Tracking system based on GSM Mobile Phone using a Realtime GSM/GPS

Ousmane Abdoulaye Oumar, M. A.Al Rashed, Damanjit Singh
Faculty of Engineering, Science and the Built Environment
London South Bank University
London, UK
{oumaro,alrashem,singhd3}@lsbu.ac.uk

ABSTRACT: *A GPS based tracking system is proposed which keeps track of the location and speed of a vehicle which can be monitored by a mobile phone text messaging system. The system is able to provide real-time text alerts for speed and current location of a vehicle. Particularly, the present location can be locked and the system will alert the owner by sending a text message if the vehicle is moved from the present locked location. In addition, the speed can be locked and an alert can be sent to owner's mobile phone if this speed is exceeded.*

Keywords: GPS, GSM, Tracking, Location, Vehicle, SMS, Labcenter Proteus

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1. Introduction

Real-time, continuous localization is essential for many applications concerning outdoors vehicles [10, 15, 16]. The GPS/GSM-based tracking system is a system that makes use of the GPS to determine the precise location of a vehicle to which it is attached. The proposed design is cost-effective, reliable and has the function of accurate tracking [8, 9].

The Global Positioning System (GPS) technology is widely used for tracking the location of a person or a lorry carrying goods. For example, for security it is crucial to track the international transportation of medicines. A GPS device gets signals from two or more satellites to calculate its coordinates, which can be translated into geographical locations using online tools such as Google etc.

The localization in wireless sensor network has been developed in the last three decades, mostly being started as a military project and today have attracted significant research interest during the last few years.

The GPS system was developed by the Department of Defense of the United States in the early 70s for military applications and is maintained by the United States government. It is freely accessible to anyone with a GPS receiver [1, 13]. It is a 24hour worldwide service that provides accurate, three dimensional information about the location as well as precise velocities and timing services. It is accessible to an unlimited number of global military, civilian and commercial users [6, 7].

The system relies on 24 satellites placed in orbits allowing them to be always distributed around the Earth. A GPS receiver placed

on a vehicle, for example, can calculate its position by measuring the time it takes for a signal transmitted by the satellites to reach him. Because of the possible drift of the internal clock of the receiver, four visible satellites are required to obtain positions of the receiver. This system is widely used in maritime transport, air or land. The big advantage of this technology is to provide a direct position and in addition it can be used anywhere on Earth at any time.

The main cause of inaccuracy comes from the calculation of the distance to satellites because of the way into the atmosphere. But it is possible to do much better with a differential receiver. Using a fixed land base, we can reduce the measurement noise and achieve a precision of about one to two centimeters. Finally, note for completeness that a new system of satellite positioning with accuracy announced to submitters, will be launched in the coming years. This is the European system Galileo, the first test satellite was launched in December, 2005.

Given this performance and the ease of use, one might ask whether it is useful to think of other positioning sensors for mobile robots. It must still bear in mind that the GPS has some limitations. The first is that the satellites should be visible. It is therefore impossible to locate by GPS within a building, in a tunnel under a bridge, in the presence of obstructions such as dense vegetation or mountain blocking the direct view to the GPS satellites [11] and even in town, if the buildings do not fully obscure the sky, the localization accuracy is not a very good as in open terrain.

In the case of the GPS has been a popular tool for outdoor localization, GPS receivers are expensive, because is not possible by construction of small, cheap sensor nodes, power consumption, cannot function properly in an indoor application because there is no direct Line Of Sight (LOS) to the satellite and it is not possible to locate and continuously throughout the centimeter due to occlusions and multipath. Work to improve the location accuracy in urban areas exist, but loses the simplicity of a receiver with direct a precise position. Finally, the GPS system allows knowing the position, but not the orientation of the receiver, which is possible with other sensors.

The specifications concerning security and availability globally have led to implementations of passive systems that receive signals from a constellation of satellites.

To exploit the near universal access to mobile phones and a global system for mobile communications (GSM), it is easy to develop an independent real-time tracking system that comprises of a GPS receiver, a microcontroller which processes the information from the GPS receiver and a GSM enabled modem which transmits and receives the information to and from a microcontroller. Real-time location alerts can be requested from the system and sent by it via the short message service (SMS).

SMS is a basic protocol to send and receive messages in the form of text [2, 8]. The early specification for SMS was made in 1985 [3, 9]. Based on cellular networks, a mobile object is located using either the signals it transmits to the cellular network or by using the received signals. Hybrid satellite and terrestrial system" as employing satellite and terrestrial components where the satellite and terrestrial systems are interconnected, but operate independently of each other [4, 5].

Utilization of SMS technology has become popular because it is an inexpensive, convenient and accessible way of transferring and receiving data with high reliability [12].

2. Requirement analysis

Some high value vehicles have advanced security systems fitted by the manufacturers already, which are nearly impossible to bypass. However, when the keys are stolen, all the systems fitted by the manufacturer offer absolutely no resistance to the thief in stealing the vehicle. There is a need to develop a system which can work independently of the vehicle systems.

When a vehicle is stolen, most of the time the owner realizes it only after it is too late. Hours pass between the actual theft and the knowledge of the theft reaching the owner and the police. With every passing minute the area of search gets bigger and bigger and the probability of the vehicle being found gets smaller. Therefore, it would be useful to have a system which can alert the owner in real-time if the position of the vehicle is moved by a few meters. It would also be useful for parents to monitor the speeds at which their children drive to reduce the high accident risk posed by drivers under the age of 25 years, usually from over speeding. It would be useful to program an upper safe limit above which someone can be alerted. There is also a need for a system which can provide speed and location of the vehicle if and when needed.

The cost factor and the simplicity of the system should also be considered. There should be no subscriptions, contracts, bonds or tie-ups which restrict the user to go to any other service provider.

We propose a system to meet the above needs which has the ability to alert the owner in real time if the vehicle is moved a few meters from its parked location. The proposed design is cost-effective, reliable and has the function of accurate tracking.

3. System details

The proposed system comprises of a EM-406A model GPS module. This was chosen for its small size as it has an inbuilt patch antenna for the GPS receiver. The tracking sensitivity is also very good of this module. The data comes out at TTL level, which is useful as it can be directly interfaced with a microcontroller without any voltage level converter. The microcontroller used is PIC16F877A for its reliable and peripheral rich features along with enough number of ports which can be used for future use as well. The GSM modem used is a SIEMENS TC35i model for its reliability and easy availability in the UK along with the easily available instruction set.

Figure 1. EM-406A GPS module

Figure 2. Siemens TC35i GSM Module

This system with added functionalities is unique and has not been proposed before in the reviewed literature. Most similar systems focus on tracking and displaying information to the user and do not concentrate on alerting the user in real time when it is most important to do so along with giving 100% ownership to the user in terms of service and operation of the system itself. The proposed system has the following features:

1. Provision of adding one admin number to the system with the option of one or more phone number.
2. Lock/Unlock the current GPS coordinates of the vehicle by sending SMS to the system.
3. Lock/Unlock the maximum speed the vehicle should go up to and get an alert if the vehicle goes beyond that speed.
4. Get current location of the vehicle at any time.

5. To provide a solution to avoid car stolen in the lower cost than advance security car system [14].

The system work as follows:

The system needs an international mobile subscriber identity (SIM) card to be operated and be able to send/receive messages. Once the SIM card is inserted, the user will need to add an admin number to the system. The admin number holds the greatest control over the system than the other number which can also be added to the system if needed.

3.1 Adding the admin number to the system

To add the admin number, a text needs to be sent to the system in the following manner from the phone which is to be added as an admin number:

admin1111

Once the system receives the above message, it will reply back with the following message:

Figure 3. Number added – Admin user

From the added number, now the user can control the system.

3.2 Location of the target

To get the location of the vehicle in which the system is installed, the user can now send the following message:
1111loc

The first 4 digits are the password '1111' and '*loc*' means the location. Once the system gets this message, it will reply as shown in Figure 4 and Figure 5.

Figure 4. The current location of the target

The above message tells the user about the current location in terms of its latitude, longitude and it also tells the current speed which is 0km/hour as the system will only register a speed above a 10km / hr.

The above information can be entered into websites like http://itouchmap.com/latlong.html and the current location on the map can be seen easily.

To lock the speed of the vehicle the following message will need to be sent.

1111lock40

The above message first includes the password '1111' then the word '*lock*' and then the maximum speed the vehicle should be allowed. The user can enter between 10 -250 in km/hr. The system will reply with the following acknowledgement of the message:

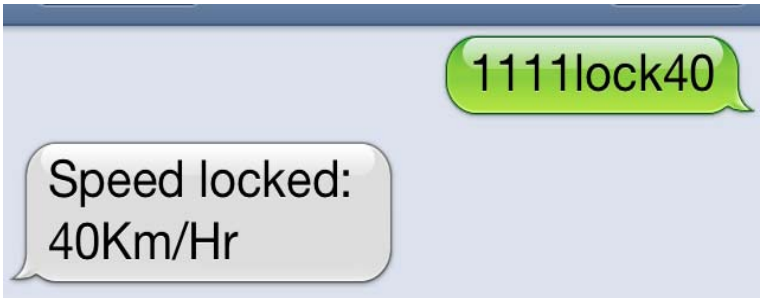

Figure 5. Speed locked: 40Km/Hr

After this, as far as the vehicle speed will remain below 41 km/hour the system will not issue any alert, but as soon as the vehicle will go above this limit an alert will be issued by the system and directed to the admin number as shown in Figure 6.

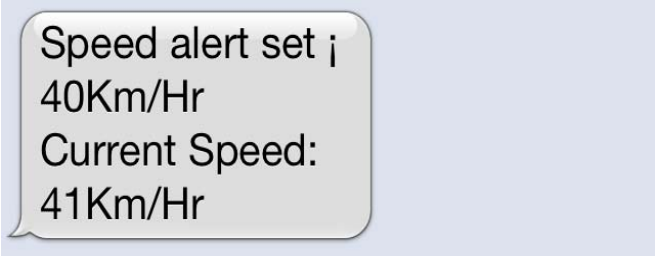

Figure 6. The message to the system

This alert will keep coming to the admin number after every few minutes until either the speed goes and stays below the maximum speed setting or speed alerts are switched off.

To switch off the speed alerts the following text should be sent to the system:

1111unlocksp

The system will reply with the following confirmation:

Speed lock removed by: +4474x xxx xxxx.

Figure 6. The message to the system

To lock the current location of the vehicle, the following text should be sent to the system:

1111lock

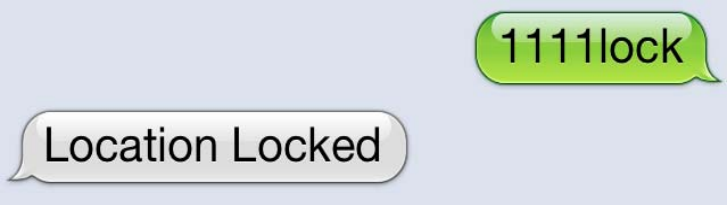

Figure 7. The message to the system

This locks the current coordinates, location of the system. If the location of the vehicle changes by a few meters, the system sends the following message to the admin number as shown in Figure 8.

Figure 8. The alert notification

The above message will keep alerting the user after every few minutes until the alerts are switched off or the vehicle returns to the same location.

To remove the location lock the following text should be sent: 1111unlock.

The reply from the system will be also displayed on the phone number which turned the location lock off: Lock removed by: +4474xxxxxxx.

4. Conclusion

This paper presents a localization system, which is able to track the position and speed of the subject of interest that is equipped with GPS and GSM devices. The system sends an SMS to the owner every time the vehicle move or exceeded speed. The owner can get the current location of the vehicle at any time by locking the initial location in real time. By doing Lock/unlock the current GPS coordinates of the vehicle to detect unauthorized movement and lock/unlock the maximum speed of the vehicle to get an alert if the vehicle goes beyond that speed.

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