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Comparative Study on vehicle Tracking System

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Abstract

Vehicle tracking system is a technology which is used by fleet system and owner of vehicle all over the world. It is a very safe and reliable technology. A system is used for tracking and positioning of any vehicle by using Global Positioning System [GPS] and Global System for Mobile Communication [GSM]. The GSM modem is used to send the position of the vehicle from remote place. The GPS modem that uses satellite technology for its navigation system which will continuously give data like longitude, latitude, speed, distance travelled etc. When the request is sent by user to the number at the modem in the form of SMS, the system automatically sends a return reply to the mobile indicating the position of the vehicle in the form of latitude and longitude via SMS. We will also view the position of vehicle on a digital mapping such as Google map with the help of software via Internet

Index Terms: GSM, GPS, Tracking, etc.

1. Introduction

The vehicle tracking system is a technology used to determine the location of a vehicle using different methods like GPS and other navigation system operating via satellite and ground-based stations. It is a total security and fleet management solution. Modern vehicle tracking system uses GPS technology to monitor and locate our vehicle anywhere on the earth. This system is an essential device for tracking car any time the owner wants to monitor it and used as theft prevention and recovery of the stolen car. A tracking system comprises of mainly three parts- vehicle unit, fixed based station and database with software system [4].

The vehicle unit incorporates the hardware part that is the Arduino, GPS and GSM modem which is kept inside the vehicle that is to be tracked. This unit is mainly based on a modem that receives signals from the satellite with the help of GPS antenna. This modem then converts the data and sends the vehicle location information through SMS as well as a mobile application named "Vehicle Tracking System" which is synchronized with the web page and to a server which can be displayed on digital map. Fixed Base station consists of a wireless network system that receives and transfer the information to the data centre. The base station contains software and geographic map useful for locating the vehicle. Maps of every city are available in the

base station that has an in-built Web Server. Database and Software are used to give the location that is the coordinates of each visiting point that is saved in the database, which can be later displayed on a screen using google map.

Vehicle Security is a biggest concern for all vehicle owners. Owners are always looking for new and upgraded vehicle security systems. For the modernization of technology, it is now possible to track and closely monitor vehicle in real time as well as to check the history of vehicle's movements. Vehicle Tracking System helped enormously to maintain the security of the vehicle by tracking its activities at regular time interval. The system uses Global Positioning System [GPS] to find information about the location of the vehicle that is to be monitored and then send the latitude and longitude to the monitoring centre through satellite. At the monitoring centre different software is used to display the location of vehicle on the Google map. This is how vehicle tracking system tracks automobiles in real time. Due to real-time tracking facility, vehicle tracking system has become increasingly popular among owners of vehicle as they can monitor their vehicle continuously [4].

The tracking hardware is installed inside the vehicle in such a way that it is not visible from outside the vehicle. Hence, it work as a secret unit which continuously sends the coordinates to the monitoring center.

Monitoring center is a software which helps the vehicle owner with a view of the vehicle location on an electronic map such as google map. The user can use any browser to connect to the server and monitor the vehicle on Google Map. Thus, it saves the user from the hassle of calling the driver to know the location of the vehicle as it is now possible to track vehicle online.

The system provides the facility to prevent theft of the vehicle. so, we divided the whole operation of the vehicle tracking system into two parts:

1. Tracking the location of vehicle
2. Providing protection of vehicle

The system consists of GPS receiver which provides real-time location of the vehicle. This real-time data is stored in the database. The GSM module is directly connected to the microcontroller that takes the data and sends this data to the user's mobile phone that has sent the request for the coordinates of the position. This data consists of longitude, latitude and a link and when we click on the link, we are able to see the location on Google map [4].

This system has another special feature which provides not only the location of vehicle but also protection. If the vehicle is stolen, after knowing the location of the vehicle, the owner can follow the car and give the information about the location of car to the police for faster recovery of the stolen car.

2.Literature Review:

Global Positioning Systems (GPS) were designed by the United States Government and military, which was intended to be used as surveillance. The GPS was invented by the United States Department of Defence and Dr.Ivan Getting as a means to create a satellite course-plotting system that is primarily used for navigation purposes [2]. At that time, the GPS project costs approximately \$12 billion for the design and launch of 18 satellites, six in each of the orbital planes spaced 120 degrees apart and their ground stations. The GPS uses these satellites as reference points to determine and give the accurate geographical positions on map. The idea for a global positioning system was initially planned to be used by military and intelligence organizational during the Cold War with the introduction of the project stemming from the Soviet-launched spacecraft Sputnik. Since in the 1960s, GPS has developed into a larger and more advanced satellite network constellation that orbits Earth at fixed points in space to send signals to anyone

with a GPS receiver. The signals carry a time code and geographic data point that enable us to display a device's exact position anywhere on the planet [2].

3. Different Technologies used in Tracking System

3.1 Active and passive tracking

Several types of vehicle tracking devices exist. Typically, they are classified as Passive devices and Active devices. Passive devices are the devices which store GPS location, speed, heading and sometimes a trigger event such as key on or off. Once the vehicle returns to a predetermined location, the device is removed and the data downloaded to a computer for evaluation. Passive systems include auto download type that transfers data via wireless download. Active devices also collect the same information like passive devices but it usually transmits the data in real-time via cellular or satellite networks to a computer or data center for evaluation.

Passive trackers do not monitor movement in real-time. When you are using a passive GPS tracker, you will not be able to follow every last move that a tracked person or object makes. In contrast to passive devices, active GPS trackers will allow a person to view tracking data in real-time. when we place an active tracker on a vehicle, we will be able to view location, stop duration, speed, and other tracking details from the comfort of your home or office. The Active GPS trackers are ideal when it comes to monitoring the vehicle that need to be tracked at regular time interval.

As compare to passive devices, active tracking devices are more expensive. An active GPS tracker comes with a reliable interface and excellent tracking software and because of this you will be able to track anything or anyone quickly and efficiently.

When most people picture a GPS tracking device, they picture a real-time tracker. These trackers can be attached to any object while a person monitors all activities from a home computer. For example, if you were placed a real-time tracker on a vehicle, you could then watch as the vehicle makes stops, takes alternate routes, and sits idling-all in real-time. GPS trackers that work on a real-time basis are usually considered "active" trackers, while those that do not include real-time tracking are considered as passive trackers.

There are many advantages of real-time tracker. The most important advantage is that the GPS locator is convenience. Rather than waiting to download data to a computer, a tracker that works in real-time does not require any waiting. Since real-time trackers come with software that allows a user to track an object in real-time and watching any object's progress is simply a matter of

sitting at a computer. Many modern vehicle tracking systems combine the abilities of both the active and passive tracking: when a cellular network is available and a tracking device is connected it transmits data to a server and 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.

4. Different Types of Tracking System

There are three main types of GPS vehicle tracking that are widely used and they all use active devices. They are as follows:

1. Automatic Vehicle Location (AVL) system
2. Assisted Global Positioning System (AGPS)
3. Radio Frequency Identification (RFID)

4.1 Automatic Vehicle Location (AVL) system:

Automatic Vehicle Location (AVL) system is an advanced method to track and monitor any remote vehicle with the device that receives and sends signals through GPS satellites. AVL comprises of Global Positioning System (GPS) and Geographic Information System (GIS) in order to provide the real geographic location of the vehicle. Automatic Vehicle Location (AVL) system consists of PC-based tracking software to dispatch, a radio system, GPS receiver on the vehicle and GPS satellites. There are two types of AVL, GPS-based and Signpost-based, GPS-based system is widely used. The tracking method uses GPS satellite to locate the vehicle that is equipped with GPS modem by sending satellite signals. The accuracy of the tracking method depends on the AVL system which provides the vehicle location with the accuracy of about 5m to 10m. The information transmitted by the tracking system to the base station is location, speed, direction, mileage, start and stop information and status of vehicle. The information of the vehicle is often transmitted to the central control system from the vehicle after every 60 seconds. If the base station receives the data, it displays it on a computerized map. GPS receiver which is equipped on the vehicle receives the signals of its geographic location. Then the receiver sends that data and also speed, direction, etc. to the base station via a radio system.

If AVL system is used to track a vehicle the average cost of per vehicle is \$1 to \$2 per day.

4.2 Assisted GPS (AGPS) system:

In Assisted GPS system, a terrestrial RF network is used to improve the performance of GPS receivers as it provides information about the satellite constellation directly to the GPS receivers. Assisted GPS uses both mobiles and cellular networks to locate the accurate positioning

information. Assisted GPS is used to overcome some limitations of GPS. The tracking method of Assisted GPS uses GPS satellites to track the vehicles. A GPS receiver in vehicle is always in contact with 4 satellites where 3 satellites determine latitude, longitude and elevation and the fourth provides element of time hence, it never fails to detect the location of the vehicle. Location of the vehicle is provided with the accuracy of between 3m and 8m and speed of 1km using this method. Information like Vehicle location, average speed, direction, path traversed in a selected period and alerts (Engaged/Unengaged, speed limit, vehicle breakdown and traffic jam) are delivered by the tracking system to the base station. This system provides continuous updates after every 10 seconds while the vehicle is in motion. It also provides data storage for up to 1 year. The location is retrieved from the GPS device and relayed as a SMS using the cell phone by the Client Node to the Base station. Assisted GPS system is more expensive than the AVL system as it gives continuous update of the vehicle location. If the user needs update after every 10 seconds then the subscription for this system is \$1.33 per day per vehicle and if the user needs update after every 5 seconds it is \$1.67 per day per vehicle.

4.3 Radio Frequency Identification (RFID) System-

Radio Frequency Identification (RFID) is an automatic identification method using devices called tags to store and remotely retrieve data. RFID system uses radio waves to capture data from tags. The tracking method of RFID system is comprised of three components: tag (passive, semi passive and active), reader (antenna or integrator) and software (middleware). RFID tag which contains microelectronic circuits which sends the vehicle information to a remote RFID reader which is then read via the software. This system provides the location of the vehicle with the accuracy of 4m to 6m. Information such as location of the vehicle, mileage and speed are delivered by the tracking system to the center. The information is updated in every one minute. The information is sent to and received from RFID tags by a RFID reader using radio waves. RFID reader is basically a radio frequency (RF) transmitter and receiver which is controlled by a microprocessor or digital signal processor (DSP). RFID reader attached with an antenna reads data from RFID tags.

4. Benefits of Vehicle Tracking System:

The vehicle tracking device or unit working along with a central server and a software, which let the user or owner of a car to know the where about of his own vehicle, surely comes with several benefits. The GPS and GSM installed inside the vehicle fetches its location information and send it to owner on regular intervals according to user's preferences, in order to remain up-to- date all the time. As all the relevant information is displayed on the screen, it is convenient for the user to monitor and take any actions in case of an emergency.

The vehicle tracking system play a vital role if it is used in any companies or organization for any kind of delivery purposes. Since the driver is aware of the fact that the car is constantly being monitored so one would be careful while driving and take shortest possible route to reach destination on right time. This system can also be named as an anti-theft tracking system as this is advanced yet affordable system that ensures the recovery of stolen vehicles. If the car is being used by unauthorized user, the location can be traced and then notified to police to reach the unauthorized location where the vehicle is residing and thus this vehicle tracking system is car safety as well.

5.Limitations:

This advanced technology-based tracking system provide benefits to users, company or any organization. There are also some limitations to use this vehicle tracking devices. Often Global Positioning System takes time to connect with the network due to poor weather conditions. For the Global Positioning System to work properly, it needs to have a clear view of the sky. That is it is unlikely to work indoor or may even have problem outside where it has no clear path of transmitting to and receiving signal from satellites. Therefore, due to obstacles like tall buildings or such infrastructure which block view of the sky, often causes error to the receiving signal of the GPS receiver. As a result, location seems is appear to jump from one place to another leading to inaccurate results. Thus, incorrect values of latitude and longitude are sent to the server for displaying in the Google map on error being initialized.

6. Conclusion:

A vehicle tracking system is flexible, customizable and accurate. The Global System for Mobile modem was configured and tested to implemented the tracking system and to monitor the vehicles location via SMS and online on Google map. To display the position on Google map we have used Google map Application Programming Interface(API). The Arduino is the brain of the system and the GSM modem is controlled by AT commands that enable data transmission over GSM network while the GPS provide the location data. Whenever the GPS receives a new data it is updated in the database and hence, we are able to see the location on the Google map. The system provides accurate data in real time that makes it possible for the user to track the vehicle and it also enable an early retrieval if the car is stolen. Hence, the system is designed in such a way that upgrading this system is very easy which makes it open for future requirement without the need of rebuilding everything from scratch, which makes our system even more efficient.

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