E-VEHICLE MONITORING SYSTEM

A MINI PROJECT-II REPORT

Submitted by

ARUN PANDIYAN P B	**717821E107**
DIVYASHREE Y	**717821E116**
REEMA MANSOORA S	**717821E143**
SURYAVADHANI D	**717821E155**

in partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

IN

ELECTRICAL AND ELECTRONICS ENGINEERING

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COLLEGE OF ENGINEERING
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Bona fide record of work done by

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Dr. M. SIVARAM KRISHNAN, Ph.D.	**Dr. V. TAMILSELVAN, M.E., Ph. D.**
Faculty Guide	**Head of the Department**

Certified that the candidate was examined in the viva-voce examination held on

……………………….

…………………….......

(Internal Examiner)

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ABSTRACT

Because of natural disasters, the use of cars has grown during the previous two decades. Global warming has expanded it dramatically. Our regular pollution causes this. Vehicle emissions cause massive pollution. E-vehicles with batteries solved this issue. "**E-VEHICLE MONITORING SYSTEM**" is our project. Our project monitors battery voltage, current, temperature, load current, voltage, percentage, smoke detection, automobile weight, and tyre pressure. Electric vehicles incorporate battery management systems (BMS) to track and regulate the charging and discharge of rechargeable batteries, which improves accuracy. Battery management software sustains the battery's security, durability, and senility without putting it in a harmful state. Several monitoring methods have been used to maintain the battery's condition of charge, comprising voltage, current, and ambient temperature. Numerous analog/digital sensors with microcontrollers are utilized for testing purpose. This project will examine a battery's maximum capacity and additionally its state of charge, health, and duration. Reviewing all these methodologies might assist in identifying possible problems in the future and alternatives.

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LIST OF ABBRIVIATIONS

IoT	Internet of Things
USB	Universal Serial Bus
TTL	Transistor-Transistor Logic
Wi-Fi	Wireless Fidelity
IDE	Integrated Development Environment
PWM	Pulse With Modulation
UART	Universal Asynchronous Receiver Transmitter
SRAM	Static Random Access Memory
SOC	State of Charge
SOH	State of Health
BMS	Battery Management System
EV	Electric Vehicle
ADC	Analog-to-Digital Converter
GPS	Global Positioning System
CTR	Click-Through Rate
DC	Direct Current
BSS	Battery Swapping Station
HEV	Hybrid Electric Vehicle
RUL	Remaining Useful Life
PCB	Printed Circuit Board

CHAPTER-1

INTRODUCTION

Today the electric vehicle (EV) has been developed in such a way that electronic motor, battery, and charger replace the engine, tank, and gasoline pump of the conventional gasoline-powered. In other word, instead of using fossil fuel to move the vehicle, in this case we used a pack of batteries to move it. The global climate change and the abnormal rising international crude oil prices call for the development of EV.

To solve these problems, a new energy needs to be developed or optimized in order to replace the current energy which is fossil fuel. A clean and green energy. Because of this, it is very important to make sure that the battery that being used is reliable as the fossil fuel. Thus, the design of the battery management system plays an important role on battery life preservation and performance improvement of EV.

The BMS also performs many tasks including the measurement of system voltage, current and temperature, the cells' state of charge (SOC), state of health (SOH), remaining useful life (RUL) determination, controlling, and monitoring the charge / discharge characteristics and cell balancing. For this project, 18650 Lithium-Ion battery is used to develop battery management for 144V 50Ah. As lithium-ion batteries have high value of specific energy, high energy density, high open circuit voltage, and low self-discharge, they are a proper candidate for EVs among other cell chemistries.

CHAPTER-2

LITERATURE SURVEY

1. Title: "Battery Health Monitoring for Commercialized Electric Vehicle Batteries: Lithium-Polymer"

Author: Fawad Ali Shah, Shehzad Shahzad Sheikh, Umar Iftikhar Description: Batteries are widely utilized to power electric vehicles, hybrid electric vehicles (HEVs), and many other high-power applications. The battery is critical to their efficiency, safety, and reliability. Reliability. Initially, numerous types of batteries are discussed in this paper. According to the research, utilized in EVs and HEVs are explored. The most recent battery management methods (BMS). Lithium- ion batteries due of their extended life, a preferred source of EVs and HEVs high power density, and good charging and charging efficiency performance discharge However, there are still some concerns. Li-polymer batteries are used in a variety of applications, including complicated electro chemistry, battery deterioration, and battery accuracy health assessment. Vehicle electrification is a global trend that includes Asia and Pakistan. Following that, the article considers the economic, environmental, and energy efficiency implications of increased use of electric vehicles.

2. Title: "Battery Swapping Technology"

Author: Shubham Jain, Azures Ahmad, Mohammad Saad Allam Description: The transportation industry contributes significantly to carbon emissions and pollutes the environment globally. Electric vehicles (EVs) have a significant promise for reducing carbon emissions. A HEV (BSS) is a promising mechanism for providing power to EVs while reducing long charging times at a Battery Charging Station. Swapping Technology is an excellent option for completing a long-distance interstate journey. This study investigates the advantages of establishing the BSS from many perspectives, and as a result, a methodology for swapping out batteries in significantly less time is given, considering the position of the battery to be fixed. This new approach can be used as a source of inspiration for a future framework that provides EVs with sensible and dependable charging.

3. Title: "Scalable and DE-centralized Battery Management System for Parallel Operation Multiple Battery Packs"

Author: Shreyas Maitreyan, Himani Jain, Priyanka Pallial Description: Multiple lithium-ion battery packs operating in parallel re required for large-scale energy storage applications. Renewable energy storage systems, battery packs for large-scale automobiles such as electric trucks, tanks, armored vehicles, diesel-electric submarines, and so on are examples of such uses. The existing method for parallel operation of numerous battery packs is highly hardware intensive. It necessitates a distinct pack management system acting as a master, as well as battery management systems in each of the battery packs deployed as slaves. This has a huge impact on the scalability of such systems because the number of battery packs that can be connected in parallel is entirely reliant on the capacity of the master. A decentralized pack management system is presented as an alternative in this study. The suggested technique eliminates the need for master-slave battery pack conFIGurations and eliminates the need for centralized hardware to manage the battery packs. Instead, this system allows individual Battery packs to communicate with one another on their own, allowing for decentralized pack administration.

4. Title: Battery Management System in Electric Vehicle

Author: Ananthraj C R, Arnab Ghosh Description: The most crucial component of any electric vehicle (EV) is battery storage, which stores the energy required for the vehicle's operation. So, in order to get the most out of a battery while also ensuring its safety, it is vital to have an effective battery management system in place. It monitors the parameters, calculates SOC, and provides the services required to ensure the battery's safe functioning. As a result, BMS are a crucial component of any electric vehicle, and more research is being done in the field to build more capable BMS. System for Managing Batteries.

CHAPTER-3

SYSTEM DEVELOPMENT

With the overall system in mind, a single circuit needed to be designed to measure the Voltage, Temperature, Smoke, Current of a single battery in the motive power pack. This circuit could then be replicated and integrated into the system to measure the voltages of all batteries in question, because the alternator can keep the battery charged if the engine is running and the vehicle can be refueled quickly. However, on the EV every joule used to power the battery Monitoring using IOT system is a joule that cannot be used to propel the car. Since electric vehicles already have a shorter range than their gas-powered counterparts and take much longer to “refuel” (on the order of a few hours compared to a few minutes) reducing power consumption is an obvious goal. The Monitoring using IOT system will be made up of several different components installed in different locations throughout the vehicle. The Arduino Uno will act as the “brain” of the Monitoring using IOT system, recording data and allowing for future expansions of the scope of the Monitoring using IOT. Even though the Arduino Uno can take direct voltage measurements, it can only do so in the ±5 V range. The high DC voltage of the main power pack leads to the necessity of an intermediate circuit with an output voltage proportional, but much lower than the voltage across the main power pack.

3.1 CHOOSING PARAMETERS

After the basic design of the circuit was decided, the operating conditions and consequent device parameters needed to be determined. The Vishay VO618A series of percolators was chosen because of its photo transistor output and lack of complicating features. Specifically, the VO618A-3 was selected because of a guaranteed current transfer ratio (CTR or the ratio of the collector current to the diode forward current), its low cost, and ability to operate well with forward diode currents on the order of a few milliamps. As with any transistor amplifier design, a DC operating point must be established. The photo transistor collector current (IC) vs. The collector emitter voltage (VCE) for several different forward diode currents. Initial designs looked at setting IF to be 1 mA, but this was changed to 5mA in the final design to allow for more stable operation and a larger collector current swing while remaining in the active region of the photo transistor. The load line method of determining collector resistance involves using the graph of collector current (IC) vs collector-emitter voltage (VCE). Because transistors are non- linear over their entire range of operation, the load line method is more intuitive and typically easier than solving a system of equations that may not be accurate at all the solutions. To use the load line method, two points must be established: the collector-emitter voltage when the collector current is zero and the minimum possible collector-emitter voltage while the transistor is both in the active region of operation and subjected to the highest possible collector current. The relationship between the collector current and collector-emitter voltage is given by Equation, where V_{out} = VCE. When the collector current is zero, the collector-emitter voltage goes to the rail, i.e., VCE = VCC = 5V. Using Equation and known values of R1, R2, VF, CTR max, and VB, max we can solve for the maximum possible collector current at the saturation voltage (the collector-emitter voltage below which the transistor exits the active region): International Research Journal of Engineering and Technology This corresponds to Normally, this would indicate a value of 100 Ω per the standard 5% resistor tables, but a resistance of 100 Ω was chosen to increase the slope of the line and thus reach the maximum collector current before the transistor enters saturation. We could continue to solve the unique equation representing the load line, but the y-intercept does not relate to a physical occurrence in the transistor and is unnecessary for this application.

3.2 BATTERY MANAGEMENT SYSTEM

A battery pack is an arrangement of battery cells electronically arranged in a row x column matrix format to be able to produce a specified range of current and voltage for a given amount of time in response to projected load conditions.

The following are common BMS responsibilities:

• Battery Monitoring

- Battery protection
- Estimating the operational state of the battery
- Constantly improving battery performance
- Reporting operational status to other devices in this situation,

The term "battery" refers to the entire pack; nevertheless, in the overall battery pack assembly, individual cells or clusters of cells known as modules are subjected to monitoring and control activities. Rechargeable lithium-ion cells have the highest energy density and are used in computer and electric car battery packs. They operate well, but if used outside of a relatively small safe operating area, they can be harsh, resulting in everything from battery degeneration to outright danger. The BMS does have a difficult job profile, and the complete complexity and oversight it requires may include digital, control, electrical, hydraulic, and thermal domains.

Since the beginning of the 20th century, Nickel batteries have been developed and used in industrial applications. With higher energy density, power capability, and other advantages, Nickel batteries dominated the rechargeable battery market for aircraft engine starting systems, communications applications, and portable devices during the 20th century. The most used types of Nickel batteries are Nickel Cadmium (Ni-Cd) and Nickel Metal Hydride (Ni-MH). The Ni-Cd batteries have significant issues with the toxicity of Cadmium and the so-called “memory effect.” Ni-MH batteries eliminate these issues; however, their rate of self-discharging is larger and increases with the rise of batteries’ capacity. Therefore, at present, Ni-MH batteries are mostly used in the pencil battery form with low capacity.

When constructing a BMS, several aspects must be considered. The entire set of concerns is dependent on the BMS’s intended end application. Apart from electric vehicles, BMSs are utilized wherever a lithium battery pack is present, such as in solar panels, windmills, and power walls. A BMS design should consider all or many of the following characteristics, regardless of the application.

A BMS main goal is to keep lithium cells within their safe operating range. A normal Lithium 18650 cell, for example, will have an under-voltage rating of roughly 3V. The BMS is responsible for ensuring that none of the cells in the pack are discharged below 3V.

Charging Control: The BMS should also monitor the charging process in addition to the discharging. When batteries are charged incorrectly, they are more likely to be damaged or have a shorter lifespan. A two-stage charger is 5 used to charge lithium batteries. The charger outputs a consistent current to charge the battery in the first stage, which is known as Constant Current.

When the battery is nearly full, the second stage, known as the Constant Voltage (CV) stage, is activated, in which the battery is fed with a constant voltage at a very low current. To avoid overcharging or fast charging the batteries, the BMS should ensure that both the voltage and current during charging do not exceed set limitations. The data sheet for the battery will tell you what the maximum charging voltage and current are.

Determination of State-of-Charge (SOC): SOC can be thought of as the electric vehicle's fuel gauge. It truly informs us the percentage of the pack's battery capacity. Exactly like the one in our phone. However, it is not as simple as it appears. To anticipate the capacity of the battery, the voltage and charge/discharge current of the pack should continually be monitored.

There are a variety of algorithms that may be used to compute the SOC of the Battery pack once the voltage and current have been measured. The coulomb counting approach is the most often used method; we will go over this in more detail later in the essay. A BMS is also in charge of measuring the readings and determining the SOC.

State-of-Health (SOH) Determination: The capacity of a battery is determined by its age and operating temperature, as well as its voltage and current profile. Based on the battery's usage history, the SOH measurement informs us about the battery's age and predicted life cycle. This allows us to determine how much the EV's mileage (distance travelled after a full charge) decreases as the battery ages, as well as when the battery pack needs be changed. The SOH should be calculated and tracked by the BMS as well.

The electric vehicles are based on the battery's technologies providing power supply. Batteries can be defined as an electrochemical power source that directly converts chemical energy into electric energy using an electrochemical reaction. Because the Carnot cycle dictated by the second law of thermodynamics cannot restrict the electrochemical reactions, batteries can gain more efficient energy conversion. The elementary unit of a battery system is called a battery cell, which consists of three main parts: the anode-negative electrode, the cathode–positive electrode, and the electrolyte-medium for the transfer of electric charges inside the cell. Battery cells are available in multiple shapes and sizes, and the most common shapes are cylindrical cells and wound prismatic cells. Based on the ability to be electrically recharged, battery cells are classified as primary and secondary ones. Primary cells cannot be electrically recharged and then, can be discharged only once. In contrast, secondary cells can be electrically recharged after discharging. Therefore, they can be used in several cycles of charge-discharge (life cycles).

By connecting multiple cells with (approximately) similar properties, we get a (multi-cell) battery that is widely used in the military as well as industrial and commercial applications. Batteries are packaged in various shapes, sizes, and configurations; and are also classified as primary batteries and secondary batteries. The secondary batteries are also called storage batteries or accumulators. Primary batteries are inexpensive, lightweight, and easy to use but have lower capacity. Hence, they are suitable for portable electronic and electric devices such as digital cameras, GPS devices, lightning, etc. However, secondary batteries are usually heavier but have higher capacity, higher discharge rate, and ability to be recharged. As a result, they are better choices for applications requiring high operating electric current with long operation time. Obviously, in the areas of EVs, secondary batteries are the optimum choice.

The secondary batteries have been used for almost two centuries since the late 1850s. Their technology has been constantly involved in two direction using high surface area electrodes and using advanced materials.

The first secondary battery, which was a Lead-Acid cell with a voltage of 2 V, was introduced in 1859 by Platte. One year later, in 1860, a series of nine connected cells was demonstrated by Platte for the French Academy of Science. Presently, the most common Lead-Acid battery configuration contains six battery cells in series for a combined voltage of 12 V. They are used widely in automotive SLI systems, EVs, HEVs, industrial trucks, aircraft, and other applications. Since the beginning of the 20th century, Nickel batteries have been developed and used in industrial applications. With higher energy density, power capability, and other advantages, Nickel batteries dominated the rechargeable battery market for aircraft engine starting systems, communications applications, and portable devices during the 20th century. The most used types of Nickel batteries are Nickel Cadmium (Ni-Cd) and Nickel Metal Hydride (Ni-MH). The NI-Cd batteries have significant issues with the toxicity of Cadmium and the so-called "memory effect." Ni-MH batteries eliminate these issues; however, their rate of self-discharging is larger and increases with the rise of batteries' capacity. Therefore, at present, Ni-MH batteries are mostly used in the pencil battery form with low capacity. The century of Nickel batteries came to an end when Lithium batteries were marketed. The first Lithium battery in the market was launched by Sony in 1991. From the first decade of the 21st century, Lithium battery technologies rapidly took place of the standard power source in multiple fields. Now, various types of Lithium are widely used every day by people all over the world. The most common types of Lithium batteries are LiCoO2, LiFeO4, and LiMn2O4. Lithium batteries are widespread because of the higher cell voltage, longer life cycle, long shelf life, rapid charge capability, no memory effect, broad temperature range of operation, and so on.

3.3 MEASUREMENT OF BASIC PARAMETERS OF BATTERIES

When it comes to Battery Management System, monitoring the basic parameters of the battery is very much essential. The basic parameters of the battery include voltage, current, temperature of the battery. These parameters are very important and needs to be measured periodically. Measurement of Voltage and Current: As the battery is charging, the voltage of the battery by any means, will not provide the charging status or charging voltage of the battery. The charging voltage and the voltage measured across the terminals of the battery need not be the same. A dead battery which is not connected to any load can show an approximate voltage of 12.5 Volts (in case of Lead Acid Batteries).

We need some complex circuitry to measure the charging voltage, smoke, temperature and current or we can use 0any detection modules to measure these parameters across the terminals of the battery. A simple voltage division network, by putting correct values of resistance, regulating it and then using signal conditioning mechanism that is nothing but using an analog to digital converter, we could easily measure these parameters with the help of the Micro controller and measure the output. By connecting the battery to a known value of load resistance, we can measure the current produced from the battery. The following FIG shows the circuit setup for the measurement of voltage and current of the battery.

We can also implement Hall Effect Current Sensor Module which is ACS712. With the principle of Hall Effect, from the voltage developed when electric and magnetic field cross each other, the current flowing from the battery can be found out. By using the LM35, MQ135 we could find the temperature and smoke level accurately. Again, by using the analog to digital converter, regulating the input voltage properly, we can give to the Micro controller and obtain the output in usable form. If V0 is the output of the ADC, then using the sensitivity of the current sensor, we can calculate the Current offered by the battery at that voltage and a particular load. The maximum current sensitivity of the ACS712 is given as 185 mV/A.

3.4 PURPOSE OF PROJECT

In the past two decades, the usage of the vehicles has been increased and now, it has been evolved to electric vehicle because there will a natural disaster was happening now and then. But recently, it was incredibly increasing because of the global warming.

This is because of the pollution we are creating in a daily basis. We are creating pollution in a huge amount in the process of vehicle emission. To overcome this problem, e-vehicles came to the trend by using batteries to drive the vehicle. Our project related to this; our project title is "**E-VEHICLE MONITORING SYSTEM**".

Our project includes the checking of Battery's voltage, current, temperature, Smoke detection. The battery of the e-vehicle must check once a while to make the utilization of E-vehicle battery, optimize the battery working and to increases the lifespan of battery.

We should monitor the voltage and current because low voltage or current will result in the increase of temperature, which ends with the reduction of battery lifespan, to take care of battery, we should monitor battery voltage and battery current. If the temperature of the battery is high, this results in the fast-draining voltage. Smoke detector has been included in our project because there may be a case of emergency like accident in the empty road, The situation will get worsen it includes fire, just for the safety purpose, we have included smoke detector and it will alarm us to indicate the emergency. It will monitor the battery percentage that if we are going for a long drive and this indication will be more helpful for the moment like that.

voltage and current that is the voltage and current that is produced during the acceleration of the vehicle. In simple words, the weight of things inside the car without the weight of car. These factors that we included in our project will extend the lifespan of the battery, basic terms of car to be checked and precautions that we have made for the unwanted emergency. This system will be more helpful for the user of the e-vehicle.

3.5 IMPORTANCE OF BMS

Not only is a BMS important in indicating the health of a battery, but it also functions to protect the battery while in operation. Each battery cell and chemistry have voltage, temperature, and current range within which it can safely operate. When a cell drops below or exceeds these ranges, it can be detected and controlled by the BMS. For instance, lithium is a highly reactive substance; thus, the BMS should monitor each lithium cell to ensure that it remains operating within predefined limits. This keeps the battery safe and preserves it in the long run.

Another important safety feature of a BMS is cell balancing. Individual cells within a battery pack do not operate equally. One cell may be weaker or stronger than the other, charging or discharging faster than others within the chain. Without proper compensation, this could degrade the health of the overall pack.

If one cell short circuits or fails, this affects the stability of the whole pack. Cell balancing equalizes the charge between individual cells based on each cell's capability. The BMS helps to monitor and control the charge demanded from each cell in the chain, ensuring that SoC remains evenly distributed.

CHAPTER-4

PROPOSED SYSTEM ARCHITECTURE

4.1 WORKFLOW

In this Smart Electric Vehicle with safety system, we will use the Node MCU ESP32 board to send the battery status data to the Website the IoT Cloud Dashboard will display the battery voltage along with the battery percentage in both the charging and discharging conditions. We all know that an improper system of charging and discharging may lead to battery damage or system failure. Most of the electrical/electronic devices have a Battery Management System. BMS monitors all the properties of the battery like the voltage, & motor speed. To ensure the proper safety and handling of Lead acid batteries.

The sensor is based on the measurement of the time of flight of an ultrasonic pulse, which is reflected by the ground. A constrained optimization technique is employed to obtain reflected pulses that are easily detectable by means of a threshold compactor. Such a technique, which takes the frequency response of the ultrasonic transducers into account, allows a sub-wavelength detection to be obtained. The development of "smart bike" requires new sensors that can measure distances in the range of a few centimeters to a few meters.

An interesting possibility, which has been investigated by several authors, is the use of ultrasonic sensors based on the well-known time of flight technique. Such sensors are reasonably cheap and work for ranges of up to a few meters, even though problems arise regarding both their accuracy and their behavior in noisy open-air conditions. In this paper the authors describe a low-cost ultrasonic dis-anemometer that performs contact less measurement of the height from the ground of a vehicle body. The sensor performance is better than many commercial devices, thanks to the possibility the sensor has of evaluating the environmental conditions and then self-adapting to these conditions. The sensor has been designed in order to satisfy typical re-requirements in the automotive field: measured distance in the range of 0.1–0.3 m.

As smart electric vehicles become more popular, the need for a comprehensive safety system becomes increasingly important. Its design combines IoT, battery and speed monitoring, accessibility, and load use. Users will be able to track and monitor their bike's performance in real time thanks to the system's IoT component. This pertains to factors like speed, battery life, and others. Users will be able to monitor their bike's performance thanks to the data collected being sent to a secure cloud server. The system's speed and battery monitoring component will give consumers up-to-the-second performance data on their bikes. This covers things like speed, battery life, and other things that will help riders make sure their bike is working at its best capacity. The system will also include a component for load utilization and handicaps. Users will be able to modify the settings on the bike in order to suit their demands.

This will make it possible for consumers to ride securely and comfortably. Users will be able to view the performance information for their bike from anywhere. Users will be able to troubleshoot any problems they might be having with their bike through the web platform. The suggested system is a complete answer that will offer people a reliable mode of transportation.

The BMS can only monitor the condition of the battery and alarm the user through a battery indicator. But in this project, we have used the Internet of Things (IoT) technology which can directly notify the users remotely. now due to the use of the Internet of Things, we can directly notify the users remotely. The user can check the battery status on their smartphones or Computer Dashboard from anywhere in the world.

4.2 METHODOLOGY

In the proposed system we are going to monitor Battery voltage, temperature, smoke and current. By doing this we would be able to see voltage, current and temperature of the battery every very hour or every minute or whenever we want. When we replace the battery in an electric vehicle at a swapping station, there is no method to check the battery’s health card, including how much battery is depleted and how bad the battery. In this way, anyone can offer us a used or defective battery, and we'll have to accept it without knowing much about it. Since a result, battery prices will be compromised, as someone might pay more for a less efficient battery with a shorter life cycle than a more efficient battery with a longer life cycle. In this project we are going to use current sensor, voltage sensor and temperature sensor. We will do the same thing for temperature sensor, smoke sensor and voltage sensor respectively. Then we will send the data to Arduino Cloud.

4.3 BLOCK DIAGRAM:

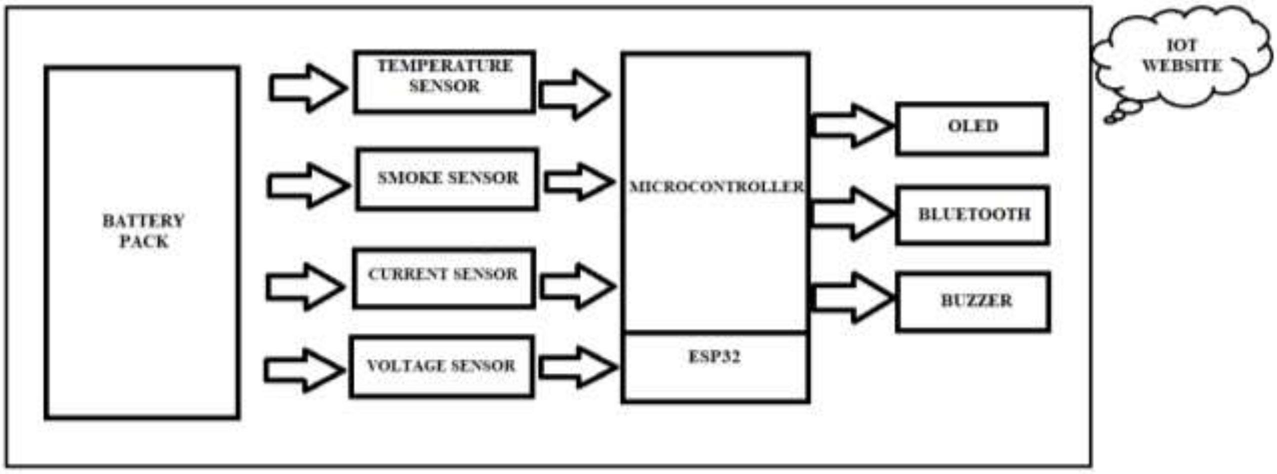

FIG 4.3.1 Block diagram

E-Vehicle Monitoring System will manage the temperature, current and detects the smoke from the E- Vehicle. Therefore, we used four different sensors to senses the temperature, voltage, current and smoke respectively. The output from the sensors is input to the Arduino UNO and ESP 32 it will indicate the output to the OLED Display by using the coding implemented into it as well as in the IoT website and buzzers to indicate the output.

4.4. CIRCUIT DIAGRAM:

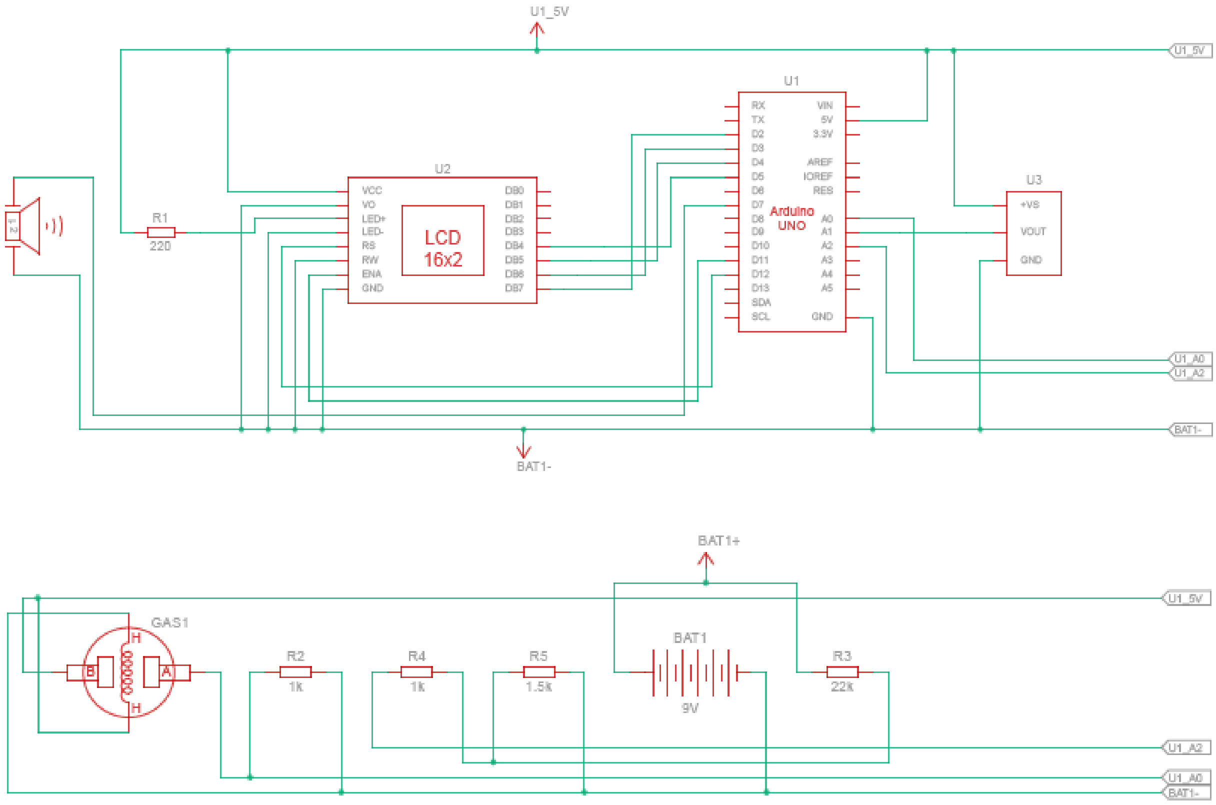

FIG 4.4.1 Circuit diagram

The above figure is the circuit diagram of E-Vehicle monitoring system. The LM35, MQ135, Current sensor and Voltage sensor senses the temperature, smoke, current and voltage respectively. The output of the sensors is the input to the Arduino UNO and it will work as per the programmer programmed in it, it is connected to the esp32 which results in the display of output in the IoT website and the Arduino displays the output in the OLED display and indicates it using Buzzer.

CHAPTER-5

COMPONENTS AND ESTIMATION

5.1ARDIUNO UNO

The Arduino Uno is an open-source micro controller based on the Microchip Atmega328P microcontroller and developed by Arduino and initially released in 2010. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.

The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable. It can be powered by a USB cable or a barrel connector that accepts voltages between 7 and 20 volts, such as a rectangular 9-volt battery.

This device is intended to provide the user with a cost-efficient means of determining air quality. Our sensor attentions on the five components of the Eco-friendly Protection Agency's Air Quality Index: ozone, particulate matter, carbon monoxide, sulfur dioxide, and nitrous oxide.

This device detects all these pollutants except sulfur dioxide. The device also contains a civic gas sensor to alert the operator to gas leaks or the presence of combustible gases. Also, a temperature and humidity sensor is involved as these situations can influence the performance of the gas sensors.

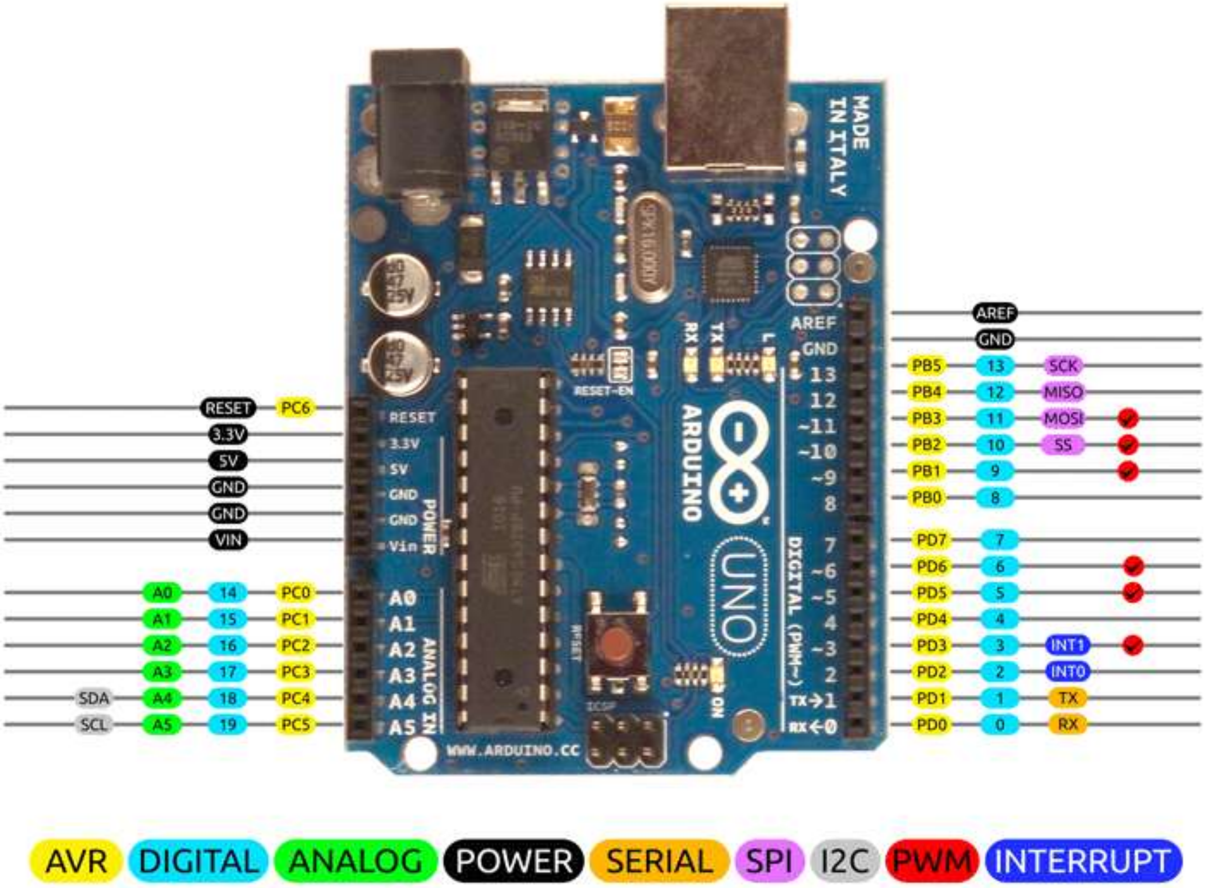

FIG 5.1.1: Arduino Uno

Pin Description:

Vin: This is the input voltage pin of the Arduino board used to provide input supply from an external power source.

5V: This pin of the Arduino board is used as a regulated power supply voltage and it is used to give supply to the board as well as onboard components.

3.3V: This pin of the board is used to provide a supply of 3.3V which is generated from a voltage regulator on the board.

GND: This pin of the board is used to ground the Arduino board.

Reset: This pin of the board is used to reset the microcontroller. It is used to Resets the microcontroller.

Analog Pins: The pins A0 to A5 are used as an analog input and it is in the range of 0-5V.

Digital Pins: The pins 0 to 13 are used as a digital input or output for the Arduino board.

Serial Pins: These pins are also known as a UART pin. It is used for communication between the Arduino board and a computer or other devices. The transmitter pin number 1 and receiver pin number 0 are used to transmit and receive the data resp.

External Interrupt Pins: This pin of the Arduino board is used to produce the External interrupt and it is done by pin numbers 2 and 3.

PWM Pins: This pin of the board is used to convert the digital signal into an analog by varying the width of the Pulse. The pin numbers 3,5,6,9,10 and 11 are used as a PWM pin.

SPI Pins: This is the Serial Peripheral Interface pin; it is used to maintain SPI communication with the help of the SPI library. SPI pins include:

1. SS: Pin number 10 is used as a Slave Select
2. MOSI: Pin number 11 is used as a Master Out Slave In
3. MISO: Pin number 12 is used as a Master in Slave Out
4. SCK: Pin number 13 is used as a Serial Clock

LED Pin: The board has an inbuilt LED using digital pin-13. The LED glows only when the digital pin becomes high.

AREF Pin: This is an analog reference pin of the Arduino board. It is used to provide a reference voltage from an external power supply.

5.2 ESP 32

Node MCU is an open-source development board and firmware based in the used ESP 32 -12E Wi-Fi module. The ESP8266 Wi-Fi module can be coded with the Arduino IDE. It is built around an inexpensive System-on-a-Chip (SOC) called the ESP 32. The ESP 32, designed and manufactured by ESP 32 if Systems, contains the crucial elements of a computer: CPU, RAM, networking (Wi-Fi), and even a modern operating system and SDK. That makes it an excellent choice for Internet of Things (IoT) projects of all kinds. However, as a chip, the ESP 32can also be hard to access and use.

You must solder wires, with the appropriate analog input voltage, to its pins for the simplest tasks such as powering it on. To overcome this, development boards are used as it is easier for students who want to experiment their own IoT projects.

The development board equips the ESP-12E module containing ESP 32 chip having Ten silica Extensor® 32-bit LX106 RISC microprocessor which operates at 80 to 160 MHz adjustable clock frequency and supports RTOS. The ESP 32 Integrates 802.11 b/g/n HT40 Wi-Fi transceiver, so it can not only connect to a Wi-Fi network and interact with the Internet, but it can also set up a network of its own, allowing other devices to connect directly to it. This makes the ESP 32 even more versatile.

ESP 32 is an open-source firmware developed for the ESP 32 Wi-Fi chip. Node MCU firmware comes with the ESP 32 Development board. It’s hardware design is open for edit/modify/build. There are online ESP 32 custom builds available using which we can easily get our custom Node MCU firmware as per our requirement.

The FIG as shown ESP 32 With its USB-TTL, the ESP 32 Dev board supports flashing from USB port directly. It acts as a WI-FI access point and makes use of the micro controller. These features make the ESP 32 a useful tool for Wi-Fi networking. It can be used to host a web server or connect to internet to transmit data. Open the Serial Monitor after uploading the code. We can also monitor the Motor Speed. Same data can be monitored through IoT Mobile App and Web Dashboard. As soon as battery percent reaches below threshold value a shown to a mobile device.

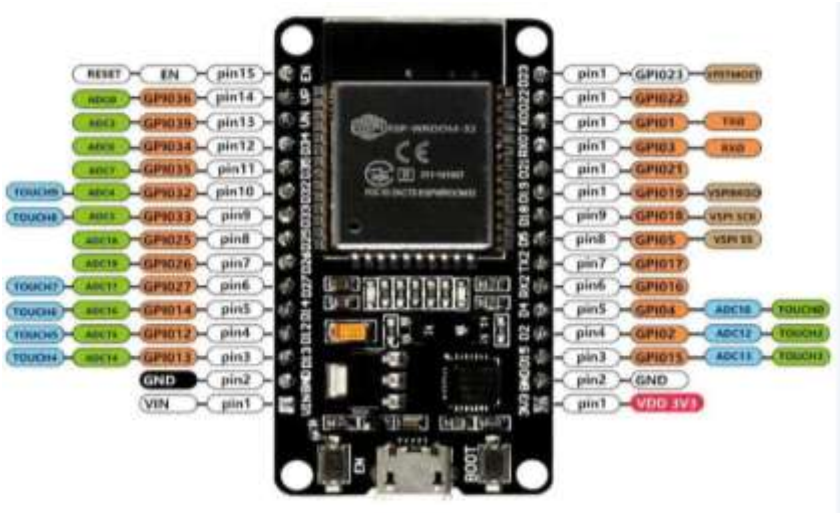

FIG 5.2.1 ESP 32 Module

Features of ESP 32:

- Micro controller: Ten silica 32-bit RISC CPU Extensor
- LX106Operating Voltage: 3.3V
- Input Voltage: 7-12V
- Digital I/O Pins (DIO): 16 Analog Input Pins
- (ADC): 1UARTs: 1
- SPIs: 1
- I2Cs: 1
- Flash Memory:4
- MB SRAM:64 KB

5.3 TEMPERATURE SENSOR

This LM35D Analog Temperature Sensor Module is based on the semiconductor LM35 temperature sensor. The LM35 Linear Temperature Sensor module is useful in detecting ambient air temperature. Sensitivity is 10mV per degree Celsius. The output voltage is proportional to the temperature.

LM35 is a precision IC temperature sensor with its output proportional to the temperature (in °C). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With LM35, the temperature can be measured more accurately than with a thermistor. It also possesses the low self-heating and does not cause more than 0.1 °C temperature rise in still air.

The operating temperature range is from -55°C to 150°C. The output voltage varies by 10mV in response to every °C rise/fall in ambient temperature, i.e., its scale factor is 0.01V/°C. It is commonly used as a temperature measurement sensors. It includes thermocouples, platinum resistance, thermal resistance, and temperature semiconductor chips, which commonly used in high-temperature measurement thermocouples.

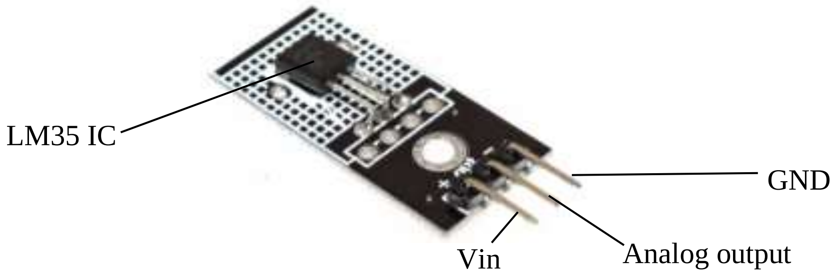

FIG 5.3.1 Temperature Sensor

Specifications & Features of LM35D Analog Temperature Sensor Module:

- Based on the semiconductor LM35 temperature sensor
- Useful in detecting ambient air temperature
- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10 mV/°C Scale Factor
- 0.5°C Ensure accuracy (at +25°C)
- Low power consumption, less than 60uA
- Low output impedance, 1mA current through only 0.1Ω
- With screw holes for easy installation and fixed. Aperture

5.4 SMOKE SENSOR:

The MQ2 sensor is one of the most widely used in the MQ sensor series. It is a MOS (Metal Oxide Semiconductor) sensor. Metal oxide sensors are also known as Chemi-resistors because sensing is based on the change in resistance of the sensing material when exposed to gasses. The MQ2 gas sensor operates on 5V DC and consumes approximately800mW. Detects LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide concentrations ranging from 200 to 10000 ppm.

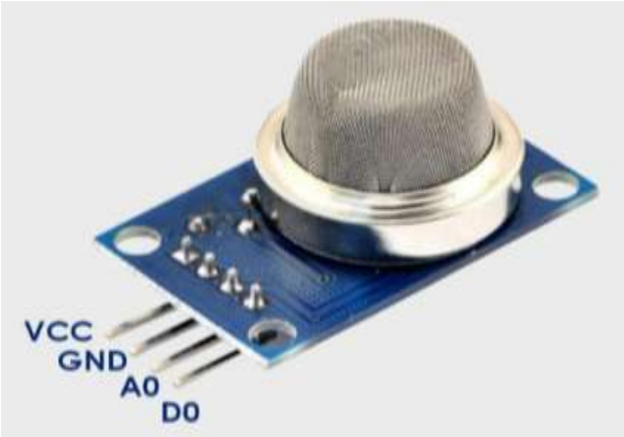

FIG 5.4.1 Smoke Sensor

Internal structure of MQ2 Gas Sensor

The MQ2 is a heater-driven sensor. It is therefore covered with two layers of fine stainless-steel mesh known as an “anti-explosion network”. It ensures that the heater element inside the sensor does not cause an explosion because we are sensing flammable gasses. It also protects the sensor and filters out suspended particles, allowing only gaseous elements to pass through the chamber. A copper-plated clamping ring secures the mesh to the rest of the body.

FIG 5.4.2 Gas Sensor

5.5 BUZZER

An audio signalling device like a beeper or buzzer may be electromechanical or piezoelectric or mechanical type. The main function of this is to convert the signal from audio to sound. Generally, it is powered through DC voltage and used in timers, alarm devices, printers, alarms, computers, etc. Based on the various designs, it can generate different sounds.

The pin configuration of the buzzer is shown below. It includes two pins namely positive and negative. The positive terminal of this is represented with the '+' symbol or a longer terminal. This terminal is powered through 6Volts whereas the negative terminal is represented with the '-'symbol or short terminal and it is connected to the GND terminal like alarm, music, bell & siren as shown in fig 5.5.1.

FIG 5.5.1: Buzzer

5.6 POTENTIOMETER

A potentiometer is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider. If only two terminals are used, one end and the wiper, it acts as a variable resistor or rheostat. The measuring instrument called a potentiometer is essentially a voltage divider used for measuring electric potential (voltage); the component is an implementation of the same principle, hence its name. Potentiometers are commonly used to control electrical devices such as volume controls on audio equipment. Potentiometers operated by a mechanism can be used as position transducers, for example, in a joystick. Potentiometers are rarely used to directly control significant power (more than a watt), since the power dissipated in the potentiometer would be comparable to the power in the controlled load.

FIG 5.6.1: Potentiometer

5.7 CURRENT SENSOR

Current Sensor detects the current in a wire or conductor and generates a signal proportional to the detected current either in the form of analog voltage or digital output. Current Sensing is done in two ways – Direct sensing and Indirect Sensing. In Direct sensing, to detect current, Ohm's law is used to measure the voltage drop occurred in a wire when current flows through it. A current-carrying conductor also gives rise to a magnetic field in its surrounding. In Indirect Sensing, the current is measured by calculating this magnetic field by applying either Faraday's law or Ampere law. Here either a Transformer or Hall effect sensor or fiber optic current sensor are used to sense the magnetic field. ACS712 Current Sensor uses Indirect Sensing method to calculate the current. To sense current a liner, low-offset Hall sensor circuit is used in this IC. This sensor is located at the surface of the IC on a copper conduction path. When current flows through this copper conduction path it generates a magnetic field which is sensed by the Hall effect sensor. A voltage proportional to the sensed magnetic field is generated by the Hall sensor, which is used to measure current. The proximity of the magnetic signal to the Hall sensor decides the accuracy of the device. Nearer the magnetic signal higher the accuracy. ACS712 Current Sensor is available as a small, surface mount SOIC8 package. In this IC current flows from Pin-1 and Pin-2 to Pin-3 and Pin-4. This forms the conduction path where the current is sensed. Implementation of this IC is very easy. ACS712 can be used in applications requiring electrical isolation as the terminals of the conduction path are electrically isolated from the IC leads. Thus, this IC does not require any other isolation techniques. This IC requires a supply voltage of 5V. Its output voltage is proportional to AC or DC current. ACS712 has a nearly zero hysteresis. Where Pin-1 to Pin-4 forms the conduction path, Pin-5 is the signal ground pin. Pin-6 is the FILTER pin that is used by an external capacitor to set the bandwidth. Pin-7 is the analog output pin. Pin-8 is the power supply pin as shown in fig 5.7.1.

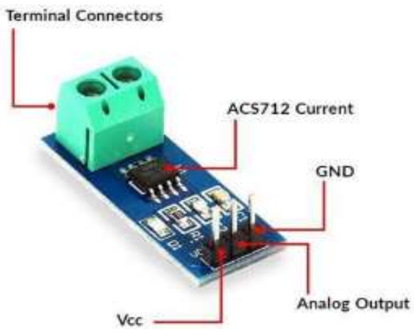

FIG 5.7.1 Current Sensor

Advantages:

- Heat generation is low because the primary conductor has low resistance.
- It supports a wide measurement current range of ±5 to ±180A.
- By using high sensitive compound semiconductor hall element for sensor, it is

high resolution without narrowing the bandwidth.

Disadvantages:

- The resistance value and the heat generation are likely to be higher.
- It is difficult to measure large current.
- Because sensitivity of the hall element is low, it is designed to narrow the frequency band to get sufficient resolution.

Pin Number	Pin Name	Description
1	Vcc	Input voltage is +5V for typical applications
2	Output	Outputs Analog voltage proportional to current
3	Ground	Connected to ground of circuit
T1	Wire In	The wire through current must be measured is connected here.
T2	Wire Out	The wire out from the sensor to take output.

Table No 5.1 Current Sensor Pin Description

5.8 VOLTAGE SENSOR:

Voltage Sensor is a precise low-cost sensor for measuring voltage. It is based on the principle of resistive voltage divider design. It can make the red terminal connector input voltage to 5 times smaller as shown in fig 5.8.1.

FIG 5.8.1 Voltage Sensor

Pin Name	Description
VCC	Positive terminal of the External voltage source (0-25V)
GND	Negative terminal of the External voltage source
S	Analog pin connected to Analog pin of Arduino
+	Not Connected
-	Ground Pin connected to GND of Arduino

Table No 5.2Voltage Sensor Module Pin out Configuration

Voltage Detection Sensor Module Features & Specifications

- Input Voltage: 0 to 25V
- Voltage Detection Range: 0.02445 to 25
- Analog Voltage Resolution: 0.00489V
- Needs no external components
- Easy to use with Micro controllers
- Small, cheap, and easily available
- Dimensions: 4 × 3 × 2 cm.

Brief about Voltage Sensor Module

Voltage Detection Sensor Module is a simple and very useful module that uses a potential divider to reduce any input voltage by a factor of 5. This allows us to use the Analog input pin of a micro controller to monitor voltages higher than it capable of sensing. For example, with a 0V - 5V Analog input range, you can measure a voltage up to 25V. This module also includes convenient screw terminals for easy and secure connections of a wire. The internal circuit diagram of the Voltage Sensor Module is given below.

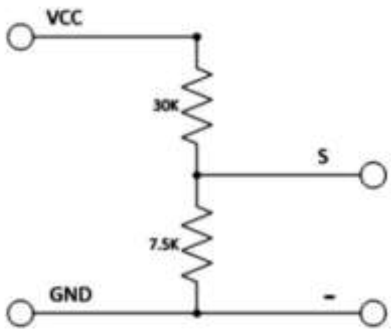

FIG 5.8.2Voltage Divider Rule

The voltage circuit consists of a voltage divider circuit of two resistors in which R1 is 30K and R2 is 7.5K.

5.9 OLED Display:

FIG 5.9.1 OLED Display Pin Out

Features of OLED Display:

- Monochrome 7-pin SSD1306 0.96" OLED display.
- 128×64-pixel resolution with 160° viewing angle.
- Supply voltage 3V – 5V (supports both 5V and 3.31v logic devices).
- Uses SSD1306 for interfacing hence can communicate through SPI or IIC.
- Multiple SPI or IIC devices are supported.
- Can be easily interfaced with Arduino (Library available).
- Supports decent graphics of bitmap images.

Available in different colors and sizes as discussed below.

The OLED displays are one of the most attractive displays available for a microcontroller. It has a good view angle and pixel density which makes it reliable for displaying small level graphics. Interfacing this IC with MCU can either be done using IIC or using SPI hence helps to save some pins as well as shown in FIG4.10.1. So if you are looking for a slim, attractive and efficient display module to make your project look cool with graphics, then this module might be the right choice.

S.No	Specification	Classification	Types
1	Monochrome (White) Yellow/Blue Colour	Based on Colour	Monochrome (Blue)
2	7-Pin (supports IIC and SPI)	Based on number of Pin	3-Pin (supports only)
3	SSD1331	Based on interface IC	SSD1306
4	0.96” (128×64)	Based on size	0.91” (128×32)

Table No 5.3 OLED Display Pin Out Specification

Applications:

- Used in consumer electronics.
- Used for Smartwatch, mobile phone, and MP3 displays.
- Small level gaming displays.
- Wide range of viewing angle enable to be used in low light.

5.10 RESISTORS:

Resistors are passive components necessary for use in circuit board assemblies. Rush PCB Inc uses resistors in their PCB assemblies to resist the flow of electric current. Electronic circuits use different types of resistors, such as linear, non-linear, fixed and variable. While fixed resistors have a stated value that does not change, it is possible to adjust the variable resistor from zero to its stated value. Both through-hole resistors and surface-mount resistors are available. Circuit designers use resistors in conjunction with other passive and active components such as capacitors, inductors, transistors, diodes, and ICs to process electrical signals in many ways. The physical size of a resistor depends on its power dissipating capacity as shown in fig 5.10.1.

FIG 5.10.1: Resistors

5.11 BATTERY:

This is General purpose 9V Original HIW marked Non-Rechargeable Battery for all your project and application needs. As we experienced the use of this battery in our testing lab for various purpose, we can assure you the best quality, long life and genuineness of this battery among all options available in the market at this cost. Its Universal 9V battery size and connecting points; it is useful in many DIY projects as well as household applications and they can easily be replaced and installed; the same as you would an AA battery or an AAA battery. Whether you need a new battery for your applications like a Flashlight, Portable Phone Charger wireless doorbell, Wireless audio transmitter-receiver systems or your kid’s toys, etc. Even if you are looking for a long-lasting, reliable option for your sensor devices like a smoke detector, everyone needs a good 9-volt battery occasionally. It is also a great idea to keep an extra 9-volt batteries around in case of an emergency. That is why we have found one of the best 9-volt battery available.

Safety Precautions

1. Avoid short-Circuit the battery terminals.
2. Do not put it beside the high-temperature condition.
3. Do not throw it into the fire or water after use.

Features

1. Constant 9V Output till lasts.
2. Metal Jacket Body.
3. Good Built Quality and hence Leakproof.

4. Easy to install and replace.
5. Corrosion-free Connector Point for long-term use.
6. 0% Mercury and Cadmium. Environment-friendly.
7. OEM Compatible.

FIG 5.11.1 12V Lead-Acid Battery

FIG 5.11.2 9V Battery

5.12 CONNECTING WIRE:

A Jump wire (also known as jumper, jumper wire, DuPont wire) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering. Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment.

FIG 5.12.1 Connecting wire

5.13 LCD:

Liquid crystal display (LCD), electronic display device that operates by applying a varying electric voltage to a layer of liquid crystal, thereby inducing changes in its optical properties. LCDs are commonly used for portable electronic games, as viewfinders for digital cameras and camcorders, in video projection systems, for electronic billboards, as monitors for computers, and in flat-panel televisions.

An LCD screen includes a thin layer of liquid crystal material sandwiched between two electrodes on glass substrates, with two polarizers on each side. A polarizer is an optical filter that lets light waves of a specific polarization pass through while blocking light waves of other polarizations.

LCDs are manufactured in cleanrooms borrowing techniques from semiconductor manufacturing and using large sheets of glass whose size has increased over time. Several displays are manufactured at the same time, and then cut from the sheet of glass, also known as the mother glass or LCD glass substrate. The increase in size allows more displays or larger displays to be made, just like with increasing wafer sizes in semiconductor manufacturing as shown in fig 5.13.1.

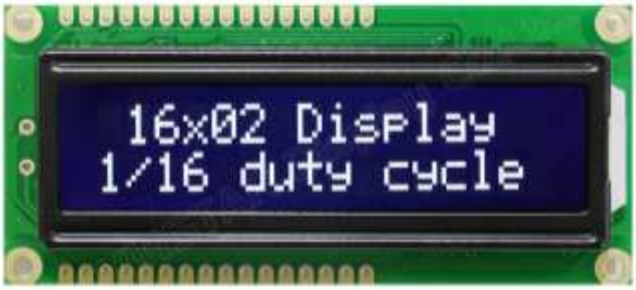

FIG 5.13.1 Liquid Crystal Display

5.14 POWER SUPPLY/ADAPTER:

5V, 1A Power Supply Adapter is compatible to handle up to 1A current so applications like toy cars, CCTV Cameras, Routers, Modems, Cordless Phones, Set-Top Boxes, Wireless Devices, and POS Machines are compatible with this adapter.

Specifications:

- The adapter is easy to use.
- Wide input voltage range (110VAC-240VAC).
- Very Low no-load power consumption.
- Very low ripple & noise output for device safety.
- Highly efficient, compact, durable and long life.
- AC input voltage: 110V - 240V, 50Hz / 60Hz
- Output DC Voltage: 5V
- Output Current: 1A
- Standby power: <0.3W

FIG 5.14.1 Power supply/adapter

5.15 BREAD BOARD:

A Breadboard, solderless Breadboard, or protoboard is a construction base used to build semi-permanent prototypes of electronic circuits. Unlike a Prefboard or stripboard, breadboards do not require soldering or destruction of tracks and are hence reusable. For this reason, breadboards are also popular with students and in technological education. A variety of electronic systems may be prototyped by using breadboards, from small analog and digital circuits to complete central processing units (CPUs). Compared to more permanent circuit connection methods, modern breadboards have high parasitic capacitance, relatively high resistance, and less reliable connections, which are subject to jostle and physical degradation. Signalling is limited to about 10 MHz, and not everything works properly even well below that frequency as shown in fig 5.15.1.

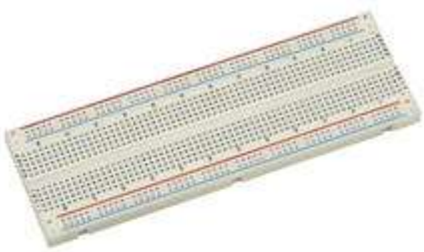

FIG 5.15.1 Bread board

5.16 ESTIMATION:

S.no	COMPONENTS	QUANTITY	PRICE
1.	Arduino-uno	1	650
2.	Bluetooth	1	225
3.	ESP32	1	435
4.	Battery with connectors	2	40
5.	Temperature sensor	1	200
6.	Smoke sensor	1	200
7.	Voltage sensor	1	120
8.	Current sensor	1	135
9.	LCD	1	140
10.	Resistors	6	20
11.	Bread Board	1	100
12.	Power Supply/Adapter	1	150
13.	Connecting wires	AS REQUIRED	40
		TOTAL	2,455

Table 5.4 Budget Plan

CHAPTER-6

INTERNET OF THINGS

6.1 INTRODUCTION:

The Internet of Things (IOT) is the network of physical objects (things) that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. ‘Thing’ in IOT can be any physical device with some sensors that has the ability to collect and transfer data over a network without the need of any human involvement. The embedded technology in the object helps them to interact with internal and external environment, which helps in decisions making process. IOT makes virtually everything "smart," by improving life quality with the power of data collection, AI algorithm, and networks. The thing in IOT can also be a person with a diabetes monitor implant, an animal with tracking devices, etc.

6.2 Internet of Things (IOT):

Internet of things (IOT) is an advanced technology that makes our lives simpler. With the hike in the number of users of the internet over the past decade has made the Internet a part and parcel in our life, and IOT is the latest development in the internet technology. IOT Technology introduces us to a world where we can connect, communicate with any device via the Internet. This results in improved efficiency and other benefits. It implements technologies such as smart grids, smart homes, and smart cities. The major benefits of IoT are:

Improved Customer Engagement – IoT improves customer experience by automating the device’s action. For e.g. any issue in the car will be automatically detected by the sensors. The driver, as well as the manufacturer, will be notified about the damaged part. The manufacturer will make sure that the faulty part is available at the service station even before the customer approaches.

Technical Optimization – IoT has helped a lot in improving technologies and making them better. The manufacturer can collect data from different car sensors and analyse them to improve their design and improve its efficiency in future.

Reduced Waste – In near future IoT can provide real-time information that results in improved decision making & management of resources. For example, if a car manufacturer finds fault in multiple parts of different cars, he can recall those units and rectify the issue with the parts as shown in FIG 6.2.1.

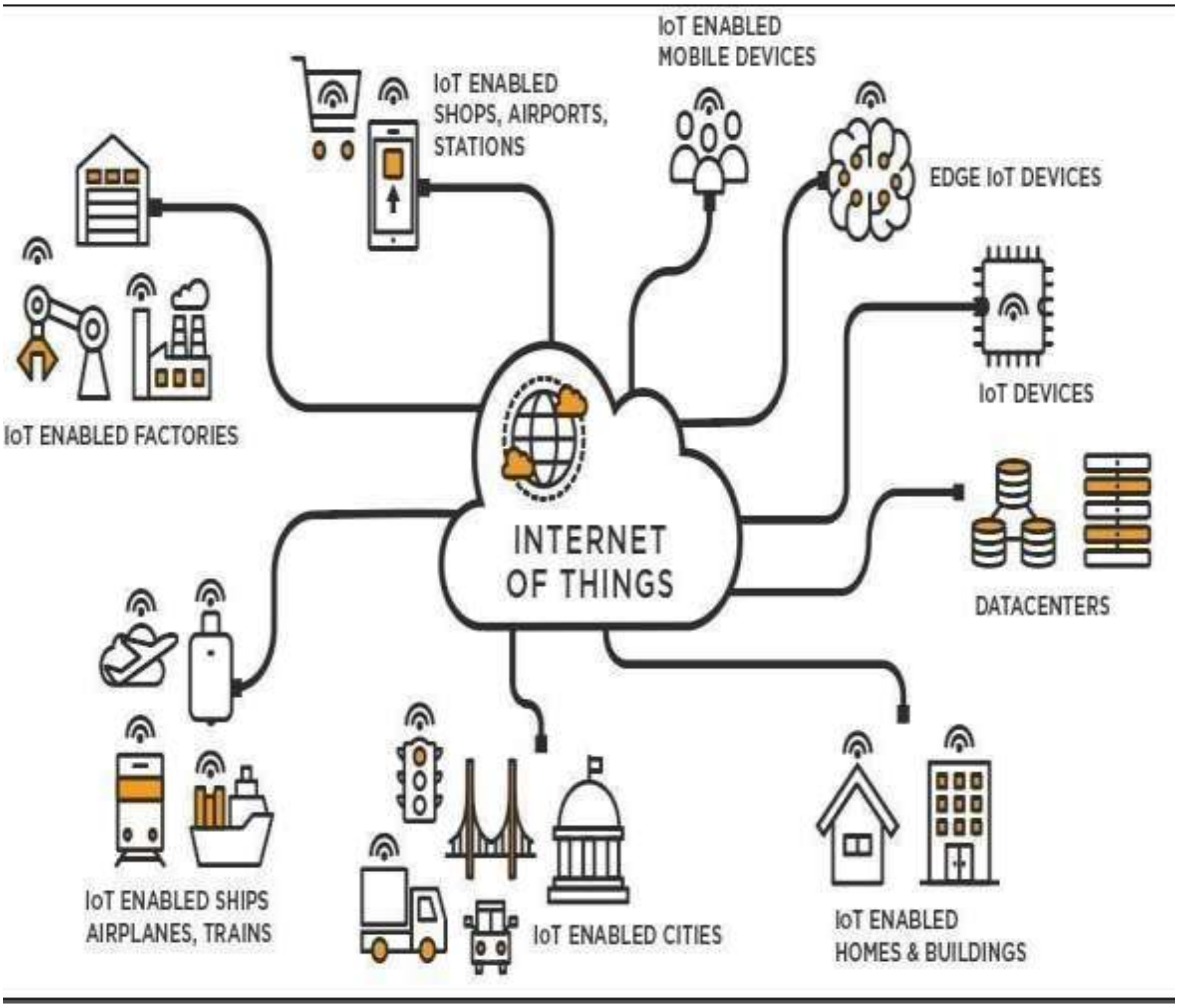

FIG 6.2.1 Internet of Things

6.3 BENEFITS OF IOT:

- Improved productivity of staff and reduced human labor.
- Efficient task management.

- Better use of available resources.
- Cost-effective operation.
- Improved work safety.
- Improved customer service.

ADVANTAGES:

Minimize human effort: As the devices of IoT interact and communicate with each other and do lot of tasks for us, then they minimize the human effort.

Save time: As it reduces human effort, it saves time. Time is the primary factor that can be saved by using IoT platform.

Improve security: if we have a system that all these things are interconnected, then an encryption can be made making the system more secure.

DISADVANTAGES:

Security: As the IoT systems are interconnected and communicate over networks. The system offers little control despite any security measures, and it can be lead the various kinds of network attacks.

Privacy: As an IoT device can work without the user, the IoT system provides substantial personal data all the time.

Complexity: The designing, developing, and maintaining and enabling the large technology to IoT system can be quite complicated.

6.4 SWOT ANALYSIS:

Most of the time we see that the use of Arduino techniques for doing business add value either by the reducing transaction cost or by creating some type of network effect, or by a combination of both. In SWOT analysis, the acronym is short for Strengths, Weaknesses, Opportunities and Threats; here we try to find out the strengths and weaknesses of our project in respect of Arduino technology. Then I try to recognize opportunities presented by that environment and the threats posed by that environment.

As shown in the following, table which shows the questions that an analyst would ask in conducting a SWOT analysis.

STRENGTHS	WEAKNESS
-Cost Saving -Collection of E –Vehicle monitoring information will be easier -Utilization of digitalized Equipment -Smart way to solve the problem	-Capacity may not fulfil the exact requirement of any adverse situation
OPPORTUNITIES	**THREATS**
-Possibility of incorporation with high capacity outcomes - Ability to choose right environment to provide appropriate facility	- Wrong or misinterpretation or anomaly in data or wrong assumption can cause failure to detect absolute / correct result

FIG 6.5.1 Swot Analysis

6.5 ARDUINO IDE

FIG 6.5.2 Arduino IDE

The Arduino IDE (Integrated Development Environment) is a piece of official Arduino.cc software that allows you to code and write accordingly on an Arduino environment. This open-source programme is very simple to install, understand learning syntax and is suitable with almost all Arduino modules. Arduino code is written in C++ with an addition of special methods and functions, which we'll mention later on as shown as FIG 4.3. C++ is a human-readable programming language. The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. This software can be used with any Arduino board. Refer to the Getting Started page for Installation instructions. The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment.

In this Smart Electric Vehicle with safety system, we will use the Node MCU ESP32_board to send the battery status data to the Website the IoT Cloud Dashboard will display the battery voltage along with the battery percentage in both the charging and discharging conditions.

Battery Voltage and speed of the motor the system consisting of Arduino IoT. The data are collected and a ESP 32 unit communicates with Arduino IoT The received real time data is processed by it. This data is send using HTTP protocol. The accessed readings can be visualized in Google Sheet.

proper value of efficiency coefficient, the EVs can estimate the SOC with an error smaller than 5%. Finally, the communication between EVs and workstation using IoT technology is verified. The user interface of the application Google Sheets. The data measured by Electric Vehicle systems are successfully transferred via the Internet to this application. Then the users with permission can access these data wherever, whenever for further uses. The uses of other IoT platforms in the BMS system.

CHAPTER 7

RESULT AND OUTPUT

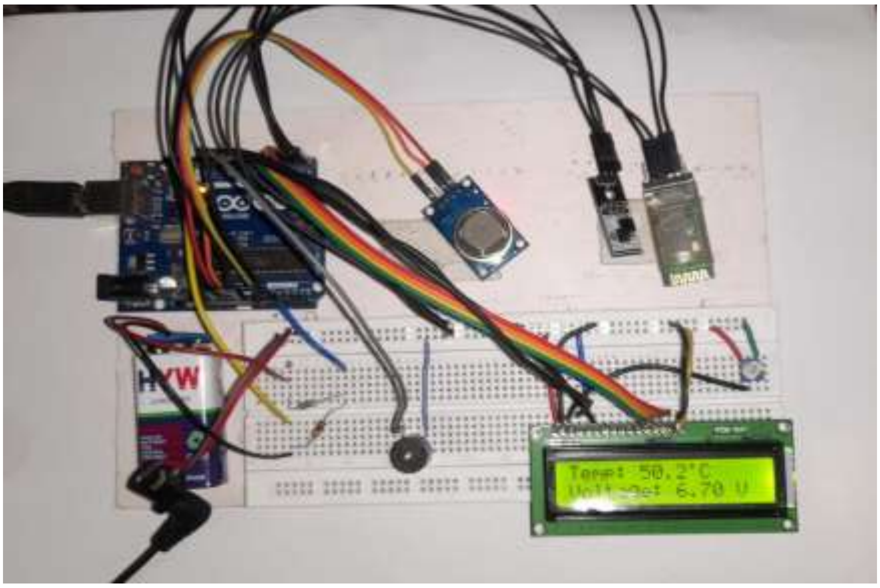

FIG 7.1 Prototype connection

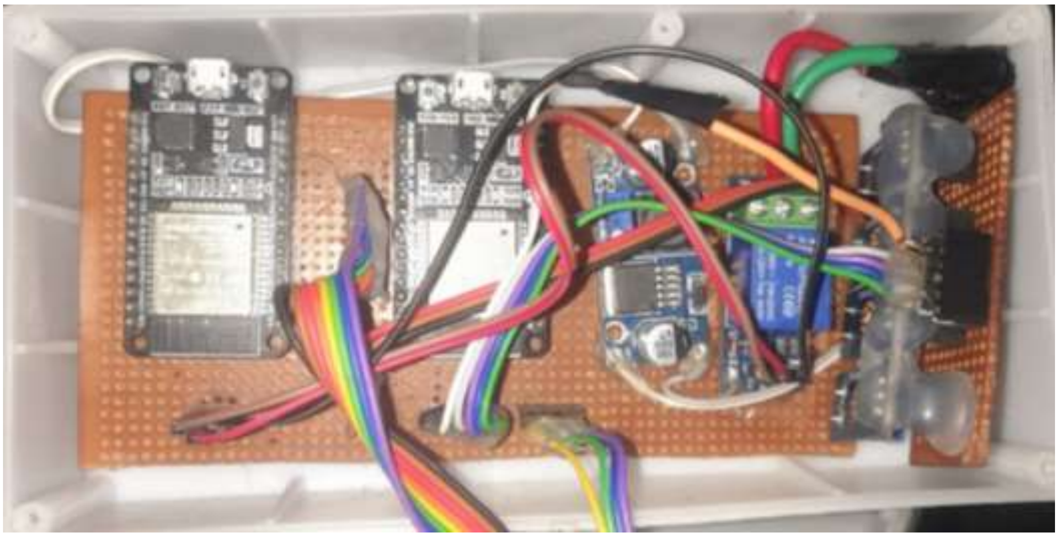

FIG 7.2 Circuit connection

FIG 7.3 OLED Output

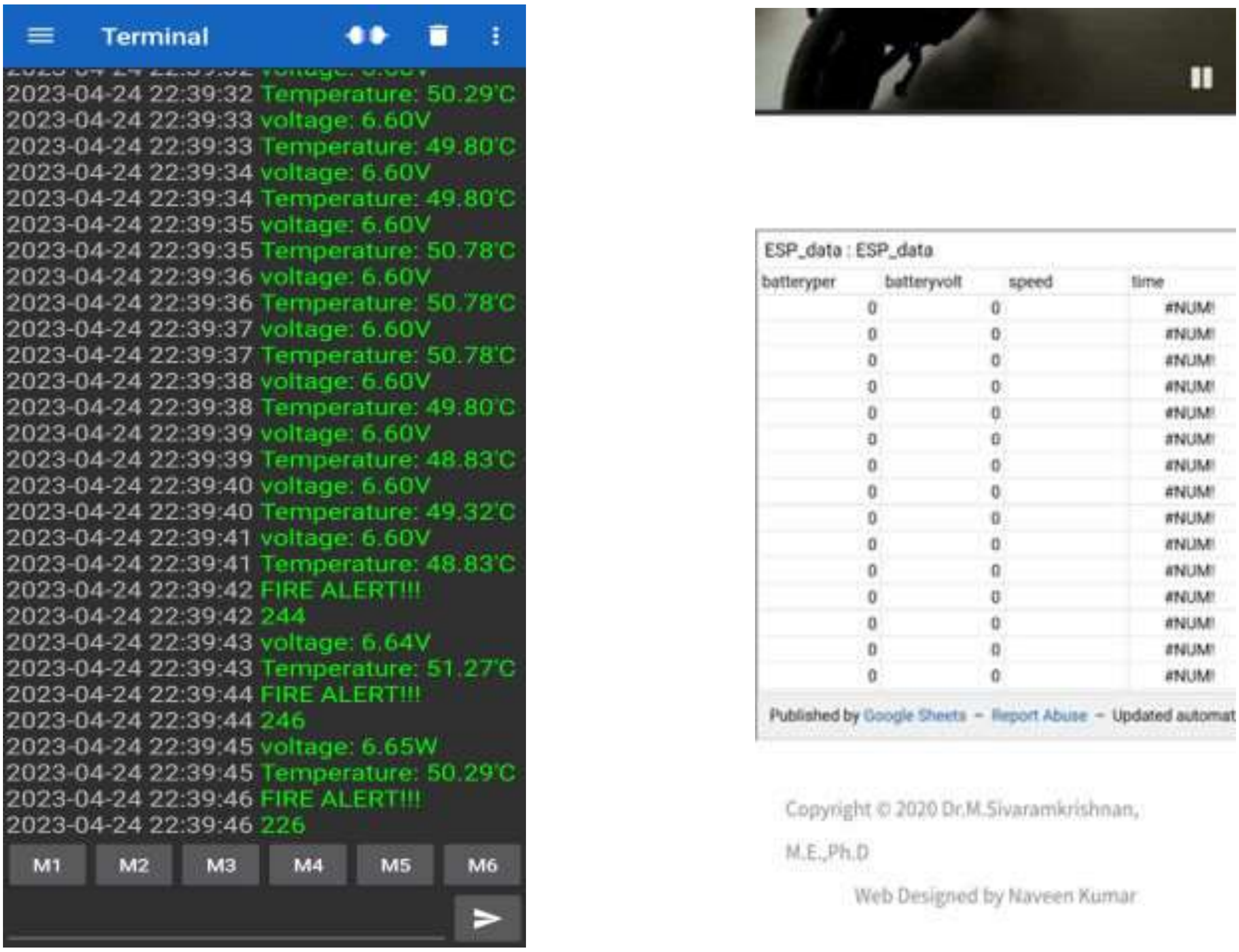

FIG 7.4 Database storage

FIG 7.5 Voltage sensors output

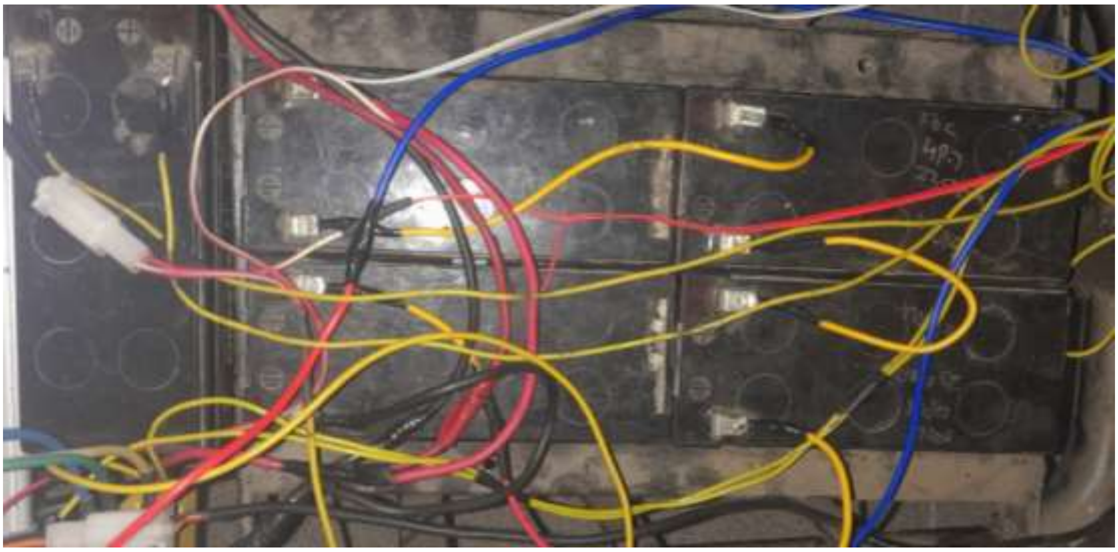

FIG 7.6 Batteries Connection

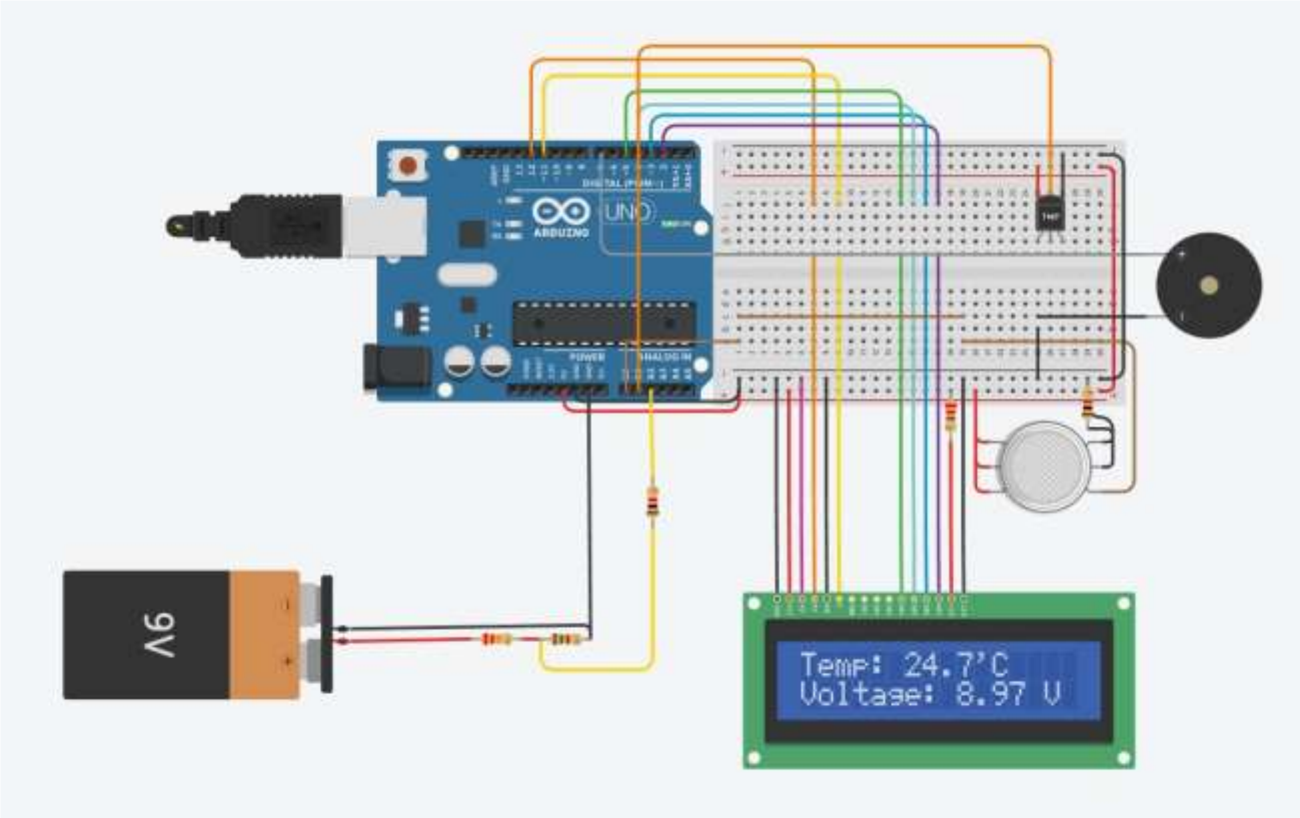

FIG 7.7 Simulation Picture

FIG 7.8 Proposed E-Vehicle with monitoring system

The E-vehicle monitoring system is a system which would be saving the battery of the E-vehicle for the long time. It monitors the battery at a particular time gap and displays the output frequently in the LCD display using Arduino Uno. The LM35 sensor can sense the temperature, MQ2 sensor can sense the smoke, Current sensor and Voltage sensor can senses the current and voltage respectively. So, it is perfect for our project E-vehicle monitoring system.

The above figure is the output of the E-vehicle monitoring system which indicates the temperature, Voltage, current and smoke from the E-vehicle and display it in the OLED using Arduino UNO.

The above figure is the output of the E-vehicle monitoring system which indicates the temperature, Voltage, current and smoke from the E-vehicle and display it in the IoT website using ESP32.

CHAPTER 8

CONCLUSION AND FUTURE SCOPE

8.1 CONCLUSION:

The project E-Vehicle monitoring system is successfully designed. It is beneficial to the people who are using the E-Vehicle by reducing the charge of changing batteries frequently. It will reduce the chance of changing batteries by protecting the existing battery by monitoring the battery and indicating it using LCD Display. It will reduce the pollution which is made through battery production in industry and it will also reduce the usage of diesel vehicle and make the people shift to E-Vehicle.

As conclusion, the system which designed for this work was perform very well, and the output is displayed as per the program through the LCD display. The E-Vehicle Monitoring System was put under a series of tests for ascertaining its performance as the monitoring system and very satisfactionary results were obtained.

Due to time considerations, the teams have also abandoned few cases in this project such as load current, voltage, battery percentage, automobile weight, and Tyre pressure left for future.

The future of the Internet of Things (IoT) in the EV industry is going to be brighter in the upcoming years. According to Net scribes Market Research Report, the global market size of the automotive IoT market will reach $106.32 billion by the end of 2023. Many governments around the globe are planning to replace the normal petrol or diesel engine-based vehicles with Electric Vehicles. But it is only possible when the global automobile industry follows all the standards.

Nowadays, people expect their Vehicles to be a whole software platform with easier control,low maintenance and running cost, and with functions like self-driving. Electric Vehicle manufacturers can use IoT technologies both for the development of the manufacturing process and for the improvement of the after-sales process.

Once IoT Technology becomes a global standard in Electric Vehicles, there are significant advantages, it will lead to reducing the cost of Battery, Safe & Secure Driving, Air Pollution Control, Easy Maintenance, Employment, Business Opportunities, and Reducing manufacturing costs, and many more. All in all, the future of IoT in the Electric Vehicle and the Automobile Industry seems very bright indeed!

8.2 FUTURE SCOPE:

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CHAPTER 9
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