Smart Data Acquisition System

(SDAS)

By

Capt Moiz Aftab

Capt Faisal Khan

Capt Abdul Wahab khan

Capt Mohsin Zulfiqar

Supervised by:

Brig Adil Masood

Submitted to the faculty of Department of Electrical Engineering,
Military College of Signals, National University of Sciences and Technology, Islamabad,
in partial fulfillment for the requirements of B.E Degree in Electrical (Telecom) Engineering.

June 2022

In the name of ALLAH, the Most benevolent, the Most Courteous

CERTIFICATE OF CORRECTNESS AND APPROVAL

This is to officially state that the thesis work contained in this report

"Smart Data Acquisition System"

is carried out by

Capt Moiz Aftab

Capt Faisal Khan

Capt Abdul Wahab khan

Capt Mohsin Zulfiqar

under my supervision and that in my judgement, it is fully ample, in scope and excellence, for the degree of Bachelor of Electrical (Telecom) Engineering in Military College of Signals, National University of Sciences and Technology (NUST), Islamabad

Approved by

Supervisor

Brig Adil Masood

Department of EE, MCS

Date: 24-May-2022

DECLARATION OF ORIGINALITY

We hereby declare that no portion of work presented in this thesis has been submitted in support of another award or qualification in either this institute or anywhere else.

ACKNOWLEDGEMENTS

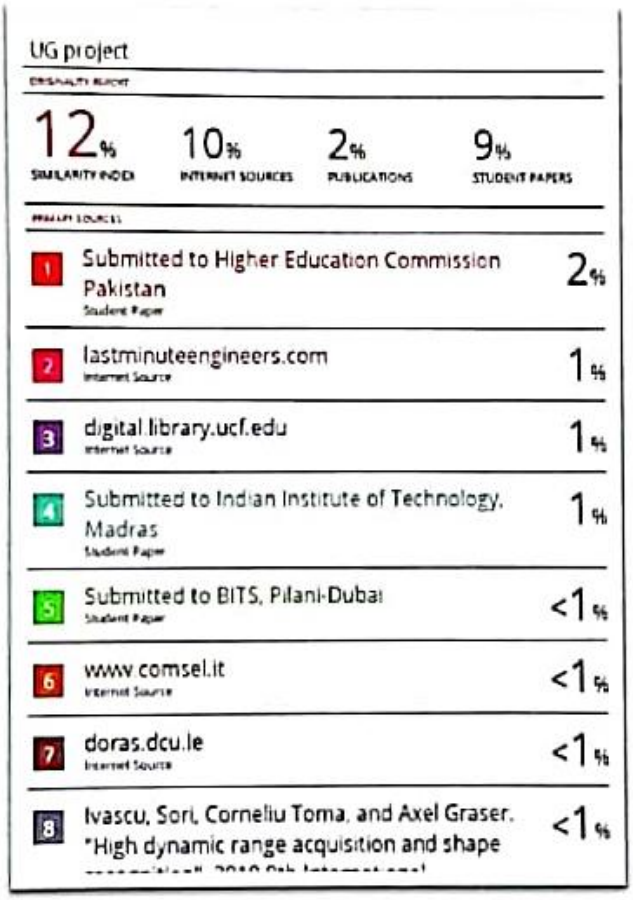
Allah Subhan'Wa'Tala is the sole guidance in all domains.

Our parents, colleagues and most of all supervisor, Brig Adil Masood with your guidance.

The group members, who through all adversities worked steadfastly.

Plagiarism Certificate (Turnitin Report)

This thesis has 12% similarity index. Turnitin report endorsed by Supervisor is attached.



UG project

12%	10%	2%	9%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Higher Education Commission Pakistan Student Paper	2%
2	lastminuteengineers.com Internet Source	1%
3	digital library.ucf.edu Internet Source	1%
4	Submitted to Indian Institute of Technology, Madras Student Paper	1%
5	Submitted to BITS, Pilani-Dubai Student Paper	<1%
6	www.comsel.it Internet Source	<1%
7	doras.dcu.ie Internet Source	<1%
8	Ivascu, Sori, Corneliu Toma, and Axel Graser. "High dynamic range acquisition and shape	<1%

Capt Moiz Aftab
NUST Serial no
00000280731

Capt Faisal khan
NUST Serial no
00000280730

Capt Abdul Wahab Khan
NUST Serial no
00000280734

Capt Mohsin Zulfiqar
NUST Serial no
00000280752

Signature of Supervisor

ABSTRACT

Our proposed project comprises of a system based on Data Acquisition that has an Over-speeding alert and location tracker module, an accident detection alert and locator, an obstacle avoidance system and a Black Box system for recording of the conversation during the course of commutation. Over-speeding alert module consists of a speedometer, a microcontroller and a GPS module that logs the location data of the point of over-speeding. The data is logged onto a memory unit that is installed on the module. The real-time speed of the vehicle can also be monitored digitally on a Liquid Crystal Display. The speedometer of the vehicle consists of an optical based speed sensor. The second module is the accident location tracker and alert system based on GPS and GSM module. The accident is detected using a 3-axis accelerometer. Exact GPS coordinates of the accident location are data logged onto memory card and an SMS based alert system sends the coordinates to contact numbers programmed into the microcontroller. The coordinates (longitude and latitude) are sent in the form of Google Maps links. The 3rd module equips with obstacle avoiding system that uses SONAR (Sound Navigation and Ranging). An ultrasonic sensor mounted onto the vehicle detects the obstacles in front of the vehicle and logs the respective data. The vehicle also senses the way to move on by looking towards either side. The 4th module is a "Vehicle Black Box" that logs the voice data of the conversation during the course of commutation. All the modules are mounted on a robot vehicle chassis. The vehicle is a rechargeable that has an option of variable speed.

Contents

List of Figures

Chapter 1: Introduction

Over speeding is one of the major issues due to which accidents takes place and many people suffer huge losses financial as well as physical disabilities. People do over speeding because there is no proper monitoring system, they abide traffic rules and get away with it. Recently the speed monitoring system that a motorway police use is laser gun. It is a gun like radar used to detect speed but cannot record it

GPS based vehicle speed monitoring system will aid the society by eradicating the risk of road traffic accidents which occur frequently on highways or motorways due to over speeding. When there will be proper monitoring system introduced people will follow traffic rules. When there is a device placed inside a vehicle entering on a motorway that is continuously monitoring its speed throughout the journey the probability of over speeding will be reduced people will not risk their life.

The system is designed primarily for surveillance and monitoring the track record of vehicle moving on road and at remote locations. It is combination of data acquisition modules and smart features that enhance the security and ensure adherence to the traffic rules. This system promotes hazard free environment and ensures the safety of lives, along with 24-hour monitoring and recording the violations of traffic rules.The accident alert system works on GPS and incase of any eventuality, the SMS is sent on predefined mobile no's automatically when collision is detected. All the mentioned features, when installed in a vehicle would add to the security and ensure rules and regulations are followed, despite this any unforeseen eventuality gets recorded and supervised even from distant or remote location of the vehicle

1.1 Overview

Today's world is a world of digitalization. The growing tech field and exponential development in the fields of transport, medicine, metropolitan cities have become the most influential developments in the lives of mankind. Smart data acquisition system will provide a secure, automated vehicle, that is bound to follow the rules of traffic. Data acquisition enables complete surveillance and supervision over the drivers and vehicles at distant locations. It ensures hazard free environment and minimizing the chances of the accidents, making lives people and traffic more secure. It also aims to reduce the manpower deployment for ensuring the safety of roads and traffic environment as this system would provide feedback and keep aware the rear HQs about current vehicular activities. It makes urban areas and colonies comprehensive, secure, tough and maintainable. The sole purpose of this project is to integrate smart features and gadgets in vehicle for data acquisition and analysis to ensure road safety and to take a step forward in the world of automotive gadgets

1.2 Problem Statement

Pakistan is a third world underdeveloped country. For traffic administration, traditionally traffic light system is used, but it has many limitations that lead to ever-increasing traffic congestion. Following are some highlights of the existing traffic control system.

1. Manual operation of traffic signals by traffic wardens increases the demand for manpower.
2. Empty roads are nothing to do with the traffic signal period that leads to time waste.
3. Large traffic congestion due to non-uniform flow of traffic about any junction.
4. Any sensors installed for traffic administration are mostly active. They must be re-installed, whenever the roads are reconstructed.
5. Increased human irritability is another cause of traffic violations.

People risk there life and over speed and sometime get away with it if there is no camera monitoring their speed. Due to over speeding accidents takes place. People have to suffer from huge financial loses as well as physical disabilities. People over speed accidents takes place these all things happen because there is no proper monitoring system in Pakistan

1.3 Proposed Solution

The major goal of our proposed solution is to continuously monitor the traffic flow and vehicle density for all the roads around a junction in Islamabad, Pakistan. Traditional open-loop traffic signal systems must be replaced by smart closed-loop traffic signal systems. The proposed closed-loop traffic signal system is capable of learning and predicting the live traffic density. Another important feature of our proposed system is to detect emergency vehicles like ambulances or fire brigade trucks and give priority to them.

1.4 Working Mechanism

The project mainly follows the principles of data acquisition amalgamated with feedback mechanism. The project is divided into different modulus and every module linked with the next module. The list of modules is as under:

- Accident / topple alert System of Vehicle
- Speed and location data collector
- Obstacle avoidance module
- Vehicle Black box (during the course of commutation)

1.5 Objectives

1.5.1 General Objectives:

"To build an innovative system designed primarily for surveillance and monitoring the track record of vehicle moving on road and at remote locations. It is combination of data acquisition modules and smart features that enhance the security and ensure adherence to the traffic rules."

1.5.2 Academic Objectives:

- Development of a smart Traffic administration System
- To promotes hazard free environment and ensures the safety of lives
- To reduce the manpower deployment
- To make urban areas and colonies comprehensive, secure, tough and maintainable.
- To merge and make use of smart features and gadgets in vehicle for data acquisition to ensure road safety

1.6 Scope

This project finds its scope wherever there is road, a nearby school and hospital. Its data acquisition enables complete surveillance and supervision over the drivers and vehicles at distant locations. It ensures hazard free environment and minimizing the chances of the accidents, making lives people and traffic more secure. It also aims to reduce the manpower deployment for ensuring the safety of roads and traffic environment as this system would provide feedback and keep aware the rear HQs about current vehicular activities. It makes urban areas and colonies; comprehensive, secure, tough and maintainable. The sole purpose of this project is to integrate smart features and gadgets in vehicle for data acquisition and analysis to ensure road safety and to take a step forward in the world of automotive gadgets

1.7 Deliverables

1.7.1 Accident Alert System

It serves as early warning system incase of any eventuality with the vehicle , and data is shared to preset phone numbers along with the google link shared for exact trace out.

1.7.2 Obstacle avoidance mechanism

It provides the mechanism to avoid collision and divert the course currently undertaken to prevent accident and front collion , it is the immediate braking mechanism applied by this system.

1.7.3 Speed and Location data collection

The speed is recorded for the zones where, violation have been reported and along with the google map link is shared in the SD card module for subsequent tracing out the violation

1.7.4 Black Box (Audio recording)

It helps to record the audio during the course of commutation and eventually save all the data in pluggable SD card for eventual retrieval of data with regards to passengers on board in vehicle

1.8 Relevant Sustainable Development Goals

“11. Make urban areas and colonies comprehensive, secure, tough and maintainable”

Our Project is linked to the above-mentioned sustainable goal, as it

- It regulates the traffic rules on roads
- Minimize the number of accidents on Highways

- Improvise the security and safety of people
- It aims to make the lives of people more safer and promote smart driving system
- It intends to make the traffic environment more sustainable

It also aims to reduce the manpower deployment for ensuring the safety of roads and traffic environment as this system would provide feedback and keep aware the rear HQs about current vehicular activities. It makes urban areas and colonies comprehensive, secure, tough and maintainable. The sole purpose of this project is to integrate smart features and gadgets in vehicle for data acquisition and analysis to ensure road safety and to take a step forward in the world of automotive gadgets

1.9 Structure of Thesis

Chapter 2: Literature review and the background analysis study this thesis is based upon.

Chapter 3: Design and development of the project.

Chapter 4: Detailed evaluation and analysis of the code.

Chapter 5: Conclusion.

Chapter 6: Future work needed to be done for the commercialization of this project.

Chapter 2: Literature Review

1. Literature Review

Map Data Distribution System & Acquisition Device

Map Data Distribution System and Acquisition Device was an electronic device used for the navigation purpose and it had a map of small area and it provides the route guidance for the specific small town. The storage medium used in this device was CD-ROM and it includes map data stored in and the map of the specific area or town was read out from CD-ROM. This device was used for the route guidance of that particular area. At the starting point user had to declare the destination and when he starts his journey the route guidance is initiated using the map.[1]

Map data was distributed through a base station by communication means. It the travelling conditions are not appropriate it alarms the user. In this device the client has to first request for the map of the specific area and when the map of the specific area is determined then it tells the user which route to follow. It was done by using the GPS device which tells about the current position of the client and the destination has to be specified by the client from source and the destination address mentioned by the client it compares it with a map and detects the shortest path and if there is a hurdle at any road it picks an alternative path. For this device he data base had to be very large because if there are numerous number of clients are sending a source and the destination address at the same time it had to save the information and match the location on the map an then had to send the desired map to the client and if there is a hurdle it had to again cross check the data and send the information about the alternative path to the client. [2]

The time required to initiate the device was too long the response time from the server can also be too long due to bad network coverage. The size of the device was also big. As much as big the size is it more difficult for the client to handle it so the device was not handy. GPS module was only used for getting initial position which was sent to serve and then serve had to send the map of that particular route to the destination it consumes lot of time. Sometime people are in hurry everyone always wants to save time they look for the quickest or the shortest path due to these reasons this device was not so successful.

The idea which we came up with was Smart data acquisition device which can be used for the automobiles travelling on highways and motorways it will store all the violations throughout the journey and it will stores it to the SD card. All the violations will be stored with date, time, latitude and longitude. From these coordinates which are obtained from GPS module the desired location can easily be known and there is no chance for the person to escape. [3]

Industrial background

In today's era, one of the major issues faced across the world is traffic road regulation. Traffic congestion has led to many further problems, as discussed in Problem Statement, which increases need for a smart system. Ultimately, results in a big marketplace for industrial development. Initially, Pakistan Industries were barren. Then, these started exporting under liberal policies resulting in increase in industrial growth due to the rapid expansion of domestic demand and encouragement for export. However, there is existing system of speed camera monitoring system designed for the surveillance of traffic and incidents occurrence, but there scope is limited to the smaller area of coverage and restricted monitoring[4]

Existing solutions and their drawbacks

1. Fixed Instantaneous Speed Camera

Fixed instantaneous speed cameras are used for monitoring speed of the vehicles and are placed beside the roads. It detects the speed of every vehicle approaching towards it. When an approaching vehicles speed is above the declared speed it takes the photograph of the vehicles.

Two piezo-electric strips are placed at some distance from the camera on the road. These strips are embedded to the road. When a vehicle passes through these strips it detects the wheel by passing over it exerts the pressure on the strips which results to proportional voltage. This voltage which is produced by the pressure acts as a signal which is further processed by the microprocessor. As we know speed is distance divided by time so the total time it takes between the two strips results in speed. The microprocessor calculates the time taken between the two strips and calculates the speed of the approaching vehicles and if the vehicle is over speeding, then the camera captures the picture

of the vehicle. [5]

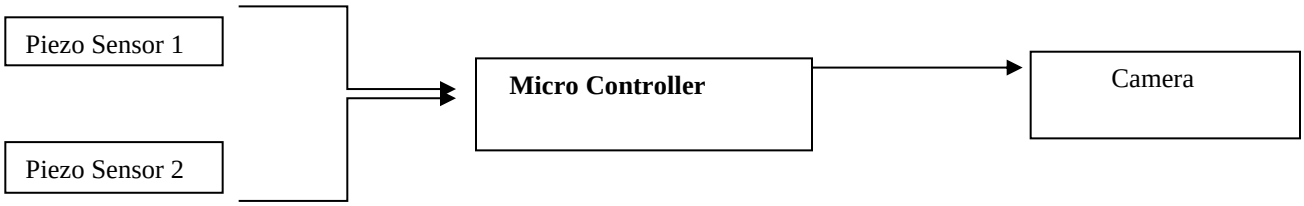


Figure 1 Flow Diagram of instantaneous Speed Camera [2]

To monitor the speed of any vehicles at any instantaneous time is not possible by this camera in order to measure the speed of vehicle on highways and motorways the camera should be present and it's very difficult and expensive way to place a camera at every location after few kilometers. The idea which we came up with monitors the speed of the vehicle throughout the journey on motorways or highways and there is no chance for the person travelling on highways to escape through the over speeding violation. The device is secure enough and it also cannot be tempered. In case of any damage to the device will result in a heavy fine to the client.

2. SPECS Average Speed Cameras

SPECS average speed camera works on the principle of Automatic Number Plate Reading (ANPR) digital technology. ANPR is a technology based on method of mass surveillance and uses optical character recognition on images to read out the registration number of the approaching vehicle. This technology can stores the images of the vehicles and also the text from the license plates and it also captures and stores the image of the driver. It works on the six primary algorithms that a software needs to acknowledge a license plate.

- Pate Localization –responsible for finding and isolating the plate on the picture.
- Plate Orientation And Seizing – responsible for extraction of data from the particular area of the license plate.

- Normalization – It modifies the contrast, brightness and saturation of the image.
- Character Segmentation –It finds the characters on the license plate.
- Optical Character Recognition – It identifies the characters on plate.
- Syntactical Analysis- It checks the characters and positions against country specific rules.

Specs consists of two speed camera both the cameras consist of infrared illuminators and are fitted at some level above the road and these cameras can work at day and night. It calculates the average speed of the vehicles from the distance covered between the two cameras. Specs average speed cameras are placed at some distance above the road to create a speed control zone and some other recording device can also be interconnected to make a velocity control network. By crossing the initial camera when a vehicle enters a speed control zone to the final camera, it records their number plates digitally for whether they are over speeding or driving within the speed limit. Then using the ANPR technology the video from the initial and final cameras are paired up. Comparing both the videos time and the distance travelled between the two points is calculated. As speed is distance divide by time it calculates the speed of the vehicle.

These cameras are more accurate than a radar or a hand held equipment and as they are mounted far away from each other they are not likely to sabotage. But these cameras are very expensive and these cameras can only be mounted on motorways not on some connecting roads because both the cameras are located at distance from one another. There is no way to alarm a driver that he is exceeding the speed limit defined for that particular area. Figure 2.5 shows the SPECS average speed camera.

Figure 2.5 SPECS Average Speed Camera

Chapter 3: Design and development of the project

2. Components Specifications:

The detailed specifications of the components used are given below.

2.1 Arduino Mega 2560:

The general specifications are given below.

2.1.1 General specifications

Parameter	Range/Description
Processor:	ATmega2560 @ 16 MHz
Size of RAM:	8 Kilobytes
Size of Program memory:	248 Kilobytes
Motor channels:	0
User I/O lines:	701
Max current on a single I/O:	40 mA
Minimum operating voltage:	7 Volts
Maximum output voltage:	12 Volts

Figure 3 Arduino Mega 2560 Development Board

Ports

The Arduino Mega 2560 R3 has 54 digital pins for input and output , and of those 54, 15 are capable of being PWM outputs. This board comes with 16 inputs for analog, an ICSP header, and 4 serial ports of hardware There's also a USB Type B port that you can use to upload programs.

Power

The R3 can be powered through the one USB Type B port or the power jack (AC to DC). You can even hook up a battery to the power jack for mobile use.

Microcontroller

The board uses an ATmega2560 microcontroller with 8 KB of memory (RAM), 4 KB of EEPROM (board-stored memory), and flash memory of 256 KBs for code storage. The Arduino Mega 2560 R3 is an 8-bit board and has a speed of 16 MHz.

Other Hardware

The R3 is equipped with a 16-MHz crystal oscillator, which allows it to accurately tell time. The board also has a pre-installed LED, which is connected to pin 13, and a handy reset button.

2.2 Liquid Crystal Display

2.2.1 General Description:

LCD is used in this project to monitor different parameters like speed, location, over-speed limit etc. It is a 20x4 LCD meaning that it has 20 horizontal rows and 4 vertical columns. The detailed specification of the LCD is given below in the table-2.[6]

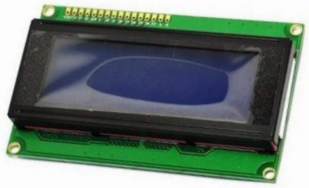


Figure 4 Liquid Crystal Display 20x4

2.2.2 Specification LCD 20X4

The general specifications of the LCD are given below

ITEM	DIMENSION	UNIT
Dot Matrix / Resolution	5×8 dots includes cursor	dots
Characters × Lines	20 Rows × 4 Columns	
Module Dimension	98.0 × 60.0 × 13.6 (MAX)	millimeter
View Area	77.0 × 25.2	millimeter
Active Area	70.4 × 20.8	millimeter
Mounting Hole	93.0 × 55.0	millimeter
Dot / Pixel Size	0.55 × 0.55	millimeter
Dot / Pixel Pitch	0.60 × 0.60	millimeter
Character Size	2.95 × 4.75	millimeter
Character Pitch	3.55 × 5.35	millimeter
Interface	6800, option SPI / I2C (RW1063 IC)	
Power Supply	5V (Also available for 3V)	
Type	Character LCD Display	

2.3 SIM800L GSM Module

2.3.1 General Description:

SIM800L

ITEM	DIMENSION	UNIT
Dot Matrix / Resolution	5×8 dots includes cursor	dots
Characters × Lines	20 Rows × 4 Columns	
Dimensions of Module	98.0 × 60.0 × 13.6 (MAX)	millimeter
View Area	77.0 × 25.2	millimeter
Active Area	70.4 × 20.8	millimeter
Mounting Hole	93.0 × 55.0	millimeter
Dot / Pixel Size	0.55 × 0.55	millimeter
Dot / Pixel Pitch	0.60 × 0.60	millimeter
Character Size	2.95 × 4.75	millimeter
Character Pitch	3.55 × 5.35	millimeter
Interface	6800, option SPI / I2C (RW1063 IC)	
Power Supply	5V (Also available for 3V)	
Type	Character LCD Display	

GSM/GPRS module is quite similar to GSM modem, such that we can call it a miniature version of GSM Modem. It will serve the purpose of sending SMS alerts about the accident location to pre-programmed contact numbers.[7]

2.3.2 SIM800L GSM Module Pin-out:

The SIM800L module has total of 12 pins. These pins connect it to the world outside. Following figure shows its connections:

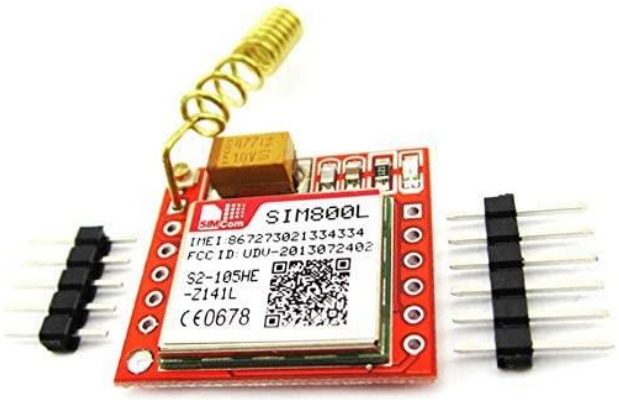


Figure 5 GSM Module SIM800L

VCC is the power of module. It ranges from 3.4 Volts to 4.4 volts.
Connection with a 5V pin can most likely ruin the module. It will not even work on 3.3 Volts.
Only Li-Po battery or DC-DC buck converters of 3.7 Volts and 2 Amperes will work.
NET is a pin where one can solder Helical Antenna which is available with the module.
RST (Reset) is a hard reset pin. In worst cases, this pin can be pulled for 100ms to execute hard reset.
RxD It is the Receiver pin i.e. present for the purpose of serial communication.
TxD It is the Transmitter pin. It is also useful in serial communication.
GND is the Ground Pin. It needs a connection with GND pin on Arduino.

2.3.4 Power Consumption:

The details of the power consumed by the module during different modes are given below.

Mode	Frequency	Current Consumption
Power down mode		60 micro-ampere
Sleep mode		1 milli-ampere
Stand-by mode		18 milli-ampere
Callmode	GSM850	199 milli-ampere
	EGSM900	216 milli-ampere
	DCS1800	146 milli-ampere
	PCS1900	131 milli-ampere
GPRS		453 milli-ampere
Transmission burst		2 Ampere

2.3.5 General Specifications:

This module can measure 1 inch² but it can pack a huge amount of features into its small framework. Some of its features are:[8]

- Supports Quad-band: GSM850, EGSM900, DCS1800 and PCS1900
- Connects with any global GSM network (with any 2G SIM)
- Makes and receives audio calls with an external 8Ω speaker & microphone
- Sends and receives Short Message Services (SMS) messages
- Sends and receives GPRS data (TCP/IP, HTTP, etc.)
- Scans and receives FM broadcasts
- AT Command Set i.e., Serial-based
- FL connectors i.e. used for cell antennae
- Serial-based AT Command Set
- FL connectors
- Accepts micro SIM Card

2.4 L298D Motor Driver Module:

2.4.1 General Description:

The dual two directional motor driver is built around the much hyped L298 Dual H-Bridge Motor Driver. This will allow the user to independently monitor and command 2 motors of 2 Ampere in each direction. This module is perfect for robotics and for the microcontroller which requires couple pf control lines per motor.

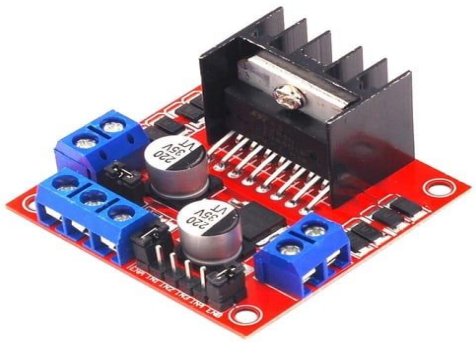


Figure 6 -L298D Motor Driver

2.4.2 Technical Specifications:

- Maximum voltage: 46 Volts DC
- Maximum output current: 2 Ampere (Peak 3 A)
- Power Supply: 25 Watt
- Input voltage: 5 Volts
- Working temperature: -25 to 130 Celsius

2.5 SD Card Module

2.5.1 General Description:

The SD Card module shown in figure-6 uses SPI protocol for communication. Here, it is being used for data logging of location coordinates, obstacles data, accident location & voice recordings.

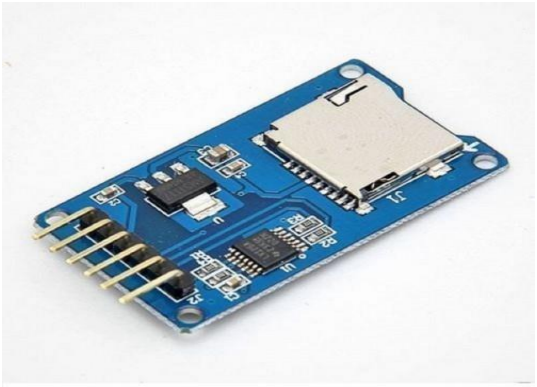


Figure 7-SD Card Module

2.5.2 Pin-out:

1. GND: Ground Pin
2. VCC: +5 Volts power
3. MISO: SPI output
4. MOSI: SPI input
5. SCK: Accepts all the clock pulses for Synchronization of data
6. CS: Chip selects signal pin for enabling or disabling the line

2.5.3 Technical Specifications:

2.6

Specs.	Change
Operating Voltage:	4.5V - 5.5V DC
Current Requirement:	0.2-200 mA
On-board Voltage Regulator	3.3 V
Supports file system	FAT
Supports SD Card	Up-to 32 GB

2.6 MAX9814 Microphone Amplifier:

2.6.1 General Description:

The module board has a 20-20KHz electret microphone soldered on it. Maxim MAX9814 is a special chip which is fabricated for amplification of electret microphones in few cases in which the volume of sound is unpredictable. In our project, the aforementioned module is being used for amplification as well as recording of the conversation during the course of commutation. The recordings are saved in SD card via SD Card module. This part is the heart of "Black Box" in our project.[9[

2.6.2 Technical Specifications:

Specification(s)	Range
Supply Voltage:	2.7V-5.5V
Current Rating	2 mA
Output:	2V
	1.25 V

Frequency Response:	20 Hertz – 20 KHz
Automatic gain (Ranges from 40dB, 50dB or 60Db)	
Low Input-Referred Noise Density of 30nV/	
min Threshold :	0.04% (typ.)

2.6.3 Technical Specifications:

Specification(s)	Range
VDD to GND	-0.3 to +6 Volts
All Other Pins to GND	-0.3Volts to (VDD +
Output Short-Cct time	0.3Volts
Regular Current (MICOUT, MICBIAS)	Continuous
All Other Pins	±100mA
Continuous Power Dissipation (TA = +70°C)	±20mA
Operating Temperature Rang	500mW
Junction Temperature	-40°C to +85°C
	+150°C

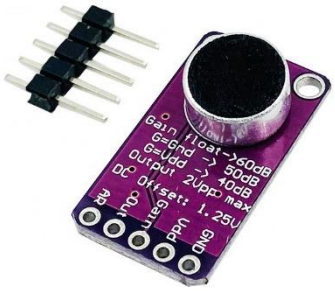


Figure-8 MAX9814 Microphone Amplifier

2.6.4 Applications

- Voice identification
- Wirless connection
- Duplex mode of communication
- Good quality Portable Recorders
- IP Phones/Telephone Conferencing
- Voice Recording

2.7 ADXL-345 Accelerometer:

2.7.1 General Description:

The ADXL335 is a tiny, minimum power consuming, complete 3-axis accelerometer with signal condition voltage outputs. Its aim is to read the value of gravitational force with a

minimum full-scale range of ±3 g. It is able to record the stationary force of gravity in tilt-sensing applications, as well as moving change in acceleration as a result of collision , jerk or sudden halt. In our project, purpose of the accelerometer is the detection of accident by sensing the position axis of the vehicle.[10]

Figure-9 ADXL-335 Accelerometer

2.7.2 Features:

- sensing on all the axis x,y,z
- tiny , low budget equipment
- 4 mm × 4 mm × 1.45 mm LFCSP
- Low power: 350 μA (typical)
- Single-supply operation: 1.8 V to 3.6 V
- Durable for extreme temperature

2.7.3 Applications:

- Cost sensitive, low power, motion- and tilt-sensing applications

- Mobile devices
- Gaming devices
- Disk drive protection
- Image stabilization
- Sports and health devices

2,8 Ultrasonic Sensor:

2.8.1 General Description:

In our project, the function of the above titled sensor is detection of any obstacle in front of the vehicle and logging of respective obstacle data onto a memory unit. Ultrasonic range module HC - SR04 provides the obstacle detection mechanism, the correct range for its measurement is 3 milli meter. The system involves a transmitter , receiver and control circuit. The basic method of operation is as under :

(1) Employing IO trigger function for at least 10us greater level signal.

(2) The system will then sends 8 times , 40 kHz and detect whether there is a pulse signal back.

(3) IF the signal back, through greater level , then time of high output IO duration is the time from sending ultrasonic to returning.

Test distance = (high level time×velocity of sound (340M/S) / 2,[11]

Figure-10 SR-04 Ultrasonic Module

2.8.2 Technical Specifications:

Parameter	Range
Operating power	DC 5 Volts
Operating Current	15mA
Operating Frequency	40Hz
Maximum Range	4m
Minimum Range	2cm
Measuring Angle	15 degree
Trigger Input Signal	10uS TTL pulse
Dimensions	45*20*15mm

3. System Design

3.1 Final Circuit Diagram

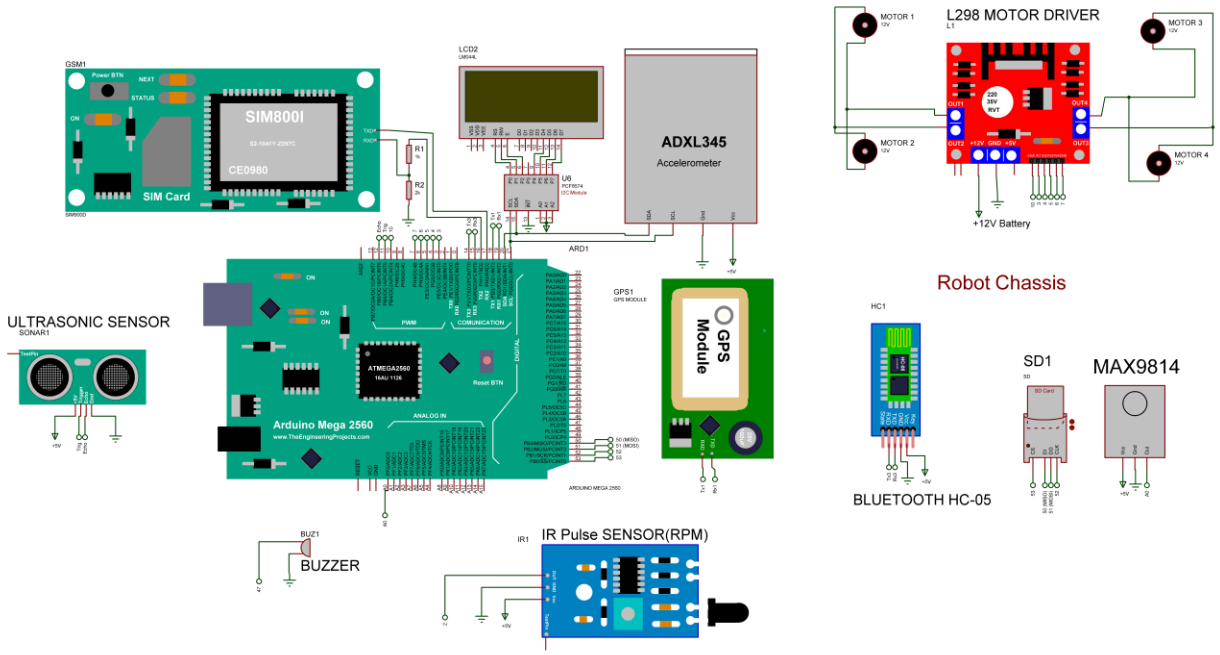


Figure-11 Final Circuit Diagram

System Flow Diagram:

Figure-12 System Flow Diagram

3.2

Components Interfacing

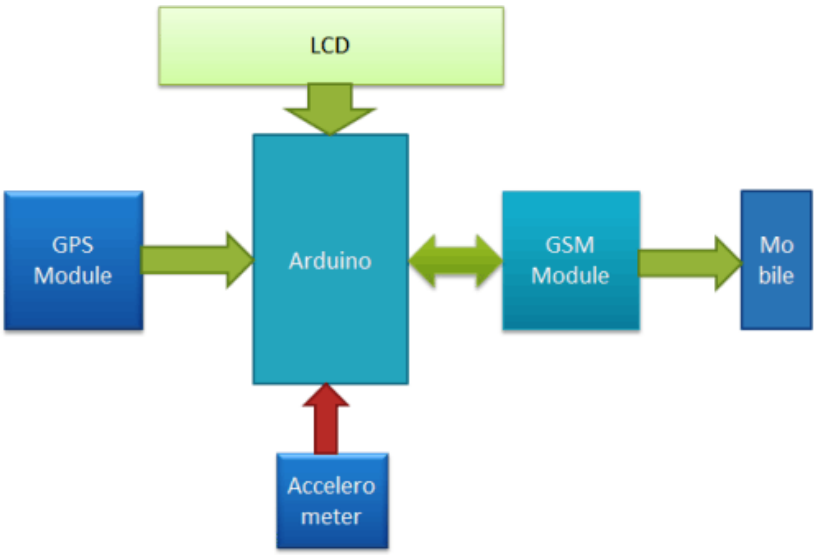
Following Components are interfaced in our project.

3.2.1 Module 1: Accident Detection & Alert System:

3.2.1.1 Description:

Incase of any unforeseen incident when the vehicle gets collided it hits the obstacle then values of g will change , eventually the axis of accelerometer values. The values are noted by the accelerometer and sent to the Arduino board. Incase of change of values the Arduino will record the values and then send the respective location coordinates to the designated phone numbers in the shape of "Google Maps" link.

3.2.1.2 Block Diagram:

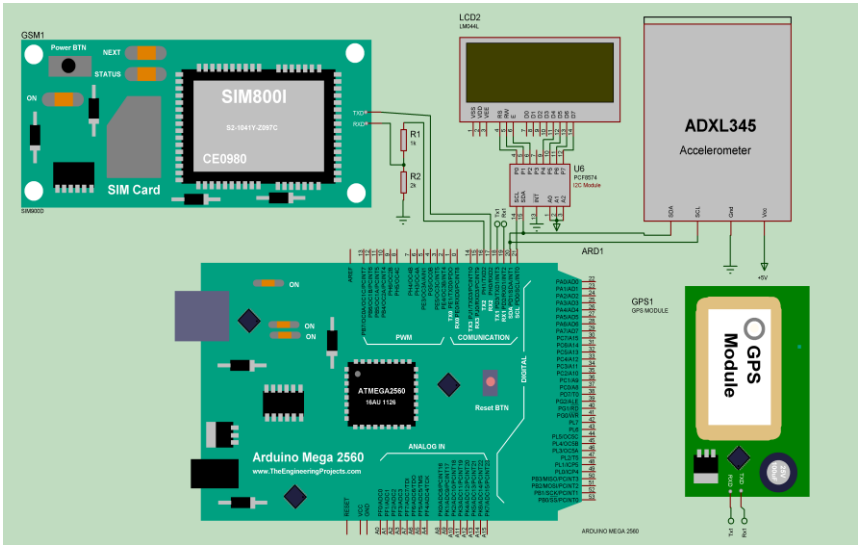


Block Diagram of Accident Detection & Alert System

3.2.1.3 Required Components:

- LCD 20x4
- GPS Module
- Microcontroller (Arduino)
- ADXL345 (Accelerometer)
- GSM Module (SIM800L)
- Power Source

3.2.1.4 Circuit Diagram:



Chapter 4: Evaluation and analysis of the code.

3.2.1.5 Interfacing of Ublox Neo-6M GPS Module with Arduino Mega 2560

The first step we did was the interfacing of Arduino mega 2560 with the Ublox Neo-6M GPS Module. For the interfacing of these two important components we had downloaded the library of GPS from the web. That library helped us to write its code in a desired manner. Code is the necessary part for any type of interfacing between the electrical components because of that they communicate with each other in a desired manner and give us desired outputs.

We have installed the software for our Arduino Microcontroller and the name of that software is Arduino IDE in which we write and edit our code. This software is the main key of the processor or microcontroller named as Arduino in our case. The library for interfacing of the Arduino and GPS is named as '<Tinygps++.h>', this holds all the functionalities of the GPS. This was the main task that we did at the software end then we physically attached these components and used those desired pins which we have used in the code (at the software end).

Arduino Mega has a 4 serial ports and GPS works on a serial port. So we have used Serial port 1 for the interfacing of Arduino with the GPS. We have attached the Tx pin of Arduino with the Rx pin of GPS and the Tx pin of GPS with the Rx pin of the Arduino. The GPS works on a 5v and we gave it the voltage from the power supply. After the successful interfacing of the Arduino with the GPS we got the values of the longitude and the latitude coordinates. We got the time and also the date by using the library of the GPS.

Circuit Diagram:

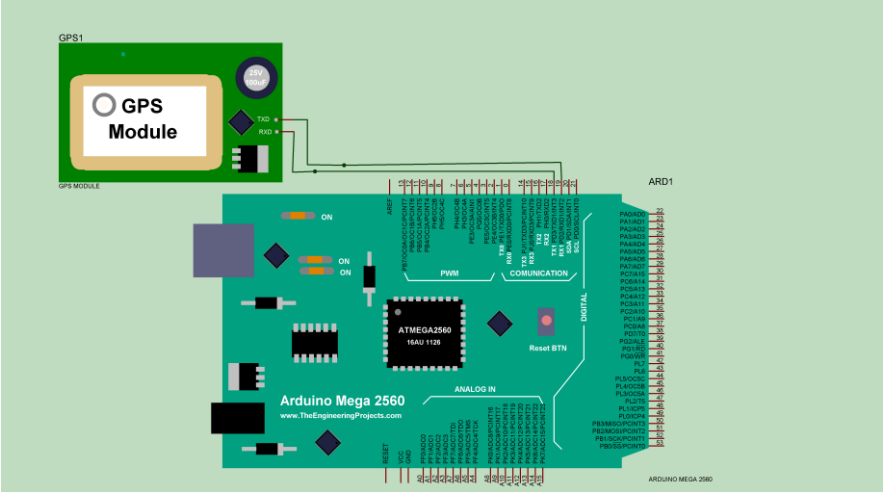


Figure-13 Ublox Neo-6M Interfacing with Arduino Mega 2560

Connection Explanation:

GPS Module	**Arduino Mega 2560**
Vcc	+5V
Gnd	Ground
Tx1	Rx1
Rx1	Tx1

Arduino Mega 2560 has 4 serial ports (UART) and GPS works on a serial port. So we have used Serial port 1 for the interfacing of Arduino with the GPS. We have attached the Tx pin of Arduino with the Rx pin of GPS and the Tx pin of GPS with the Rx pin of the Arduino. The GPS works on a 5v and we gave it the voltage from the power supply.

3.2.1.6 Interfacing of LCD & Ublox Neo-6M GPS Module with Arduino Mega 2560

1.1.1.1 Circuit Diagram:

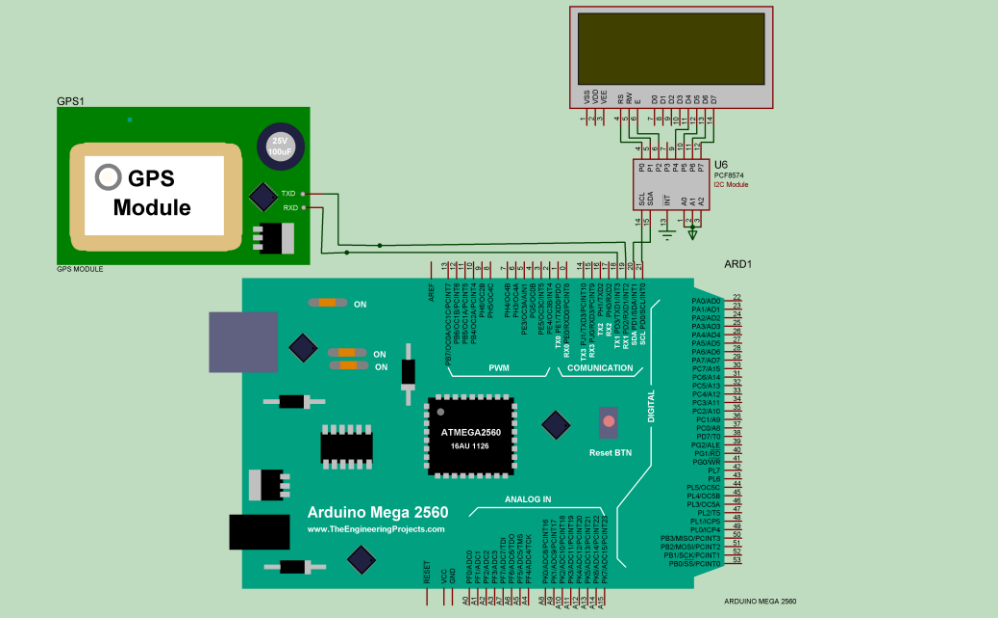


Figure-14 Schematics of Ublox Neo-6M & LCD Interfacing with Arduino Mega 2560

1.1.1.2 Connection Explanation:

GPS Module	Arduino Mega 2560	LCD	Arduino Mega 2560
Vcc	+5V	SCL	SCL
Gnd	Ground	SDA	SDA
Tx	Rx1		
Rx	Tx1		

1.1.1.3 Physical Connections:

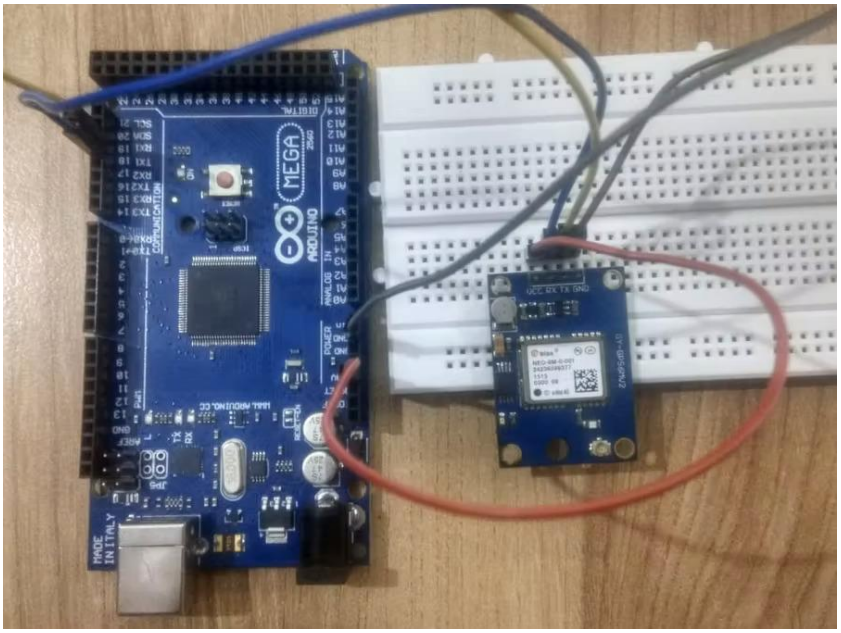


Figure-15 Ublox Neo-6M Interfacing with Arduino Mega 2560

3.2.1.7 Interfacing of SIM800l GSM Module with Arduino Mega 2560

1.1.1.4 Circuit Diagram:

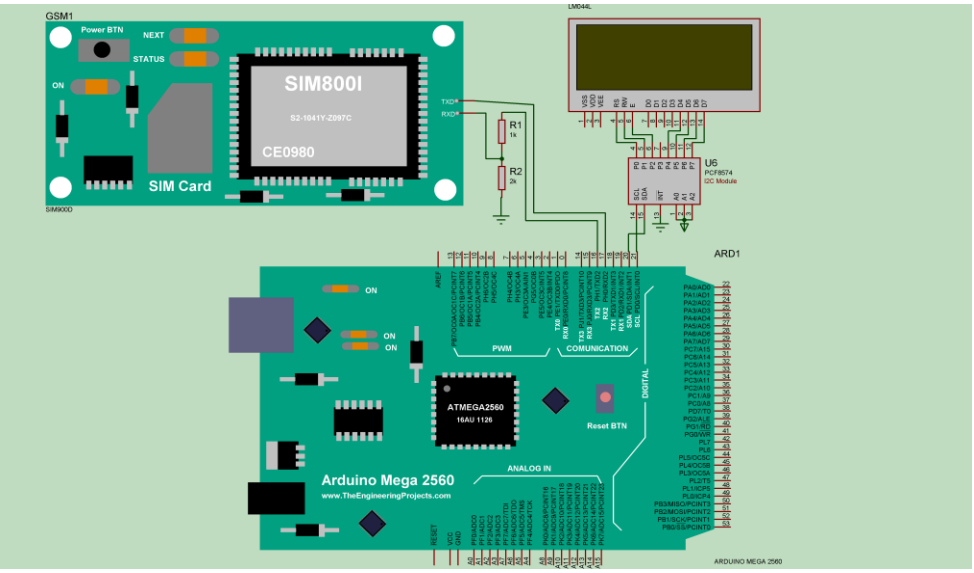


Figure-16 Schematics of SIM800l GSM Module Interfacing with Arduino Mega 2560

Connection Explanation:

GSM Module	**Arduino Mega 2560**
Vcc	+5V
Gnd	Ground
Tx	Rx2
Rx	Tx2

The SIM800L GSM module communication protocol is UART. As Arduino Mega 2560 has 4 Serial Communication options, we've connected the GSM Module to Serial Port-2 of the Arduino Mega 2560. If we focus on the datasheet of Module, the power required by Module is 3.3V as powering the module with greater than 3.3V will likely kill the Module. Moreover, the Rx pins of the module are 3.3V tolerant but the pins on Arduino work on 5V. So we need to proportionate the output of from the Arduino pins to GSM Module. For this purpose, a simple resistive potential divider is used. The simple voltage divider rule is given by:[12]

$$V1 = Vsource \cdot \frac{R1}{R1 + R2} \qquad (1)$$

$$R1 = 1\ k\Omega$$

$$R2 = 2\ k\Omega$$

$$Vsource = 5\ V$$

By putting these values in above voltage divider equation:

$$V1 = 3.3\ V$$

1.1.1.5 Physical Connections:

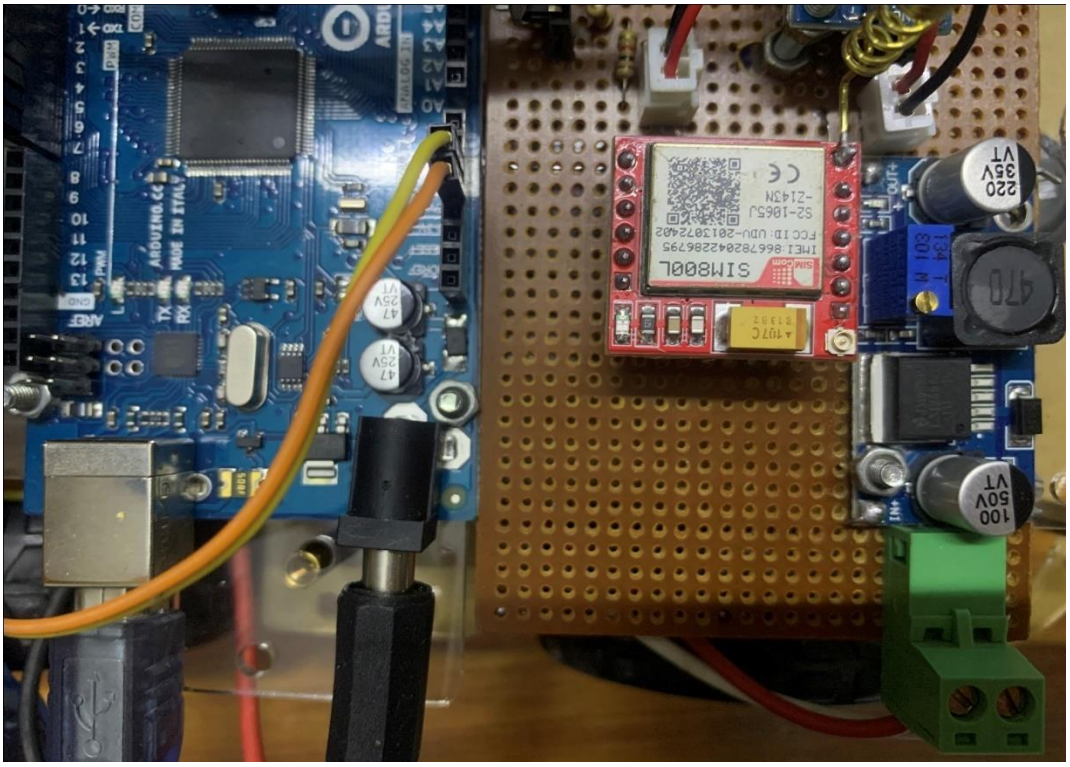


Figure-17 SIM800l GSM Module Interfacing with Arduino Mega 2560

3.2.1.8 Interfacing of SIM800l GSM Module with Arduino Mega 2560

1.1.1.6 Circuit Diagram:

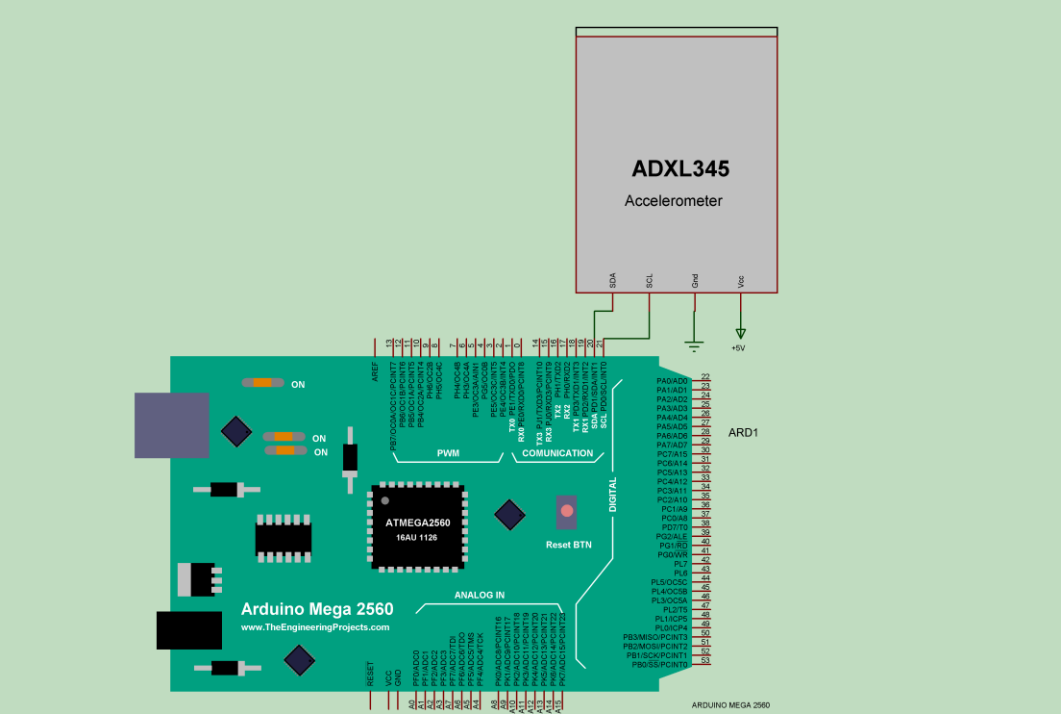


Figure-18 Schematics of ADXL-345 Accelerometer Interfacing with Arduino Mega 2560

1.1.1.7 Connection Explanation:

GSM Module	**Arduino Mega 2560**
Vcc	+5V
Gnd	Ground
SCL	SCL
SDA	SDA

The ADXL-345 Accelerometer communicates in I2C Protocol that stands for “Inter Integrated Circuit”. It is a 2-Wire communication SCA (Serial Clock) & SDA(Serial Data). The SCL & SDA pins on the Accelerometer are connected to SCL & SDA pins on the Arduino Mega 2560 respectively.

1.1.1.8 Physical Connections:

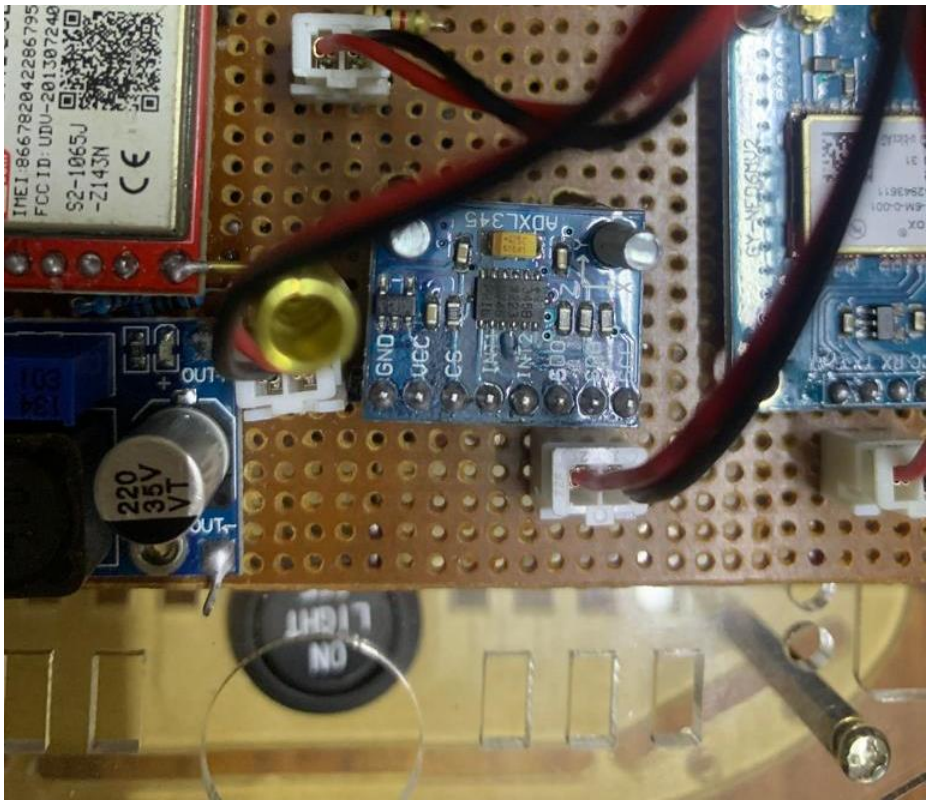


Figure-19 ADXL-345 Accelerometer Interfacing with Arduino Mega 2560

3.2.2 Module-2 Speed Limit Violation and Location data collector :

1.1.1.8.1 3.1.1 Description:

In this module the device which will monitor the track record of a vehicle on the roads and if any person over speeds and crosses the defined speed barrier at that particular place. The device will store the violations on memory unit. The number of violations will be visible on the LCD and also will be logged onto a memory unit. The speed of the vehicle is obtained by the GPS receiver then this speed obtained is compared by the microcontroller to the set speed. At every instant the speed is visible on LCD.

1.1.1.8.2 3.1.2 Required Components:

- Arduino Mega 2560
- GPS NEO-6M
- LCD (20x4)
- SD card module
- Buzzer/warning module
- IR Sensor for Speed Measurement

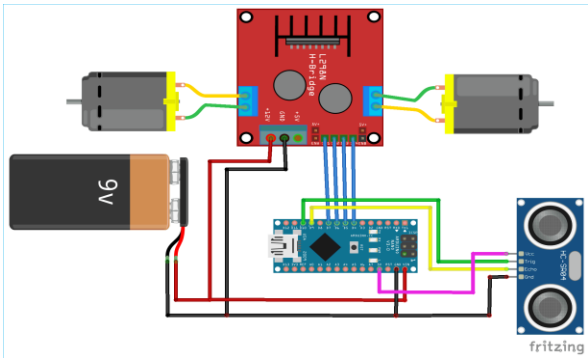
3.2.3 Obstacle Avoidance:

3.3.1 Description:

Obstacle avoiding sensor is an automated device that can sense the presence of an obstacle infront of the vehicle and then transfer this data to Arduino Board connected. This module is designed to enable the movement in unknown features and location , also keeping the track and journey safe in vehicles, which is a primary requirement for any autonomous mobile. The implementation of the Obstacle Avoiding vehicle is not limited to only the local population , instead many of the government organisations and agencies are employing the use of such technology for the achievement of their desired tasks and objectives safely.

- Required Components:
- Microcontroller (Arduino Mega 2560)
- SONAR Sensor (Ultrasonic Sensor)
- Motor Driver Module (L293D) for motor driving
- Power Source

3.3.2 Block Diagram:



3.2.4 Module-4 Vehicle Black Box (Voice Recording during the course of commutation):

3.2.4.1 Description:

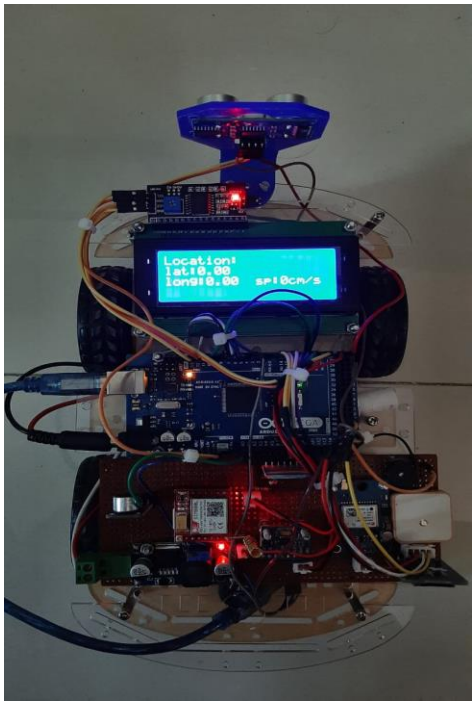
Voices and conversations can be recorded during travelling. This acquired data can be logged into a memory unit usually a memory card and SD Card module. Data can be retrieved later using memory card.

3.2.4.2 Required Components:

- Arduino NANO
- MAX9814 Amplifier board
- SD card module
- SD card
- 5V power supply unit

4.0 Results:

Start Up:



Chapter 5: Conclusion

From this project we have improved the monitoring system for roads. Most of the time as people risk there life sometimes for fun and sometimes without any reason. They would not do it just because of the improved monitoring system. If someone over speed, then his violations will be stored, and he will have to pay for it. Safety of the people will be ensured, and the rate of accidents will also be reduced. Smart data acquisition system is highly efficient device so no one can escape or get away with the violation made by the driver. No self-monitoring or trained persons are required to operate this device. So, this system will reduce the human effort. It will generate more profit and regulation on roads because when people will over speed then they will have to pay for it. Despite this , the modules of accident alert system will update with current situations to the main HQ located at the rear and prompt action can then be taken eventually.

Chapter 6: Future work needed to be done for the commercialization

Following are the future enhancement that can be made in this device.

- Smart Data Acquisition system can be used for track record monitoring of different vehicles of companies.
- We can store the record of violations in encrypted form to reduce the probability of tempering.
- We can enhance the features of augmented display of vehicle stats
- We can add the smart traffic light detection and stopping mechanism for motion of car

References

1. Geological Society London Special Publications

Authors:

R. R. Jones

2. https://scienceon.kisti.re.kr/srch/selectPORSrchPatent.do?cn=USP2000046052645&dbt=USPA

3. Savage Charles (Chester NY) Barone ; Jr. Frank G. (Florida NY) Demetrious Gregory(Chester NY) Volpe Vincent (Haworth NJ). Directional information system.

4. http://www.jkuat.ac.ke/departments/eee/wp-content/uploads/2014/05/JOEL-MIGWI-KARIUKI-S.-KAIRU

5. https://www.rac.co.uk/drive/advice/cameras/speed-cameras/

6. http://www.influx.co.uk/features/gatso-schmatso/

7. http://www.newnham-jordan.co.uk/wp-content/uploads/2014/05/iStock_000020564456Small-Truvelo.jpg

8. http://www.speedcamerasuk.com/specs.htm

9. https://www.digitalallyinc.com/speed-detection.html

10. http://www.onsitetools.com/cat/speed-measurement/sports-radar-gun/hand-held-sports-traffic-speed-gun.aspx

11. http://mechanicalmcq.blogspot.com/2011/07/what-is-function-of-governor.html

12 .https://www.google.com.pk/search?q=interfacing+of+arduino+with+gps+smk+53&biw=1366&b

ih=667&source=lnms&tbm=isch&sa=X&ei=dAFJVbewMpXuaP_ogIAL&ved=0CAYQ_AUoAQ#imgrc=YyifAv0xOP845M%253A%3B-rL7TxtSsYaqKM%3Bhttp%253A%252F%252Fwww.rhydolabz.com%252Fwiki%252Fwp-content%252Fuploads%252FGPS-with-