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Design and Implementation of Vehicle Tracking System using GPS/GSM/GPRS Technology and Smartphone Application

MOHAMMED KHAIZER[1], K. SANTHA[2]

[1]PG Scholar, Dept of ECE, AVR & SVR Engineering College, Kurnool, AP, India.
[2]Assistant Professor, Dept of ECE, AVR & SVR Engineering College, Kurnool, AP, India.

Abstract: An efficient vehicle tracking system is designed and implemented for tracking the movement of any equipped vehicle from any location at any time. The proposed system made good use of a popular technology that combines a Smart phone application with a microcontroller. This will be easy to make and inexpensive compared to others. The designed in-vehicle device works using Global Positioning System (GPS) and Global system for mobile communication / General Packet Radio Service (GSM/GPRS) technology that is one of the most common ways for vehicle tracking. The device is embedded inside a vehicle whose position is to be determined and tracked in real-time. A microcontroller is used to control the GPS and GSM/GPRS modules. The vehicle tracking system uses the GPS module to get geographic coordinates at regular time intervals. The GSM/GPRS module is used to transmit and update the vehicle location to a database. A Smartphone application is also developed for continuously monitoring the vehicle location. The Google Maps API is used to display the vehicle on the map in the Smartphone application. Thus, users will be able to continuously monitor a moving vehicle on demand using the Smartphone application and determine the estimated distance and time for the vehicle to arrive at a given destination. In order to show the feasibility and effectiveness of the system, this paper presents experimental results of the vehicle tracking system and some experiences on practical implementations.

Keywords: Vehicle Tracking; Microcontroller; Google Mapsapi; Smartphone Application; GPS/GSM/GPRS Technology.

I. INTRODUCTION

The ability to accurately detect a vehicle‟s location and its status is the main goal of automobile trajectory monitoring systems.& also The high demand of automobiles has also increased the traffic hazards and the road accidents. This is because of the lack of best emergency facilities available in our country This design is a system which can detect accidents in significantly less time and sends the basic information to first aid center within a few seconds covering geographical coordinates, the time and angle in which a vehicle accident had occurred. This alert message is sent to the rescue team in a short time, which will help in saving the valuable lives. These systems are implemented using several hybrid techniques that include: wireless communication, geographical positioning and embedded applications.

A. Automatic Accident Detection and Reporting System using GSM and GPS

Traffic has become an important event in the national interest now-a-days. We see that a lot of life spoils in every accident because of typically long response time to access the appropriate care that may be available if informed in-time. Application of our project can significantly shorten the response time of accident. This is a platform for emergency rescue which will operate optimally in order to reduce the golden time of arrival of rescuers in case of road accidents, when every microsecond counts. Our project aims to present a technology automatically detecting the accident and a hardware tracking device based on GSM/GPS technology informing at the occurrence of accident with sufficient details like exact location and time at which accident happened. This project will establish a communication between the control station and the unit installed in vehicles. Vehicles will have GPS/GSM enabled tracking modules and will be tracked in real time using cellular networks. The software embedded in the microcontroller will control the various operations of the device by monitoring waveform from the vibration sensor. In case of accident the device will send an alert message along with location data from GPS module to control station using GSM network. It is a comprehensive and effective solution to the poor rescue response in case of accident.

The accident reporting can automatically find a traffic accident, search for the spot and then send the basic information to the rescue agency covering geographical coordinates and the time and circumstances in which a traffic accident took place. At the server end, a control function will extract relevant data and store it in a database, to which accident information from prototypes will be polled in real time. Our system combines advanced hardware design and sophisticated control technology into a compact, reliable package. The vehicle tracking systems are designed to assist corporations with large number of automobiles and several usage purposes. A Fleet management system can minimize

the cost and effort of employees to finish road assignments within a minimal time. Besides, assignments can be scheduled in advanced based on current automobiles location. Therefore, central fleet management is essential to large enterprises to meet the varying requirements of customers and to improve the productivity [1]. So taking in action all these things we are going to design and develop a machine, which will track the real time location of the vehicle using blue tooth technology with the help of an android base mobile phones. The ability to accurately detect a vehicle‟s location and its status is the main goal of automobile trajectory monitoring systems. These systems are implemented using several hybrid techniques that include: wireless communication, geographical positioning and embedded applications. The vehicle tracking systems are designed to assist corporations with large number of automobiles and several usage purposes. This system can minimize the cost and effort of employees to finish road assignments within a minimal time.

So taking in action all these things we are going to design and develop a machine, which will track the real time location of the vehicle using blue tooth technology with the help of an android base mobile phones. The main goals of this project is to design and develop anconomical model, which requires less power with less complex in structure, easy to implement. An additional setting could be implemented to interface the system to the car‟s alarm to alert the owner on his cell phone if the alarm is set off. The auto mobile‟s airbag system can also be wired to this system to report severe accidents to immediately alert the police and ambulance service with the location of the accident.

II. LITERATURE REVIEW

Traditionally, navigation systems have been large, expensive, and used only in aviaion or military applications. However, the presence of the GPS and the recent proliferation of small low-cost motion sensors have made possible navigation systems that are small and inexpensive enough to be used in consumer products. Commercial consumer-grade navigation systems are, in fact, readily found today in Japan, Europe, and the United States, with one application being automobile navigation systems. The concept of in-vehicle navigation systems is not new, but implementations of such systems are relatively recent. Programs investigating the possibility of establishing an infrastructure to support widespread navigation for motor vehicles began in the U.S. as early as the late 1960‟s.However, results from these studies deemed that the supporting infrastructure for such a system would be too expensive, and further study in the United States was dropped until the 1980‟s. In the late 1980‟s, the U.S.government, recognizing that parts of the country‟s road system were taxed nearly to capacity, launched a campaign to promote the application of high-tech solutions to enhance roadway efficiency. Outlined in the National Program Plan for Intelligent Transportation Systems(NPP), this campaign includes a strategy for improving the efficiency of the U.S. highway system over a 20-yearperiod.

The NPP‟s goals include reducing high way congestion and fuel consumption and the number of traffic accidents by providing drivers with real-time traffic information, route guidance, electronic toll collection, advanced vehicle collision avoidance systems, and automatic notification to authorities in the event of a traffic emergency. These ambitious renovations to the U.S. road system involve a number of diverse technologies, and knowledge of a vehicle‟s location lies at the heart of many services described in the NPP (e.g., route guidance and emergency response). In Japan, research efforts in real time automobile route guidance were begun in the 1970‟swith the goal of reducing traffic congestion. Through out the 1970‟s and 1980‟s, the Japanese government, in cooperation with industry, was continuously involved in launching initiatives which helped to mature vehicle navigation technology. Today, most Japanese car manufacturers offer factory-installed navigation systems in at least some of their models. Estimates indicate that, by the year 2000, per annum sales of vehicles with factory installed navigation systems will be reach 2.5 million. Many researchers have proposed the use of cutting edge technologies to served the target of vehicle tracking. These technology include Communication remote Control, GPS,GIS server systems and others.

III. ARCHITECTURE OF GPS TRACKINGAND GSM MODULES

In this paper, we describe the design of a proposed tracking system in this paper is designed to track and monitor automobiles‟ status that are used by certain party for particular purposes, this system is an integration of several modern embedded and communication technologies. To provide location and time information anywhere on earth, Global Positioning System (GPS) is commonly used as a space-based global navigation satellite system. The location information provided by us GPS systems can be visualized using Google Earth technology. In wireless data transporting, Global System of Mobile (GSM) and Short Message Service (SMS) technology is a common feature with all mobile network service providers. Utilization of SMS technology has become popular because it is an inexpensive, convenient and accessible way of transferring and receiving data with high reliability. As shown in Fig.1, the proposed system consists of: in-vehicle GPS receiver, GSM modems (stationary and in-vehicle), and embedded controller. The users of this application can monitor the location graphically on Google Earth; they also can view other relevant information of each automobile in the fleet. The implemented tracking system can be used to monitor various parameters related to safety, emergency services and engine stall. The paper shows an implementation of several modern technologies to achieve a desirable goal of fleet monitoring and management.

The system has two main modules, as shown in Fig.2. The first module is the tracking device which is attached to the moving automobile. This module composes of a GPS receiver, Microcontroller and GSM Modem the GPS Receiver receives the location information from satellites in the form of latitude and longitude real time reading. The Microcontroller has three main tasks to read certain engine parameters from automobile data port (OBD-II), to processes the GPS information to extract desired values and to transmit this data to the server using GSM modem by SMS. The

chosen engine parameters are Revaluation per minute, engine coolant temperature, vehicle speed.

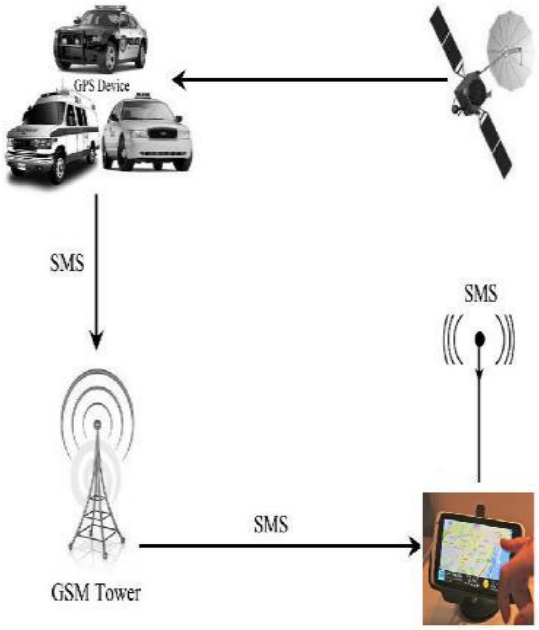

Fig.1. The block diagram of GPS tracking system.

The second module consists of a recipient GSM modem and workstation PC. The modem receive the SMS that includes GPS coordinates and engine parameters. This text is processed using a Visual Basic program to obtain the numeric parameters, which to be saved as a Microsoft Office Excel file The received reading of the GPS is further corrected by Kalman filter technology. To transfer this information to Google Earth, the Excel file is converted to KML, Keyhole Markup Language format. Google Earth interprets KML file and shows auto mobile‟s location and engine parameters on the map. The system‟s efficiency is depend on the sufficiency of the used communication network. An additional setting could be implemented to interface the system to the car‟s alarm to alert the owner on his cell phone if the alarm had set off. The automobile airbag system can also be wired to this system to report severe accidents to immediately alert the police and ambulance service with the location of the accident.

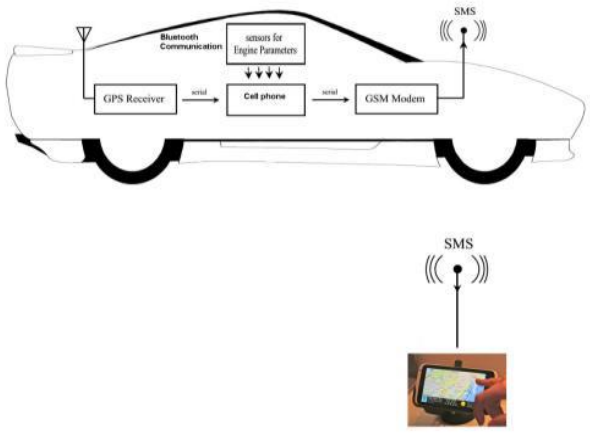

Fig.2. The system architecture: GPS tracking and GSM modules.

IV. CONCLUSION

In this paper, a real-time automobile tracking system via Google Earth is presented. The system included two main components: a transmitting embedded module to interface in-vehicle GPS and GSM devices in order determine and send automobile location and status information via SMS. The second stationary module is a receiving module to collect and process the transmitted information to a compatible format with Google Earth to remotely monitor the automobile location and status online. The transmit location of the vehicle has been filtered using Kalman filter to achieve accurate tracking. The 2DRMS accuracy of estimated vehicle coordinates has been enhanced. The accuracy of filtered coordinates was less than 15 meters compared to about 43 meters for transmitted co-ordinates received by in vehicle GPS module.

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