JSS Mahavidyapeetha

JSS SCIENCE AND TECHNOLOGY UNIVERSITY
MYSURU-570006

DESIGN AND IMPLEMENTATION REPORT

2021-22

ACCIDENT DETECTION AND ANALYSIS SYSTEM

Submitted By

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Submitted in partial fulfilment of the requirement of academic event in BE

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Abstract

An accident is an unpredicted and unintentional event. Considering the alarming increase in the number of motor bike riders and the number of accidents happening in our country, this system ensures to make the two-wheeler driving safer than before for the rider. The lack of treatment in proper time is the major reason for half of the deaths in road accidents. This system aims at providing early detection of accidents and communicating the information immediately to the emergency responses on time to provide quick assistance for the injured person. When the rider meets with an accident and the helmet hits the ground, the vibration sensor which is embedded in the helmet senses the vibration frequency and transfers the value to the raspberry pi module that is interfaced to it. While vibration threshold frequency exceeds the programmed maximum limit, the raspberry pi board extracts GPS data from the GPS module and the message with all the necessary information is sent quickly to the registered emergency contacts of the rider. This system ensures immediate assistance to the victim of the accident. The results give exact locations of the accident.

Keywords: GPS, Helmet, Internet of Things, Pushbullet, Raspberry pi, Slack, Vibration Sensors.

Chapter 1
Introduction

1.0.1 Overview

In this project we intend to utilize the capability of a GPS receiver to monitor the speed of a vehicle and detect an accident based 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 Center.

As a whole this project aims to develop a cost-efficient smart vehicle system focusing on accident detection, passenger safety, drunk driver prevention, and an interactive cabin monitoring system.

1.0.2 Brief Description

The development of a transportation system has been the generative power for human beings to have the highest civilization above creatures in the earth. Automobiles have 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. A total of 151,113 people were killed in 480,652 road accidents across India in 2019, an average of 414 a day or 17 an hour,

according to a report by the transport research wing of the ministry of road transport and highways. 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. Figure 1.1 depicts the Accident report of Indian Roads in the year 2019. One death occurs every four minutes due to a road accident in India

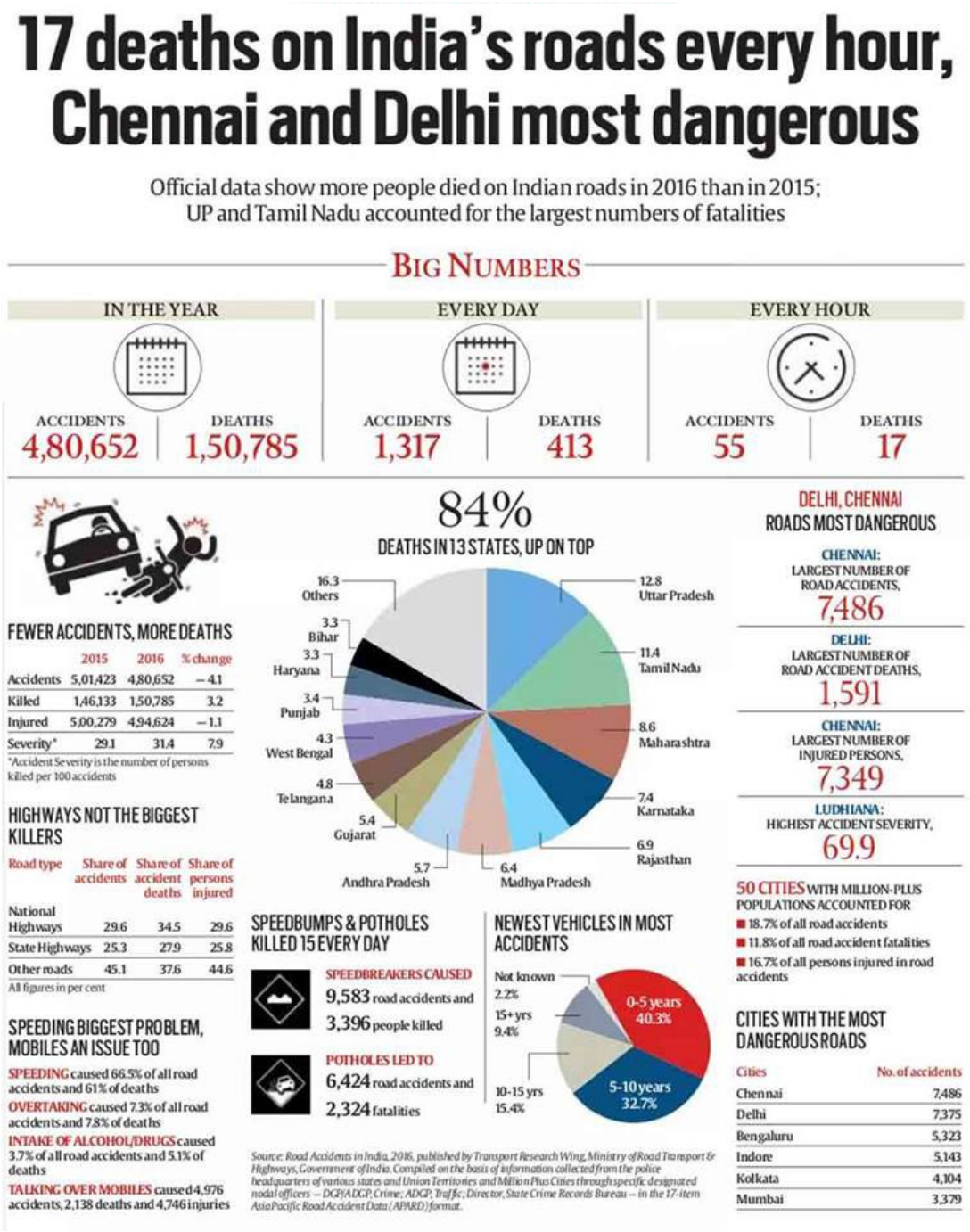

Fig. 1.1 Accident Report of Indian Roads

Despite many efforts taken by different governmental and non-governmental organizations all around the world by various programs to be aware of careless driving, 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. A study shows that 5.6% of the fatalities in accidents could have been prevented only if the emergency services could be provided at the place of accident at the proper time. As such, an 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.

1.0.3 IOT

The Internet of Things (IoT) is the term used to refer to the communication between people to things and things to things. In today's society, technology is improving at an exponential rate. Broadband Internet is more widely available and more cost-efficient than ever before. Technology costs are going down and as of 2021, 48% of the world's population use smartphones. The number of smartphone users worldwide is forecast to grow from 3.8 billion in 2021 to around 7.33 billion in 2023. IoT is the focus of research, and industries are investing heavily due to the potential benefits of IoT in various fields. All of these things are creating a ripe environment for IoT. The health-care industry is benefiting from the technological advances that IoT has to offer with improved access to care, increased quality, efficiency, and reduced costs. As the technology for collecting, analyzing and transmitting data in the IoT continues to grow, more IoT-driven healthcare applications, services, and systems emerge.

1.1 Objectives

- To construct a smart vehicle system with minimizing the limitations of existing methods
- To enhance the security of vehicles and human beings
- To Reduce accidental injuries.
- To control the accidents by sending a message to the registered mobile using wireless communications techniques
- To minimise drink and drive cases.
- To monitor the environmental factors of the car

Chapter 2
Literature Survey

2.1 Methods of Communication

The One-Way Communication using GPS for Non-navigational Information[1] provides a better method of communication in the absence of cellular networks. But, when implemented in our project, one of the major drawbacks is the transmission signal frequency. The estimated signal frequency is 0.5B/s. To transmit the latitude and longitude of the location which is usually 64 bits (8 Bytes), it takes approximately 16s, which is too large in an emergency.

The conventional method of signal / message transmission by making use of GSM[5], is cost effective, and simpler than the other non-conventional techniques. It offers Larger network coverage, along with two-way voice and data communication between the in-vehicle unit and the Control Station.

Emergency Communications is another efficient method of communication[2] (emergency). For each emergency call for which the subscriber or user number has been identified, public telephone network operators provide the capability to public safety answering points and emergency services of renewing the location information through a call back functionality (pulling) for the purpose of handling the emergency, also the transmission of information in the form of SMS is possible.

Another way to communicate is by using a Satellite phone[4]. The Satellite phones can be tracked through their own built-in GPS devices or weak encryption protocols. The key advantage is observed in an environment where normal Internet access is either shut down or severely restricted, satellite phones remain a key way to transmit and report information.

GPS-Based Message Broadcasting for Inter-vehicle Communication[3] is an alternate method of communicating in the absence of cellular networks. Inter Vehicle Communication (IVC) is the exchange and distribution of data such as congestion or emergency information from one vehicle to another (nearby) and thereby reaching the data center. But this method of communication fails in the absence of nearby vehicles.

Many research works are going on in this topic. Md. Marufi Rahman developed a system that can locate the real time GPS coordinate which will then be sent to a cell phone[7]. Prof. Dr. Bharati Wukkadada, proposed a device that can track animals, resources, and also automobiles that are being robbed[8]. Seok Ju Lee also developed a system that is of low cost and was able to locate a vehicle's position in an effective way[9].

Chapter 3
System Architecture and Methodology

3.1 Block Diagram

The controller used in this project is Arduino which is used for controlling all the modules in the circuit. The two major parts other than the controller is the GPS module which is used as a receiver and the other module is GSM. To receive the coordinates of the vehicle GPS module is used and GSM will send the received coordinates to the user through SMS.There is an additional LCD which is used for displaying status message or coordinates. When a person is driving the vehicle met with an accident then the vibrations of the vehicle is received by the vibration sensor and the sensor acts as a accident detection module which further send the information to the micro controller and the location of the vehicle is received through GPS module and the coordinates

The vehicle is send to the GSM module. The received information is send to arduino uno. The received coordinate information is collected and is send to the

respected person through SMS.

Fig. 3.1 depicts the flow / block diagram of the project.

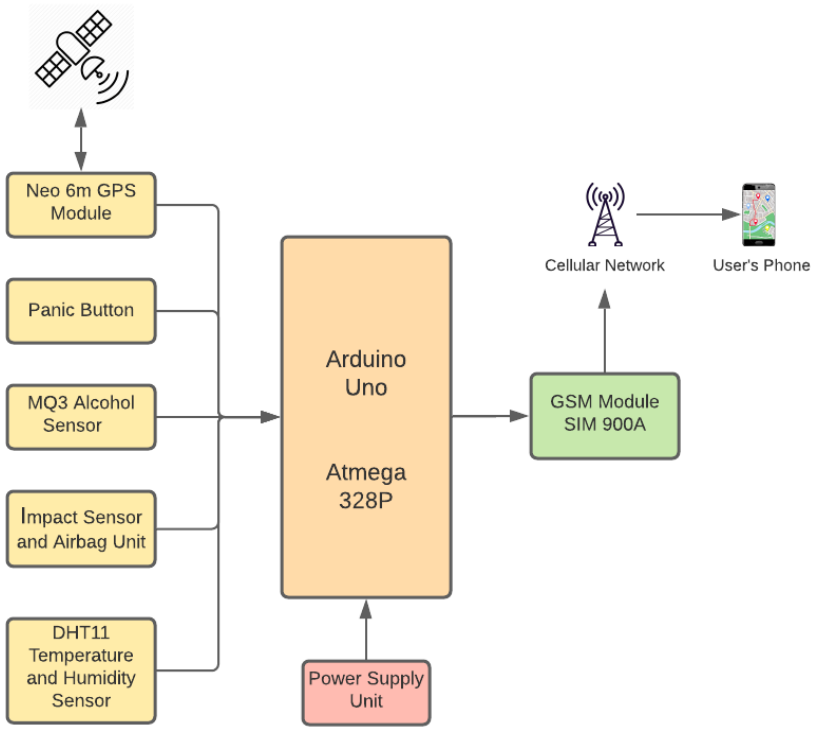

Fig. 3.1 Block Diagram

3.2 Architecture Design

3.2.1 Hardware Interface:

- Power supply with processor
- Vibration Sensor with processor
- GPS with processor as input and output and device tracker
- Display unit for output from processor

3.2.2 Software Interface:

- Attaching and integrating message system with display
- Calling Google Map API and converting latitude and longitude location.

3.2.3 Communication Interface:

- Messaging apps to send location, to be used by any browser.

3.3 Physical Design

3.3.1 Power Supply

The following components require a power supply of +5V.

- Arduino Uno
- SW-420 Vibration Sensor
- GPS-6m
- DHT11 Temperature and Humidity Sensor
- MQ-4 Gas Sensor
- LCD Display
- Panic Button
- Buzzer

3.3.2 Input

i. Arduino Uno:
   - Input is received from the interfaced sensors

ii. SW-420 Vibration Sensor
   - Input is either received from panic button or any vibration

iii. GPS-6m
   - The input location is received from the satellite.

3.3.3 Output

i. Arduino Uno
   - The output of the Arduino is either displayed on the LCD or in the virtual terminal (in the case for Temperature and Humidity)

ii. SW-420 Vibration Sensor
   - The binary valued output of SW-420 is sent to the Arduino for further processing.

iii. GPS-6m
   - The received latitude and longitude details are sent to the Arduino for further processing (displaying and transmitting through GSM).

iv. DHT11 Temperature and Humidity Sensor
   - The sensed temperature and humidity values are sent to the Arduino and displayed in the virtual terminal.

v. MQ-4 Gas Sensor
   - On detection of Alcohol, the binary valued output is sent through the Arduino to display in the virtual terminal.

Chapter 4
Hardware and Software Components

4.1 Hardware requirements

4.1.1 Arduino Uno

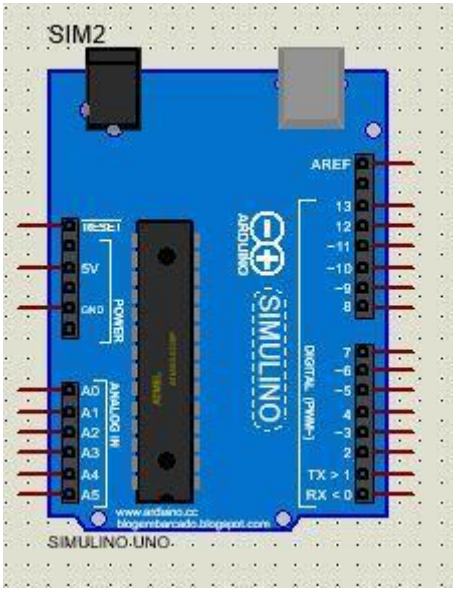

Fig. 4.1 Arduino Uno Module

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

4.1.2 Neo 6m GPS

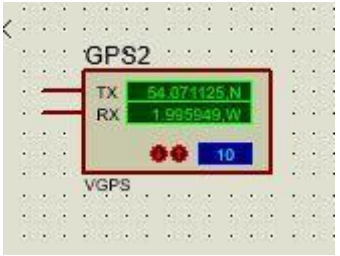

Fig. 4.2 Neo 6m GPS Module

The NEO-6m module is a stand-alone GPS receiver featuring the high performance u-blox 6 positioning engine. It is a flexible and cost effective receiver that offers numerous connectivity options in a mini 160 x 122 x 24

cm package. It has a compact architecture and power and memory options which makes NEO-6m modules optimal for space constraint, low cost devices. It has an acquisition engine, and 2 million effective correlators, and is capable of making enormous parallel frequency searches, thus it can find satellites within a small time. This 50-channel u-blox 6 positioning engine gives a Time to First Fix of around 1-2 seconds. It has an anti jamming technology, Eeprom for storing settings which gives these receivers fantastic navigation performance even when placed in extremely difficult environments.

4.1.3 SW 420 Vibration Sensor

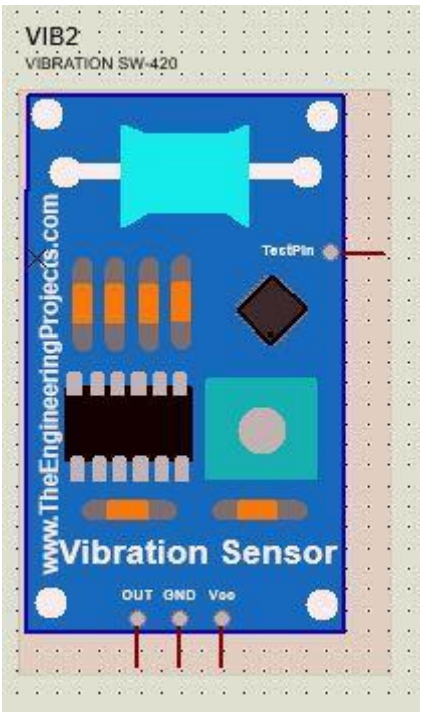

Fig. 4.3 sw420 Vibration Sensor Module

The sw420 sensor module gives outputs as ‘1’s or ‘0’s depending on vibration, tilt and external force applied on it. In the absence of vibration, this module gives logic ‘0’ as output and in presence of vibration, it gives logic ‘1’ as output. It has a sensitivity control on the board.

4.1.4 Panic Button

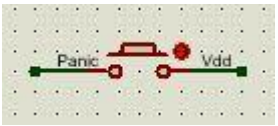

Fig. 4.4 Panic Button Module

A Panic button is placed such that whenever a passenger feels terror and discomfort due to certain reasons, an alert message is raised by sending an SMS on pressing the button. There can be multiple panic buttons placed at different spots in the vehicle and connected to the Arduino.

4.1.5 *MQ-4 Gas Sensor*

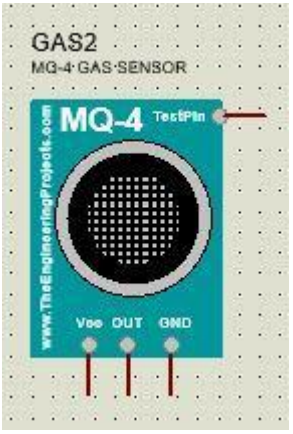

Fig. 4.5 MQ-4 Gas Sensor Module

In this proposed system, an MQ-4 Ethanol Sensor is placed on the steering of the car or seat belt of the driver seat, such that it can monitor the percentage of alcohol in the breath of the driver. If it is found to be higher than set limits, then the arduino signals the GSM to send an alert for the same to the driver's predefined safety number (such as a home number). Measures can also include not to start the car engine unless the alcohol percentage reduces.

4.1.6 *DHT-11 Temperature and Humidity Sensor*

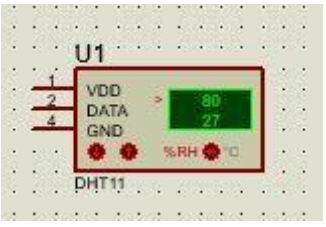

Fig. 4.6 DHT-11 Temperature and Humidity Sensor Module

The DHT11 is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the

surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). Its fairly simple to use, but requires careful timing to grab data.

4.2 Software Components

4.2.1 *Proteus Simulation Tool*

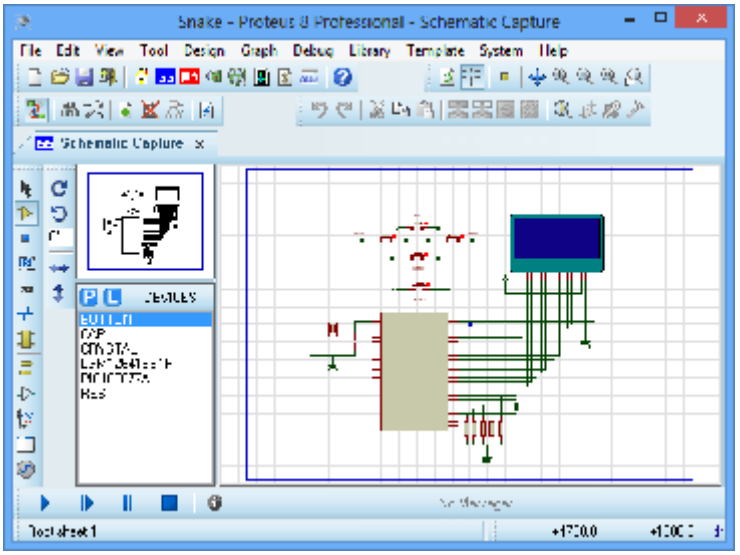

Fig. 4.7 Proteus simulation tool

The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards.

4.2.2 *Arduino IDE*

Fig. 4.8 Arduino Open Source IDE

The Arduino Integrated Development Environment is a cross-platform application that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards.

Chapter 5
Implementation and Results

5.1 Implementation

The Global Positioning System (GPS) is a popular technology which was developed by American Department of Defense (DoD) for military use. Later on it was available for civilian use. It is utilized for a wide range of applications such as location, direction, speed, timing, surveying, logistics, traffic management, security etc. Nowadays, it has become an integral part of a vehicle system for tracking and navigation. It can provide accurate time, location coordinate and speed.

On the other hand, Global System for Mobile communications (GSM) is a digital mobile telephony system that is widely used. More than 690 mobile networks provide GSM services across 213 countries and GSM represents 82.4% of all global mobile connections. Besides the voice communication it also offers Short Message Service (SMS) and General packet radio service (GPRS) to transfer data.

This can eliminate the need for an operator. When the vehicle is in an accident it communicates directly with emergency services and family members giving the severity of the accident, GPS location, and the car ID. Ambulances are currently capable of sending patient information to the hospital. The uniqueness of this project is that sensors detect an accident and information is sent immediately to the hospital, thus eliminating the need for an intermediary step. In our proposed system, we send the live location of the victim, if an accident occurs, then the same is detected using sensors, and it will be sent to the microcontroller. Further the GPS modem continuously receives the coordinates and gives the data to the microcontroller after that information obtained from the GPS module is sent to the hospital, which can be further sent to the ambulance and also to family members and nearby police stations. Also an alarm is rung after the accidents so that ambulance, police, and family members easily locate the place. From this module we can also detect the theft vehicle through GPS modem and microcontroller and easily locate the theft vehicle. From this project we can save many lives everyday by providing timely aid to the victims if accidents have happened.

A panic button can also be placed such that whenever a passenger / driver feels terror and discomfort (health emergencies) due to certain reasons, an alert message is raised by sending an SMS on pressing the button. There can be multiple panic buttons placed at different spots in the vehicle and connected to the Arduino.

In the intended system of Drink and Drive prevention, an MQ-3 Ethanol Sensor will be placed on the steering of the car or seat belt of the driver seat, such that it can monitor the percentage of alcohol in the breath of the driver. If it is found to be higher than set

limits, then the arduino signals the GSM to send an alert for the same to the driver's predefined safety number (such as a home number). Measures can also include not to start the car engine unless the alcohol percentage reduces.

In the intended system of Cabin Monitoring, on sending a pre-designated string such as a "hello" to the SIM card in the GSM module, the real-time parameters such as temperature and humidity are read by the sensors in the car (eg. DHT-11) and sent via an SMS to the user.

5.2 Input / Output

Input to the accident detection system is obtained through the sensor, which is triggered due to an accident.

The output of the accident detection system is the GPS coordinates sent to the hospital, police station, predefined number.

The Alert signal along with the Location can be sent using either of the three techniques:

i. GSM
ii. Non-navigational information using one-way communication(OWS) in GPS
iii. Satellite communication using Satellite Phone
iv. Emergency Calling features

5.3 Result

The figure 5.1 shows the schematic of the designed proposed accident detection system. The figure 5.2 shows the welcome screen when the device is turned on. On encountering an accident, the gps module sends the current location through GSM, and the same is displayed on the LCD. An emergency switch called Panic Button is also linked to the GPS Module, which when triggered sends the current location to the registered mobile number, using GSM, as shown in figures 5.3 and 5.4. The device successfully detects the presence of alcohol in the breath of the driver as shown in the figures 5.5 and turns off the car.

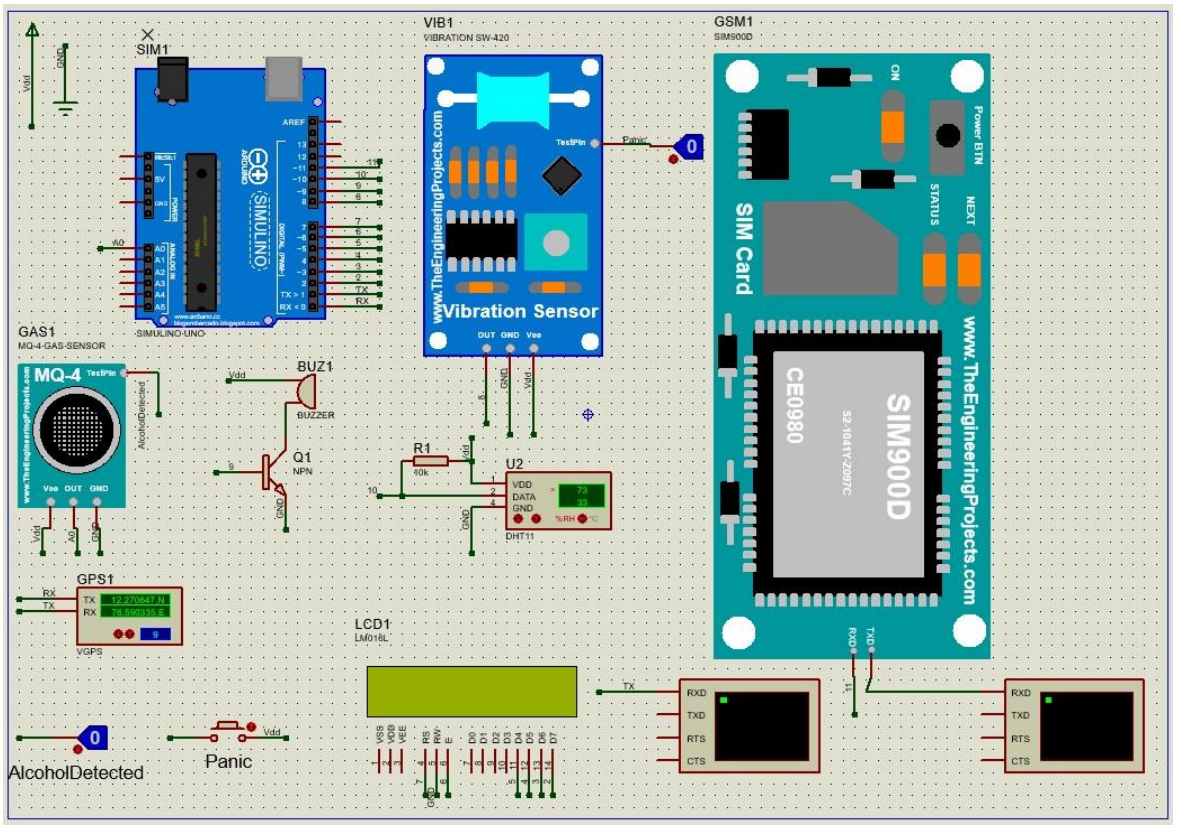

Fig. 5.1 Schematic Capture

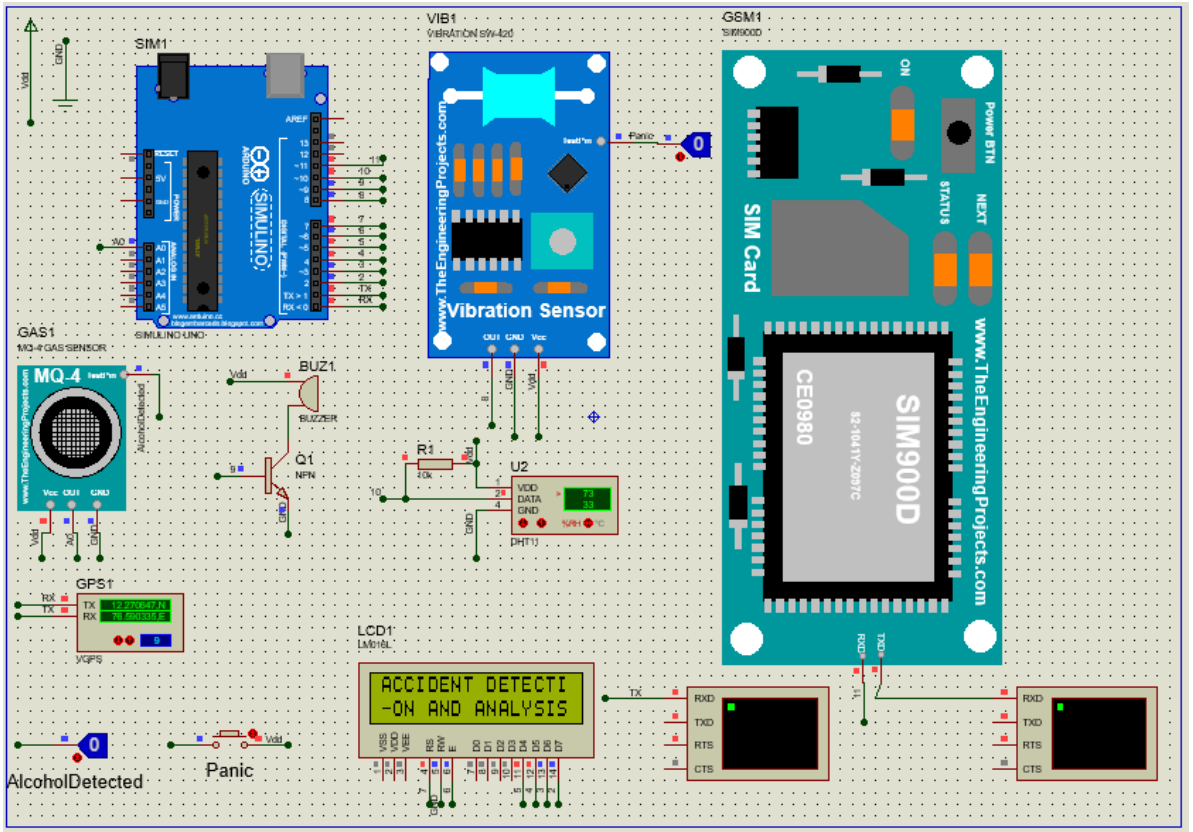

Fig. 5.2 Welcome Screen Capture

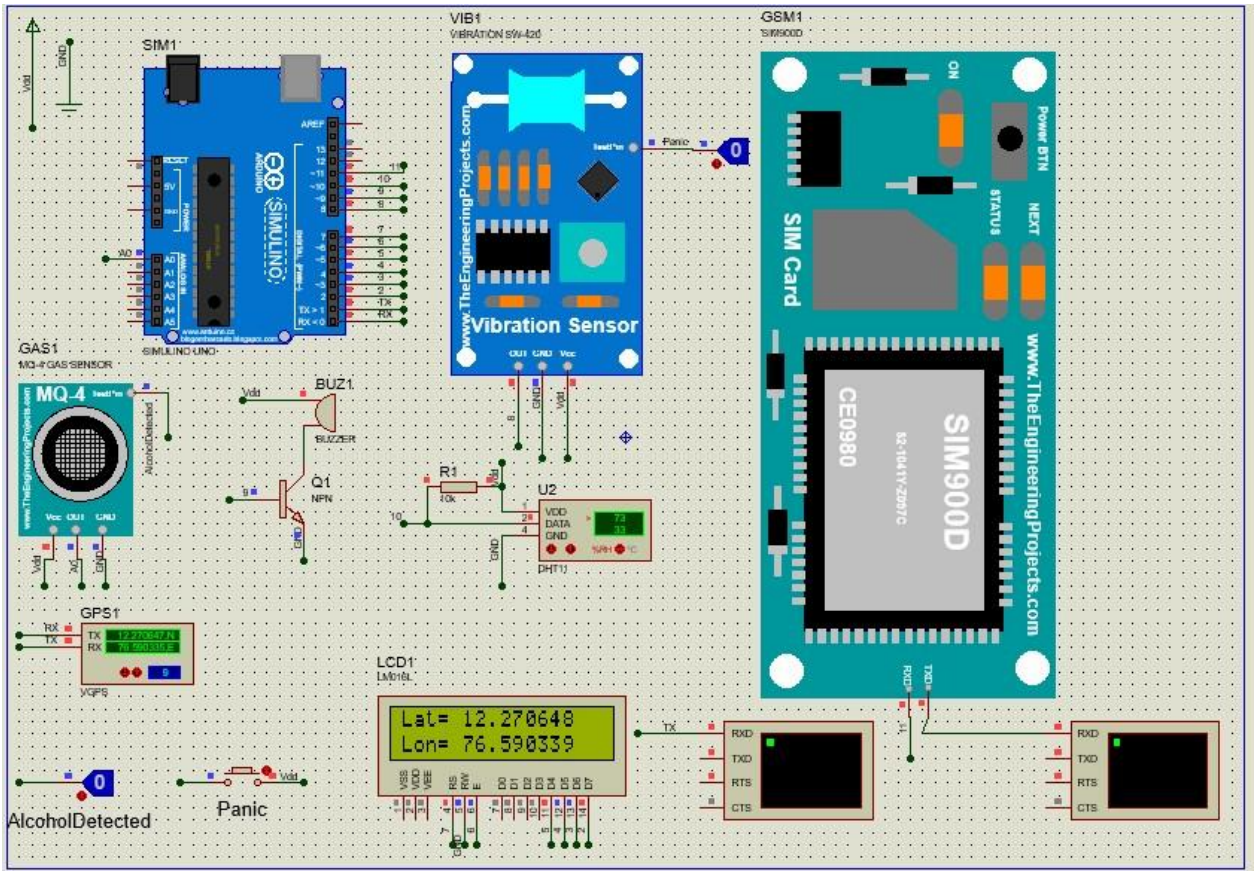

Fig. 5.3 Geographic Location Display

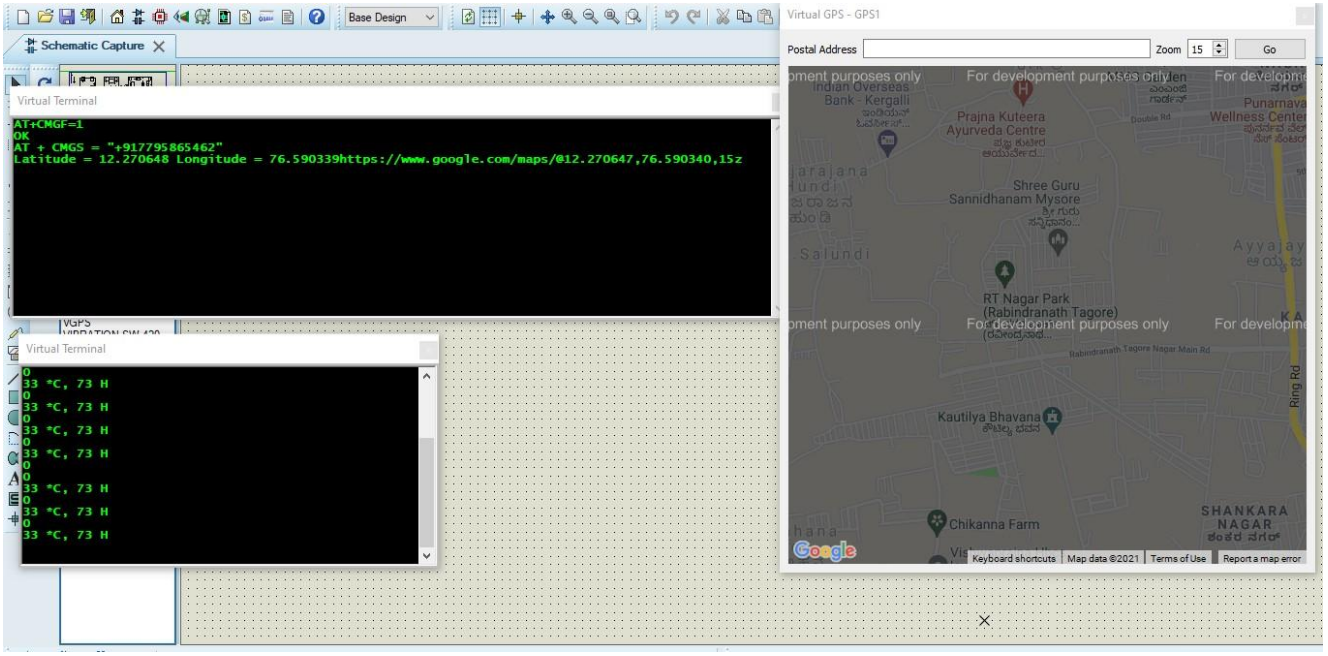

Fig. 5.4 Geographic Location sent through GSM

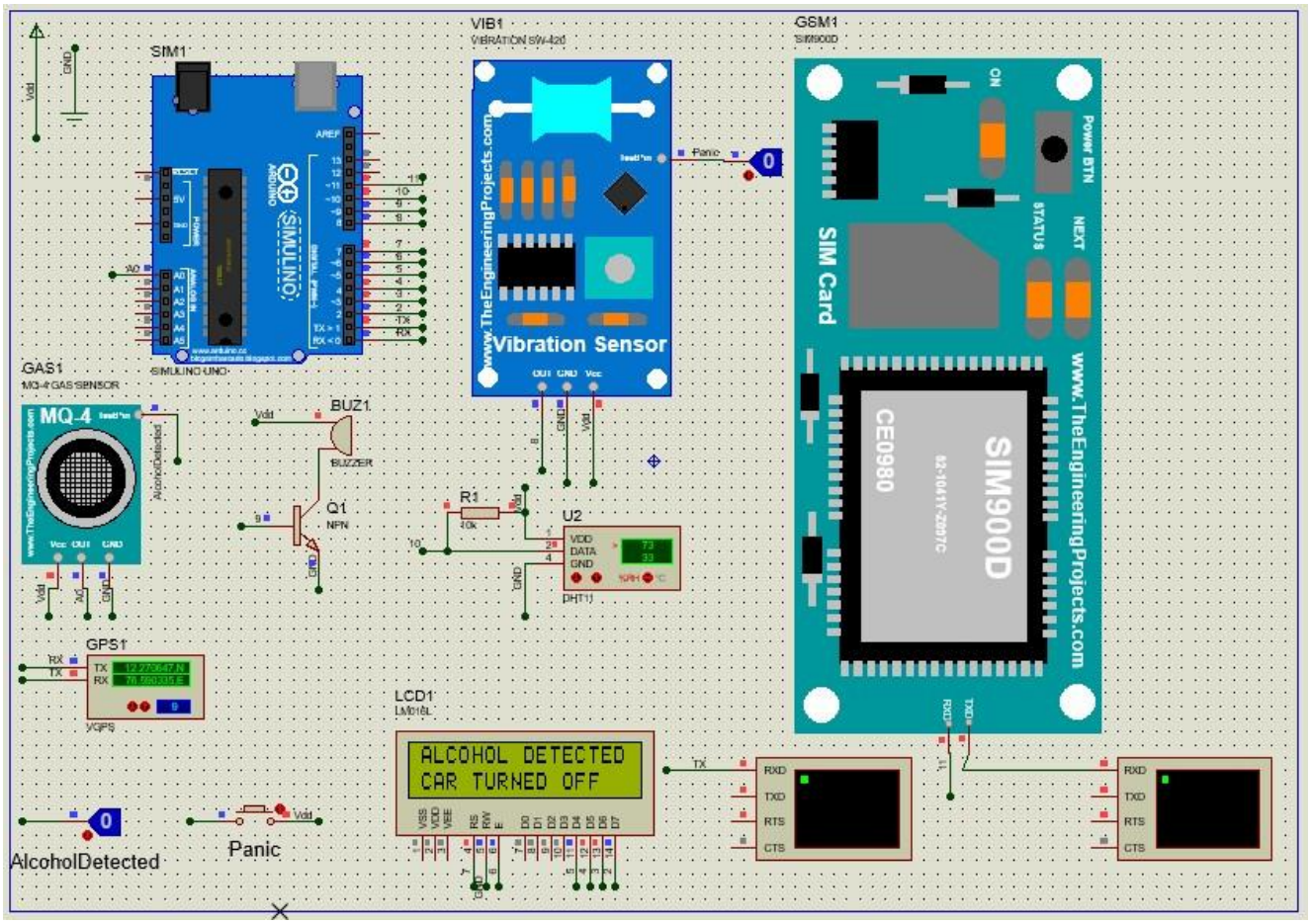

Fig. 5.5 Alcohol Detection Display

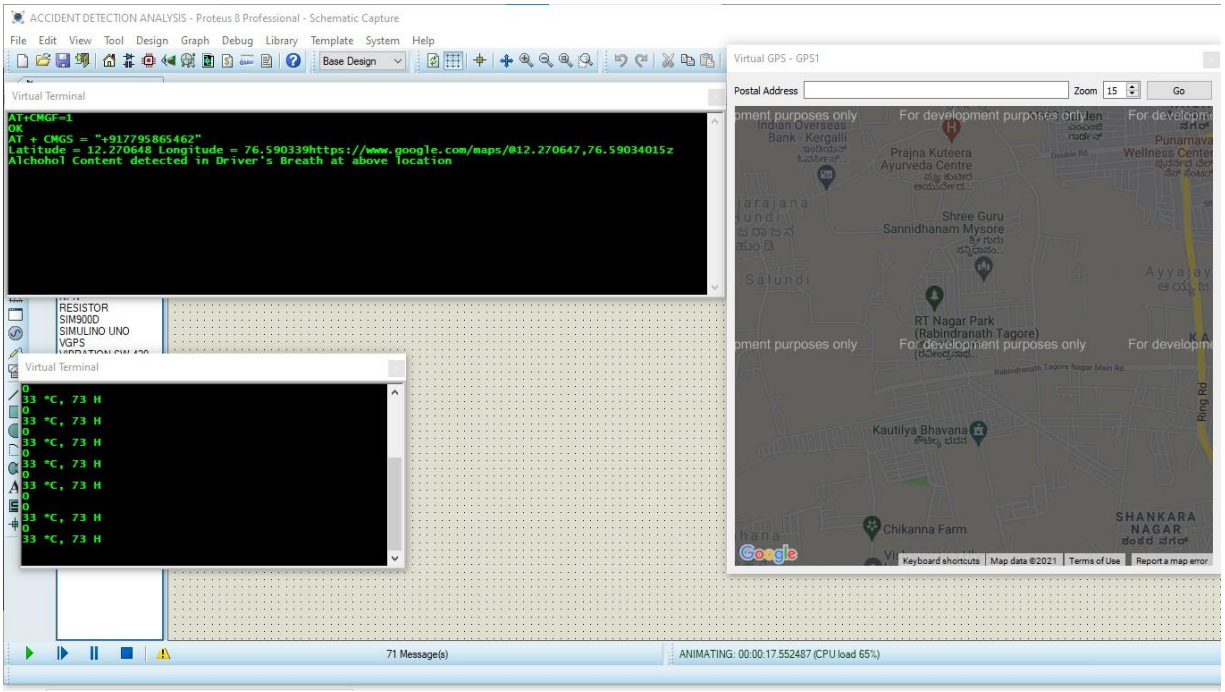

Fig. 5.6 Alcohol Detected message sent through GSM

The Tables 5.1 and 5.2 represent the delay time of events. This is due to the heavy load on the CPU by the simulator.

Event	On time (s)	Off time (s)
Initial Boot Display	7.9	13.2
Temperature and Humidity Display	14	NA
Gas Sensor Trigger	21	NA
Buzzer / LCD Display	28	53.7
Vibration Sensor Trigger	59.6	NA
LCD Display	1:08.6	1:13.9

Table. 5.1 On and Off time of various operations

Event	On Time after Trigger (s)
Booting (Display)	7.9
Gas Sensor output	8
Vibration Sensor Output	9

Table. 5.2 Delay time

Chapter 6
Conclusion

6.1 Advantages

- This system is an immediate aid system.
- Monitors all hazards and threats.
- Alert messages are sent to the nearby hospitals and police stations.
- It is an affordable system.
- Can be used in any kind of vehicle.
- The alert message regarding the accident is automatically sent,
- This system can be used for a social cause.
- It does not need any operation manually.

6.2 Conclusion and Future Work

In modern cities, the volume of vehicles has increased drastically in recent years. This increased traffic has resulted in increase in the number of accidents. While there exist a number of accident detection systems being brought to market, still a significant number of fatalities arise. At least part of this problem is due to the lack of a timely response to serious accidents, caused by inadequate automatic accident detection and inefficient notification and routing of emergency response. The lack of availability of effective systems, for affordability and retrofitting capability issues, only exacerbates the problem. To address these issues, we propose an IoT-based system for accident detection. We have shown that using a variety of different sensors can help in detecting a road accident more accurately. The proposed system immediately detects the location of an accident and calculates the nearest hospital and sends an emergency request for assistance to the required hospital department. This system takes the decision on the basis of data received from smartphone sensors, detecting information about the vehicle status. We have demonstrated that our proposed approach reduces the number of false alarms seen in earlier work. In the near future, the system performance can be enhanced by introducing mobile edge computing to reduce latency, security and privacy. Indeed, the system requires a full security and privacy analysis, and we intend to address this in future work.

6.3 Project Outcome:

i. The completion of the project, enables the demonstration of the working of prototype model.
ii. A technical report is prepared and submitted

6.4 Applications

i. Accident detection
ii. Vehicle Theft detection / tracking
iii. Real time monitoring of car

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