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Design and Development of a Low Cost Ubiquitous Tracking System

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Abstract

In this paper, design and development of a ubiquitous tracking system is proposed, in which vehicles are tracked and controlled using the prevailing cellular technologies. The system contains a GPS receiver and a GSM modem interfaced with a microcontroller. To track any vehicle, the vehicle's owner has to send an SMS to the tracking system installed inside the vehicle. Upon receiving the SMS, the microcontroller takes the current location's longitude and latitude coordinates from GPS receiver, packs it into an SMS and sends it to the owner and on a web server using GSM modem. When the web server receives the SMS containing vehicles coordinates, it will show location of the vehicle on Google Maps. For android users, the location is also displayed on an android application. In case of vehicle theft, the owner is able to turn off the main ignition switch, check status and speed of the vehicle simply by sending an SMS. The system is also equipped with a special security button for parked vehicles. By turning the button ON, the system will come in ACTIVE mode and will keep a special check on the vehicle's movement meanwhile performing the normal tasks. If the system senses any movement of vehicle during the ACTIVE mode, it will turn the main ignition OFF and will inform the owner immediately be sending 5 SMSs. Record of the vehicle's movement will be continuously managed on the web server where each owner will have vehicle's account. We have used a wide number of technologies including, but not limited to, Global Positioning System (GPS), Global System for Mobile Communication (GSM) and Microcontroller.

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Keywords: Global Positioning System (GPS), Global System for Mobile Communication (GSM), Google Maps, Microcontroller (μC), Mobile Assets, Short Message Service (SMS), Tracking

1. Introduction

Global Positioning System (GPS) tracking systems play an important role in the position aware applications [12]. Global positioning satellites network is known to have offered users a number of services and application especially in the field of tracking. It can also be used in tracking the distance travelled on a trip, vehicle mileage, and speed. It can

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keep the record of driving activity, including address of each destination reached and the length of stay. Today, there exists a lot of tracking systems but that facilitate a user with limited services. Along with the facilities, a ubiquitous navigation and tracking system must satisfy the following performances: scalability, integrity, portability, usability, precision and uninterrupted service.

Interestingly, there are a number of GPS devices offering a number of amenities. However, their cost is significantly high in contrast with their performance and facilities offered. Consequently, investing in these systems costs a lot which motivates the need of design and development of cheaper as well as high performance systems.

As per 2013 report of Pakistan Telecommunication Authority (PTA), there are over 129.6 million mobile phone subscribers [14] and over 14.4 million Mobile Internet Subscribers (GPRS, 3G, and WAP) [15] in Pakistan which brand it a gigantic marketplace for initiating an expedient application such a GPS based tracking system of mobile assets. There already exists tracking systems but these systems are, firstly, too expensive to be taken advantage of, secondly, not user friendly, and thirdly, none of them exploit the capability of a mobile device to provide tracking through GPS. For that reason, customers of such systems need to buy additional devices to get a tracking service. Also, in most cases, the user is not given the authority to track his/her own vehicle and has to consult the company to track the mobile assets indirectly. This delay of service is larger enough to, lets say, for thieves to robe the asset successfully. On the contrary, mobile phone users could easily find an application that offers GPS tracking on the internet but in most cases, such systems have limited functionalities or their functionalities are not free. So, the need of a low cost, powerful and high performance GPS based tracking device is emerging in order to provide full security to mobile assets and keep the track of its movement.

Rest of the paper is organized as follows: section 2 presents the related work, while Section 3 presents the motivation. Overview of Proposed System design is described in section 4. Section 5 presents the Results and Analysis, and finally, section 6 concludes the paper.

2. Related Work

Due to the increasing need of security, a number of tracking systems have been proposed, designed and implemented. Authors in [4] introduces an efficient approach for mobile asset tracking using contexts. The aim is to develop an efficient and improved geographical asset tracking solution and conserve valuable mobile resources by dynamically adapting the tracking scheme by means of context-aware personalized route learning techniques. A novel light sensor based information transmission system for indoor position and navigation has been presented in [2].

Implementations of tracking systems have been presented in [5] and [7]. The work included theoretical explanation of system and failed to present a hardware system and its working. In [6], authors introduced an integrity monitoring algorithm based on ultra-tight configuration. They also used Kalman filter residual based on the ultra-tight filter to find the test statistics.

Authors in [8] propose and implement a low-cost GPS tracking system. The system provide user with real time monitoring but it fails to be an independent tracking system because it uses GPRS and SMS gateways. In [9], authors proposed a ubiquitous vehicle tracking and management system. They provide two types of end user application, a web application and a mobile application. However, they are also using SMS gateways for transmitting message, and GPRS for uploading data on internet which is unreliable. The system may crash if the SMS gateway and GPRS is blocked, so, the system is totally dependent and is not standalone.

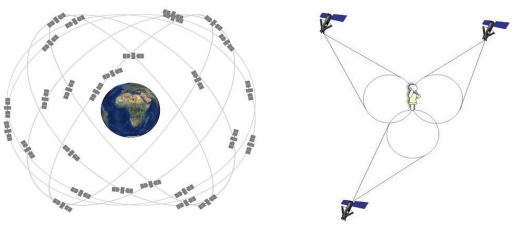

Fig. 1. (a) GPS Satellites around the earth (b) Trilateration Position