

A Review on Applications of GPS Technology

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Abstract: Tracking living beings and devices using the Global Positioning System (GPS) has become prevalent and indispensable over the last few years. Applications range from national and military security to personal safety and comfort. This paper presents some of the recent application areas such as a general tracking system to locate lost and misplaced devices (and those that carry such devices), introduces an active alarming system for predicting a collision between two or more vehicles using GPS and IEEE 802.15.4 MAC/PHY specification compatible system on chip (show the correct position of the vehicle to the user on the basis of the location information sent by the GPS Device). A land vehicle tracking system which determines the position of land rover with a terminal with embedded GPS receiver or PCS phone and displays the position on a digital map, a GPS based system which monitors the movement of the earth's surface by measuring precise position (within 5mm or less) of stations near active faults relative to each other. To help a driver move ahead safely, detecting other vehicles in vicinity proves to be of great help. With the help of GPS we are able to identify a possible collision the vehicle must acquire its positional knowledge with respect to others

Keywords: GPS, Tracking system

1 Introduction

The Global Positioning System (GPS) is a satellite based navigation system that can be used for locating, positioning, navigating, surveying and determining the time and are employed both by private individuals (e.g. for leisure activities, such as trekking, balloon flights and cross-country) and companies (surveying, determining the time, navigation, vehicle monitoring etc.). Designed and operated by the U.S. Department of Defense, it consists of satellites, control and monitor stations, and receivers. GPS receivers take information transmitted from the satellites and use triangulation to calculate a user's exact location. GPS can be used in a variety of ways, such as: determination of position locations; for example, you need to radio a helicopter pilot the coordinates of your position location so the pilot can pick you up, Navigation from one location to another; for example, you need to travel from a lookout to the fire perimeter, creation of digitized maps; for example, you are assigned to plot the fire perimeter and hot spots, Determination of distance between two points or how far you are from another location. GPS can be used both by civilians and military personnel. The civil signal SPS (Standard Positioning Service) can be used freely by the general public, whilst the military signal PPS (Precise Positioning Service) can only be used by authorised government agencies. First satellite was placed in orbit on 22nd February 1978, and there are currently 28 operation satellites orbiting the Earth at a height of 20,180 km on 6 different orbital planes. Main attraction of GPS is relatively high positioning accuracies, from tens of meters down to the millimeter level, capability of determining velocity and time, to an accuracy comparable with position, signals are available to users anywhere on the globe: in the air,

on the ground, or at sea. So no user charges are there in GPS system, that simply requires the use of relatively low cost hardware, an all-weather system, available 24 hours a day.

2 Applications of GPS

2.1 GPS based Seismic Monitoring System for Earthquake

Using GPS, a system is developed to monitor the movement of the earth's surface by measuring precise position (within 5mm or less) of stations near active faults relative to each other. GPS will be used to measure the movement of the earth, i.e., how far earth has actually moved & also in what direction.

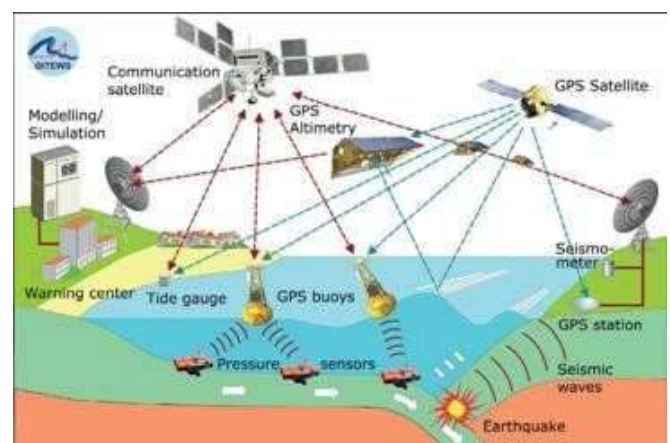


Figure 1: Schematic diagram representing the complete system of monitoring earthquake using GPS technology [1]

By continuously measuring distances between specific points, geologists can determine the movement along faults or between plates. Velocity maps can be used to describe how GPS

sites on the Earth's plates are moving. First velocities are calculated for each GPS site in centimeters per year. After that the velocity vectors are placed, on a map of the Earth. This allows to get a better picture of how the plates are changing.

How is GPS used to measure earthquakes?

In real-time monitoring, signals from seismic sensors in the field (either analog or digital) are sent to a central receiving station for processing. The system consists of:

(1) Sensors deployed in field, (2) a telemetry, (3) receiving station where real-time data acquisition and processing are performed, and (4) if an potential damaging earthquake is detected, then the results are communicated to users. For an earthquake warning system, the response time must be such that action can be taken before strong earthquake arrives. The system will use GPS to calculate the characteristics of large earthquakes to aid early warning and disaster relief efforts. These systems allow earthquake parameters to be broadcasted to users in a few minutes after the earthquake occurred.

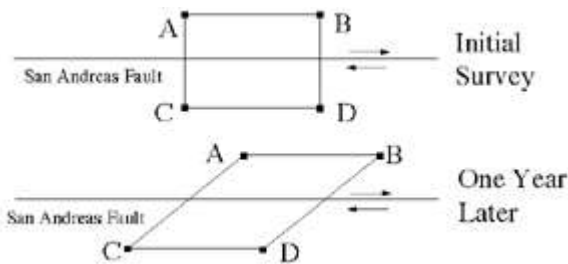


Figure 2: Monitoring movement of plates

The network uses real-time GPS measurements, when earthquake is detected, GPS data is used to automatically calculate its vital characteristics like location, magnitude and details about the fault. We want to know how stations near active faults move relative to each other. Several stations observe the same satellites and precise calculation of relative positions of stations can be done. The distance between the stations is determined. Months or years later we occupy the same stations again. By calculating how the stations have moved we calculate how much strain is accumulating and which faults are slipping.

2.2 Land-Vehicle Navigation Using GPS

The Global Positioning System (GPS) has made navigation systems practically possible for a number of land-vehicle navigation applications. Today, GPS-based navigation systems can be found in motor vehicles, farming and other land-based vehicles.

Positioning for land vehicles

Simply put, the most basic function of a land-vehicle navigation system is to accurately identify the location of a vehicle. In many existing land-vehicle navigation systems, this

is achieved typically by an on-board computer that continuously collects data from sensors that are mounted inside the vehicle. The computer uses the sensor data to compute the vehicle's location and conveys this location to the vehicle's driver by means of an electronic user interface.

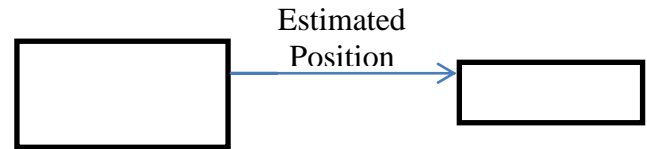


Figure 3. Functional schematic of a land-vehicle navigation system [2]

Examples of positioning sensors that might be utilized in a land-vehicle navigation system include a GPS receiver, a gyroscope, an electronic compass, and a tap into the vehicle's odometer. Fig. shows a simple functional schematic diagram representing the operation of a land vehicle navigation system.

In order to compute its location in three-dimensional space, a GPS receiver must be able to lock onto signals from at least four different satellites. Moreover, the receiver must maintain its lock on each satellite's signal for a period of time that is long enough to receive the information encoded in the transmission.

2.3 GPS Tracking of Mobile Devices

Tracking living beings and devices using the Global Positioning System (GPS) has become prevalent and indispensable in the last few years. Applications of GPS range from military and national security to personal safety and comfort.

The presence of GPS in vehicles not only allows the vehicles to know where they are, but also helps the owners of the vehicles to locate the vehicles. This particularly helps when a vehicle is stolen. Being able to locate a vehicle using GPS can be extended to other scenarios as well. Any GPS equipped item can be located when stolen or misplaced

Frame work for tracking the lost

As GPS-equipped items with communication support can be located when stolen or misplaced, provided there is appropriate software

The requirements for such a framework are as follows.

- 1) The location reported by the item should be demand driven.
- 2) Privacy of the owner of the item needs to be respected. In other words, demand for location information should only reveal the location to those who are authorized.
- 3) It is desirable that the framework is technology independent as far as practically possible.

To be able to report its location, the device should have communication capabilities. We therefore assume a mobile device that is able to send and receive SMS text messages. SMS text messages are widely supported, and therefore it somewhat fits the third requirement. The location should be learnt when and only when the text message is received. To ensure that the location is sent only to those who are authorized, the received text message is checked for the existence of a pre-registered pass key (i.e. password). The location is reported back only if the key is present in the text message.

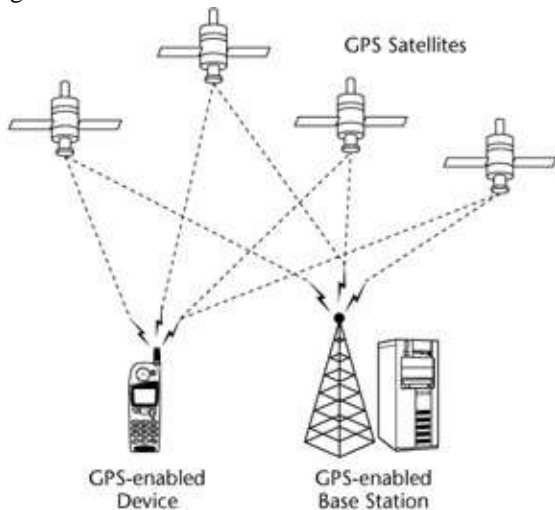


Figure4: Tracking architecture using GPS[3]

A tracking architecture based on the mobile device having a GPS receiver is illustrated in Figure. An authorized user (typically the owner of the device) sends to the mobile device the text message “FIND pass key” where pass key is a preregistered secret known only to the authorized user. On reception of the text message, the device will reply with a text message containing its current GPS location. However, not all devices may be equipped with a GPS receiver. Those that do not have access to a GPS receiver may calculate their location based on location of (at least) three base stations. This technique is known as multilateration

To be tracked, a mobile device is installed with a service that is set to activate upon receiving a text message.

2.4 Real Time Tracking of Complete Transport System Using GPS

Now a day’s lot of people face problem while travelling through travel agency vehicles because the travel agency owner as well as the user don’t have the exact information of the position of vehicle. That’s where our Application comes into picture. The application will ask the user (Passenger) to enter the bus number in which he/she wishes to travel. Then the user will enter the source and the destination of their journey. After entering all the required information, the user will click on the locate button. Upon clicking the locate

button, the user will get all information about the location of the vehicle, the fare user has to pay for his/her journey. Our real-time tracking management system is composed of four components, aGPS Tracking Device, a server and database, GCM & Client application. System Building Blocks: Global Positioning System (GPS) is a system composed of a network of 24 Satellites of the United States, The satellites emit radio signal periodically to GPS receivers. Any GPS receiver has to receive signal from at least three satellites in order to calculate distance and uses a triangulation technique to compute its two-dimension (latitude and longitude) position. Once a location is computed, it can calculate an average speed and direction of traveling. Thus GPS is a key technology for giving device its position. Google Cloud Messaging for Android (GCM) is a service that allows to send Data from your server to your users' Android powered device, and also to receive Messages from devices on the same connection. The GCM service handles all Aspects of messaging and delivering it to a meant Android application running on the target device. GCM is completely free for any size of messages. Google Map is very popular free software that provides maps using satellite Images around the world. Google Map shows the maps on-line using with a web server and a web browser

Algorithm:

GPS Device receives the GPS co-ordinates and sends it to the server after every fixed time. The server has to store the information received from GPS. When a user requests for any particular vehicle, The server gives the latest position to the client.

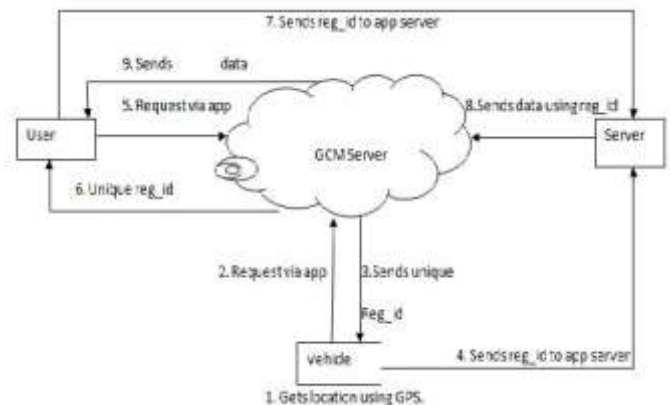


Figure 5: System Architecture[5]

2.5 GPS based Vehicular Collision Warning System

To help a driver move ahead safely, detecting other vehicles in vicinity proves to be of great help. To be able to identify a possible collision the vehicle must acquire its positional knowledge with respect to others

A common assumption of such systems is the homogeneity of vehicles, where the dimension of each vehicle does not feature in the determination of collision boundaries. Further, the future

position of a vehicle is estimated by the vehicle receiving the broadcasted information. Thus vehicles of varying profiles are integrated. Secondly, the safety zone is made a function of the speed, acceleration and the braking power of the vehicle.

Calculation of vehicle’s safety zone coordinates:

Figure 1 shows the calculation of the four safety coordinates of a vehicle. The front (F) and back (L) and width (W) would change with size. These generic mechanisms are particularly applicable in city traffic where cars would require a smaller safety clearance than a truck.

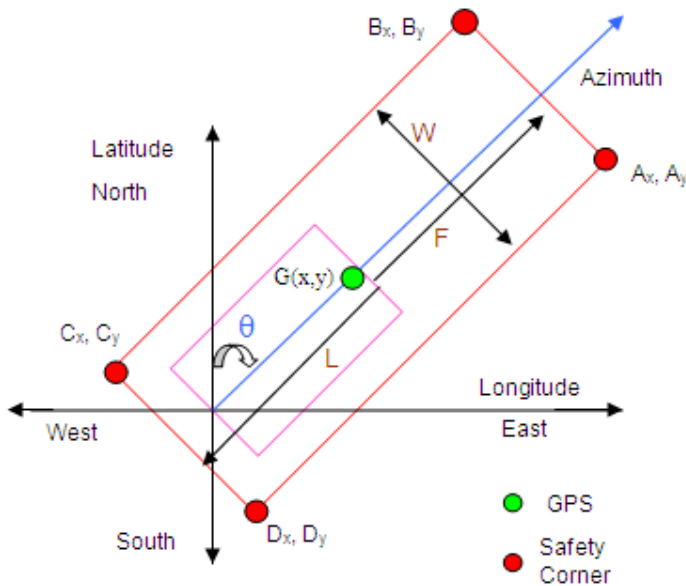


Figure 6: Schematic diagram for calculating the four safety-coordinate of a vehicle.[6]

Calculation of front safety distance: F

The calculation of the safety distance *F*, is made taking into account the current speed, acceleration and the braking power of the vehicle. Also included in the calculation is the human reaction time (which we have ignored in our implementation), which is defined as the amount of time taken on average to apply the brakes once an indication is provided. We make an assumption in the calculation that the brakes are applied at its maximum potential.

3. CONCLUSION

GPS-enabled monitoring and tracking of devices has become prevalent and

In the last few years. Applications of GPS in various fields help in safety and comfort. This paper reviewed some of current application areas and Benefits. Thus it shows how GPS applications prove to be beneficial.

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