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A Model for Smart Vehicle Tracking: A Review

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Authors' contributions

This work was carried out in collaboration among all authors. Author FKU designed and developed a model for the study, wrote the protocol and wrote the first draft of the manuscript. Authors GY and OS managed the analyses of the study and literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The ability to track vehicles is useful in many applications including security of personal vehicles, public transportation systems, fleet management and others. Furthermore, the number of vehicles on the road globally is also expected to increase rapidly. Therefore, the development of vehicle tracking system using the Global Positioning System (GPS), Global System for Mobile Communications (GSM) modem, General Packet Radio Service (GPRS) and Google or Open street map respectively is undertaken with the aim of enabling users to locate their vehicles in real time with ease and in a convenient manner. The system will provide users with the capability to track vehicle remotely through the mobile network. This project presents the development of the vehicle tracking system's server and client software. Specifically, the system will utilize GPS to obtain a vehicle's coordinate and transmit it using GSM modem to the user's phone through the mobile network. The system is divided into two parts which are the tracking and monitoring part. The tracking part consist of GPS and an android/IOS mobile phone for navigation purpose. The GPS will provide information about the location of the vehicle. After receiving the location data from the web server, the data is monitored by a personal computer. After processing the data, the location of the vehicle can be viewed on the map.

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1. INTRODUCTION

Originally developed in the 1970's [1] Global Positioning Satellite (GPS) technology was not widely adopted until the 1990's for a variety of reasons. Since the increase in adoption, large segments of the commercial economy have taken advantage of the benefits of GPS. GPS is currently deployed in a wide array of applications including Cell Phones and in vehicle navigation systems. This technology allows individuals and/or vehicles to be tracked to a level of accuracy within 4 meters. It has been reported by the GPS Innovation Alliance that the economic benefits of using GPS within a commercial environment are estimated to be over $67.6 billion per year in the United States.

One of the key benefits of GPS technology is the capability to track assets [2], which can include individuals or physical assets. The importance of knowing an individual's whereabouts at any point in time can be extremely valuable to a business. Businesses are responsible for the well-being of their employees and the utilization of GPS technology provides employers with specific data on the location of their employees.

Potential unauthorized personal use of company vehicles can also drive up fuel and maintenance costs as well as create a potential non-business-related liability [1]. GPS tracking can help manage the efficient use of all company moveable assets; they further assert that certain parameters can be set for the following:

Off hours movement report – identifies when and where vehicles are being used during weekends, after work or during non-official work hours.

Odd hour's alerts identify unauthorized vehicle usage as it occurs so that immediate action can be taken.

Geo-fencing capability allows for setting specific parameters around where a vehicle can be operated [2]. Vehicles violating this policy can be immediately contacted to determine the cause of the violation and take corrective action. Once again, this level of monitoring can reduce fuel and maintenance costs and reduce potential liabilities. The use of GPS tracking technology can save significant amounts of money on commercial vehicle insurance.

2. RELATED STUDY

Several types of vehicle tracking devices exist. Typically, they are classified as "passive" and "active". In [3], the use of GPS and GSM technologies was explored in a way that they can track the location of a stolen vehicle equipped with the tracking device. In this system the car stays in an active mode while the owner is using it otherwise it is in its active mode. Then in the active mode if there is any disturbance, it is sensed by the IR sensor. It sends the location of the car to the owner. When the owner replies then the engine motor speed decreases and gradually switches off and the doors are locked automatically. Hence, trapping the thief and preventing any form of escape. Our model was conceived from this system with an additional functionality of a smartphone client and a web server utilizing existing technologies such as satellite covering in an event of GPRS failure. In [4], the authors designed the automobile anti-theft system and gave a detailed description of it. The system comprises of single-chip C8051F120. Vibration sensors are used to detect the theft. In [5], the energy consumption is decreased, and the durability of the system is increased by closely linking the GPS and the GSM modules with the microcontroller. It is less expensive as it does not involve the use of sensors to detect the theft. The user can know the location of the stolen vehicle with the android app. The hardware and software of the GPS and GSM network were developed. The proposed GPS/GSM based System has the two parts, first is a mobile unit and another is controlling station. The system processes, interfaces, connections, data transmission and reception of data among the mobile unit and control stations are working successfully. But these results were compatible with GPS technologies [6].

Vehicle tracking system is an electronic device, installed in a vehicle to enable the owner or a third party to track the vehicle's place. This paper proposed to design a vehicle tracking system that works using GPS and GSM technology [7,8]. This system built based on embedded system, used for tracking and positioning of any vehicle by using Global Positioning System (GPS) and Global system for mobile communication (GSM). This design will continuously watch a moving Vehicle and report the status of the Vehicle on demand this however it's based on request which

in cases of theft, such request is not broadcasted as expected [9].

Face Detection System used to detect the face of the driver and compare with the predefined face. The car owner is sleeping during the night time and someone theft the car. Then Face Detection System obtains images by one tiny web camera, which is hidden easily in somewhere in the car. Face Detection System compared the obtained images with the stored images. If the images don't match, then the information sends to the owner through MMS. The owners get the images of the thief in mobile phone [10] and trace the place through GPS. The place of the car and its speed displayed to the owner through SMS. The owner can recognize the thief images as well as the place of the car and can easily find out the hijacker's image [11].

According to Sahitya and Swetha [12], a real-time visual tracking system for vehicle safety applications was developed to automatically detect and track several moving objects, like cars and motorcycles, ahead of the tracking vehicle. Joint with the concept of focus of expansion (FOE) and view analysis, the built system can segment features of moving objects from moving background and offer a collision word of warning on real-time [4]. The proposed algorithm using a CMOS image sensor and NMOS embedded processor architecture. The constructed stand-alone visual tracking system validated in real road tests. The results provided information of collision warning in urban artery with speed about 60 km/hour both at night and day times.

Remote monitoring system based on SMS and GSM was implemented. Based on the total design of the system, the hardware and software designed. In this paper, the GSM network is a medium for transmitting the remote signal. This includes two parts that are the monitoring centre and the remote monitoring station. The monitoring centers consist of a computer and communication module of GSM [13]. To determine the precise location of an object, [14] proposed a tracking unit which is attached and using GSM modem, this information can be transmitted to remote user. This system contains GPS and GSM modems along with ARM processor that is setup in the vehicle. Through SMS the location of vehicle can be reported. GSM and GPS technologies helps to track the vehicles exact information. Real time control is provided by SMS system.

3. METHODOLOGY

3.1 System Model

A mobile client installed on the smartphone constantly communicates with the central server with its location details which is being used to locate the device on Google map in real time.

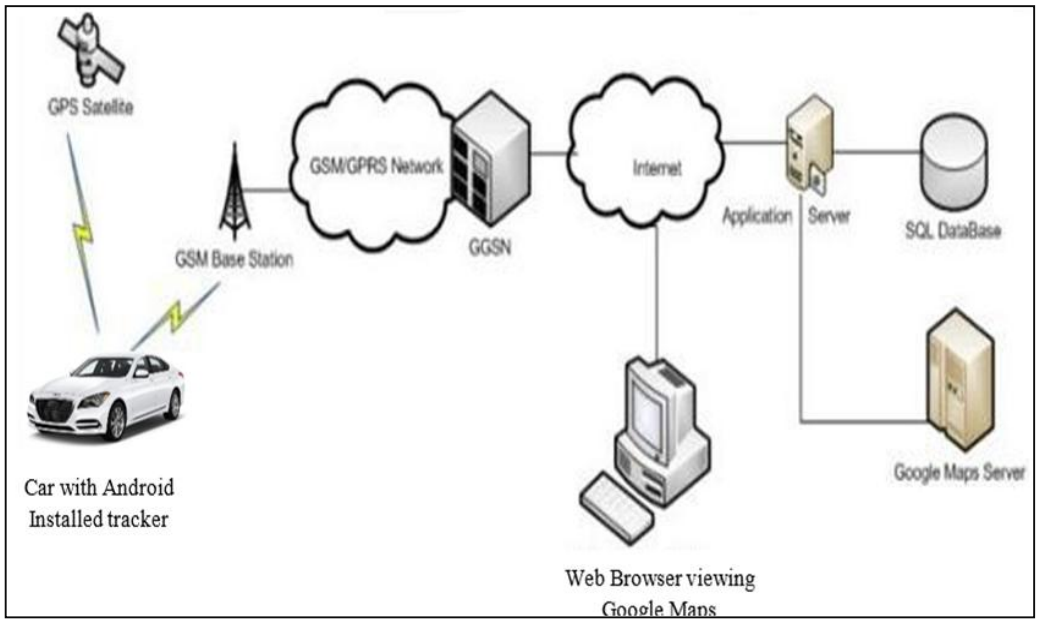

Fig. 1. System model

3.2 Diagram Description

The vehicle tracking mobile application client will be installed in either the android or iPhone client so as soon as the engine starts the system installed in the vehicle sends a confirmation message to the server using the sim in the GSM modem.

In this research, we build a GPS tracker with integrated Google maps. The imbedded GPS chip outputs in the mobile client will transmit the position information of the car which is transferred over GPRS link to a mobile operator`s GGSN and then to a remote server over HTTP connection. The HTTP server stores the incoming positional data in a MySQL database. When a client logs in to the tracking webpage, a PHP web application embedded with JavaScript code. The JavaScript runs in the browser and integrates this information into Google Maps through Google Maps API which displays the position on a map. Since the positional information is retrieved every second and the maps updated at the same frequency, a real time GPS tracking effect is achieved.

3.3 Google Map

With the Google Maps API, we can add maps based on Google Maps data to the web application. The API automatically handles access to Google Maps servers. We will also use API calls to add markers. We will set the center location of map by using google.maps. LatLng. As Google Maps API provides different kind of maps view, we will use ROADMAP for this web application. For fetching the data into the Google Map, we will use get Element by ID method.

We will write the PHP script for the web page, in this script Google Map API is embedded. We got the Google Map API key from https://console.developers.google.com. For storing the data into database, we have used a text file. By using GET and POST function in the PHP script, data has been fetched into the Google map to show the location of vehicle.

4. EXPECTED RESULTS

In the proposed vehicle tracking system, GPS receiver receives the location data like latitude and longitude of a vehicle and send them by using a HTTP request to web server. Then browser is used to load the PHP webpage which contain Google maps to show the location of the vehicle in real time. At the initial stage, the SIM module has been powered up by using the device power and the car battery to provide power to the system in an event of discharge in the device battery. After getting the data of vehicle's location we will send the data to the server.

We will also develop a web application to view the location of the vehicle in the map in our working system. HTML will be written to show the web page in the browser including with PHP and JavaScript for making the web page more dynamic. In the PHP script, it will contain Google embedded map that will show the map and given parameters to the user. Google Map API key will be used for embedding the map into the PHP script. The script is also used to handle POST and GET functions to fetch or store the data into database respectively.

5. CONCLUSION

The merger of GPS with GPRS provides a real-time tracking capability and reducing cost by using GPRS service instead of SMS. Google Map free service and the use of HTTP protocol as a data sending method reduces the monthly cost for an individual user or an enterprise. The proposed system will be expandable with unlimited number of users and support independent different type of authorization. Accuracy of the system is highly dependent on the GPS device and the coordinates received from GPS satellite while reliability and usability depend on the reliability of the mobile communications network. The system is very effective in areas where there is wide mobile network coverage; ease of use is another factor, the client application is a mobile based application, which enables user to log check track where and when ever internet access is available. The web designed to be user friendly, interactive, secure, and reliable. Normalized database tables used results in reduction in cost as the redundancy is avoided as much as possible. Repetition when occurs exhausts the server and database engines by checking similar data exist in several different tables. Using the standardized set procedures and distributing database functionality into set of stored procedures reduces the needed code amount and syntax lines of code used.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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