A seminar report on Accident Detection and Reporting System using GPS, GPRS and GSM Technology

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A SEMINAR REPORT ON

ACCIDENT DETECTION AND REPORTING SYSTEM USING GPS, GPRS AND GSM TECHNOLOGY

Submitted in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

In

CIVIL ENGINEERING

Submitted by

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Seventh Semester

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September 2013

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CERTIFICATE

This is to certify that the seminar report titled " *Accident Detection and Reporting System using GPS, GSM and GPRS Technology"* submitted by *Amala James* to Department of Civil Engineering, Amal Jyothi College of Engineering, Kanjirappally, as partial fulfillment for the award of degree B.Tech in Civil Engineering is a bonafide work undertaken under my supervision.

HOD **Guide**

Prof. Sr. Claramma Rosary **Name: Deepak John Peter**

Date:

ABSTRACT

Speed is one of the basic reasons for vehicle accident. Many lives could have been saved if emergency service could get accident information and reach in time. Nowadays, GPS has become an integral part of a vehicle system. This seminar analyses the capability of a GPS receiver to monitor speed of a vehicle and detect accident basing on monitored speed and send accident location to an Alert Service Center. The GPS will monitor speed of a vehicle and compare with the previous speed in every second through a Microcontroller Unit. Whenever the speed will be below the specified speed, it will assume that an accident has occurred. The system will then send the accident location acquired from the GPS along with the time and the speed by utilizing the GSM network. This will help to reach the rescue service in time and save the valuable human life.

ACKNOWLEDGEMENT

I take this opportunity to express my deep sense of gratitude and sincere thanks to all who helped me to complete the work successfully .My first and foremost thanks goes to God Almighty who showered his immense blessings on my effort.

I would like to express my sincere gratitude to **Sr. Claramma Rosary** (Head of the department), for her support and co-operation. I am deeply indebted to my guide, **Mr. Deepak John Peter** (Assistant Professor, Department of Civil Engineering) for his excellent guidance, constant encouragement, suggestions and constructive feedback in the completion of the seminar. I also thank **Ms. Mini Mathew** (Associate Professor, Department of Civil Engineering) for extending her valuable support for the seminar.

I wish to express my sincere gratitude towards the staff members of our Department and Department Library.

Finally I thank my parents, all my friends, near and dear ones who directly and indirectly contributed to the successful completion of this work.

AMALA JAMES

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1. INTRODUCTION

The development of a transportation system has been the generative power for human beings to have the highest civilization above creatures in the earth. Automobile has a great importance in our daily life. We utilize it to go to our work place, keep in touch with our friends and family, and deliver our goods. But it can also bring disaster to us and even can kill us through accidents. Speed is one of the most important and basic risk factors in driving. It not only affects the severity of a crash, but also increases risk of being involved in a crash. Despite many efforts taken by different governmental and non-governmental organizations all around the world by various programs to aware against careless driving, yet accidents are taking place every now and then. However, many lives could have been saved if the emergency service could get the crash information in time. As such, efficient automatic accident detection with an automatic notification to the emergency service with the accident location is a prime need to save the precious human life.

This seminar proposes to utilize the capability of a GPS receiver to monitor the speed of a vehicle and detect an accident basing on the monitored speed and send the location and time of the accident from the GPS data processed by a microcontroller by using the GSM network to the Alert Service Centre.

2. ACCIDENTS

Automobiles are important to go to workplaces, meet family and friends and to deliver goods. But often they pave the way to big disasters. According to Wikipedia, accidents are is an unforeseen and unplanned event or circumstance, often with lack of intention or necessity.

Road accident is most unwanted thing to happen to a road user, though they happen quite often. The most unfortunate thing is that we don't learn from our mistakes on road. Most of the road users are quite well aware of the general rules and safety measures while using roads but it is only the laxity on part of road users, which cause accidents and crashes. Main cause of accidents and crashes are due to human errors. Following are the major reasons of accidents:

1. Over Speeding
2. Drunken Driving
3. Distractions to Driver
4. Red Light Jumping
5. Avoiding Safety Gears like Seat belts and Helmets
6. Non-adherence to lane driving and overtaking in a wrong manner.

3. GPS, GSM and GPRS.

3.1 GPS

Global Positioning System was developed by the United States' Department of Defence. It uses between 24 and 32 Medium Earth Orbit satellites that transmit precise microwave signals. This enables GPS receivers to determine their current location, time and velocity. The GPS satellites are maintained by the United States Air Force.

GPS is often used by civilians as a navigation system. On the ground, any GPS receiver contains a computer that "triangulates" its own position by getting bearings

from at least three satellites. The result is provided in the form of a geographic position - longitude and latitude - to, for most receivers, within an accuracy of 10 to 100 meters. Software applications can then use those coordinates to provide driving or walking instructions.

Getting a lock on by the GPS receivers on the ground usually takes some time especially where the receiver is in a moving vehicle or in dense urban areas. The initial time needed for a GPS lock is usually dependent on how the GPS receiver starts.

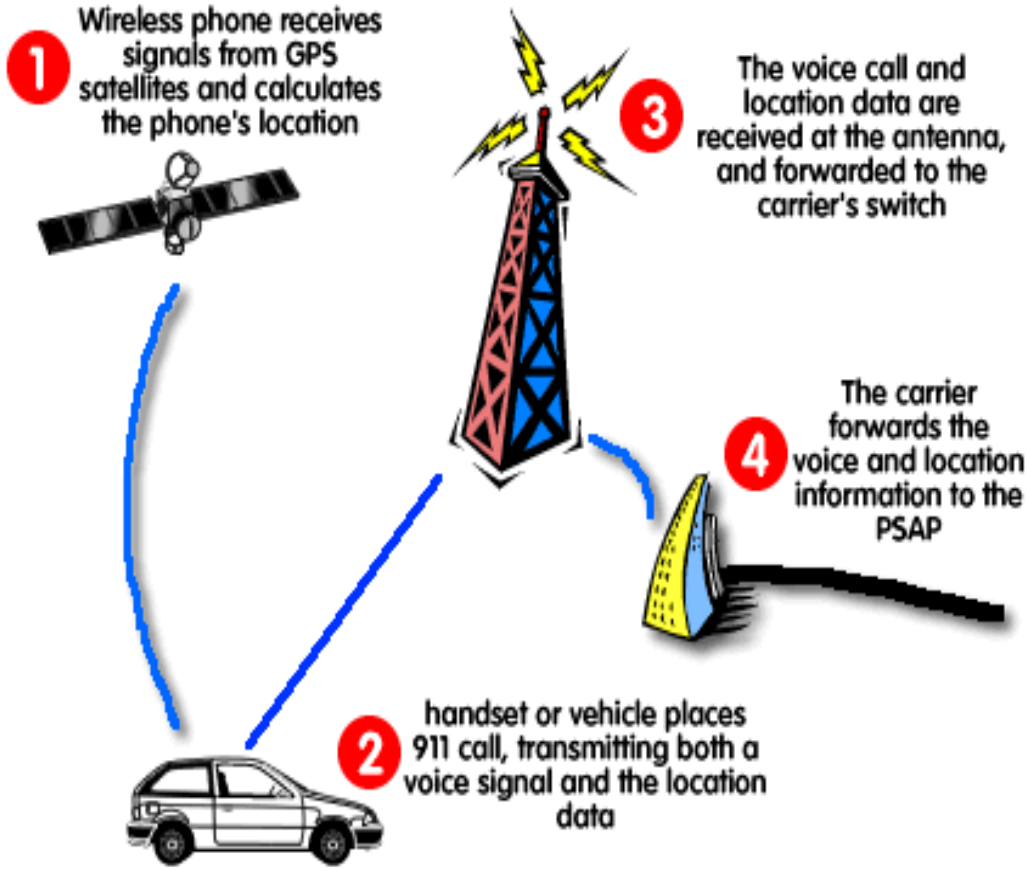

Fig.3.1. GPS system

3.2 GSM

GSM (Global System for Mobile Communications, is a standard set developed by the European Telecommunications Standards Institute (ETSI) to describe protocols for second generation (2G) digital cellular networks used by mobile phones. General packet radio service (GPRS) is a packet oriented mobile data service on the 2G and 3G cellular communication system's global system for mobile communications (GSM) where protocols means set of invisible computer rules that govern how an internet document gets transmitted to your screen and 2G is short for second-generation wireless telephone technology and provides advantages like to provide the services such as text messages, picture messages and MMS (multimedia messages).

In simple language, GSM is primarily used to carry your voice on cell phone networks that uses that type of technology.

GSM also introduced a series of features such as short messaging service (SMS), international roaming, fax and data messaging services. Another popular feature was the ability to let users download ringtones, logos, photos, that enabled the users to personalize their phones.

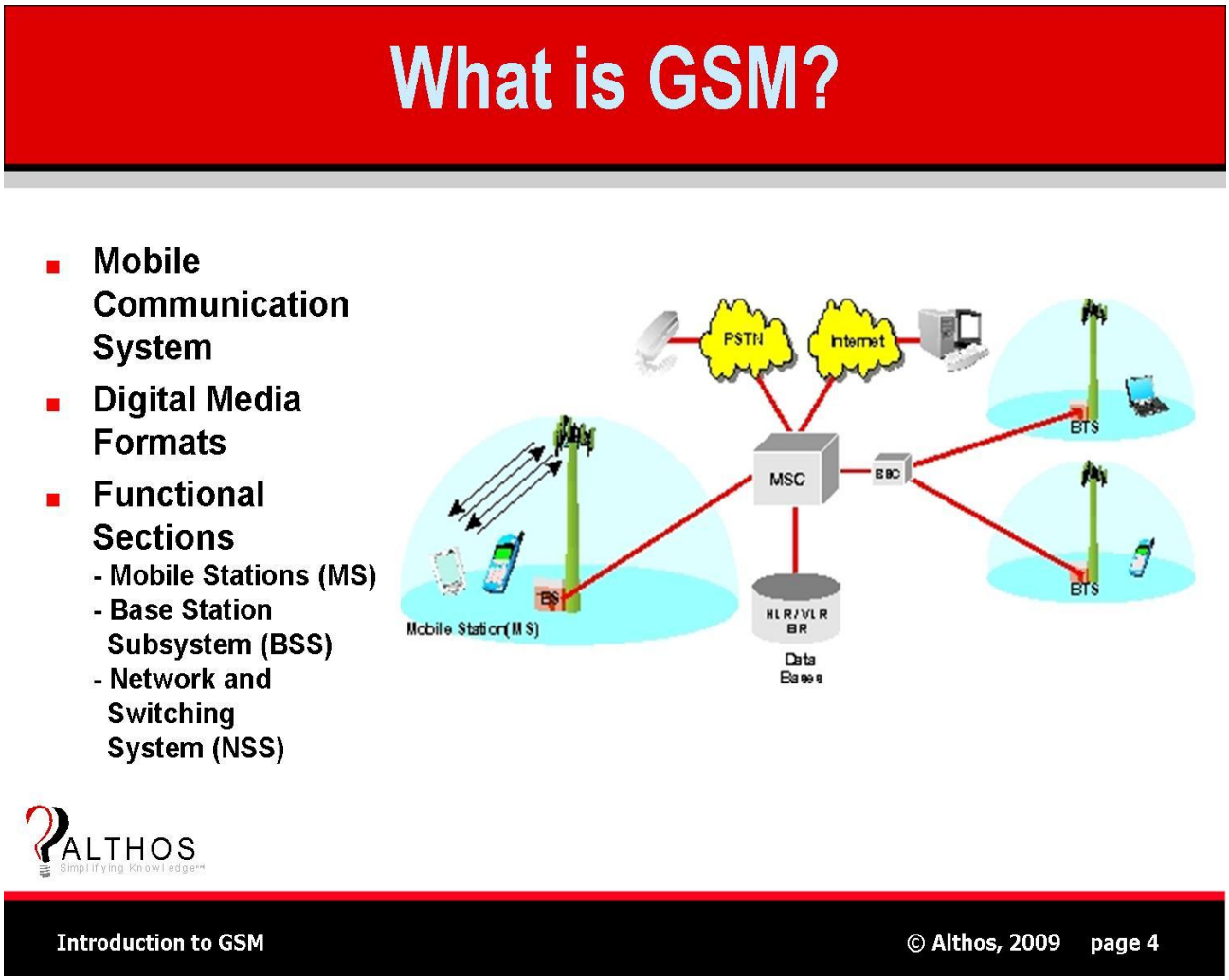

Fig. 3.2: GSM

3.3 GPRS

GPRS was originally standardized by European Telecommunications Standards Institute (ETSI) in response to the earlier CDPD and i-mode packet-switched cellular technologies. It is now maintained by the3rd Generation Partnership Project (3GPP).

Fig 3.3: GPRS

Or we can say, GSM is mobile service provider and GPRS is the services which they provide for using internet or GSM means mobile calling, GPRS means mobile internet.

4. ACCIDENT PREDICTION SYSTEM

There are 2 types of accident prediction system:

- Traditional accident prediction system
- Real time accident prediction system

4.1. Traditional Accident Prediction System

-It uses long-term traffic data such as annual average daily traffic and hourly volume.

4.2 Real Time Accident Prediction System

-It relates accident occurrences to real-time traffic data obtained from various detectors such as induction loops, infrared detector, camera etc.

5. ACCIDENT DETECTION SYSTEM

It detects the accident rather than predicting it. They are of three types.

- Manual detection system
- Driver initiated detection system
- Automatic detection system

a. Manual Detection System

In this method, accident is detected from

-motorist report

-transportation department

-public crews report

-aerial surveillance

-close circuit camera surveillance.

The drawback of this type of detection system is that someone has to witness the incident. Driver initiated detection system. Moreover, there are delays and inaccuracies due to the expression problem of the witness.

b. Driver Initiated Detection System

Driver initiated incident detection system has more advantages which includes the quick reaction, more incident information etc. However, with the severity of the accident, driver may not be able to report at all.

c. Automatic Detection System

There are different types of automatic detection system.

- Conventional built-in automatic accident detection system utilizes impact senor or the car airbag senor to detect an accident and gps to locate the accident place. However, the system did not utilize the gps to detect the accident.

Fig 5.1: Air bags

- A smart phone based accident detection system is proposed. However, smart phones are very expensive and due to false alarm filter, it may not detect all accidents.
- An acoustic accident detection method is proposed. There are possibilities of false alarm in the system and also does not guarantee the occurrence of an accident.

- Accident detection by utilizing an impact sensor and reporting system by wireless module is proposed. However, a wireless reporting infrastructure is very expensive and difficult to implement as installation of repeated receivers on the road at a very short interval are required.

The proposed method aims to overcome the above mentioned limitations and utilizes only the gps data to detect the accident and gsm network to send the location and activate a voice channel with the alert service centre.

6. DIFFERENCE BETWEEN ACCIDENT PREDICTION AND DETECTION SYSTEM

Prediction is the change of traffic conditions before an accident occurrence while traffic incident detection takes into account the change of traffic conditions after an incident occurrence.

7. METHOD

a. GPS Receiver

The sensor for the accident detection is the GPS receiver. Nowadays, GPS technology has become more accurate, smaller, reliable, and economical. A very sensitive and accurate GPS signal acquiring device is required for the system.

Fig 7.1: Different GPS Receivers

7.2 GSM/GPRS Modem

GSM also introduced a series of features such as short messaging service (SMS), international roaming, fax and data messaging services. Another popular feature was the ability to let users download ringtones, logos, photos, that enabled the users to personalize their phones.

The GSM/GPRS modem utilizes the GSM network to send the location of the accident. The modem can be controlled by a microcontroller.

7.3 Microcontroller Unit

The microcontroller unit (MCU) is the heart of the system. It receives data from the GPS, processes all data and detects the accident from the processed data. The location of the accident is also sent by the microcontroller.

7.4 Accident Detection Algorithm

Speed is one of the most important and basic risk factors in driving. It not only affects the severity of a crash, but also increases risk of being involved in a crash. People need some processing time to decide whether or not to react and then to execute an action. At high speeds the distance between starting to brake and a complete stand still is longer. The braking distance is proportional to the square of speed [8]. Therefore, the possibility to avoid a collision becomes smaller as speed increases.

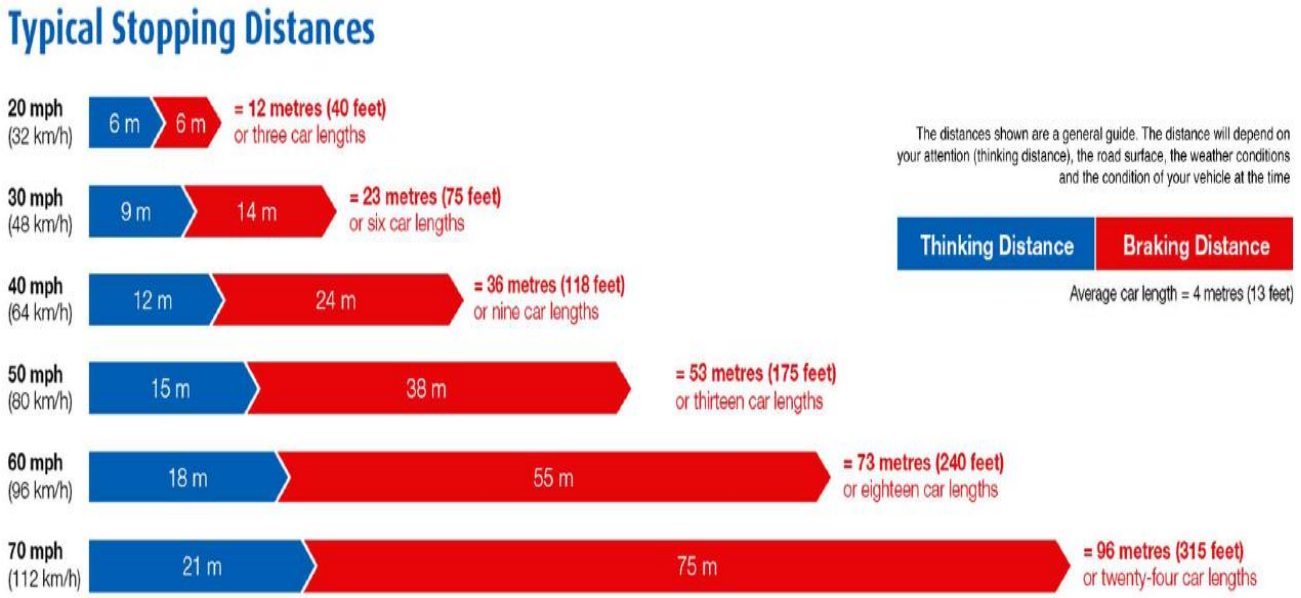

Fig 7.2. Typical Stopping Distances

A moving body contains kinetic energy according to (1). When an accident occurs, kinetic energy is transformed into destructive forces [9] cause injury to occupants as well as to the vehicle.

$$\textbf{Kinetic Energy} = (1/2)\, mv^2 \qquad (1)$$

where m = mass of object and v = speed of the vehicle.

When brake is applied, two forces work on the vehicle to decelerate the speed. One is the gravitational force (g) and the other one is the friction force (f). Considering

the friction coefficient 0.8 for a plain road surface and standard gravitational force (9.8 metres per square second), from the Equation 2, we can get the final speed of a vehicle *(u)* after one second once the brake is applied. This is the maximum speed after considering the deceleration factors. Table 1 shows the maximum speed starting from the initial speed of 160 kph after one second once the brake is applied. As such, if the speed is less than these maximum speed, than it would be assumed that some other deceleration force worked on the vehicle to reduce the speed and an accident has occurred.

$$\mathbf{t} = \frac{v-u}{a} \qquad (2)$$

where v = initial speed, u = final speed, a= acceleration or deceleration.

TABLE I. SPEED OF A VEHICLE AFTER ONE SECOND

Initial Speed	Max Speed afer 1 second
160 kph	131.77 kph
150 kph	121.77 kph
140 kph	111.77 kph
130 kph	101.77 kph
120 kph	91.77 kph
110 kph	81.77 kph
100 kph	71.77 kph
90 kph	61.77 kph
80 kph	51.77 kph
70 kph	41.77 kph
60 kph	31.77 kph
50 kph	21.77 kph

8. ACCIDENT DETECTION AND REPORTING PROCEDURE

8.1. Speed Measurement

Many techniques can be used to measure vehicle speed. The most common is the car speedometer. But analog to digital converter is required to acquire speed from the Speedometer. Laser speed guns are limited to single point and instantaneous measurements. But a GPS receiver provides speed information in every second. Therefore, it is more convenient to monitor the speed with a GPS receiver. GPS receiver communication is defined by National Marine Electronics Association (NMEA) specification [10]. The idea of NMEA is to send a line of data called a sentence that is totally self-contained and independent from other sentences. Out of these sentences, GPRMC is the most common sentence transmitted by the most GPS devices. This sentence contains nearly everything a GPS application needs. A GPRMC sentence contains the following:

$GPRMC, time (hhmmss), (A or V), latitude (ddmm.mmm), (N or S), longitude (dddmm.mmm), (E or W), ground speed in knots (kkk.k), direction (ddd.d), date (ddmmyy),,*CS where Hhmmss: is time in hours, minutes, seconds in Coordinated Universal Time (UTC).

A or V: "A" (for "active") indicates that a fix is currently obtained, whereas "V" (for "inValid") indicates that a fix is not obtained.

ddmm.mmm: latitude in degrees minutes and fraction of minutes.

N or S: "N" indicates the North and "S" indicates the South hemisphere.

dddmm.mmm: longitude latitude in degrees minutes and fraction of minutes.

E or W: "E" indicates the East and "W" indicates the West.

kkk.k: speed over ground in nautical miles per hour

ddd.dd: indicates the current direction of travel in degree.

ddmmyy: indicates days, months, year in UTC.

**CS* is check sum used to identify errors in the data.

8.2. Detection Procedure

The GPS receiver acquires the GPRMC sentence in every second. From the GPRMC sentence, the speed information will be extracted by counting the number of comma (,) by the MCU. Two memory spaces will be allocated for the speed, one memory space for the time and another for the latitude and longitude. The latest time and latitude/longitude will be always saved in the memory overwriting the previous values. The last two speed information will be always kept in memory. The latest speed information will be stored in the first memory space and will move to the second memory speed once new speed information is acquired. The MCU will compare the latest speed with the previous speed by utilizing the Equation (2). If the speed is less than the maximum speed found from Equation (2), the MCU will raise a flag to indicate that an accident took place.

8.3 Reporting Procedure by MCU

When a flag is raised for accident, the MCU will initiate an emergency situation automatically. The MCU will wait for 5 seconds for the driver to press a button to cancel the accident reporting procedure. This will enable to reduce the false alarm to the Alert Service Centre. Once the 5 seconds waiting time is over, the accident information containing the location, time and the speed along with the contact number of relative of the occupant will be sent as a GPRS data to the Alert Service Centre through the GPRS modem by the MCU. However, GPRS coverage is not always available in every place. As such, simultaneously an SMS will also be initiated containing the same information. After the SMS is sent, the MCU will also initiate a voice call to the Alert Service Centre. This will enable the vehicle occupant to describe the emergency situation if they are in a condition to describe. Besides automatic accident detection system, b pressing the Manual Detection Switch, the vehicle occupant will also be able to initiate an emergency situation and it will report like the automatic accident detection system.

8.4 Accident Data Interpretation

The information sent as a GPRS data and SMS will be received by a GSM/GPRS modem connected to a computer. A middleware will be written to interpret the SMS and GPRS data. An appropriate program will be written so that Google Maps can be incorporated and the accident location is automatically plotted in the map utilizing the information from the interpreted SMS/GPRS data. It will also show the previous speed of the vehicle before committing the accident. This data will help the Alert Service Center to assess the severity of the accident basing on the speed. The modem will also establish a voice channel with the Alert Service Center. The flow chart is shown in Fig. 3.

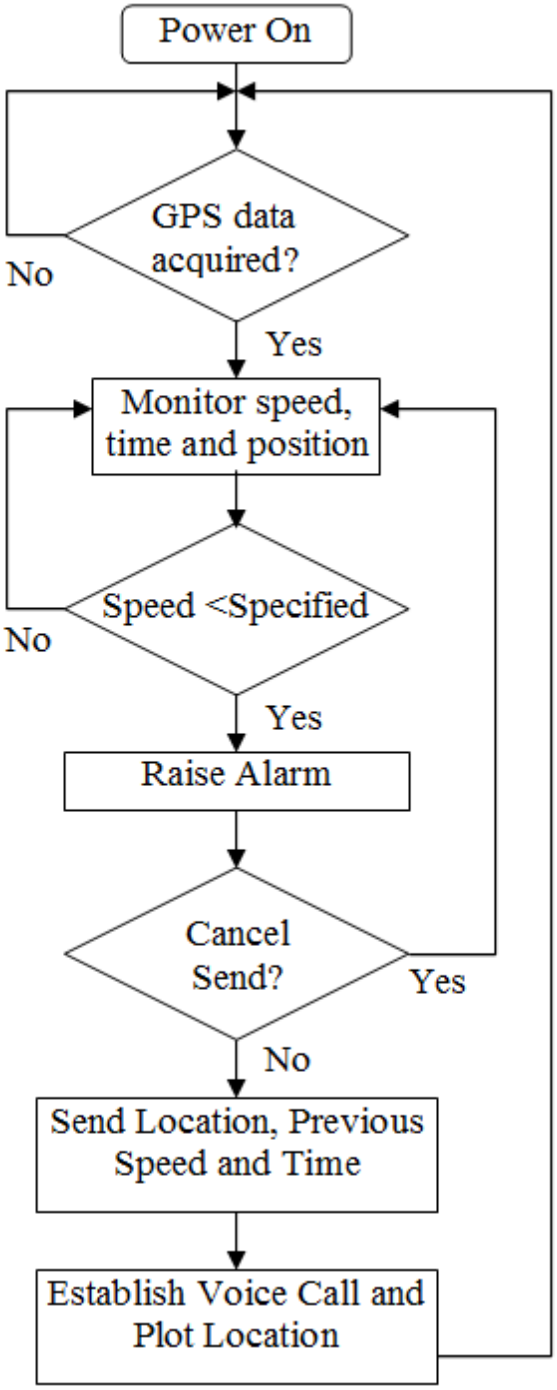

Fig. 8.1 Flowchart of the Accident Detection and Reporting System

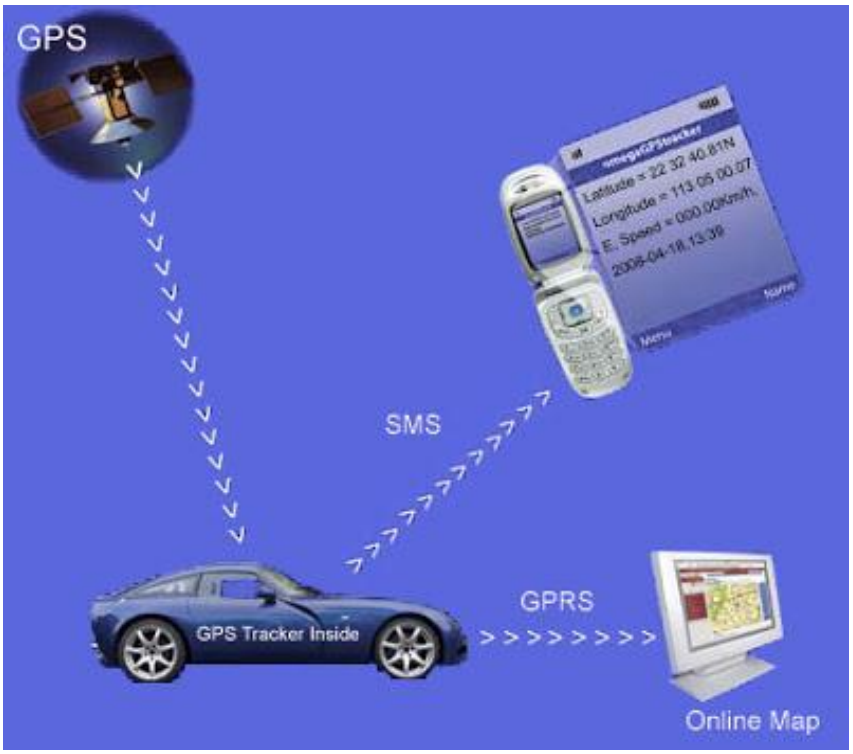

Fig. 8.2: Tracking system

Above figure shows the tracking system using GPS and GPRS data. The place where the accident was occurred, speed before accident, day, time etc. will be available through sms.

9. CONCLUSION

Speed is one of the most significant causes of an accident. Nowadays, GPS receiver has become an integral part of a vehicle. Besides using in other purposes, the GPS can also monitor the speed and detect an accident. It can use a very cheap and popular GSM modem to send the accident location to the Alert Service Centre. It can also send the last speed before accident which will helps to assess the severity of the accident and can initiate a voice call. Beside the automatic detection system, the vehicle occupant will be able to manually send the accident situation by pressing the Manual Detection Switch. A rescue measures in time with sufficient preparation at the correct place can save many life. Thus, the proposed system can serve the humanity by a great deal as human life is valuable.

10. QUESTIONS

- ✓ What is the full form of GPS, GSM and GPRS?

  GPS – Global Positioning System

  GSM – Global System for Mobile Communication

  GPRS – General Packet Radio Service

- ✓ What is the requirement of 3 or 4 satellites in a view while obtaining data?

  Data from a single satellite may not be reliable because it may be subjected to errors due to poor weather conditions. So for obtaining accurate data, a minimum of 3, usually 4 satellites in view is aligned to provide the accurate position.

- ✓ Who established satellites of GPS system?

  By the United States government.

- ✓ What is the need for Google map?

  Latitude and longitude of the accident spot will be send to a relative's phone. Therefore if these latitudes and longitudes are entered into Google maps, it will show the name of place where the accident has been occurred. This is helpful to know the accident accurately.

- ✓ Which is the receiver in this process?

  Mobile phone with GPS facility or any built in GPS positioning system in cars can act as receivers.

- ✓ What if there is no reduced speed? Then how the accident can be detected?

  This particular system has been designed to detect the sudden reduction in speed. So even if there is no reduction in speed, manual detection switch can be used to manually indicate the accident.

- ✓ How the message will be sent to relative?

  In this system, there is provision of storing a relative's number. The GPS receiver will automatically sent the information to relative.

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