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Identifying Efficient Electronic Asset Tracking System Using GPS and GSM/GPRS

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A b s t r a c t

An efficient assets tracking system is designed and implement for tracking the movement of any equipped assets from one location to another at any time. The proposed system made good use of a popular technology that combines a Smartphone application with microcontroller. This will be easy to make and inexpensive compared to others. The designed in-assets 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 assets tracking. The device is embedded inside an asset whose position is to be determined and tracked in real-time. A microcontroller is used to control the GPS and GSM/GPRS modules. The asset 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 asset location to a database. A Smartphone application is also developed for continuously monitoring the asset location. The Google Maps API is used to display the asset on the map in the Smartphone application. Thus, users will continuously monitor a moving asset on demand using the Smartphone application and determine the estimated distance and time for the assets to arrive at a given destination.

Keywords: *Electronic asset, Tracking system, GPS, GSM, GPRS*

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Background to the Study

These days' car theft cases are higher than ever, give your car an excellent protection with the only reliable anti-theft device. Car central locking system ensures the best guarantee to protect your car from different kinds of theft cases. It is a car security device that offers excellent protection to your car. A car with central locking security system helps the user to lock and unlock doors at the press of a button. Mainly two types of central locking systems are used in Auto industry- Automatic central locking system and Manual central locking system that ensures smoother secured operation. Again this system could not prove to provide complete security and accessibility of the vehicle in case of theft. So a more developed system makes use of an embedded system based on GSM technology. Automatic vehicle location (AVL) is a means for determining the geographic location of a vehicle or any mobile asset and transmitting this information to a point where it can be stored and used with certain software and database applications. A common practice is to stand up a centrally located server that is connected to a network and the server acts as the gathering point where data is received and stored in a database.

Most commonly, vehicle location is determined by using a Global Positioning System (GPS) device, and the transmission mechanism of the data is a satellite, terrestrial radio or cellular connection from the vehicle to a receiving satellite, radio receiver, or nearby cell tower. Also GLONASS provides an alternative to Global Positioning System (GPS) and is the second alternative navigational system in operation with global coverage and of comparable precision. Manufacturers of GPS devices say that adding GLONASS made more satellites available to them, meaning positions can be fixed more quickly and accurately, especially in built-up areas where the view of some GPS satellites is obscured by buildings. Modern Vehicle tracking systems commonly use GPS or GLONASS technology for location the vehicle. Originally designed for fleet management, automatic vehicle location (AVL) systems have been in use fir ever 20 years to increase the accountability of field personnel and boost the efficiency of an organization's dispatching procedures. The integration of automatic vehicle location (AVL) data into a geospatial information system (GIS) combines the concepts of dynamic geospatial location, intelligent geographic data and situational awareness.

The added information of vehicle tracking information into an existing geospatial information system provides a comprehensive approach for decision making and asset management. The aggregated information makes the system extremely useful since the data is updated on a minute by minute basis to provide real-time applications. A vehicle tracking system combines the use of automatic vehicle location in individual vehicle with software that collects these data for a comprehensive picture of vehicle locations. Modern vehicle tracking systems commonly use GPS or GLONASS technology for locating the vehicle. Vehicle information can be viewed on electronic maps via the internet or specialized software. Several types of vehicle tracking devices exist. Typically they are classified passive and Active. Passive devices store GPS location, speed, heading and sometimes a trigger event such key on/off, door open/closed. Once the vehicle returns to a predetermined point, the device is removed and the data downloaded to a computer for evaluation. Active devices also collect the same information but usually transmit the data

in near-real-time via cellular or satellite networks to a computer or data center for evaluation. Many modern vehicle tracking devices combine both active and passive tracking abilities: when a cellular network is available and a tracking device is connected it transmit data to a server; when a network is not available the device stores data in internal memory and will transmit stored data to the server later when the network becomes available again.

Objective the Study

The primary objective is to a novel method of vehicle tracking and locking system used to track a vehicle by using GPS and GSM technology. The specific objectives are putting the system into sleeping mode while the vehicle is handled by the owner or authorized person otherwise it goes to active mode, the mode of operation changed by in person or remotely. If any interruption occurred in any side of the door, then the IR sensor senses the signals and SMS sends to the microcontroller. The controller issues the message about the place of the vehicle to the car owner or authorized person. When send SMS to the controller, the controller issues the control signals to the engine motor. Engine motor speeds are gradually decreases and come to the off place. After that all the doors locked. To open the door or restart the engine, authorized person needs to enter the passwords. This system will determine the impact of a real time tracking system using GPS and GSM technology in asset monitoring and management.

Significance of the Study

AVL technology is assisting decision support, situation awareness, and emergency response situations. It is well known that the most critical time factor is the availability of basic information such as the location of an incident, location of emergency resources, distance to a certain location and travel time. Aside from emergency response support, AVL technology provides improved response time, resource management, schedule adherence and increased productivity on a day to day application. The use of this technology can support many activities such as fleet management, snow plow routing, garbage truck tracking, and mobile workforce management. The value of dynamic geospatial information is extremely powerful especially when it is integrated with existing static geospatial information because of the added capability it provides. Knowing where "something" is located as it moves along the earth's surface, gives you the ability to predict, react and respond accordingly. By having the authority or ability to change the direction of a moving vehicle, certain users are essentially "enabled" to make more efficient use of these valuable resources in real time.

Need of GPS

You may think that one only need a GPS tracking device to get you from point A to Point B if you are driving, but did you know that there are many other tracking systems that you may have a need for? GPS tracking systems are used to track anyone and anything these days. Technology has rapidly advanced in the past few years and it has become very easy for the average person to use a tracking system. If you have a vehicle, then you will want o place a GPS tracking system under your dash or in your glove compartment. This way, if your car ever gets stolen, you will be able to locate it within seconds. If you have a small

child, you will want to have a tracking system in place in case he/she gets lost or wander. Every second counts with a lost or abducted child, so a tracking device is imperative to avoid a possible disastrous and heartbreaking outcome. If you have valuable items in your home like jewelry, or electronics you will want a GPS tracking system in case they are ever stolen. There are also various tracking systems that can locate items inside buildings and parking garages. If you have a teenager, you will want to use a GPS tracking system to make sure that they are driving responsibly and they are going where they told you they were going. If you suspect your spouse of significant form of cheating, a good tracking system will be able to confirm or absolve your suspicions.

How does it Work?

The GPS satellite gives the exact position of the device which is situated in the Car. This device in turn is connected to the local GSM service provider via a GSM network as it has SIM card present in it. Thus the GPS parameters which the device has are send to the tracking server which has a Static IP address via a GPRS network. The tracking server consists of a Socket listener application running in the back-ground which listens at a particular port. The GPS parameters received by the port listener are given to the Parser and converter for proper conversions and this data is stored in the database. These values from the database are fetched and are manipulated to get the reports in proper format.

Review of the Body of Knowledge

Real-time tracking and management of vehicles has been a field of interest for many researchers and a lot of research work has been done for tracking system. Recently the various anti-theft modules like steering wheel locked equipment, network tracking system and traditional electronic alarm are developed along with client identification and real time performance monitoring. The paper present by (El-Medany et al; 2010) describes a real time tracking system that provides accurate localizations of the tracked vehicle with low cost. GM862 cellular quad band module is used for implementation. A monitoring server and graphical user interface on location of a vehicle on a specific map. This paper also provides information regarding the vehicle status such as speed mileage. (Hu Jian-ming et al; 2012) describes an automobile anti-theft system using GSM and GPS module.

The system is developed using high speed mixed type single-chip C8051F120 and stolen automobile is detected by the use of vibration sensor. The system remains in contact with automobile owner through the GSM module, for the safety and reliability of the automobile. (Nelson et al; 2012) describes development and deployment of GPS (Global Positioning System)/GSM (Global System for Mobile Communications) based Vehicle Tracking and Alert System. This system allows inter-city transport companies to track their vehicles in real-time and provides security from armed robbery and accident occurrences. (Vu Phung; 2010) describes a system based on the based on the Global Positioning System (GPS) and Global System for Mobile Communication (GSM). It describes the practical model for routing and tracking with mobile vehicle in a large area outdoor environment. The system includes the Compass sensor-YAS529 of Yamaha Company and Accelerator sensor-KXSC72050 of Koinix Company to acquire moving direction of a vehicle. The system will acquire positions of the vehicle via GPS receiver and

then sends the data to supervised center via the SMS (Short Message Services) or GPRS (General Package Radio Service) service. The supervised center comprises of a development kit that supports GSM techniques- WMP100 of the Wavecon Company. Finally, the position of the mobile vehicle will be displayed on Google Map. (Yuvraj Kasture et al; 2014) described Multi-tracking system is a real time tracking platform which uses integration of technologies such as GPS and GSM.

The platform supports multiple tracking devices for variety of applications such as live vehicle tracking, personal tracking and also assets tracking. The GPS device installed in the vehicle continuously movies with the vehicle and will calculate the co-ordinates with other related information at each position and then transmit this information via GSM to the tracking server, thus storing it in the database; which further can be viewed on electronic map, i.e., Google Map via Internet providing up-to-date information. The proposed system also supports for real time control like, if owner sends an SMS, it automatically turns of the ignition of vehicle or other different purposes. (Baburao et al; 2015) in their paper described a vehicle tracking system that combines the installation of an electronic device in a vehicle, or fleet of vehicles, with purpose-designed computer software to enable the owner or a third party to track the vehicle's location, collecting data in the process.

Modern vehicle tracking systems commonly use Global Positioning System (GPS) technology for locating the vehicle, but other types of automatic vehicle location technology can also be used. In the hardware and software of the GPS and GSM networks were developed. The proposed GPS/GSM based Systems has the two parts, first is a mobile unit and another controlling station. The system processes, interfaces, connections, data transmission and reception of data among the mobile unit and control stations are working successfully. These results are compatible with GPS technologies. In a 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. This system is 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). The design will continuously watch a moving Vehicle and report the status of the Vehicle on demand.

Methodology

A research methodology defines what the activity of research is, how to proceed, how to measure progress and what constitutes success. Methodology is generally a guideline for solving a problem with specific components such as phases, tasks, methods, techniques and tools. It can be defined as the analysis of the principles of methods, rules and postulates employed by a discipline. It could also be seen as a documented process for the management of projects that contains procedures, definitions and explanations of techniques used to collect, store, analyze and present information as part of a research process in a given discipline. The study adopts SSADM (Structural System Analysis and Design Methods) for development which follows definite steps to achieve a given task.

Method of Data Collection
This involves gathering facts about the existing system. The purpose of this analysis is to identify the inefficiencies associated with the existing system and the requirement analysis for the proposed system, Vehicle Tracking System. There are many fact-gathering techniques that can be use in gathering the information such as interview, observation, internet and other method.

Standard Architecture of Tracking Unit

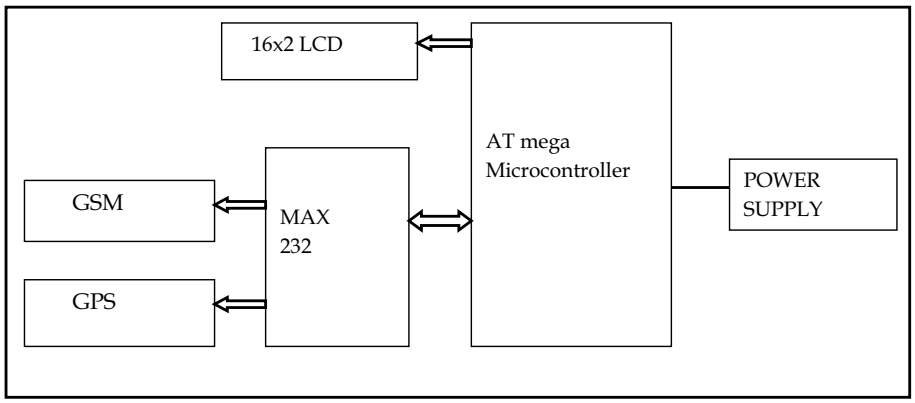

Figure 1 Architecture of transmitting unit

Features of the Architecture
GPS: The Global positioning System (GPS) is a satellite-based navigation system consisting of a network of 24 satellites located into orbit. The system provides essential information to military civil and commercial users around the world and is freely accessible to anyone with a GPS receiver. GPS works in any weather circumstances at anywhere in the world. Normally no subscription fees or system charges are required to utilize GPS. A GPS receiver must be locked on to the signal of at least three satellites to estimate 2D position (latitude and longitude) and track movement. With four or more satellites in sight, the receiver can determine the user's 3D position (latitude, longitude and altitude). Once the vehicle position has been determined, the GPS unit can determine other information like, speed, distance to destination, time and others. GPS receiver is used for this research work to detect the vehicle location and provide information to responsible person through GSM technology.

GSM: The GSM modem is a specialized type of modem which accepts a SIM card and operates on a subscriber's mobile number over a network, just like a cellular phone. It is a cell phone without display. Modem sim300 is a tri-band GSM/GPRS engine that works on EGSM900MHz, DCS1800MHz and PCS1900MHz frequencies. GSM Modem is RS232-logic level compatible, i.e., it takes -3v to -15v as logic high and +3v to +15 as logic low. MAX232 is used to convert TTL into RS232 logic level converter used between the microcontroller and the GSM board. The signal at pin11 of the microcontroller is sent to the GSM modem through pin 11 of max232. This signal is received at pin2 (RX) of the GSM modem. The GSM modem transmit the signal from pin3 (TX) to the microcontroller through MAX232, which is received at pin 10 of ICI.

Microcontroller: The system uses a CMOS 8- bit microcontroller. It is based on RISC architecture. It comprises of 16k bytes of flash program memory, 1k byte internal SRAM and 512 bytes EEPROM.

MAX 232: It is used for GSM, GPS and microcontroller to communicate serially.
16x2 LCD: A 16x2 LCD is used for displaying location values and a 9v battery is used power up the circuit.

Standard Architecture of Monitoring Unit

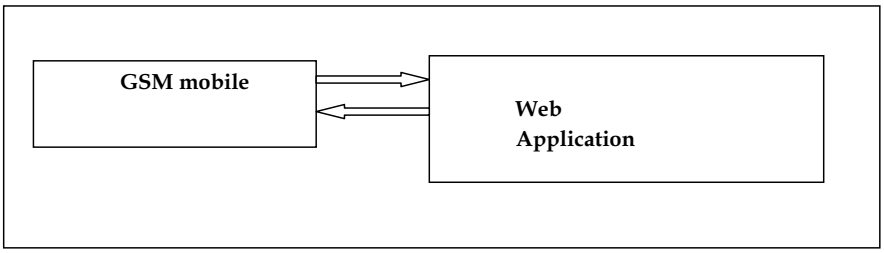

Figure 2: Monitoring Unit Architecture

Analysis of the Present System
The GPS satellite gives the exact system position of the device which is situated in the Car. This device is in turn connected to the local GSM service provider via a GSM network as it has SIM card present in it thus the GPS parameters which the device has are send to the tracking server which has a Static IP address via a GPRS network. The tracking server consists of a Socket listener application running in the back-ground which listens at a particular port. The GPS parameters received by the port listener are given to the Parser and converter for proper conversions and this data is stored in the database. These values from the database are fetched and are manipulated to get the reports in proper format.

Weaknesses of the Present system

1. It doesn't give exact location of the asset
2. It is not compatible with Google map location
3. Reports were not received in proper format and on time
4. It doesn't transmit in rural areas because of lack of network
5. It doesn't have user friendly interface
6. The tracker doesn't take full control of the engine incase of theft.

Overall flow chart diagram of the system

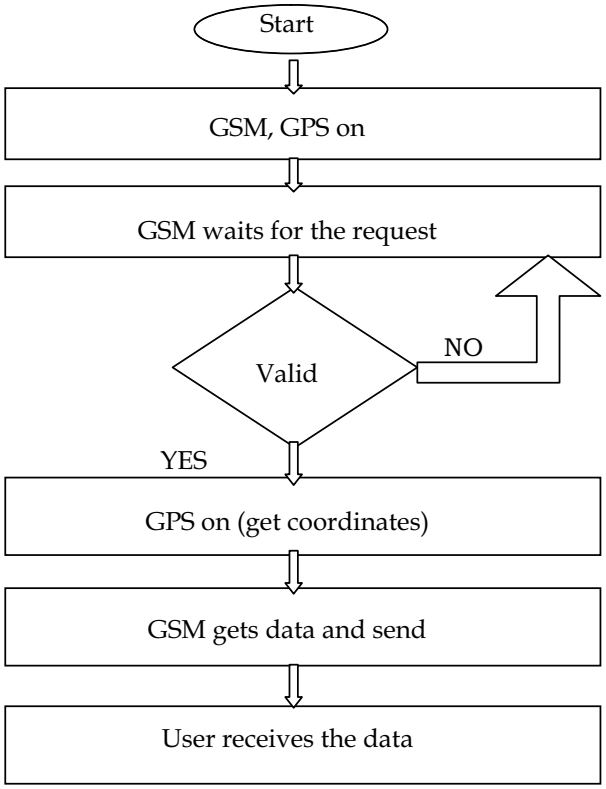

Figure3: flowchart of the new system.

Conclusion

This Asset (vehicle) tracking system is used to track the theft of vehicle by using GPS and GSM technology. This system puts into sleeping mode while the vehicle is handled by the owner or authorized person otherwise it goes to active mode, the mode of operation changed by in-person or remotely. If any interruption occurred in any side of the door, then the IR sensor senses the signals and SMS sends to the microcontroller. The controller issues the message about the place of the vehicle to the car owner or authorized person. Electronic Asset (vehicle) Tracking System offers a promising means managing and securing our assets. The fleet management functions such as fleet tracking, routing, dispatching, on board information and security by fleet operators will be accessible and manipulated to get reports in proper format. Ability to obtain data/information on a real-time basis makes it easier to recover a stolen asset. By integrating tracking and tracing in a single system the fraudulent activities in most organization will be reduced drastically.

Recommendation

This paper can be further enhanced by the use of camera and by developing a mobile based application to get the real time view of the vehicle instead to check it on PC, which will be more convenient for the user to track the target.

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