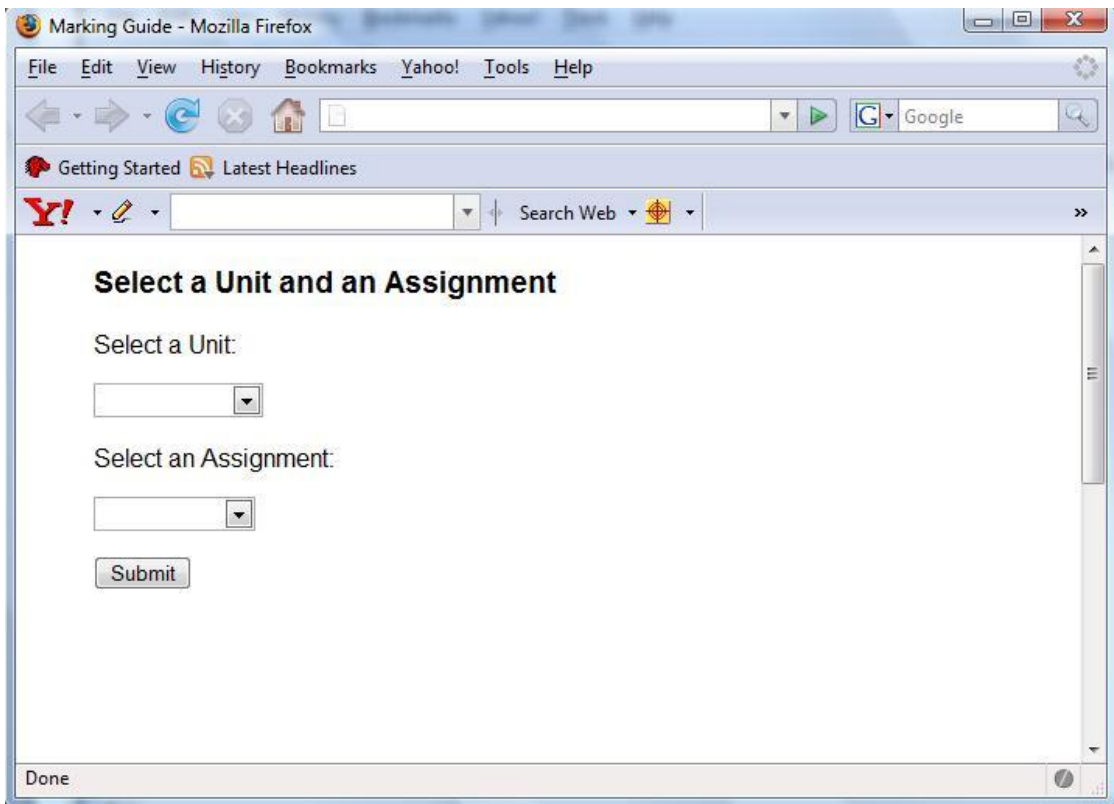
Figure 13 Sketches of Marking Guide 1
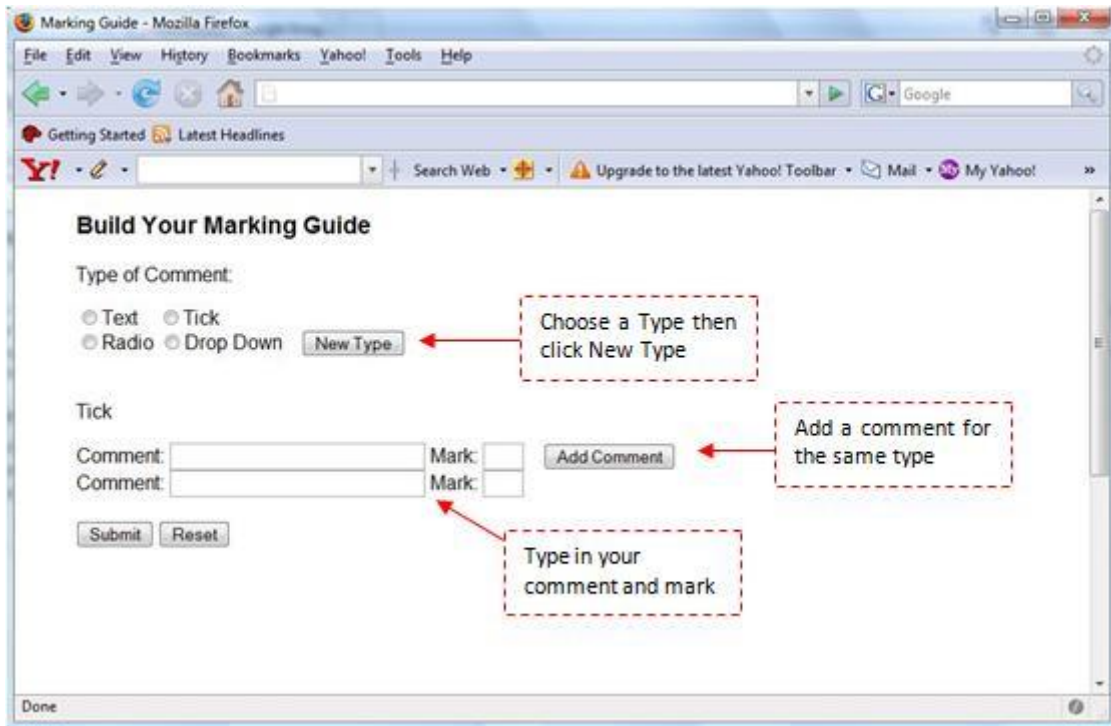
Figure 14 Sketches of Marking Guide 2
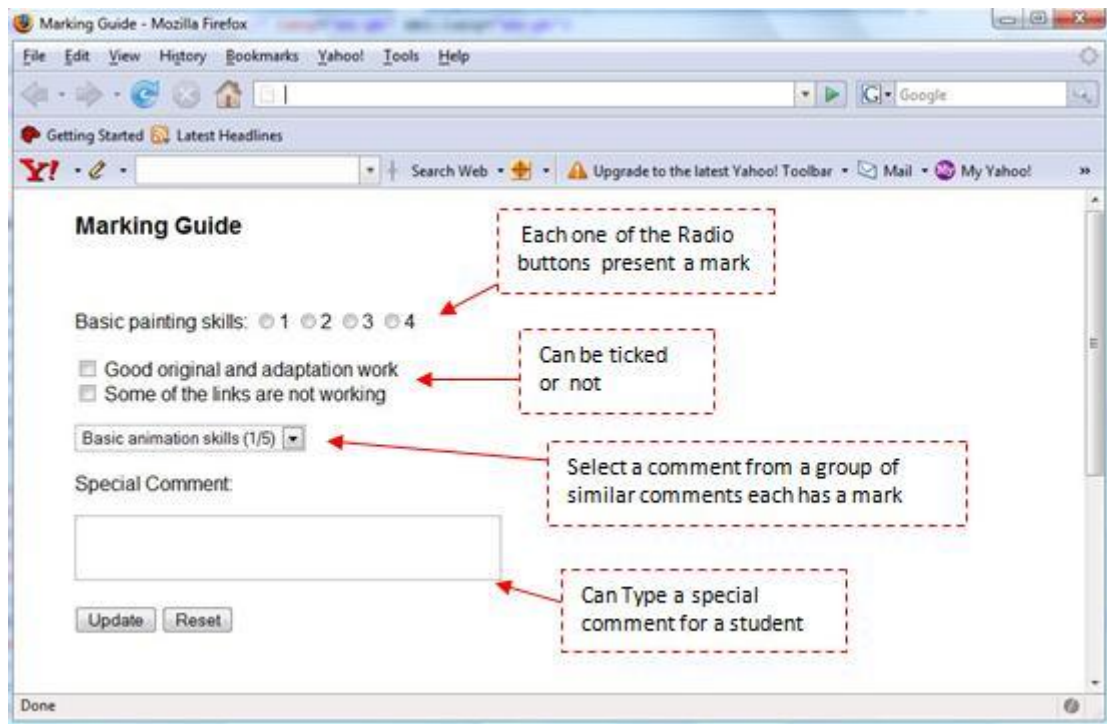
Figure 15 Sketches of Marking Guide 3

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Chapter 5 : Implementation

This chapter will consider the implementation and development of the application. The system roadmap discussed in the previous chapter is mainly about the interface, what the user of this application would see when interacting and using it. On the other hand, this chapter emphasis on the actual development of the application. What happens behind the scenes of the interface.

5.1 Technologies Chosen

Since the project is Web-based and for the purpose of this project, Java , JSP, JavaScript/Ajax, Java 2 Platform, Enterprise Edition (J2EE) technology, will be used running on Tomcat 6.0.16 as the web server. Mckoi's database will be used embedded in Tomcat.

Java

Java was chosen to be the implementation language due to number of advantages which includes:

- Sun System has released many libraries and support under public license.

- Java is platform independent.

- Web services uses Java widely.

- The Department of Computer Science in the University of Bristol uses Java and its related technologies in their web site.

   Java classes created in this project was compiled and packaged. The package was named "data" and was placed in Tomcat 6.0\webapps\ROOT\WEB-INF\lib directory.

J2EE

Java 2 Platform, Enterprise Edition (Java EE) is a platform-independent environment. It is a standard used to develop server-side Java applications. It has the Standard Edition (SE) of Java's functionalities plus its features such as Enterprise Java Beans (EJBs), JavaServer Pages (JSP), servlets, and several Web Service technologies.

JavaServer Pages will be used in the development of this project.

AJAX and JavaScript

AJAX (Asynchronous JavaScript And XML) is a technique for creating more interactive web applications. JavaScript is used between a web browser and a web server to send and receive data using the XMLHttpRequest object.

JavaScript and AJAX are likely to be used in the project to provide a interactive dynamic browser-based tool.

In some cases AJAX was used instead of JavaScript given that JavaScript only runs on the client machine while AJAX contacts the server. These cases needed to contact the server which gives us to choices either asynchronous with AJAX or synchronous by submitting to the server and receiving what is needed from it. Both ways are correct but the first is more efficient and friendly.

Mckoi Database

Mckoi Database is an SQL database management system written for the Java platform. It can either run as a client/server database server or it can be embedded in an application. It is highly multi-threaded and features an extendable object-oriented engine (Mckoi SQL Database, 2004).

Mckoi Database will be used embedded in the project to ease access to it.

Tomcat 6.0.16

Tomcat is a web server from the Jakarta project of the Apache software foundation. It is an open source result of collaboration of developers. It is a Java servlets container and renders Web pages that include JSP. Tomcat can be used either a stand-alone web server or with other web servers, such as Apache, or Microsoft Internet Information Server (IIS). To run Tomcat a system must have a Java Runtime Enterprise Environment JRE 1.1 or later.

5.2 Hardware Used

For the purpose of developing this application, a laptop which runs on Microsoft® Windows Vista™ Home Premium operating system with Processor Intel(R) Core(TM)2 Duo CPU T7500 @ 2.20GHz, 2201 Mhz, 2 Core(s), 2 Logical Processor(s). The web browser used was Mozilla Firefox version 2.0.0.16.

5.3 Database

As mentioned above, Mckoi's Database was chosen to be the database used in this project. The database was chosen to be embedded into Tomcat's server to be owned by Tomcat to ease access to the database.

The table below shows the data needed in the marking guide and feedback.

Table 2:Some Database field names and description

Field Name	Description
For the Comment table:	
Comment:	To contain the comment inserted by the marker
Type:	To contain the type in which the comment would appear in, in the marking guide.
Mark	To contain how much this comment weighs.
SEQ	To contain the sequence of the comment in that assignment.
Id	To contain the number of the comment. Comments with the same number belong to the same group. i.e. the same Drop Down.
For the Feedback table:	
Ticks	To contain a string of 1's and 0's showing what comments the student was given.
Special Comment	To contain any special comment the student was given
Extra Marks	To contain any extra marks the student was given.
Total Mark	To contain the total mark the student got in this assignment.
For the Component table: CID	To contain the id of the component. A component is basically an assignment.
Name	To contain the name of the assignment.
Deadline	To contain the date of the deadline the students should submit their work by.
Display	To contain either „No' to not display the feedback to students yet, which is the default value, or „Yes' to display.

5.4 Software Implemented

The software implemented in this project was mainly divided into two parts: Java classes and JSP pages. To avoid having a heavyweight JSP pages, Java classes were created to handle complicated parts of the application. This will make the JSP pages that deal with such tasks will contain, mostly, only a variable of that class that calls in the class's method.

Inserting multiple comments in one go, when creating the marking guide, could be complicated. Especially when the program does not know how many comments the user intends to insert. A class called Insert which deals with such ma matter was created. To know how many comments a user wishes to insert, a parameter that carries that number is passed.

```java
int num = Integer.parseInt(request.getParameter("numOfComment"));
```

Figure 16 Code Segment of Insert.java

This technique also was applied when updating an existing marking guide in class Update. Where the user can edit and add more than one comment in one go.

To mark each student's assignment with the marking guide, the guide must be retrieved from the database and displayed in a JSP. This can be a complicated task to perform especially if the user wants to edit a previously marked student. This means that what was given to that student should be displayed.

In order to deal with such a task, a class called Marking was created. The first thing this class does is to check if this student has been marked before or not. If so, it gets from the Feedback table what was given to this student and display it. If not, it only displays the marking guide.

Moreover, a Feedback class was created to deal with storing the feedback given to each student. It first checks if the student was previously marked or not and accordingly either to update or insert. The class is also responsible for calculating the total mark the student got on this assignment.

However, other tasks were mostly carried out in JSP pages directly. JSTL was used in one instance in the project. It was used in the page where the marker has to choose a unit and an assignment.

```html
<p>Select a Unit:</p>
<p><select name="unitCode" size="1" id="unit" onchange="sendRequest(this.value)">
<option selected ="selected" >${param.unitCode}</option>
<sql:query var="results">
select distinct unitCode from Mark where markerID='<%= session.getAttribute("markerID") %>'
</sql:query>
<c:forEach var="row" items="${results.rows}">
<option name="unitCode" value="${row.unitCode}">${row.unitCode}</option>
</c:forEach>
</select></p>
```

Figure 17 JSTL Code

Ajax was used in the project to improve the performance and promote friendliness. It was implemented in two tasks. The first was to retrieve all assignments in a chosen unit and the second to display the a number of text boxes for the user to type in the comment and mark depending on the number chosen. Below is one of the two codes written for AJAX followed by the JSP code that prints out the text boxes in the number chosen by the user.

```javascript
var http = false;

if(navigator.appName == "Microsoft Internet Explorer") {
  http = new ActiveXObject("Microsoft.XMLHTTP");
} else {
  http = new XMLHttpRequest();
}

function sendRequest(str){
url = "addcomment.jsp?numOfComment="+str;
http.open("GET",url);
http.onreadystatechange = function() {
    if(http.readyState == 4) {
       document.getElementById('numOfComments').innerHTML = http.responseText;
    }
  }

http.send(null);
}
```

Figure 18 AJAX Code from ajaxcomment.js

```jsp
<%

int num = Integer.parseInt(request.getParameter("numOfComment"));
String[] comment = new String[8];
String[] mark = new String[8];
for(int j =0; j < 8 ; ++j)
{
    comment[j]="";
    mark[j]="";
}
for( int i = 0; i < num ; ++i)
{

  out.print(" Comment:<input type=\"text\" id=\"comment\" name=\"comment"+i+"\" value=\"\" size=\"30\" />");
  out.print(" Mark: <input type=\"text\" id=\"mark\" name=\"mark"+i+"\" value=\"\" size=\"1\" />    <br />");

  }
%>
```

Figure 19 JSP Code from addcommet.jsp

5.5 Development of the Interactive Application

In order to have a user-friendly system, the application must allow interaction with the user. The requirements identified earlier showed that it would be best for the user's experience to create a dynamic interactive web tool.

5.5.1 Choosing Units and Assignment

After Successful log in by the marker, he or she would choose a unit, an assignment from this unit, then a number of choices to choose from. These are building a marking guide, editing an existing one, marking students' assignments, or releasing marks for the chosen assignment. Each one of the alternatives will have a different action than the others and will take the marker to a different page mostly.

Logging into the system will allow identifying the marker and thus getting the units he/she is assigned for. When the marker chooses a unit, the assignments for this unit will be retrieved and will appear in the second drop down. This is done via AJAX to provide the user with asynchronous interaction rather than submitting the choice to server to get the assignment back.

Some problems were tackled when trying to introduce AJAX to be instead of using the server. The web has a lot of lessons of AJAX but most of it was either using PHP or ASP which did not work well with JSP. However, after a couple of trials and errors the correct way of using AJAX with JSP was found and is working perfectly.
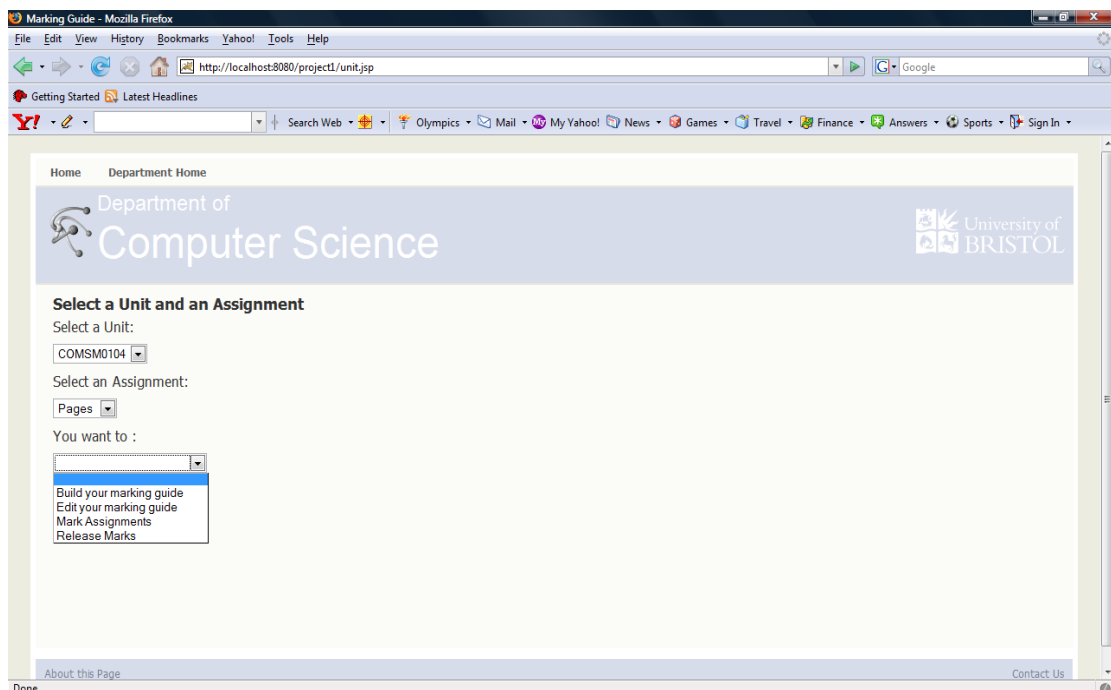
Figure 20: Marking Guide

5.5.2 Marking Guide Builder

To build a marking guide for a particular assignment, the marker can choose the type in which a particular comment would appear in when marking. Is it better for this comment to appear as a checkbox to be selected? or in radio buttons to choose what mark to give the student from the total mark of this comment, or is this comment related to a number of other comments and it is better to have in a drop down menu to choose from. After making a choice, the type chosen will appear in the screen to remind the marker of the type he/she chose in case anything distracted him/her from the screen. He or she would, then, choose the number of comments to insert in one go. If the type of comments were tick or radio each comment in a text box the user will insert is independent from the others. While if the type was drop down the comments in the text boxes inserted in one go are related, they will appear in one drop down menu in the marking guide. Choosing the number of comments will make text boxes for comments and marks appear. The number of comments can be up to eight. AJAX was used here as well as described above in Software Implemented. It was significant to ease creating the marking guide for the marker and not to make the process time consuming. In this part a Java class called Insert was used.
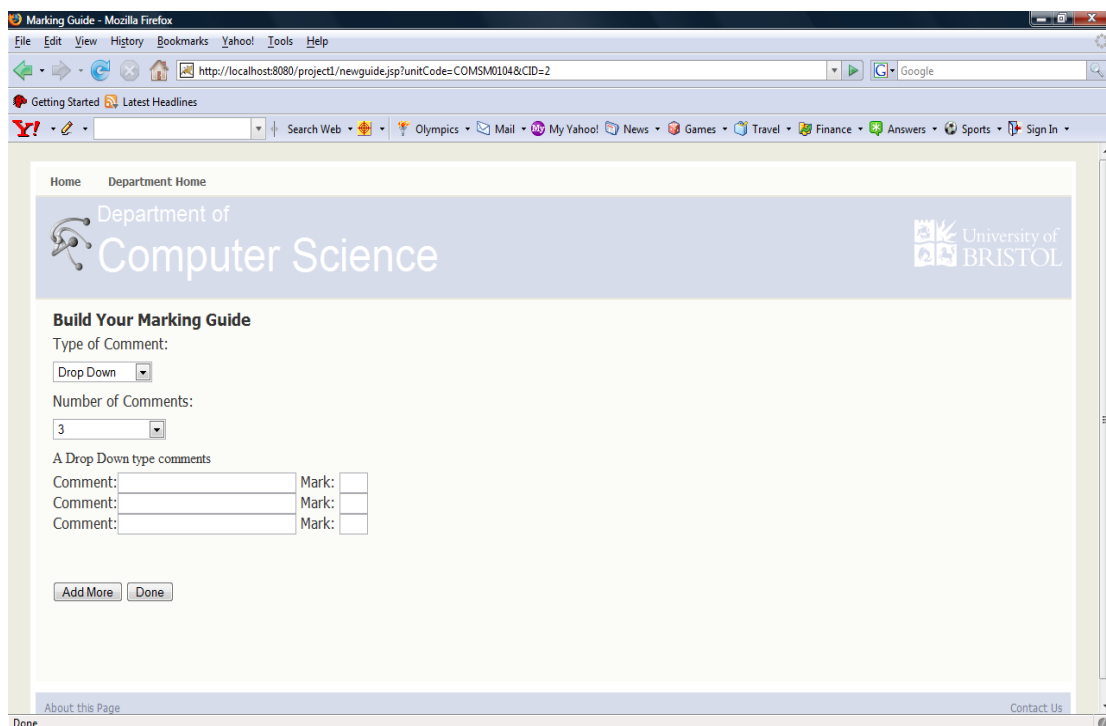
Figure 21 Marking Guide Builder

5.5.3 Marking Guide Editor

After the creation of the marking guide, the marker may choose to edit it. Editing includes modifying or deleting existing comments or adding new ones. the marker may realise the need of a particular comment due to questions raised from students when doing their assignments or after noticing a number of common mistakes or comments in students' assignments. The marker can edit the guide in any form before starting to mark. Once marking has started he/she can only add new comments but not modify or delete an existing comment or mark.

The editor is provided with a table. The first rows are for the existing comments the last four rows will be left empty for new comments and marks that the marker would want to add. Any changes made to existing comment will be updated in the database whenever the marker presses Update or Mark. The difference between Update and Mark is that the first will do the update the come back to the editor to add more comments while the last will do the update then automatically directs the mark assignments. In this part a Java class called Update was used.

Figure 22 Marking Guide Editor

5.5.4 Choosing Which Students to Mark

when the marker have decided to start marking the first page he/she will go to a page that lists all students registered in this units by their usernames. Another list will appear below the first list which has all students that have not been marked yet. Of course, at the beginning the two list will be identical but afterwards any student that have been marked will not appear in this list anymore. This allows the marker to

know who was not marked yet. Not having this feature will mean that the marker has to go through the entire list to know the unmarked students, which will, indeed, cost him/her a lot of time and effort that can be eliminated by this feature.
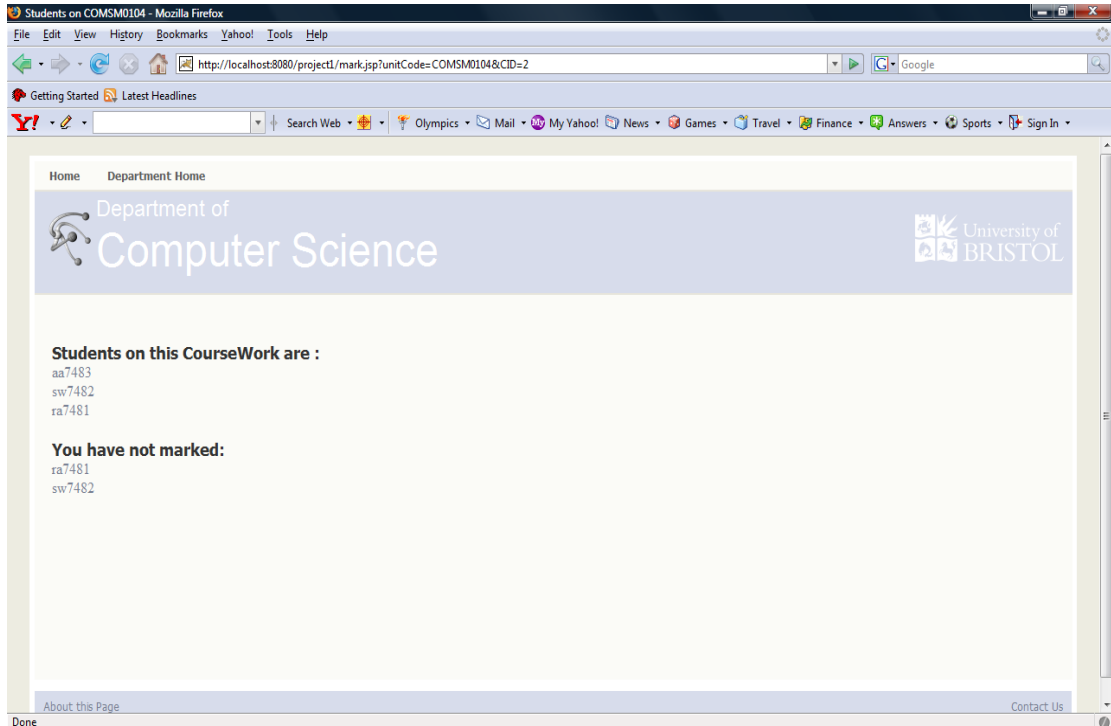
Figure 23 Students on a Coursework

5.5.5 Marking Student's Assignment

Now that the marker chose a student to mark, he or she will be presented a page with the marking guide produced earlier. The page will also include a text area to write any special comments the marker wants to give to this student and any extra marks. Furthermore, at the end, the marker will find all the files submitted by this student for this assignment. As soon as the marker clicks on one it will appear in a box. This will make it much easier for the marker to see both the marking guide and the assignment on one page. However, this will not prevent from opening it in a different page if needed.

If the chosen student was marked before, and for some reason the marker wished to alter what was given to him/her, the marker does not have to go through marking process again. As soon as the page starts, what was given to that student will occur and the marker can then do the changes intended and submit it. In this part two classes were mainly used: Marking and feedback.
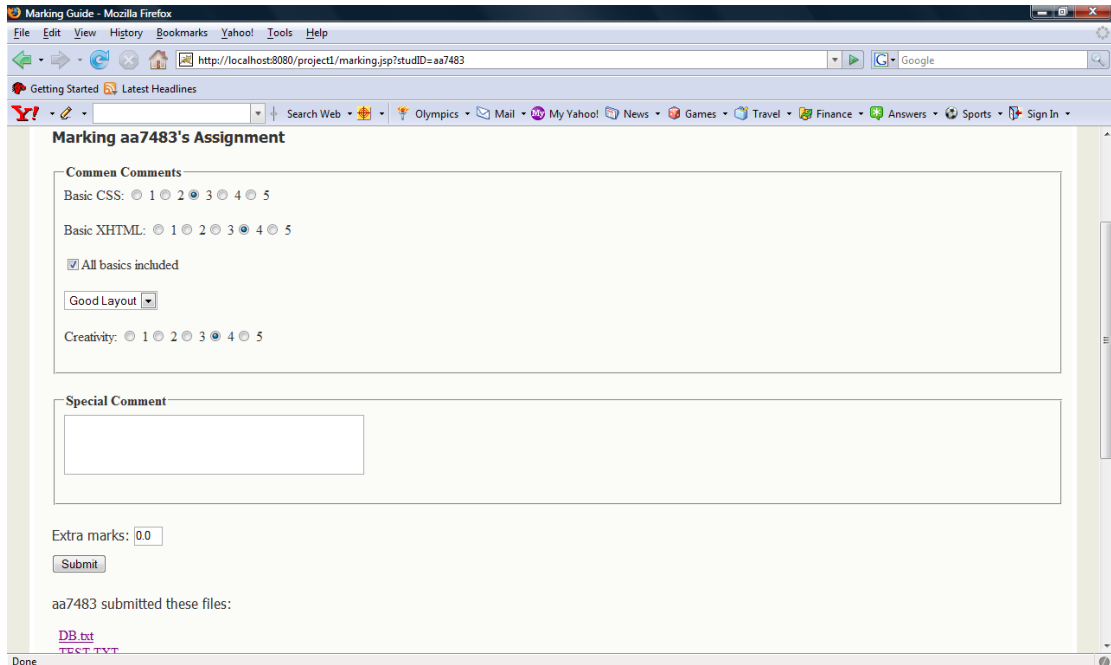
Figure 24 Marking Student's Assignment

5.5.6 Submitting Assignments by the Student

After successful log in, the student will be directed to a page with all the units he/she are registered in. He or she can choose a unit where he/she will be directed to this unit's page containing all assignments and deadline. By choosing an assignment, the submission page for this assignment will be displayed. The student can submit up to five files in one go. The submitted files will be uploaded to a directory. The structure of the directory is as follows : \Units\UNITCODE\CW\Assignment's Name\Student's username. This page also has a link to the individual feedback this student got for this assignment. In this part two classes were mainly used: Upload and copyFile.

5.5.7 Reading the Feedback by the Student when Marks are Released

Students can see what feedback and mark they received assignment whenever the marks were released. The feedback is shown to the student in a JSP page containing each comment that was given alongside its mark. The page will also consist of any special comments that was written and at the end the total mark given for this assignment. The feedback is meant to be clear for students to understand and to know where their weaknesses and strengths were.
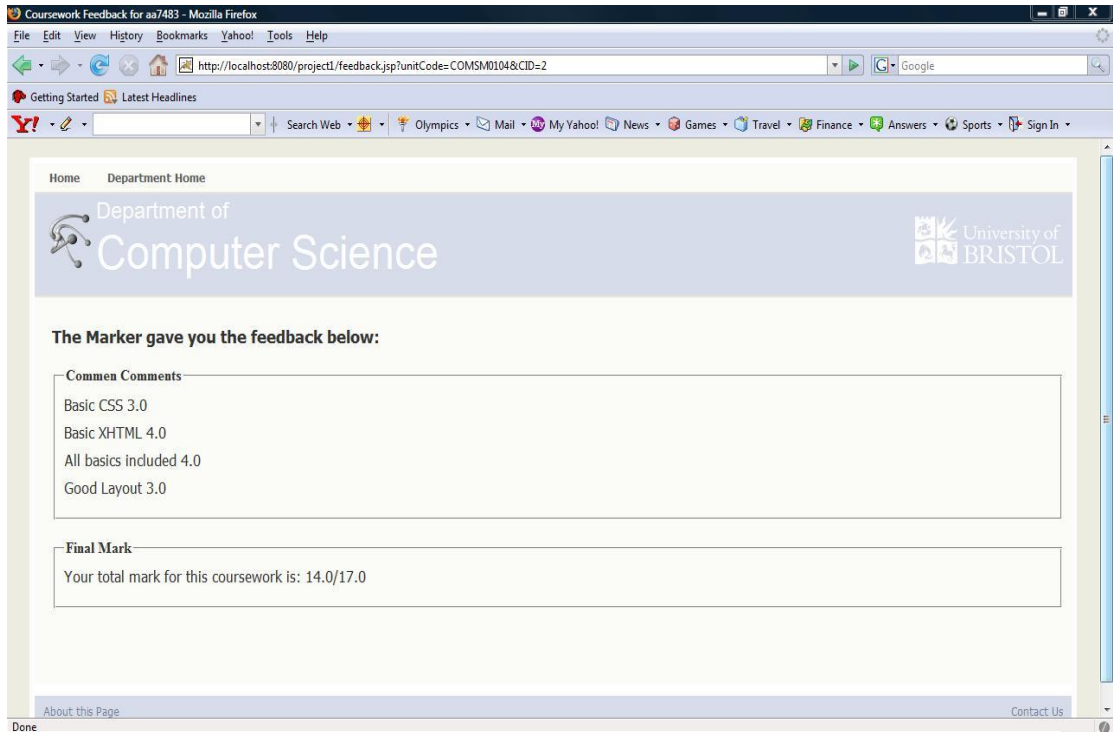
Figure 25 Student's Feedback

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Chapter 6 : Evaluating and Testing

This chapter will discuss the evaluation and testing of the application. Testing plays a significant role in any software. It is crucial to determine whether the application is usable or not, whether it behaves as described. The testing and evaluation should be carried out by experts in the same area and/or real time users. Testing would give the developers a clearer vision about the software's usability and functionality to do any modifications that would be for the user's best interest.

6.1 Heuristic Evaluation

To evaluate the application, it was best to let an expert test it and provide comments and suggestions for improvement. Upon completion of all parts of the application, it was evaluated by a computer expert that is a faculty member of the department of Computer Science in King Abdulaziz University and is an administrator involved in the E-learning track of her university.

She tested the functionality and usability of the application and had the following comments:

- In the Marking Guide Editor, the user must not be given the ability to type in parts that might corrupt the system if a spelling mistake was made. Thus the user must only be able to type in his/her comments other parts must be only selected rather than typed.

- In the Marking Guide Builder, the two submission buttons should reflect their meaning to clearly indicate their function.

- When marking a student's assignment the page should has an indication of the student whom the marker is marking his or her assignment. In other words, the page should contain the student' name or username. The marker, for any reason, may get interrupted while marking and this interruption may take a while. The marker may forget whose assignment this is and having the name would be helpful.

- When marking a student's assignment, the submitted files by the student should be shown on the page. It should not disappear when clicking one of the files, and pressing the browser's back button was not an efficient way.

The application was modified to reflect all the comments provided by the evaluator.

6.2 Comments on the Poster Day

Upon evaluation on poster day, a number of comments were received. These comments were:

- The validation of the user's input especially inputting the marks. The user may input a letter instead of a number and the system must not accept it..

- The total mark on the feedback page viewed by the student should show clearly what was the full mark.

- The security of the application.

The application was modified to reflect the first two comments and to include what was missing. The third comment was left to discuss for the future work section due to the shortage of time.

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Chapter 7: Conclusion

The main aim of this project was to develop a web-based semi-automated marking and feedback application to be used by markers in marking students' assignments. The application was intended to be aimed at markers whatever department they are in; not limiting it to computer scientists. The application eases markers' job and will reduce the time spent on marking and feedback which will give them more time to research.

All objectives listed in the plan was covered. Some difficulties were tackled during the process of developing the application such as introducing AJAX to the system and inserting multiple records to the database.

7.1 Summery of the Dissertation

In order to implement a marking and feedback application for markers, an application that markers can make the most of it. A review of the literature must be carried out. The review was discussed in chapter two along with some previously created systems; whether it was computer-based or web-based systems.

The drawbacks found in the systems reviewed in the literature have been put into account. A database was used to store the marking guide and the students' feedback rather than XML which was used in the Vula Marking System. Furthermore, the marker does not have to type in a student id, name, and email address each time he/she marks a student's assignment which is the case in Simon Fraser University. The marker will be supplied with a list of all students in a particular unit and only has to click on a student's username to start marking his/her assignment and the application will know which student without needing to specify any more details.

Chapter three discussed the specification and analysis of the developed application. What the requirement analysis were, the initial user stories, and a use case of the system's analysis. This chapter included, as well, a brief discussion about the initial meeting with the supervisor that gave a much clearer view of the project.

Having known the specification of the desired application gave a good idea of how the system should be designed which is what chapter four is about. This chapter showed the what the architecture of the system was and a detailed architecture showing variant parts of the application. Furthermore, a design of the database was explained. The chapter was concluded with a discussion about the initial design of the user interface.

Chapter Five demonstrated the implementation of the application. It went through the development process, What the technologies chosen were and why they were chosen, a discussion about some tables used in the database along with a description of their fields, and demonstration of the most important pages in the application.

It was crucial to know the what the state of the application was. Is it functioning well ?, is it user-friendly and if it can be navigated easily by non computer scientist ?. These questions were significant to the application. However, the only way

to get them answered was to test and evaluate the application by an expert. This was what chapter six was about. Almost all comments on the system were taken into account and the application was modified accordingly. Due to the shortage of time, a comment was left behind. This will be discussed in the next section, the future development.

7.2 Future Development

Although a lot of essential work have been done for the semi-automated marking and feedback application, there are still improvements that can be included. In this section, what was not been included in the system due to the lack of time and suggestions of what might be done in future will be presented.

Security Issues in the Current Application

The application, currently, does not include any extra measures of security. As the application was intended only to aid markers in marking assignments and providing students with feedback, extra security measures was not considered. However, when applying this application to real-time users, security should be taken into account.

In the current state of the application, each user has a role, either a marker or a student. This allows the system to identify each user without mixing roles. The system authenticates a user by the ID and password. If the user is not authenticated, he/she will not be authorised to use the application. However, the passwords in the database are not encrypted, currently. In order to prevent any administrator from reading the passwords, this field must be encrypted. This can be done by applying a Java class to encrypt each input of this field before storing it.

Moreover, another security issue may arise. The encryption of the data from and to the pages. If the data were very sensitive, then this would have been a big problem. However, in such an field, it is better to be safe than sorry. Security can be applied to this application by using HTTPS rather than HTTP and protecting pages with passwords.

Applying SSL , or Secure Socket Layer, will make the communication of the web browsers and web server occur over a secure connection. Which will encrypt the transmitted data sent by one side and decrypt the received data by the other side before processing.

Applying HTTPS, is a matter of configuring Tomcat. According to Apache Tomcat 6.0's Documentation a number of settings should be done:

- Creating a certificate keystore by executing the bellow command in the Command Prompt in Windows:

```
%JAVA_HOME%\bin\keytool -genkey -alias tomcat -
keyalg RSA
```

- Remove the Comments from the "SSL HTTP/1.1 Connector" which is located in `$CATALINA_BASE/conf/server.xml`.

Future Work

A number of ideas could arise when talking about what could be developed in this area. Whether it was additions to the existing application or creation of new tools that will aid marker in a way or another.

For the existing application, new features can be added. A feature that will give markers a deadline to mark a particular assignment. When the deadline approaches the system will send an e-mail to the markers reminding them of the approaching deadline and that there are a number of unmarked assignments. This feature will keep track of unmarked assignments, will put limitation on period of marking, and will encourage getting the feedback to students as soon as possible.

Another possible addition is creating a marking tool which helps in marking online tests and exams. Since the test was taken online, it would be very helpful to have a tool that would ease the marker's job. A tool that would, for example, help in marking short answer questions by a number of ways. Put answers in an alphabetical order, merge identical answers into one line, and sorting the answers with the marker's help by choosing a keyword. These can be some of the features of such a marking tool.

However, these were only some ideas that can be developed in the future. Many other ideas can be thought of in this area that would play a significant role in e-learning in particular and in education in general.

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A review of the literature was carried out on education in general then marking and feedback in particular. Moreover, to find out the current state of e-marking and feedback systems, a number systems developed by other universities and the Department of Computer Science in the University of Bristol was investigated in this project. Different techniques were used in almost each system. This was due to variant approaches used in each university and to the type of the system, either a computer-based or a web-based system. The technologies used in this project was chosen for several reasons; they are on open source technologies, many libraries and support were released under public licence, and these are, mostly, the technologies used by the Department of Computer Science in the University of Bristol, to name but a few.

The application will give markers the opportunity to create a marking guide for any assignment they wish. The marking guide will contain comments each of which has its own mark. These comments, created by the marker, are the kind of comments he/she would anticipate students would get as feedback for a particular assignment. Moreover, the guide can be edited when needed and markers can start marking student's assignment whenever they are done with the guide.

Although feedback from the evaluation of this application was positive, there is still room for improvements such adding extra security measures by applying SSL to encrypt the transmitted data sent by one side. Improvements and future development are discussed at the end.

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DEPARTMENT OF COMPUTER SCIENCE

Web-Based Semi-Automated Marking and Feedback

Abeer Al Nuaim

A dissertation submitted to the University of Bristol in accordance with the requirements
of the degree of Master of Science in the Faculty of Engineering

September 2008 | CSMSC-08

Declaration

A dissertation submitted to the University of Bristol in
accordance with the requirements of the degree of Master of Science in
the Faculty of Engineering. It has not been submitted for any other
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Chapter 1 : Introduction

As technology develops, it is providing new dimensions for teaching and learning. The number of students seeking higher education is growing year by year. Many courses have more than 80 students enrolled. Having this large number of students makes it harder for a lecturer to mark each student's assignment and give a feedback individually.

E-learning has been an important element in the learning process, new tools and services should be developed to cover the needs of the e-learning environment. However, many tools and methods are provided for students to access materials online regardless of their location, discussion forums has become a popular place for learners to share ideas and find information, and online submission systems gave e-learning a special feature allowing students to submit their assignments online rather than by hand, saving them time and hassle . Yet, assessment and feedback, which are key aspects of education, were not given a priority in this environment.

1.1 Motivation

This project was chosen due to the time and effort spent by markers in the marking process. The project intends to reduce these issues for busy markers by letting them only manage the subjective parts leaving the calculations to the system to deal with.

1.2 Aims and Objectives

The main aim of this project is to (1) investigate the e-marking systems developed and based on that (2) develop a web-based interactive semi-automated marking application for markers. Here are some specific objectives that will help reach the primary aim:

- Review the literature on education in general then marking and feedback in particular.
- Investigate some marking systems both computer-based and web-based. Knowing how their system works and what languages were used.
- Learn about the tools that will be used to build the project. What might be the best options.
- Configure the developed system with the server and the database.
- Design an initial state of the application to start with.
- Develop the application gradually and test it.
- Integrate the entire application.

Chapter 2: Background

2.1 E-Learning

Distance learning was a method of learning, where postal service , or what is now known as "snail mail", was the medium used to deliver education (Moore, et al., 2001). The Internet has been the dominant technology for of distance learning today in what is known now as E-learning.

E-learning can be defined in a number of ways depending on who uses it. It can be known as a way of delivering knowledge or education electronically. Where a computer is used side by side to the World Wide Web as the medium to deliver learning. E-learning can be a way of self-studying or involve both face-to-face teaching and web-based learning. Cloete and Kotzé (2002) defined E-learning as "a combination of learning services, technologies and products that provides a coherent institutional environment for instruction on the Internet".

2.1.1 E-Learning Benefits

There are many reasons that makes e-learning a convenient learning method for learners (WorldWideLearn, 2008):

- Students can speed up or slow down learning whenever this is needed.
- Students can choose their what, how, and when they want to learn.
- E-learning does not have geographical boundaries.
- Encourages student to interact and collaborate with each other and to get in touch with instructors.
- Materials can be read online or downloaded to be read whenever it is convenient.

There are also many reasons that makes e-learning a convenient teaching method for instructors such as (E-learning system & Technology, 2002):

- Instructors can access resources whenever it is convenient despite their physical location.
- It allows them to develop their teaching materials using Internet resources.

- Instructors can provide information to be accessed by all students.

2.2 Learning Management Systems

Learning Management Systems (LMS) are systems which offers tools and features designed to support learning: distant (online) and traditional (in-class). It allows lecturers to monitor and report students profiles, grades, and participation within the class. It also allows students to manage their progress, download lectures, submit their

assignments, answers tests and participate in discussion with other students. This is done through a ,collaborative learning environment'.

Administrators also benefit, it gives them the opportunity to give students and staff various privileges to access the system depending on their needs and roles. In addition, they can assign students and lecturers to courses.

Nowadays, many Learning Management Systems have been adopted by universities and schools. Either it was an open source LMS such as Moodle and eFront or a commercial LMS such as Blackboard.

Figure 1 LMS (Nichani, 2001)

2.3 Assessment and Marking

Assessment is the only way where a teacher or a lecturer can measure students' performance and determine whether a student had satisfactory accomplished the required assignments or clearly understood the subject. Moreover, assessment is the way to feedback. An assignment or a task must be assessed or marked first in order to for the instructor to give a feedback. However, to have a good practice of assessment, a number of principles should be met (Barrs, 1990):

- The purpose of learning as well as the product should be included in assessment;

- When assessing competencies and skills, how students execute complex processes should be considered;

- Assessing students in a day-to-day manner is probably known to be valid and reliable;

- A teacher or lecturer should share the assessment criteria with students;

- Student should be able to assess their learning.

Assessment must reflect the criteria set out in a learning sequence, if it was meant to guide student's learning in the duration of the course.

When an instructor decides to assess his or her students, a number of steps must be taken (Wells, 2005):

- Creating a task or an assignment to be given to students to solve;

- Setting a deadline in which the students must submit their work;

- Marking and evaluating each student's submission;

- Grading each assignment and recording the mark;

- Generating a feedback for each student and maybe a general feedback for the entire group; and

- Sending the results in conjunction with the feedback to the students.

As we can see assessment is not only about evaluation, it is more than that. The instructor has to go through a set of steps to complete an assessment task. He or she should manage and develop their own methods. Nowadays, where classes are increasing year by year, the assessment task is getting harder and harder for instructors. They face difficulties to make sure that their assessment and feedback is constant and is completed within a specific time (Thomson, 2001). Students, on the other hand, need to see comments and feedback on their work in order complete their learning and promote understanding (Stephens et al., 1999).

2.4 Feedback

Feedback is a term used in many fields in which each field uses it under its own perspective. The history of feedback is as early as Thorndike (1912) when he wrote „the law of effect' which stated that any behaviour that produces a pleasing reaction will more possibly be repeated in the future. Pressey (1926) tried to produce a machine that enables a students to progress at their own speed. He was believed to be the first to accentuate the significance of giving feedback immediately.

Mory (2003) stated that the three definitions of feedback that goes back to the early 1900s are amazingly alike to the ones used nowadays. Kulhavy and Wager (1993) introduced "feedback triad" which was about motivation, reinforcement, and information. Firstly," feedback as a motivator for increasing response rate and/or accuracy". Secondly, "feedback reinforcing a message that would automatically

connect responses to prior stimuli – the focus being on correct responses". Thirdly and lastly, "feedback providing information that learners could use to validate or change a previous response – the focus being on error responses".

According to Vasilyeva, et al. (2007) feedback must have the ability to work simultaneously and be analysable at three levels: on the emotional level as a motivator, on the cognitive level as a provider of information, and on the behavioural level as reinforcement. They also stated that these levels are of a significant importance in the e-learning systems.

Feedback can be categorised in different ways. Kulhavy and Stock (1989) divided feedback into two labels: verification and elaboration. Verification is about simply stating whether an answer is right or wrong. On the other hand, elaboration is the information contained in a feedback message besides correct or incorrect, in other words, it is hints given to guide the student to the right answer. Elaborative feedback definitely consumes the instructor's time more than its counterparts.

Feedback can also be classified depending on the level of verification and elaboration. According to Mason and Bruning (2001):

- No feedback: this is the minimal level where no verification and elaboration is provided. The learner only gets a performance overall score.
- Knowledge of response feedback: here the learner gets a simple response of whether his/her answers were correct or not.
- Answer until correct feedback: modifies knowledge of response which makes the learner stay in one item while he/she is giving incorrect answer until the correct answer is figured out.
- knowledge of correct response or correct response feedback: gives the correct answer for each individual item.
- Elaborated feedback: provides the learner with the correct answers as well as information such as why the answer is incorrect.

Gregory (1993) gives us another way to categories feedback, where he discusses that there is a difference between adapted feedback and adaptive feedback. Adapted feedback is about giving a general feedback to the group as a whole regardless of the individual. Whereas adaptive feedback is about giving each individual a separate special feedback depending on their own work.

Another classification of feedback can be encountered. Either immediate or delayed feedback. Immediate feedback where the learner gets feedback as soon he/she gives an answer. In contrast, delayed feedback is where the feedback is not presented immediately after an answer is given but is delayed to be given after a period of time, before the next task or after couple of tasks (Vasilyeva, et al., 2007).

When it comes to grading, feedback can be either formative or summative. Formative feedback is more about feedback information rather than grades. That does not mean it does not consist of grades but emphasises on comments. Summative feedback, on

the other hand, is about the learner's final grade and final report showing the level of knowledge a learner has gained (Dirks, 1997).

2.4.1 Feedback in Web-Based Systems

Feedback plays a significant role in learning in general and in web-based learning in particular. In higher education, feedback is not well exploited. This is due to the large number of students in each class, or because of having a single assignment moving towards the end of the course. Where the feedback loses many of its benefits such as its motivational purpose. Moreover, many instructors are not willing to spend a lot of time and effort on feedback.

Students need periodic feedback to know that their work was assessed, how they can prevent mistakes in the future, how they can improve their performance, and how their marks are going to be calculated (Bischoff , 2000).

Using a web-environment to give learners the feedback they need to the series of assignments they have throughout a course would be a good solution to some of the problems stated above. A web-based system does not restrict the instructor. But it gives him or her the flexibility he/she needs. An instructor can log into the web whenever it is suitable and generate feedback to the students without needing to go to the office. The learner gain from this benefit too, as he or she does not have to go to the instructor's office or wait for the lecture to know the feedback on his or her performance (Collis et al., 2001).

According to Schwartz and White (2000) and Mory (2003) web-based feedback has to be " a) multidimensional, b) nonevaluative, c) supportive, d) student controlled, e) timely, and f) specific". They also argued that students expect some qualities and features from feedback in a web-environment. These include:

- "Prompt, timely, and thorough on-line feedback
- Ongoing formative feedback about on-line group discussions
- Ongoing summative feedback about grades
- Constructive, supportive, and substantive on-line feedback
- Specific, objective, and individual on-line feedback
- Consistent on-line feedback."

Feedback in a web-environment can be in different forms making use of many technologies. It can be written presented as text like in e-mails, forms, documents or chats. It also can be spoken using multimedia. Moreover, it can use model comments or a database for comments that occurs frequently (Collis et al., 2001).

However, this does not make feedback in a web-based system free of problems. A couple of problems may occur. The presentation of the feedback can be one of the problems. How it should be presented, what should be included and how it should be structured. Well, generally speaking, feedback should be mainly about the assignment and the learner. Another problem is the timing of the feedback; should it be immediate or delayed. Mathan (2003) discussed the tradeoff between both types feedback. He argued that researchers happen to believe that immediate feedback is

more efficient during training periods, whereas delayed feedback might be a better supporter to transfer and retention. Nevertheless, different aims can always change the benefits and drawbacks of the immediate and delayed feedback.

Mandernach (2005), on the other hand, studied the influence and the impact of presenting different levels of computer-based feedback (no feedback, knowledge of response, knowledge of correct response, topic contingent and response contingent 'elaborated feedback'). His study showed that level of feedback did not have any effect on increasing students' learning. There were no significant differences in learning between students who received more elaborative forms of feedback and those who received less elaborative forms of feedback. This was mainly because of the timing of the feedback. It seems that students were more concerned about their marks, whether they passed or not, at that time rather than learning the information. Hence, providing feedback with the results will more likely to reduce its potential benefits.

2.5 Computer-Based Marking Tools

Many of the marking tools found on the Internet are run on windows. Stephens et al. (1999) stated that the majority of these products were created to be used in an American High School environment. They were designed to record students' grades and then generate a report based on them. These tools were also able to store data about the student such as attendance and class plan. Stephens et al. (1999) illustrates that by giving 'Blackboard' as an example that focuses on students' progress(Figure 2).

Figure 2 Blackboard software as displayed on the Web (Stephens et al., 1999)

Markin

Another windows-based software is „Markin' . This software from Creative Technology can be downloaded on the teacher's computer. It can import students essays or texts either as a RTF (Rich Text Format) or text file. The teacher can annotate and mark the assignment and after marking is completed the teacher can export the marked assignment either as a web page or as a RTF file (Creative Technology, 2007) (See figure 3).

Figure 3 Markin software

Marking Assistant

Markers Assistant is a software that was developed over a four year period in Deakin University, Australia. It was designed to be able to assess a v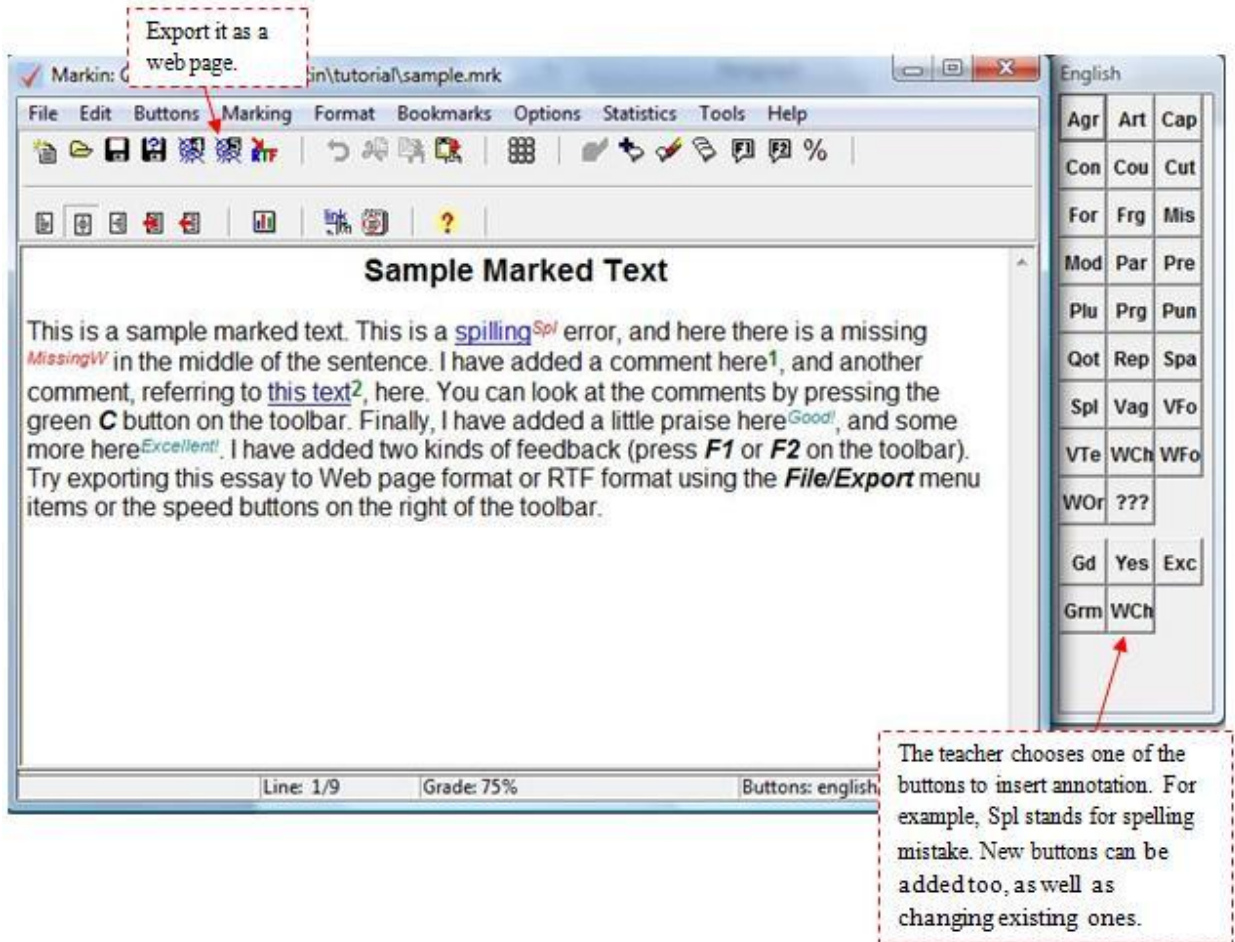ariety of tasks such as essays, short answer assignments, reports, programming assignments, databases, to name but a few. The application has many features such as creating a marking guide to suit the assignment that is going to be marked and adding feedback either generally to all students or individually. The software also supports sending e-mails to the students with the results as well as saving them as text or HTML files (wells, 2005).

Automatic Marking of MS Word and Excel Files

The Sapporo Gakuin University developed two software written in VBA (Visual BASIC for applications) with a second version is written in VB.NET (Visual Basic 2005) to make it a stand-alone program not depending on specific clients running in a LAN environment.

One was to automatically mark MS Word files and the other to automatically mark MS Excel files. The need for this development was very important to the university

since they made computer literacy a compulsory course to be taken by all students, and since the university is Japanese, the programs' interface is written in the Japanese language.

The MS Word marking program is given an answer file containing the criteria to mark. Since the course is about mastering MS Office applications, the program evaluates the students' ability to use MS Word. For example, it checks page settings, fonts, colours, paragraphs, and so on. However, the students have the ability to download the software from the course's page to check their performance before submitting their work (see figure 3). This allows the students to get immediate feedback about their assignment. One thing must be pointed out, the program does not have the ability to read the text in the submitted file which does not give it the ability to mark reports (Koike et al., 2006).

The MS Excel marking program is similar to the MS Word marking program the only difference that it marks excel files.

Figure 4 Automatic Marking System for MS Word (Koike et al., 2006)

Koike et al. (2006) stated that the problem they faced was that many students preferred to choose their own computers rather than the Department of Social Information's specified computers. This often raised problems regarding the need of extra installations in order for the system to work. The students were notified about such issues but still there were several students who preferred to get their own computers (Koike et al., 2006).

This issue made the developers decide to develop a web-based version of the systems.

Mark

Mark is a automatic marking program, written in Java, used in the Department of Computer Science at University of Bristol by running a group of tests. For example, different input will be tested to see whether the program deals with it in a desired way or not. The program then produces a text file named feedback.txt which has the summary results and feedback of the marking. The program can be used on a number of programming languages such as C and Java. Mark works by writing a test script in a text file containing the command line for the compiler, the name of the program, the wanted output that the program should produce and the word total.

For example, in a C language program the test script should look something like this:

```
SETUP gcc -o myprogramme myprogramme.c
TEST myprogramme
OUT First C programme
TOTAL
```

The main drawback of Mark is that the output produced by the tested program must be identical to the output written in the test script otherwise the result will fail and the total is zero. To overcome this disadvantage the instructor must clearly notify the students about the desired output tested by Mark. Yet many students may likely mistype a character or two which will result in failing the assignment.

Mark is mainly useful to mark for first year beginners simple not complex programmes.

2.6 Web-Based Marking Systems

Web-based systems have some advantages over computer-based systems. One of these benefits is that a web-based system does not require a specific machine.

Vula Marking System

The Vula marking system is a web-based marking system developed by the University of Cape Town. It was developed by three students as a project. It was aimed to be used in all the departments of the university to mark as well as comment on students' assignments. The need of this system came as an enhanced version to the original Vula system which did not have a marking tool.

Every user of the system is allowed to access only the courses they are members of. The user can view the assignments of each course and all students

enrolled in that course. The instructor of a course has the ability to create a marking guide for the assignments, as well as editing it, whereas the tutors can only view the marking guide and mark students' assignments.

The system automatically sums the marks as well as the bonus marks. It also generates a marking guide for the students to view in a HTML format.

The marking guide creates a tree like structure in which each node has a certain value (See figure 5)(Rammutla, et al., 2006).

Figure 5 Vula's Marking-Guide Editor

Online Assignment Marking System in Simon Fraser University

The School of Computing Science at Simon Fraser University developed an online marking system as a solution to the previous system in which the marker had to annotate on the submitted paper that is then returned to the student. Leaving the instructor without the comments and marks unless he or she copied them.

The system is web-based created with Perl and MySQL database. The system allows more than one marker to mark a certain assignment as long as they were

assigned to mark this course. Each assignment has a number of criteria that students must meet. These criteria are set by the instructor or the markers. The marker has to enter the student user id their student number and email address. Then he or she can write comments which can be up to 64k characters. The system deals with the repeated comments that many students share, it allows the marker to predefine a mark and a comment to a particular problem. This then appears as a button, when the marker clicks that button the comment is inserted and the mark is deducted according to the mark specified (see figure 6).

When the marking is completed an email is sent to the students as a report or a feedback containing the comments and mark for each criteria (Baker, 2003).

Figure 6 Online Marking System in SFU (Baker, 2003)

Automated Feedback for "Fill in the Gap" Programming Exercises

The "Fill in the Gap" programming analysis framework was developed at Queensland University of Technology (QUT) to test students' programming solutions to programs with gaps. Students fill in these gaps and submit their solution to get an immediate feedback either positive or negative. Gaps can be for beginners which are small such as an expression or for more advanced programmers such as a complete class. The framework is used with the Environment for Learning to Programming (ELP) at the university.

The students download the exercise and run it on their own computer. The student must compile the program before submitting it. If no syntax errors were found the system now can analyse the program. The analysis framework contains two components: static analysis and dynamic analysis. The static analysis is to check the quality of student's code, it does not execute it but only analyses it whereas dynamic

analysis executes the student's code using a set of test data to test the correctness of the code (Truong, et al., 2005).
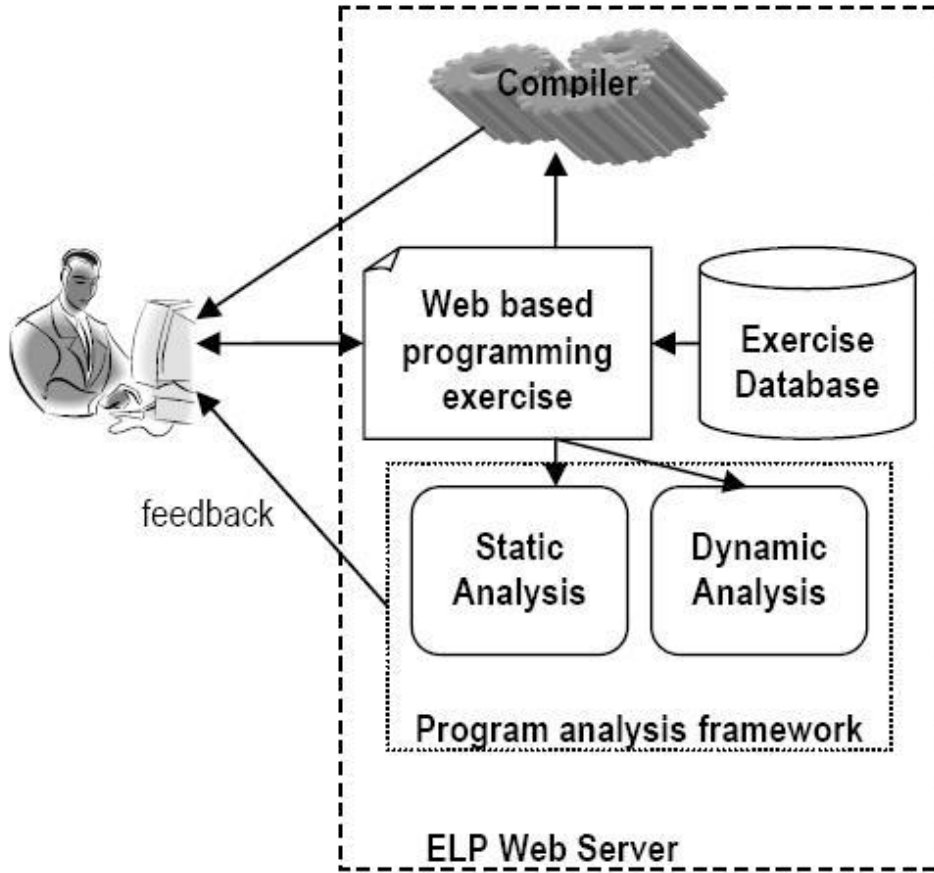

Figure 7 The ELP and the Program Analysis Framework Integration (Truong, et al., 2005)

2.7 Summary

The systems discussed above were categorised either to be a computer-based application or a web-based application. In general, the computer-based applications have one major drawback. To make a computer-based application beneficial, it must be cross-platform. This is not the case for many computer-based systems such as ‚Markin' and ‚Markers Assistant', which are windows-based applications. Another disadvantage, is the demand of installation. We can never be able to use a computer-based application before installing it on our PCs. That might be an issue when a marker wants to access the application then realises that it is not installed in this computer and maybe cannot be installed due to the different specifications. This was the reason that made the developers of the MS Word and Excel Files automatic marking system in Sapporo Gakuin University decide to develop a web-based version of the application to override this problem.

As far as Web-based systems, and as mentioned above the Web-based application overrides some of the drawbacks of the computer-based systems. A web-based application is known to be cross-platform, which can work on any computer no matter what operating system it is running on. It does not need to be installed on the computer in order to access it as long as there is a browser. However, this does not make it work perfectly on all computers. Some computer still use old versions of browsers which do not support new web technologies such as Ajax.

The Online Assignment Marking System in Simon Fraser University is a good example of marking and feedback. The only drawback that occurs is that the marker needs to enter the marker student's user id, student's number and email address. Which means that the marker must have all these details ready when marking each student's assignment. A better approach is, what is done currently in the Department of Computer Science in the University of Bristol, when an assignment is chosen a list of all students, by their user name, in that course and assignment is presented. The marker then starts marking by selecting the user name of each student.

The "Fill in the Gap" programming exercise framework was an example of a good web-based feedback application. Such an application can be very useful for programming courses especially for first-year programming units. However, this application is limited to programming only and not useful for any other course.

Chapter 3: Specification

As the aim of the project is to provide markers with a web-based marking and feedback tool to ease the process of marking, reduce time spent on it, and to provide students with an accurate feedback that will help them understand their strength and weakness in particular unit or assignment. It was essential to know what features a marker would like this tool to have. What features would aid in reducing the time consuming of marking. Having surveyed a number of marking systems gave a rough idea of what the application should look like and it should behave.

3.1 Initial Meeting with the Supervisor

The very first meetings with the supervisor helped understanding basic specification of the project. It was understood that creating a system that would assist the lecturers / markers in setting up a marking guide for each assignment and use this guide in marking student's assignment would improve and accelerate the marking process.

These initial meetings helped determine the scope of this project, identify use case and analyse user scenarios.

3.2 Requirements Analysis

To aid markers in their marking, the application must:

- Allow markers to create a marking guide for each assignment. This is done by anticipating what kind of comments and marks would be needed in each assignment. Thus, creating a marking guide which has the most common comments each of which has an assigned mark would help reduce time and effort for the marker when marking a large number of assignments.

- Allow markers to edit a previously created guide either by modifying, deleting an existing comment or adding new ones. The marker can start marking whenever the guide is ready. The application should allow him/her to edit a previously marked student's assignment.

- However, the system must not allow him/her to modify or delete comments and marks from the marking guide since he/she has started marking already but should allow adding more comments. Allowing the ability to edit the marking guide even after assignment had been marked would compromise fairness. The lecturer/marker should be of a great knowledge of the particular assignment that the marking guide will be created for. The assignment's criteria should be clear enough to be able to know what to assess students on and thus create an accurate marking guide.

- Show the marker which students are registered in the unit and which students' assignments have not been marked yet.

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Appendix A: Use Cases

Table A.1 Use Case: Log in

Use Case Name	Log in	
Actors:	Marker	
Description	The marker will be logged on to the system if authentication is valid. If not he/she will be rejected from logging in	
Typical Course of Events:	User's Action: 1- The user will type in his/her username and password through the interface	Application's Response: 1- The username and password will be validated via the Database through the server. 2- The user is issued a session which will last up to 12 hours. 3- On successful log in, courses assigned to that user will be displayed
Alternate Courses	1- Same as above	1- If the information provided was invalid an error massage is displayed and the user can try again
Pre-Condition:		
Post-Condition:	Now that the user has logged in he/she can use the system's features.	

Table A.2 Use Case: Build New Marking Guide

Use Case Name	Build New Marking Guide	
Actors:	Marker	
Description	The marker will be able to create a marking guide for any assignment in a unit and save it to the DB	
Typical Course of Events:	User's Action: 1 The user will choose the option to Build A marking guide after choosing a unit and an assignment. 3 The user now would choose a type the comment would appear in 4 Choose the number of comment wanting to enter in one go. 5 Starting to write comments and their corresponding marks 6 Chooses either to Add more or Submit.	Application's Response: 2 Display the page for creating the marking guide with all its features. 7 The guide is save to the DB.
Alternate Courses		
Pre-Condition:	The marker is logged in.	
Post-Condition:	The marker can choose any of the application's feature.	

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Table A.3 Use Case: Edit Marking Guide

Use Case Name	Edit Marking Guide	
Actors:	Marker	
Description	The marker will be able to Edit a previously created marking guide	
Typical Course of Events:	User's Action: 1 The user will choose the option to Edit A marking guide after choosing a unit and an assignment. 3 The user can modify/delete/add new comments and marks. 4 The user save the changes made	Application's Response: 2 Display the page for editing the marking guide with all the comments and marks created previously. 5 The changes is saved.
Alternate Courses		
Pre-Condition:	The marker is logged in.	
Post-Condition:	The marker can choose any of the application's feature.	

Table A.4 Use Case: Mark Students' Assignments

Use Case Name	Mark Students' Assignments	
Actors:	Marker	
Description	The marker will be able to Mark a student's assignment using the marking guide.	
Typical Course of Events:	User's Action: 1 The user will choose the option to Mark Assignments after choosing a unit and an assignment. 3 The user can choose a student to start marking his/her assignment. 5 The user starts marking and submits when finished	Application's Response: 2 Display the page that has all students registered in this unit. 4 Display the page that has the marking guide for this assignment and the files submitted by this student. 6 Saves what was given to the student. 7 Redirects back to page with all students' names
Alternate Courses		
Pre-Condition:	The marker is logged in.	
Post-Condition:	The marker can choose any of the application's feature.	

Table A.5 Use Case: Edit previously Marked Students' Assignments

Use Case Name	Edit previously Marked Students' Assignments	
Actors:	Marker	
Description	The marker will be able to Mark a student's assignment using the marking guide.	
Typical Course of Events:	User's Action: 1 The user will choose the option to Mark Assignments after choosing a unit and an assignment. 3 The user can choose the student that he/she needs to edit his/her mark and feedback. 8 The user makes the desired changes the submits when finished	Application's Response: 2 Display the page that has all students registered in this unit. 4 Display the page that has the previously marked marking guide for this assignment and the files submitted by this student. 9 Saves what was given to the student. 10 Redirects back to page with all students' names.
Alternate Courses		
Pre-Condition:	The marker is logged in.	
Post-Condition:	The marker can choose any of the application's feature.	

DEPARTMENT OF COMPUTER SCIENCE

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