إقرار

أنا الموقع أدناه مقدم الرسالة التي تحمل العنوان:

نظام تتبع للبشر في الزمن الحقيقي و ذات تكلفة منخفضة
Real Time Cost Effective People Tracking system

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Real Time Cost Effective Of People Tracking System

A Thesis Proposal Submitted to the Faculty of Information Technology
in Partial Fulfillments of the Requirements for the
Degree of Master in Information Technology

By

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نظام تتبع للبشر في الزمن الحقيقي وذات تكلفة منخفضة

Real Time Cost Effective People Tracking System

وبعد المناقشة التي تمت اليوم الأحد 18 رمضان 1436هـ، الموافق 2015/07/05م الساعة الثانية عشرة ظهراً، اجتمعت لجنة الحكم على الأطروحة والمكونة من:

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واللجنة إذ تمنحه هذه الدرجة فإنها توصيه بتقوى الله ولزوم طاعته وأن يسخر علمه في خدمة دينه ووطنه.

والله ولي التوفيق ،،،

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Dedication

To the soul of my mother in his eternal existence.

To my beloved parents.

To my kids, my eye on the future.

To the steadfast Palestinian people.

Abstract

The wide coverage of mobile and satellite network leads to various useful applications that increase the convenience of our daily life. One of such applications is people tracking or positioning system. The real time location of a person can be tracked by using the GPS (Global Positioning System) which is a satellite-based navigation system consisting of several satellites revolving around the earth and GSM (Global System for Mobile communication) technology which is a set of standards to describe technologies for Second Generation (2G).

The Palestinian region use 2G service for transmission data with high cost and low bandwidth in comparing with other countries surrounded us which have third generation (3G) that have high bandwidth and low cost for data transmission.

The purpose of this thesis is to propose and implement a cost effective method of people tracking system using general packet radio service(GPRS) and global position system (GPS) equipped mobile which will make our system a low cost tracking solution for localizing an object position and status.

We apply our rule for the transmission point from client (Mobile Phone) to server and making the processing at the client side itself which reduce the cost of transmission to 35%.

Evaluation done using mobile phone with integrated GPS receiver which works great for the proposed GPS tracking system by reducing the number of transmitted packet & cost.

Keywords: GSM, GPRS , GPS , Cost Effective , Tracking System , People Tracking System .

ملخص الرسالة

أدي الانتشار الواسع لشبكات الهاتف المحمول والاقمار الصناعية والثورة التكنولوجية المستخدمة إلي إضافة الراحة لمستخدميها في العالم. واحدة من هذه التطبيقات هي تحديد المواقع أو تتبع تحركات البشر. يمكن تتبع الموقع في الوقت الحقيقي للشخص باستخدام GPS (نظام تحديد المواقع العالمي) وهو نظام الملاحة يتكون من عدة الأقمار الصناعية التي تدور حول الأرض،GSM (النظام العالمي للاتصالات المتنقلة) التي هي مجموعة من معايير لوصف تكنولوجيات الجيل الثاني (G2) التي ما زلنا نستخدمها في فلسطين وذلك بسبب الحصار المفروض علينا ومنع الاحتلال المستمر لاستخدام شبكات الجيل الثالث والرابع اسوة بباقي الدول المحيطة بنا وفي العالم مما رفع تكلفة استخدام تقنيات الجيل الثاني.

والغرض من مشروع البرنامج المقدم بالرسالة هو اقتراح وتنفيذ طريقة فعالة من حيث تكلفة منخفضة لنظام تتبع البشر باستخدام خدمة حزمة الراديو العامة (جي بي آر إس)، نظام تحديد المواقع العالمي (GPS) لأجهزة المحمول الشخصية بدلا من استخدام جهاز استقبال GPS . وينقسم النظام بأكمله إلى قسمين، والتي هي جزء تتبع وجزء رسم الخرائط. سيتم تنفيذ التجارب في تطبيقات الهاتف المحمول باستخدام نظام أندرويد وسيتم مقارنة النتائج ودراستها مع أنظمة متبعة في البلاد.

لقد تم تطبيق مجموعة من القواعد علي البيانات المرسلة من الهاتف المحمول بعد استلام وتحديد المواقع بواسطة الأقمار الصناعية إلي جهاز الخادم مما ساهمت بتخفيض كلفة نقل البيانات بنسبة 35%.

وقمنا بالعديد من التجارب لتقييم الأداء علي فئات مختلفة تم تقسيمها الي مجموعتين وتزويدها بجهاز الهاتف المحمول وكانت النتائج مبهرة مقارنة بالاجهزة العادية المستخدمة في المركبات حيث قلت التكلفة وكمية البيانات المرسلة.

كلمات مفتاحية : نظام تتبع للبشر ، نظام تتبع ، الجيل الثاني ، نظام تحديد المواقع العالمي

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List of Abbreviations:

GPS	Global Positioning System
GSM	Global System for Mobile communication
2G	Second Generation
TDMA	Time Division Multiple Access
SMS	Short Message Service
3G	Third Generation
RTO	Real Time Online
AVL	Automatic Vehicle Location
GPRS	General Packet Radio Service
GSM	Global system for Mobile Application
GPS	Global Position System
RFID	Radio-frequency identification
NAVSTAR	Navigation System with Timing and Ranging Global Positioning System
NMEA	National Marine Electronics Association
MMS	Multimedia Message Service
PLMN	Public Land Mobile Network
SIM	Subscriber Identity Module
SS	Switching System
HLR	Home Location Register
MSC	Mobile Services Switching Center
VLR	Visitor Location Register
EIR	Equipment Identity Register
AUC	Authentication Center

BSS	Base Station System
BSCs	Base Station Controller
BTSs	Base Transceiver Station
OSS	Operation And Support System
AVL	Advance Vehicle Locator
WAP	Wireless Access Protocol
MIDP	Mobile Information Device Profile
IMEI	Irrational Mobile Equipment Identity
MOD	Mobile Object Database
GIS	Geographic Information System
OSM	Open Street Map
OpenGTS	Open GPS Tracking System

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Chapter (1):

Introduction

This chapter introduction to people tracking system .It composed of seven section which are :introduction , problem statement, objectives, important of the thesis , scope and limitation and thesis outline.

In the introduction an overview of the problem and the proposed approach.

1.1 Introduction:

The wide coverage of mobile and satellite network leads to various useful applications that increase the convenience of our daily life. One of such applications is people tracking or positioning system. The real time location of a person can be tracked by using the GPS (Global Positioning System) which is a satellite-based navigation system consisting of several satellites revolving around the earth and GSM (Global System for Mobile communication) technology which is a set of standards to describe technologies for Second Generation (2G) [1].

GPS is a satellite based navigation system which can provide accurate location, time, speed and direction data. The satellite that is placed into the orbit will transmit the coded information to the GPS receiver. This data allows us to determine the precise location on the earth by measuring the distance from the satellite[2].

GSM is the digital mobile network which is used to transmit the mobile voice and data service through the narrow band with Time Division Multiple Access (TDMA) Technique. It can be used to detect the location of the mobile phone based on the signal strength to the nearby antenna tower. The GSM technology operates in several bands of frequency for different country. Good number of tracking systems had so far been developed with a wide range of tracking facilities , But the operation cost of most of these systems is higher as vehicle to be tracked is equipped with a costly GPS receiver and relay on the obtained coordinates via mobile or satellite networks to a home station[2].

Also , SMS service used for the communication to the server which turned out to raise the communication costs and used handheld GPS receiver which also expensive (SMS are used for communication to device) which prevents from widespread use. GPS is a satellite-based radio positioning system providing both time and position information.

However, GPS has not been able to provide seamless coverage. It suffers in urban canyons and indoor areas in spite of huge demands. The Palestinian region used 2G service for transmission data with high cost and low bandwidth in comparing with other country which have third generation (3G) that have high bandwidth and low cost for transmission data because of Israeli restriction [3]. So, the challenging for existing live tracking systems that are used in 2G network available nowadays is reducing the cost for transmission .

Generally a **tracking system** is used for the observing of persons or objects on the move and supplying a timely ordered sequence of respective location data to a model e.g. capable to serve for depicting the motion on a display capability. There are a myriad of tracking systems. Some are 'lag time' indicators, that is, the data is collected after an item has passed a point for example a bar code or choke point or gate. Others are 'real-time' or 'near real-time' like GPS depending on how often the data is refreshed [4].

The Real Time Online (RTO) device receives the real time position from the satellite and relays the information to the server at all time. The general online system is based on GPS/GPRS/2G for the information relayed to the server. This online tracking is commonly used with operations requiring locations at all time, e.g., logistics system, traffic system, taxi system, etc. The advantages lie in convenience of use. Managing and control is also efficient owing to the server that functions as a monitor and controller[5].

There is various research discuss different usage of technologies to detect the location of an object based on the requirement of the user. There is differences between these technologies include the **cost** needed, **accuracy** , **availability**, type of **coverage** and coverage areas. Restrictions imposed by the Israeli occupation for providing Palestinian people with 3G service that allow them for sending high bandwidth of data packet with low cost which created the need to exploit the 2G service of our country to reduce the cost of sending data packet to be nearly equivalence to 3G cost for tracking service system. While comparing price between countries surrounded us we observe as example Jordan company monthly fees for sending 2.5 GIGA about 50 shekel and the same for Egypt company which used 3G network while Palestinian company for transmission 600kb costs 129 shekel[6].

The wide coverage of mobile and satellite network leads to various useful applications such as **vehicle tracking system and people tracking system. A vehicle tracking system** combines the installation of an electronic device in a vehicle, or fleet of vehicles, with purpose-designed computer software to enable the owner or a third party to track the vehicles location, collecting data in the process. Modern vehicle tracking systems commonly use Global Positioning System (GPS) technology for locating the Vehicle. To achieve automatic vehicle location (AVL) system that can transmit the location information in real time. GPS device embed in vehicle has not been able to provide seamless coverage. It suffers in urban canyons and indoor areas in spite of huge demands and have high cost which prevent it available to the common people[1].

People tracking system using mobile technology, which a mobile phone tracking system is most precise when it is used in an urban area, because urban areas are populated with antenna towers. Rural areas or areas with few inhabitants can contain fewer base stations. When mobile phone tracking is attempted in these areas, results are less likely to be precise. A mobile phone usually can be located within a precise area of about 160 feet (about 50 m) in urban areas but sometimes only to within a mile range in rural areas and cheap in comparing with electronic device installed in a vehicle[7].

Practical applications for a mobile phone tracking system are varied. Parents can choose to use a mobile phone tracking system to keep tabs on their children's movements. It can be used to locate a lost or stolen phone. Law enforcement officials can locate persons of interest using the system. Mobile phone owners can also choose to upload their positions to websites so that friends, family or other users will be able to find their current location[7].

1.2 Purpose:

The purpose of this thesis is to propose and implement a cost effective method of people tracking system using general packet radio service (GPRS) which is a packet mobile service on the 2G and mobile global system for mobile communications(GSM) and global position system (GPS) equipped mobile rather than using a handheld GPS receiver and will use the GPRS service instead of SMS which will make our system a low cost tracking solution for localizing an object position and status [6][7]. The whole system is divided into two parts are the tracking part which is responsible for obtaining the user location and the mapping part which is responsible for displaying the detected location on the OSM through Android system application.

1.3 Problem Statement:

The problem is that overall cost of continuously sending data for tracking people system is very high because of the cost of packet size transmitted.

1.4 Objectives:

Main Objective:

- The goal of this research is to design and develop real time cost effective tracking people location system using GPS for positioning information and GSM/GPRS for transmission data.
- Evaluate the system performance , accuracy and cost comparing with other used device.

Specific Objectives:

- Study and experiment with existing GPS based navigation/tracking system.
- Find opportunity for enhancing performance and reducing cost.
- Design phase for reducing the cost of software .
- Implement the proposed system in two parts for obtaining the user location and displaying the detected location

1.5 Significant of the research

- Generate rule on the transmission data from client side to server side.
- Reducing the cost for such system will make application to be used by common people according for difficult economic situation.
- Reducing the number of transmission point which will reduce the cost.

1.6 Scope and Limitation

The main emphasis of this resarch is to design a people tracking embedded system which involves software part with low cost. The scope and limitation of this project is as follows:

- The research is limited to mobile operating Android system.
- The project limited to mobile phone that supports tracking using GPS.
- The research used Wifi networks when available.
- The research used for people tracking but could used for cars or other.
- Developing web based software to display all transmitted information to end user along with displaying location of people on a map.

1.7 Thesis Outline:

This thesis consists of sex chapters. First chapter focuses on the project background, problem statements, objectives and scopes of the project. Chapter two will review all of the related study regarding on this project. In Chapter three, the discussion will be on the methodology in conducting this project which includes the methods and techniques used. In Chapter four project implementation. In Chapter five, the results and the discussion will be discussed. Finally, conclusion and future work are presented in chapter five.

Chapter (2):

LITERATURE REVIEW

The main objective of this project is to design and develop real time cost effective tracking people location system using GPS for positioning information and GSM/GPRS for transmission data. This chapter discuss the basic concept of the technologies involved. Besides, some of the related works will be discussed as well.

2.1 Tracking Device

A tracking device is an electronic tag that can be used to monitor the location of an object or people by using the radio signal or satellite signal. Basically, the design of the tracking devices is depending on several factors such as the nature of the object being tracked, the information needed by the tracker and the budget of the tracker. The indoor location tracking is available with various technologies such as ultrasonic, mechanical, infrared, inertial or radio signal measurement. The GPS is the most effective outdoor tracking system with high accuracy [8].

The tracking devices can be categorized into two groups which are globally and locally. For local tracking system, it does not require the global coverage such as GPS. It operates based on the local technology such as Wi-Fi, Bluetooth and RFID. While for global positioning system, satellites have to be used in order to obtain the required information [8].

Besides that, the tracking system can also be divided into passive or active device. The active tracking devices will send out a constant signal continuously while the passive tracking system only will send out a signal when the user require the data. In our work we are using GPS and GSM as tracking devices.

2.2 Global Position System (GPS)

Navigation System with Timing and Ranging Global Positioning System (NAVSTAR) is the full description of GPS. GPS is a space based navigation system which being developed, operated and maintained by the Defense Department of US. Although it is being controlled by the US government, it is freely accessible by anyone with a GPS receiver.[9] The GPS is comprised of three important segments as shown in figure 2.1.

These segments of GPS are:

(i) **Space segment:** The space segment consists of satellites that orbit the earth on six different orbital planes. Each of these planes has four satellites which will transmit the one way signals to the receiver equipment on earth.

(ii) **Control segment:** The control segment is the earth equipment that carrying out the task of monitoring and controlling the space segment, satellite tracking, telemetry and maintain the satellite orbit configuration.

(iii) **User segment:** The user segment is the satellite receiver equipment's which are used to receive the signal from the satellites and determine the current location of the user based on the received signals.

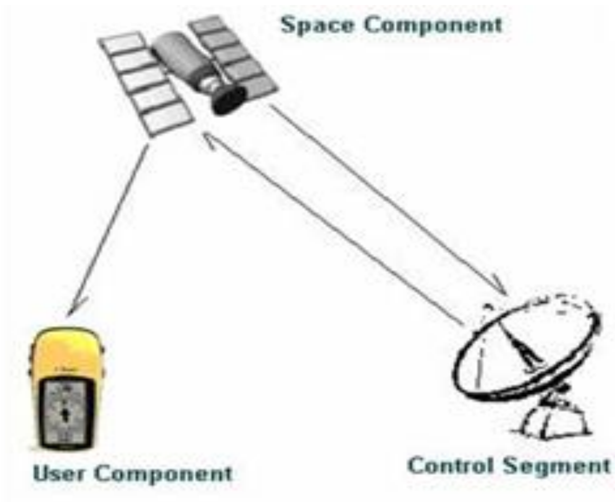


Figure 2.1: Segments of GPS[9]

The GPS is suitable to be used in the people tracking embedded system because the GPS can work in any weather condition, anywhere in the world, 24 hours a day with no subscription fees or setup charges [10]. Besides that, the GPS also can provide three dimensional positioning. Thus, it can be used to detect the location of the user with high accuracy.

2.2.1 GPS Position Determination:

The satellite of GPS will transmit the one way signals to the GPS receiver equipment on the earth. Every satellite transmits the data that indicates its location and the time they sent out the signal. The timing information plays an important role in determine the users location on the earth . Thus, GPS satellites are equipped with atomic clock on board to provide an accurate time reference [11]. The distance between the particular satellite and the GPS receiver as shown in figure 2.2 can be determined by calculating the travel time of a signal from the satellite to the receiver , where :

Travel time = signal reception time - signal transmission time

Distance = Travel time x Speed of light

Figure 2.2: The distance between satellite and one's position on earth[11]

Trilateration (triangulation) is used to calculate the current position of the GPS receiver based the information on GPS signal's travel time from three nearby satellites and their exact locations in the orbit. However, in order to determine one's location in 3D space, 4 satellites are needed instead of three [11] . Figure 2.3 shows the intersection point that indicates the location of GPS receiver.

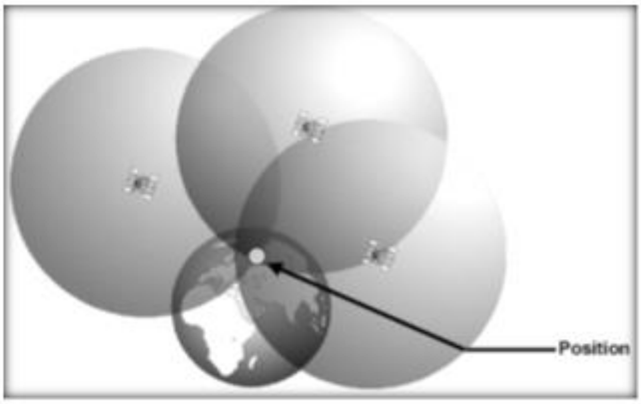


Figure 2.3: The intersection Point indicates the location of the GPS receiver[11]

2.2.2 NMEA Data:

NMEA (National Marine Electronics Association) has developed a specification that is used to define the interface between various pieces of marine electronic equipment which includes the GPS receiver communication. Each type of devices has their own standard sentences and each of these sentences has two letter prefix. For example, the prefix for GPS receiver is GP. There are another three letters followed by prefix that are used to define the contents of the sentences. The standard sentence is begins with $ sign, followed with “talker ID” (2 characters), “message ID” (3 characters), various data fields (each information is separated by commas), optional checksum (begins with * sign), and ends with carriage return or line feed [12]. Figure 2.4 shows the list of GPxxx sentences.

```
$GPBOD - Bearing, origin to destination
$GPBWC - Bearing and distance to waypoint, great circle
$GPGGA - Global Positioning System Fix Data
$GPGLL - Geographic position, latitude / longitude
$GPGSA - GPS DOP and active satellites
$GPGSV - GPS Satellites in view
$GPHDT - Heading, True
$GPR00 - List of waypoints in currently active route
$GPRMA - Recommended minimum specific Loran-C data
$GPRMB - Recommended minimum navigation info
$GPRMC - Recommended minimum specific GPS/Transit data
$GPRTE - Routes
$GPTRF - Transit Fix Data
$GPSTN - Multiple Data ID
$GPVBW - Dual Ground / Water Speed
$GPVTG - Track made good and ground speed
$GPWPL - Waypoint location
$GPXTE - Cross-track error, measured
$GPZDA - Date & Time
```

Figure 2.4: List of GPxxx sentences[12]

2.2.3 $GPGGA Sentence:

$GPGGA sentence is one of the NMEA sentences which is commonly used. The talker ID "GP" stands for GPS while the message ID "GGA" contains position fix information as shown in (Figure 2.5). $GPGGA sentences contain the information's of UTC time, which is the time when the GPS data is taken and followed by latitude, latitude ordinal ,longitude, longitude ordinal, GPS fix quality, number of satellites being tracked, horizontal dilution of position, altitude, height of geoid, time in seconds since last DGPS update, DGPS station ID number and checksum data. In order to determine one's location, there are only four critical information is needed, which are latitude, latititude ordinal, longitude and longitude ordinal. Number of satellites being tracks is depend on how many satellites being used to determine one's location while the horizontal dilution of position represent the relative accuracy of horizontal position[1].

Besides that, altitude determine the position above mean sea level and the checksum data is used by program to check for transmission errors. By referring to figure 2.5, the data was taken at 12:35:19, the GPS receiver is located at Latitude 48 deg 07.038’ N and Longitude 11 deg 31.000’ E, 545.4 meter above mean sea level and 46.9 meter above WGS84 ellipsoid. Furthermore, 8 satellites being used to track the location of GPS receiver and there is no last update and do not have station id.

```
$GPGGA,123519,4807.038,N,01131.000,E,1,08,0.9,545.4,M,46.9,M,,*47

Where:
     GGA            Global Positioning System Fix Data
     123519         Fix taken at 12:35:19 UTC
     4807.038,N     Latitude 48 deg 07.038' N
     01131.000,E    Longitude 11 deg 31.000' E
     1               Fix quality:
                     0 = invalid
                     1 = GPS fix (SPS)
                     2 = DGPS fix
                     3 = PPS fix
                     4 = Real Time Kinematic
                     5 = Float RTK
                     6 = estimated(dead reckoning)(2.3 feature)
                     7 = Manual input mode
                     8 = Simulation mode
     08             Number of satellites being tracked
     0.9            Horizontal dilution of position
     545.4,M        Altitude, Meters, above mean sea level
     46.9,M         Height of geoid (mean sea level) above WGS84
                    ellipsoid
    (empty field)   time in seconds since last DGPS update
    (empty field)   DGPS station ID number
     *47            the checksum data, always begins with *
```

Figure 2.5: Explanation of $GPGGA sentence

2.3 Global System for Mobile Communication (GSM):

GSM is the short for global system for mobile communication [13]. It is a communication system that originated in Finland Europe and developed by using digital technology. GSM is a 2G technology that is implemented globally and used to transmit voice and low volume digital data service. Examples of low volume digital data are SMS (short message service) and MMS (Multimedia Message Service).

Besides that, GSM has four frequency ranges, which are 850MHz, 900MHz, 1800MHz and 1900MHz. In Malaysia, the GSM standard uses the 900MHz and 1800MHz.

2.3.1 GSM Modem

GSM modem is similar to mobile phone. It is a specialized wireless modem which needs a SIM card and works with a GSM wireless network. GSM modem utilizes the radio wave for sending and receiving the messages. Utilization of SMS technology has become popular because it is an inexpensive, convenient and accessible ways of transferring and receiving data with high reliability [14].

Besides that, GSM modem can be used for automating business process, sending SMS from a computer and vehicle tracking with integrated GPS. There are three different types of GSM modem [15], which are:

(i) A GSM modem with SIM card can be an external modem device which is connected to a computer through USB port, serial port, Bluetooth or infrared.

(ii) A GSM modem can be a PC card or PCMCIA card which is installed in a notebook computer.

(iii) A GSM modem can also be a standard GSM mobile phone

A GSM modem is controlled by using the AT commands. If the user would like to do the operation such as reading, writing, deleting and sending messages, an extended set of AT commands which are defined in the GSM standard is needed[15].

2.3.2 GSM Network:

GSM network [16] is a public land mobile network (PLMN). Mobile station which is made up of a SIM (Subscriber Identity Module) card is the user terminal in GSM network while the mobile terminal refers to the user device such as mobile phones. A system that uses a mobile network based around broadcast stations or satellite technology that is connected to signal from orbit are part of the GSM network.

The main purpose of the GSM network is to facilitate easier access to mobile and satellite platforms across international lines. A GSM network comprises of three major systems, which are:

(i) Switching System (SS): The main functions of this system are performing call processing and subscriber related task. The functional units under the switching system are home location register (HLR), mobile services switching center (MSC), visitor location register (VLR), authentication center (AUC) and equipment identity register (EIR).

(ii) Base Station System (BSS): Base station system is responsible for radio related functions, which consists of the base station controller (BSCs) and base transceiver station (BTSs). The base station controller is used to manage the resource distribution while the base transceiver station is radio equipment which responsible for handling the radio interfaces to the mobile station.

(iii) Operation and Support System (OSS): The OSS connect to the equipment in the switching system and base station system. Operation and support system is used to provide a network overview, customer support for operation and maintenance activity which required for a GSM network.

2.4 General Packet Radio Service (GPRS)

GPRS is the acronym for General Packet Radio Services which is available with almost every mobile network. GPRS can be considered as an upgrade over the basic features of GSM. GSM and GPRS systems provide inter-working and share the resources between the users. For the mobile phone which has GPRS, it can be used to track the subscriber's location when connected to the mobile network.

However, the standard GSM network is unable to transmit the data in packet-switched mode, so it has to be altered to support the GPRS. There are several advantages of using this technology, it allows the user to connect to internet all the time and communicate on a worldwide scale[17][18].

2.5 Related Work :

There are various technologies that can be used to detect the location of an object based on the requirement of the user. The differences between these technologies include the cost needed, accuracy, availability, type of coverage and coverage area.

An overview is given on some previous works which are related to tracking system.

2.5.1 Application of GSM and GPS technology

The wide coverage of mobile and satellite network leads to various useful applications such as vehicle tracking system, agriculture monitoring system and people tracking system.

2.5.1.1 Vehicle tracking system

The following is some works in vehicle tracking system.

Amirmassoud et. al in [19] , developed a fleet tracking system using GIS technologies, the GPS and GPRS. The system displays the location of moving vehicles with an error less than 50m in real time on the Map. It is expected that the full implementation of the proposed system would ultimately replace the traditional and costly SMS based tracking systems .The author's system is shown in figure 2.6. **In their research they introduce the mean of using GPRS for transmission instead of SMS for low cost. They used special hardware in their work .**

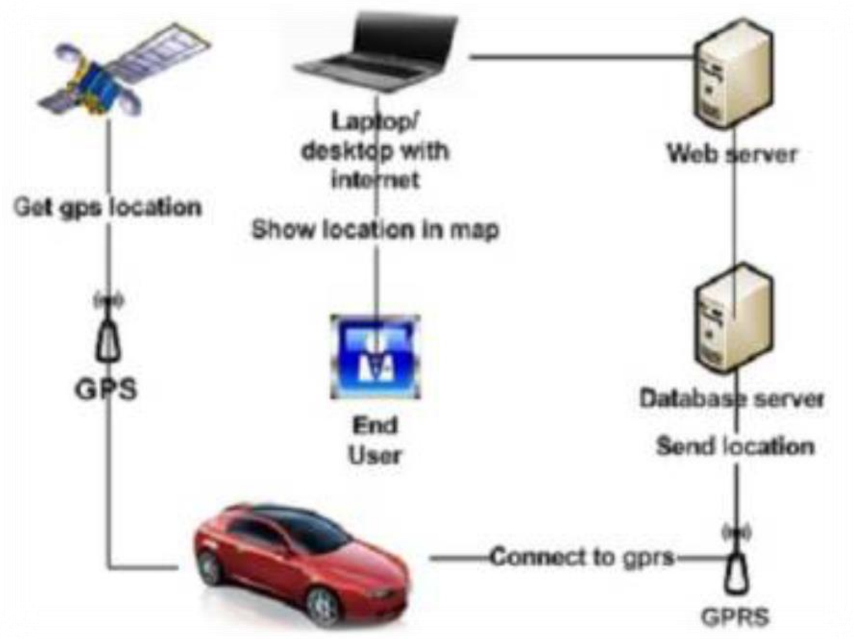


Figure 2.6 GPRS instead of SMS

Kasture et. al. in [20] , presented a low cost tracking system using GPS and GPRS of GSM network, suitable for wide range of applications all over the world. The combination of the GPS and GPRS provides **continuous and real time** tracking. The cost is much lower compared to SMS based tracking systems. GPRS was used for data transfer instead of SMS. To reduce the total system cost, a single

GSM/GPRS/GPS module shown in **figure 2.7** was used instead of separate devices. Using free Google map API and HTTP protocol the service cost has been reduced dramatically.

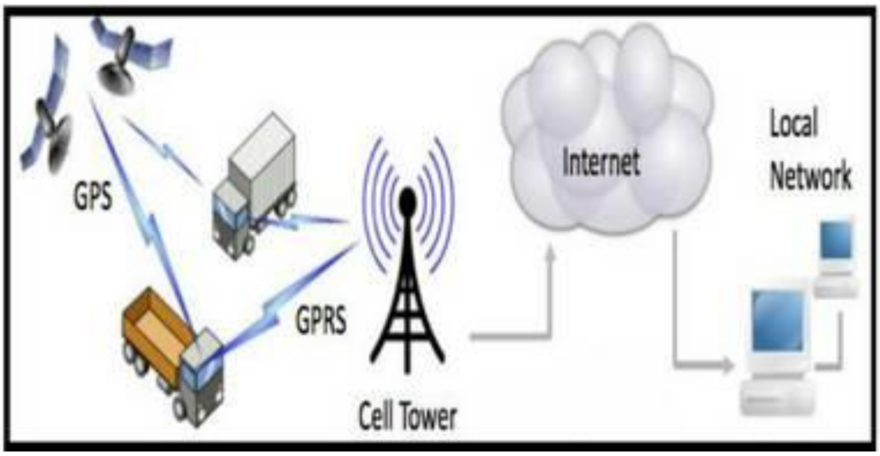
In their research they present cost effective by using single module called Telit GM862-GPS GPS/GPRS instead of separate devices. They also using GPRS for reducing the cost instead of using SMS and using free map service either. But, they not explain the performance of their module at high altitude or in closed area. Either, The large size and high prize cost is very high for common people to gain and use it.

Figure.2.7 :Block diagram illustrating the module[20]

Yuvraj et.al in [21] , the major components of this system as shown in figure 2.8 are Advance Vehicle Locator (AVL) device, tracking Server and user Interface. The system is a real time tracking platform which uses integration of technologies such as GPS and GSM. The platform supports multiple tracking devices for variety of applications such as live vehicle tracking, personal tracking and assets tracking. The GPS device installed in the vehicle continuously moves with the vehicle and will calculate the co-ordinates with other related information at each position and then transmit this information via GSM to the tracking server, thus storing it in the database; which further can be viewed on electronic map. The AVL device which is placed in vehicle that accepts data from GPS satellites and stores it temporarily in the device.

The device is installed with a SIM card which is useful for the purpose of communication with local network .

In this paper they tracking more than one object online and using SMS service for transmission data for remote server .They used two modems, one on the vehicle side and the other on server side which made the overall cost high with addition the SMS cost.



Figuer.2.8: Physical working of the proposed system

Sameer et. al in[22] , used physical components of tracking system which are GPS satellite , car or person with compatible device , GSM service provider , tracking server and client PC. GPS satellite sends GPS data to the device which temporally stores the data in case of car they use AVL and in case of person they use a specially prepared device with panic button for the purpose of emergency. This device contains a SIM card which is used to communicate with the local GSM network thus the device uses GPS as well as GSM network. The system will provide solution for tracking and tracing of multiple movable objects at a same time, so the name Multi-Tracking System. The proposed system shown in figure 2.9**.**

In this paper GPS and GSM integration for vehicle and other objects tracking can be very helpful instead of using GPS network alone. The researcher introduce practical approach system could be extended for application with low cost if used mobile included GPS/GPRS technology .So there is no need to using parser to convert data received from hexadecimal format to readable format before stored it on database. Thus, by developing mobile application we could save time for converting process and save cost for purchasing tracking device.

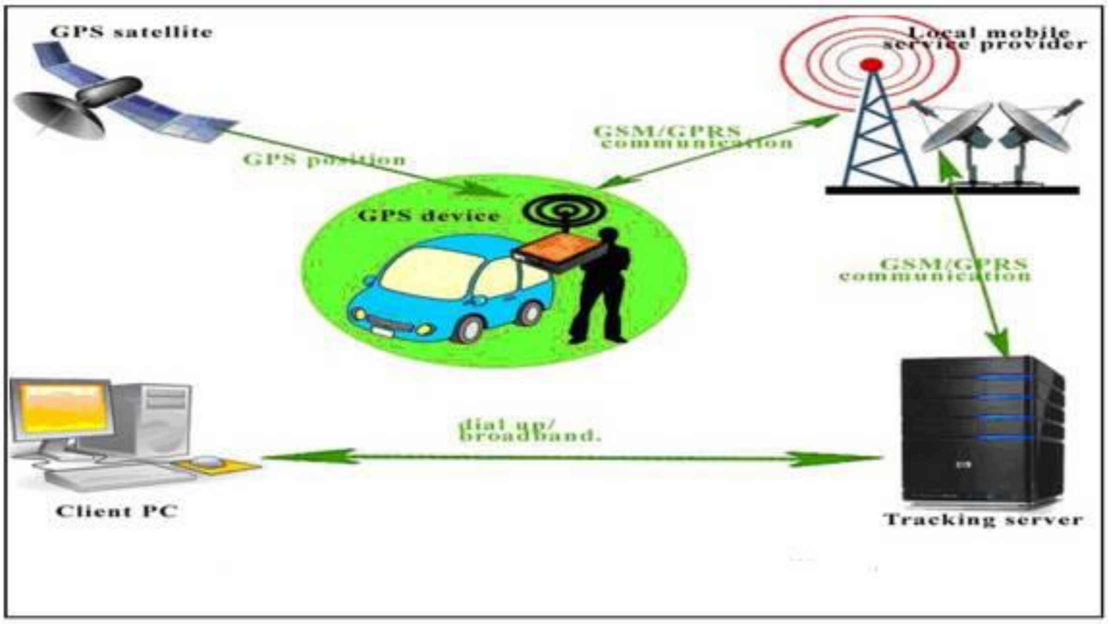


Figure.2.9: Block diagram[22]

2.5.1.2 People tracking system

The following are works of people tracking systems.

Moloo and Digumber[23] , have made a successful attempt to reduce both initial investment cost as well as the operational cost in terms devices and services. There is no need for someone to buy other expensive and specific devices. a mobile phone with integrated GPS receiver or external Bluetooth GPS, works great for

In this research a free Google Maps APIs, HTTP protocol, intelligent logging, and an intelligent positioning calculation. The service cost has been reduced dramatically, providing most services provided by existing systems. With the new developed system, the concept is that the calculation is done on the mobile phone itself and thus fewer data is sent to the server, reducing costs .

The solution is a three parts approach; the first being the Java application (Midlet) that needs to be installed on mobile phones. The second part of the system is the server which gets data from all devices connected to the system and stores it in a database for visualization purposes. The third part consists of web-based application that allows registered users to view their devices live on Google maps or the past tracks of their devices.

In this research they use mobile device for tracking process because it is a cheap cost in comparing with traditional tracking device. The application to be used is compatible only with phones having MIDP 2.0. Another limitation might be the memory of the mobile phone because they process all data calculation on mobile phone itself also the SMS alert could be sent only if the mobile phones of the recipients have wireless access protocol (WAP)on their mobile phone while the WAP

service have limitation like inability of mobile devices using WAP to transfer large amount of data and the high cost of WAP [24]**.**

Mrunmayee et. al in[25] , proposed a cost effective method of tracking a human's mobility using two technologies GPRS and GPS. They have reduced the cost of device by using the mobile phone which has an inbuilt GPS receiver. And further the cost is reduced by using GPRS rather than using Short Message Service (SMS) for communicating the information to the server .The proposed system shown in **figure 2.10**.

A mobile phone application has been developed and deployed on an Android Phone whose responsibility is to track the GPS location and send it to a remote location by creating a GPRS packet. As unique identifier mobile owner have used mobile's Irrational Mobile Equipment Identity (IMEI) number which will be sent along with the coordinates. The person's position is further saved in a Mobile Object Database (MOD) for live tracking which is created in MySQL. From MOD the data will be first transferred into an XML file which will be fed as an input to a web application .

In this paper they introduced cost effective method for reducing device cost and sending data cost but not explain how they controlled the sending packet size and how will the system plots the coordination on the map through GPS .

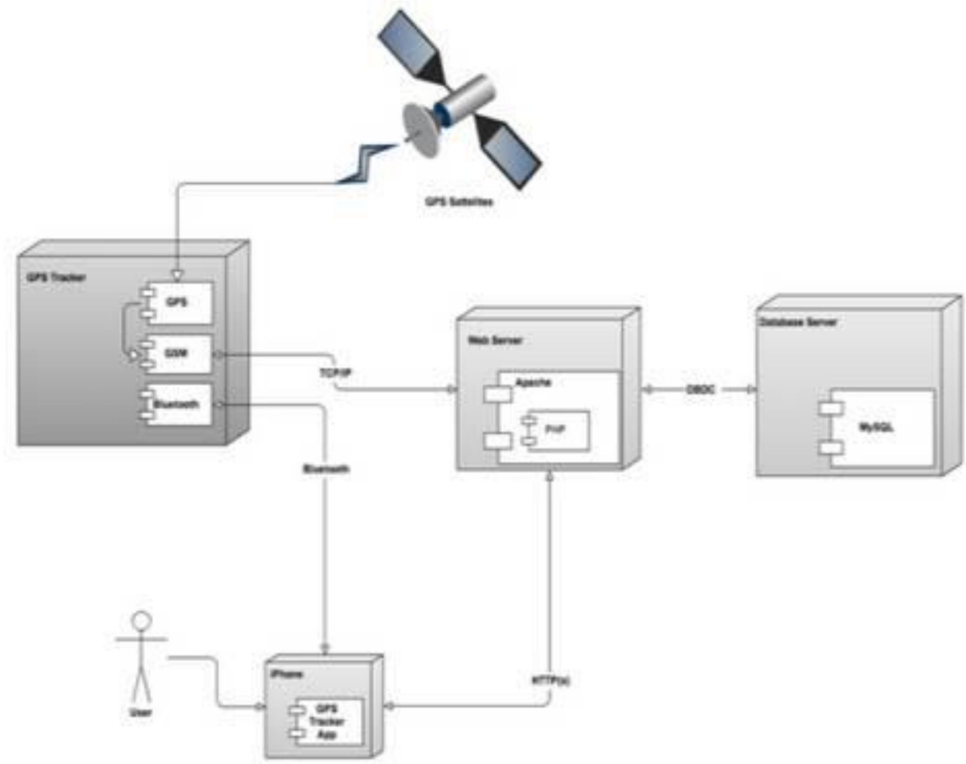


Figure 2.10. Overall description of system[25]

Michael et. al in [26], presented a paper on location based intelligence in which they did an observational study of a GIS based tracking system Centre is by default 2 mints but can be changeable done on a person whose movements were tracked by a GPS device which he carried for 2 weeks with him 24x7. The participant of the study handheld a GPS receiver which transmits the location of the device after every 3 seconds to the GIS database for storage.

After each day the data was dumped because the size of the database was increasing hugely. During the study it was observed that the device due to its misplacement suffered from signal dropouts and some miscalculations in the speed was also observed. It was also observed that with the new set of batteries the device responded in a better way as compared to the older batteries.

GPS may prove very beneficial in knowing about the details of the accidents that took place like the details What was responsible for the accident etc. One of the major drawback that was faced during the study was GPS is an outdoor tracking system, which fails indoor.

2.6 Summary:

Because of the high cost of single module device , the weak accuracy on plotting coordination on map using this device and the limitation of coverage areas as seen in previous section.

Mobile phone with embedded GPS receiver used integrated with GPRS can design and develop solution cost effectively which could be reduced the overall cost and make it available for common people.

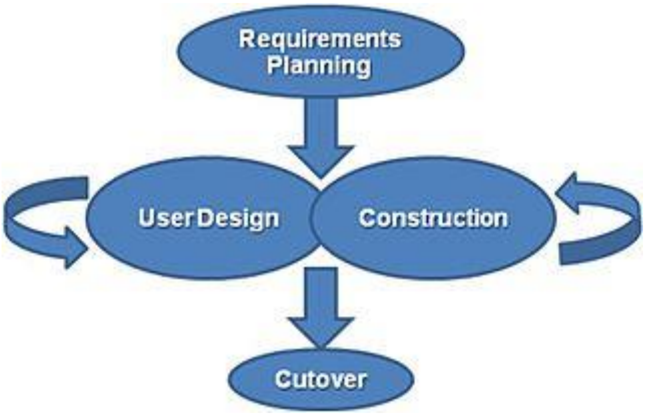
Chapter (3):

METHODOLOGY

This chapter discusses the overall methodology used. It concentrate on create tracking scenarios and GPS Measurement and analysis.

3.1 Methodology

The main objective of this research is to develop a position data acquisition system for tracking purpose. We develop our system using rapid application development model (RAD) to show the flow between different components.



1. **Requirements planning phase** –.Through this phase we select the groups which will be used through the research from different users, places visited are chosen managers, and IT staff members. Research business need ,constraint's and system requirement and scope are agree and discuss. Paper sheet design to write notes about movement to compare coordinate time sending and receiving at server database.

2. **User design phase** – during this phase, users interact with systems analysts and develop models and prototypes that represent all system processes, inputs, and outputs. A customized open source was developed to meet the project requirement's. System architecture are design, client site interaction are clear, finally server side input and output done. SDLC Flow chart and activity diagram drawn to show the interaction between user and systems.
3. **Construction phase** – focuses on program and application development task similar to the SDLC. As system is an open source improvement done to meet the requirement discussed for the research as show in chapter 4.

4. **Cutover phase** – SDLC implementation phase, including data conversion, testing, changeover to the new system, and user training this illustrate clearly at figure 4.1.

In design process we develop our system using Android application at client site and web application for server side. Finally testing done at both side to ensure the system work correctly.

The signal received from satellite is sent to hardware devices for further processing and finally the signal is sent to the PC for displaying on the Open Street Map(OSM). This project is divided into two parts which are the tracking part and control and displaying part. The tracking part is responsible for obtaining the user location while the control and displaying part is for displaying the detected location on the OSM through Android system application.

Figure 3.1 The model has two main components: the GPS Server (Control and Displaying Part) , and the Client-Side Applications(Tracking Part) . GPS trackers fitted in people mobile on the roads acquire position information continuously from GPS satellites. The tracker sends the acquired information to the nearest GSM network access point via GPRS. This occurs periodically based on the specified time interval, IP address and port configured in the GPS tracker. The GSM network bases on the SIM installed in the tracker. The GSM network access point transmits the data to the Control Room's receiver at the server side. Finally using PC or other devices using internet we can visualize the people movement map.

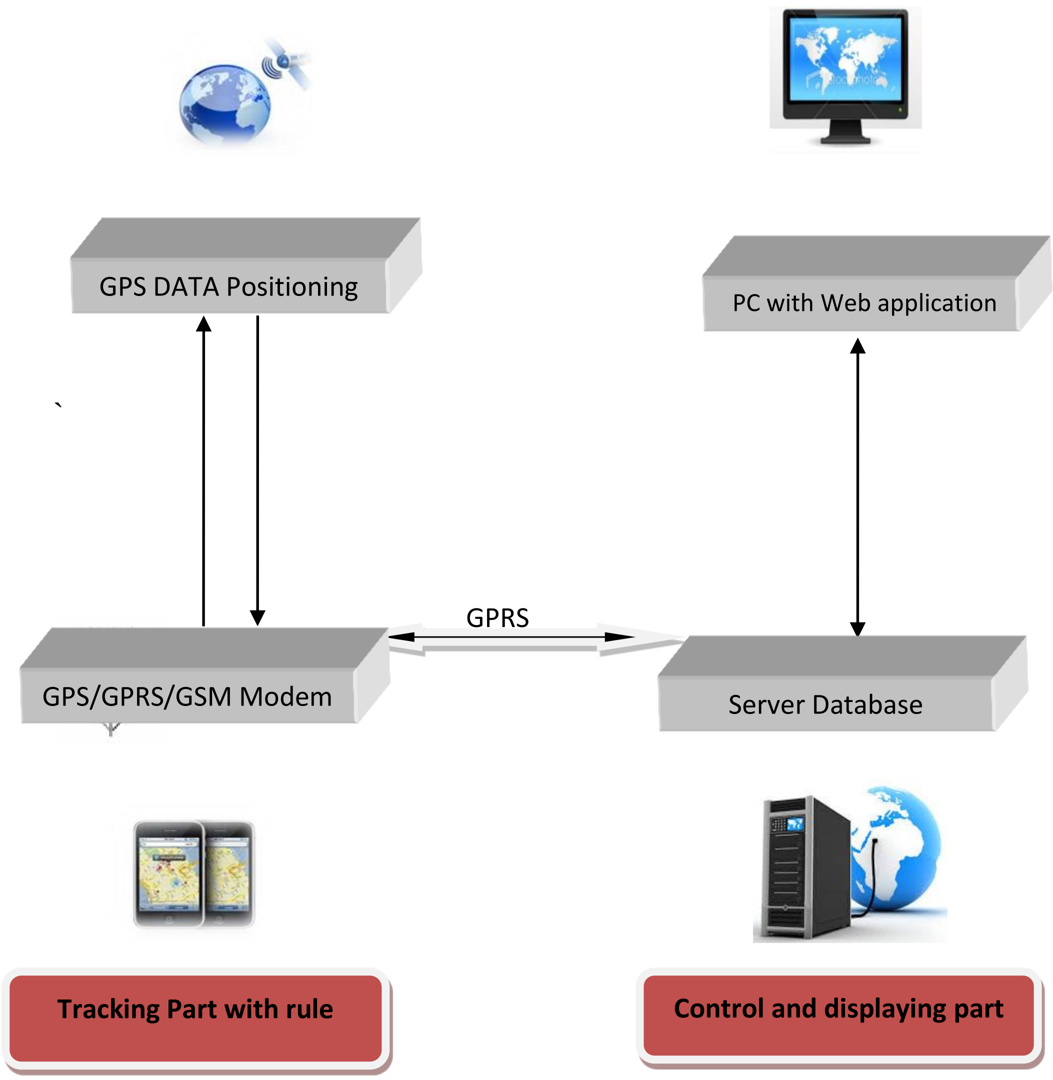


Figure 3.1system architecture of the people tracking system.

3.1.1 Tracking Module Development

Figure 3.2 shows the flows at the tracking part for people tracking system which is responsible to capture the current location of people. The project is started by initializing mobile switching on ,GPS technology is used the location of the people. Using the GPS receiver and antenna that is embedded in the tracking unit. Information about people locality is transmitted from satellites to the tracking unit. In case there is an WiFi network the system used instead of GSM network for sending location to save cost.

After that , GPRS mobile technology is used as a medium for transmission. Using existing medium towers and GSM mobile networks, the GPRS – enabled modem that is contained in the tracking unit will feed the location information back to the central server at predetermined frequency. Before sending the data the system will used the rule which will discuss in the next section to choose the suitable scenario to sending data. After that the system will start tracking.

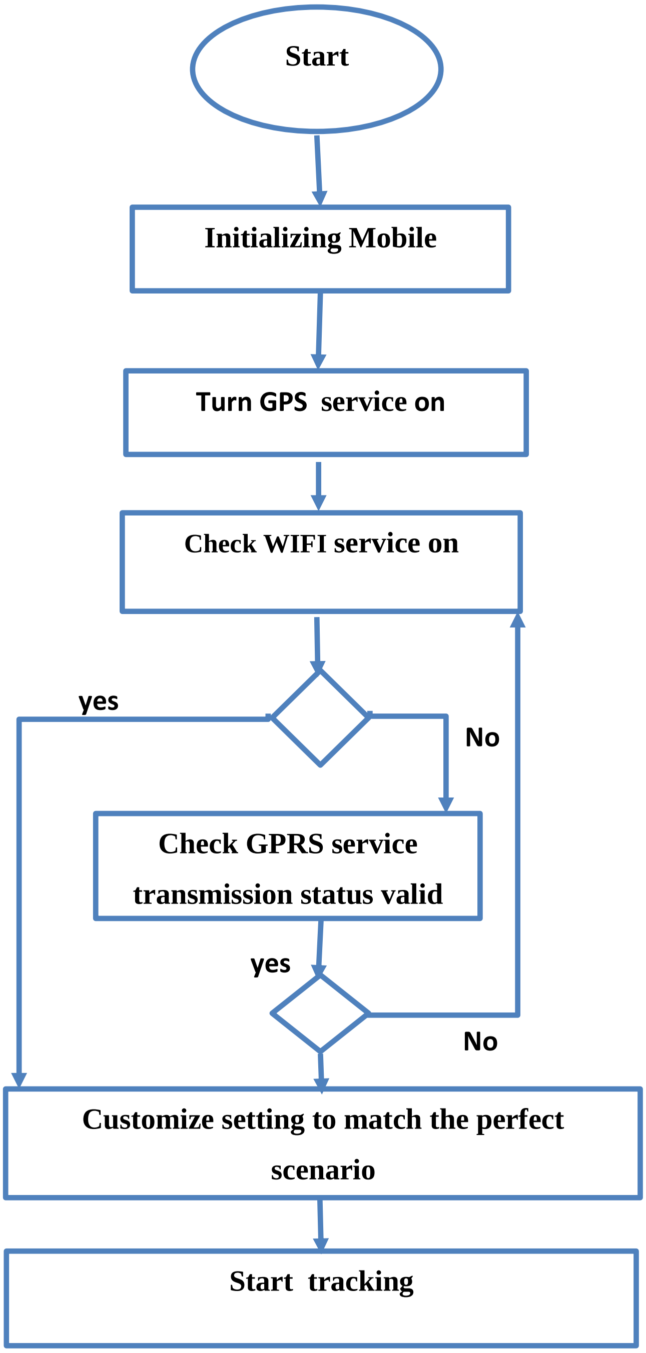


Figure 3.2 The flows at the tracking part for people tracking system

3.1.2 Control and Displaying Module

When all required information is extracted and processed, it needs to be transmitted to a remote Tracking Server which will be able to display this information to the end user. For real time tracking of people, reliable data transmission to remote server is very important. Wireless network is required to transmit person movement information to remote server if it's available to reduce the cost of transmission. Existing GSM network is selected to transmit people information to remote server because of broad coverage of GSM network. It is also cost effective rather than to deploy own network for transmission of people information. For data transmission over GSM network GSM modem is required. GSM modem can send and receive data SMS text messages and GPRS data over GSM network.

This information will be stored in SQL Database (DB) in the server computer. The tracking unit will allow monitor the tracked person movement over the internet from any web-enabled device anytime of the day .Information of people location is retrieved from the DB of the central server. When logs on to the website to make location queries , a web service that can transform latitude and longitude information into a graphical display is used to generate a map of the child location. OSM is used to generate this graphical display. This scenario is illustrate in figure 3.3.

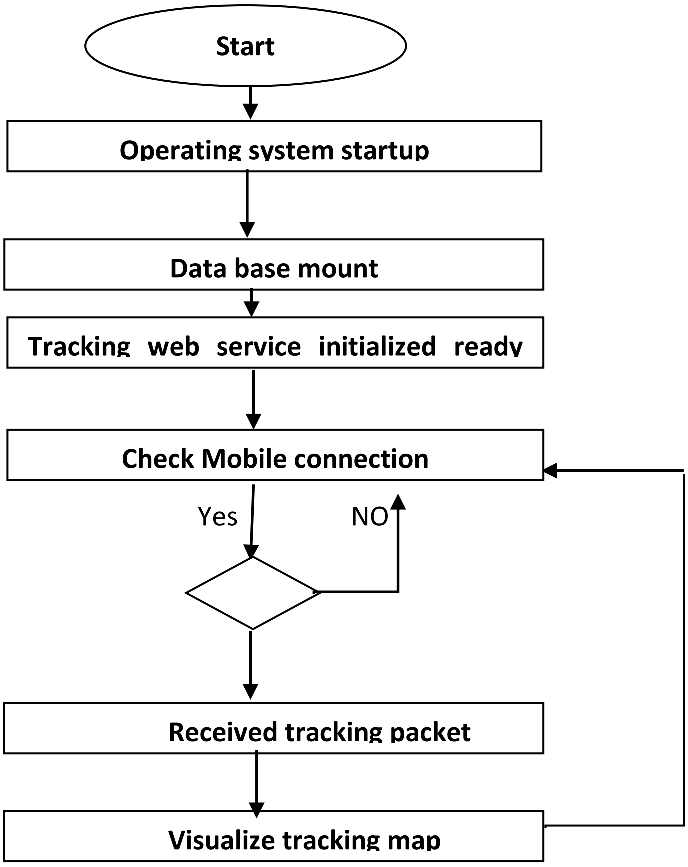


Figure 3.3The flows at the displaying part for people tracking system

3.2 GPS Measurement and Analysis

According to related work and previous research there is a need to make good scenario to reduce the cost for systems used GPS technology especially for those still use (2G) as in Palestinian Region So, for people tacking there is two kinds of trips done which are:

1. **Routine Trip** is the path followed by each person along his/her itinerary, it characterized by the path and the timestamps (trip start and trip end). As example , (school , Mosque , supermarket,…etc) which is known trip done every day or week according to his need. In this type of trip we need to reduce cost by :
    - Generate coordination point at server side automatically.
    - Patch point (sending more than one coordination per packet).
    - Sending new packet when leave or enter new track zone.
    - Send short packets (by eliminating unneeded data as header ,date..etc) from client to be received by the server application and finally received

back at the client. It characterizes the end-to-end latency, which is important for time-critical applications and dynamic behavior of Internet protocols.

2. **New Trip**

   All travel times related to each path are stored in the database, using path id and two timestamps (trip start and trip end).

   - Sending coordination point every 2 minutes as example.
   - Sending new coordination point when arrive or leave known Geozone.

We will list in details the definition above and explain the different situation according to the perfect scenario will be used for people tracking in the next section when we discuss measurement metric unit **.**

3.2.1 Measurement Metric unit

This section briefly discusses the measurements used to evaluate the performance and explaining the rule scenario used to reduce cost of GPRS networks and transmitted packets or points. GPS/GPRS measurements, which map into the model illustrated in next steps:

- **Performance measurement**

Data Performance: This category emphasizes data-transfer-quality measurements (as perceived by customers) and GPRS layer specific measurements. Data performance measurements are used to establish quality benchmarks and to detail the performance of individual layers. For our test purposes, one end node is the client (mobile) and the other is a measurement server. This server can be a located at the Internet world. Since the measurements are made end-to-end, in the uplink the server measures the data received from the mobile and sends back the results. In the downlink the measurements are made by the same software that generated the uplink data.

- **Transmitted data measurement :**

The GPS-Travel scenario is designed to extract the trip-daily information for one traveler at a time. Correspondingly, in the first step , all data for a single traveler are read in. In the next step, the pre-processed navigational stream is scanned until a potential trip-end is detected. In third step , the characteristics of the detected trip are determined according to the rule scenario below. In fourth step , the reasonableness of the detected trip is examined. If the potential trip passes the validation checks, it is recorded as a trip. If not, the potential trip is not recorded as an actual trip. If the end of the GPS navigational stream has not been reached, the scenario reverts to the second step to continue examining the rest of the stream. If not, the scenario reverts to first step and proceeds with the processing of the next traveler.

- **Rule Scenario**

There are four categories of data required as inputs to the GPS-traveler scenario. The first input is the preprocessed (obtained from the raw GPS output streams by primarily removing the invalid records) GPS streams. Each record in this stream contains the local date and time, latitude, longitude, speed, heading, and the number of invalid records immediately prior to this record in the raw file. The second set of inputs GPS status (number of satellites). This information is used in the determination of trip-purpose. The third input is a Mobile network information(Mcc,mnc,lc,cell id).The fourth input is the set of sender status (network, signal strength ,battery level). The overall size of transmitting point of the above parameter is 36 byte the key issue is to reduce the cost and packet size according to the level mode bellow to reduce the overall cost.

Rule level used while transmitting data to reduce cost and packet size:-

1. **Rule one: Per point (Point Level) :-**

- **Reduce packet size**: Send short packets (by eliminating unneeded data as header ,date,..etc) from client to be received by the server application and finally received back at the client. It characterizes the end-to-end latency, which is important for time-critical applications and dynamic behavior of Internet protocols. For first transmitting point send all needed data at the second transmitting for the same traveller we send different time and coordinate by eliminating other unneeded data.

- **Sending patch point:** If the track is the same track the mobile client collect number of coordination data in one packet and sending to server. The mobile client continuously sends location data to server and updates the location data of tracking objects **.** Here just sent the time and coordinate.

- **Predict location point** by server the objects moving in more or less predictable patterns that we could anticipate server-side and omit most data transmissions this way. If the client-side detects there's no need to send updates to the server.

- **Special case** : when battery level down no GPS signal ,traveller out of zone then the alert system send notification for responsible go to step **rule five.**

2. **Rule two: Per track (Track level) :-**

- **Applicable with previous track pattern** by server the objects moving in more or less predictable patterns that we could anticipate server-side and omit most data transmissions this way, if the client-side detects there's no need to send updates to the server.

- **Reduce count of transmission point:** if the track is the same track for moving object there is no need to send every coordinate to server side we just send first and last coordinates in one packet. We just send either the time or coordination.

3. **Rule three: Per trip(Trip level)**

- Applicable with previous trip pattern : reduce count of transmission point and reduce count of track by auto add pattern track point from server saved data .

4. **Rule four : Per time(Time level)**

The trip start time is computed as the time stamp on the first GPS navigational stream record corresponding to a trip start and the trip end time is computed as the time stamp on the last GPS navigational stream record corresponding to the same trip. The trip duration can then be computed as the difference between the start and end times of the trip. The duration of activity at a trip end can be computed as the difference between the end time of a trip and the start time of the subsequent trip. The activity duration at the origin of the first trip and at the destination of the last trip cannot be determined.

- Sending moving objects data every known time interval. The mobile client continuously sends location data to server.
- Decrement time of interval when object coordination out of known zone as example (suppose the objects leave the track so the client side

continuously sending new coordination to server side in decrement time to track the movement to.

- Increment time of interval when point in the same zone as example(increment transmission time from 3 minutes to 5 minutes if the objects move in the same track)

5. **Rule five : System alert**

When sending process stabile mode the above rule work normally otherwise the system will send alert message and work in normal mode (sending point by point not care about cost).The main objective is to keep person a live.

5.1) Normal mode: when the traveller stays static (no movement) in a place for 3-10 minutes with GPS signal reception, the user can send SMS"move+coordinate+0200" to the server (Suppose area of a radius of 200 meters, it supports 4 digits at most. Unit: Meter). It will reply "move OK". In case of such a movement (the default distance is 200m), it will send SMS "Move+ latitude & longitude" to the authorized numbers at interval of 3 minutes

5.2) Out of zone mode: Send SMS "speed+ coordinate+" to the server , and it will reply "zone OK!". When the target moves out of zone, the unit will send SMS "speed+ latitude & longitude" to the authorized numbers at interval of 3 minutes.

5.3) Low battery mode: it send SMS "low battery + latitude/longitude" to authorized numbers 2 times in total in 15 minutes interval when voltage of battery is going to be about 3.55V.

5.4) Power of mode: it will send SMS "power alarm +latitude/longtitude" to authorized numbers every 3 minutes when external power is cut off.

5.5) GPS blind Spot mode: it will send alert SMS "no GPS + last valid latitude/longitude before lost signal"

Chapter (4):

Implementation

This chapter discuss the system development .Also, it describes software used at both server and client side and the feature they have.

4.1 System Development

Figure 4.1 shows the design flow of people tracing system. The design process starts by configuring the tracking module and displaying module. Both of the customized coding for tracking and displaying parts is then tested to make sure they meet the specification. When both of the part meet the specification, the whole system is being tested to ensure it works properly. Testing and debugging is done to get the output needed if any error occurred. If the system run without errors and the output data needed is get , the data is analyzed and compared whether it is as expected or otherwise. In the next section we will discuss the rule used to measure and analysis the data sending in between device side and server side.

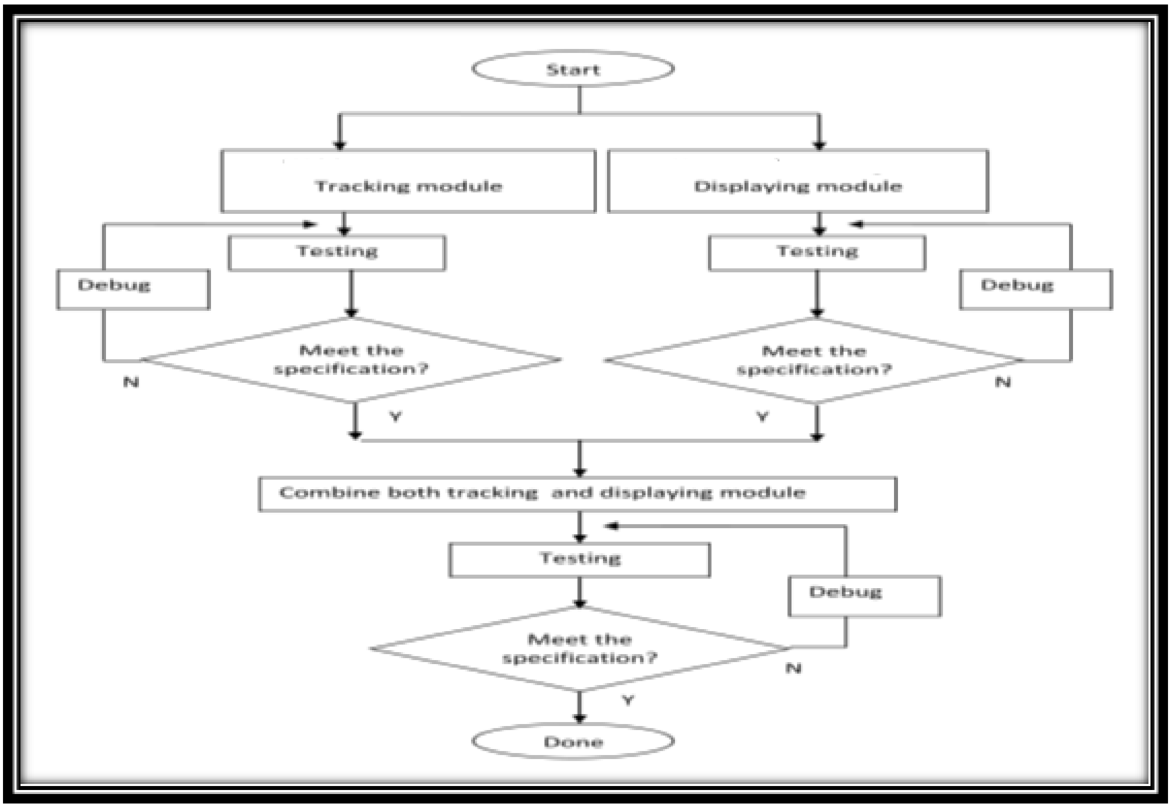


Figure 4.1 Testing flow of people tracing system

This project is divided into two parts which are the tracking part and a displaying part.

1. **The tracking part** is responsible for obtaining the user location and sending it to server using android mobile application.
2. **The control and displaying part** is for displaying the detected location on the OSM through a Java web application.

4.2 Tracking Module

In this module we used a customizable CelltracGTS™/Free[27] is the official Android phone GPS tracking application for the open-source OpenGTS® project and GTS enterprise GPS tracking systems. The CelltracGTS™/Free Android phone tracking application support the following features:

- Provides selectable GPS update rates.

- Automatic event generation based on current GPS state analysis. Generates a "Start" of motion event when phone moves a selected distance from its original location, followed by periodic "In-Motion" events while moving, or "Heading-Change" events if direction of travel changes. When the phone has come to rest for a selected period of time a "Stop" event is generated, followed by periodic "Dormant" events when the phone is still at rest.

- Displays an estimated "Odometer" based on accumulated distances between GPS points, Which is also sent to the server with each event.

- Includes the battery level and battery temperature in event packet data sent to the server.

- Provides the ability to send "impromptu" events to the server

- Unsent events are queued until cell coverage is available.

-Supports enabling auto-start at phone reboot

- No tracking time limits.

- Intelligent log: In this research feature added to control the number of transmission point from mobile side for the rule classification used and describe at chapter 3 which are :-

- Per point :single or patch.
- Per track : routine or new.
- Per trip : routine or new .
- Per time : per minutes..

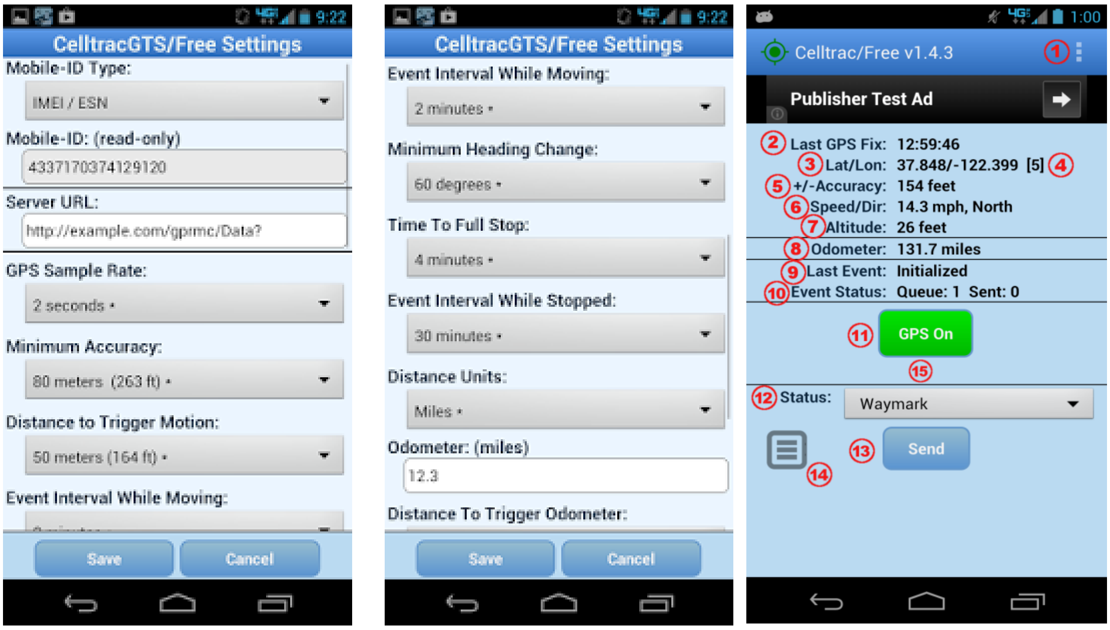


Figure 4.2 CellTrac Mobile Application

4.3 Displaying Module

In this module we used a customizable ***OpenGTS***™[28] ("Open GPS Tracking System") it is the first available open source project designed specifically to provide web-based GPS tracking services for a "fleet" of vehicles.

To date, ***OpenGTS***™ has been downloaded and put to use in over 110 countries around the world to track many 1000's of vehicles/assets around all 7 Continents. The types of vehicles and assets tracked include taxis, delivery vans, trucks/trailers, farm equipment, personal vehicles, service vehicles, containers, ships, ATVs, personal tracking, cell phone and more.

While ***OpenGTS***™ was designed to fill the needs of an entry-level fleet tracking system, it is also very highly configurable and scalable to larger enterprises as well[28].

we have customized it to meet the need for my project by adding feature which is auto position generation which used by server side according to the rule used to minimize the sending point when there is no need to transmit it so the server will auto generate this point at map .

Current Features:

OpenGTS not only supports the data collection and storage of GPS Tracking and Telemetry data from remote devices, but also includes the following rich set of features:

- **Web-based authentication**: Each account can support multiple users, and each user has its own login password and controlled access to sections within their account.
- **GPS tracking device independent**: Devices from different manufacturers can be tracked simultaneously. Support for the following GPS tracking devices is included with ***OpenGTS***:
  - Most TK102/TK103 tracking devices (using the common TK102/TK103 protocols).
  - CelltracGTS™/Free for Android phones

  These features could be supported with ***OpenGTS open source program ,but in this research we use mobile device for people tracking to make comparison between GPS device listed above and Mobile tracking application.*** With custom coding, other devices can also be integrated as well using the included example "template" device communication server.

- **Customizable web-page decorations**: The look and feel of the tracking web site can easily be customized to fit the motif of the specific company.

- **Customizable mapping service**: ***OpenGTS*** comes with support for OSM in Within the ***OpenGTS*** framework, other mapping service providers can also easily be integrated.
- **Customizable reports**: Using an internal XML-based reporting engine, detail and summary reports can be customized to show historical data for a specific vehicle, or for the fleet.
- **Customizable geofenced areas**: Custom geofenced areas (geozones) can be set up to provide arrival/departure events on reports. Each geozone can also be named to provide a custom 'address' which is displayed on reports when inside the geozone (for instance "Main Office").
- **Operating system independent**: ***OpenGTS*** itself is written entirely in Java, using technologies such as Apache Tomcat for web service deployment, and MySQL for the data store.
- **i18n Compliant**: ***OpenGTS*** is i18n compliant and supports easy localization (L10N) to languages other than English. Languages supported currently include Dutch, English, French, German, Greek, Hungarian, Italian, Portuguese, Romanian, Russian, Slovak, Spanish, Serbian, and Turkish.

- In this research a customizable software built to meet mobile use instead of other devices. Figure 4.2 show displaying map at server side.

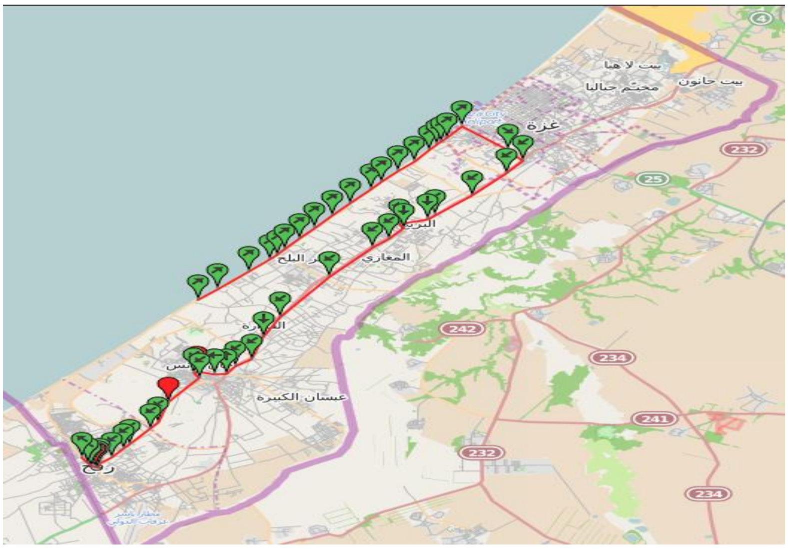


Figure 4.2 Displaying map

CellTrack Mobile Main application page field layout

This section describes the various available fields on the main application page

1) **Menu button**

Pull-down menu where "About", "Setting", "Help" are displayed. Depending on phone manufacturer and model, the location of menu button may differ from the location displayed in the image).

2) **Last GPS Fix**:

The time of the most recently acquired GPS fix (relative to the local phone timezone).

3) **Lat/Lon**:

The most recently acquired GPS latitude/longitude.

4) **Satellites**:

The number of satellites used in the recent GPS fix. If the GPS fix was obtained from Network information, this value will be "[N]".

5) **+/-Accuracy**:

The relative accuracy of the recent acquired GPS fix. If this value is greater than the acceptable accuracy value selected on the Settings page, then the accuracy will also indicate "(rejected)".

6) **Speed/Dir**:

The Speed and Direction of the most recently acquired GPS fix.

7) **Altitude**:

The Altitude of the most recently acquired GPS fix.

8) **Odometer**:

The current odometer value calculated by the phone, based on accumulated distances between acquired GPS points. The initial value for the odometer can be set on the Settings page.

9) **Last Event**:

The status code of the most recent event generated by the phone.

10) **Event Status**:

The current event queue status. "**Queue:**" indicates the number of events waiting in the queue to be sent to the server. "**Sent:**" indicates the number of events which have been sent to the server.

11) **GPS ON /GPS OFF**

- This button indicates the state of the GPS tracking on the phone. "GPS On" indicates that the GPS tracking is actively acquiring locations. "GPS Off" indicates that the GPS tracking has been suspended. Clicking on this button will cause the GPS tracking to toggle from On to Off, etc. When transitioning from "GPS On" to "GPS Off", any current "Moving" Trip Status will be set to "Stopped" (with the accompanying "Stop" event), then the GPS will be set to the "Suspend" state and a "GPS Suspend" event will be generated. The transition from "GPS Off" to "GPS On" will resume the GPS operation, and will generate a "GPS Resumed" event on the next received GPS location.

12) **Status**:

This pull-down menu allows selecting an event status-code type which can be manually generated and queued for sending to the server.

13) **Send**:

This button allows creating a manually generated impromptu event, using the selected "Status Code", which will be queued for sending to the server. Select a desired "Status Code" from pull-down menu, then press the "Send" button. When the next GPS location is acquired, it will use this new location to generate an event with the selected status-code, which will then be queued for sending to the server.

14) **Alternate Menu Button**: [*Versions v1.6.1+ only*]

This is an alternate method for displaying the available menu options. (this button provides a consistent method between phone platforms for displaying menu options)

15) **Error/Warning Messages**:

Error, warning, and other messages will be displayed in this area.

4.4 System Interface

Figure 4.4 show customized mobile interface application used in this research which contain Trip (New Trip /Routine Trip) and Send Patch points (Patch point or single point) according for the trip mode. In the second feature it explain Track feature with system alert setting.

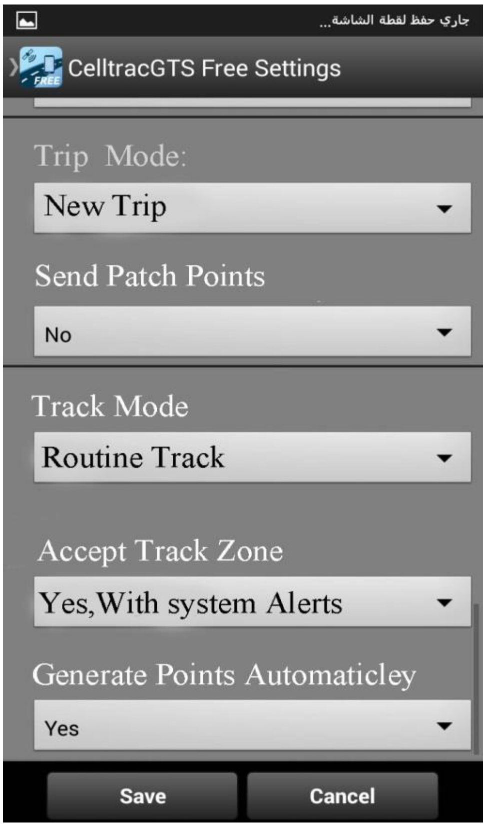


Figure 4.4 Customized System Interface

4.5 System component

The proposed system has the following component as seen in figure 4.5 and 4.6:

List of Function :

- Check_Network ( ) check mobile network connection at client side.
- Check_Rule ( ) check system processing rule used at both client and server side.
- Check_Zone ( ) check system coverage area availability inside or out of zone.
- Check_Trip ( ) check trip type and GPS positioning
- Check_Track ( ) check track type and GPS positioning
- Check_Patch_Points ( ) check when to send point or patch point's
- Generate_Points( ) automatically generate points when using the same path
- Alert_Sender( ) when the movement out of zone system alert start

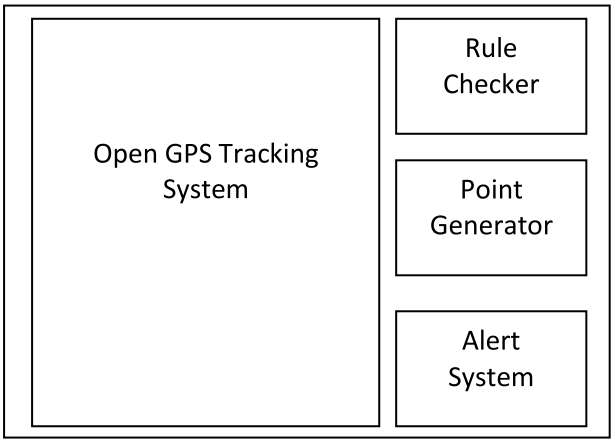


Figure 4.5 Server Side System Components

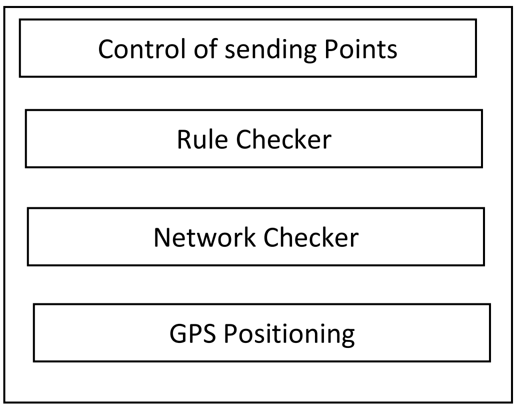


Figure 4.6 Client Side System Components

Figure 4.7 shows the activity done on tracking side (Mobile application) before data send to server. User can login and start a new track for live tracking. An internal GPS receiver is used on mobile device , a device search is done for connection and retrieval of GPS coordinates. Once connected, the application sends data to the server while the device is moving. The application however does some calculations before sending the data using the rule setting specified before.

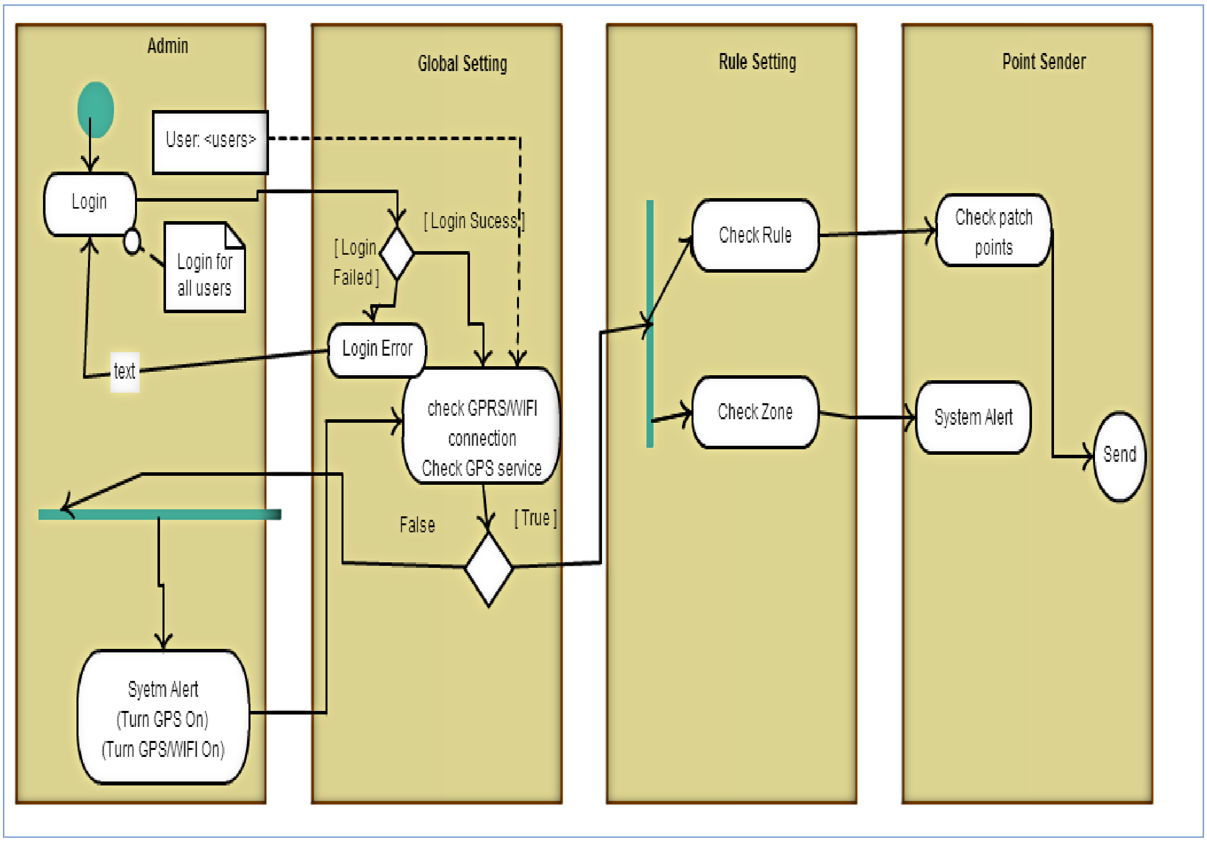


Figure 4.7 Client Side Activity Diagram

Figure 4.8 shows the activity done on control side (Server application) which firstly check the connection. The second part of the system is the server which gets data from all devices connected to the system and stores it in a database for visualization purposes.It also check the received data acoording to rule setting

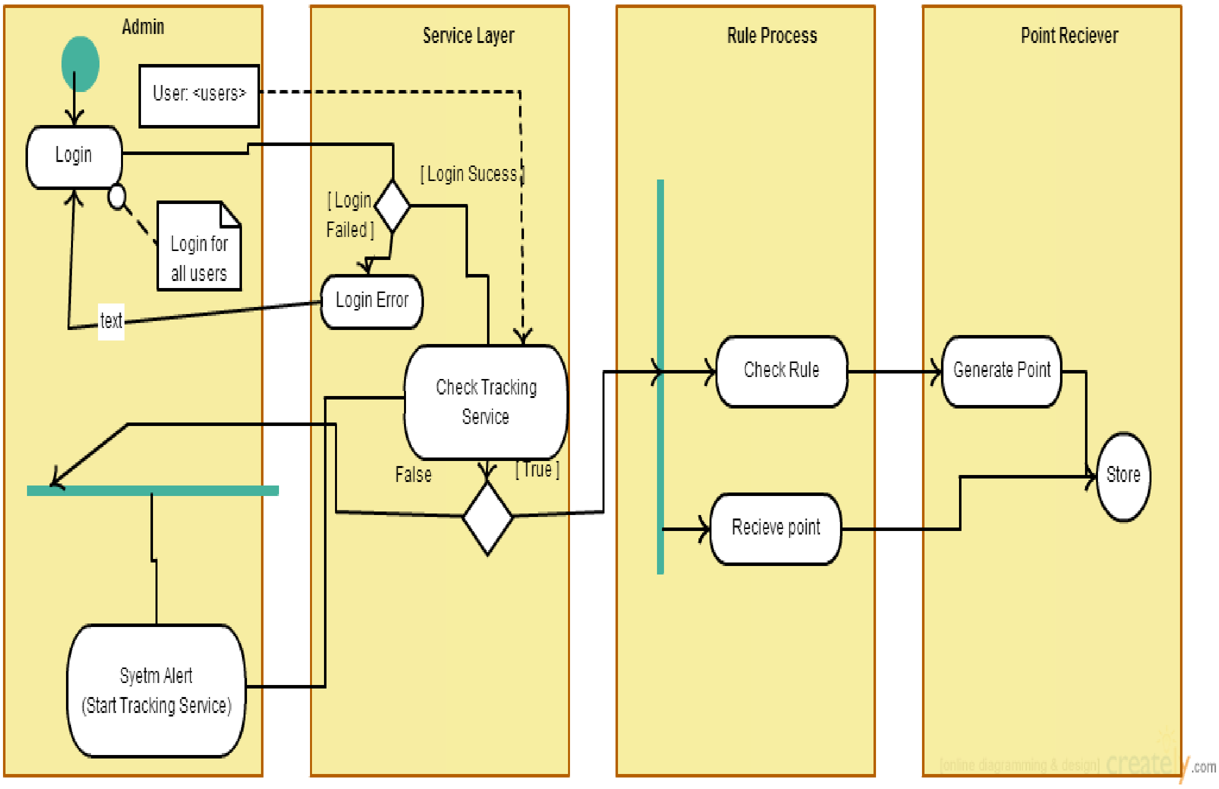


Figure 4.8 Server Side Activity Diagram

Chapter (5):

Experiments and Result

In this chapter experiment steps as definition, context, subject selection, design, and Measurement.

5.1 Experiment Definition

The objective of our study is to investigate the impact of Implementation Human Tracking rules on cost , correctness and quality . The aim is to assess the impact of the tracking rules on the time, correctness and quality of the tracking. Furthermore, It is also important to assess the effect of experience on the mobile tracking system .

5.2 Experiment Context

To analyze the above research objectives, a controlled experiment was conducted with peoples . The experiment was carried out during a half day training. The session was organized as two modules. The first module modern mobile devices provided with localization capabilities could be used to automatically create a diary of user's whereabouts, and use it as a complement of the user profile in many applications. The application used running on a GPS-equipped mobile device that records the list of relevant places visited by the user. The diary runs autonomously without requiring user's interactions and is able to classify *semantically* the places being visited in an unsupervised way, the result will be compared with the second module which will be a handled device tracking system as these used by car .

5.3 Subject Selection

To test the effectiveness of the whereabouts diary, we collected GPS traces for three weeks for two groups from three members (kids , old men and disabilities) of each group as they went about their normal lives. Table 5.1 describe these group.

Table 5.1 group classification

Group Name	Age	Sex	Number
Group 1 (Kids)	4-6	M/F	4
Group 2 (Disabilities)	35-45	M	4
Group 3 (Old Men)	50-55	M	4

Each member carried either an mobile device smart phone. We doing 24 trip for each group ,every 12 trip using GPS device and the other 12 trip using our research mobile tracker device to compare the output for the two system. Kids group have going daily trip for SOS school at Canada Camp in Rafah city. Disabilities group have doing trip for Mosque ,Market ,Training Center and SOS. Old Men group have doing trip for Masjed Sa'ed, Baerout Pharmacy ,Market and Sons.

Overall, this resulted in 24 trip being identified as relevant. During the data collection weeks, data collectors recorded ground-truth information about the places they have been. For trips done by mobile application such information has been collected with a simple application running on the mobile smart phone which record time and date about visited places. For trip done with GPS device the user have diary log sheet write on the time ,date and places visited. The collected data will be compared for the two modules.

5.4 Experimental design

The experiment used two distinct systems: (1) Mobile Tracking system and (2) a device tracking system. We use a software to compare the trip for each module to measure time, accuracy and performance . In a first set of experiments, we tried to verify the accuracy of the system to identify relevant places on the basis of the GPS trace log. We classify the incorrect results into: *(i) wrong*: the user is in a place, but the diary reports he is in a different place, *(ii) false negative*: the user is in a place, but the diary reports he is moving, *(iii) false positive*: the user is moving, but the diary reports he is in a place. In a second group of experiments, we tried to evaluate the performance of retrieving the coordination performed on a given place. Comparing the results with the ground-truth annotations, we first tried to determine whether the correct place is retrieved. In a third group of experiments we compared the time sending to measure the difference and accuracy for each module.

5.5 Measurement

For each exercise, groups were given the relevant system equipment's and were asked to go target location. In our experiment, all the groups were manually reset tracking system setting ,to assess the correctness and quality attributes of trip tracking points . Correctness is measured as a ratio of the number of correctness common mistakes over the total number of potential correctness mistakes for a given trip log. Similarly, quality is measured as a ratio of the number of quality common mistakes over the total number of potential quality mistakes for a given trip log. Furthermore, after completion of each exercise, the groups was fill in a questionnaire to collect data about the estimated time spent on the trip ; and their respective views on the strengths and weakness of using the mobile for tracking .

On other side, tracking log recorded on mobile and server data relevant to (Live Tracking, Static Recorded Tracking , History Playback ,Track Reports and Alerting Services using SMS).

5.6 RESULTS AND ANALYSIS

Our system was implemented successfully and showed interesting results. Figure 5.1 below shows a track registered by a device. The red marker shows the starting and finishing spots of the track. Information such as speed can be obtained by clicking on the markers as Figure 5.2 . The user can also view past tracks from the web application.

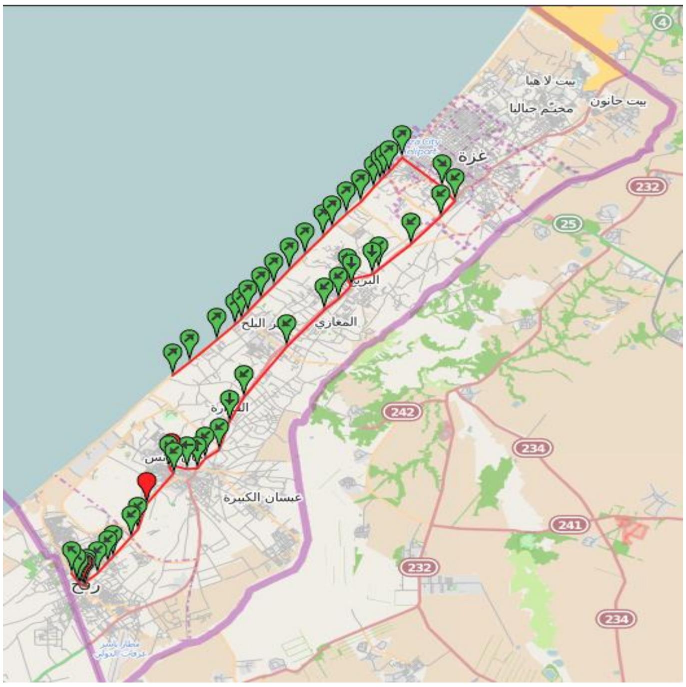


Figure 5.1viewing people movement

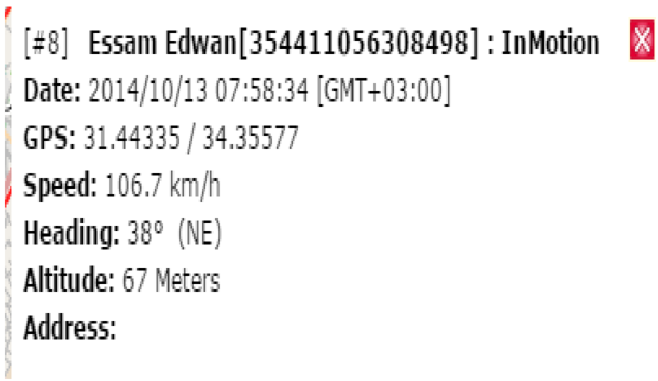


Figure 5.2 viewing people information speed

For the purpose of analysis, we tested our system against the GPS Device tracker TK103 over the same track. The difference in costs was then calculated. This difference is based on one primary factor namely the number of GPS positions the applications send to the server. It has been noted that for the GPS Device tracker, GPS positions were sent to its server and from there that there was processing whether to store the data or not.

With the new developed system, the concept is that the calculation is done on the mobile phone itself and thus fewer data is sent to the server depend on sending rules per (point/ track/ trip/time) which discuss in chapter three and reducing costs. Also the system has an automatic logging ability to log data to a mobile memory storage whenever there is no internet (GPRS) connection and system hire an SMS alert message .

- Cost Analysis Result

Table 5.2 we do cost analysis between two module system which are the GPS Device tracker TK103 and our mobile system for the features they could have which are :

- **Live Tracking** : It allows any registered user to have a real time Google Map view of the position of devices corresponding to the user. It can allow simultaneous view of several devices at the same time or a single device view.
- **History and Track Report:** Reports and charts for each device and each track can be downloaded in PDF and Excel format. Tracks can be visualized on OSM Charts with information such as speed, altitude, time, coordinates, name of location and speed.
- **Alert & Geofencing :** Alerts are automatically generated based on Geofence options set up by the user for each device. In the event that a specified device enters a Geofence zone, an automatic text alert is sent to the specified mobile number. If the user has chosen an email alert as his preference, an email alert will be sent instead of a text alert.

- **Intelligent Tracking :** the system have intelligent Rule proposed.
- **Mobile based :**the system support mobile used.
- **OSM:** the system support open street map.

From Table 5.2 we collect cost of each device from internet market ,we show that both device have the same cost while mobile tracking has advantage of OSM and intelligent rule.

Table 5.2 investment cost system compared

		Cost –Analysis Of Tracking System						
System	Live Tracking	History &Report	Mobile Based	Alert & Geofencing	Google Maps	OSM	Intelligent Tracking	Investment Costs($)
GPS Tracking Device (TK102/TK103)	✓	✓	×	✓	✓	×	×	200$
Mobile Tracking	✓	✓	✓	✓	✓	✓	✓	200$

In Table 5.3 we describe the number of transmitted point for every device .We will show the difference between the generated point done at server side for mobile application and the other device by doing comparing for every trip level.

Table 5.3 number of transmitted point for every device(Trip Level)

Group	Trip	Trip Description	GPS Device	Mobile-routine	Mobile-new
Kids	Trip1	SOS School	78	22	77
	Trip2	SOS School	76	23	78
	Trip3	SOS School	76	22	77
	Trip4	SOS School	80	26	81
Disabilities	Trip5	SOS School	77	27	82
	Trip6	Training Center	76	24	79
	Trip7	Masjed	78	26	81
	Trip8	Market	78	28	83
Old Men	Trip9	Masjed Sa'ed	79	22	77
	Trip10	Baerout Pharmacy	76	23	78
	Trip11	Market	80	24	79
	Trip12	Sons	79	23	78

In Table 5.3 we show a summary for the number of trips done by each group (Kids ,Disabilities ,Old Men). We s show the number of transmitted point using GPS device and Mobile device .We comparing for the sample selected when using mobile with applying rule used which we describe as (Mobile-routine) in table above and without it. In group Kids as example the number of transmitted point with applying rule is 22 for trip 1,while the same trip when using GPS device is 78.The summary is when using mobile application with rule the number of transmitted point is less so the cost is less. Table 5.4 shown the average saving for Kids trip :

Table 5.4 computation of saving point for every device(Trip Level)

Device Type	Average of Kids Trip	Saving transmission cost
Mobile tracking	22+23+22+26/4=23.25	77.5-23.25=54.25
Device tracking	78+76+76+80/4=77.5	

In Table 5.5 we describe the number of transmitted point for every device .We show the difference between the generated point done at server side for mobile application and the other device by doing comparing for the same track level.

Table 5.5 number of transmitted point for every device(Track level).

Track Description : from Essam Home to Masjed Saed ben Waqas			
Track	**GPS Device**	**Mobile-routine**	**Mobile-new**
Track1	30	10	28
Track2	32	12	26
Track3	31	12	33
Track4	27	11	27
Track5	31	10	33
Track6	30	9	32
Track7	31	13	33
Track8	34	13	31
Track9	30	10	31
Track10	31	11	27
Track11	30	10	28
Track12	33	11	24

In Table 5.5 we show that the GPS device as example track 1 the number of transmitted point sending to server side is 30.when comparing this number by the 2 cases at mobile application used for the same track the number when using (Mobile-new) which mean that this track new movement the number is 28 which is less than GPS device point because the mobile application needn't to send more point to server side which will generate it the point automatically when the person at the same track. When we use measure the number of transmitted point after system learnability for the same track when use the other case which is(Mobile-routine) the number is reduced to 10 this mean that the server plotted the point whiteout the need for mobile to send it .So the number and the cost is reduced.

In Table 5.6, we present a cost analysis of the existing systems as an indication of the price range of having a GPS System for tracking purpose in Palestine according to the methodology we used. For the purpose of analysis, we tested our system against the rule used in application (lowest cost application from our cost analysis) over the same track.

Table 5.6 cost estimation for every trip level

			Cost –Analysis Of Tracking System						
System	Per Point		Per Track		Per Trip		Per Time	Total	
	Single	Patch	Routine	New	Routin e	New	Per Minutes	Per single point	Per patch point
GPS Tracking Device	36 byte	36 byte	30*36 byte	30*36 byte	80*36 byte	80*36 byte	2*36 byte	N*36 byte	N * 36 byte
Mobile Tracking	36 byte	26 byte	10*36 byte	(30*26) +10 byte	24*36 byte	(80*26)+10 byte	2*36 byte	(N*0.65)	(N*0.65) * 26 byte

The table contains the total trips made by the groups of the device and the other group carry mobile and show us the a bove results listed in Table 5.6. As shown in table when we used the GPS tracking device using per point rul for single transmission the transmission point is 36 byte for both the single point which is every coordination with time and patch point which is if the track is the same track the mobile client collect number of coordination data in one packet and sending to server here we send time and coordenation as described in chapter three section(3.1.1).When we used the rule at our mobile application the number of transmission poin was reduced for the same track trip.When we apply the rule per trip at our mobile application the number of transmission point was reduced because the server itself generate the point by predicting it for routine trip.In case of new trip the the first packet will contain 10 byte describes in chapter 3 at rule scenario section which are the start bit , stop bit , backet length ,protocol number,error check and serial number plus the number of tansmission point multiply with 26 byte.We have improved the cost of transmission by reducing it to 35% from the total cost.

Finally, as we shown accordence to our expermint's the total number was reduced for single point to (N*0.65) and for patch point to (N*0.65)*26 byte, so the overall cost reduced by factor 0.65 is the factor calculated by divide the count of point sending by mobile and the summation of point sending by device to measure the cost reducing between the two module(device , mobile).

We calculate the average for all trips sending point by :-

1. **Collected point from GPS device (220 points):**

80	80	30	30

2. **Collected point from Mobile device(144 points) :**

80	24	30	10

By divide the total number for point's collected by mobile device which is 144 point's by the collected points for GPS device which is 220 point's the result shown as:

144/220 is equal 0.654545

In conclusion , the researcher found after conducting test trips and study the effect of paths and send points on the quality and correctness of the data sending in real time. All this in conjunction with the analytical and detailed study of the cost, which is the focus of work in this research.

To conduct experiments on the navigation devices served as a control group and a fixed experimental trips through mobile system developed by researcher experimental group to represent the process of implementation of the rules, which are based on the level of the points ,paths ,trips and time , also, adding another factor is the alarm and warning through the system messages.

We shows system performance by comparing traveller places visited by written groups annotation and server stored time for the same point we shown that the correct place is retrieved.

The accuracy of visited places of the system is highly correct comparing with group annotation with wrong rate from one to three meter in comparing with device which give wrong place from nine to fifteen meter.

This demonstrates that the second generation of mobile networks can adapt across replaced by sending the points they generate cross-server system taking into consideration the quality ,correctness and sending point at real time.

5.7 Discussion

After the completion of monitoring all trips with participating groups, which included children, elderly and people with special needs because they are the most sought follow-up groups.We provide each person with mobile phone with system processing on mobile itself. Rule based applying for transmission point from client to server which have improved the cost by reducing the number of transmission point and the cost to 35% from the total cost in comparing with the other device.

In this research the study of all the points , paths and journeys in terms of correctness , quality and cost of a real time show that the points have been monitored from the tracking devices are equally with those points that have been monitored using mobile in all trips that send points to the server independently.

As for the trips that rely on the server to generate points depending on the trips pattern are saved on the server was more correctness than those trips that are sent through the tracking devices.

The points that were sent through the tracking devices were sent in real time as the points that were sent through mobile devices

As for the flights that rely on the server to generate points depending on the pattern of trips saved on the server was different in real-time for those trips that send via tracking devices.

The points that are sent through the tracking devices are equal in quality to those sent via mobile shown through trips that were sent to tracks within a specific area and was aimed at people with special needs and children. While those trips that targeted the elderly, which was based on the tracking devices more quality due to the presence of a set of points describes the places stop and that did not send via the mobile.

All the rules that have been developed directly targeted cost and adopted to reduce the number of points sent also reduce the size of the transmitted package per point through excluded repeated data and send the points in the form of a batch points.

Chapter (6):

CONCLUSION

- **CONCLUSION**

A successful attempt was made to reduce cost of transmission point using rules used and reduce factor cost which is (0.65) which reduced the cost to 35% from the total cost. The calculation using rule before transmission point's is done at mobile itself. When There is no need to send more point's the server generate these point's itself to reduce the cost . WiFi network used instead of GPRS transmission to reduce the cost. A cheap mobile phone with integrated GPS receiver, works great for the proposed GPS tracking system. By using OSM Maps APIs, HTTP protocol, intelligent logging, and an intelligent positioning calculation using the rule used, the service cost has been reduced dramatically, providing most services provided by existing systems. The intelligent positioning by rule used and smart server automatic generation the calculation reduces the amount of GPS data sent to the server. If a device's position is static, the application in the device checks whether there is need to send GPS data to the server or not. There is a distance calculation performed by the application prior to the last, GPS data received. In the event that there is a small change in the GPS position, no data is sent to the server, thus reducing costs.

Using the free OSM Maps API for tract visualization, there was no need to develop a map solution and this contributed in the cost reduction of developing the system. Using WIFI service when available will reduced the cost because there is no need to used GPRS. Also for SMS alerts, the existing option of is exploited. The proposed system, though cost-effective, has some limitations. The system can give false GPS position if confined in a building or under a bridge where there is no possibility to capture a GPS position. Another limitation might be the memory of the mobile phone. Actually one hundred records are allowed to be stored on the mobile phone when there is the automatic logging. Absence of enough memory space will block the application so we used enough memory size to resolve this people. the overall cost reduced by factor 0.65 is the factor calculated by divide the count of point sending by mobile and the summation of point sending by device to measure the cost reducing between the two module(device , mobile).

- **Future work**

- Developed tracking device in such a way that they do not bother the elderly and function automatically.

- WiFi service should be the main connection in new updated system in all places bcause the cost will be zero.

- This resarch was done for people we hope that it update to used for car commercial.

- We have done the resarch through a web based application but it could be developed to used as cloud system in future.

- The resarch done for Android system we hope that it could developed in such way to be suitable for other system.

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