A Project Report on

"Arduino Based Vehicle Accident Alert System using GPS, GSM and Accelerometer"

Submitted in partial fulfillment of the requirement for
Degree in Bachelor of Engineering (Information Technology)

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CERTIFICATE

This is to certify that the project entitled

Arduino Based Vehicle Accident Alert System using GPS, GSM and Accelerometer

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In partial fulfillment of degree of T.E in **Information Technology** for term work of the project is approved.

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Internal Guide

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ABSTRACT

Nowadays we are able to track vehicles using many applications which helps in securing personal vehicles, public vehicles, feet units and others. Furthermore there is a rapid increase in the occurrence of the Road accident.

Here in this project, we are going to build a Arduino based vehicle accident alert system using GPS, GSM and accelerometer. Accelerometer detects the sudden change in the axes of vehicle and GSM module sends the alert message on your Mobile Phone with the location of the accident and also alert the nearest hospitals and medical services about it. Location of accident is sent in the form of Google Map link, derived from the latitude and longitude from GPS module. The Message also contains the speed of vehicle in knots.

This Vehicle Accident alert project can also be used as a Tracking System and much more, by just making few changes in hardware and software.

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Chapter 1

INTRODUCTION

1.1 Background

The high demand of vehicles has also increased the traffic hazards and the road accidents. Life of the people is under high risk. This is because of the lack of best emergency facilities available in our country. An automatic alert system for vehicle accidents is introduced in this paper. The proposed system which can detect accidents in significantly less time and sends the basic information to first aid centre within a few seconds covering geographical coordinates, the time and angle in which a vehicle accident had occurred. This alert message is sent to the central emergency dispatch server in a short time so that the emergency dispatch server will inform to the ambulances which are near to that location, which will help in saving the valuable lives. A Switch is also provided in order to terminate the sending of a message in rare case where there is no casualty, this can save the precious time of the ambulance. When the accident occurs the alert message is sent automatically to the central emergency dispatch server. The message is sent through the GSM module and the location of the accident is detected with the help of the GPS module. The accident can be detected precisely with the help of vibration sensor. This application provides the optimum solution to poor emergency facilities provided to the roads accidents in the most feasible way.

1.2 Purpose / Need

Life of the people is under risk, a millions of people die every year as a result of road traffic crashes. This is because of the lack of best emergency facilities available in our country.

1.3 Problem Statement

Vehicle accidents are one of the most leading causes of fatality. The time between an accident occurrence and the emergency medical personnel are dispatched to the accident location is the important factor in the survival rates after an accident. By eliminating that time between an accident occurrence and the first responders are dispatched to the scene decreases mortality rates so that we can save lives. One approach to eliminate that delay between accident occurrence and first responder dispatch is to use An Accident Alert and Vehicle Tracking System, which sense when a traffic accident is likely to occur and immediately notify emergency occurred. In this project, that system is described the main application of which is early accident detection. In this system, initially the GPS continuously takes input data from the satellite and stores the latitude and longitude values. If we have to track the vehicle, we need to send a message to GSM device, by which it gets activated. It also gets activated by the sudden change in the axes of vehicle connected to Arduino Uno. Parallely activates GPS .Once GSM gets activated it takes the last received latitude and longitude positions values from the buffer and sends a message to a central emergency dispatch server or family which is predefined in the program.

1.4 Project Scope

- This system can be improved by incorporating a tiny camera to record the scene of the accident.
- In near future, the system can be improved by using more sensor to detect accident with more accuracy and more different way of accident detection.
- This system will try to communicate at least three nearest hospitals if any major accident occurs and show the shortest path to reach the accident spot.
- Moreover, the system will integrate with other system. For example, an insurance company can use the project database to inquiry about an accident and provide money to the owner in time.

1.5 Proposed System Features

1.Easy operation.

2.Highly secure.

3.Simple and Reliable Design.

4.Isolates both GSM & GPM.

1.6 Project Objective

Our project objective is to eliminate the time between an accident occurrence and the first responders are dispatched to the scene.
Hence our system allows people to immediately to take care of the injured Person, admit the person in hospital and save life.

1.7 Issues/ Limitations

1. Network is must.

Chapter 2

LITERATURE SURVEY

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2.1 Existing System

From the past event and the existing approach the below Drawback are been noted:
1. Manual system is adopted.
2. Tracking of accident is a crucial process in the system.
3. Required medical attention cannot be given to the needed person.
4. Life loss and Property loss were not stopped in large scale.

Currently there is no technology for accident detection. As it is done manually there is loss of life in golden hours. The accident victim is dependent on the mercy of others to rush him to hospital. Many a times an accident goes unnoticed for hours before help comes in. Due to all these factors there is a high rate of mortality of the accident victims. In addition to this there is delay in the ambulance reaching the hospital due to the traffic congestion between accident location and hospital which increases the chances of the death of victim.

2.2 Related Work

At present criteria, we cannot detect where the accident has occurred and hence no information related to it, leading to the death of an individuals. The research work is going on for tracking the position of the vehicle. In this project GPS is used for tracking the position of the vehicle, GSM is used for sending alert message. To make this process all the control is made using Arduino whereas LCD is used to display the accident information. Hence with this project implementation we can detect the position of the vehicle where the accident has occurred so that we can provide the first aid as early as possible.

Considering all the drawbacks into account we have formulated a proposed system which covers all the above mentioned drawbacks.
1. A Automated system is used once the accident occurs.
2. This system gives the Latitude and Longitude of the system accident occurred area without any delay.
3.More Human life can be saved using this automated system.

This system is very efficient and hence worthy to be implemented. Accident detection and messaging system can be fitted in vehicle (Ambulance, Police or to the communication device of the near and dear) and they are informed about any such untoward incident at the go. Accident detection and messaging system is execution simple as the system makes use of GSM & GPS technologies. GPS is used for taking the coordinate of the site of the accident while GSM is used for sending the message to phone. To make this process all the control is made using Arduino whereas LCD is used to display the accident.

The Rapid growth of technology and infrastructure has made our lives easier. The advent of technology has also increased the traffic hazards and the road accidents take place frequently which causes huge loss of life and property because of the poor emergency facilities. This paper will provide an optimum solution to this drawback. This paper presents vehicle accident detection and alert system with SMS to the user defined mobile numbers. The GPS tracking and GSM alert based algorithm is designed and implemented with Arduino UNO in embedded system domain. The proposed Vehicle accident detection system can track geographical information automatically and sends an alert SMS regarding accident. Experimental work has been carried out carefully. The result shows that higher sensitivity and accuracy is indeed achieved using this project. EEPROM is interfaced to store the mobile numbers permanently. This made the project more user friendly and reliable. [2] This paper proposes a new dimension in order to allow early response and rescue of accident victims; saving lives and properties. Proposed system uses the capability of GPS and GSM along with the android phone to provide a solution which can be used to precisely detect the accident spot and to send the emergency notification to the nearby hospital's ICU and to the victim's relatives Sensors and the switches/other components used in system is distributed throughout the car hence provides more flexibility while mounting into the vehicle. Using the open source android adds another advantage as we can work on top of some already built APIs for GPS and GSM interfacing hence decreasing the total project completion time. Overall the system performance is increased.

In highly populated Countries like India, everyday people lose their lives because of accidents and poor emergency facilities. These lives could have been saved if medical facilities are provided at the right time. This paper implies system which is a solution to this drawback. Accelerometer sensor can be used in car security system to sense vibrations in vehicle and GPS to give location of vehicle, so dangerous driving can be detected Automatic accident detection and reporting system is designed in this paper. When accident occurs, it is sensed by Accelerometer. Short message including location of accident obtained using GPS, is sent via GSM network. It provides more than 70% safety for four wheelers.

After analyzing the requirements of the task to be performed, the next step is to analyze the problem and understanding its context. The first activity in the phase is studying the existing system and other is to understand the requirements and domain of the new system. Both the activities are equally important, but the first activity serves as a basis of giving the functional specifications and then successful design of the proposed system. Understanding the properties and requirements of a new system is more difficult and requires creative thinking and understanding of existing running system is also difficult, improper understanding of present system can lead diversion from solution. The proposed system design involved the following research paper analysis:

[1]"Wireless black box using MEMS accelerometer and GPS tracking for accidental monitoring of vehicles" by Watthanawisuth, N., IEEE conference in Jan, 2012:
This survey presents an overview of wireless black box using MEMS accelerometer and GPS tracking system is developed for accidental monitoring. The system consists of cooperative components of an accelerometer, microcontroller unit, GPS device and GSM module. In the event of accident, this wireless device will send mobile phone short message indicating the position of vehicle by GPS system to family member, emergency medical service (EMS) and nearest hospital. The threshold algorithm and speed of motorcycle are used to determine fall or accident in real-time. The system is compact and easy to install under rider seat. The system has been tested in real world applications using bicycles. The test results show that it can detect linear fall, nonlinear fall and normal ride with high accuracy.
[2]"Development of vehicle tracking system using GPS and GSM modem" by Hoang Dat Pham, IEEE conference in Dec, 2013:
The ability to track vehicles is useful in many applications including security of personal vehicles, public transportation systems, fleet management and others. Furthermore, the number of vehicles on the road globally is also expected to increase rapidly. Therefore, the development of vehicle tracking system using the Global Positioning System (GPS) and Global System for Mobile Communications (GSM) modem is undertaken with the aim of enabling users to locate their vehicles with ease and in a convenient manner. The system will provide users with the capability to track vehicle remotely through the mobile network. This paper presents the development of the vehicle tracking system's hardware prototype. Specifically, the system will utilize GPS to obtain a vehicle's coordinate and transmit it using GSM modem to the user's phone through the mobile network. The main hardware components of the system are u-blox NEO-6Q GPS receiver module, u-blox LEON-G100 GSM module and Arduino Uno microcontroller. The developed vehicle tracking system demonstrates the feasibility of near real-time tracking of vehicles and improved customizability, global operability and cost when compared to existing solutions.
[3] "Traffic-incident detection-algorithm based on nonparametric regression" by Shuming Tang, IEEE conference in March, 2005:
This paper proposes an improved nonparametric regression (INPR) algorithm for forecasting traffic flows and its application in automatic detection of traffic incidents. The INPRA is constructed based on the searching method of nearest neighbors for a traffic state vector and its main advantage lies in forecasting through possible trends of traffic flows, instead of just current traffic states, as commonly used in previous forecasting algorithms. Various simulation results have indicated the viability and effectiveness of the proposed new algorithm. Several performance tests have been conducted using actual traffic data sets and results demonstrate that INPRs average absolute forecast errors, average relative forecast errors, and average computing times are the smallest comparing with other forecasting algorithms.

[4]“Automatic Accident Detection: Assistance Through Communication Technologies and Vehicles” by Fogue, M., IEEE conference in August, 2012:
In this article, e-NOTIFY system is presented, which allows fast detection of traffic accidents, improving the assistance to injured passengers by reducing the response time of emergency services through the efficient communication of relevant information about the accident using a combination of V2V and V2I communications. The proposed system requires installing OBUs in the vehicles, in charge of detecting accidents and notifying them to an external CU, which will estimate the severity of the accident and inform the appropriate emergency services about the incident. This architecture replaces the current mechanisms for notification of accidents based on witnesses, who may provide incomplete or incorrect information after a long time. The development of a low-cost prototype shows that it is feasible to massively incorporate this system in existing vehicles.

Chapter 3
SYSTEM DESIGN

3.1 Architecture Diagram

In this project, Arduino is used for controlling whole the process with a GPS Receiver and GSM module. GPS Receiver is used for detecting coordinates of the vehicle, GSM module is used for sending the alert SMS with the coordinates and the link to Google Map. Accelerometer namely ADXL335 is used for detecting accident or sudden change in any axis. And an optional 16x2 LCD is also used for displaying status messages or coordinates. We have used GPS Module SIM28ML and GSM Module SIM900A.

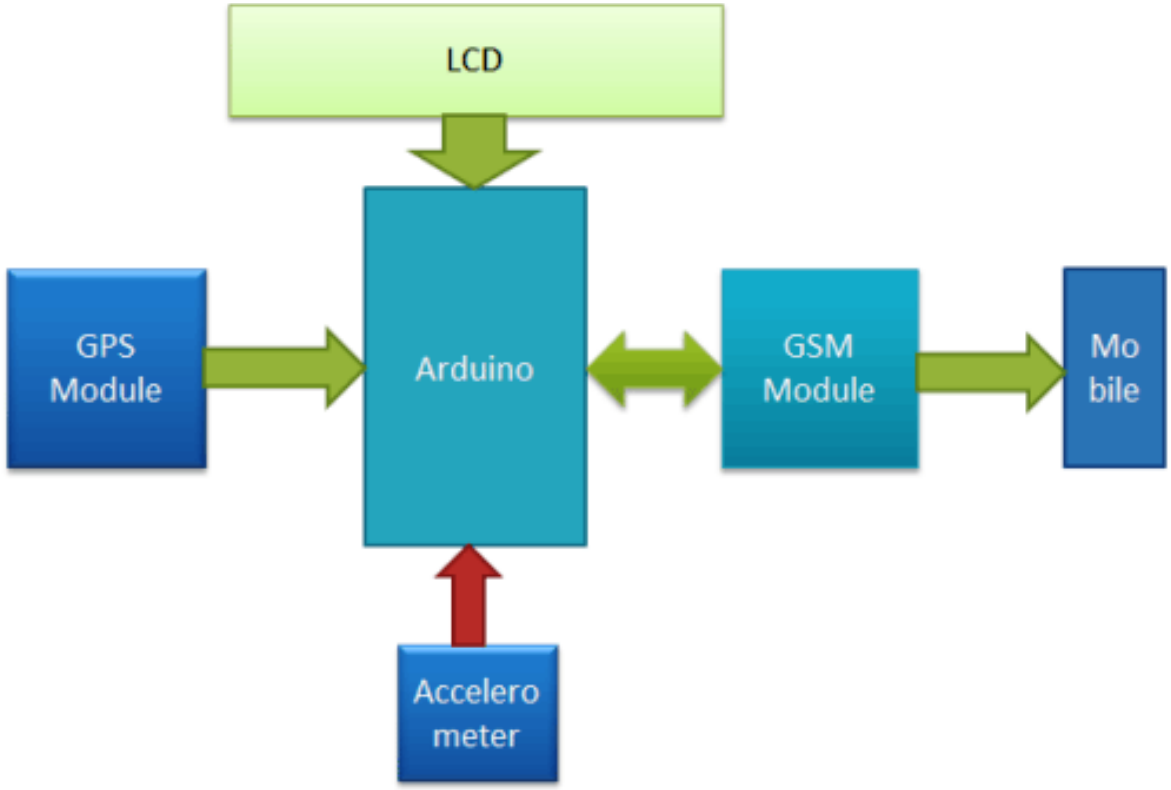

Figure No. 3.1 Architecture diagram

When we are ready with our hardware after programming, we can install it in our vehicle and power it up. Now whenever there is an accident, the car gets tilt and accelerometer changes his axis values. These values read by Arduino and checks if any change occurs in any axis. If any change occurs then Arduino reads coordinates by extracting $GPGGA String from GPS module data (GPS working explained above) and send SMS to the predefined number to the police or ambulance or family member with the location coordinates of accident place. The message also contains a Google Map link to the accident location, so that location can be easily tracked. When we receive the message then we only need to click the link and we will redirect to the Google map and then we can see the exact location of the vehicle. Speed of Vehicle, in knots (1.852 KPH), is also sent in the SMS and displayed on the LCD panel.

3.2 Flow Chart

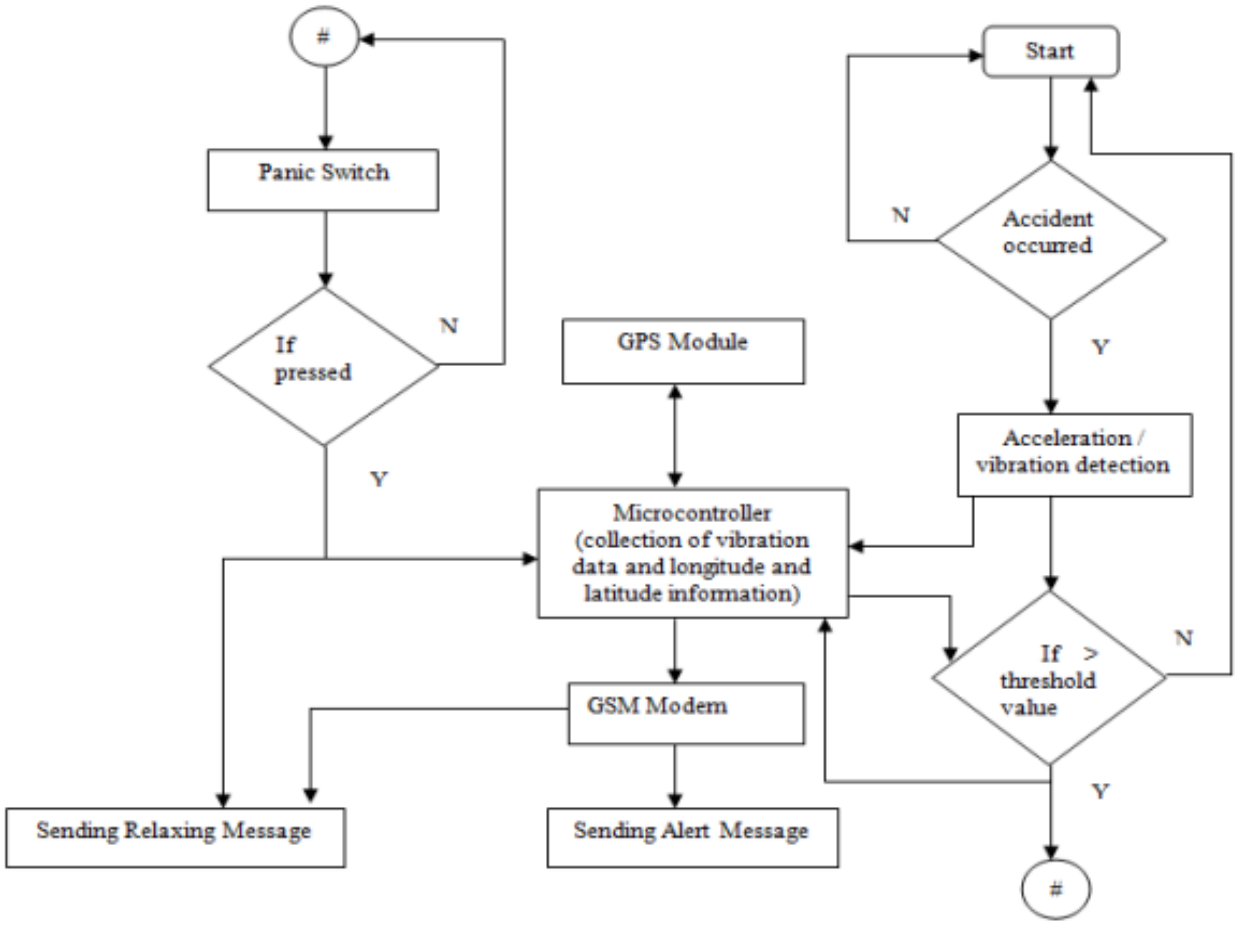

Figure No. 3.2 Flowchart

The system is implemented in vehicles. The vehicles are monitored continuously through microcontroller. Hence, when accident is detected, accelerometer sensor gets activated, these sensor have threshold values depend on different vibration intensities. If the vibration intensity is more than the specific threshold value, the accelerometer sensor activated at the same time, GPS module and GSM modem which are interfaced to microcontroller are also activated. So, through GPS module, the exact location of latitude & longitude of the location can be identified and GSM modem sends the messages as per condition.

Chapter 4

SYSTEM REQUIREMENT

4.1 Hardware Required:

- Arduino Uno
- GSM Module (SIM900A)
- GPS Module (SIM28ML)
- Accelerometer (ADXL335)
- 16x2 LCD
- Power Supply
- Connecting Wires
- 10 K-POT
- Breadboard or PCB
- Power supply 12v 1amp

4.2 Software Requirements

- Operating System :Windows 8
- Tools used : Arduino IDE software

Chapter 5

IMPLEMENTATION DETAILS

5.1Circuit Explanation:

Circuit Connections of this Vehicle Accident Alert System Project is simple. Here Tx pin of GPS module is directly connected to digital pin number 10 of Arduino. By using Software Serial Library here, we have allowed serial communication on pin 10 and 11, and made them Rx and Tx respectively and left the Rx pin of GPS Module open. By default Pin 0 and 1 of Arduino are used for serial communication but by using the SoftwareSerial library, we can allow serial communication on other digital pins of the Arduino. 12 Volt supply is used to power the GPS Module.
GSM module's Tx and Rx pins of are directly connected to pin D2 and D3 of Arduino. For GSM interfacing, here we have also used software serial library. GSM module is also powered by 12v supply. An optional LCD's data pins D4, D5, D6, and D7 are connected to pin number 6, 7, 8, and 9 of Arduino. Command pin RS and EN of LCD are connected with pin number 4 and 5 of Arduino and RW pin is directly connected with ground. A Potentiometer is also used for setting contrast or brightness of LCD.
An Accelerometer is added in this system for detecting an accident and its x,y, and z-axis ADC output pins are directly connected to Arduino ADC pin A1, A2, and A3.

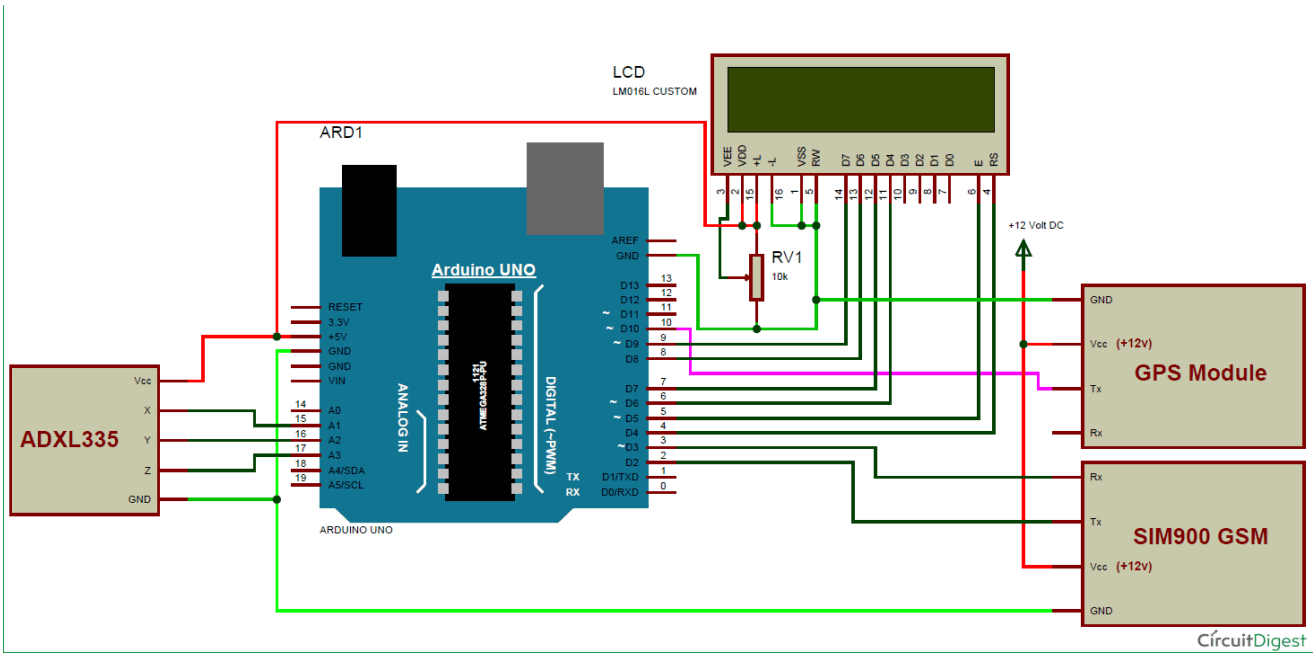

Figure 5.1 Circuit Diagram

Chapter 6

EXPERIMENTAL RESULTS

Step1: After giving Power supply to all the modules (i.e. Arduino, GPS,GSM) and uploading the code the system is Initialize.

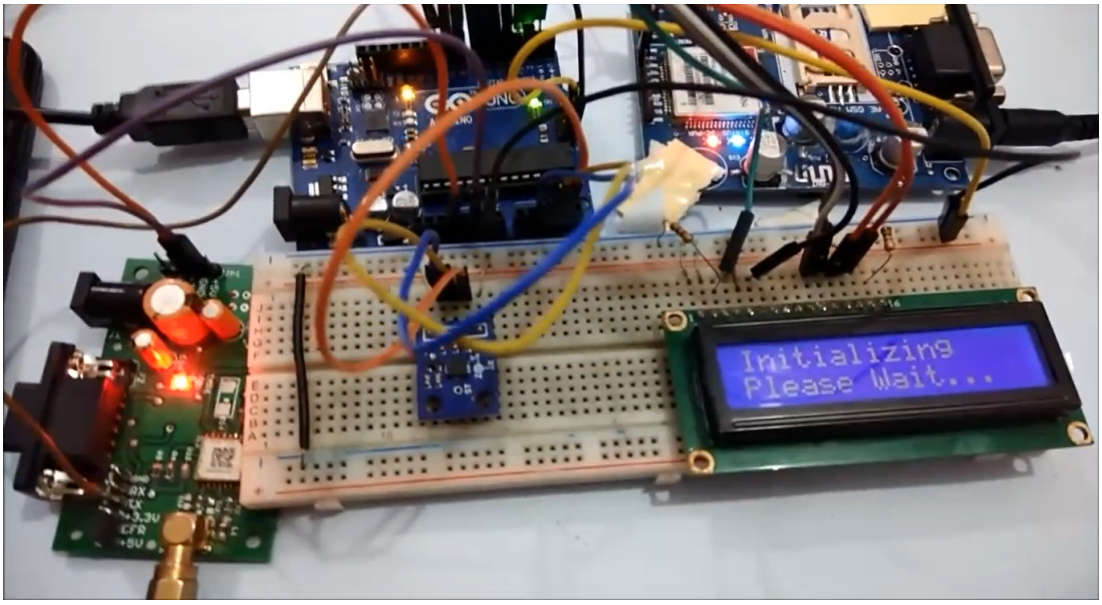

Figure No.6.1 Initializing

Step2: After initialized it checks all the modules if everything is fine it shows initialized successfully message on the LCD screen.

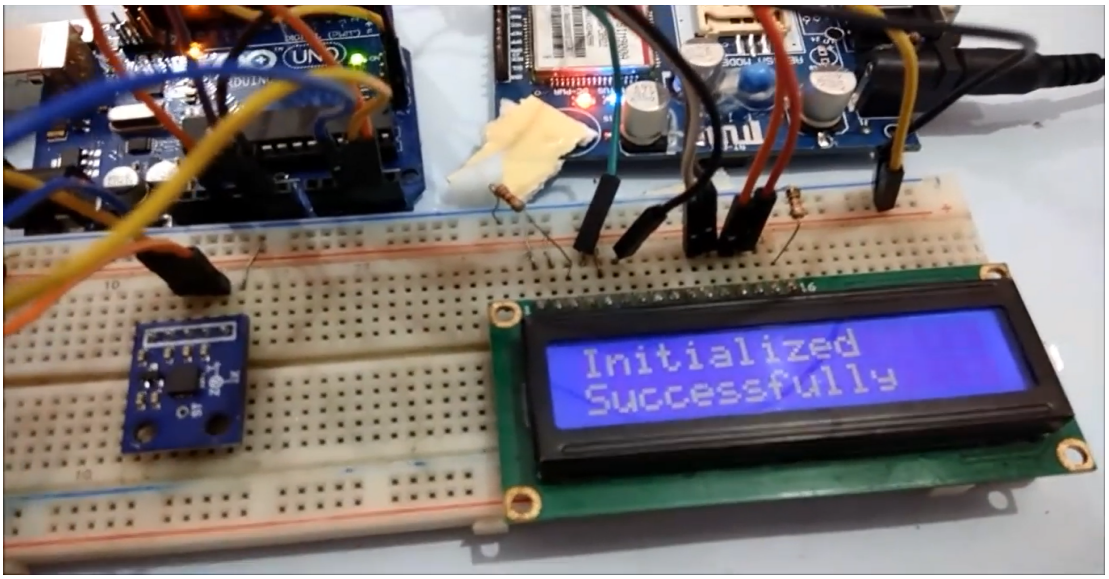

Figure No. 6.2 After initialized

Step3: It finds the location where the accident occur using GPS module.

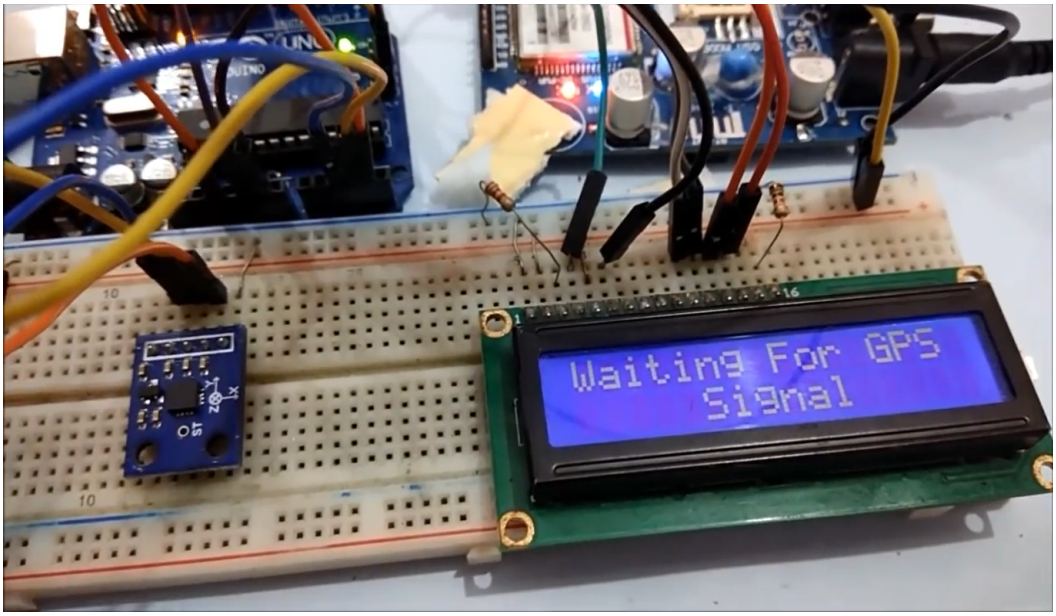

Figure 6.3 Waiting for GPS Signal

Step4: It get the location in terms of longitude and latitude to get exact position

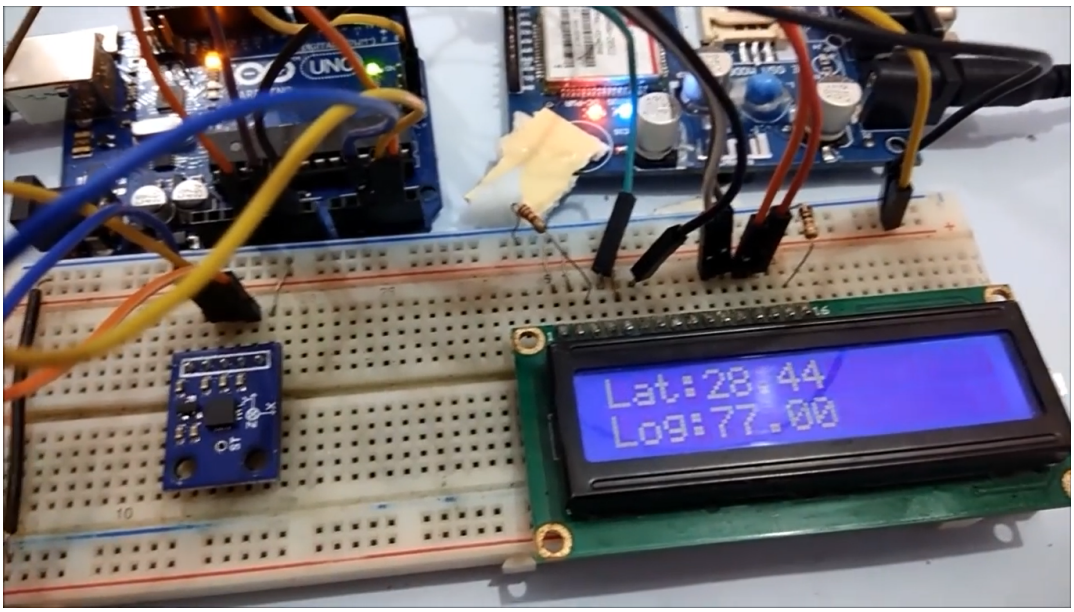

Figure no.6.4 Location

Step5: It check the vehicle Speed also in terms of Knots.

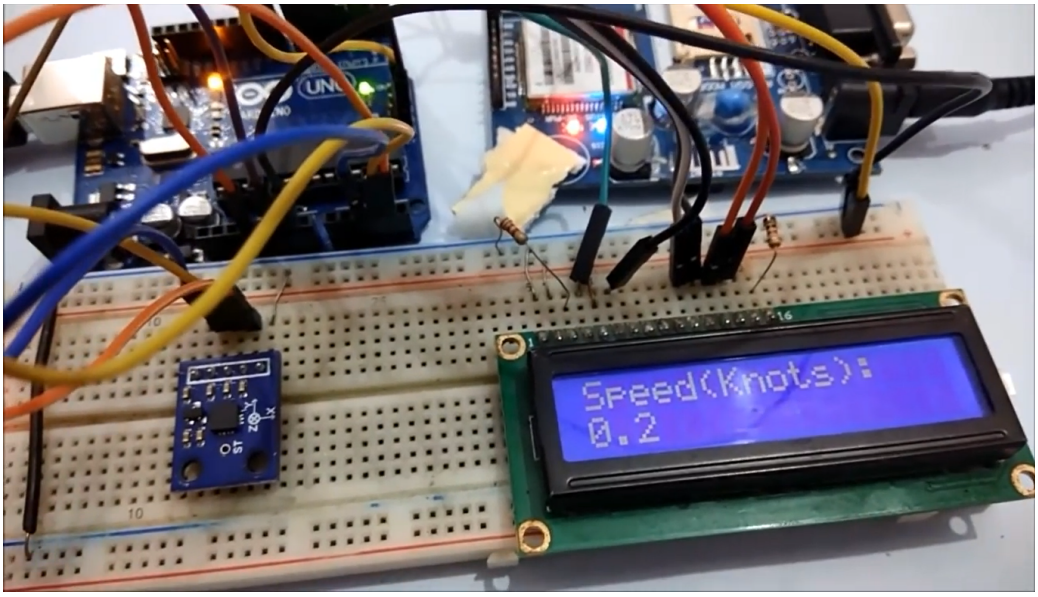

Figure No.6.5 Speed checking

Step6: It sends the message using GSM module to registered number or nearest hospital.

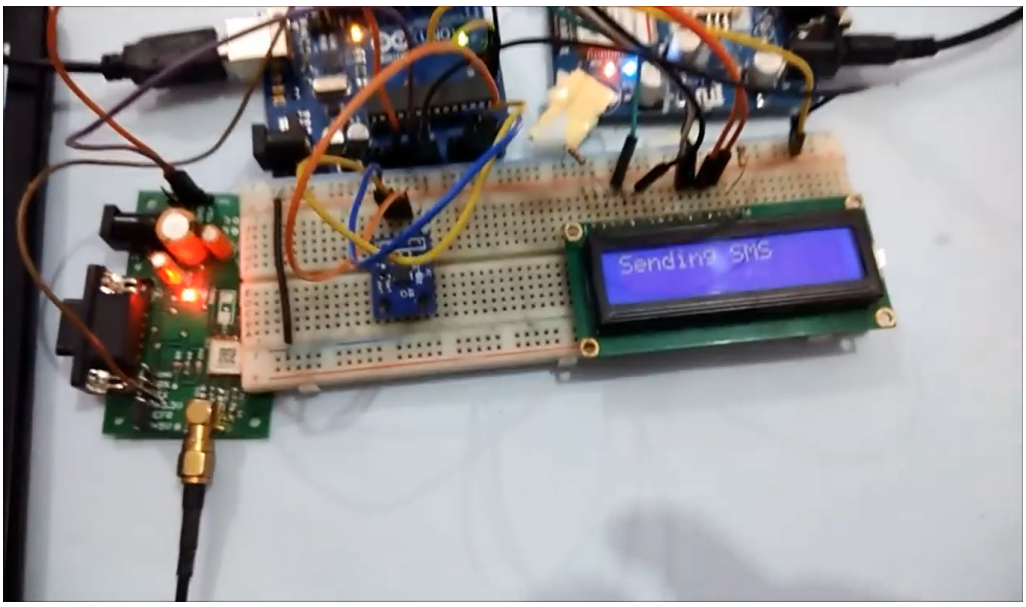

Figure No.6.6 Sending SMS

Chapter 7
CONCLUSION

7.1 Conclusion

The Expected performance is achieved through implementation of the proposed system. The sensor and other required components are distributed throughout the car providing more optimal results to detect accidents. The proposed system can also be used for traffic estimation and system performance estimation to prevent loss of life to its maximum. The proposed system is developed to provide the information about the accident occur and the location of the accident. It helps to easily provide the assistant and help to the victim of the accident. This system uses GPS module to locate the vehicle. GSM is used to provide the information of accident. The results of the proposed systems are satisfactory.

7.2 Future Scope

Further this system can be implemented by using sound sensor, in order to make it more accurate and efficient to detect an accident. This is extended with alcoholic detection also. If the person took alcohol who is driving then the vehicle will be stopped immediately by giving alarm. This can also be developed by interconnecting camera to the controller module that takes the photograph of the accident spot makes tracking easier.

Chapter 8

APPENDIX: CODE SAMPLE

First we have included all the required libraries or headers files and declared various variables for calculations and storing data temporary.
After this, we have created a function void initModule(String cmd, char *res, int t) to initialize the GSM module and checking its response using AT commands.

```
void initModule(String cmd, char *res, int t)
{
while(1)
{
Serial.println(cmd);
Serial1.println(cmd);
delay(100);
while(Serial1.available()>0)
{
if(Serial1.find(res))
{
Serial.println(res);
delay(t);
return;
}
else
{
Serial.println("Error");
}
}
delay(t);
}
}
```

After this, in void setup() function, we have initialized hardware and software serial communication, LCD, GPS, GSM module and accelerometer.

```
void setup()
{
Serial1.begin(9600);
Serial.begin(9600);
lcd.begin(16,2);
lcd.print("Accident Alert ");
lcd.setCursor(0,1);
lcd.print(" System ");
delay(2000);
lcd.clear();
.... .....
..... .....
```

Accelerometer calibration process is also done in setup loop. In this, we have taken some samples and then find the average values for the x-axis, y-axis, and z-axis. And store them in a variable. Then we have used these sample values to read changes in accelerometer axis when vehicle gets tilt (accident).

```
lcd.print("Callibrating ");
```

```
lcd.setCursor(0,1);
lcd.print("Acceleromiter");
for(int i=0;i<samples;i++)
{
xsample+=analogRead(x);
ysample+=analogRead(y);
zsample+=analogRead(z);
}
xsample/=samples;
ysample/=samples;
zsample/=samples;
Serial.println(xsample);
Serial.println(ysample);
Serial.println(zsample);
```

After this, in the void loop() function, we have read accelerometer axis values and done a calculation to extract changes with the help of samples that are taken in Calibration. Now if any changes are more or less then defined level then Arduino sends a message to the predefined number.

```
void loop()
{
int value1=analogRead(x);
int value2=analogRead(y);
int value3=analogRead(z);
int xValue=xsample-value1;
int yValue=ysample-value2;
int zValue=zsample-value3;
Serial.print("x=");
Serial.println(xValue);
Serial.print("y=");
Serial.println(yValue);
Serial.print("z=");
Serial.println(zValue);
..... .....
..... ...
```

Here we have also created some other function for various puposes like void gpsEvent() to get GPS coordinates, void coordinate2dec() for extracting coordinates from the GPS string and convert them into Decimal values, void show_coordinate() for displaying values over serial monitor and LCD, and finally the void Send() for sending alert SMS to the predefined number.

Chapter 9
REFERENCES

[1] M Rajendra Prasad, P Aswani Kumar," An Automated Traffic Accident Detection and Alarm Device" in International Journal of Technological Exploration and Learning (IJTEL), Volume 1 Issue 1 (August 2012).
[2] C.Vidya Lakshmi, J.R.Balakrishnan,"Automatic Accident Detection Via Embedded GSM message interface with Sensor Technology " in International Journal of Scientific and Research Publications Volume 2, Issue 4, April 2012.
[3] “GSM SIM 300 Module”, Internet: www.positronindia.in, Product URL: http://positronindia.in/PT0006.aspx.
[4] “Microcontroller (Atmel AT89S52 Data Sheet)”, Internet: http://www.atmel.com.
[5] “GPS Module”, Internet: www.iwavesystems.com.
[6] “Accelerometer Sensor (MMA7361L)”, Internet: www.pololu.com.
[7] Jules White, Chris Thompson, Hamilton Turner, Brian Dougherty, and Douglas C.Schmidt, "WreckWatch: Automatic Traffic Accident Detection and Notification with Smartphones" in Journal of Mobile Networks.
[8] Global Status Report on Road Safety 2013, Executive Summary(IEEE), October 2013.
[9] P.Jyothi, G. Harish. Design and Implementation of Real time vehicle Monitering, Tracking and Controlling System, IEEE