Synopsis on
"Smart Car with Accident Detection"

Carried out on
"Design And Implementation Lab (EC67L)"

Submitted by

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1. Concept

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.

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. 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. 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. 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.

In this project we intend 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 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.

2. Literature Survey

The One-Way Communication using GPS for Non-navigational Information[1] to provides better method of communication in the absence of cellular network. 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. It is also capable of Sending vehicle location and other information as an SMS or GPRS message.

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. This information is not provided by the network and it is routed via a different path than the voice service. But its implementation requires permission from the organization / Government.

Another way to communicate is by using 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 network. Inter Vehicle Communication (IVC) is the exchange and distribution of data such as congestion or emergency information form one vehicle to another (nearby) and thereby reach the data center. But this method of communication fails in the absence of nearby vehicles.

3. System Design

3.1 Architecture Design

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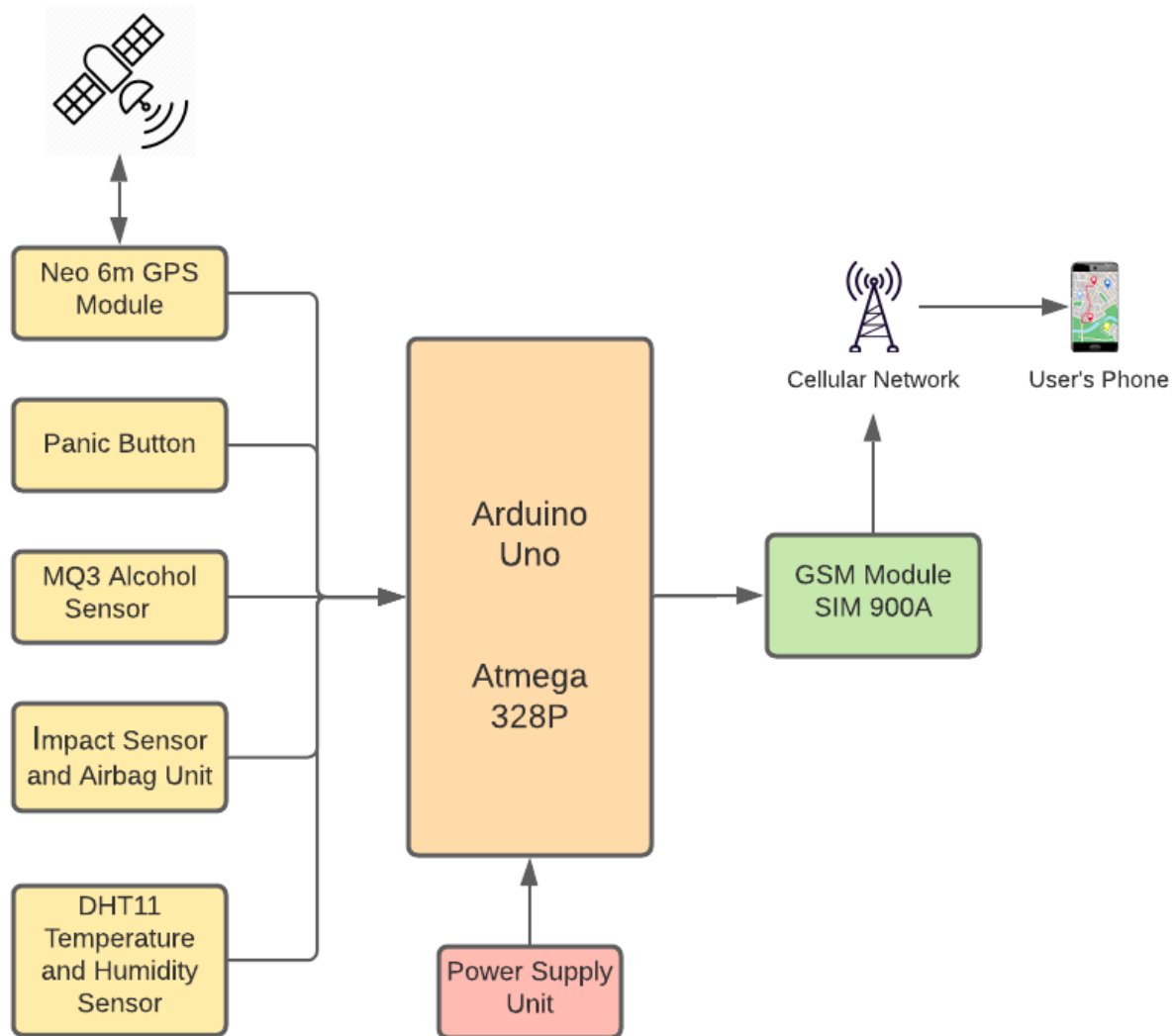

Fig. 3.1 Block Diagram

3.1.1 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

3.1.2 Software Interface:

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

3.1.3 Communication Interface:

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

3.2 Logical Design
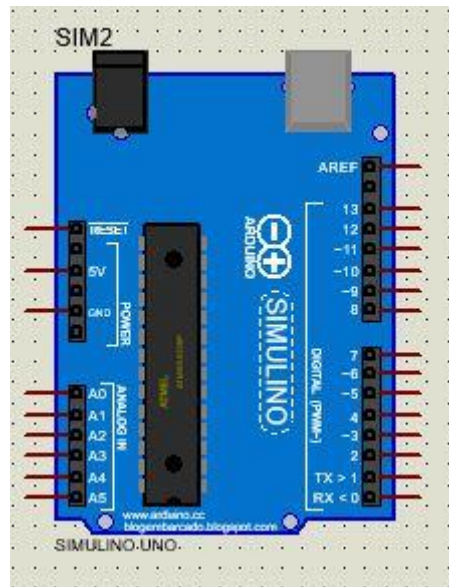
3.2.1 *Arduino iUno*

Fig. 3.2 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.
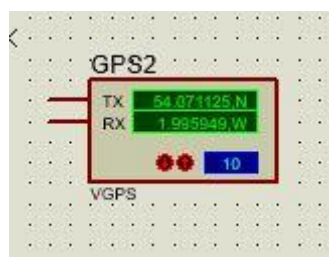
3.2.2 *Neo 6m GPS*

Fig. 3.3 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 an 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 a acquisition engine, and 2 million effective correlators, and is capable of making enormous parallel frequency search, thus it can find a 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.
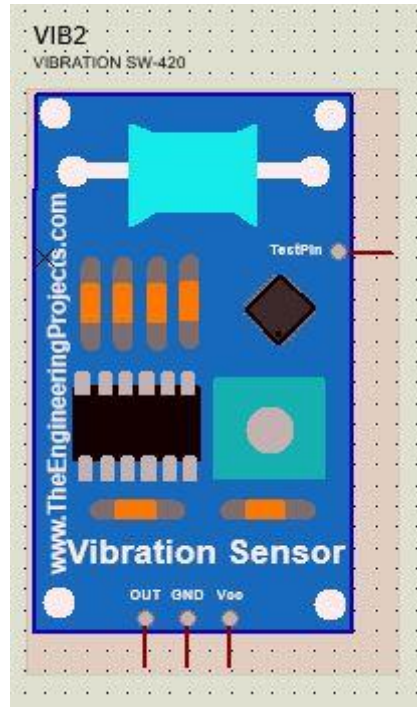
3.2.3 *SW 420 Vibration Sensor*

Fig. 3.4 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 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.

3.2.4 *Panic Button*

Fig. 3.5 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.
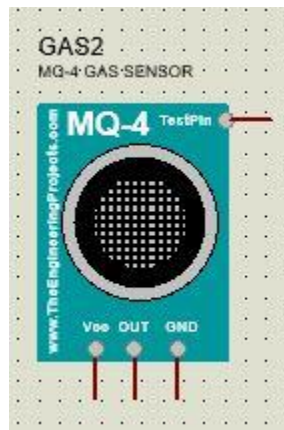
3.2.5 *MQ-4 Gas Sensor*

Fig. 3.6 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 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.

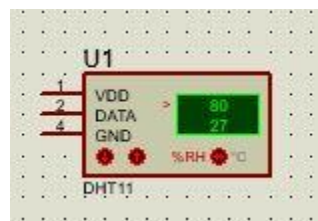### 3.2.6 *DHT-11 Temperature and Humidity Sensor*

Fig. 3.7 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.

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.

4. Brief Description

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 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 system. 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 victim, if somewhere accident occurs, then the same is detected using sensors, and it will be sent to the microcontroller. Further the GPS modem continuously receives the co-ordinates and gives the data to microcontroller after that information obtained from GPS module sends to the hospital, which can be further sent to the ambulance and also to family members and nearby police station. Also an alarm is rung after the accidents so that ambulance, police, and family member 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 has 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 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. Input / Output

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

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

6. Applications

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

7. Project Outcome:

  i.   After the completion of the project, we will demonstrate the working of prototype model using hardware components
  ii. A technical report will be prepared and submitted.
  iii. Throughout this project we intend to work with an aim of writing (publishing) a paper.

8. Schedule / Pert Chart

Week / Date	Work
1st and 2nd / 10.03.2021 – 23.03.2021	Literature Survey
3rd / 24.03.2021 - 30.03.2021	Topic finalization and Synopsis
4th – 7th / 01.04.2021 – 20.04.2021	Design and Component Specification
8th - 11th / 23.04.2021 – 18.05.2021	Implementation / Working Verification
12th - 14th / 24.05.2021 - 10.06.2021	Changes / Corrections / Final Submission / Report

9. References

[1] C. Xi-jun, X. Jiang-ning, C. Ke-jin and Z. Ying-bin, "Analysis on the One-Way Communication Capability of GPS Satellites in Orbit Transmitting Non-navigational Information," 2009 International Conference on Computer Technology, Malaysia, 2009, pp. 24-29, doi: 10.1109/ICCTD.2009.135.

[2] Technical Report Emergency Communications (EMTEL); Basis of requirements for communication of individuals with authorities/organizations in case of distress (Emergency call handling)

[3] Min-Te Sun, Wu-Chi Feng, Ten-Hwang Lai, K. Yamada, H. Okada and K. Fujimura, "GPS-based message broadcasting for inter-vehicle communication," Proceedings 2000 International Conference on Parallel Processing, Toronto, ON, Canada, 2000, pp. 279-286, doi: 10.1109/ICPP.2000.876143.

[4] Caveat utilitor: Satellite phones can always be tracked By Frank Smyth/CPJ Senior Adviser for Journalist Security on February 24, 2012 6:03 PM EST

[5] Fernandez Savari, George & Palanisamy, R. & Krishnasamy, Vijayakumar. (2018). GPS & GSM based accident detection and auto intimation. Indonesian Journal of Electrical Engineering and Computer Science. 11. 356-361. 10.11591/ijeecs.v11.i1.pp356-361.