PROJECT: VEHICLE BLACK BOX SYSTEM

A Project Report Submitted by

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in partial fulfillment of the requirements for the award of the degree of

BE (Bachelors in Engineering)

Design Innovation Center, Panjab University

(University Institute of Engineering and Technology)

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Declaration

I hereby declare that the work presented in this Project Report titled Title of the Project Report submitted to the Design Innovation Center, Panjab University, Chandigarh is a bonafide record of the research work carried out under the supervision of Name of the Supervisor. The contents of this Project Report in full or in parts, have not been submitted to, and will not be submitted by me to, any other Institute or University in India or abroad.

Signature

Ashish, Kunal Singh and Manav

UE199089,UE199093, UE203063

Certificate

This is to certify that the Project Report titled Title of the Project Report, submitted by Ashish, Kunal Singh, and Manav (UE199089, UE199093, UE203063) to the Design Innovation Center, Panjab University, Chandigarh for the award of the degree of BE(Mech, Mech, CSE), is a bonafide record of the research work done by her or him under my supervision. To the best of my knowledge, the contents of this report, in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma.

Signature

Name of the Supervisor

Acknowledgments

I would like to thank Prof Naveen Aggarwal who gave me a golden opportunity to work on this project.

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I must also thank my teammates, parents, and friends for their immense support and help during this project. Without their help, completing this project would have been very difficult.

Abstract

According to the World Health Organization, more than a million people in the world die each year because of transportation-related accidents. In order to react to this situation, the black box system draws the first step to solve this the problem that crosses national boundaries and threatens the safety and health of people worldwide. Introduced to a part of the United States market in 1999, the black box system proved to be efficient. However, in the latter case, the system was embedded in the vehicle. Therefore, in addition to improving the treatment of crash victims and the road status in order to decrease the death rate, construct safer vehicles, and helping insurance companies with their vehicle accidents investigations, the main purpose of this paper is to develop a black box system that can be installed on any vehicle all over the world.

Like flight data recorders in aircraft, the “black box” technology can now play a key role in a motor vehicle crash investigations. A significant number of vehicles currently on the roads contain electronic systems that record information in the event of a crash. That is why it is so important to have recorders that objectively track what goes on in vehicles before, during, and after a crash as a complement to the subjective input that is taken usually from victims, eye witnesses and police reports. This system is committed mainly to two approaches. The first one is how to detect and record data from the vehicle. The second is how to present the data recorded to the user in a simplified way. To implement the first approach, some major components and different types of sensors were used. While the second approach was implemented using a Visual Basic .NET computer program. This program receives the data serially from the black box memory, presents it in real-time graphics , and finally saves it to a formal excel report for future use.

In order to know what type of sensors should be installed into the vehicle, research was carried out to identify the main information needed for better accident analysis. After filtering the information and taking into consideration what could be done and what could help the most, the following data were found to be the most important ones needed after an accident: Belt status, Road condition, flame detection, Speed Measurement, Position of the accident.

The main purpose of this project is to develop a prototype of the Vehicle Black Box System (VBBS) that can be installed into any vehicle. This prototype can be designed with a minimum number of circuits. The VBBS can contribute to constructing safer vehicles, improving the treatment of

crash victims, vehicle crash investigations, and enhancing road status in order to decrease the death rate and rescue operations.

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VEHICLE BLACK BOX SYSTEM

1 Introduction and background

The main purpose of this project is to develop a prototype of the Vehicle Black Box System (VBBS) that can be installed into any vehicle. This prototype can be designed with the minimum number of circuits. The VBBS can contribute to constructing safer vehicles, improving the treatment of crash victims, vehicle crash investigations, and enhancing road status in order to decrease the death rate and rescue operations.

Requirement Analysis

The main purpose is to deliver a prototype that can collect different data parameters such as live location, instantaneous acceleration, engine temperature, and more. Therefore, on the basis of that data, any situation can be analyzed and actions can be taken appropriately.

- Programmer /microcontroller
- Location tracking apparatus
- Temperature detection Apparatus
- Acceleration detection system
- Memory – for storing information from sensors
- Network connectivity

A. Microcontroller

A microcontroller is a compact integrated circuit designed to govern a specific operation in an embedded system. A typical microcontroller includes a processor, memory, and input/output (I/O) peripherals on a single chip.

The microcontroller for this project we are using is universal and extensively used in the market i.e Arduino UNO. The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller which is developed by Arduino. cc.

The board is equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits.

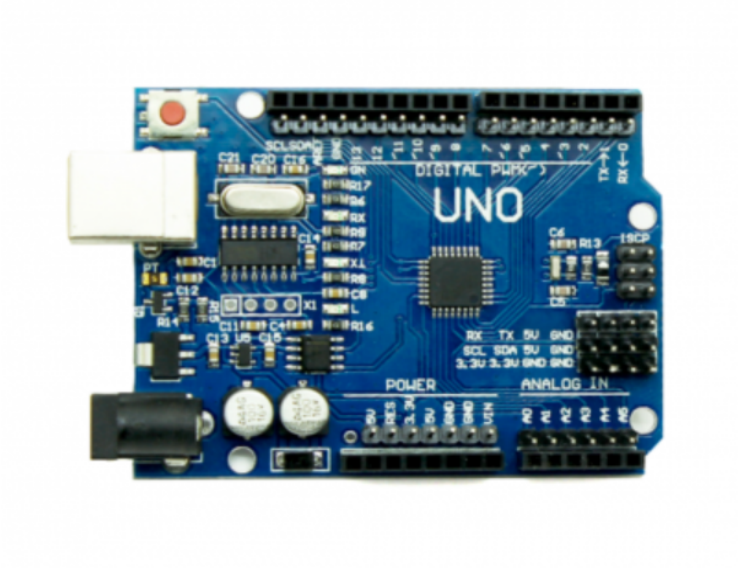


Figure 1.1: ARDUINO UNO

B. Location tracking

For the purpose of location tracking, we in this project will use the NEO 6M GPS module interfaced with Arduino.

The GPS satellites continuously transmit data about their current time and position. A GPS receiver monitors multiple satellites and solves the equations to determine the precise position of the receiver and its deviation from true time. At a minimum, four satellites must be in view of the receiver for it to compute four unknown quantities (three position coordinates and clock deviation from satellite time).

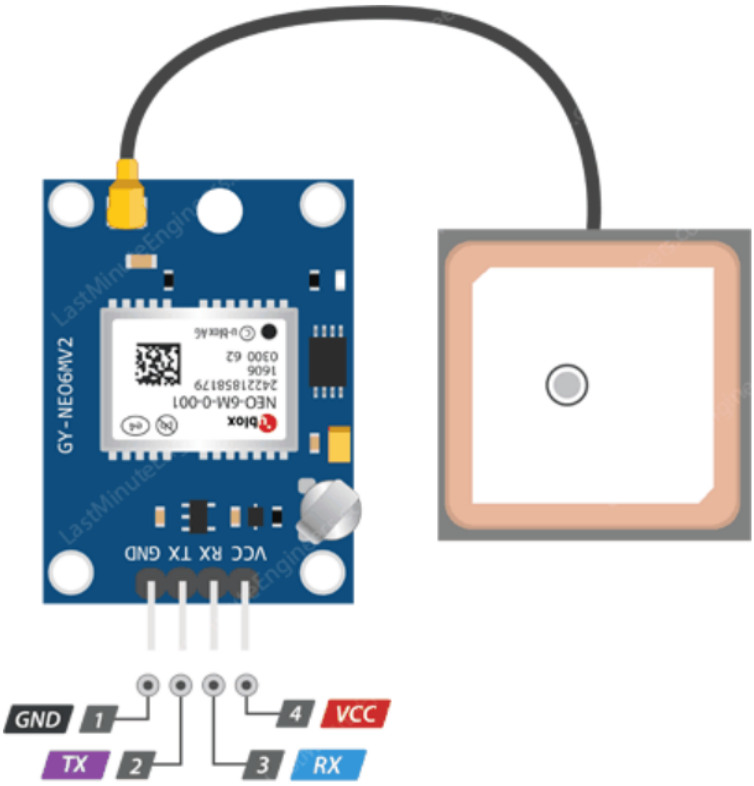


Figure 1.2 : NEO 6M GPS module

C. Temperature detection

NTC thermistor is a low-cost digital sensor that is used for sensing temperature and humidity. This sensor can be easily interfaced with any microcontroller such as Arduino, Raspberry pi, etc. sensor is used to measure the temperature and humidity instantaneously.

Figure 1.3: NTC thermistor

D. Acceleration Detection

A collision Sensor is also called an impact sensor. It is a piece of electronic safety equipment that detects an impact through vibrations. Collision sensors are used in industrial settings, and in cars for collision detection purposes.

For this purpose, we are using ADXL 345 as accident detection because it notices and captures every sudden jump in acceleration and speed. The sensor has three axes of measurements, X Y Z, and pins that can be used either as I2C or SPI digital interfacing. You can set the sensitivity level to either +-2g, +-4g, +-8g, or +-16g. The lower range gives more resolution for slow movements, the higher range is good for high-speed tracking. The ADXL345 is the latest and greatest from Analog Devices, known for its exceptional quality MEMS devices.

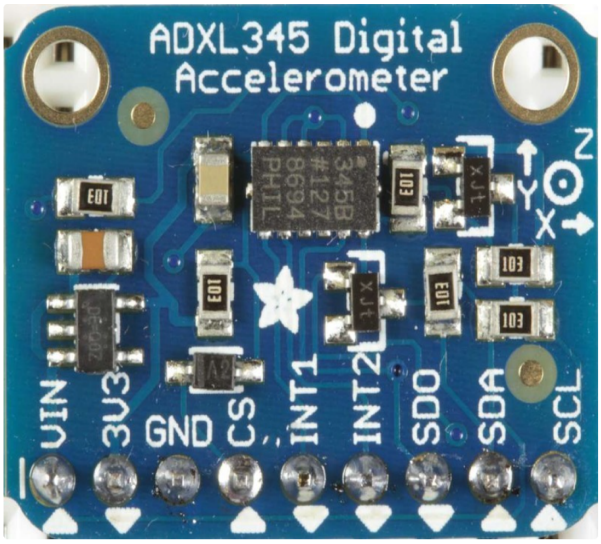


Figure 1.5: different layers of protection in a black box

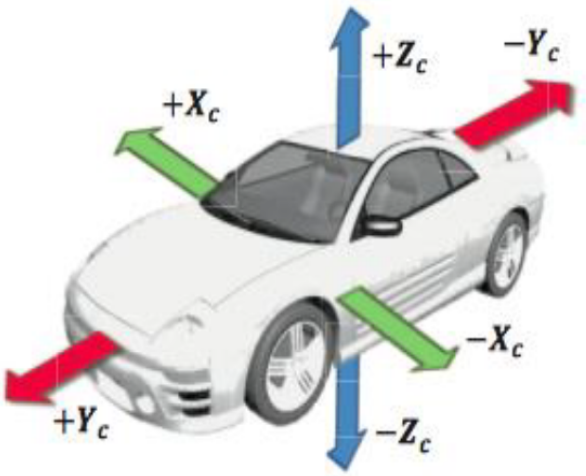


Fig. 4. Accelerometer axis in the Vehicle

E. SD card module / Memory

The SD and micro SD card modules allow you to communicate with the memory card and write or read the information on them. The module interfaces with the SPI protocol.

To use these modules with Arduino you need the SD library. This library is installed on the Arduino application by default.

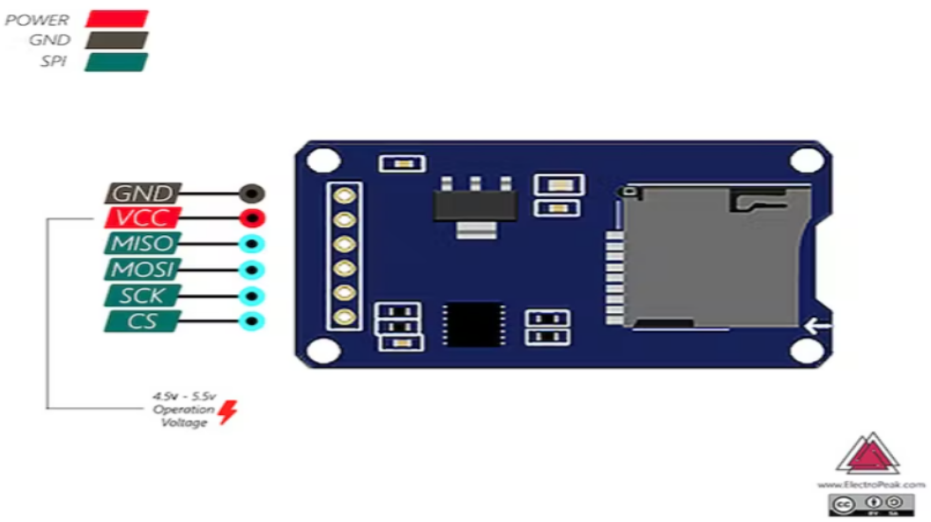


Figure 1.6: different layers of protection in a black box

2. Methodology

Interfacing of Arduino UNO with accelerometer and Neo 6M GPS module

The device is used to reduce the number of deaths caused due to medical services not reaching on time after the accidents so to overcome this situation this wireless device is made. It will also be useful for the concerned authorities to know the cause of accidents. This wireless device has been used in Aeroplanes for recording purposes before an accident, we try to bring this technology to ON-Road Vehicles. It will have a number of sensors attached to Arduino UNO which will store the data and send information to registered mobile numbers. After a Collision is detected, sensors will get activated which in turn triggers all the other modules to store and send information. When we power on the system Arduino and other attached components get turned on. First, we get the location by the GPS module and the Temp of the inside of the vehicle. Then we use the Accident detector to check whether the accident has occurred or not. If YES then we send the message to the respective authority and save the data on the local SD card. If NO then we save the DATA on the SD card and then we check the location and temp again and the loop continues.

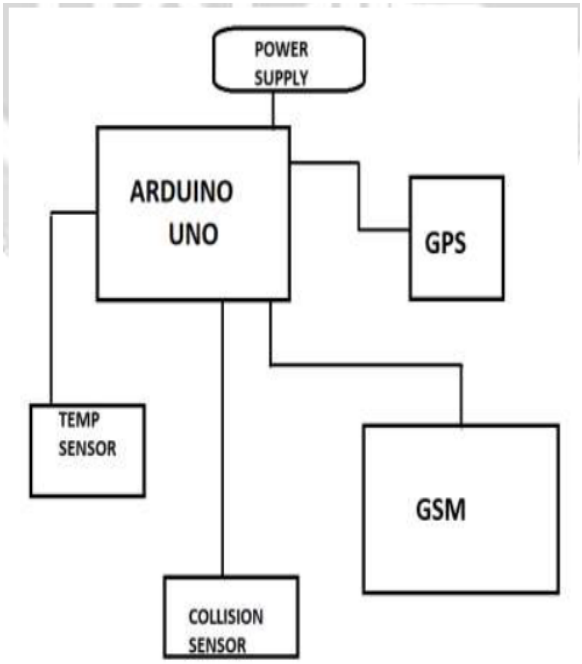
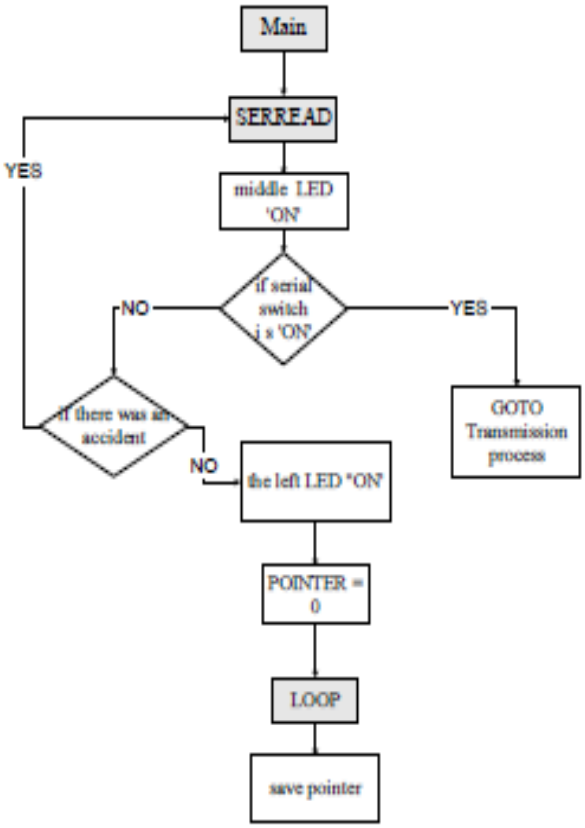
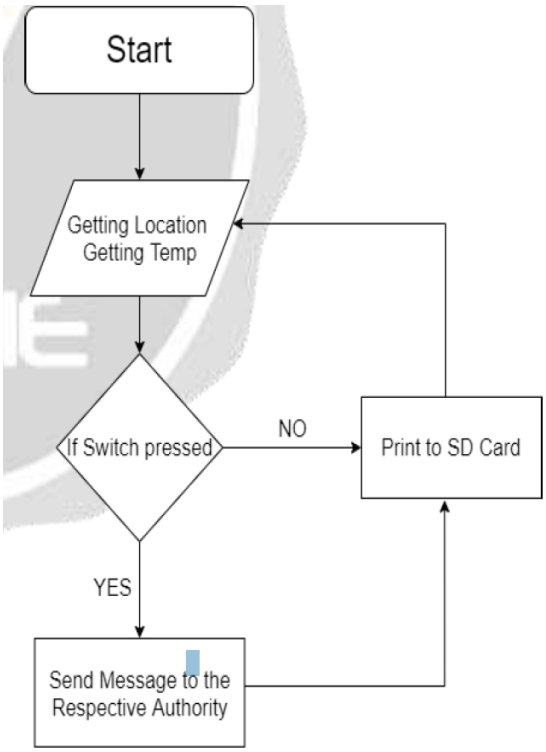


Fig-1: Block Diagram



3. Program structure

The program structure flows with a collection of data to analyze it, hence having the correct protocols according to situations



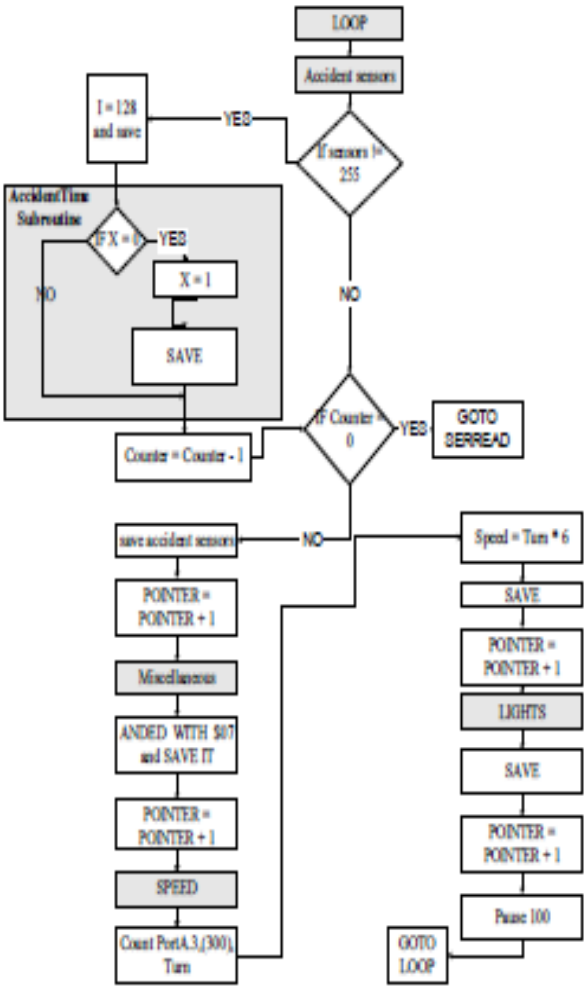


Fig.5. Flow Chart of the Main Program

4. LITERATURE REVIEW

Nowadays, the number of accidents is rapidly increasing in crowded cities as well as on highways. So we
have constructed a wireless device that can track the vehicle and send the location on the registered number. The
functions of this automobile Black Box are much similar to an airplane Black Box. It is used to analyze the cause of
vehicular accidents and prevent the loss of life and property due to vehicle accidents. This paper proposes a model of an
Automobile Black Box system that can be implemented into vehicles. The system also involves the improvement of
security by preventing damage by the Black Box data. An Event Data Recorder(EDR) is a device that is used to
record the movement parameter of a vehicle mainly used for accident analysis purposes and for safety measures.
In some vehicles, Video Event Data Recorder(VEDR) is used. A Video Events Data Recorder(VEDR) is a device that
records the video in a vehicle to create records of accidents. This research will be continued in the near future by
researching new features such as data compression, security, low energy, and more safety measures.

5. Hardware Organization

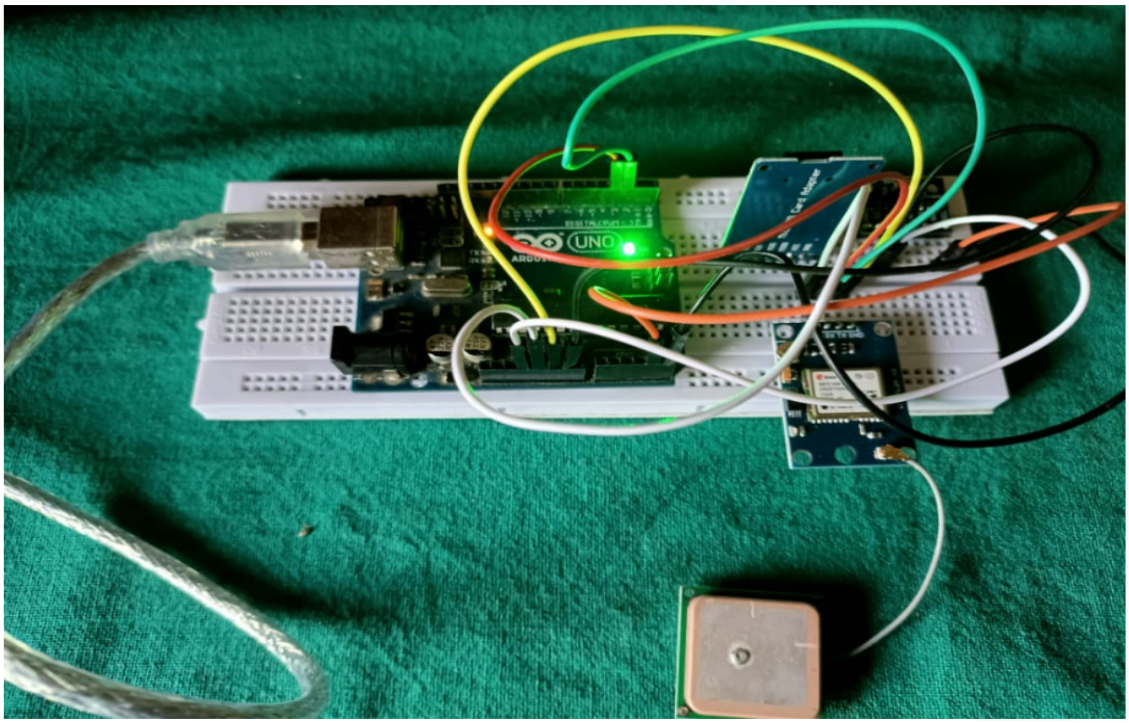


Figure 1.9: Hardware Organization of VBBS

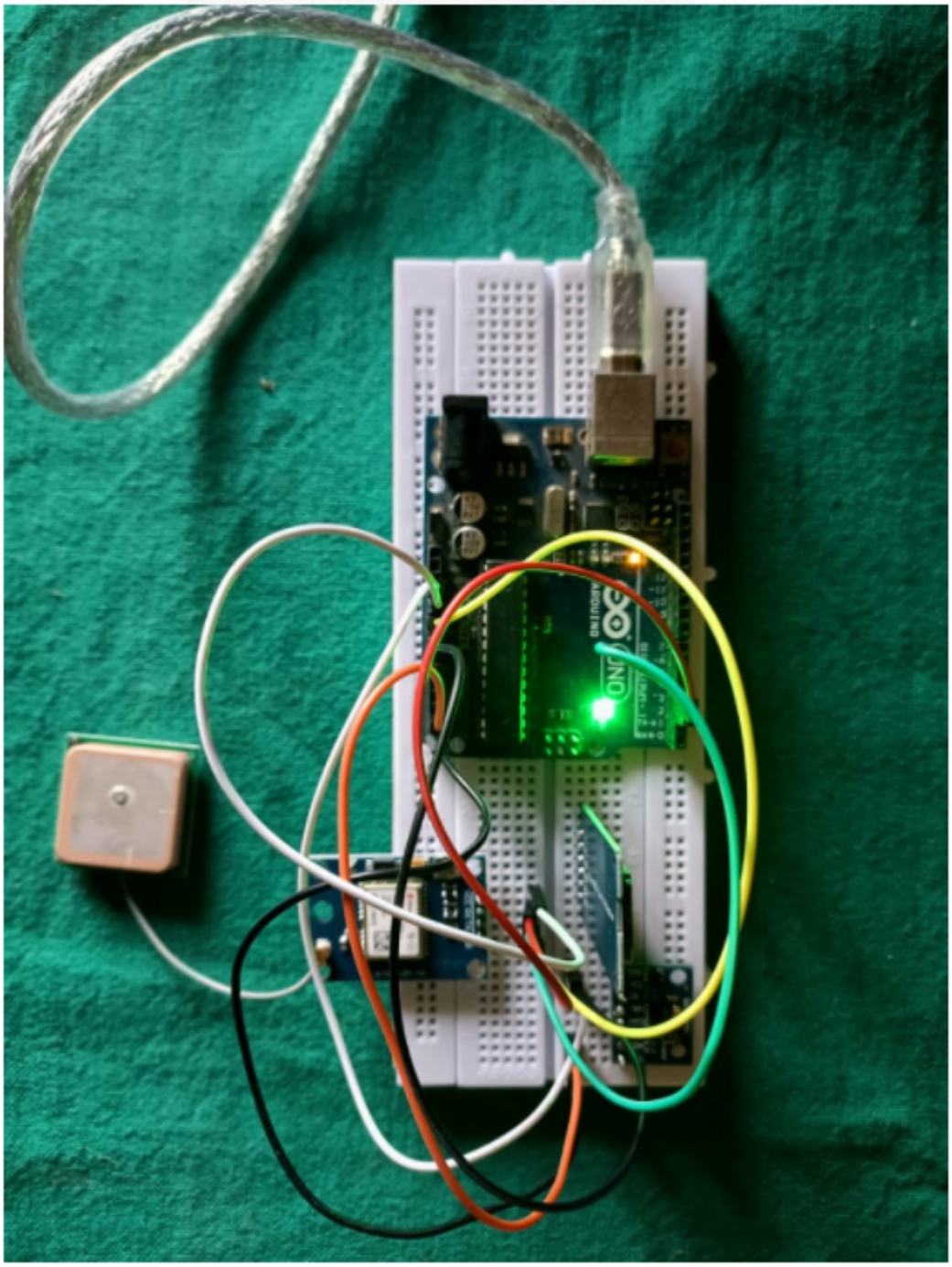


Figure 2.1: different layers of protection in a black box

6. BLACK BOX DESIGN

MATERIAL:- To make a solid black box for a vehicle we need to make an indestructible model for that we need to protect the inside components with a multilayer protective shell. The manufacturing process has the following procedure :

- LIST OF COMPONENTS

1. Breadboard : {170 * 55 * 12}
2. Arduino UNO
3. Adxl 345 accelerometer
4. SD card module
5. NEO6M GPS
6. Flame sensor

7. The upper part of the box:- Material: Stainless Steel or Titanium
   Dimensions: 250 * 81 * 22.

8. The lower part of the box:- Material: Stainless Steel or Titanium
   Dimensions:- 250*81*34
9. Nut and Bolt:- material- Stainless Steel; Dimensions: M10.
10. Aluminium housing

11. Insulation material:- Dry-silica material

- PROPERTIES OF STAINLESS STEEL

1. Corrosion resistant
2. High tensile strength
3. Very durable
4. High temperature resistant
5. Low-maintenance (last long)

- DIFFERENT LAYERS OF PROTECTION

The exterior is made up of 8mm thick stainless steel, while inside an aluminum housing is surrounded by fireproof insulation almost an inch thick. At last bicarbonate soda is shaken into the container to absorb the heat.
In this design, the black box can wear an impact up to 2000 times the weight of a black box and can wear it at a very high temperature for several hours.

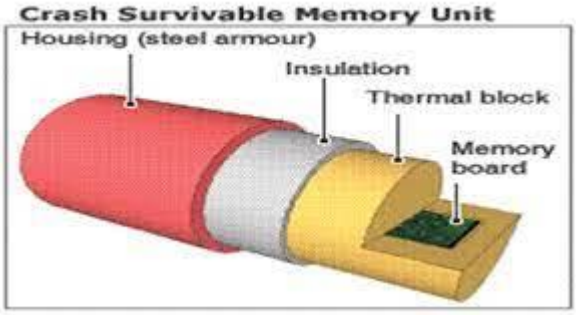


Figure 2.1: different layers of protection in a black box

- DESIGN OF BLACK BOX

In this design segment, we have one upper part and one lower part each having a minimum 8 mm thickness, inside these upper and lower part we have a layer of the aluminum housing, then a layer of bicarbonate soda followed by insulation materials. The Upper and lower part of the black box is joined by the use of a nut and bolt with a leakproof metal Gasket.
The stress concentration is reduced by using a chamfer and fillets at every corner by which the black box has a minimum weak point.

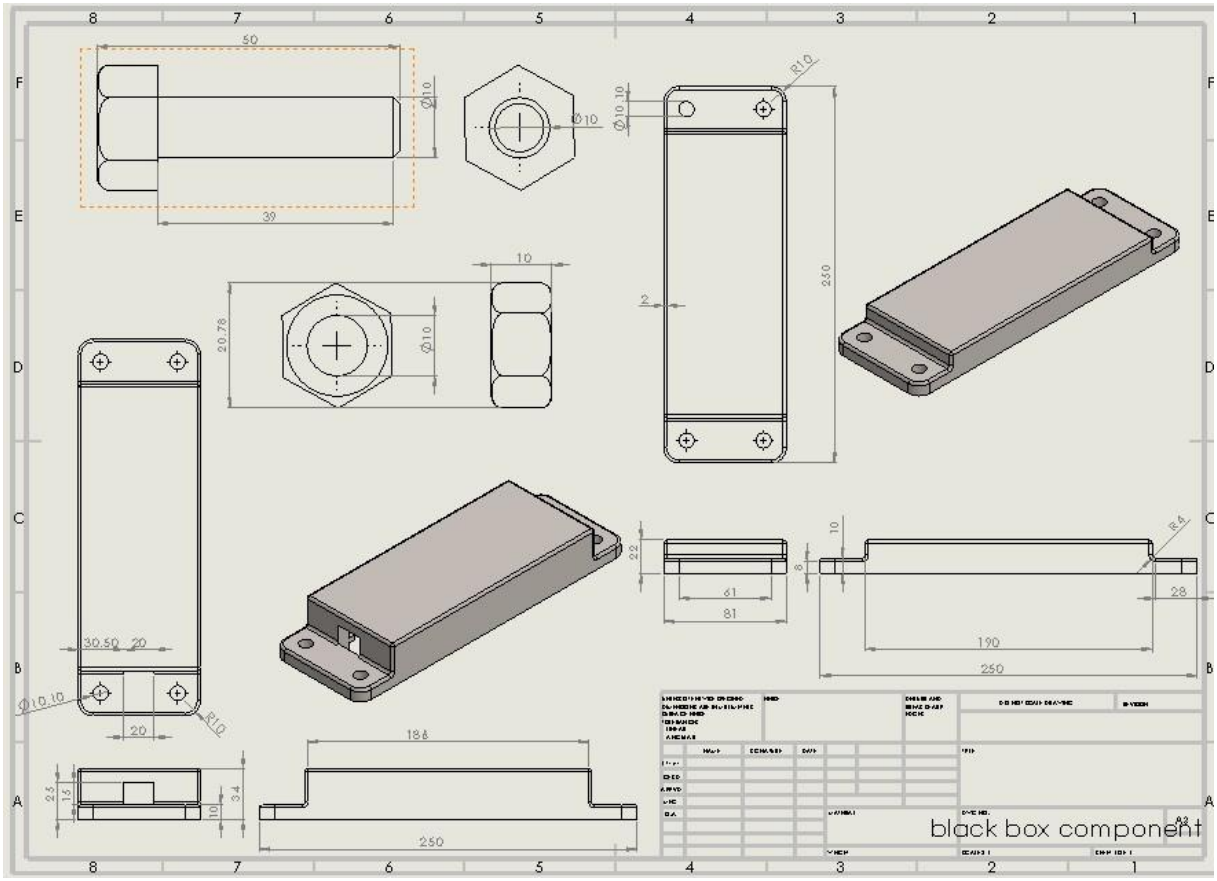


Figure 2.2: different components of a black box, nut and bolt, stainless steel
Upper and lower part of the casing

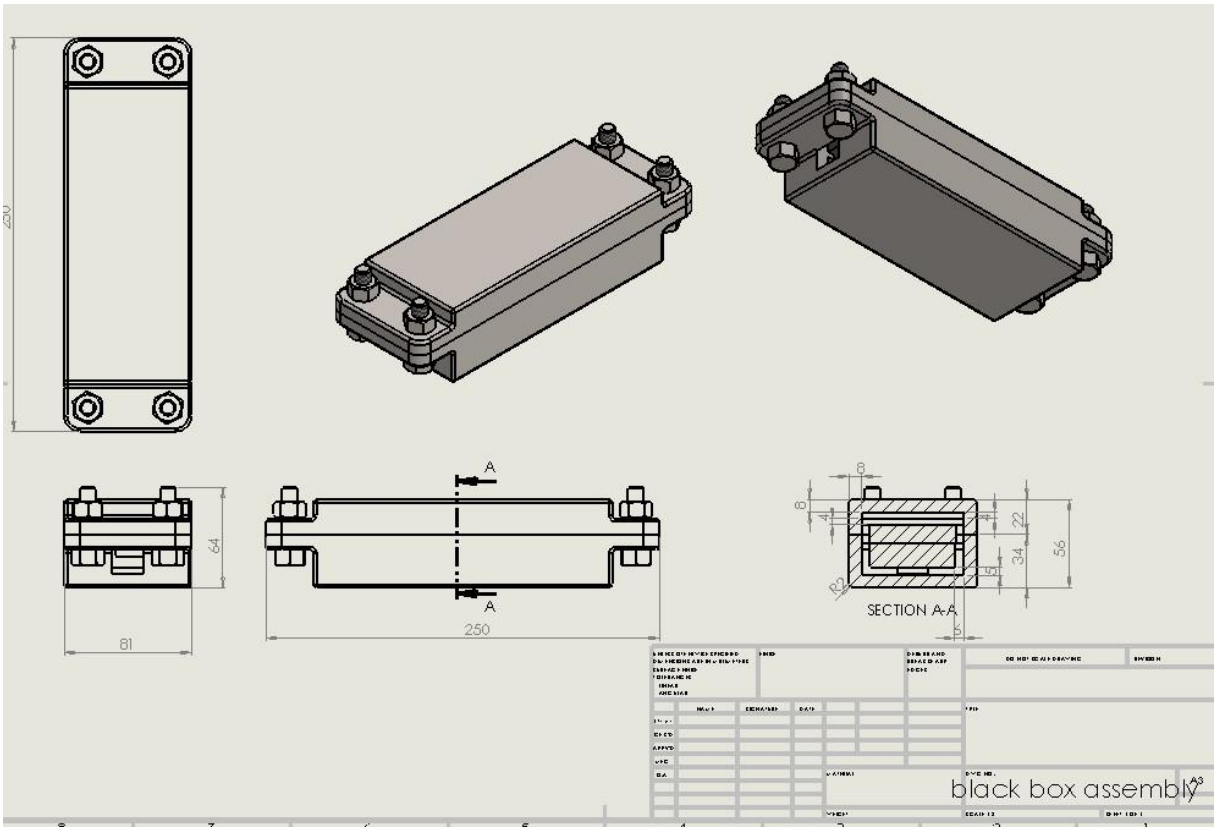


Figure 2.3: stainless steel casing assembly with sectional view

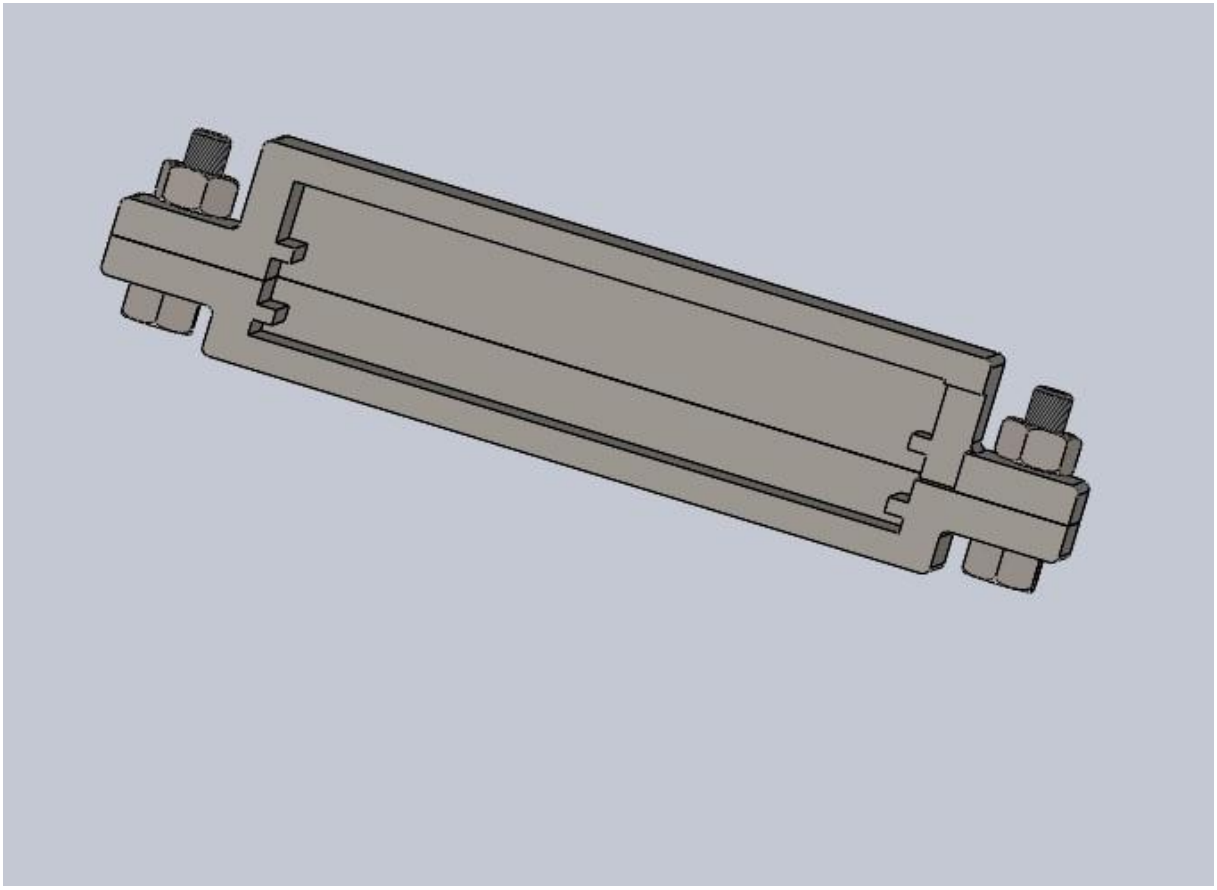


Figure 2.4: a sectional view of assembled stainless steel casing

These figures show the size and dimensions of the vehicle's black box

- POSITIONING OF SENSORS

1.**Adxl 345 accelerometer**

The accelerometers were located at position C for the front right and left suspension system and position A for the rear system. It was easy to attach the sensors because the maximum reduction level for each position was similar.

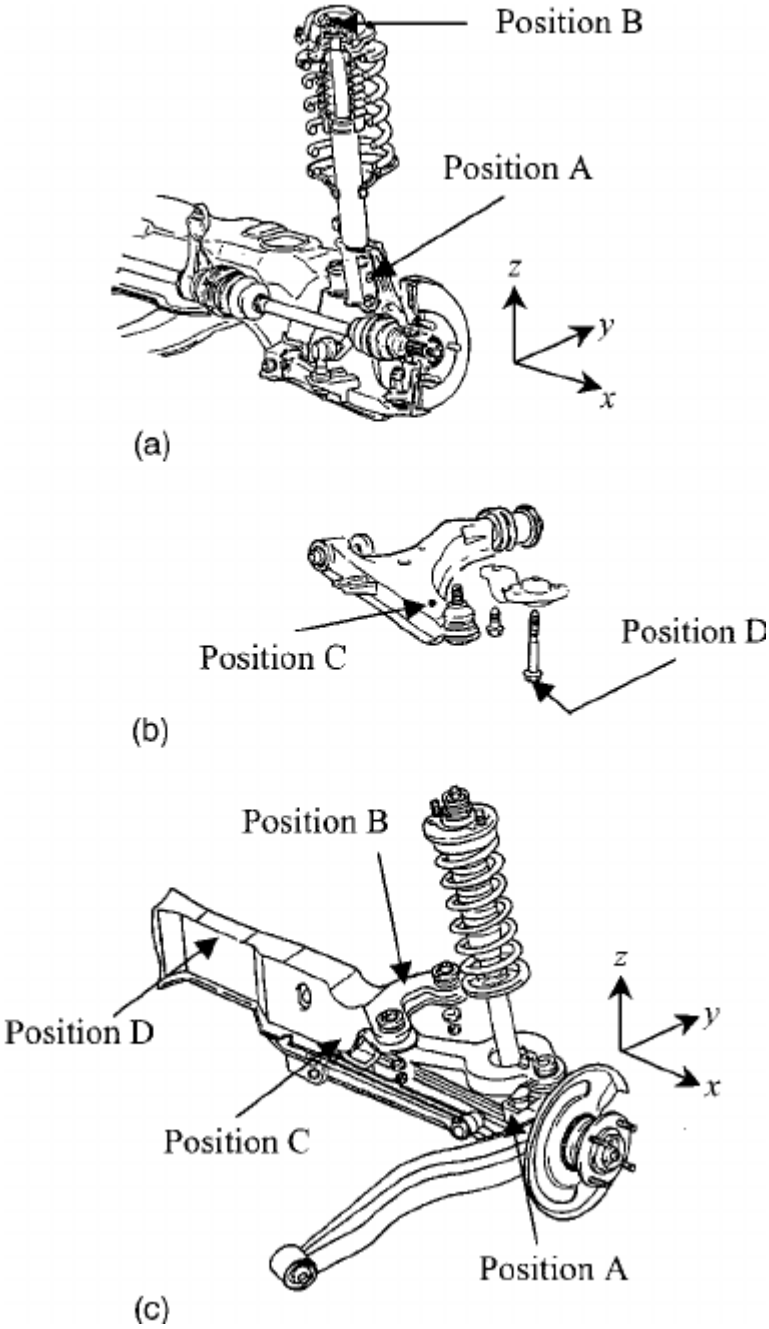


Figure 2.5: position of Adxl 345 accelerometer

2.**NEO6M GPS**

We can install a GPS sensor in the front or rear bumper, under a Glove compartment

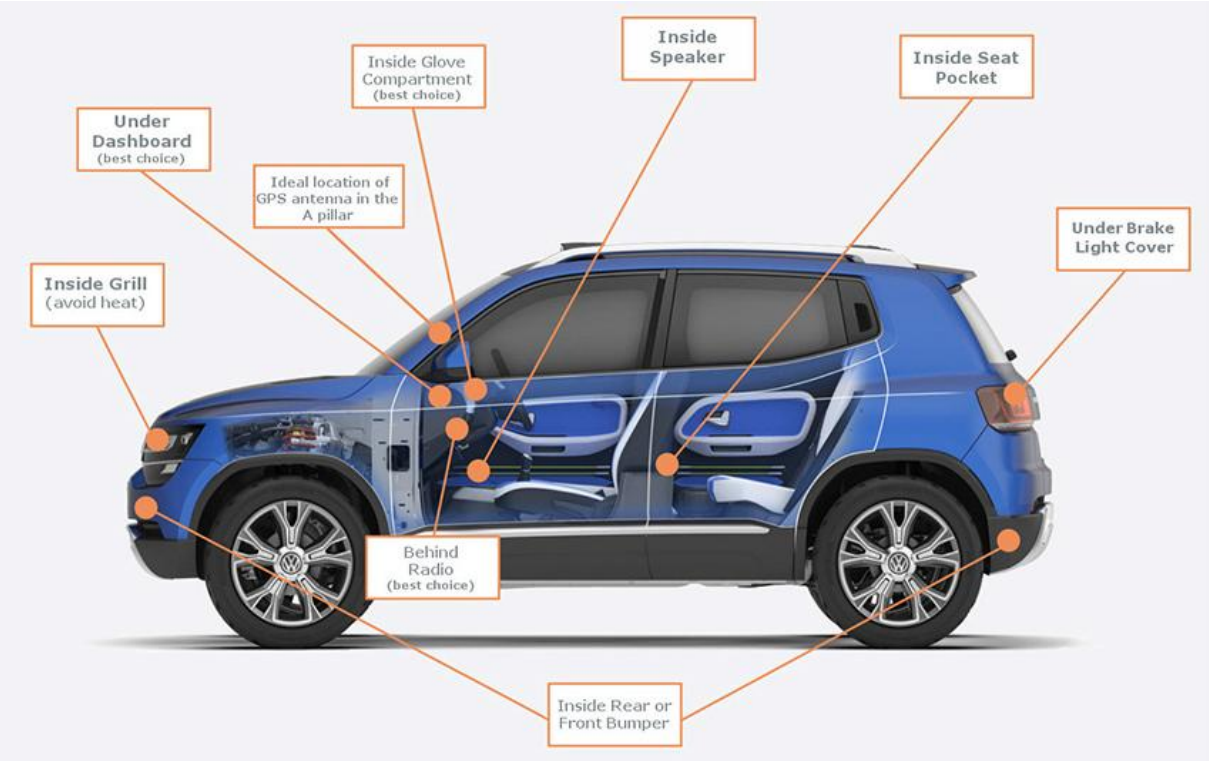


Figure 2.6: position of NEO6M GPS sensor

3. **Flame sensor**

We can install our flame sensor at the top of the car bonnet

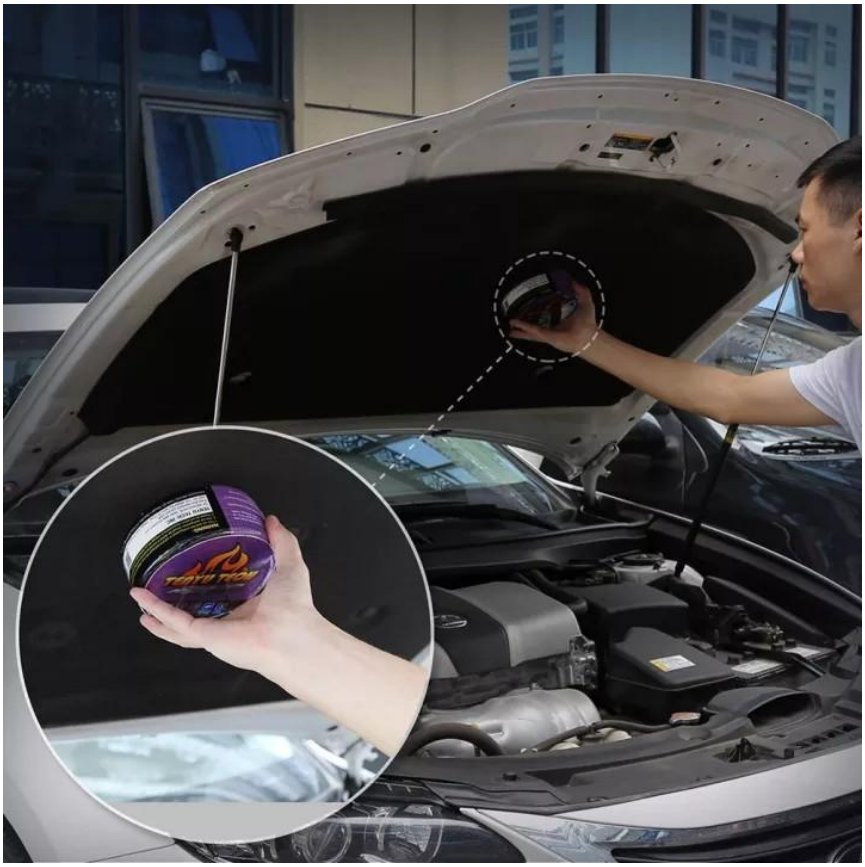


Figure 2.7: position of Flame sensor

7.Location of Black Box

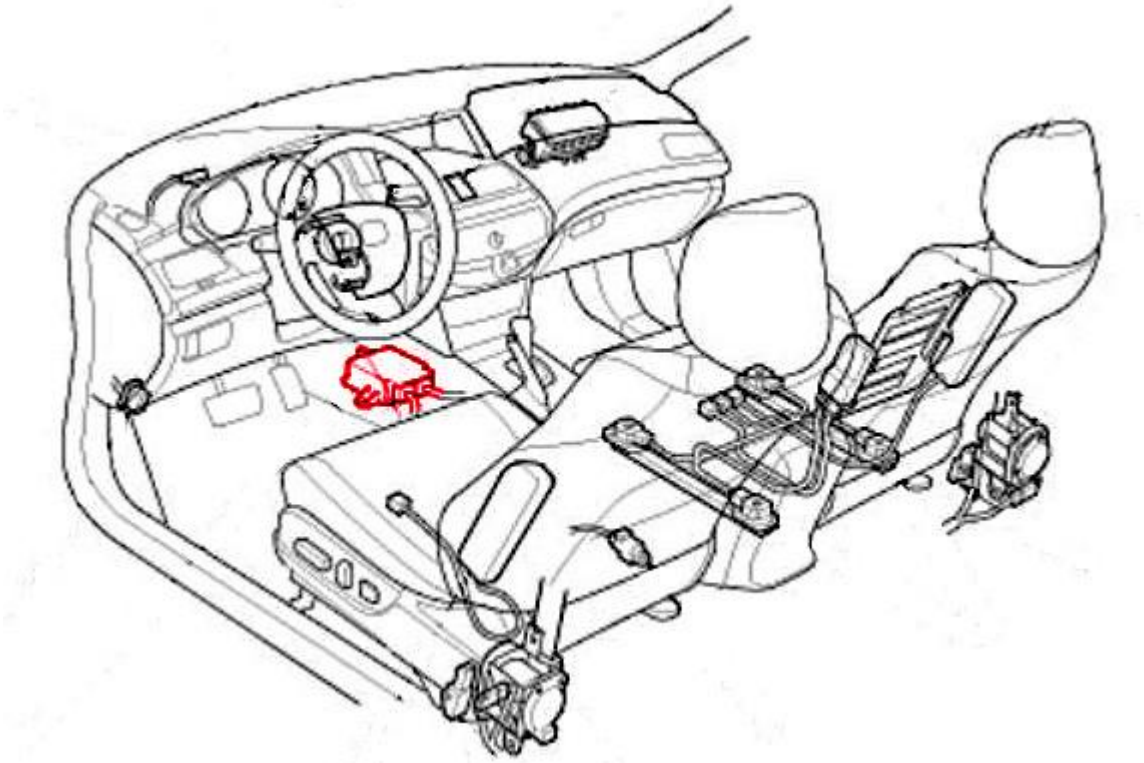


Figure2.8: position of BLACK BOX

We can install a black box near the acceleration, brake, and clutch paddles, near the gear nob by which we can easily install our sensors and take all the important information regarding vehicle position speed, etc.

8. Result and Conclusion

This paper has presented a new vision for the vehicles industry, which is the Black Box system used for vehicles. A full and detailed description was made for every part of this system. This paper has also offered a user-friendly visual basic program to analyze the data of the accident. In addition, the transmission method between the two parts has been introduced and developed.
The paper proposed a project which can be useful in saving many lives. The use of all the sensors and Arduino
helps to keep the cost of the project minimum while still achieving the result. The Arduino acts as the brain of this
device, it gathers information and sends it to registered numbers in a

timely manner. We used the Arduino programming language with TinyGPS++ library to successfully implement the working.