ISSN: 2349- 5197
Impact Factor (PIF): 2.138

INTERNATIONAL JOURNAL OF RESEARCH SCIENCE & MANAGEMENT

# VEHICLE ACCIDENT AVOIDANCE AND DETECTION SYSTEM USING GPS, GSM AND ANDROID APPLICATION

Nachiket Wani[1*], Piyush Pangarkar[2], Tarun Kewaliya[3], Guga Priya G[4].
[1*2 3 4]School of Electronics and Communication Engineering, Vellore Instituite of technology Chennai, India.
Correspondence Author: nachiket.sandeep2011@vit.ac.in

**Keywords:** Global System for Mobile Communications (GSM), Global Positioning System (GPS),Ultrasonic Sensors, Infrared Sensors (IR), Light Dependent Resistor (LDR), Android Application.

## Abstract
Deaths due to road accidents have always been an issue for many countries. Most of the time people die in these accidents because they do not receive timely help. The existing accident detection systems used in automobiles do not have the feature of displaying the address of the place of accident in textual form. It only displays the latitude and longitude of the place of accident, which becomes cumbersome to understand and causes undue delay in locating the place. This paper, proposes an additional feature in addition to the prevailing features that displays the address of the place of accident and also the nearby hospitals. The proposed system comprises of four sub-systems namely: Accident Avoidance Sub-System, Accident Detection Sub-System, Location Extraction- Transmission Sub-System and Location to Address Translation Sub-System. The Location to Address Translation Sub-System converts the numeric coordinates into textual address automatically using an Android Application that runs on a smart phone which is the novel feature of the proposed project. Thus, it saves address decoding time and facilitates provision for speedy help.

## Introduction
The subtle time elapsed between occurrences of an accident and having medical assistance can be a differentiating factor between life and death. Thus, bringing a victim to a hospital in time can save a precious life. The number of deaths due to road accidents accounted for 1.24 million in the year 2010 as per a study conducted by the World Health Organization (WHO) [1]. Nearly, 0.2 million, which is nearly one sixth of the total number of road accidents happened in India alone. Many of them died of want for timely Emergency Medical Service (EMS). Thousands of lives can be saved if a help is provided to a victim quickly and this is the motive of the proposed project. Traditional accident information systems only send the latitude and the longitude via Short Messaging Service using Global Systems for Mobile (GSM) that makes knowing the place of accident difficult and wastes time.
However, this proposed system automates the process of information transfer of an accident and also the process of location to textual address translation, expediting the whole informing process. Hence, facilitates help without much delay. The system is tested and is found to be more user friendly and useful than the traditional accident detection systems. It is realized using Global Positioning System (GPS), GSM and an Android application on a smart phone.
The Accident Avoidance Sub-System primarily reduces the chances of an accident by alerting the driver. Despite the system if an accident occurs, it will automatically extract the location through GPS and send a message via SMS to a fixed mobile number through GSM modem. The receiver could be a friend, a family member, a hospital or a special helping agency. The proposed Android Application would open itself automatically as soon as it detects a message with location coordinates and would indicate the address, navigation path(s) and nearby hospital(s) on the Google Maps. Thus, the pictorial representation and automation, speeds up the entire process saving a lot of time**.**

## Related work
Many researchers have been involved in developing accident detection systems. The Map Matching Based Vehicle Accident Detection System was developed using GPS and GSM modems. This system used speed as a parameter to judge a possibility of an accident. This system used GPS based speed sensing which was developed by Md. Syedul Amin and his colleagues [2]. However, only high or low speeds cannot be attributed to cause of accidents as it is an unstable parameter. Additionally, this system gives only the coordinates of the place of accident and not the textual address. Thus, it may cause undue delay in decoding the address. Apart from it, the scope is limited to accident detection unlike the proposed project.
A vehicle to vehicle communication system for prevention of accident was designed by Liang Li et.al. [3].This project involved wirelesses inter- communication between vehicles running on roads. However, with fast moving vehicles on highways and bad weather conditions the sensors may give false results to the driver and cause bad driving experience. In addition, this project does not deal with forward collision which happens to be a major cause of road accidents. Further, accident detection module is not implemented and is thus narrow in scope.

INTERNATIONAL JOURNAL OF RESEARCH SCIENCE & MANAGEMENT

Bankar Sanket Anit et.al had developed an Intelligent Vehicle Accident Detection and Notification System that made use of accelerometer for accident detection and a camera to acquire real time video of the accident [4]. However, accelerometers give precarious readings and cannot be solely relied upon it. Minor variations in the topology of roads may give false alarms. The accelerometer reading may also vary with the design of the vehicle and hence cannot be generalized. In addition the system only transmits the latitude and the longitude after an accident is confirmed making it difficult to decode the actual address to the message receiver.

A similar system was proposed by Nadeem Akhtar ET. Al, made use of the accelerometer and GPS modem present in smart phones [5]. The author of this paper assumes a particular orientation of the mobile phone while using the inbuilt mobile accelerometer and GPS modem for the calculations of acceleration produced in the X, Y and Z directed axes. However, if the position of the phone changes, the axes orientations will also change and eventually end up giving false results. The accelerometer module of this system does not warn of bumps on roads before the car actually bumps into it, consequently making the driver vulnerable to unpleasant driving experience. As mentioned earlier the threshold values of accelerometer is highly dependent on vehicle design, it cannot be generalized. The GPS, GSM modems used collectively in this system only transmits coordinates and not the actual address thus limiting its utility.

Fahim Bin Basheer had proposed an accident detection system for motor cycles using accelerometer, pressure sensor and GPS-GSM modems [6]. The system measures the tilt angle by an accelerometer to decide if an accident is about to occur or not. The system sets 60 degrees to be the threshold tilt value. However, actual dangerous angle of tilt can be much lower for a few motorcycles while it can be much higher for a few other motor cycles. This threshold would change with the design of the motor cycle that includes: weight of the motor cycle, tyre width, clearance level and weight of the rider. Hence, a generalized threshold value is highly impractical. In addition, the system uses a pressure sensor that measures the force exerted by air on the chassis of the motor cycle to predict if it is dangerous to the rider. However, the parameter like air pressure is highly impractical as for very low speeds of the vehicle, high air pressure is possible due to high absolute wind speed. Thus, it can give false alarm. Additionally, like other systems this system also lacks ease of decoding the actual address. This paper includes the location coordinates to address translation in future scope which is a part of the proposed system in this project.

N. Wattanawisth ET. AL, have proposed a Vehicle Accident Detection System using MEMS accelerometer and GPS modem [7]. It detects linear as well as non-linear accidents through accelerometer. However, the system is not reliable as the critical values for the accelerometer is highly dependent on vehicle parameters and would vary from vehicle to vehicle. Additionally, the system ignores weight of the rider which is a crucial factor while deciding the critical values for an accelerometer. Accelerometer can give false triggers at lower safe speeds if the road is extremely uneven. Thus, it limits the utility. The system gives the navigation path between the SMS receiver and the place of accident but does not give the location of nearby hospitals unlike the proposed system.

A basic Accident Detection and Messaging System was developed by C. Prabha et.al. [8]. However, the system only transmits latitude and longitude through SMS while address is not decoded at the receiver's end making it inconvenient for usage. A similar approach was adopted by Md. Syedul Amin and M.B.I Reaz that made use of GPRS Technology. However, this system also does not solve the problem of location to address translation [9]. A vibration sensor collision detection method was proposed by S.Sonika et.al. [10]. However, accurate threshold value of a vibration sensor is difficult to set. If roads have extreme terrains then vibration sensor may react to it and raise an unnecessary collision alarm. Additionally this system also does not decode the coordinates into textual address which causes limitation over its' utility.

A five Ultrasonic Sensor based alarm system was proposed by Rashida Nazir et.al. [11]. In this project the vehicle collects information from adjacent vehicular traffic and alerts the driver if any of these vehicles is too close. It makes use of vibration sensor to detect collision. However, five sensors each with an alarm may result in poor driving experience. Additionally, vibration sensors are inaccurate in detecting impacts and the problem of decoding coordinates into textual address remains unsolved.

Hence in the proposed project, instead of using five Ultrasonic Sensors it makes use of just two Ultrasonic Sensors together with a Light Sensor and a couple of Infrared Sensors as a part of Accident Avoidance Sub- System. Finally the automated Android Application speeds up the process of location to address translation.

## Proposed design and methodology

The block level diagram of the proposed system is shown in figure 2. The two Ultrasonic Sensors are connected to the slave controller board (Arduino UNO) by digital pins; ECHO TRIG, GND and Vcc. The LDR is connected to analog pin of the slave board using voltage divider circuitry. The two IR Sensors are connected to the board through two different analog pins apart from Vcc and GND. The GPS and GSM modems are connected to the master controller (Arduino MEGA). Both these modems engage a pair of UART available on board. In case of events occurring simultaneously the Master controller would have priority over the slave controller. Finally, the message is received in a smart phone in which the Android Application detects the message with co-

ISSN: 2349- 5197
Impact Factor (PIF): 2.138

INTERNATIONAL JOURNAL OF RESEARCH SCIENCE & MANAGEMENT

ordinates and displays textual address of the place of accident along with pictorial representation. The flowchart of the algorithm is manifested in figure 1.

The frontal Ultrasonic Sensor constantly checks for an obstacle ahead of the vehicle whereas the rear Sensor senses if some vehicle is trying to overtake from the wrong side. If an obstacle or a vehicle trying to overtake from wrong side is found to be in dangerously close proximity, lesser than 15cms, buzzer goes ON. The Light Sensor constantly monitors for the ambient light intensity and whenever, the acquired value falls below 500 Lux, it triggers ON the headlight LEDs. When the button (confirming collision) is pressed GPS and GSM modems are activated, consequently extracting the coordinates and sending a message via SMS to a fixed mobile number. Meanwhile the Android Application installed in the smart phone polls for an incoming message containing the latitude and the longitude and opens up automatically once it recognizes the message containing the location coordinates of the place of accident and displays address of the place of accident, navigation path(s) and nearby hospitals. The whole process is put in to an infinitely running loop as evident from the flowchart.

The interfacing of each of the components is delineated below:

**Ultrasonic sensor interfacing with arduino UNO board and its algorithmic approach**

The Ultrasonic Sensor has four pins, ECHO, TRIGGER, Vcc and GND. The ECHO and the TRIG pins are connected to digital pins 2 and 3 respectively of the controller. A trigger pulse of minimum 10uS duration has to be given to the sensor). The pulse width value is read through the digital pin connected to the ECHO pin of the sensor. The pulse width value is converted into centimeters by using the formula:

Value in centimeters = ((pulse width/2) /29.13)……………….(1)

A threshold value is set at around 20cms, below which the controller switches ON the buzzer instructing the driver to slow down.

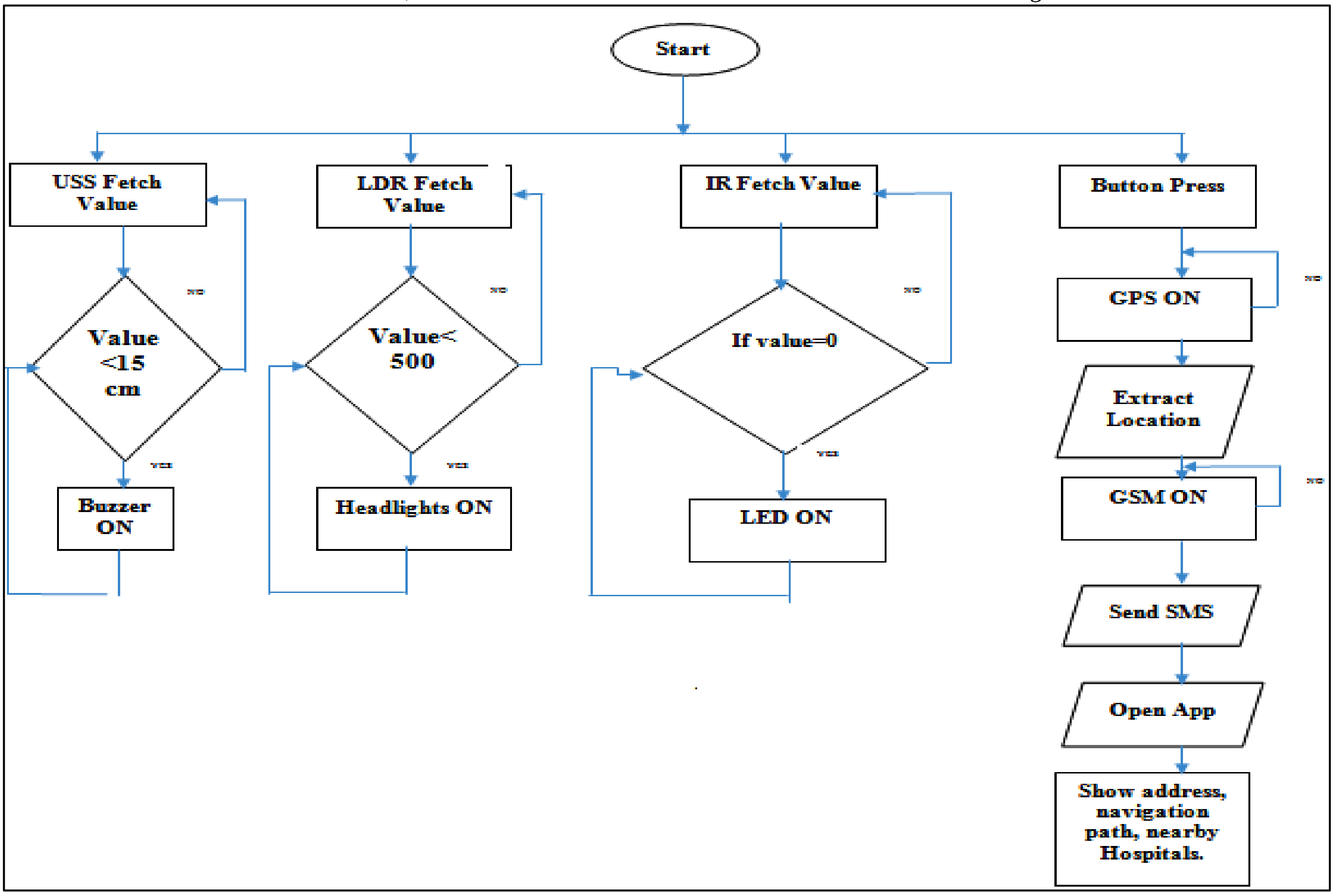


***Fig1 - Flowchart of Vehicle Accident Avoidance and Detection System***

INTERNATIONAL JOURNAL OF RESEARCH SCIENCE & MANAGEMENT

**LDR interfacing with Arduino Mega and its algorithmic approach**

Light Dependent Resistor is used whose one end connected to Vcc through1K resistor while the other end is grounded. The LDR value is acquired by controller board through analog input pin A2. If the acquired value falls below 500 Lux; the headlight LEDs are turned ON.

**Infrared sensor interfacing and its algortithmic approach**

Two IR Sensors senses color change and turns ON the LED corresponding to the side of lane cut by the driver. The sensor reads data into the board through analog pins A0 and A1 for the right and left sensors respectively. If the sensor receives a logic '0' (for white) it means the car is above to depart from lane limits and hence turns ON LED until the sensor receives back logic '1'.

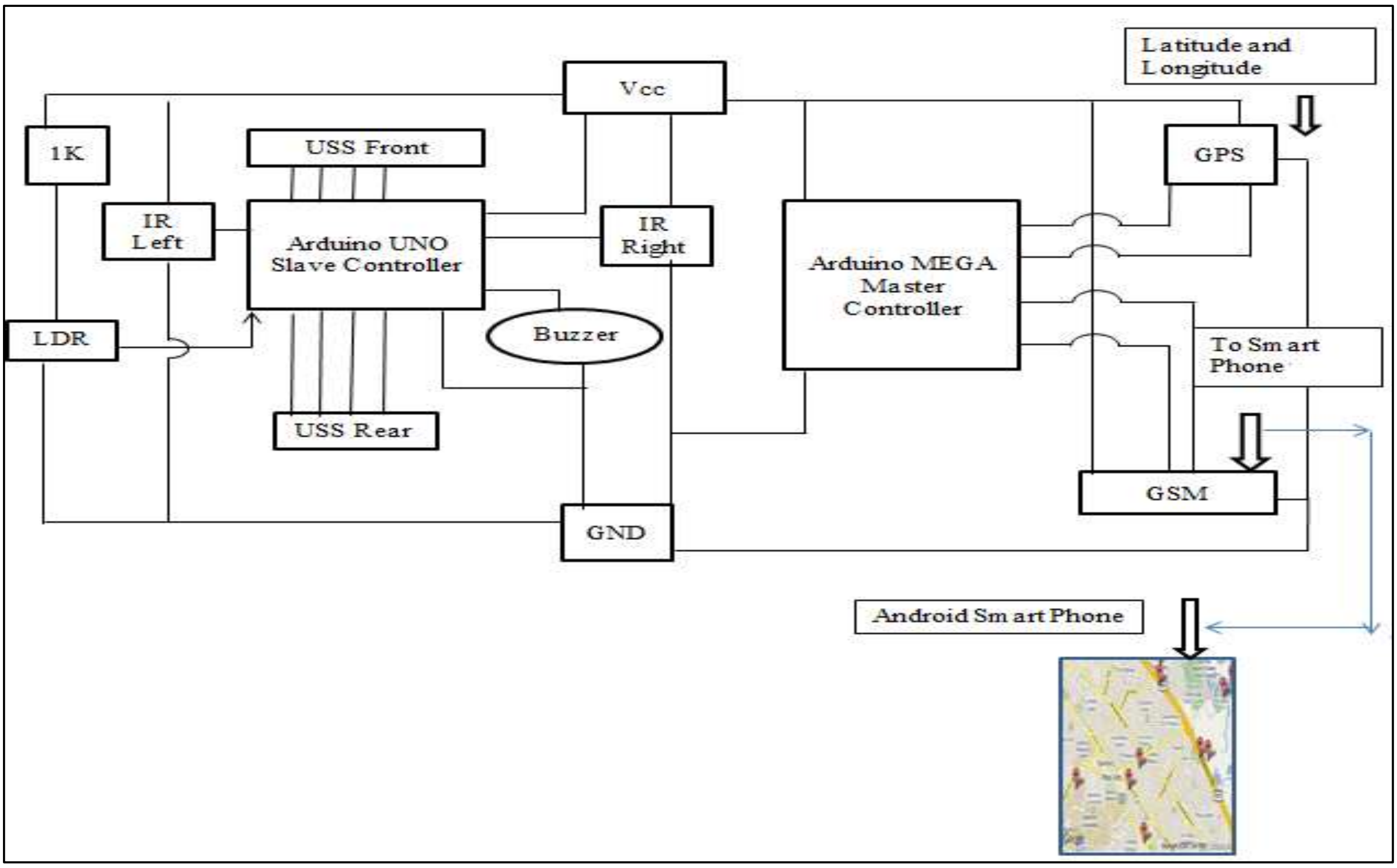


*Fig2- Schematic of Vehicle Accident Avoidance and Detection System*

**GPS modem interfacing with arduino mega and its algorithmic approach:**

The Rx pin of the GPS goes into Tx pin of the board whereas the Tx pin of the GPS goes to Rx pin of the board. The GPS modem is given a trigger pulse similar to Ultrasonic Sensor for it to be activated. As soon as the modem is activated it starts collecting data in NMEA format. The $GPRMC string contains the lattitude and the longitude. Using an inbuilt library for GPS interfacing present in the Arduino IDE, "AdaFruit.h", the latitude and the longitude is extracted and send to the GSM modem.. In each of the iterations the GPS modem is cleared and reset to collect new set of data at time intervals of 1 sec. The clearGPS() function does the flushing process and starts afresh. The coordinates are read using GPSread() function wherein two arrays (LAT and LONG) of type character are used that stores the latitude and the longitude values after extraction. These two arrays are passed to the GSM modem for it to send the message via an SMS.

**GSM modem interfacing with arduino mega and its algorithmic approach:**

The Rx pin of GSM modem is connected to Tx pin whereas Tx pin of GSM is connected to Rx pin of the board. A red LED keeps blinking on the modem with a delay of two seconds indicating it to be under network coverage; otherwise the LED blinks with a delay of one second. The modem responds to "AT" commands which have to be given in the following sequence to enable SMS sending feature:

ISSN: 2349- 5197
Impact Factor (PIF): 2.138

INTERNATIONAL JOURNAL OF RESEARCH SCIENCE & MANAGEMENT

- Serial.write("AT") //Modem wake up
- Serial.write("AT+CMGF=1"):
  //To set the modem in SMS text mode.
- Serial.write("AT+CMGS="+9181244xxxx2\r\n)
  //To Fix message destination
- Serial.write(LAT), Serial.write(LONG).
- Serial.write(0x0A) :
  //To send the ASCII value of "ctr+z".

As soon as the modem detects 0x0A the SMS is send to the given mobile number with the latitude and longitude values.

**Android application for location to address translation**

The Android application is developed using Android Studio software. The software uses JAVA as a default programming language. The program makes use of inbuilt Android JAVA classes like the Maps Activity (Google Maps API), Splash Activity (Home Screen) and Broadcast Receivers (polling for SMS). The app runs over Android version phones above 4.5 (jelly beans) up to Android 5.0 (Lollypop). The application uses the class "BroadCast Receiver" for polling for incoming message and opens the app as soon it detects latitude and longitude in the message. It recognizes the message through an identifier string attached before actually sending the coordinates. After the SMS is detected, the Splash Activity or the home screen opens up for about 5 seconds to play a recorded emergency message which in turn triggers the Google Maps Activity and displays a red balloon over the place of the accident. In addition, the app also displays navigation route(s) from current location of the SMS receiver to the place of accident and gives information about nearby hospitals.

## Results and discussions

The snapshots of the results have been documented subsequently in detail:

**Prototype model overview**

The final design is implemented over a toy car as shown in figure 3 given below.

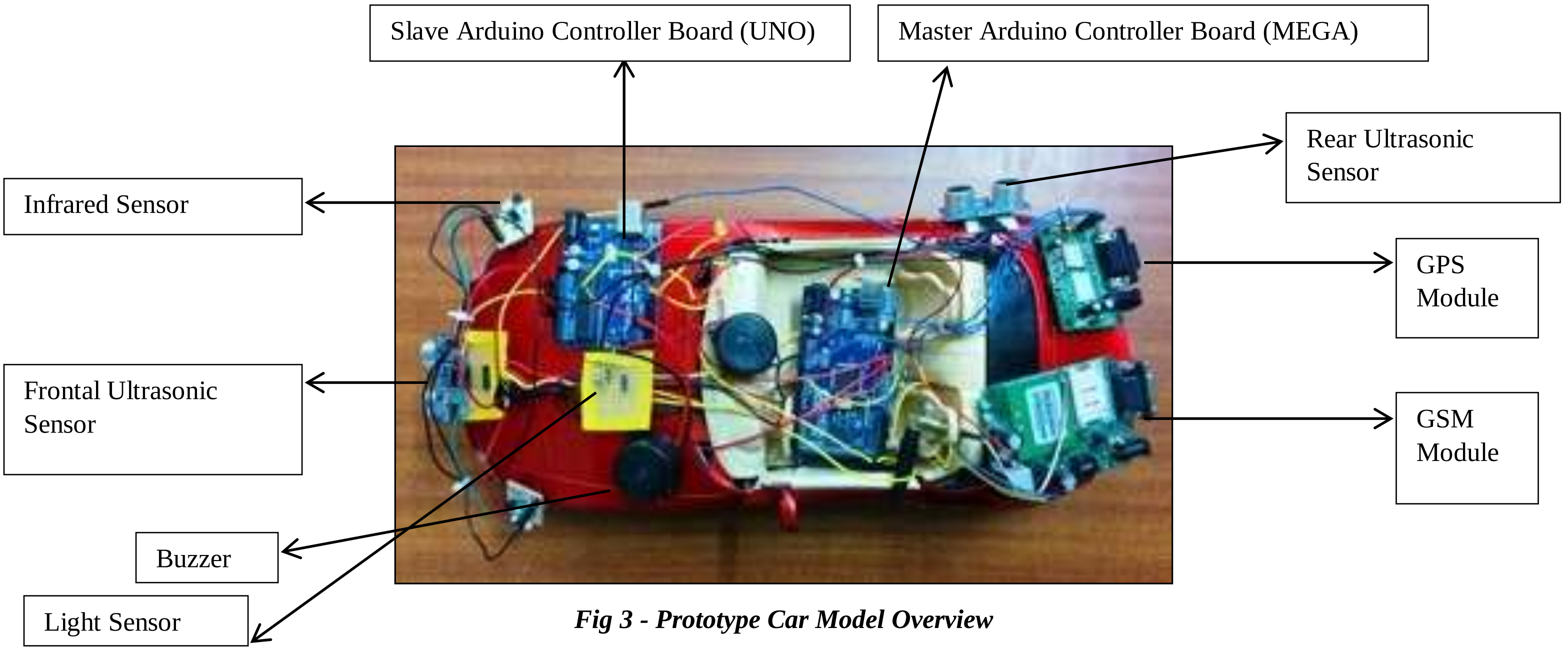


***Fig 3 - Prototype Car Model Overview***

The two Ultrasonic Sensors are fixed in the front and in the rear respectively. The IR Sensors are fixed in the front edges of the car. The two Arduino boards are placed with one in the center and the other over the bonnet of the car. The GPS and GSM modems are placed over the boot of the car.

**Accident avoidance sub-system:**

INTERNATIONAL JOURNAL OF RESEARCH SCIENCE & MANAGEMENT

The Accident Avoidance Sub-System consists of three sensors namely: Ultrasonic sensor, Infrared Sensor and Light Sensor. They are used for Proximity Detection, Lane Maintenance and Automatic Headlights activation respectively.

**Obstacle detection output:**

This module monitors if the vehicle has an obstacle or another vehicle in front which may be in dangerous proximity. If the sensor detects such an obstacle it alarms the driver to be careful and maintain greater distance from it.

***Fig4 - Forward Obstacle Detection***

The obstacle ahead of the car is shown with a book in the figure 4 above. As soon as the car comes dangerously close to an obstacle buzzer goes ON.

**Blind spot detection output**

Blind spot is a spot created wherein the driver of a vehicle is unable to see vehicle coming from behind through any of the rear view mirrors. The Blind Spot created is dependent on the design of the vehicle.

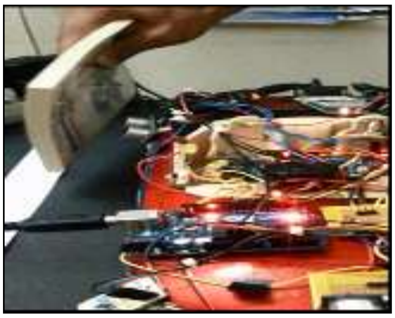

***Fig5 - Blind Spot Detection***

When a vehicle tries to overtake from behind,illustrated with a book in figure 5 above, the buzzer goes ON alerting the driver to be cautious of a probable vehicle overtaking from behind.

**Automatic headlight output**

This module switches ON headlights automatically as soon as the ambient light intensity falls below a minimum threshold. It is implemented using LDR sensor and LEDs in conjunction.

***Fig6 - Automatic Headlights in ON state***

ISSN: 2349- 5197
Impact Factor (PIF): 2.138

INTERNATIONAL JOURNAL OF RESEARCH SCIENCE & MANAGEMENT

The headlight LEDs are turned ON when the ambient light intensity falls below a certain threshold. When the Light Sensor is covered with the palm as shown in figure 6 above, the ambient light intensity falls below the set threshold consequently turning ON the headlights.

**Lane maintenance output**

This module is specifically helpful while driving on highways at fast speeds. It prevents driver from drifting away from the current lane.

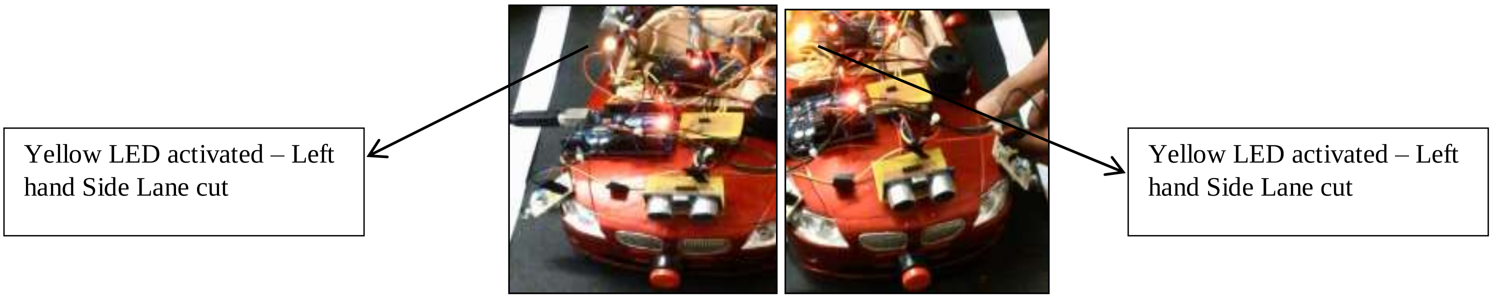


***Fig7 - Left and Right Lane Departure***

The above figure shows a scenario of lane departure by the car. As soon as the IR Sensors detects white strips on black roads it turns ON the yellow LED as shown in figure above. The LED remains in ON state until the car is steered back within the lane limits.

## Accident detection sub-system

This sub-system detects the occurrence of a forward collision that is illustrated using a Push Button as far as prototype model is concerned

**Button press**

The press of a button confirms an impact and triggers the Location Extraction-Transmission Sub-System.

***Fig8 - Accident Detection***

The figure 8 above, illustrates the event of an impact replicated by a button press. As soon as the button is pressed the GPS modem extracts the location coordinates and sends it to the GSM modem which in turn transmits it to a fixed mobile number.

## Location extraction-transmission sub-system

This sub-system sends a message using SMS and consequently triggers the Android Application.

**SMS receive output**

As soon as the message is received in inbox the message is displayed as shown below in the rectangular box. The image is the logo of the proposed Application as shown below

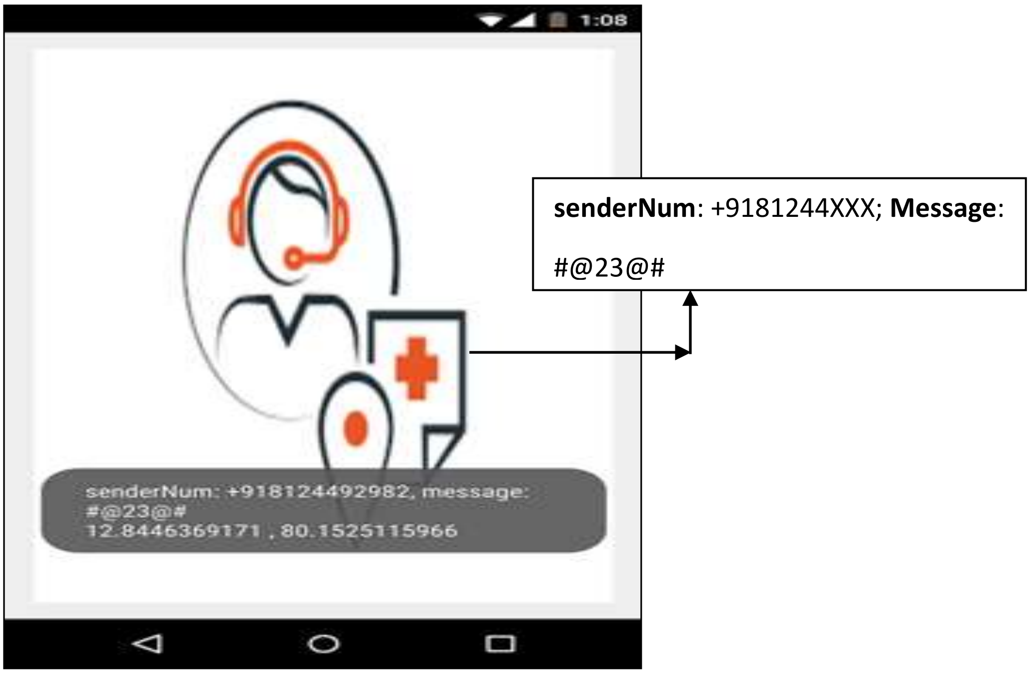


***Fig9 - SMS Detection and App Triggering***

Figure 9 above shows the event of receiving a message on a smart phone. The screen shown above is the home screen of the app that last for around 3 seconds. The text field seen above is called “Toast” which displays: sender’s number and the message. Location being: 12.8438615798, 80.1527633666 (Latitude and Longitude in degrees respectively). The app is triggered automatically after it detects a message by the identifier string “#@23@#” with location coordinates in SMS inbox

## Location to address translation sub-system

As seen above the numeric coordinates is inconvenient in understanding the exact place of the accident. To solve this problem the Android Application was developed using Android Studio software and is coded in JAVA.

**Location with marker display output**

The figure 10 below shows the pictorial representation of the place of accident.


***Fig10 - Accident Location Displayed***

INTERNATIONAL JOURNAL OF RESEARCH SCIENCE & MANAGEMENT

The orange balloon is the place of accident with coordinates in the text field.

**Location to address decoded output**

The figure below gives information of the place of accident in textual format.

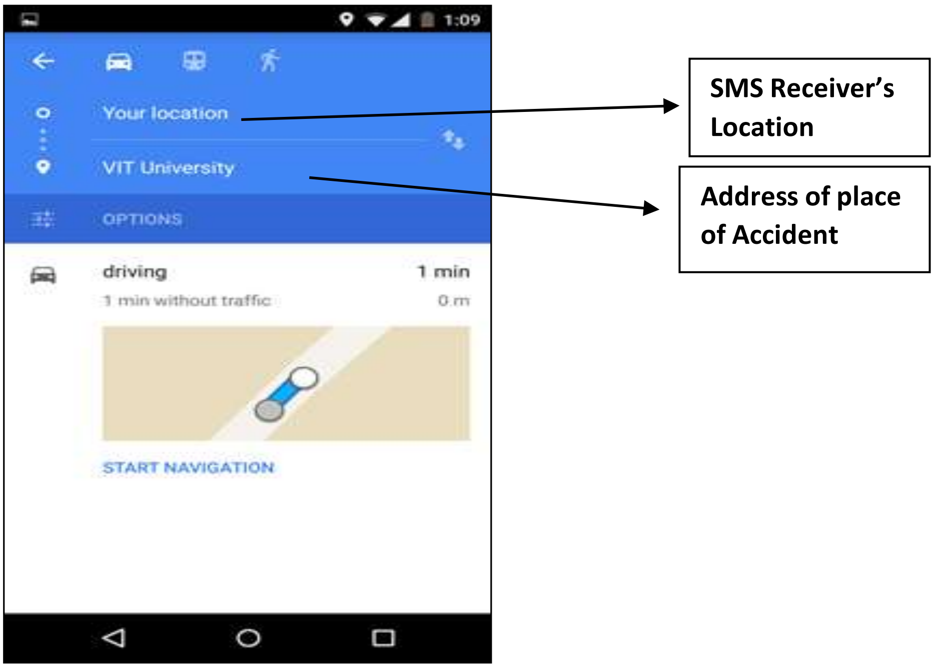


***Fig11 - Address of Place of Accident Displayed***

The "*Your Location*" field is the location of SMS receiver whereas "*VIT University*" is the place of accident.

**Navigation path output**

In addition to address of the place of accident, the path to the victim must also be known for help to reach in time.

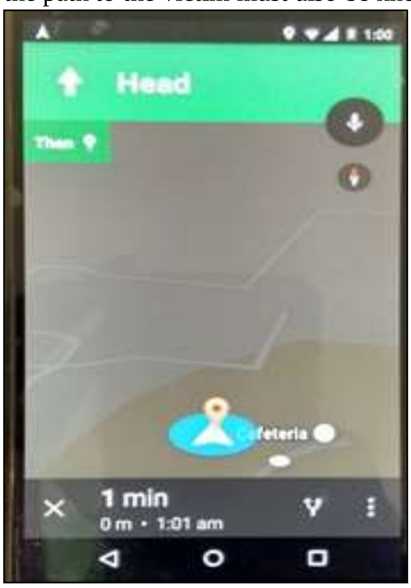


***Fig12 - Navigation Path to the Place of Accident***

The figure 12 above, gives the navigation path from the location of message receiver to the place of the accident. The user has to just follow the directions given by the application.

ISSN: 2349- 5197
Impact Factor (PIF): 2.138

INTERNATIONAL JOURNAL OF RESEARCH SCIENCE & MANAGEMENT

**Nearby hospitals display output**

One of the most important information needed during medical emergencies is the information of hospitals in the vicinity of place of accident. The following feature of the app gives the graphical as well as textual information of hospitals within a default radius of 5 Kms.

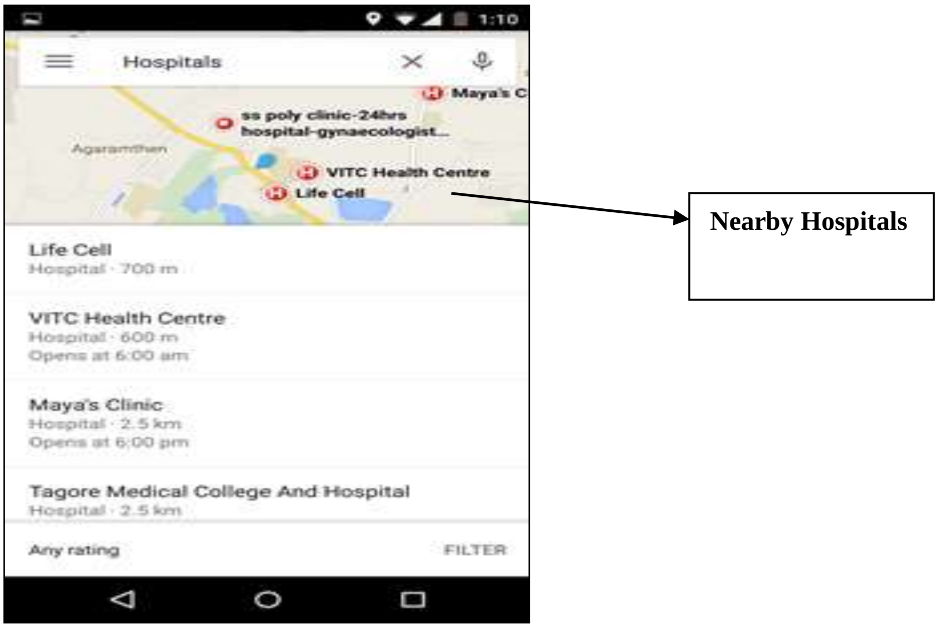


***Fig13 - Nearby Hospitals***

The figure 13 shown above, gives information of nearby hospitals indicated by an "H". On clicking any of the symbols detailed information of the hospitals can also be obtained.

## Conclusion

This paper illustrates an advanced version of available Accident Detection Systems that makes use of smart phones and Android technology which has had great utility in recent times. It has the capability to comprehensively ease the process of numeric Location to textual Address of the place of accident. However, the scope can be extended to two-wheelers and to Intelligent Vehicle Systems (IVS),capable of self-maneuvering. Intelligent Traffic Control System can be implemented in conjunction with the proposed system that can enable quick help from ambulances and other emergency vehicles.

## References

1. www.who.int/mediacentre/factsheets/fs358/en
2. Md. Syedul Amin, Mohammad Arif, Sobhan Bhuiyan,Mamun Bin Ibne Reaz, and Salwa Sheikh Nasir, "GPS and Map Matching Based Vehicle Accident Detection System", IEEE Student Conference on Research and Development (SCOReD), 16 -17 December 2013, Putrajaya, Malaysia.
3. Liang Li, Guangquan Lu, Yunpeng Wang, and Daxin Tian, "A Rear-end Collision Avoidance System of Connected Vehicles", IEEE 17th International Conference on Intelligent Transportation Systems (ITSC) October 8-11, 2014. Qingdao, China.
4. Bankar Sanket Anil, Kale Aniket Vilas and Prof. S. R. Jagtap, "Intelligent System for Vehicular Accident Detection and Notification", International Conference on Communication and Signal Processing, April 3-5, 2014.
5. Nadeem Akhtar, Kush Pander and Sarah Gupta, "Mobile Application for Safe Driving", Fourth International Conference on Communication Systems and Network Technologies, 2014.
6. Fahim Bin Basheer, Jinu J Alias, Mohammed Favas C, Navas V, Naveed K Farhan and Raghu C V, "Design of Accident Detection and Alert System for Motor Cycles", 978-1-4799-1095-3/13/$31.00 ©2013 IEEE.
7. N. Watthanawisuth, T. Lomas and A.Tuantranont, "Wireless Black Box Using MEMS Accelerometer and GPS Tracking, for Accidental Monitoring of Vehicles", IEEE-EMBS International Conference on Biomedical and Health Informatics (BHI 2012), Hong Kong and Shenzhen, China, 2-7 Jan 2012

8. C.Prabha, R.Sunitha and R.Anitha, "Automatic Vehicle Accident Detection and Messaging System Using GSM and GPS Modem" - International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (IJAREEIE), Vol. 3, Issue 7, July 2014.
9. Md. Syedul Amin and M.B.I Reaz, "Accident Detection and Reporting System using GPS,GPRS and GSM Technology", IEEE/OSA/IAPR International Conference on Informatics & Vision 978-1-4673-1154-0/12, ICIEV 2012.
10. S.Sonika, Dr.K.Sathiyasekar and S.Jaishree, "Intelligent Accident Identification System Using GPS, GSM Modem" - International Journal of Advanced Research in Computer and Communication Engineering (IJARCCE) Vol. 3, Issue 2, February 2014.
11. Rashida Nazir, Ayesha Tariq, Sadia Murawwat and Sajjad Rabbani, "Accident Prevention and Reporting System Using GSM (SIM 900D) and GPS (NMEA 0183)" - International Journal of Communications, Network and System Sciences, 7, 286-293, 2014.