# IoT BASED VEHICLE AND DRIVER MONITORING SYSTEM

An Undergraduate CAPSTONE Project
By


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Under the Supervision of

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**Fall Semester 2022-2023**
**January, 2023**


**Faculty of Engineering**
American International University - Bangladesh

# IoT BASED VEHICLE AND DRIVER MONITORING SYSTEM

A CAPSTONE Project submitted to the Faculty of Engineering, American International University - Bangladesh (AIUB) in partial fulfillment of the requirements for the degree of Bachelor of Science in their mentioned respective programs.


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# APPROVAL

The CAPSTONE Project titled "**IoT BASED VEHICLE & DRIVER MONITORING SYSTEM"** has been submitted to the following respected members of the Board of Examiners of the Faculty of Engineering in partial fulfillment of the requirements for the degree of Bachelor of Science in the respective programs mentioned below on **January 2023** by the following students and has been accepted as satisfactory.

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# TABLE OF CONTENTS

# LIST OF FIGURES

# LIST OF TABLES

# ABSTRACT

Vehicle monitoring system is a smart way to improve the safety of drivers and passengers. The vehicle monitoring system can also be a part of a virtual assistant that helps drivers with navigation, route planning and other tasks while driving. Vehicular accidents are one of the most common causes of death in the world. In most countries, a high percent of all deaths is caused by road accidents each year. Even though many people have survived severe injuries after being involved in an accident. IoT is used in a variety of fields, including intelligent automobiles and their safety, security, navigation, and economical fuel use. The goal of this research is to find a way to prevent the loss of priceless human lives in traffic accidents. Maximum vehicles in the developing are not equipped with modern sensors most of the vehicles are old model and not in good condition so alternative solution is needed. Another factor is the vehicles owner are not willing to buy costly solution but they will accept a low-cost solution. Keeping cost friendliness back of the mind we think of a solution that can be implemented using low-cost sensor.

# Chapter 1

# INTRODUCTION

## 1.1. Overture

How dangerous our roads are compared to what we may believe, Vehicle safety is something that should not be taken lightly. The number of car accidents is rising quickly along with the global population and automobile use, which is also raising the number of fatalities from traffic accidents. This project goal is to ensures vehicle security and safety. Every driver of a vehicle must be aware of the vehicle's condition.as well as the owner also wants to know his vehicle condition and location. Modern vehicle has so many safeties feature but country like Bangladesh there more than 70%-80% vehicle do not have modern feature and sensors. With their wide range of uses, sensors are now an essential component of every modern automotive design. They play a key role in assisting automakers in introducing safer models to the market.so our aim is to use sensors to get data from the vehicles and the project will be based on The Internet of Things (IoT).The term "Internet of Things" (IoT) refers to a network of physical items, or "things," that have sensors, software, and other technologies built into them in order to connect to and exchange data with other systems and devices through the internet. Which will provide the information of the vehicles to the drive with on board display and to the owner with the help of The Internet of Things (IoT). The aim is to use this data to minimize road accidents. Also, will measure the driver condition to stop him/her to driving the vehicle if driver does not pass or undergo those tests and provide that information to owner with the help of The Internet of Things (IoT).

## 1.2. Significance of the Project / Research Work

Over the past several years, Bangladesh has seen an alarming increase in the number of traffic accidents. From 2020 to 2021, the number of accidents and fatalities grew steadily. Between January and December 2021, at least 6,284 people died and 7,468 others were injured in

traffic accidents, according to the Bangladesh Road Safety Foundation's (RSF) annual report, compared to 5,431 fatalities and 7,379 injuries in traffic incidents in 2020. Day by day every year the rate of accident is increasing and big reason of its alcoholic driver numerous ways that alcohol affects the body, tired driver many buses driver drives the bus non-stop for 24 hour or more without taking rest. In this project we are focusing on how we can get the driver's condition so that we can have no alcoholic and tired drivers also sometimes drive become monotonous so driver get sleep so building up a beep alarm system so driver can think of a break. In order to keep attentive and reduce the hazards that come with driving for too long without a break, it is generally advised to take breaks of at least 15 minutes every two hours and to limit your driving time to no more than eight hours per day. Also, other sensors will provide information to the diver so the diver can take action. Project is a system with various sensor that will constantly inform the diver about the vehicle as well as information about diver himself. This surely reduces accidents on the road and saves lives. Everything can be monitored by the owner or admin with the help of Internet of Things (IoT)

## 1.3. Engineering Problem Statement

Road accident is increasing in Bangladesh day by day as well as over the world. One of main problem is not knowing about the vehicle condition because in developing country like us most of the vehicles are reconditioned, old model, in the case of bus and trucks maximum vehicle importer import only chassis and make body in the country workshop so inbuild sensors are out of work so aim is to provide as many information as we can to the diver so diver can take steps when needed. The project can be used in any vehicle to ensure safety and security. The project focuses on cost friendly sensors we will use and provide information to the diver with the help of on-board display. As this project based IoT also provides the information (Diver condition, vehicle condition, vehicle location etc.) to the admin in this case to the vehicle owner or company. Implementing the right sensor for more accurate data or information So, need to find out the sensors implement that together and taking data make sure the error rate is in lower side. Some sensors might not work together. Finding out the best sensors in making sure behind the mind that the sensors are cost friendly. The goal is to make it a user friendly and low-cost product so that vehicles owners are willing to buy this product. Connecting with different will be a problem in future when it will be

in market so goal is to make it compact as well as modular so that the device can easily install in every type of vehicles. The simulation of the project will be done with the help of Proteus.

## 1.4. Objective of this Work

**Primary objectives**

- Use proper sensors to get proper data
- Aware the driver about his vehicle
- Check driver is alcoholic or not
- Provide information to vehicle owners

**Secondary Objectives**

- Low-cost sensors
- Ensuring safety features like seat belt
- Location tracker

## 1.5. Comparison with Traditional Method

The main aim is to use all the safety features in one system and provide data frequently so that it is easy for divers to take steps. Also, if we can stop acholic and tired diver form starting the vehicle then it can minimize road accidents. Traditionally the are few third-party systems that have many features like this project. There are GPS (Global Positioning System) tacker, IP cameras or some in build safety feature but our goal or target is to give safety and security solution to the vehicles that do not have modern feature as we as modern vehicles user also can use this as they want to monitor diver that he is alcoholic, tired, or not. Now a days we see only the use of GPS and IP cameras in use by many so it is clear no-good solution in the market that can be in use for safety and security.

Road accident is on peak and everyday people are losing life so there is no solution that can prevent silly reason like alcoholic, tired diver, no air bag in the vehicle, engine temperature and fire, no seat belt then surely the rate of accident will decrease.

## 1.6. Organization of Book Chapters

Briefly discussed how the contents of the book has been arranged chapter wise. Provide details how the contents are continued and interconnection between the chapters.

Chapter-2: Literature Review with in-depth investigation:

This chapter is focused on the recent and earlier research work on this topic. Literature review is important to analysis how much advanced work has been done. Finding out the shortcomings of existing research work and try to work to improve shortcomings.

Chapter-3: Project Management:

Project manage is very important for progress of any project. This chapter is focusing on how this project will done. How much time and cost needed.

Chapter-4: Methodology and Modeling

In chapter will give idea about the process. Before simulation block diagram is needed. In this focusing on block diagram.

Chapter-5: Implementation of Project

This chapter will give idea about how simulation and hardware implementation is done.

Chapter-6: Results Analysis & Critical Design Review

Result analysis & critical analysis review chapter is mainly focusing on how protype is working how much similar result between simulation result and hardware result.

Chapter-7: Conclusion

# Chapter 2

# LITERATURE REVIEW WITH IN-DEPTH INVESTIGATION

## 2.1. Introduction

The physical network of things or objects devices, buildings, cars, and other items embedded with electronics, software, sensors, and internet connectivity is known as the Internet of Things (IoT). This network allows these things and objects to gather and share data. This project is for vehicles safety and security using sensors and sending data with the help of IoT. We found a similar sensor-based project but we did not find any project that has many features like us and many of them are based on only one objective.

As well as many projects are not based on IoT but from some projects we get the idea of suitable sensor for this project. The focus is that many IoT based sensors can implement and share the data on web.

## 2.2. Related Research Works

### Earlier Research

Earlier there was research on vehicle fuel level sensor, engine temperature sensor like the engine temperature of the system and the carbon dioxide emission from the vehicle are both accurately measured by sensors in a system. Thus, their microcontroller receives measured data for analysis. The microcontroller has some predefined threshold values pre-programmed, such as the vehicle's standard engine temperature and standard emission rate in accordance with regulations. [1,2]

The microcontroller will then make a comparison between the sensor readings and the predetermined threshold values. A notification will be issued to the user to inspect his or her car and have it serviced if these numbers are higher than the threshold value. Also, on there was work on GPS for vehicles safety While the global positioning system (GPS),

which is frequently used as a global navigation satellite system, is used to locate the vehicles and to stop the vehicle if it is stolen, the authors of many previous research works have provided some analytical views of the circuit used in the various projects. The owner of the car receives a message with the position information, which includes latitude, longitude, and speed information. The location may also be seen online using Google Maps. [3] About alcohol sensors there was research using Pd-doped SnO2 sensors. The advantages of gas sensors made of semiconductor materials are their low cost, compact design, and ability to work with electronic systems. In a variety of industrial areas, such as monitoring and controlling air pollution, energy efficiency, transportation, health and safety, these systems enhance process control, productivity, and quality. Other uses include quality control in the automobile sector and medical diagnostics.[4] But we get less IoT based systems more like single feature focus project.

**Recent Research**

Recently in the past years there is work on IoT based work going on there is anti-theft tracking system based on Internet of things. There is an IoT based project on drowsiness, alcohol content, seatbelt check, engine control. [5] The Internet of Things (IoT) is simplifying every element of human life. The possibilities it affords are incomprehensible. IoT is an abstract concept that links all gadgets, tools, and devices together through the Internet so they may communicate with one another. It makes use of network technology, embedded technology, and information technology. To produce the intended result and simplify life, several sensors and tracking devices are connected. IoT has several uses, including smart automobiles with their enhanced safety, security, navigation, and fuel efficiency.[6] The goal of their research is to find a way to prevent the loss of priceless human lives in traffic accidents. The suggested system includes.

## 2.3. Validity and Accuracy of Existing Solution

Existing solution are good because they are focusing 1 or 2 feature most of the case IoT based GPS tracking devise we found in every project that really in use for locating the automobile but in case of other sensor there are less IoT based solution one solution [7] we find out one close to us is a IoT based solution that is doing same but we feel we can come up with better solution and cost efficient.[6] Eye blink sensor is the most common tiredness measuring sensor this is in use more or less in every project. [8] Every research goal in this topic is finding a solution to stop the loss of irreplaceable human lives in road accidents and make sure security.

## 2.4. Wide Range or Conflicting Research Works

We try to address the problems that lead to deadly collisions while simultaneously including safety precautions. The idea of a life without transportation is unimaginable. But we must admit the road in the developing like Bangladesh is not so safe the vehicles condition is not good. Many irresponsible divers so the project is to help the owner of the vehicles and passengers to get a safe and secure journey and get a responsible diver. Our project is a one stop solution for solving maximum safety issues. And all the features can be monitored with the help of IoT. One of the main reasons is if minimum security test is not passed by the driver and automobile then the automobile will not start. Passengers can easily know whether the air bag is already used or not, whether the driver is tired or not and other safety factors by the help of on-board display. The current solution does not offer as many features we are offering.

## 2.5. Critical Engineering Specialist Knowledge

First, there are many sensors for the same work but finding the best sensor is a challenge. Back of the mind we had to think about the cost friendliness, as well as the speed of the sensor. Knowledge about sensors is important so that implementing the project can be easy. Another specialist knowledge required is to knowledge about IoT how and maximum input we can give from the sensors and how fast we get output on app.

## 2.6. Stakeholders from Research Literatures

Many stakeholders are founded are linked with this project that are obtained from the research works and publications. We took idea of different sensor from different research works and publication. We get some ideas how we can implement all those features in this project. So main stakeholders of this project are researchers. There finding help us to think ahead and come up with improved system.

## 2.7. Summary

In this modern era of automobile safety is a big concern. Every research work we mentioned we think somewhere all researchers are thinking of vehicles safety and security. From our finding there are not many works based on IoT. There are work on a single feature of two. We mainly find out there are less work based on IoT about vehicles safety and security we want to fill that gap.

# Chapter 3

# PROJECT MANAGEMENT

## 3.1. Introduction

Project management is a common method used to assure the success of a project. When it comes to project management, it's critical to have a clear picture of the objectives of the project, the resources this project needs, and achieve it. This chapter is all about getting down to business. The purpose of project management is to plan and execute a project in such a way that its stated goals and deliverables are met. Additionally, it includes the identification and control of potential risks, along with a thorough budgeting process and cross-organizational communication. Project schedules can benefit from using the Gantt chart. Money can be saved on the project's equipment by manipulating the data. Managing a project is a critical managerial ability. Planning, scheduling, and regulating actions to achieve a certain goal within a given time and budget are all part of the process. By completing initiatives that contribute to project aims, many businesses can meet the objectives. In most cases, projects have a specific start and end date, a specific number of participants, a specific number of resources, and a specific budget. This is planned and monitored by the group leader and adjusted just as needed.

## 3.2. S.W.O.T. Analysis

A project's opportunities and threats, as well as its strengths and weaknesses, can be analyzed using the SWOT framework. Using a functional approach, the internal analysis pinpoints the projects' strengths across the board (finance, management, infrastructure, procurement, production, distribution, marketing, reputational factors, and innovation) as well as its weaknesses (the same) and opportunities for growth (the same). Finding the source of competitive advantage requires a thorough internal study. In doing so, it identifies areas for investment in developing resources that will keep a team motivated. Potential advantages and disadvantages in the sector are uncovered through research on the surrounding environment, including the competition, the industry, and the

broader economy. Analysis of the capabilities and assets of each competitor constitutes the competitive landscape. Competition, new entrants, suppliers, customers, and product substitution are analyzed as part of the industry's external environment using the five Forces Model. Political, economic, sociological, technological, environmental, demographic, ethical, and regulatory repercussions are examined in the context of the external environment. The objective of doing a Strengths, Weaknesses, Opportunities, and Threats (SWOT) study is to inform a company's strategy development considering its specific context. In this using SWOT analysis, the strength and weaknesses are found.

**Strengths**

- Can safe life
- Low cost of ownership
- No operation cost
- Realtime monitoring

**Weaknesses**

- First time implementation
- Always need internet connection

**Opportunity**

- Increasing accident
- Improve safety
- More feature can be implemented

**Threats**

- Malfunction of any sensor
- Some owners will not willing to use car batteries

## 3.3. Schedule Management

Project activities and tasks are organized using a schedule management structure, which uses time variables to do so. Outlines what has to be done for the project's completion to be on time and within the budget. Implementing a schedule management system is crucial to getting a project off the ground, tracking its progress, and ensuring that it is completed on time

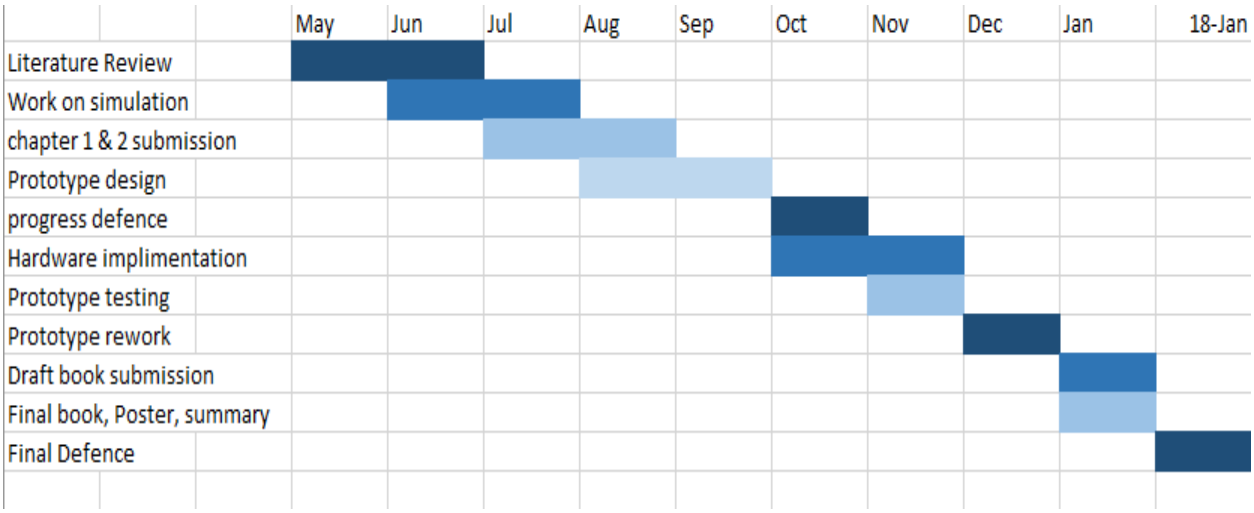


Figure 3.1: Gantt Chart

## 3.4. Cost Analysis

Table 3.1: Cost analysis of the project

| **No** | Component Name | Quantity | Projected Cost (Tk) | Actual Cost (Tk) |
|---|---|---|---|---|
| 01 | Step down transformer | 1 pec | 350 | 300 |
| 02 | ESP32 With GSM module | 1 pec | 3100 | 3000 |
| 03 | AC Cable | 1 pec | 100 | 100 |
| 04 | Arduino Nano | 1 pec | 550 | 550 |
| 05 | Ultrasonic Sensor | 2 pecs | 450 | 500 |
| 06 | Oil Tank | 1 pec | 60 | 60 |
| 08 | MQ3 Alcohol sensor | 1 pec | 20 | 20 |
| 09 | Varo board | 2 pecs | 80 | 80 |
| 10 | Sit Belt Sensor | 1 pec | 1100 | 1000 |
| 11 | Ebonite sheet | 1 pec | 300 | 300 |
| 12 | Capacitor | 4 pecs | 40 | 40 |
| 13 | Diode | 3 pecs | 20 | 20 |
| 14 | Resistor | 20 pecs | 10 | 10 |
| 15 | Eye Blink IR sensor | 1 pec | 350 | 300 |
| 16 | 18B20 Temperature Sensor | 1 pec | 180 | 200 |
| 17 | Power Supply Module | 1 pec | 600 | 500 |
| 18 | LCD Display Module | 1 pec | 350 | 400 |
| 19 | GPS Module | 1 pec | 2100 | 2000 |
| 20 | GSM Module | 1 pec | 550 | 500 |
| | Total Taka | | 10,310/- | 9,880/- |

The cost was predicted 10,310 Tk. The hardware was bought from local electronic market and also from the online shop. Finally, the total cost is 9,980 Tk. Actual cost is less the predicted cost. The prediction was little high because rising commodity of the price

## 3.5. P.E.S.T. Analysis

The PEST analysis is an essential tool for evaluating a project's current state, prospects for the future, and strategic course of action. PEST issues are frequently taken into account when conducting market analyses by companies and other organizations. Other factors, such as those connected to the law and the environment, are taken into account in a PESTLE analysis.
There are four key point of PEST analysis

**Political Analysis:**

Political analysis is made available and engaging by making political structures, institutions, ideas, and behaviors, as well as most importantly the political processes by which they are continuously formed and altered. Government approval won't be necessary for this project to carry out its initiative. There are no limitations on how this project can be carried out. In this project there is big opportunity if transport politician agreed to implement this system in their transport, then this project has a good future.

**Economic Analysis:**

The foundation of economic analysis is cost-benefit analysis. First, in order to distribute funds more effectively, it rates projects based on their economic viability. This study's objective is to assess a project's social impact.

**Social Analysis:**

Social analysis includes analyzing stakeholder priorities and perspectives as well as including as many pertinent stakeholders as possible in the development process. The sociocultural, institutional, historical, and political context of Bank-financed operations is taken into consideration as we conduct this analysis. It's a group project, and its intended audience might be impacted by particular societal trends, practices, or attitudes.

**Technological Analysis**

One of the main goals is to make this project as cost friendly as possible. In technical ground the project should have hardware that are low cost and founded in the market eastly and making a system shouldn't require and high-cost equipment. So objective was utilized available technology to build this system

## 3.6. Professional Responsibilities

The responsibility of an engineer is to ensure the effectiveness and safety of a system, procedure, or product. Engineers must be able to collaborate with others and work well in teams in order for projects to be successful. Effective communication between engineers, clients, and companies is essential. Additionally, engineers are accountable for the following:

- Using comprehensive drawings to draw out plans
- Preparing estimates and budgets for projects
- Defining the scope of the project
- Designing experiments in the field of engineering
- Producing customer-facing technical reports
- Completing safety-related regulatory documents
- On-time and within-budget completion of projects
- Informing clients and co-workers of findings and conclusions from the analysis

## 3.7.Norms of Engineering Practice

A "norm" is a set of moral laws or guidelines. When making design trade-offs, normative design should be applied to strike a balance between technological and ethical possibilities. In order to ensure that designs have a positive impact on society, engineers are required by law to conduct

impact assessments. Making sure your employees feel valued is crucial as a business owner. Engineering managers must place a high priority on staff talent development if they are to complete the tasks effectively. The manager must have a well-defined growth strategy and maintain open lines of communication with the staff about their skills, needs, potential, and goals.

### 3.7.1. Individual Responsibilities and Function as Effective Team Member

In a group project team work is mandatory to get final successful outcome. It's very important to communicate properly with the team member. Leadership quality is also very important. When everyone completes their duty a very good outcome will come.

**Fahad Ahmed Monir**: He was leader of the group. he tries to make sure everyone does their part but as an individual he worked on the simulation and hardware with the team and he wrote maximum part of the book and he done a big part of result analysis.

**Polash Chandra Gope:** He worked on simulation and hardware part. Also helped on result analysis. He done the poster.

**Md.Kawser Ahmed:** He worked on simulation and hardware part. Also helped on result analysis. He done the poster.

**Biswas Shuvodip:** He worked on the hardware and result analysis part.

## 3.8. Management Principles and Economic Models

Through the simplification of their descriptions of reality, economists use models to produce testable hypotheses about the behavior of the economy. Economic models are by their very nature subjective because there is no accepted benchmark for measuring economic performance. Different economists will come to different conclusions regarding what is required to explain the world as they perceive it. Theoretical and empirical models of the economy are the two main categories. Theoretical models try to derive demonstrable implications about economic behavior under the assumption that agents maximize specified objectives within clearly defined model constraints. They provide in-depth analyses of complex issues, such as market failures and the effects of asymmetric knowledge, which occurs when one party to a transaction has more information than the other. Conversely, empirical models seek to translate the qualitative outcomes of theoretical models into more tangible numerical results. For example, if we were to apply a

theoretical model of a consumer's behavior, we might anticipate that the expenditures would rise as the income did. To try to put a dollar value on the typical percentage increase in spending that occurs with a percentage increase in income, the theoretical model would be empirically modified.

## 3.9. Summary

Discussed in this section are the project's objectives, budget, task management, and SWOT analysis, as well as any potential dangers or advantages. Researchers can have faith in their decision to carry forward with the study because of what they have learnt from past initiatives and expense estimations. Due to the specified stakeholders, many more people will be able to take use of a wide variety of new possibilities.

# Chapter 4

# METHODOLOGY AND MODELING

## 4.1. Introduction

The system is a real time monitoring system for drivers and vehicles. IoT is used to collect data from the sensors, display it on the display that will be mounted on the car, and transfer it over the internet. In this project, the information is processed using a microcontroller. Implement an Internet of Things-based microcontroller because this project is IoT-based. This project's objectives are to gather data, analyze it, and provide feedback.

## 4.2. Block Diagram and Working Principle

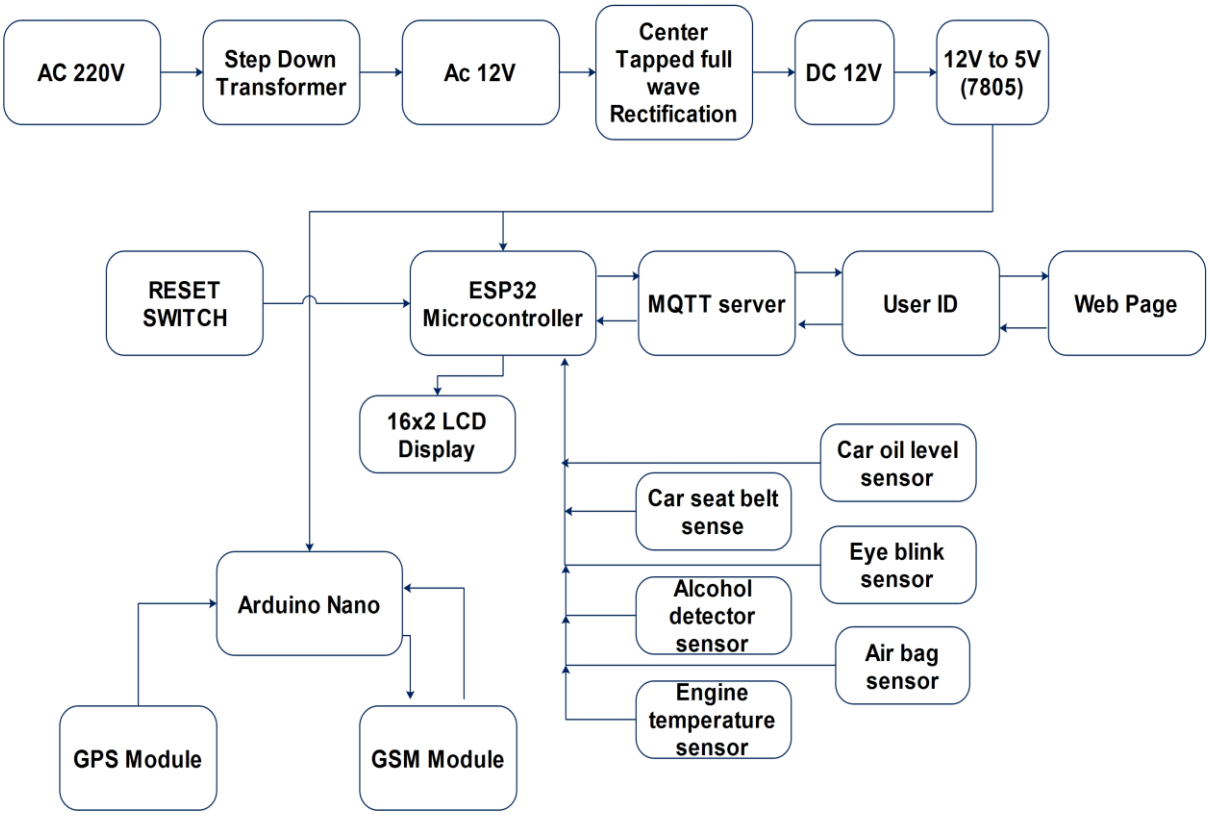


Figure 4.1: Block diagram of vehicle and driver monitoring system

On the top of this figure there is the block diagram of the power supply unite it will first make AC 220 volt to AC 12 volt with the help of a step-down transformer then convert AC voltage to DC voltage with center tapped full wave rectification then give the system 12 volt to 5 volt.

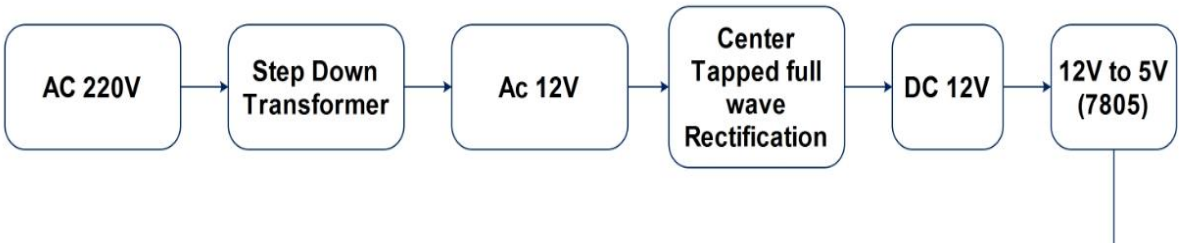


Figure 4.2: Power supply part of block diagram

Taking data from the sensors and show on the display that will mount on the vehicle as well as send data to the web with the help of IoT. In this project we use microcontroller to process the information. Because this project is IoT based implement a IoT based microcontroller. In the middle of the block diagram there is ESP 32 microcontroller the IoT based microcontroller. It will take input data from all the sensor like car seat belt sensor, diver alcohol detector sensor, engine temperature sensor, car oil level sensor, Eye blink sensor to check diver is tired or not and last Air bag sensor. The data taken from the sensor will be displayed on the mounded display on the car and on the web page by the ESP 32 microcontroller. ESP 32 is one of the convenient IoT based microcontroller that can be used in the system. This microcontroller also has a reset switch so if all error happens easy reset everything. We can use Arduino codes for ESP 32 as well as additionally this microcontroller is affordable, this microcontroller will help in achieving the project's objectives. Here it is showing there is two-way communication between web and microcontroller it means web will continuously asking data from the system but with the other sensors it is a one-way communication that’s mean the system just requires only data from the sensors.

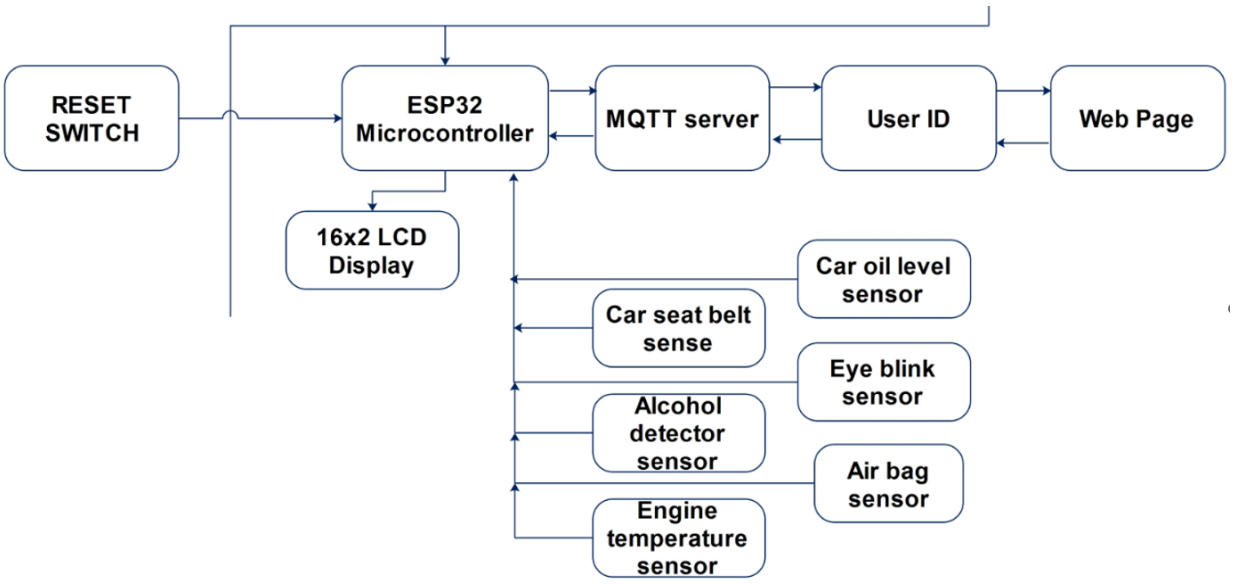


Figure 4.3: Microcontroller input Output block diagram

The question of why using two microcontrollers in a single system. Because first the system is online constantly and secondly the location of a vehicle is very important when thinking of the monitoring of a vehicle as we know microcontroller do one work at a time so we think we might get wrong location of the vehicle or wrong data from the vehicle. Finally, in the bottom left of the figure, we can see the GPS module of this system where we used another microcontroller and that is Arduino Nano. There it is showing two-way communication with GSM module because the system requires all time connectivity with the internet, but GPS module will only send the location of the vehicles at a time.

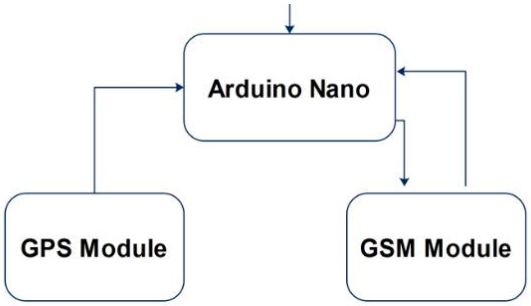


Figure 4.4: GPS module of the system block diagram.

## 4.3. Summary

In short, this system has four different sections in the block diagram. On top is power supply unite it will take 220 AC volt from the car battery and convert it to DC 5 volt to DC 12 volt. Next all the sensor part all necessary sensors are connected with the micro controller the then a on board vehicle display and connection with the web is showing connection with the web is a two-way communication. Everything mentioned is connected with the ESP 32 an IoT based microcontroller. The at last an Arduino nano is connected with the GPS and GSM module we used two microcontrollers because microcontroller we use, they are single core so at a time monitoring data and live location will be not possible.

# Chapter 5

# PROJECT IMPLEMENTATION

## 5.1. Introduction

We have been working on a project that will live monitor vehicle and driver. It is an IoT base project that will also send data to the website any one has access they can live monitor the vehicle and driver basically car owner or the admins. In this system we came up with microcontroller and sensor-based solution microcontroller will take data from the sensor and work along it. Sensors will take data constantly and send to the microcontroller.

## 5.2. Required Tools and Components

**Components:**

**Microcontroller Module:**

A microcontroller is integrated into a system to manage a certain device function. In order to accomplish this, it uses its core CPU to interpret data coming from its I/O peripherals. The microcontroller receives temporary data, which is stored in its data memory, which the processor accesses in order to interpret and apply the incoming data using instructions kept in the program memory. The relevant action is subsequently carried out by communicating with its I/O peripherals. A wide variety of devices and systems employ microcontrollers. Numerous microcontrollers are frequently used in devices, and these microcontrollers cooperate to complete the device's various responsibilities.

In this system we used two microcontroller modules.

1. ESP 32

ESP32 is a line of inexpensive, low-power system on a chip microcontroller featuring built-in dual-mode Bluetooth and Wi-Fi. The primary application processor's communication stack overhead is decreased by the ability of the ESP32 to operate as a fully independent system or as a slave device to a host MCU. ESP32 may connect to other systems through its SPI/SDIO or I2C/UART

interfaces to enable Wi-Fi and Bluetooth capability. Because it is an IoT based microcontroller we connected every sensor other the GPS module.

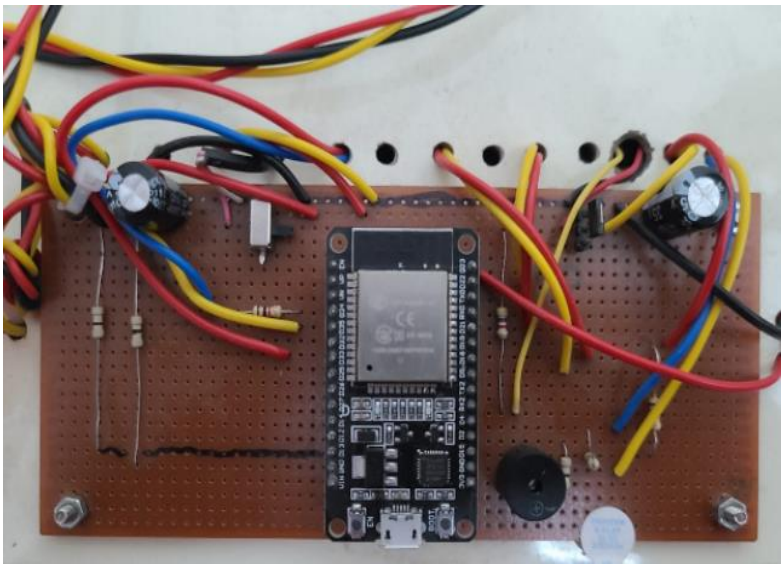

Figure 5.1: ESP 32

2. Arduino nano

Based on the ATmega328, the Arduino Nano is a compact, comprehensive, and breadboard-friendly board (Arduino Nano 3. x). It comes in a different packaging but has about the same capabilities as the Arduino Duemilanove. It only lacks a DC power connector and uses a Mini-B USB cable rather than a conventional one to operate. interfaces T. Only GPS module of this system is used separate microcontroller because microcontroller is single core so it will be difficult for the microcontroller monitor live location and output data of every sensor.

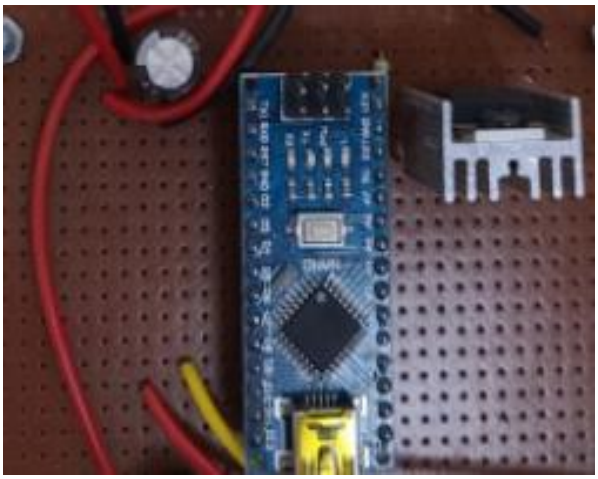

Figure 5.2: Aridno nano

**LCD Display or Module:**

In this project, a 16x2 LCD module was utilized. The liquid crystal display, or LCD, relies on the liquid crystals' light modulation capabilities. It is offered in flat panel displays, video displays, and electronic visible displays. You may see it on your smartphone, laptop, computer, and television screen, and there are many different categories and features available in LCD marketplaces. The development of LCD revitalizes the electronic sector and displaces LED and gas plasma technologies. The CTR (cathode ray tube) that was utilized for visual display is also replaced. The liquid crystal display uses less input power than a plasma or light-emitting diode display.


Figure 5.3: 16x2 LCD module

**Ultrasonic distance sensor Car Oil Level Sensor:**

This sensor continually measures the engine oil level in the static and dynamic regions to monitor the oil level. For this system we used Ultrasonic distance sensor. The time elapsed between the emission and reception is measured by ultrasonic sensors to determine the target's distance. While an ultrasonic sensor employs a single ultrasonic element for both emission and reception, an optical sensor uses a transmitter and a receiver. We set the volume of the oil tank and tank height the distance will measure by the sensor is empty space and then microcontroller will calculate how much oil is in the oil tank.


Figure 5.3: Ultrasonic sensor

**Reed Switch for Car Seat Belt Sensor:**

A reed switch is an electromagnetic switch used to regulate the flow of electricity in a circuit. They consist of two or more ferrous reeds enclosed in a tiny glass tube-like envelope, which become magnetized and move together or apart when a magnetic field is applied towards the switch. If passenger seat belt is on then sensor will send digital signal 1 if the seat belt is not on then sensor will send digital signal 0 to microcontroller.

Figure 5.4: Reed switch for seat bel

**Eye Blink Sensor:**

An infrared sensor is used to measure eye blinks. There are two components to it. a sender and a recipient. The eye is exposed to infrared rays continually from the transmitter. While the receiver keeps an eye out for changes in the reflected waves that signify an eye blink. If the eye is shut, a high output is expected. The output will be modest if the eye is open. Due to its high performance and low cost, this sensor may be employed in a wide range of robotics and mechatronics projects. Continuous infrared waves are sent by the eye blink sensor, which are reflected and picked up by the receiver. The sensor's output spikes as soon as the eye blinks. It is the Arduino board that receives this output. The buzzer creates the noise by receiving the signal from the Arduino. A blink can be found in this method. The driver drowsiness system is another usage for which this technology may be put to use. This technique may be used to see if the driver has a history of dozing off behind the wheel. With a few modest adjustments to the Arduino code, this is possible. Depending on your taste, the Arduino should vibrate when the driver's eyelids are closed for longer than 2-3 seconds rather than only detecting blinks. It may be used to count a person's blinks. It may be used to monitor the driver and ensure that he or she is not sleepy. Many accidents might be avoided thanks to this.

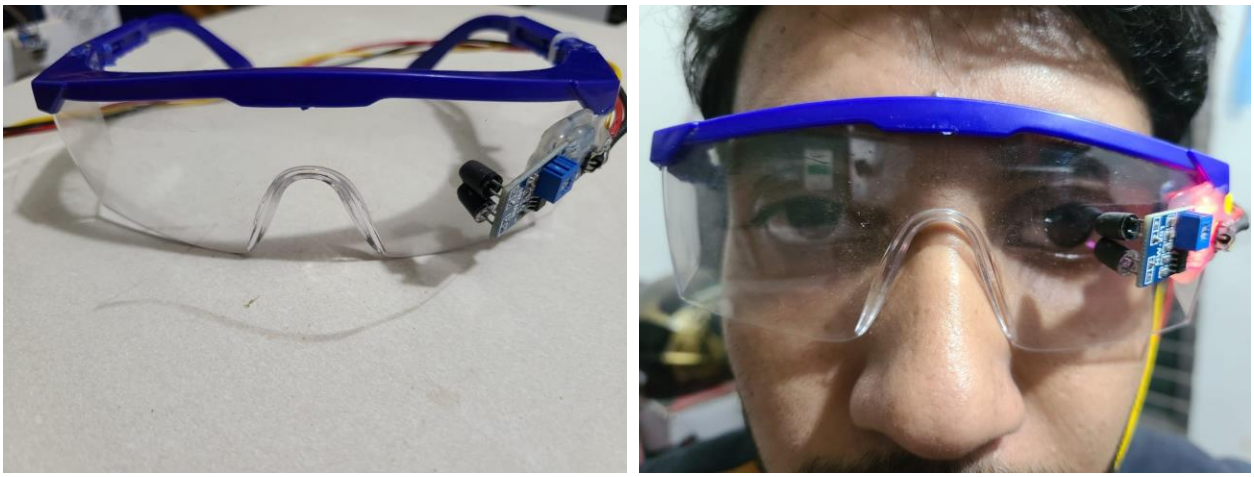

Figure 5.5: IR sensor for eye blink monitor

**Alcohol Detector MQ-4 Sensor:**

Technically known as a MQ-4 sensor, the alcohol sensor detects ethanol in the air and is attached to a microcontroller pin. When a drunk individual breath close to an alcohol sensor, the sensor detects the ethanol in his breath and outputs information dependent on the amount of alcohol in his breath. Buzzer will buzz if alcohol level is high.


Figure 5.6: MQ-4 sensor

**Air Bag Sensor:**

In this system we used a high and low switch for air bag sensor. It basically tells that airbag is available or not. If sensor gives digital signal low then the sensor is not used if sensor give digital

signal high then the airbag is used. It also helps to detect accident form the web that airbag is used so surely there is an accident occurs.


Figure 5.7: air bag sensor

**Temperature DS18b20 Sensor:**

The DS18B20 temperature sensor is reasonably accurate and works without any additional components. It has an accuracy of 0.5°C and a temperature range of -55°C to +125°C. The resolution of the temperature sensor may be changed to 9, 10, 11, or 12 bits. In order to record, monitor, or communicate temperature changes, a temperature sensor is an electronic device that monitors the temperature of its surroundings and turns the input data into electronic data. In our system if temperature is more than 90° C then buzzer will buzz.


Figure 5.8: DS18B20 temperature sensor

**Buzzer:**

A beeper or buzzer, for example, could be electromechanical, piezoelectric, or mechanical in design. The signal is converted from audio to sound as its primary function. It is often powered by DC voltage and used in timers, alarm clocks, printers, computers, and other electronic devices. It can produce a variety of sounds, including alarm, music, bell, and siren, according on the varied designs. Buzzer in this project is used for to alert diver and passenger something went wrong or driver is sleepy or alcoholic.

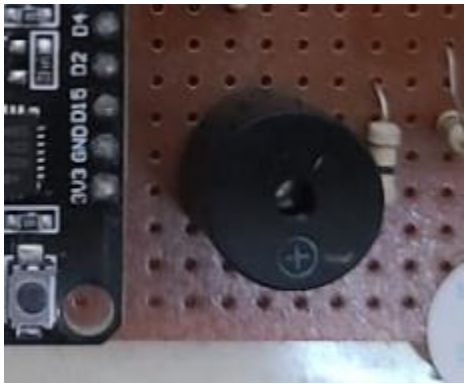


Figure 5.9: Buzzer

**Car on off indicator:** It is an indicator light if the light is on every thing is ok driver can drive the car. If light is off then some thig went wrong buzzer is buzzing and car is not ready to drive.


Figure 5.10: Car on off indicator

**GPS module:**

Small processors and antennas found in GPS modules are used to directly receive data from satellites using specific RF frequencies. From each visible satellite, it will then obtain a timestamp

and other data. In the system the GSP and GSM module is connected with Arduino nano for stay connected all the time. A SIM card also needed to operated this module.

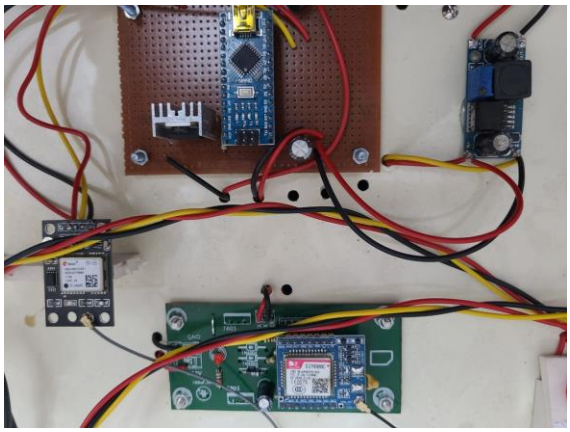

Figure 5.11 : GPS and GSM module

**Power supply unite:**

With the help of a step-down transformer, convert AC 220 volt to AC 12 volt, then use center tapped full wave rectification to change AC voltage to DC voltage, giving the system 12 volt to 5 volt.

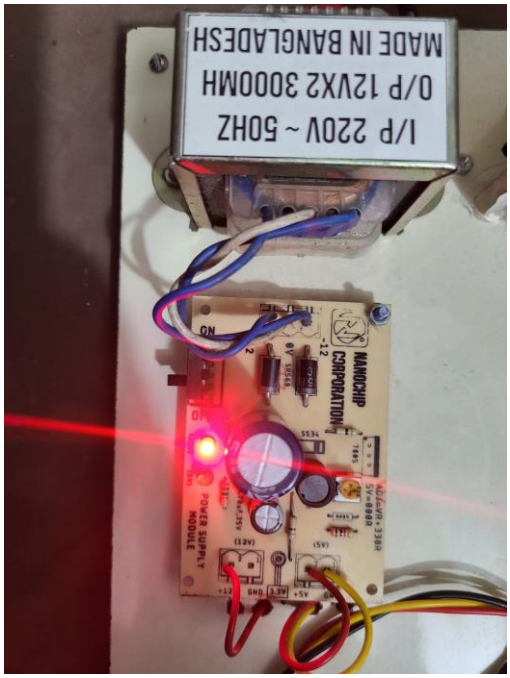


Figure 5.12: Power supply unite

**Breadboard:**

Building temporary circuits on a breadboard is common practice. Designers may quickly remove and change components because to its usefulness. We set our microcontrollers on the breadboard to make connection easier.

**Wire, resistor and capacitor:**

We used required amount of wire to connect the components along with resistors and capacitors.

**Required Tools:**

**Soldering iron:**

A soldering iron is a hand tool used to heat solder at high temperatures above the melting point of the metal alloy, often from an electrical source. This enables the solder to move easily between the workpieces that need to be connected.

**Wire stripper:**

Electric wire insulation can be removed with a wire stripper, a compact hand tool. In order to replace or repair the wire, electricians and even do-it-yourselfers frequently use these portable, hand-held equipment to remove the insulation.

**Glue gun:**

An electric instrument that often looks like a gun and is used to melt and apply adhesive sticks. We use this to stick component.

**Drill machine:**

A drilling machine is a piece of equipment used to create holes in a variety of materials, including metal, ceramic, wood, and plastic. It can either move about or remain still. In our case we used it to make hole in the 5 mm PVC sheet

## 5.3. Implemented Models

Implementation is a process that should followed in every system. At first, we simulate the system in proteus 8 simulation software the we collected all the components and tools that are needed to build this system after the we make the connection as per, we simulated and finally we came up with hardware model.

## Simulation Model

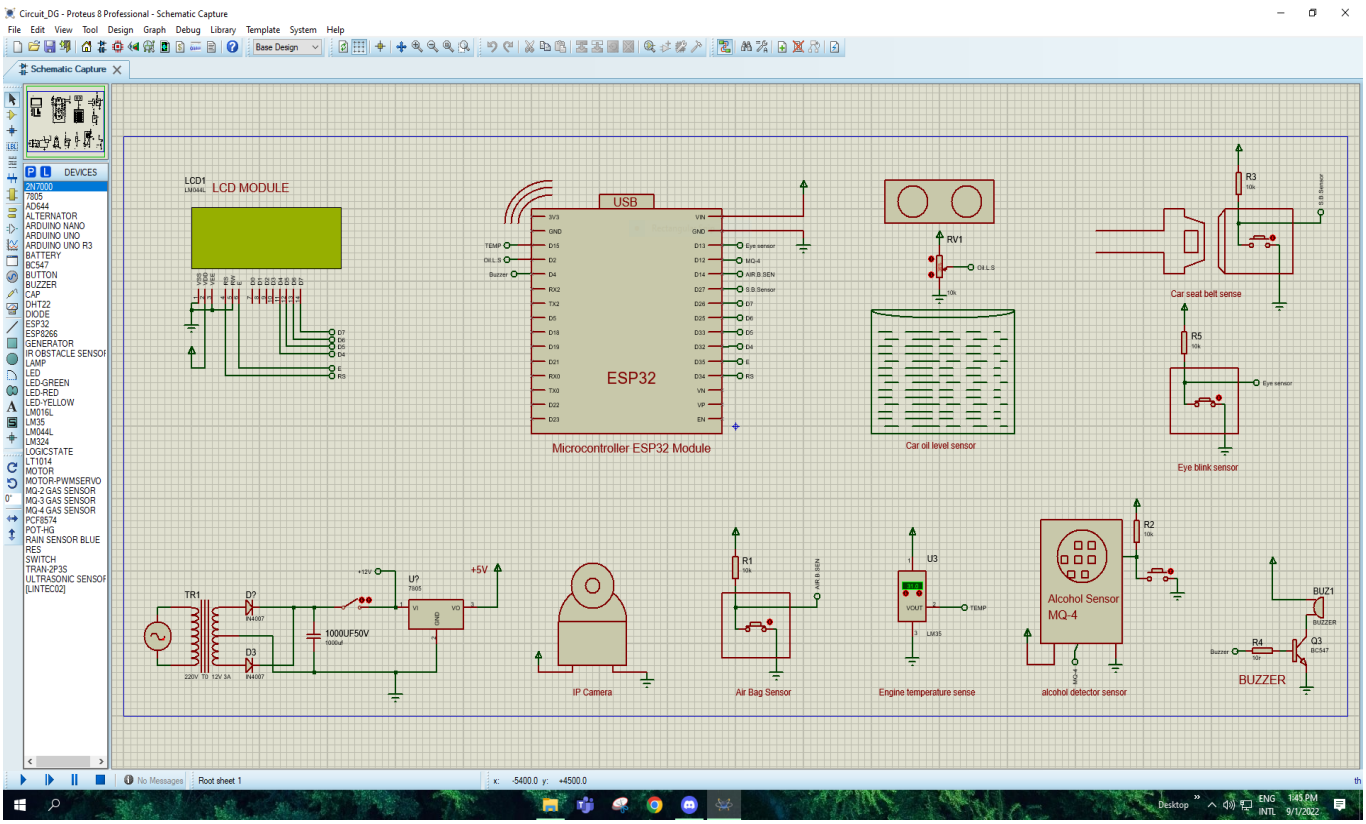


Figure 5.13: Simulation of the system in proteus 8

Here is the simulation of the system in the middle there is ESP 32 system's IoT based microcontroller that is connected with all the sensors. Here is indicated which pin will connected with which sensor. Temperature sensor will connect with D15. Oil level sensor is connected with D2. Then buzzer is connected with D4 pin. These are the analog sensor connected with analog pins. With D13 eye blink sensor will be connect. MQ-4 will connect with D12. D27 will be connect will seat belt sensor lastly D14 will connect with air bag sensor.

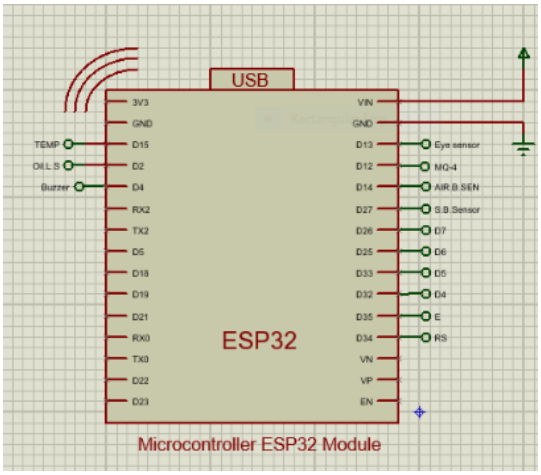


Figure 5.14: ESP 32 microcontroller.

Power supply unite in the figure 5.14 there is a step-down transformer TR1 that will convert 220-volt AC to 12-volt 3-amp AC. After that there is a center tapped full wave rectification that will make 12 volt and 5-volt DC output. Also, a power switch is installed and a 7805 IC to get 5 volt & 12 volt output line. Here 12 volt is indicated as circle and 5 volt indicated as triangle. In simulation if we see the power line of the sensor is triangle means it is powered with 5volt line if we see circle means connected with 12 Volt line

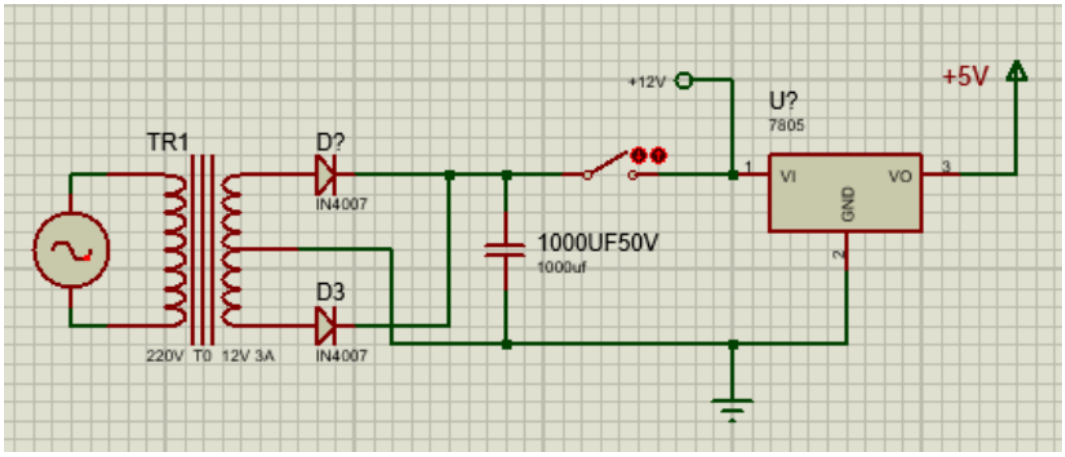


Figure 5.15: Power supply unite

Display module will connect with the microcontroller and will display all the outputs. All the connected pins are showing in the figure 5.16.

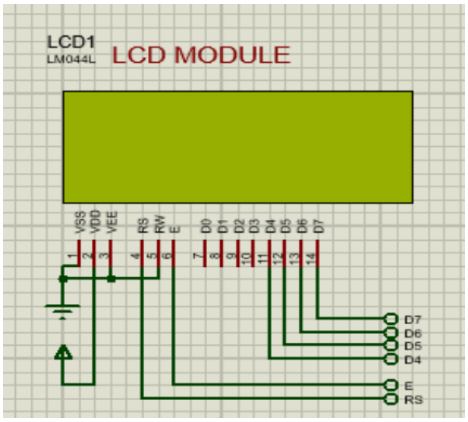


Figure 5.16: 16x2 Display simulation

As mentioned, the analog sensors will connect with the analog pins and digitals sensors will connected with the digital pins. Reason behind taking ESP 32 is not only a cost friendly IoT based solution but also we also can run aridno code on it.

The simulation ran flawlessly. The outcome was expected. We find some limitation but altogether given that cost friendly and code in aridno it is one of the best simulations we can come up with. Back of the we have future progress so we can easily improve.

The sensors are mostly compatible with this microcontroller nevertheless we get expected simulation result.

### Hardware Model

Phase by phase Implemented Hardware and final configurations. Implementation is one of the tough steps of any project. It is like the thing the vision we had when we propose that coming alive. The first step is to make list of components and required tools and collect them all. he first we implement the power supply unite we collect 220-volt 50 Hz step down transformer and connected that with a center tapped full wave rectification with 7805 IC to get 12 volt and 5-volt DC supply. From the power supply we get three line one is 5V line 2$^{nd}$ one is 12 V line and last one is ground. We took a common ground line.

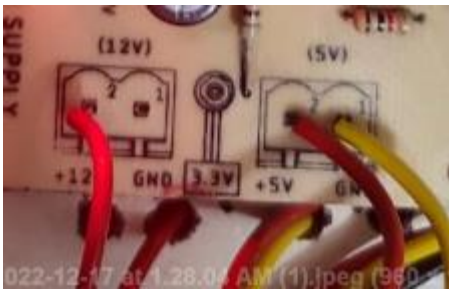


Figure 5.16: Output line.

As per the simulation we connect the power supply to the sensors. Basically, maximum sensor required not more than 5 volt as well as we connect both of the microcontroller with the power supply unite. We used two bread board to set both of the microcontroller set the bread board with a glue gun the we set those two microcontrollers and connect with the power supply then we connect all the sensors with the pins of the microcontroller as per simulation like Connecting the temperature sensor to D15. Sensor for oil level is coupled to D2. Then the D4 pin is used to connect the buzzer. These are analog sensors that are attached to analog pins. Eye blink sensor will be connected to D13. D12 will be connected to by MQ-4. Last but not least, D14 will be connected to the air bag sensor via D27. Then finally connect the display to with the microcontroller

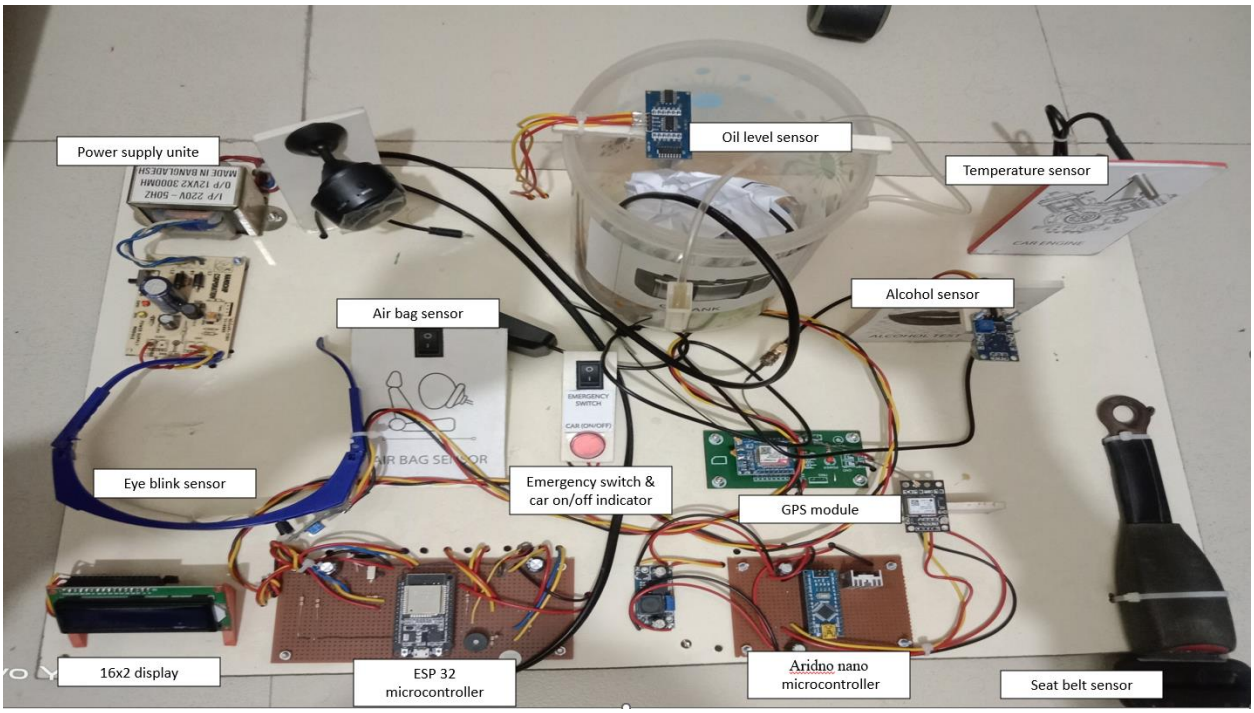


Figure 5.17: Hardware model

## 5.4. Engineering Solution in accordance with professional practices

Engineering is a path of solution problem and make life easier as well as find out of solution that can make people life safer it also needed. Our proposed solution is how make people life safer or we should say how people feel safe when they are travailing. We take this as a project because in country like us road safety is questionable as well as vehicle are not safe a large number of vehicles are not equipped with modern sensor. And in country like us when the passenger pressure at peak like in religious event like Eid, Puaj or Government long holiday driver drive without break as well as a number of accident happen when driver fall sleep our system will help driver and alert him when he fall sleep as well as all the other data will provided to the driver and passenger to take step when needed there we implement a emergency button we a passenger need assistance we call draw driver attention its will be helpful for public transport. Alcoholic driver is a problem from every other country but its impossible for the police to check everyone. And country like us police don't even have alcohol tester. We implement MQ4 sensor to test diver is alcoholic or not and every data will be sent to the website. As well as GPS and other feature will ensure that vehicle safer. Not only for the personal vehicle for big transport company they will have data of every vehicle and driver. They also have information about oil there is a complain that oil has been stolen by the drivers but there is no information to the company.

Finally, we can say if vehicle will be felt more safer to the passengers. The owner can know about the information of the driver and the vehicle any time.

## 5.5. Summary

IoT based vehicles and driver monitoring system is a real time driver and vehicle monitoring system. In process first we done the simulation and get the expected result. Next, we done the hardware part finally we done the coding and come up with this prototype.

# Chapter 6

# RESULTS ANALYSIS & CRITICAL DESIGN REVIEW

## 6.1. Introduction

The results section of the project book should aim to narrate the findings without attempting to interpret or evaluate them and also serve as a guide for the discussion section. The analysis is revealed by the results, which are reported. Results analysis and critical design review is different and vary from project to project. It's a process that should be followed in every other project. In engineering project, it follows a pattern. In every other project first and for most needed a simulation after run simulation the findings are on the hand then need to build the project prototype here comes the second part of taking data after getting data now it's time to compare data. The changes between simulation data hand hardware data are really significance. The comparison between hardware data and simulation data is needed to take decision whether this project is successful or not.

In this project we followed the same process first we did the simulation of this project after avail to run simulation successfully then we took data from the simulation after that we worked on the hardware prototype when prototype was ready, we took the data and analysis and compare both data and take critically reviewed the design.

## 6.2. Results Analysis

The results part of the project should endeavor to tell the findings without attempting to analyze or evaluate them. It should also serve as a guide for the discussion section. The findings are provided, which highlights the analysis. Every engineering project should follow a pattern in this case first do simulation take data after that do hardware and take data then analysis and compare both and find outcome. In result we in-deathly analysis both simulation result and hardware result.

**Simulated Results**

In figure 6.1 we showed the simulation diagram. In this section we will analysis the simulation that had done on proteus 8. We will run the simulation and check whether we are finding the expected result we wanted.

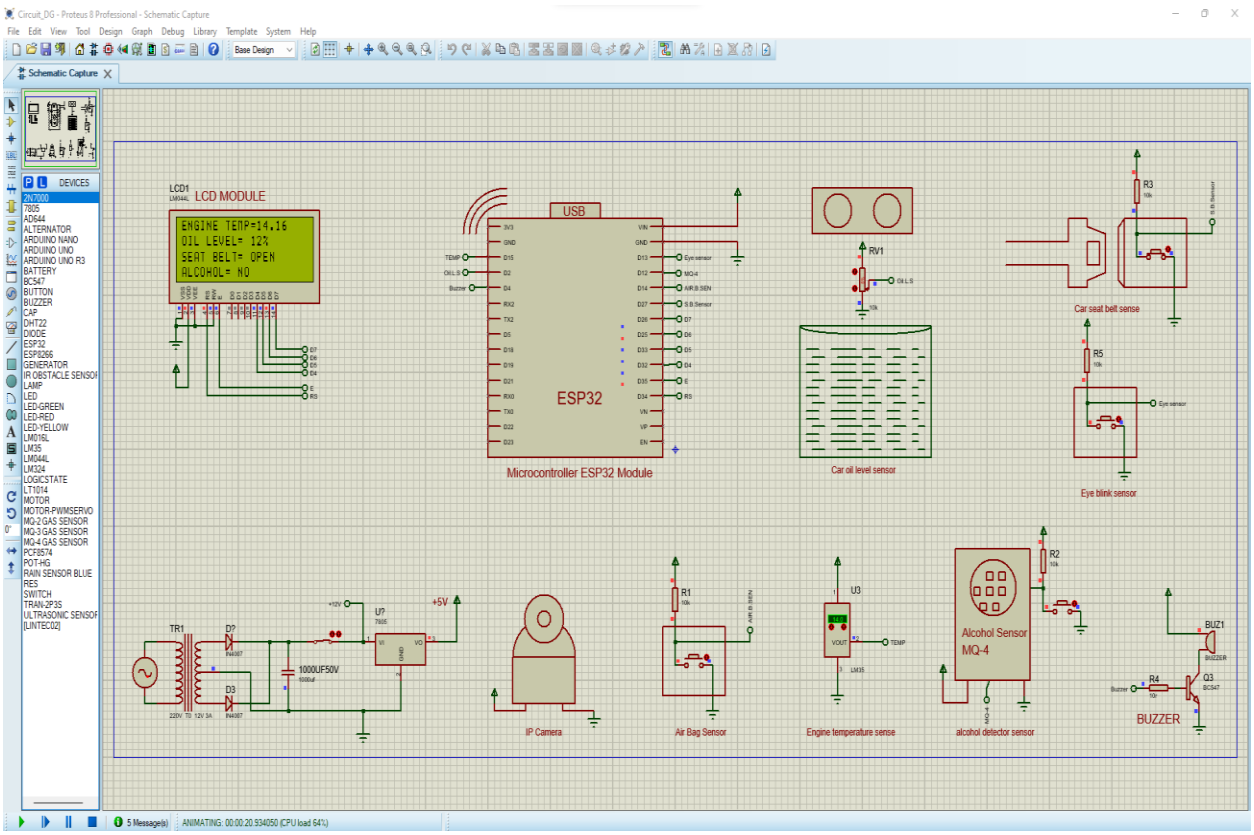


Figure 6.1: Working Simulation

Here we have a display is showing the result from the ESP32 IoT based microcontroller cheap there we can see many sensors are working but there is two different type of sensor some are analog that are connect with analog pin of the microcontroller the analog sensors are oil level sensor, temperature sensor and buzzer. The reason behind they are analog sensor because they will give variable data on the other hand some sensors are connected with the digital pins because they are digital sensor in this case digital sensors are Eye blink IR sensor, alcohol sensor, air bag sensor and seat belt sensor. They are digital sensor because they only have two results either when the sensor is on the output will be high means digital output 1 or when the sensor is off the output will be low and result will be low means digital output 0.

Now, we will analysis the data output sensor by sensor.

**Oil level sensor:**

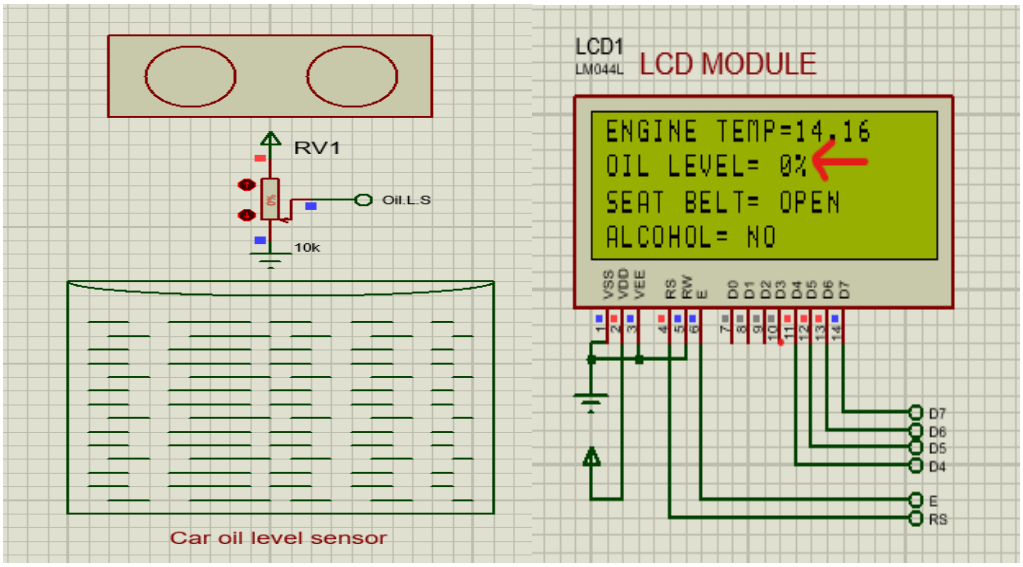


Figure 6.2: Oil level sensor simulation and result.

From the fig 6.2 it's visible that if the parameter is increasing or decreasing the data will be shown in the display. Here on the display, it is showing the oil level is 0% and as we can see the input data is also 0%. We input 0-100 % in the analog sensor and display give same result as like the input data is given. In graph shown in the fig 6.3 blue lines are input data and orange line are output data and after analyzing the data from the graph we can see the input and output are same that was expected data we wanted.

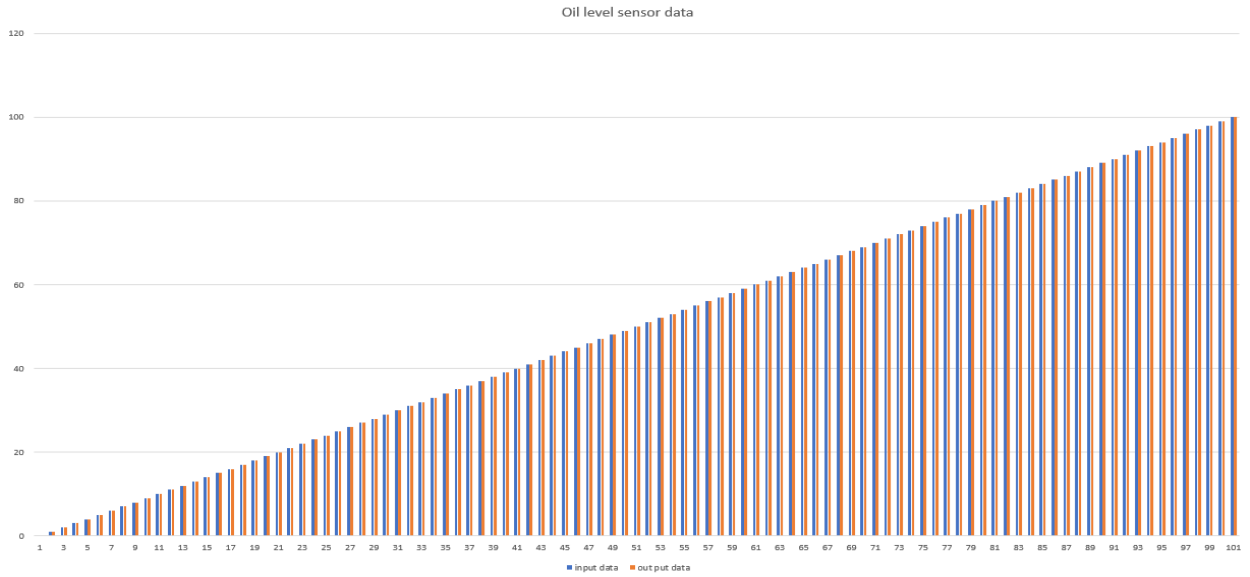


Figure 6.3: oil level sensor simulation data

**Temperature sensor:**

Temperature is another sensor that is analog sensor and give various data. The temperature sensor will connect with the analog pin of the microcontroller.

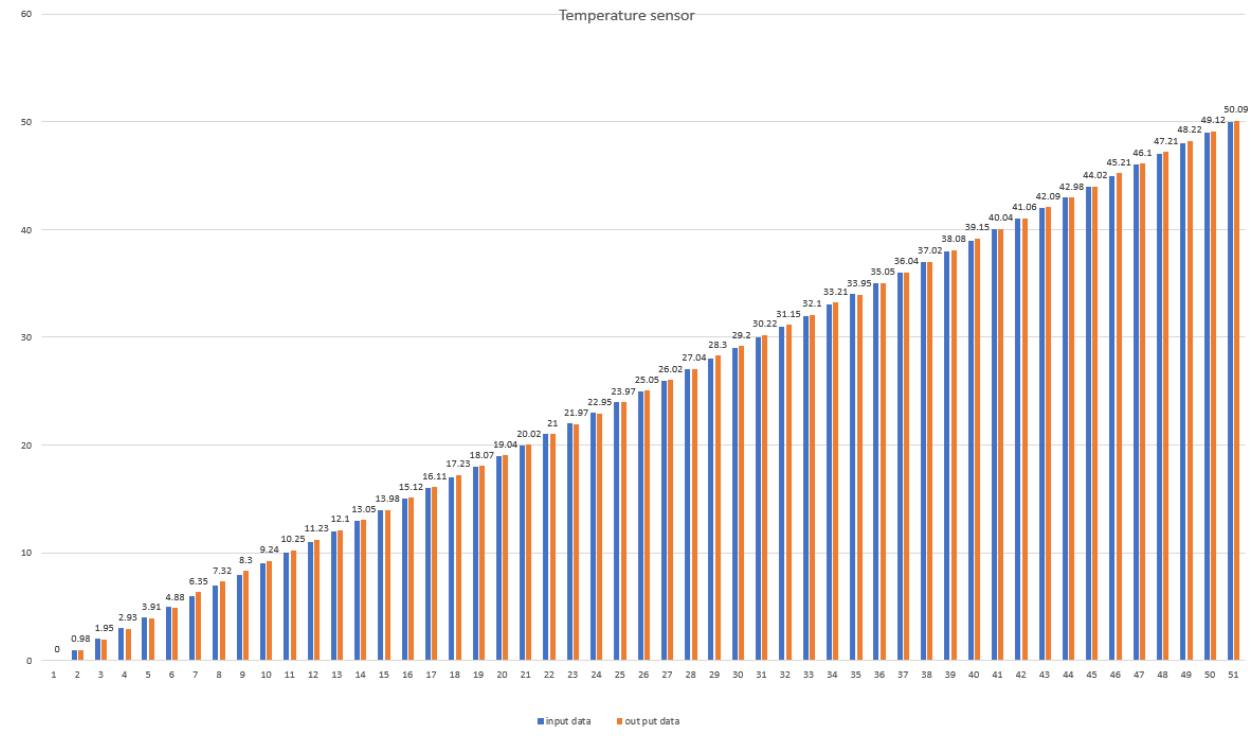


Figure 6.4: Temperature sensor simulation data

In this graph (Fig 6.4) the input data shown by blue lines and output data is shown by orange line. We input 0 to 50 degrees Celsius in input every blue line represents plus one then last data. The out value of every input data is showing in the graph (Fig 6.4). The outcome in not precise we can see on average .15 % +/- data. But for this project it takeable because in a vehicle one or two degree Celsius is not a big issue. For better understanding of the graph, we show 0 to 50 degrees Celsius means 51 data. But it is quite evident the curve tendency. So final out come is we are getting .15 % +/- data error in the simulation data.

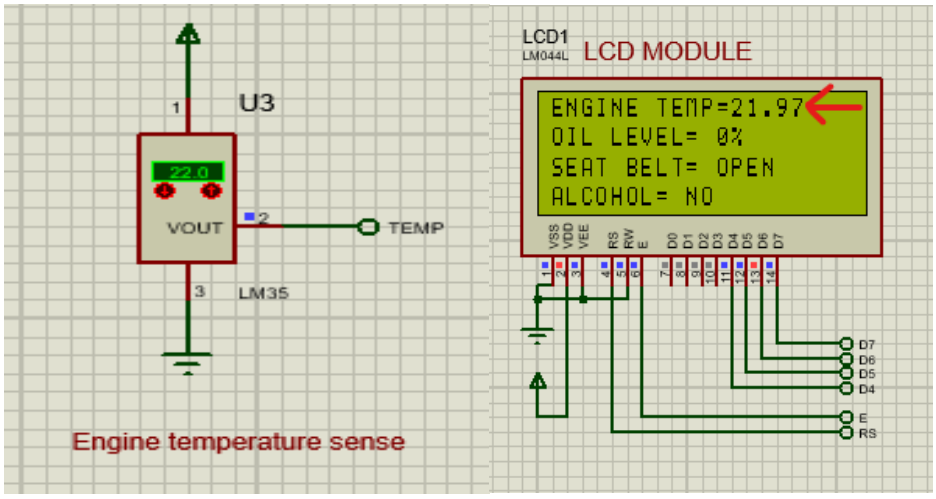


Figure 6.5: Temperature sensor simulation and result.

**Seat belt sensor:**

Seat belt is a digital sensor. Digital sensor is an electrical or electrochemical sensor that transmits data digitally. In this system reed sensor used for car seat belt is on or off. We tested 30 times 15 times with on and last 15 times with off. We had a 100% accuracy in the simulation result. In fig 6.5 blue lines are input data and orange lines are output data.

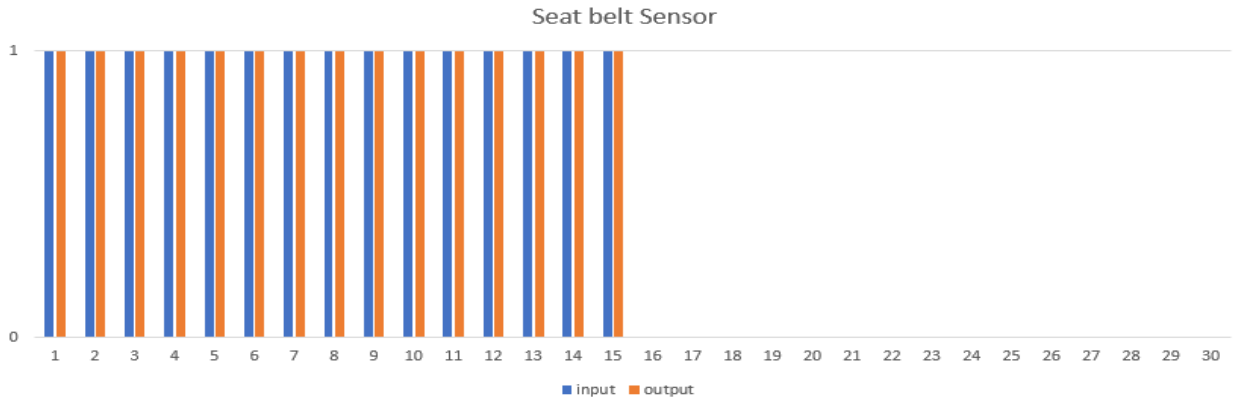


Figure 6.5: Simulation result of seat belt sensor.

As said first 15 tests with sensor on and as result blue line value is one as well as output value orange line value is also one and last 15 tests with sensor off as result blue line value is zero as well as output value (orange line) is also zero.

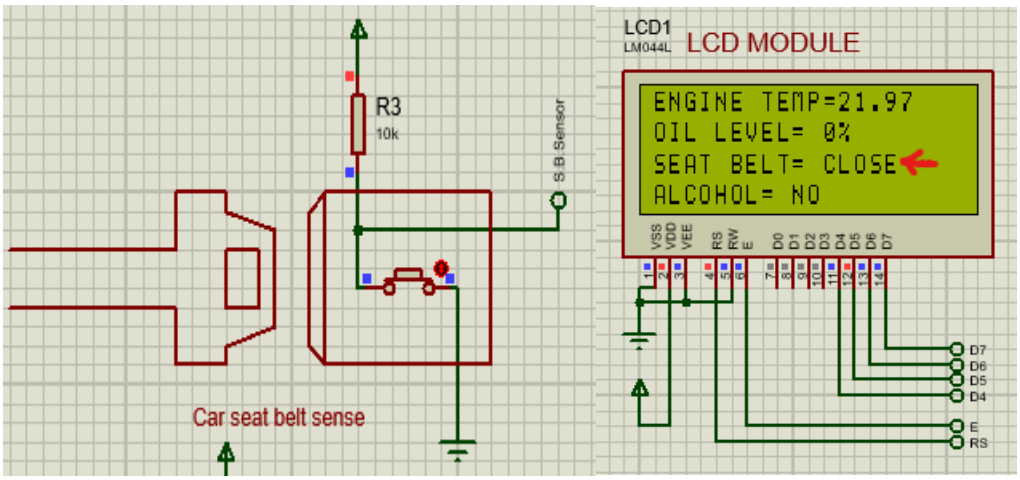


Figure 6.6: seat belt simulation.

**Eye blink sensor:**

This sensor is also a digital sensor. The concept is when eye is blinking the sensor will detect. So, either eye is open or closed. So, in simulation we simulated something that will give result digital high or low it may sound very easy on simulation but as we mention detecting will IR sensor in a very closed distance it was very herd.

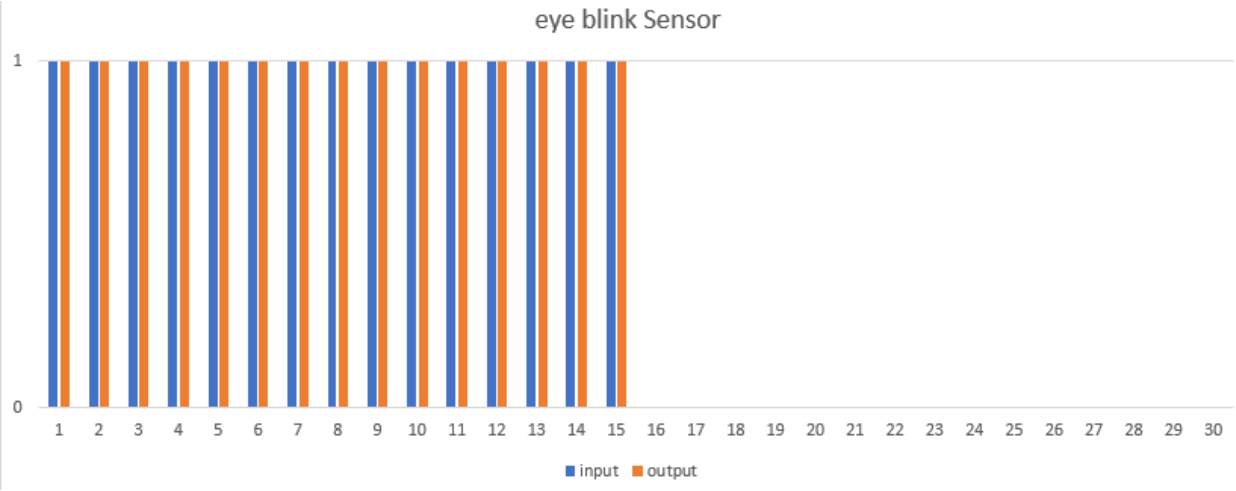


Figure 6.6: Simulation result of eye blink sensor.

The output of a digital sensor is the distinct digital signal of the quantity which is being measured. The output is in the form of 1s and 0s, where 1 indicates an ON condition and 0 indicates an OFF condition. Same like seat belt sensor we took 30 data first 15 with sensor on and last 15 with sensor off and we get 100% accuracy on simulation result input and output data are same so it's easy to say we got expected result.

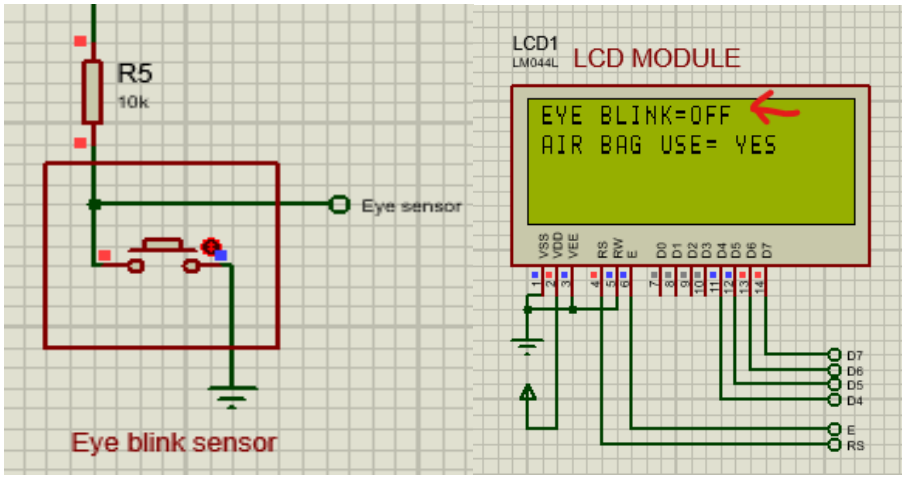


Figure 6.7: Eye blink sensor.

**Alcohol sensor:**

Alcohol sensor is to detect the driver is alcoholic or not. So, the result is either driver is alcoholic or not. So, simulate this thing we thing digital sensor can be used for simulation but analog sensor also can be used to check the how much driver is alcoholic. For the simulation we pick a digital sensor.

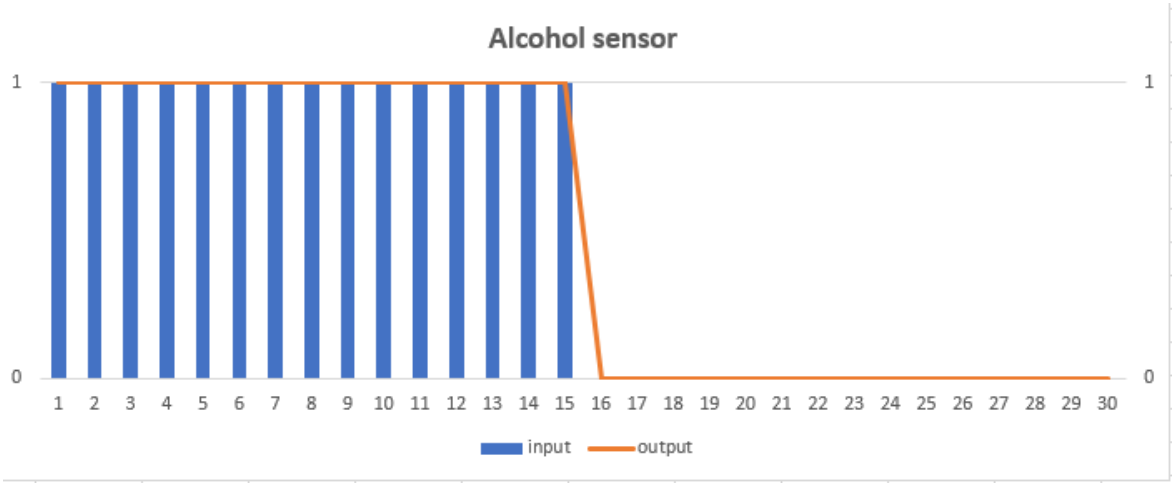


Figure 6.8: Simulation result of alcohol sensor.

In the graph (fig 6.8) blue lines are input lines and orange lines are output lines. In first 15 tests input set to on and last 15 tests the sensor set to off and the output result was expected.

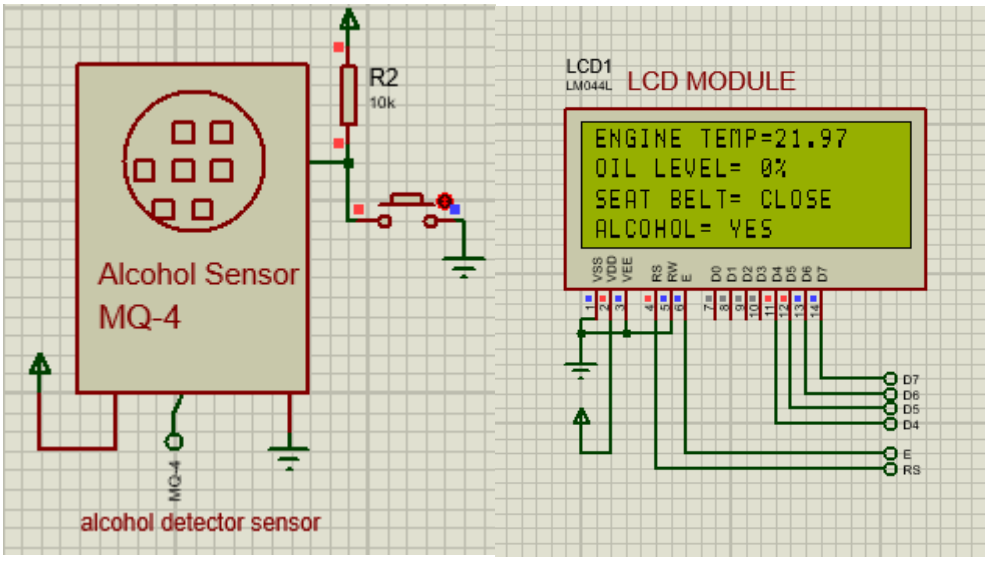


Figure 6.9: seat belt simulation.

**Air bag sensor:** For the air bag sensor in this system, we used a high and low switch. In essence, it indicates whether an airbag is available or not. If a sensor's digital signal is low, it is not used. When a sensor outputs a high digital signal, the airbag is activated.

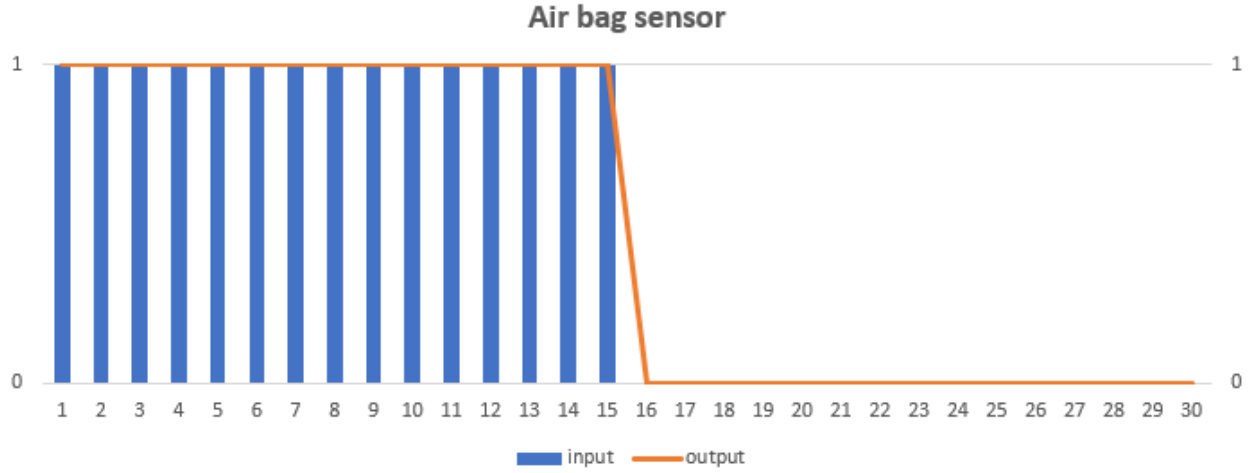


Figure 6.10: Simulation result of air bag sensor sensor.

We take 30 data first 15 when air bag is used and last 15 air beg is not used and we get a 100% accurate result as shown in the graph (Fig 6.10)

**Hardware Results**

Project Hardware refers to all components, tools, instruments, equipment, machinery, supplies, apparatus, devices, equipment, and appliances that will be used in the Project. Hardware result analysis is an In-depth analysis of the findings and result. The hardware result portray that the project objectives are on the right path or not. It's also clarified whether the findings are close to the simulation findings. It's also helps to understand the components are working together simultaneously or not. The hardware result analysis also helps if any modification or correction is needed in the hardware prototype mode.

**Oil level sensor:**

We used an ultrasonic distance sensor for this setup. Ultrasonic sensors measure the interval between the emission and reception to calculate the target's distance. While an optical sensor needs a transmitter and a receiver, an ultrasonic sensor uses a single ultrasonic element for both emission and reception. The microcontroller ESP32 will calculate the data from the sensor and tell the oil level in the percent. The display it will show how much oil is in the tank in percent.


Figure 6.11: Oil level on Display

The sensor sends the data to ESP32 microcontroller then after calculating microcontroller command display to show the value.

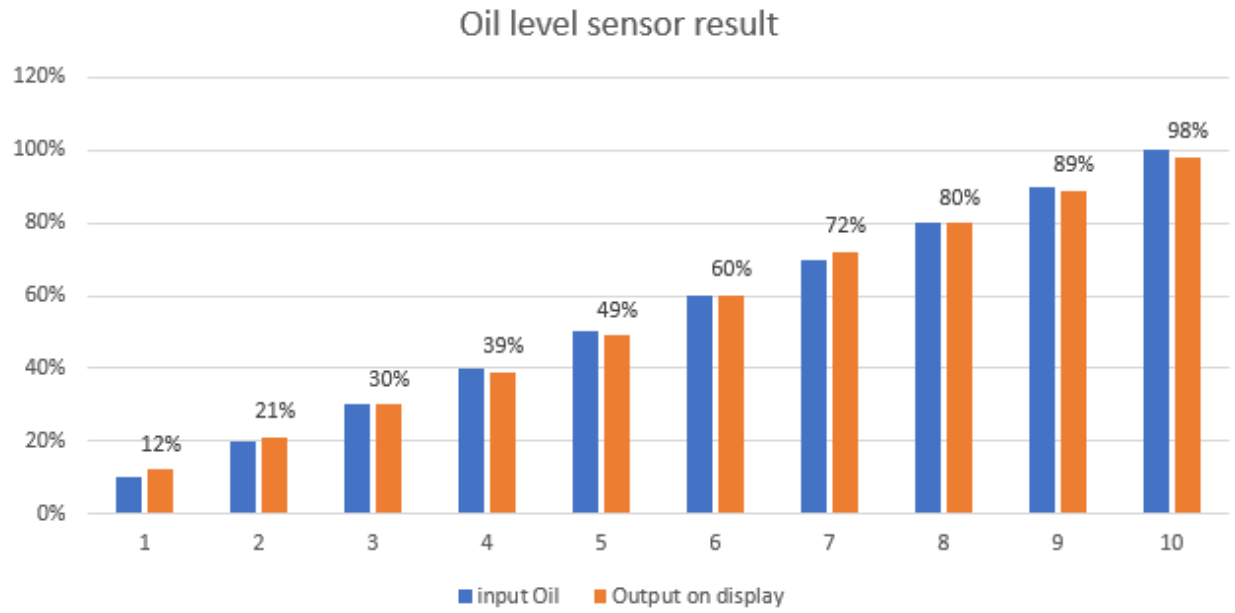


Figure 6.12: Oil level sensor result

The graph is showing the result of the oil level sensor. Here showing the result for every 10%. The see there is maximum +/- 2% error in the result. The blue bar represents the input oil and the orange bar represent the output on the display. There is a beep alarm system when the oil level is less than 20% the alarm will beep.

**Temperature sensor:**

The DS18B20 temperature sensor functions without any additional parts and is comparatively accurate. Its temperature range is from -55°C to +125°C, and its precision is 0.5°C. So, it can give comparatively accurate data and the temperature level will work for this system reason we are not working with too much high temperature. If there we set buzzer range on a higher side but not as high that fire already start.


Figure 6.13: Temperature sensor results on display

In the (Fig 5.13) showing after give heat to the sensor the sensor showing a high temperature on the display. Before the sensor giving data was room temperature.

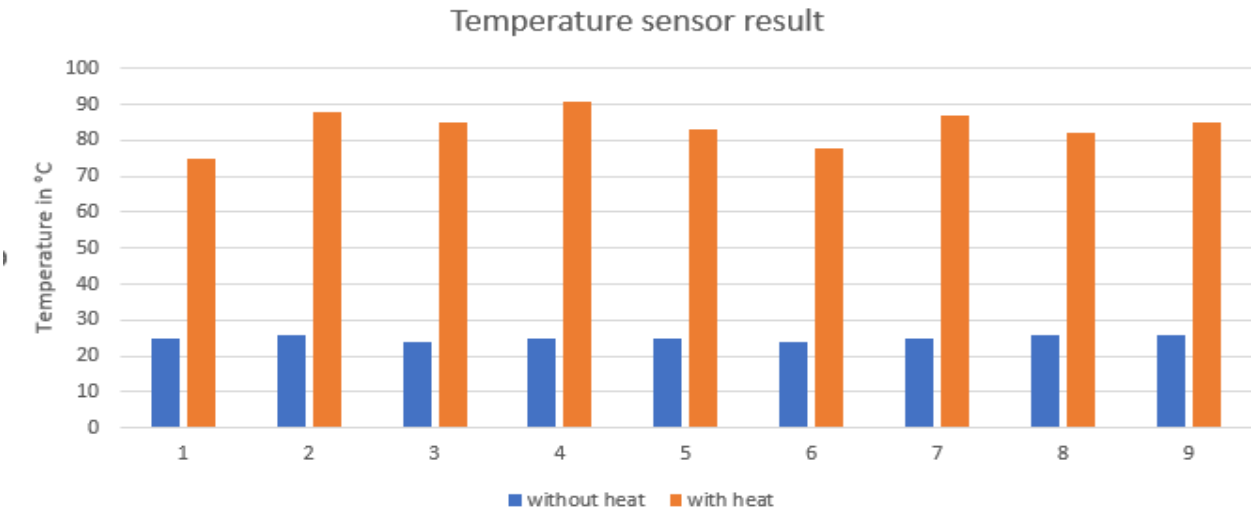


Figure 6.14: Temperature sensor results on analysis

So, in this graph it is showing when no heat is given to the sensor it is always between 23°C to 26°C the normal room temperature but when we give heat to the sensor (Fig 6.14 ) the result is always high and between 70°C to 90°C. On paper the sensor has an accuracy of 0.5°C the precision level is low so this sensor is working fine.

**Eye blink sensor:**

The average human blink lasts 100 milliseconds, or one tenth of a second. It may potentially last up to 400 milliseconds at times. To put that in perspective, a clock tick lasts one second, which enables you to blink three times in that period. Keep in mind that this is merely an average and that each person's real blinking time may vary. Age, weariness, illness, disease, and even medication can all have an impact on how often people blink. When taking sedative medications,

when ill, or even just when they are weary, a person's blink rate may slow down. The caffeine in tea, coffee, and other caffeinated drinks helps some individuals get up in the morning. Humans blink a lot, that much is certain. A person blinks 15 to 20 times each minute on average. [9]
So, there is two ways to monitor eyeblink one with blinking time and another with blink count with the sensor. but no means if anybody blink more than that person is every time sleepy. When someone is in discomfort, they will typically blink more. It is also brought on by strong light and temperature fluctuations. [10] So, either the system needs to count the eye blink or eye blink time. When people are sleepy, they blink for longer time as well as before get into the sleep people normally blink 2 or more trying to give eyes some rest ultimately fall in sleep. In this system the sensor will count the time two sec if someone blink for 2 sec the buzzer will buzz immediately.

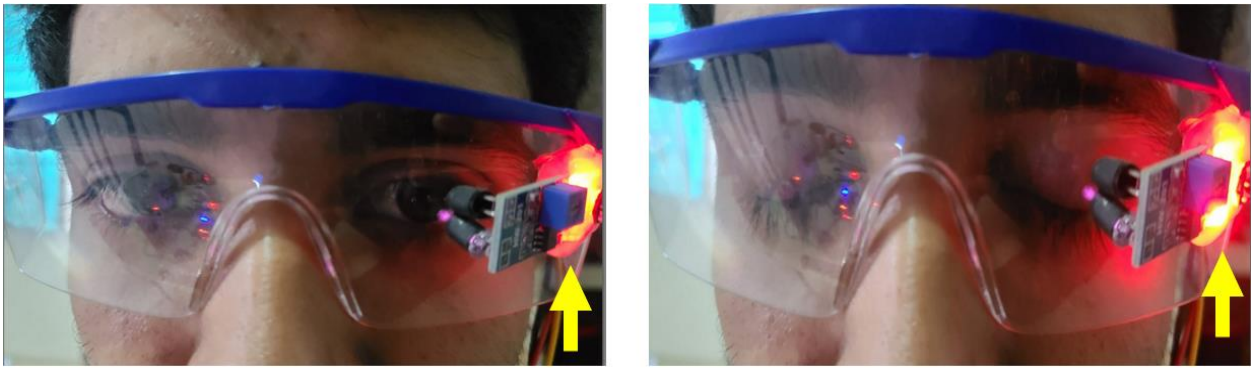

Figure 6.15: Working Eyeblink sensor

There two indicating light on the sensor one is for the sensor is working and second one is for when the eye is blinked the indicator light will be on and instantly the buzzer will start buzzing.
If driver blinks for more than two sec the sensor will send signal the buzzer will start buzzing. The reason behind we took two sec is normally before fall in to sleep or when anyone is tired normally blink longer. On that point system will give warning with the help of buzzer. In case any one fall on sleep within two sec drivers will get alarm as well as if passenger on board the passenger also can check driver after listening the alarm.

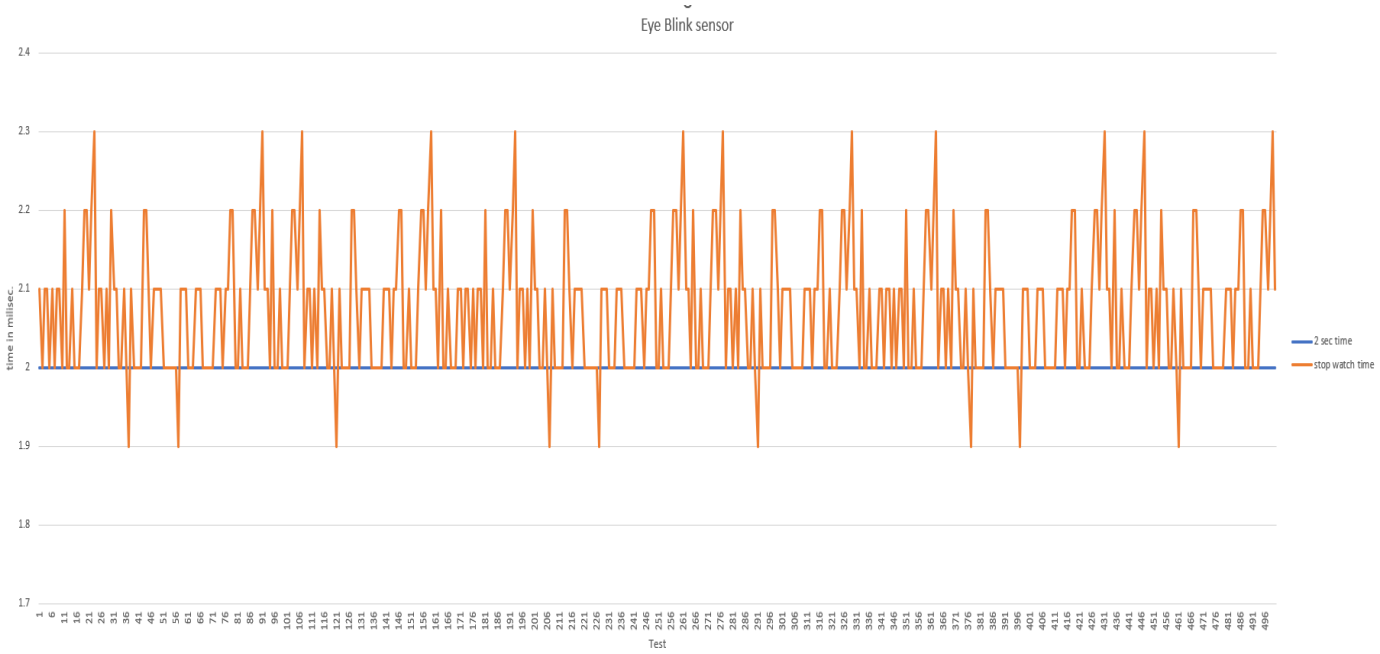


Figure 6.16: Latency of eyeblink sensor result

The system will not count how many time the driver is blinking but the how much long time the driver is blinking. If the blink time is more then 2 sec the sensor will give data to the microcontroller and the microcontroller will send command to the buzzer to buzz. In the graph (fig 6.16) it is showing the time of buzzer buzz and its latency. We used a stop watch to count the time manually. About 500 test was done to analysis the latency. it's clear the buzzer latency is 100 milliseconds in so many tests. Almost it gone to 300 milliseconds but for very small number of the time. Some tests results are showing 1.9 sec these are errors. Other the result is 2 sec. Because the test was done manually with the help of a stopwatch some human delay is must be there in the test result.  After all the result is satisfactory from the eyeblink sensor.

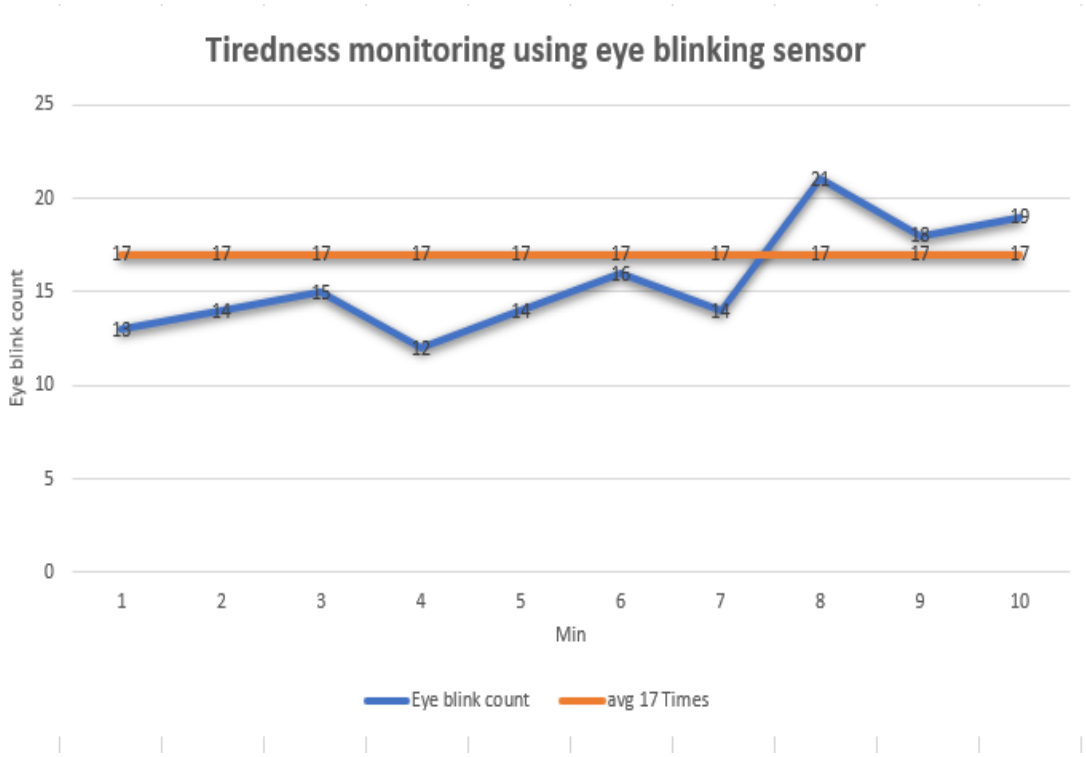


Figure 6.16: Tiredness monitoring using eye blinking sensor

For test we set average 17 time a driver blinks most in normal times. As we know normal people blinks 15-16 time most in a min. Eyeblink will be counted by the sensor. If the blink is more than 17 the buzzer will buzz and inform. The reason behind this is not implemented in the main system is in the research didn't find any concrete evidence that can say blinking more means sleepy. It can vary person to person as well as it difficult for a microcontroller counting bling in min as well as count the time.

**Seat belt sensor:**

A reed switch is an electromagnetic switch used to control how much electricity is flowing through a circuit. When a magnetic field is directed toward the switch, the two or more ferrous reeds inside the tiny glass tube-like envelope get magnetized and move together or apart. The sensor will provide a digital signal of 1 to the microcontroller if the passenger seat belt is on, and a digital signal of 0 if it is not.

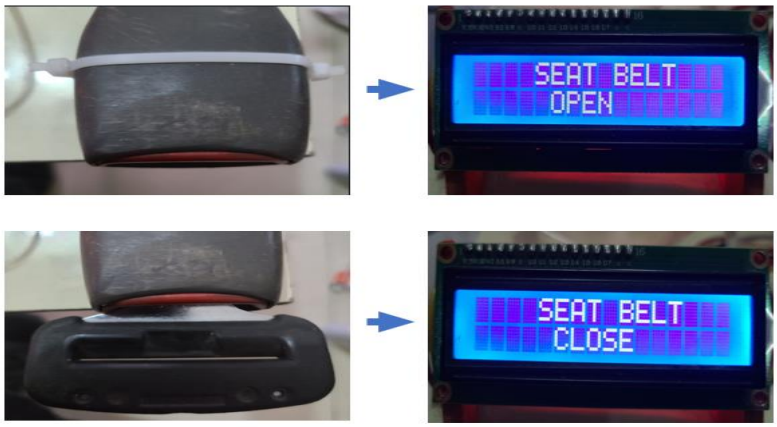


Figure 6.17: seat belt sensor results on display

| seat belt on /off | display outout | status |
|---|---|---|
| 1 | 1 | on |
| 0 | 0 | off |
| 1 | 1 | on |
| 0 | 0 | off |
| 1 | 1 | on |
| 0 | 0 | off |

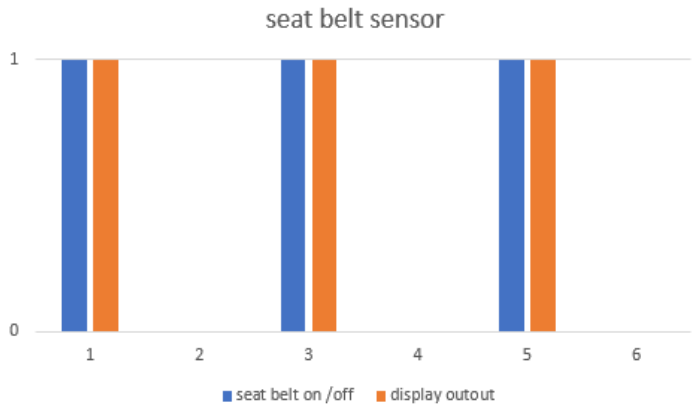


Figure 6.18: seat belt sensor results analysis.

The result analysis of seat belt sensor is basic digital sensor analysis the sensor will give high signal means the seat belt on and when sensor will give low signal means the seat belt off. In every test the result was 100% correct.

**Alcohol sensor:**

The sensor for alcohol will measure the level of alcoholic the driver is. In the normal state the result is 0-5% but when the sensor detects the alcohol in the sensor it shows a very high result. When sensor provides a very high result to the microcontroller then microcontroller commands to the display to show the result and buzzer to buzz.

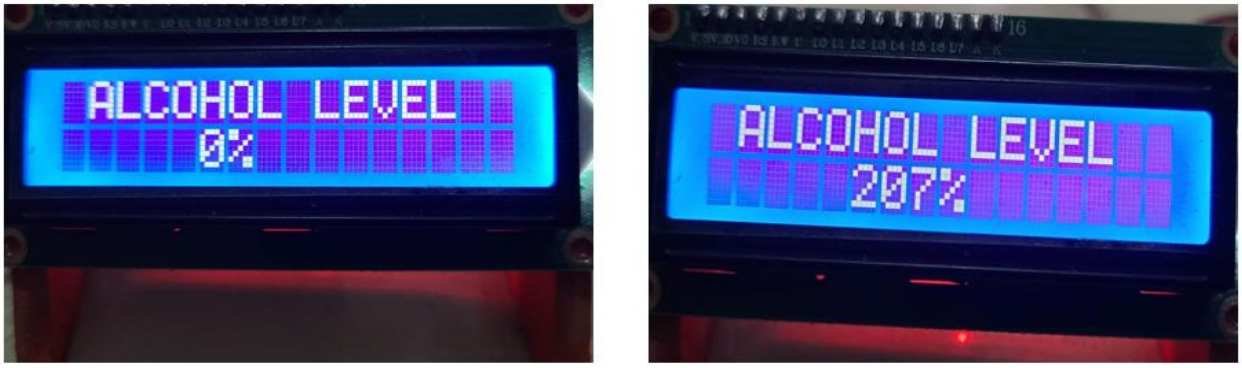


Figure 6.19: Alcohol sensor result on display.

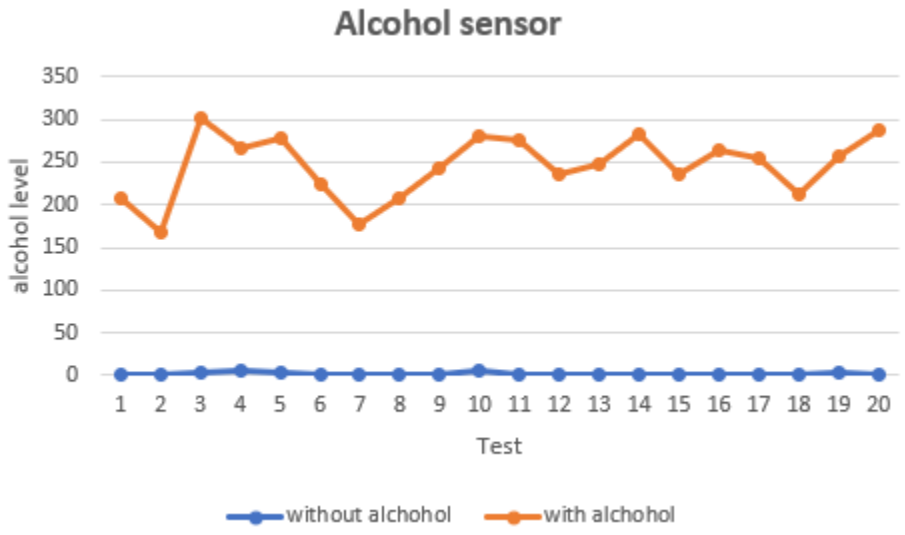


Figure 6.20: Alcohol sensor result.

On the graph (Fig 5.20) the blue line represents when the alcohol was not put on the sensor and the orange line represents when the alcohol was put on the sensor. With out alcohol the result is between 0-5% but whenever it detects the alcohol the sensor sends a very high data in the result its between 160-300%.

## 6.3. Comparison of Results

Simulation is one of the first things to do after the research simulation is a starting point of many projects simulation result shows the proposed solution is possible or not the result get from the simulation is very useful while doing the hardware result analysis. The simulation result may vary

in the hardware result. In this project the result we got from the simulation was satisfactory and predicted. Simulation also helps on the hardware implementation after the hardware implementation the next step is hardware result analysis. The result was taken from the simulation is similar or not. In this project in the hardware result was expected the error is very low for this project. In the market there are solution but not one stop solution the result sometimes is really poor. In market research we found one driver tiredness monitor system implemented on the Bashundhara Group LPG transport vehicle. In not many vehicles not many monitoring device is used the reason behind it they are no up to the mark the also result are full of error.

## 6.4. Summary

The outcome of this project was analyzed and the result was very satisfactory. The predicted solution worked. The simulation that was done was good. There were not many changes in the hardware to get predicted result. The result of simulation and the result of hardware was similar.

# Chapter 7

# CONCLUSION

## 7.1. Summary of Findings

The project is IoT based vehicle and driver monitoring system. This project can minimize the number off accident on the road. The vehicle and driver should be continuously monitor by a system and this system will do this. The reason behind makes it IoT based because vehicle owner or transport company can monitor the status of their drive and vehicle. The result was really satisfactory all the sensors are giving appropriate data. The quality of life will be improved by continued IoT research and its full or partial implementation.

## 7.2. Novelty of the work

The Internet of Things (IoT) is simplifying every element of human life. The possibilities it affords are incomprehensible. IoT is an abstract concept that links all gadgets, tools, and devices together over the Internet so they can communicate with one another. It makes use of network technology, embedded technology, and information technology. To produce the intended result and simplify lives, numerous sensors and tracking devices are connected. IoT has several uses, including smart cars with their enhanced safety, security, navigation, and fuel efficiency. This project is to find a way to prevent the loss of priceless human lives in traffic accidents. The work on the topic vehicle safety based on IoT is not that much. Maximum time vehicle company want to implement the technology in their newer model. There is not much example that vehicle is getting any software updates or and safety hardware update in their older model. So, this market is capture by the third-party companies but the problem is they do not sell a lot of features in a package. The driver sleep monitoring system is one of the unique selling points of this project. It will surely give driver more

confidence on the road and the accident because of sleepy will be less. There is research on vehicle and driver safety based on IoT but they have some limitation that we worked on. [5] [6].

## 7.3. Cultural and Societal Factors and Impacts

Bangladesh ranks 106th for having the most fatal traffic accidents, according to a report from the world life expectancy based on data from 183 nations. In 2020, 3,918 people died in 4,198 accidents. According to police data, at least 4,138 people died in 4,147 accidents in 2019, while 2,635 people died and 1,920 others were injured in 2,629 traffic accidents in 2018. The real number maybe more brutal than this. [12] Bangladesh rank 106 it means there are countries that have more bad record than Bangladesh. It clears the developing and poor countries have bad record. One of the reasons is the vehicle are not up to the mark have don't have any good feature also most of the driver have no info about their vehicle. Also, drivers are not careful most of the driver push their limits also a large number of drivers are alcoholic. It matters of study but we can confidently say that after implement this project in the vehicle the number of the accident will be less. The impact on the society will be huge because this project can save life. Before designing this project, the aim was to make unsafe vehicles safe. As mentioned, the vehicles in country like Bangladesh are not have any technical safety feature. Drivers don't have any information about the vehicles other than oil level. There is a big role of IoT in this project information about driver and vehicle will available to the vehicle owner or transport company. The owner will fell more safer about their vehicle. Oil cannot be stealing any more as the data will be on IoT all the time. This project can safe life and make the road safer.

## 7.4. Limitations of the Work

Project constraints are the overall restrictions placed on a project, such as its schedule, budget, and risk profile. Because they have an impact on project performance, it is crucial to comprehend project constraints. In this article, we'll go into great detail about project restrictions and explain how to handle them. The project goal is to safe life and make the road safe here comes if the system malfunction, then miss data will be projected and make some error in the driving. There are so many sensors in this project the data can be overlap. If there is any voltage malfunction then the sensor can be burn. The eye blink sensor has a limitation that driver needs to wear a big googles

that may create problem to driver sight. In this project there we used microcontroller. Microcontroller is good for one job at a time. If two problems happen at a time there may be latency. There is a buzzer that will buzz if there is any problem but if two problems happen at a time the its maybe a problematic case to find out but display will help on that. The display size is a problem it will show one sensor data at a time but it can be overcome with a larger display.

## 7.5. Future Scopes

Provide future scopes where the shortcomings of the project can be addressed.

Future scopes of this project a really wide. Addition of vibration sensor can measure engine vibration. A pressure sensor can observe the tier pressure. Also, addition of a bigger display to provide more information at a time. This project is run by ESP 32 microcontroller in future if we can add microprocessor so many ways will be open camera addition will be easy there will be no need for another microcontroller for the GPS module. As mentioned, the eye blink sensor has a limitation that driver needs to wear a big googles that may create problem to driver sight a small IR sensor can be implemented so that driver no need to wear big googles. As this project is an IoT based project in future the system can provide more information.

## 7.6. Social, Economic, Cultural and Environmental Aspects

### Sustainability

Sustainability refers to being able to meet our requirements without sacrificing the capacity of future generations to do the same. One of the objectives of this project was use existing solution and make better. This device will not emit any Carbon. As this project can save passengers life if this project work as good as a product also people will be willing to buy the product. One of the major sustainable points is the product is modular if any sensor is not working easily can change that sensor only other the replacing the full product.

### Economic and Cultural Factors

This project is an IoT based Vehicle and diver monitoring system. The system will provide information about the driver and vehicle. The target consumer of this product is not so modern car. Developing country like Bangladesh there are not so many modern cars. A large number of cars are old outdated model. Goal is making awareness to vehicles owner about vehicle safety and importance of monitoring driver and vehicles. As developing they will be not willing to pay a big amount for this kind of product because safely is pretty much overlooked by them so, the plan is making this product as cost friendly as possible. This project features are not any gamic rather the feature is really useful.

## 7.7. Conclusion

The project primary goal was how to make vehicle safer. It is important to take vehicle safety seriously. Along with the worldwide population and automotive use, there are more car accidents happening more frequently, which also means that more people are dying in traffic accidents. The safety and security of vehicles is what this initiative aims to assure. Every driver of a vehicle is required to be aware of the state of the vehicle. Life quality will be improved by the IoT project, whether it is fully implemented or only partially. IoT can help monitor the system remotely. Project that will live monitor the driver and the vehicle. Since it is an Internet of Things-based project, anyone with access to the website will be able to live-monitor the vehicle and driver, which is essentially the car owner or the admins. We developed a sensor-based system for this system that uses a microcontroller to process data from the sensor. Data will be continuously collected by sensors and sent to the microcontroller. This project another objective is to make it low costly. So, everyone is willing to use this project.

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[11]“Bangladesh 106th among 183 countries for having most road accidents: Report,” *The Business Standard*, Nov. 27, 2021. https://www.tbsnews.net/bangladesh/bangladesh-106th-among-183-countries-having-most-road-accidents-report-335299 (accessed Jan. 15, 2023).

# Appendix A

## iThenticate Plagiarism Report

2022.2.18

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# Appendix B

# Arduino Code

```
//#define CAYENNE_DEBUG
#define CAYENNE_PRINT Serial
#include <CayenneMQTTESP32.h>

// WiFi network info.
char ssid[] = "Palash Ghosh";
char wifiPassword[] = "cd345678";

// Cayenne authentication info. This should be obtained from the Cayenne Dashboard.
char username[] = "e0f93e20-6c8e-11ed-8d53-d7cd1025126a";
char password[] = "95717a215a74b42f663b013d2cc4efaf920ad05f";
char clientID[] = "b2bc69c0-6ebd-11ed-8d53-d7cd1025126a";




//For Temperature
#include <OneWire.h>
#include <DallasTemperature.h>

//_____________________________Pin Define
const int oneWireBus = 4;
const int BUZZER = 15;
const int ALCOHOL_ANALOG_SENSOR = 34;
const int AIR_BAG = 2;
const int SITBELT_SENSOR = 19;
const int EYE_BLINK_SENSOR = 35;
const int trigPin = 5;
const int echoPin = 18;
const int CAR_ON_OFF = 23;
const int Emergency_SWITCH = 33;



OneWire oneWire(oneWireBus);
```

```
DallasTemperature sensors(&oneWire);

#include <Wire.h>
#include <LiquidCrystal_PCF8574.h>

LiquidCrystal_PCF8574 lcd(0x27);  // set the LCD address to 0x27 for a 16 chars and 2 line display

//_____________________AULTRASONIC SENSOR
//define sound speed in cm/uS
#define SOUND_SPEED 0.034
#define CM_TO_INCH 0.393701

long duration;
int distancePER;
int Air_Bag_State = 0, SITBELT_SENSOR_State = 0;
int EM_LED_COUNT = 0;
int ALCOHOL_SENSOR_state = 0;
int ALCOHOL_DETECTED_COUNT=0;
int sensorValue = 0;
int outputValue = 0;
int Emergency_State =0;
int Priority_Sounder =0;
int Car_Start_State =0;
int Priority_Sounder_1 =0;
int Priority_Sounder_2 =0;
//_____________________________All Veriable
int temperatureC =0;
int LCD_Counter=0;
int Eye_Blink=0;




//_____________________________________IOT CHANNEL
// Use Virtual Channel for uptime display.
#define VIRTUAL_CHANNEL 5
#define VIRTUAL_CHANNEL 6
#define VIRTUAL_CHANNEL 7
#define VIRTUAL_CHANNEL 8
#define VIRTUAL_CHANNEL 9
#define VIRTUAL_CHANNEL 10
#define VIRTUAL_CHANNEL 11
#define VIRTUAL_CHANNEL 12
```

```
void setup()
{
  sensors.begin();
  Serial.begin(115200);
  Cayenne.begin(username, password, clientID, ssid, wifiPassword);

  Wire.begin();
  Wire.beginTransmission(0x27);
  lcd.begin(16, 2);      // initialize the lcd
  lcd.setBacklight(255); // Backlight Allowase ON

  //_____________________________I/O Pin Config.
  pinMode(BUZZER,OUTPUT);
  digitalWrite(BUZZER,LOW);
  pinMode(trigPin, OUTPUT);
  digitalWrite(trigPin,LOW);
  pinMode(CAR_ON_OFF,OUTPUT);
  digitalWrite(CAR_ON_OFF,LOW);

  pinMode(echoPin, INPUT);
  pinMode(AIR_BAG, INPUT);
  pinMode(SITBELT_SENSOR,INPUT);
  pinMode(EYE_BLINK_SENSOR,INPUT);
  pinMode(Emergency_SWITCH,INPUT_PULLUP);



  lcd.home();
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("VEHICLE SAFETY &");
  lcd.setCursor(0, 1);
  lcd.print("SECURITY SYSTEM");
  delay(1000);
  lcd.clear();
  lcd.setCursor(5, 0);
  lcd.print("*AIUB*");
  lcd.setCursor(5, 1);
  lcd.print("*AIUB*");

  lcd.clear();
  delay(1000);
  digitalWrite(BUZZER,HIGH);
  delay(1000);
  digitalWrite(BUZZER,LOW);
```

```
}

void loop()
{
//_____________________IOT
Cayenne.loop();
Analog_cahannel();

//_____________________EYE BLINK SENSOR
   if(digitalRead(EYE_BLINK_SENSOR)==LOW)
     {
      Priority_Sounder_2 =0;
      delay(500); //2sec eye off time
      if(digitalRead(EYE_BLINK_SENSOR)==LOW)
        {
         digitalWrite(BUZZER,HIGH);
         Eye_Blink=1;
        }
     }
   else
     {
      if(Priority_Sounder_2 == 0)
        {
         digitalWrite(BUZZER,LOW);
         Eye_Blink=0;
         Priority_Sounder_2 =1;
        }
      }



//_____________________TEMPERATURE SENSOR
   sensors.requestTemperatures();
   temperatureC = sensors.getTempCByIndex(0);


//_____________________AULTRASONIC SENSOR
   digitalWrite(trigPin, LOW);
   delayMicroseconds(2);
   digitalWrite(trigPin, HIGH);
   delayMicroseconds(10);
   digitalWrite(trigPin, LOW);
   duration = pulseIn(echoPin, HIGH);
   duration = ((duration-2)/10);
   distancePER = (100 - duration);
```

```
    //Serial.print("Distance (cm): ");
    Serial.println(distancePER);

//_____________________SIT BELT SENSOR
    if(digitalRead(SITBELT_SENSOR)==HIGH)
      {
       SITBELT_SENSOR_State = 1;
      }
    else
      {
       SITBELT_SENSOR_State = 0;
      }

//_____________________AIR BAG SENSOR
    if(digitalRead(AIR_BAG)==HIGH)
      {
        Air_Bag_State = 1;
      }


//_____________________Emergency_SWITCH
    if(digitalRead(Emergency_SWITCH)==LOW)
      {
        Emergency_LEDLOOP();
        Emergency_State =1;
        Priority_Sounder =0;
      }
    else
      {
         if(Priority_Sounder ==0)
          {
           digitalWrite(BUZZER,LOW);
           Priority_Sounder =1;
           Emergency_State =0;
           EM_LED_COUNT=0; //RESET COUNTER
          }

        }


//_____________________ALCOHOL_SENSOR
    sensorValue = analogRead(ALCOHOL_ANALOG_SENSOR);
    outputValue = map(sensorValue, 0, 1023, 0, 100);

    if(outputValue > 90)
       {
```

```
      Priority_Sounder_1 =0;
      ALCOHOL_DETECTED();
      }
   else
    {
      if(Priority_Sounder_1 ==0)
        {
          digitalWrite(BUZZER,LOW);
          Priority_Sounder_1 =1;
          }
      }


//_____________________________________________Car Start
  if((SITBELT_SENSOR_State==1 && Air_Bag_State==0 && Emergency_State == 0) &&
(outputValue < 90))
   {
    digitalWrite(CAR_ON_OFF,HIGH); //Car ON
    Car_Start_State =1;
    }
   else
    {
     digitalWrite(CAR_ON_OFF,LOW); //Car OFF
     Car_Start_State =0;
    }




/*

//_____________________________Priority Sound Controll
if(Priority_Sounder == 1)
  {

    }

*/




//_____________________________LCD
 LCD_Counter++;
```

```
if(LCD_Counter>0 && LCD_Counter<=5)
  {
   lcd.setCursor(2, 0);
   lcd.print("ENGINE TEMP");
   lcd.setCursor(6, 1);
   lcd.print(temperatureC);
   lcd.print("C");
  }
if(LCD_Counter>5 && LCD_Counter==6)
  {
   lcd.clear();
  }
if(LCD_Counter>6 && LCD_Counter<11)
  {
   lcd.setCursor(4, 0);
   lcd.print("OIL LEVEL");
   lcd.setCursor(6, 1);
   lcd.print(distancePER);
   lcd.print("%");
  }
if(LCD_Counter>11 && LCD_Counter==12)
  {
   lcd.clear();
  }
if(LCD_Counter>12 && LCD_Counter<17)
  {
   lcd.setCursor(1, 0);
   lcd.print("AIR BAG SENSOR");
   if(Air_Bag_State == 1)
     {
      lcd.setCursor(7, 1);
      lcd.print("ON");
      }
   else
     {
      lcd.setCursor(7, 1);
      lcd.print("OFF");
      }
  }
if(LCD_Counter>17 && LCD_Counter==18)
  {
   lcd.clear();
  }
if(LCD_Counter>18 && LCD_Counter<23)
  {
```

```
    lcd.setCursor(4, 0);
    lcd.print("SEAT BELT");
    if(SITBELT_SENSOR_State == 1)
      {
       lcd.setCursor(5, 1);
       lcd.print("CLOSE");
       }
    else
      {
       lcd.setCursor(5, 1);
       lcd.print("OPEN ");
       }
   }
  if(LCD_Counter>23 && LCD_Counter==24)
    {
     lcd.clear();
    }
  if(LCD_Counter>24 && LCD_Counter<28)
    {
     lcd.setCursor(1, 0);
     lcd.print("ALCOHOL LEVEL");
     lcd.setCursor(5, 1);
     lcd.print(outputValue);
     lcd.print("%");
    }
  if(LCD_Counter>28)
    {
     lcd.clear();
     LCD_Counter = 0;
    }









} // END VOIDE


void Emergency_LEDLOOP()
 {
  EM_LED_COUNT++;
```

```
 if(EM_LED_COUNT <=2)
   {
    digitalWrite(BUZZER,HIGH);
   }
 if(EM_LED_COUNT >2)
   {
    digitalWrite(BUZZER,LOW);
   }
 if(EM_LED_COUNT >4)
   {
    EM_LED_COUNT=0; //RESET COUNTER
     }
 }


void ALCOHOL_DETECTED()
 {
  ALCOHOL_DETECTED_COUNT++;
  if(ALCOHOL_DETECTED_COUNT <=3)
    {
     digitalWrite(BUZZER,HIGH);
    }
  if(ALCOHOL_DETECTED_COUNT >3)
    {
     digitalWrite(BUZZER,LOW);
    }
  if(ALCOHOL_DETECTED_COUNT >6)
    {
     ALCOHOL_DETECTED_COUNT=0; //RESET COUNTER
     }
  }



 void Analog_cahannel(void)
  {
    Cayenne.virtualWrite(5,  outputValue);
    Cayenne.virtualWrite(6, temperatureC);
    Cayenne.virtualWrite(7, distancePER);

    Cayenne.virtualWrite(8, Air_Bag_State);
    Cayenne.virtualWrite(9, SITBELT_SENSOR_State);
    Cayenne.virtualWrite(10, Emergency_State);
    Cayenne.virtualWrite(11, Car_Start_State);
    Cayenne.virtualWrite(12, Eye_Blink);
```

# Chapter 8

# DETAILED DIRECTIONS ON FORMATTING

## 8.1. Introduction

In this section, how the students can use the template is explained. Follow the specific sections for any specific query.

This template is made keeping in mind the needs of **students in AIUB.** The template will help you a lot of formatting work. If you follow the steps, your thesis will have some less reason to get rejected.

## 8.2. From Declaration to Abstract

For these sections, the work is simple and straightforward. Modify the contents there e.g. select **Fall/Spring/Summer** from the drop-down menu list, fill up different information etc. Select the **semester of your registration along with academic year** (**final defense semester**) for **Capstone Project. Moreover, month of final Defense should be selected in title page, cover page and approval page.**

## 8.3. Entering the Text

To enter your own text, just replace your text in template. For example, suppose the title of your second chapter is 'Literature Review'. Then you will have to just replace "DETAILED DIRECTIONS ON FORMATTING" (see above) with "LITERATURE REVIEW". **Do not change the font name or size there. Similarly, in the introduction section and other sections, replace your text.**

**Beginning a sentence by the words 'but' and 'and' should be avoided. Passive voice should be used as far as possible.**

### 8.3.1. Using Bold, Italic or Underline and use of Bullets

You can use BOLD or *italic* text in your writing for giving emphasis. But using them very frequently or without much thinking will make your report visually unpleasant. Use them only for giving some selected point more importance.

#### 8.3.1.1. Text Justification

Always justify your passages so that the lines are uniformly spread along the margin. To justify select the passage and press *Ctrl + J* (or, alternatively go to Microsoft word Ribbon: Home ⇒ Paragraph Section ⇒ Justify ($4^{th}$ option)).

### 8.3.2. Spacing Option

Use 1.5 of line spacing [go to Microsoft word Ribbon: Home ⇒ Paragraph Section ⇒spacing (just right to the justify option)]

### 8.3.3. How to use Numbering

As you can see, give your sections number like 1.2., 1.3., 1.3.1.etc. This will also help the table of content as you will see later.

To create numbering, go to Home ⇒ Paragraph Section ⇒ Numbering. You will also see that writing (writing 1.2.+ press space) will automatically create aligned number after 1.1. You can also use “change list level” and “set numbering value” in numbering menu (Right click) to change the numbering style and starting number.

### 8.3.4. Using Color

You can use color to give emphasis. But try to use eye soothing colors and again do not overuse.

A general rule for formatting text is presented here. Use this table as your guideline.

Table 8.1 A summary of rules for text editing presented with example

| | | | | | | |
|---|---|---|---|---|---|---|
| **8.3.** | **8.3.6.** | **8.3.** | **8.3** | **8.3.9.** | **8.3.10** | **8.3.1** |
| 8.3. | **8.3.13.** | 8.3. | 8.3 | 8.3.16 | 8.3.17 | **8.3.1** |
| 8.3. | **8.3.20.** | 8.3. | 8.3 | 8.3.23 | 8.3.24 | **8.3.2** |
| 8.3. | **8.3.27.** | 8.3. | 8.3 | 8.3.30 | 8.3.31 | **8.3.3** |
| 8.3. | **8.3.34.** | 8.3. | 8.3 | 8.3.37 | 8.3.38 | **8.3.3** |
| 8.3. | 8.3.41. | 8.3. | 8.3 | 8.3.44 | 8.3.45 | **8.3.4** |
| 8.3. | 8.3.48. | 8.3. | 8.3 | 8.3.51 | 8.3.52 | **8.3.5** |

*Do not go beyond subheading level 3.

**The custom style (look last column of the table) is very important**. You can found them is MS WORD ribbon ⇒ Home ⇒ Style. Select appropriate style. If you are just replacing your text in this template, you will automatically use them.

The custom style is important because it is used to automatically generate the table of content. (See next section 9.4: Table of contents)

## 8.4. Table of Contents

You can manually edit the table of content. But a more efficient way is used here. **The table of content will be updated automatically when you change anything. So, you don't need to edit anything manually.**

### 8.4.1. How to Update Table of content Automatically

#### 8.4.1.1. Mark your text according to Table 9.1

Suppose, you have created a chapter named “How to use this template”. After writing this, you have to select the text (“How to use this template”) and go to Home ⇒ Styles ⇒ select AIUB_2 (table 9.1 says so).

If you are writing the caption 9.4.1 named “How to Update Table of content automatically” (This is in subheading level 2), you have to select the lines (“How to Update Table of content automatically”) and select the styles named “AIUB_4” (see table 9.1).

If you are writing any normal text (inside any subsection), like this line, according to table 9.1, you have to select this passage and select style “**AIUB_T**” (‘T’ for text here).

#### 8.4.1.2. Update the Table

Just right click the “Table of content” and select “**Update field**” & “**Update Entire Table**”. **Only make sure, you have used specific style (see last column of the table) because ‘Table of content’ uses the style to pick up the titles.** If the page number or any of the titles changes, update the table and the correction will be automatic.

You will see the content will be updated according to new page number automatically.

If you see any problem in table of content, just ctrl + click on the page number (from the right side of the table of contents). This will take you to the page. Find there what you have mistaken.

**How to update Table of Contents manually**

This is quite straightforward. Edit as you like. Keep track of the page number by yourself. And, if you change any page, correct all the pages by typing again.

## 8.5. List of Figures

Using list of figure is same as table of contents, only difference: Select the title of the figure and select style "**AIUB_F**" (F stands for figure). Then right click "list of figures" and select "update field". The figure list will be updated according to new page number automatically.

## 8.6. Use of Table

Always give table no. according to chapter (see Table 9.1 – indicating that it is table from chapter 9 & 1st table). Also give a good caption that explains the purpose of the table. **Mention the table name in the text** (e.g. the result of our work is presented in Table 9.1 or something like that, etc). "Auto fit" the table to windows –

1. Select the whole table
2. Go to : layout ⇒Autofit⇒Autofit to Windows

## 8.7. Use of Figures

Do not use directly copied figure from other publications. If you have to use some copyright contents, then give reference of that source like Figure.1 is taken from [1] (means this figure has been taken from reference 1).


Figure 8.1 Logo of AIUB [1]

Always give a figure name, figure caption explaining what the figure implies and mention your figure in your writings. Align the figure and its caption in the middle, e.g. see the above Figure 8.1.

It is wise to keep the aspect ratio of figure fixed; do not distort it. Do not use blurred images (see Figure 8.2).

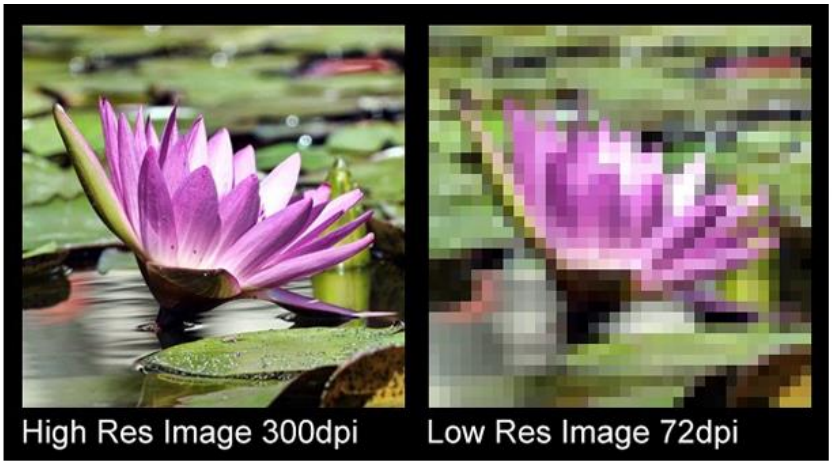


Figure 8.2 Example of an image with acceptable resolution (left one) and unacceptable resolution (right one).

Please check all figures in your paper both on screen and on a black-and-white hardcopy. When you check your paper on a black-and-white hardcopy, please ensure that:

- The colors used in each figure contrast well,
- The image used in each figure is clear,
- All text labels in each figure are legible.
- Keep the images properly sized and at the middle of the margin (Do not cross margin and do not give extra-large or extra-small images)

In case of presenting graph, you can use color. But, use color that can contrast well even in black & white print. Use symbols in your graph, label them properly with units (see figure 9.3).

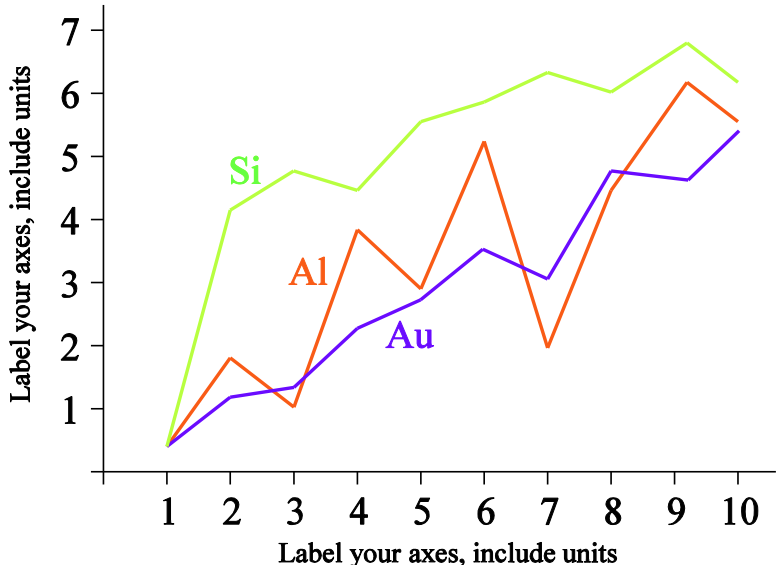


Figure 8.3 An example of graph that uses color which can be easily distinguished even in black and white print; the graphs are properly labeled also.

To draw the curves, it is highly recommended to use professional software "**ORIGIN 8.5**" or later version. But you can also use **MATLAB** or **Microsoft Excel** but these are not professional.

## 8.8. Writing Equations

Use MS word equation writer (Insert ⇒ Equation) to write the equations, e.g.

$$P_{avg} = \frac{1}{T}\int_0^T A\, sin\omega t\, dt \qquad (9.1)$$

Also use equation number according to the chapter, e.g. equation (9.1) is the 1st equation from chapter 9.

## 8.9. Using Symbols

(Go to the menu Ribbon) Insert ⇒ Symbol to create symbols (ω, φ, ϕ, δ etc).

## 8.10. Appendices

In the appendix section, give those parts of your thesis which are not essential to understand the main idea or findings of the thesis. But if the reader wants the details or more explanation, then the appendix will help them.

Give the code you used in simulation or in project, the data sheets (only important parts, not full sheet), and necessary diagrams for details understanding in the appendix.

For example, if you have worked on mathematical modeling, do not give the details derivation in your results chapter because it will hamper the flow of reading and obscure the findings. Rather, present the main equations and results there and give the detail derivation in the appendix.

## 8.11. References

It will contain list of references: books, journal / periodical papers, URL sites).

- The heading of the References section must not be numbered.
- All reference items must be in 12 point font.
- Please use Regular and Italic styles to distinguish different fields as shown in the References section.
- Number the reference items consecutively in square brackets (e.g. [1]).
- When referring to a reference item, please simply use the reference number, as in **[2].** Do not use "Ref. [3]" or "Reference [3]" except at the beginning of a sentence, e.g. "Reference [3] shows …".
- Multiple references are each numbered with separate brackets (e.g. [2], [3], [4]–[6]).

Examples of reference items of different categories shown in the References section include:

- example of websites [1]
- example of a book in [2]
- example of a book in a series in [3]
- example of a journal article in [4]
- example of a conference paper in [5]
- example of a patent in [6]
- example of a website in [7]

- example of a web page in [8]
- example of a data book as a manual in [9]
- example of a datasheet in [10]
- example of a master's thesis in [11]
- example of a technical report in [12]
- example of a standard in [13]

For example, if you are using any book as reference, see [2] in 'reference section' of this template to know how to cite the book.

A more effective way is to use professional software named '**ENDNOTE**' that can automatically update the references as you change anything. If you get time, better use that software.

## 8.12. Error Correction

Use Microsoft word spelling checker for possible error. Want to be perfect! A more effective way to check spelling: Get a hard copy of your thesis and read from backwards of the line. This will lose your focus on content and increase attention on the spelling.

## 8.13. Summary

This section works as a thesis guide by demonstrating how to use this template in detail. This section also focuses on general techniques regarding 'how a dissertation should be written'.