

GPS and GPRS Based Cost Effective Human Tracking System Using Mobile Phones

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This paper proposes a cost effective method of tracking a human's mobility using two technologies viz General Packet Radio Service (GPRS) and Global Positioning System (GPS). The whole system allows the user's mobility to be tracked using a mobile phone which is equipped with an internal GPS receiver and a GPRS transmitter. 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 we have used mobile's International 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 which is developed with JavaScript Ajax based Google Map API integrated into it which will be responsible for the showing the current location of the mobile phone. Most of the applications developed so far use a handheld GPS receiver device for tracking the location, but we 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.

Key Words: GPS, GPRS, MOD, Ajax, XML, Google API.

Introduction

A wide range of tracking systems has been developed so far tracking vehicles and displaying their position on a map, but none of the applications has been developed so far which tracks the mobility of a human being. Now a day's tracking a person's mobility has become a crucial issue these days be it tracking a criminal came on payroll or a detective going to detect a case or any other utility. The overall objective of this research is to develop a system which is cost effective and can be used for tracking a human being using a GPS and GPRS equipped mobile phone rather than using a handheld GPS receiver.

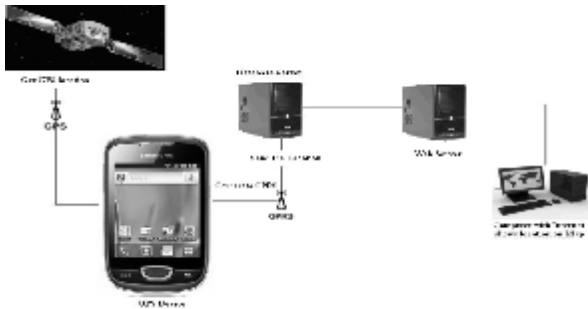
The main focus of our research is to reduce the overall cost of tracking based on GPS system which

is a satellite based service which is available 24X7 everywhere in the whole world. GPS system can be used to get location which includes details like latitude, longitude and altitude values along with the timestamp details etc. it a free of cost service available to every individual. In order to track the movement of the person we have used Google Maps for mapping the location sent by the mobile phone. The mobile phone which fetches the GPS location communicates with the server using General Packet Radio Service (GPRS). This service is a low cost service provided by the service providers which is a wireless data communication system. Mobile phones equipped with GPS receiver are easily available in the market these days and is a booming technology these days. This cell phone technology has enabled us to communicate almost

every part of the world across the boundaries. The GSM/GPRS is one of the best and cheapest modes of communication present these days and in future.

System Overview

Fig. 1: Overall Description of the System



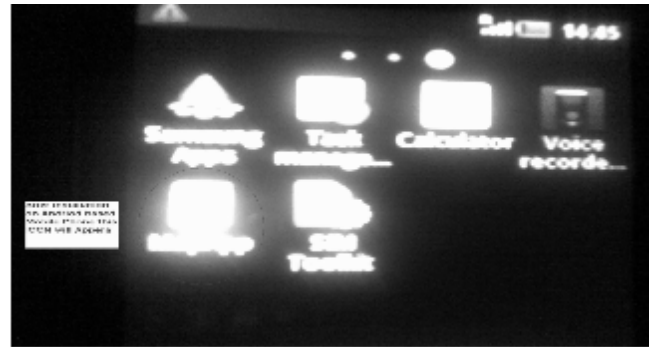
The system proposed in this paper works in two phases: tracking phase and mapping phase as shown in the figure 1 above. In the tracking phase the mobile device's application developed in Android using the mobile phone GPS receiver fetches the GPS location, after calculating the exact location it further creates a GPRS packet which includes the along with the location details a unique identifier called International Mobile Equipment Identity (IMEI) number and timestamp details. The same application later sends this GPRS packet to the server which stores the data in a Mobile Object Database (MOD) developed in MySQL. The next phase is mapping phase in which the data is fetched from the database and is displayed on the Google map on the web application developed in JavaScript based Ajax technology for live tracking.

Mobile Application Specifications

We need a GPS receiver enabled Android Mobile phone for receiving the GPS data from the satellite. There are a wide range of such mobiles are easily available in the market. This mobile will act as a

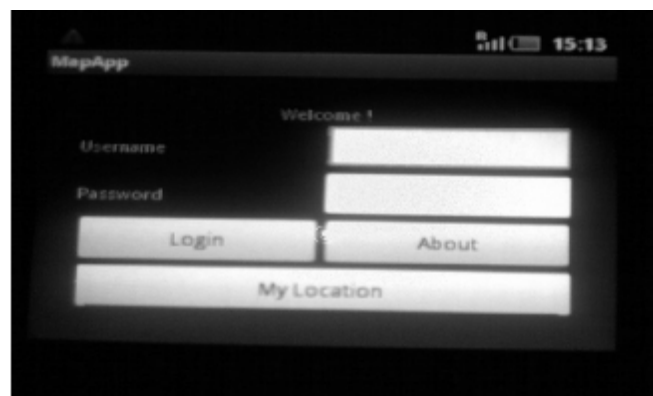
both GPS receiver and GPRS transmitter which will use the GSM network to transmit the GPRS packets. On this phone itself we'll install our application which is supposed to perform all the operations of the first phase that is tracking phase.

Fig 2: Snapshot of Mobile Application after Installation on the Android based Phone



As soon as the application on the phone is started is asks a Username and Password from the mobile phone user which needs to given by the user as displayed in Figure 2.

Fig 3: Snapshot of the Mobile Application running on the Android based Mobile Phone which prompts for Username and Password



The user as soon as enters the Username and Password it is checked for its validity whether it's authentic or not, if it is non authenticated then the user is prompted with a message of wrong username or password as displayed in Figure 3.

Fig 4: Snapshot of the Mobile Application running on the Android based Mobile Phone which prompts for wrong Username and Password.



Once the mobile application successfully logs in it goes into the background and starts fetching the GPS coordinates of the mobile.

Fig 5: Snapshot of the Mobile Application running on the Android based Mobile Phone which prompts for Successful Login.



The mobile application will work in two modes:

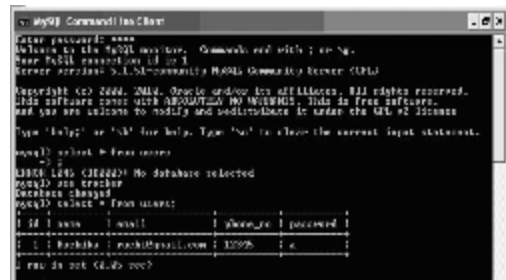
- 1) Activity (the visible portion of application): this will ask user to enter his username and password and start the tracker service button.
- 2) Service: This will run in background and send location data to server along with username and password.

Database Specifications

The database which is going to store the coordinates sent by the mobile application is

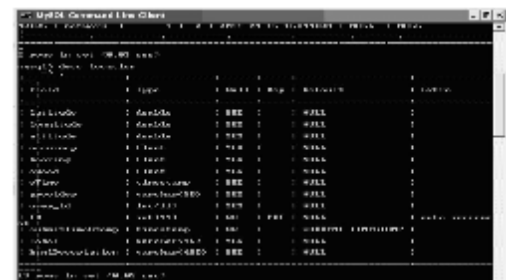
developed in MySQL. The database which we are going to use in our application is named as "TRACKER". It contains two tables namely: Users and Location. The figure 6 below displays the users table which contains the information about only one user. The fields are ID, NAME, EMAIL, PHONE_NO, and PASSWORD.

Fig 6: Displays the details of the users table which contains the details of the users



There is another table which contains the information about the Location as sent by the mobile application, whose detail about the columns is displayed in the Figure 7.

Fig 7: Description of Location table



Web Application Specifications

This application will provide user interface to user:

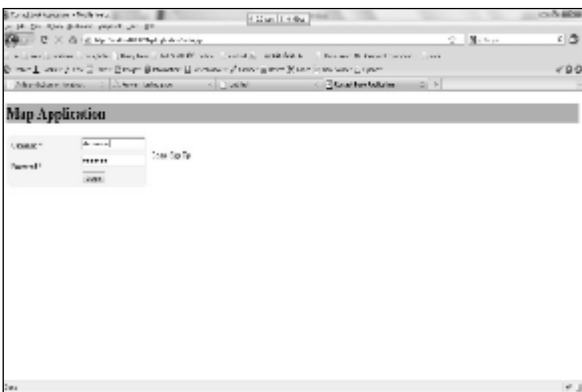
- 1) Register with a username and password (this username and password will also be used with mobile client so that user specific data can be stored)(a.jsp page send request to a servlet)

Fig 9: Snapshot of the Map Application which prompts the user for New User SignUp



- 2) Login with the username and password created above : after logging in the user can see his travel details(location details) on a Google map and by clicking on the plotted points he can get more details about that point (extra details) (a.jsp page send request to a servlet)

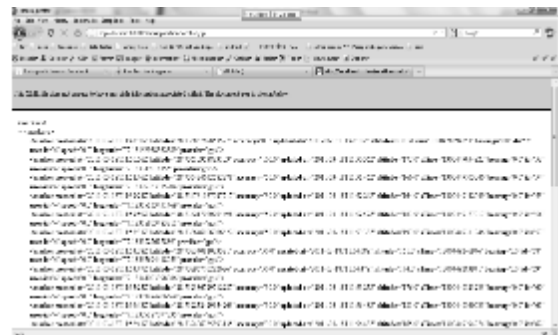
Fig 10: Snapshot of the Map Application this prompts the user for Login



This will work as follows

- 1) The data send by mobile client will be stored in database(MySQL)
- 2) Google map service provide us the ability to plot location coordinates using their JavaScript based Ajax API

Fig 11: Snapshot of the XML file which is generated dynamically to get the coordinates.



- 3) The coordinate data will be provided in form on xml file which will be generated on the fly based upon the logged in user.
- 4) This xml will be parsed by Google's JavaScript API to plot on the map

Database JSP(page that will generate XML based upon logged in user) this page will be used in user's welcome page that have all the Google map implementation code to plot on map(this is also a jsp page) which will display the location in four views : MAPS, SATELITE, HYBRID and EARTH which is displayed in the figure 12 to 15.

Fig 12: MAP View.



Fig 13: Google Earth View

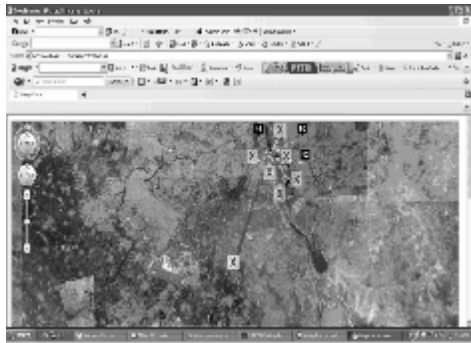


Fig 14: Satellite View

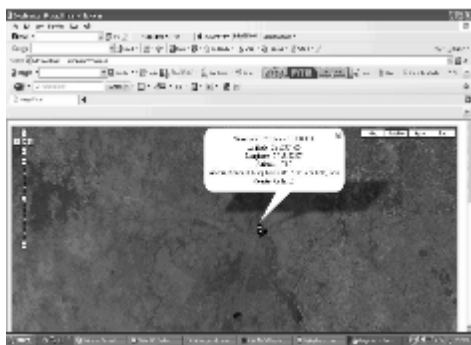
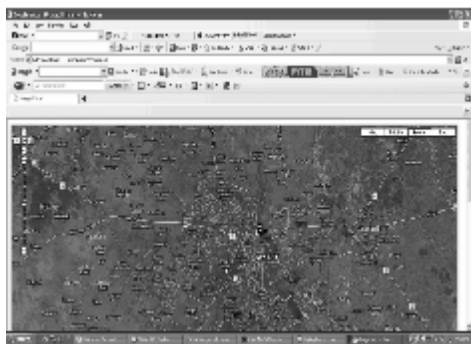


Fig 15: Hybrid View



Discussion on Low Cost Factor

We have put our best effort to reduce the total cost of the system including the device and services. We have used available resource i.e. our mobile phone which is any usual Android based mobile phone which has GPS and GPRS facility. By using free Google API we have drastically reduced the cost of the services. This system which is presented in the paper can be used by any person who has a mobile phone. A high cost GPS receiver's requirement has been eliminated by using mobile phone as both

GPS receiver and GPRS transmitter.

Instead of using costly SMS system for sending the information to the server, we have used GPRS for that purpose. The SMS based systems are neither efficient nor they are cost effective. Most of the service providers provide a cheaper GPRS in around 1 paisa/1KB as compared to SMS whose cost ranges from 50paisa to 1 Rupee per SMS.

In order to reduce the cost of using GSM/GPRS/GPS using separate devices, we have used a mobile phone which contains all the facilities and can be used very easily with a mobile application.

Related Work

Many researchers have tried various methods of object tracking using GPS technology. Most of the researches defined below can be used for Object Tracking whether that object is a Vehicle, a person or anything. Some of the research work which has been done this field is abstracted below:

Khondker Shajadul Hasan, Mashiur Rahman, Abdul L. Haque, M. Abdur Rahman, Tanzil Rahman and M. Mahbubur Rashed [1] have proposed a cost effective method of object tracking using GPS and GPRS technology. The user can view the present location of the object as well as the past history of its movement using Google Map and Internet. The system that is proposed reads the current position of the GPS device and after adding few more details like IMEI number a GPRS packet is created and transmitted through GSM network to the web server and is displayed on a Google map at the web application. This paper presents cost effectiveness in terms of the cost that was earlier spent in sending the coordinates to the web server using Short Message Server (SMS); in this paper they have presented the idea of using GPRS for the transmission of coordinates rather than the SMS service. The cost of sending an SMS is around 50

paisa to 1 Rupee per SMS, but using GPRS the cost comes out to be 2 paisa/KB.

Gannan Yuan, Zhi Zhang and Wei ShangGuan [2] have proposed a GIS based Vehicle Tracking System which uses a GPS data is transmitted through GPRS by a GPS device placed within each vehicle which transmits the current GPS location at a constant rate of 2 mins to the database server called the Command Centre. Each vehicle is called a Data Terminal transmits the Latitude, Longitude, speed and time information to the command centre by making a GPRS packet of the information gathered along with a unique identifier such as number plate etc. VMS presented in this paper can display information of more than one vehicle at a single instance of time on a single map and if the number of vehicle increases then it provides a multi-window environment which can be used by creating a group of vehicles and only participant group of vehicles will be displayed per window. The frequency at which the data is sent to the Command Centre is by default 2 mins but can be changeable and can be changed by the Data Terminal. Along with the basic object tracking this paper has also presented an alarming system which will send the alarms to the Command Centre at the time of theft or accident or any other emergency.

O. Aloquili, A. Elbanna and A. Al-Azizi [3] proposed an Automatic Vehicle Location (AVL) Tracking System based on GIS, GPRS and GPS technology. The AVL proposed in this paper basically works on 3 phases namely Management, Communication and Map phase. The first phase i.e. Management phase basically deals with the organizing the information such as drivers, or the data received from the vehicle's GPS/GPRS modem or the GIS data. In the same phase user is allowed to add/delete/edit the information of the drivers, and can track the driver accordingly. The National Marine Electronics Association (NMEA) data is sent to the server by the GPRS/GPS modem at a constant rate.

Using this NMEA data only the GPRS Server fetches the necessary data such as Latitude and Longitude coordinates which represent the location of the vehicle which can be directly displayed on the map. The second phase namely Communication phase is responsible for making connection with the GSM modems, fetching the GPRS packets and performing some processing and data management, which is further inserted in the database. The third and the last phase namely Map phase is responsible for fetching the coordinates stored in the database and displays them on a GIS based map. In this paper Dijkstra's algorithm is used to find out the minimum cost from sources to destination. Further Kruskal's algorithm is used to find out the minimum path spanning tree.

Katina Michael, Andrew McNamee, M.G. Michael and Holly Tootell[4] presented a paper on location based intelligence in which they did an observational study of a GIS based tracking system 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 that 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.

Fengli Zhang, Xinggao He, Bo Xu and Minglin

Deng [5] presented an overview of how a Web Application fetches and integrates the moving object data stored in a database. It is pre assumed that the MOD (Mobile Object Data) is fetched and stored from the object through a GPS enabled mobile object which could be a taxi, tanker, airplanes etc. It is the responsibility of these objects to populate the MOD with the required data so that can be used by a GIS based Web Application for displaying its position. The MOD will be updated by the GPS after every one or two seconds. The Web Application thus developed for getting the GIS data stored in the MOD database is fetched at a constant rate and thus displays the updated location as described by the MOD database.

Conclusion and Future Scope

This paper presents a low cost human tracking system using GPRS GPS on GSM network. The combination of both the technologies i.e. GPS and GPRS provides a constant, continuous and real time human tracking system. The cost of the overall system has been reduced by two facts one is using the existing mobile phone and another is using GPRS instead SMS. It has been hoped that the use of the overall system can eliminate the requirement of first the traditional GPS receivers and second costly SMS based tracking systems.

The future scope of such system is that it is Android based tracking system, and the same application can be developed for other phones as well such as Symbian, Blackberry etc.

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