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EV Battery Management and Fire Protection System

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Abstract: *The utilization of Web of-things (IoT) in checking the introduction of electric vehicle battery. Doubtlessly an electric vehicle totally depends upon the wellspring of energy from a battery However, the proportion of energy gave to the vehicle is reducing consistently that prompts the presentation webasement .This is a critical concern for battery create. In this work, noticing the show of the vehicle using IoT methodologies is proposed, so the checking ought to be conceivable clearly. The proposed IoT-based battery checking system is contains of ESP 32 lcd and voltage sensor. These days, electric vehicle (EV) is getting well known since the fuel costs getting more costly. As a result of these circumstances, various vehicle producers looking for alternatives of fuel sources other than gas. The usage of electrical fuel sources may improve the environment since there is less pollution. Additionally, EV produces amazing advantages the extent that energy saving and common affirmation.Most EVs utilized battery-powered battery which is lithium particle battery. It is more modest to be contrasted and lead corrosive. Truth be told, it has a consistent force, and energy's life cycle is 6 to multiple times more prominent contrasted and lead corrosive battery. Lithium particle battery life cycle can be abbreviated by certain reasons, for example, cheating and profound releases. Of course, EV conventionally has limited extent of making an excursion on account of battery size and body structure. This abstract provides an overview of the IoT-based BMS technology and its benefits, including improved battery performance, increased reliability, and reduced environmental impact.*

Keywords: Web of-things

I. INTRODUCTION

1.1 Background

Nowadays, electric vehicle (EV) is getting mainstream since the fuel costs getting more costly. Due to these circumstance, various vehicle maker looking for alternatives of fuel sources other than gas. The usage of electrical fuel sources may improve the environment since there are less tainting. Moreover, EV produces exceptional advantages the extent that energy saving and natural protection. Most EVs used battery-controlled battery which is lithium molecule battery. It is more unobtrusive to be differentiated and lead destructive.Believe it or not, it has a consistent power, and energy's life cycle is 6 to different occasions more noticeable differentiated and lead destructive battery. Lithium molecule battery life cycle can be abbreviated by specific reasons, for instance, cheating and significant deliveries. On the other hand, EV normally has limited extent of going on account of battery size and body structure. As of now, a huge clarification that limits the use of EV is the security of existing battery advancement. Portrays the blueprint of the proposed structure. All together for the structure to work, from the outset, the voltage sensor appraises the lead destructive molecule battery's voltage level.At a comparable time The battery's voltage level readings are given to an esp 32 center mcu microcontroller for taking care of., the pre-arranged data are sent off a battery noticing UI in a PC distantly using the cloud thing talk .When data move is compelling, the battery noticing interface on the lcd will show the invigorated data of battery status.Right when the battery made low voltage level, a notification email is sent off exhort the customer. The online battery system not only can measure the voltage of the batteries yet also talk with the battery noticing structure to get the limit of batteries. The detail plan of the system is portrayed in the accompanying regions.Traditional battery management systems are designed to monitor and control battery charging and discharging processes, ensuring optimal performance, longevity, and safety. However, integrating Internet of Things (IoT) technology enhances these systems by enabling real-time data acquisition, remote monitoring,.

1.2 Methodology

A battery monitoring system for EV that can notify the user about the state of the battery is necessary to avoid the mentioned problems.

Measuring the battery voltage using the voltage sensor can be done by connecting it in parallel to the battery. However, because the battery has a slow reaction time to change the voltage, so, a variable power supply is connected to the voltage sensor for experimental purposes. The measured voltage is an analog form which it is then converted to digital formby 10-bit analog to digital converter (ADC) built-in the Arduino Uno when the voltage sensoris connected to analog port of Arduino Uno. The ADC output value can be obtained from theArduino Uno that can be displayed on the computer screen. The relationship between the measured voltage and ADC output is plotted.

1.3 Problem Statement

• The problem statement for an Electric Vehicle Battery Management System (EV BMS) and Fire Protection System typically revolves around ensuring the safe operation of electric vehicles, particularly focusing on the management and protection of the battery system. Here's a breakdown of the key aspects that would be included:

• Safety Concerns: Start by highlighting the safety concerns associated with electric vehicle batteries, such as thermal runaway, short circuits, overcharging, and physical damage.

• Battery Management: Detail the need for an efficient Battery Management System (BMS) that monitors various parameters of the battery pack, including voltage, temperature, and state of charge. Emphasize the importance of maintaining optimal operating conditions to prolong battery life and prevent safety hazards.

• Fire Protection: Discuss the risks of fire or thermal events in electric vehicle batteries, which can be catastrophic if not properly managed. Outline the requirements for a robust fire protection system to detect, suppress, and mitigate fire incidents in EVs, both during operation and in case of accidents.

• Integration with Vehicle Systems: Highlight the necessity of integrating the BMS and fire protection system seamlessly with other vehicle systems, such as the powertrain, charging system, and onboard electronics, to ensure coordinated responses to safety threats.

• Regulatory Compliance: Address the regulatory standards and guidelines that govern the design and implementation of EV BMS and fire protection systems, such as those set forth by automotive safety agencies and organizations.

• Reliability and Durability: Stress the importance of designing systems that are reliable and durable under various operating conditions, including extreme temperatures, vibrations, and mechanical stresses.

• Cost Considerations: Acknowledge the cost implications of implementing advanced BMS and fire protection systems in electric vehicles and explore strategies to optimize cost-effectiveness without compromising safety.

• Future Scalability: Discuss the need for scalable solutions that can accommodate advancements in battery technology and evolving safety requirements in the rapidly changing landscape of electric mobility.

1.4 Objectives

• Voltage and Current Monitoring.
• Temperature Monitoring and Alerts on IoT Device.
• Battery Cooling if Temperature rising detected.
• Buzzer alert for driver.
• LCD Display for current battery status.
• IoT Based Monitoring System
• Remaining kilometre calculation & display
• Auto-Cut-off

1.5 Propose System:

• We are going to make an IoT battery monitoring system for the Lithium ion battery using Arduino IoT Cloud and Nodemcu ESP8266 WiFi module. We will send Battery status on IoT device & LCD display
• Overheating protection for prevent battery blast.
• Provide Fan cooling system to prevent battery heating.
• While battery gets full charged automatically cut off feature inbuilt.
• Continuously current and voltage monitoring to observe parameter accordingly performance.
• Message sending to the owner regarding battery management system.
• Batteries used in system should not be overcharged or over-discharged to avoid damaging the battery, shortening the battery life, and causing fire or explosions.
• It is one of the key points to protect the battery and optimize the utilization of the battery.it is a very important in the electronic systems to monitor the status ofa battery.

II. LITURATURE SURVAY

1st Global Gathering on Advances in Science, Designing and Advanced mechanics Innovation 2019
1Abu Shufian, 1Md. Mominur Rahman, 2Koushik Ahmed, 1Riadul Islam, 1Mahmodul Hasan, and 1Toufiqul Islam 1,2Department of Electrical and Electronic Designing
Plan and Execution of Sun based Force Remote Battery Charger
• Solar power remote charger can charge the battery productively with no wire. This remote charging framework is ideal to use for some versatile gadgets like cell phones and other remote applications. This examination depends on sun oriented force and remote innovation IEEE Exchanges on modern gadgets 0278-0046 (C) 2015 IEEE
• Giuseppe Buja, IEEE, Life Individual, ManueleBertoluzzo, and Kishore N. Mude
• A deliberate investigation of the force misfortunes in the WPTBC segment has been likewise done. Thereafter, a prototypal WPTBC has been set up as indicated by the plan results and tried in various working conditions. Various estimations acquired from the model have been accounted for that completely affirm the sufficiency of both the plan system and the misfortune investigation of the WPTBC.
• 978-1-5090-5117-5/16/$31.00 c 2016 IEEE
• Shared Sun based controlled EV Charging Stations: Plausibility and Advantages
• Stephen Lee, Srinivasan Iyengar, David Irwin, Prashant Shenoy College of Massachusetts, Amherst
• use of sun oriented controlled chargers has arisen as an intriguing chance. These chargers give clean power to electric-fueled vehicles that are themselves contamination free bringing about certain natural impacts. In this paper, we plan a sun oriented controlled EV charging station in a parking garage of a vehicle share administration. In such a vehicles rabbit administration rental get and drop off occasions are known. We define a Direct Programming way to deal with charge EVs that augment the usage of sun powered energy while keeping up comparative battery levels for all vehicles

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III. THEORY

3.1 Block Diagram

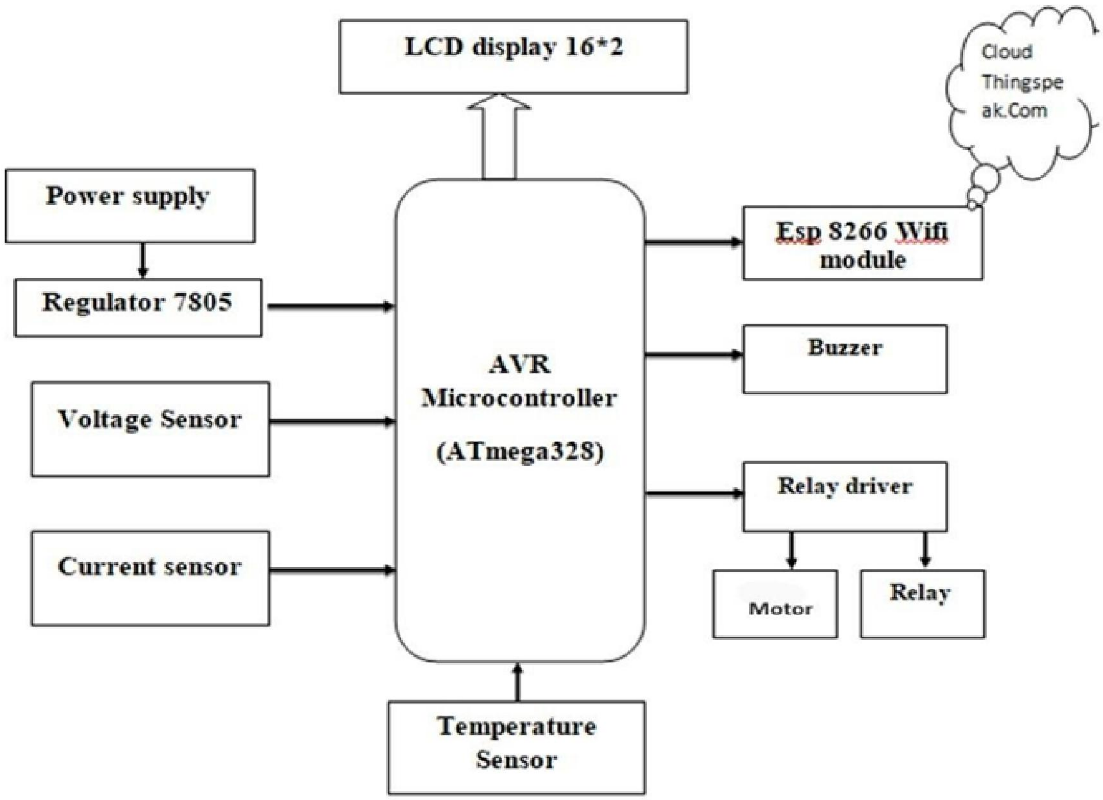

Fig: 3.1 Block diagram of system

3.2 Block Diagram Explanation

Block diagram of the battery monitoring system is shown in Above Fig. In this system there are several blocks namely relay Driver, 12v battery, Microcontroller atmega 328 , temperature Sensors, voltage sensor, current sensor, LCD, etc.

The sensor measures individual battery cell voltage charging and discharging current. These data are transferred to monitoring system controller. Monitoring system controller is where the data are stored and then trended with the battery monitoring software.

the battery is the most important component for any device as it powers the entire system. So, it is important to monitor the voltage level of the battery as improper or excess charging/discharging may lead to damage to the Battery or System Failure. Most of the electrical/electronics devices has a separate system called Battery Management System (BMS). The BMS monitors allthe properties of the battery like the voltage, current, temperature & auto cut-off system. This ensures the safety and proper handling of Lithium-Ion or Lithium Polymer batteries.

Earlier BMS only monitors the condition of the battery and alarms the user via a battery indicator. But now due to the use of the Internet of Things, we can directly notify the users remotely. They can check the battery status on their smartphones or Computer dashboards from anywhere in the world.

In this IoT-based Battery Monitoring System, we will use ESP8266 Chip to send the battery status data to ThingSpeak cloud. The Thingspeak will display the battery voltage along with the battery percentage in both the charging and discharging cases.

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IV. HARDWARE IMPLEMENTATION

4.1 All details of hardware.

1) MICROCONTROLLER- AT mega 328
2) battery 12v Li-Ion
3) motor
4) Buzzer
5) Esp 8266 wifi module
6) Current sensor(Ina219)
7) Voltage Sensor
8) Temperature sensor
9) Resistor

4.1.1 Microcontroller AT mega 328

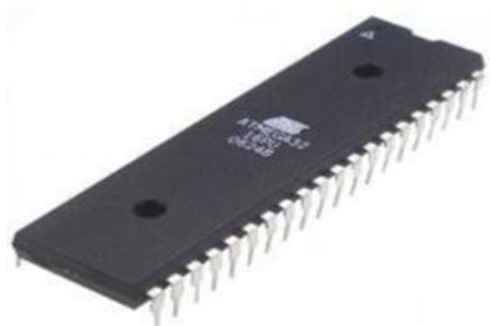

Fig 4.1.1(a) Microcontroller AT mega 328

ATmega328 is an 8-bit high performance microcontroller of Atmel's Mega AVR family.
Atmega32 is based on RISC architecture with 131 powerful instructions. Most of the instructions run in one machine cycle. Atmega32 can work on a maximum frequency of 16MHz. ATmega32 has static RAM of 2 KB, EEPROM of 1 KB and 32 KB programmable flash memory. The endurance cycle of flash memory and EEPROM is 10,000 and 100,000, respectively.

Features

• High Performance, Low Power Atmel® AVR® 8-Bit Microcontroller
• Advanced RISC Architecture
– 131 Powerful Instructions – Most Single Clock Cycle Execution
– 32 x 8 General Purpose Working Registers
– Fully Static Operation
– Up to 20 MIPS Throughput at 20MHz
– On-chip 2-cycle Multiplier

• High Endurance Non-volatile Memory Segments
– 4/8/16/32KBytes of In-System Self-Programmable Flash program memory
– 256/512/512/1KBytes EEPROM
– 512/1K/1K/2KBytes Internal SRAM
– Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
– Data retention: 20 years at 85°C/100 years at 25°C(1)

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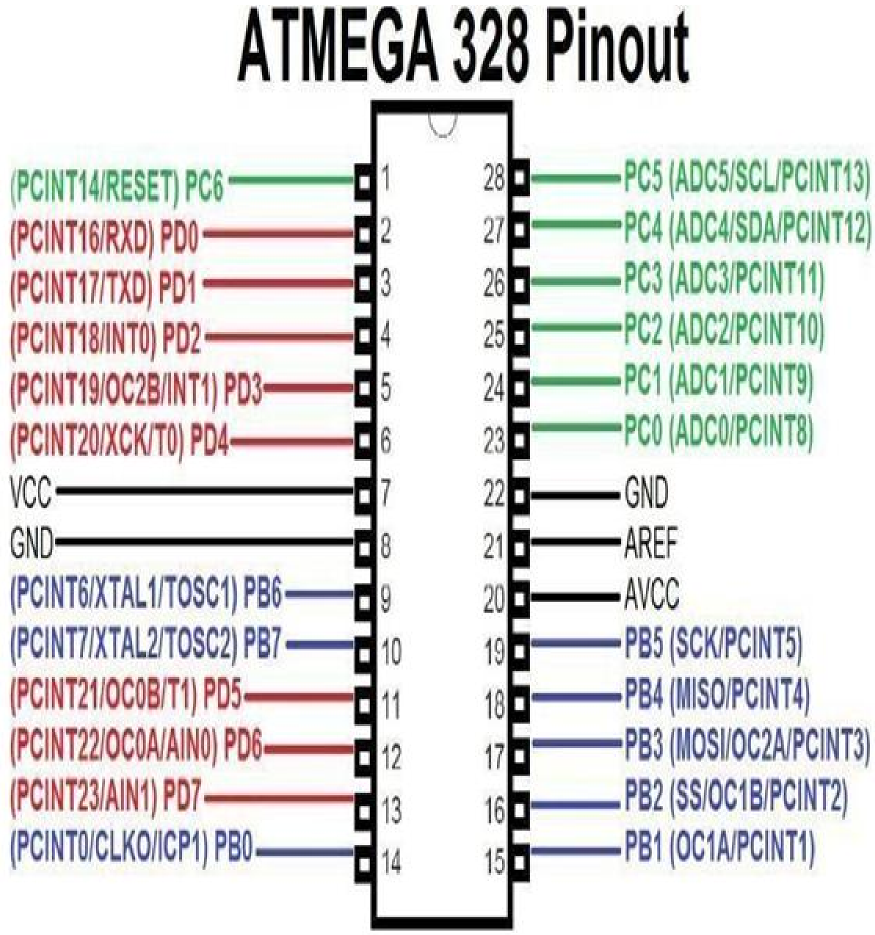

Fig: 4.1.1(b) Pin diagram

- Bus width – 8 bits
- Pin Count – 40 (PDIP, SOIC) / 44 (QFN, PLCC, TQFP)
- Program Memory – 14.3 kilobytes
- CPU Speed – 5 million instructions per second
- RAM Size – 368 bytes
- EEPROM Size – 256 bytes

4.1.2 DS18B20

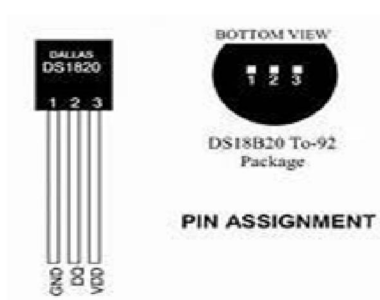

Fig: 4.1.2 DS18B20

PIN DESCRIPTION
GND- Ground
DQ- Data In/Out
VDD- Power Supply Voltage
NC- No Connect

The DS18B20 Digital Thermometer provides 9 to 12-bit (configurable) temperature readings which indicate the temperature of the device. Information is sent to/from the DS18B20 over a 1-Wire interface, so that only one wire (and ground) needs to be connected from a central microprocessor to a DS18B20. Power for reading, writing, and performing temperature conversions can be derived from the data line itself with no need for an external power source. Because each DS18B20 contains a unique silicon serial number, multiple DS18B20s can exist on the same 1-Wire bus. This allows for placing temperature sensors in many different places. Applications where this feature is useful include HVAC environmental controls, sensing temperatures inside buildings, equipment or machinery, and process monitoring and control

4.1.3 Temperature Sensor – NTC Thermistor

FIG 4.1.3:Temperature Sensor

Thermistors are variable resistors that change their resistance with temperature. They are classified by the way their resistance responds to temperature changes. In Negative Temperature Coefficient (NTC) thermistors, resistance decreases with an increase in temperature. In Positive Temperature Coefficient (PTC) thermistors, resistance increases with an increase in temperature. NTC thermistors are the most common, and that's the type we'll be using in this tutorial. NTC thermistors are made from a semiconducting material (such as a metal oxide or ceramic) that's been heated and compressed to form a temperature sensitive conducting material The conducting material contains charge carriers that allow current to flow through it.

Since the thermistor is a variable resistor, we'll need to measure the resistance before we can calculate the temperature. However, the Arduino can't measure resistance directly, it can only measure voltage.

The Arduino will measure the voltage at a point between the thermistor and a known resistor. This is known as a voltage divider. The equation for a voltage divider is:

$$V_{out} = V_{in} \times \Bigg(\frac{\quad}{R1}$$

In terms of the voltage divider in a thermistor circuit, the variables in the equation above are:

V_{out} : $Voltage\ between\ therm$
V_{in} : $V_{cc},\ i.e.\ 5V$
$R1$: $Known\ resistor\ value$
$R2$: $Resistance\ of\ thermist$

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4.1.4 Voltage Sensor

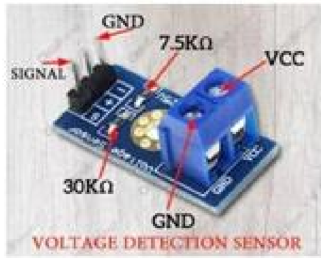

Fig:4.1.4 voltage sensor

With a slight modification in the code, we can now measure 0 to 12V. Analog value is read as before. Then, using the same formula mentioned previously, the voltage between 0 and 12V is measured. value = analogRead(A0); voltage = value * (5.0/1023) * ((R1 + R2)/R2);

In this Arduino Project, you will learn how to build an Arduino voltage sensor which can measure the DC voltages ranging from 0 to 25 Volts. This works as a DC voltmeter with maximum 25V. As you all know Arduino and few other microcontroller can measure up to 5V directly from the analog pins, but if you want to measure the voltage beyond 5V, it is not possible and even if you connect more than 5V the chip may get damaged or burnt. So, with the help of this Voltage sensor we can measure up to 25V from Arduino Analog pins.

Voltage Detection sensor Module overview:

This Voltage sensor is small and low cost module whose principle is based on Resistive voltage divider circuit. With the help of it the voltage is divided by 5. Which makes the voltage 5 times smaller, 25/5=5 thus with this we can measure up to 25V.

Arduino AVR chips have 10-bit ADC, so this module simulates a resolution of 0.00488V (5V/1024), so the minimum voltage of input voltage detection module is 0.00488Vx5(for 25v)=0.02440V.

- For 5V systems the input voltage should not be greater than 25V
- For 3.3V system the input voltage should not be greater than 16.5v as 3.3X5=16.5. Related: Measure AC current by interfacing ACS712 sensor with ESP32

Technical specifications:

- Voltage input range: DC 0-25V
- Voltage detection range: DC 0.02440V-25V
- Output signal type: Analog
- Voltage Analog Resolution: 0.00489V Voltage sensor module pinout:

From the above pinout diagram we can notice there are 5 pins to voltage sensor module. 3 pins are male head connectors which are to be connected to Arduino and other 2 pins has a plastic screw pin terminals where the voltage to be measured is connected.

- VCC: Positive terminal for the external voltage source (0-25v)
- GND: Negative terminal for the external voltage source (0-25v)
- S: signal pin or Analog output pin
- +: Not connected
- -: Ground pin

Build Own voltage sensor using below Schematic diagram:

As we already discussed this sensor works with the principle of voltage divider circuit. we can even build the circuit by our own with a very few components as 2 resistors 7.5KΩ and 30KΩ. This circuit reduces the voltage by 5 times. Follow the below schematic diagram to build own voltage sensor with range 0-25V DC.

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4.1.5 Power Supply Module

We are using AVR Microcontroller ATmega328 - The Atmel 8-bit AVR RISC-based microcontroller combines 32 KB ISP flash memory. The device operates between 1.8 and
5.5 volts. We are using IC7805 that gives 5v at the output. This 5v applied to the PIC microcontroller.

4.1.6 Display

We are using 16 x 2 LCD this means 16 characters per line by 2 lines LCD Pin descriptions. The LCD discussed in this section has 16 pins.
Specifications of LCD 16X2
Specifications of LCD 16X2 are discussed below.
- The operating voltage of this display ranges from 4.7V to 5.3V
- The display bezel is 72 x 25mm
- The operating current is 1mA without a backlight
- PCB size of the module is 80L x 36W x 10H mm
- HD47780 controller
- LED color for backlight is green or blue
- Number of columns – 16
- Number of rows – 2
- Number of LCD pins – 16
- Characters – 32
- It works in 4-bit and 8-bit modes
- Pixel box of each character is 5×8 pixel
- Font size of character is 0.125Width x 0.200height LCD 16X2 Pin Configuration

The pin configuration of LCD 16 X 2 is discussed below so that LCD 16×2 connection can be done easily with external devices.

16X2 LCD Pin Diagram

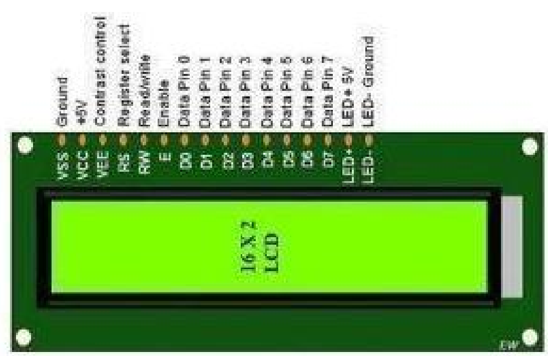

Fig: Fig:4.1.6 LCD 16X2

- Pin1 (Ground): This pin connects the ground terminal.
- Pin2 (+5 Volt): This pin provides a +5V supply to the LCD
- Pin3 (VE): This pin selects the contrast of the LCD.
- Pin4 (Register Select): This pin is used to connect a data pin of an MCU & gets either 1 or 0. Here, data mode = 0 and command mode =1.
- Pin5 (Read & Write): This pin is used to read/write data.
- Pin6 (Enable): This enables the pin must be high to perform the Read/Write procedure. This pin is connected to the data pin of the microcontroller to be held high constantly.

• Pin7 (Data Pin): The data pins are from 0-7 which are connected through the microcontroller for data transmission. The LCD module can also work on the 4-bit mode through working on pins 1, 2, 3 & other pins are free
• Pin8 – Data Pin 1
• Pin9 – Data Pin 2
• Pin10 – Data Pin 3
• Pin11 – Data Pin 4
• Pin12 – Data Pin 5
• Pin13 – Data Pin 6
• Pin14 – Data Pin 7
• Pin15 (LED Positive): This is a +Ve terminal of the backlight LED of the display & it is connected to +5V to activate the LED backlight.
• Pin16 (LED Negative): This is a -Ve terminal of a backlight LED of the display & it is connected to the GND terminal to activate the LED backlight.

4.1.7 Node MCU ESP8266

In this IoT-based Battery Monitoring System, we will use the NodeMCU ESP8266 board to send the battery status data to the Arduino Iot Cloud. The IoT Cloud Dashboard will display the battery voltage along with the battery percentage in both the charging and discharging conditions.

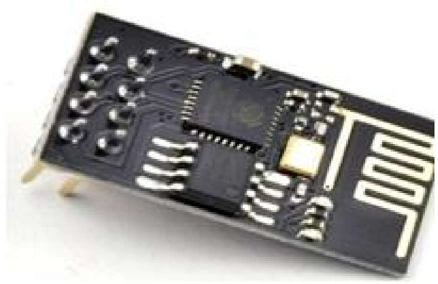

Fig 4.1.7 : ESP 8266 Wi-Fi Module

NodeMCU ESP8266 Specifications & Features
• Microcontroller: Ten silica 32-bit RISC CPU Xtensa LX106.
• Operating Voltage: 3.3V.
• Input Voltage: 7-12V.
• Digital I/O Pins (DIO): 16.
• Analog Input Pins (ADC): 1.
• UARTs: 1.
• SPIs: 1.
• I2Cs: 1.

4.1.8 12v li-ion battery pack

A Lithium-ion or Li-ion battery is a type of rechargeable battery, which uses the reversible reduction of lithium ions to store energy. It is the predominant battery type used in portable consumer electronics and electric vehicles. It also sees significant use for grid-scale energy storage and military and aerospace applications. Compared to other rechargeable battery technologies, Li-ion batteries have high energy densities, low self- discharge, and no memory effect

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Fig 4.1.8 12v li-ion batterypac

Specification:

Specific energy	100–265 W·h/kg(0.36–0.875 MJ/kg)
Self-discharge rate	0.35% to 2.5% per month depending on state of charge
Cycle durability	400–1,200 cycles
Nominal cell voltage	3.6 / 3.7 / 3.8 / 3.85 V, LiFePO4 3.2 V, Li4Ti5O12 2.3 V

4.1.9 Relay:

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as relays. Relays are used where it is necessary to control a circuit by a separate low signal, or where several circuits must be controlled by one signal. low-cost digital temperature and humidity sensor.

Fig:4.1.9 Relay

Contact Rating

 Nominal Load (Resistive Load Cosφ=1) Contact Capacity: RW 12A at 120VAC.(UL)
10A at 120VAC.
10A at 24VDC.
RWH 12A at 250VAC.(UL)
10A at 277VAC(TUV) TV-5 at 120VDC.
15A at 24VDC.
Rated Carrying Current RW: 10A & RWH: 15A.
Max. Allowable Current RW: 10A & RWH: 15A.
Max. Allowable Voltage AC 240V, DC 110V.
Max. Allowable Power Force.RW: 1500 VA, 240W. RWH: 1800VA, 360W.
Min. Switching Load RW: DC 5V, 10m

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4.1.10 Transistor

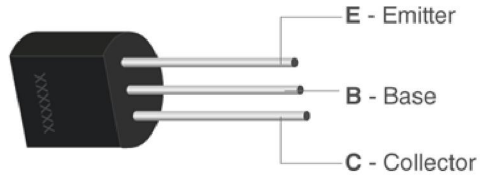

Fig:1.1.10 Transistor

A transistor is a type of a semiconductor device that can be used to both conduct and insulate electric current or voltage. A transistor basically acts as a switch and an amplifier. In simple words, we can say that a transistor is a miniature device that is used to control or regulate the flow of electronic signals.

Transistors are one of the key components in most of the electronic devices that are present today. Developed in the year 1947 by three American physicists John Bardeen, Walter Brattain and William Shockley, the transistor is considered as one of the most important inventions in the history of science.

4.1.11 BUZZER

An audio signaling 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 like alarm, music, bell & siren.

Specifications

• Color is black.
• The frequency range is 3,300Hz.
• Operating Temperature ranges from – 20° C to +60°C.
• Operating voltage ranges from 3V to 24V DC.

4.2 Hardware Cost

Sr No	Description	Qty	Cost
1	Microcontroller AT Mega 328	1	250
2	LCD display 16 X 8	1	200
3	Battery 12V Li-Ion	1	1000
4	ESP 8266 Wi-fi Module	1	450
5	Current Sensor INA219	1	150
6	Buzzer	1	50
7	PCB film	1	500
8	PCB Cost	1	500
9	DS18B20	1	70
10	Voltage Sensor	1	150
11	Temperature Sensor	1	50

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12	Wires	1	100
13	Resistor	4	20
14	Motor	1	200
15	Battery charger	1	500
16	etc		100
		Total	

4.3 Methodology

The block diagram of the proposed methodology is explained here. The proposed system consists of different sensors like the current sensor, voltage sensor, a temperature sensor for monitoring different battery conditions in the vehicle. Current sensor INA219 is used to monitor the current through battery and voltage sensor is used to monitor battery voltage in real-time.

The voltage sensor can monitor the voltage of up to 25V DC and the current sensor can monitor the current of up to 5A. The temperature sensor will monitor the temperature of the battery so that it will decide the performance of the battery. The outputs of the current sensor, voltage sensor, and temperature sensor are analog in nature and we need to convert that analog output from the sensor into digital format, and for that, we are going to use inbuilt ADC of the controller which is 10-bit and 13-channel ADC.

4.3.1 Circuit Diagram

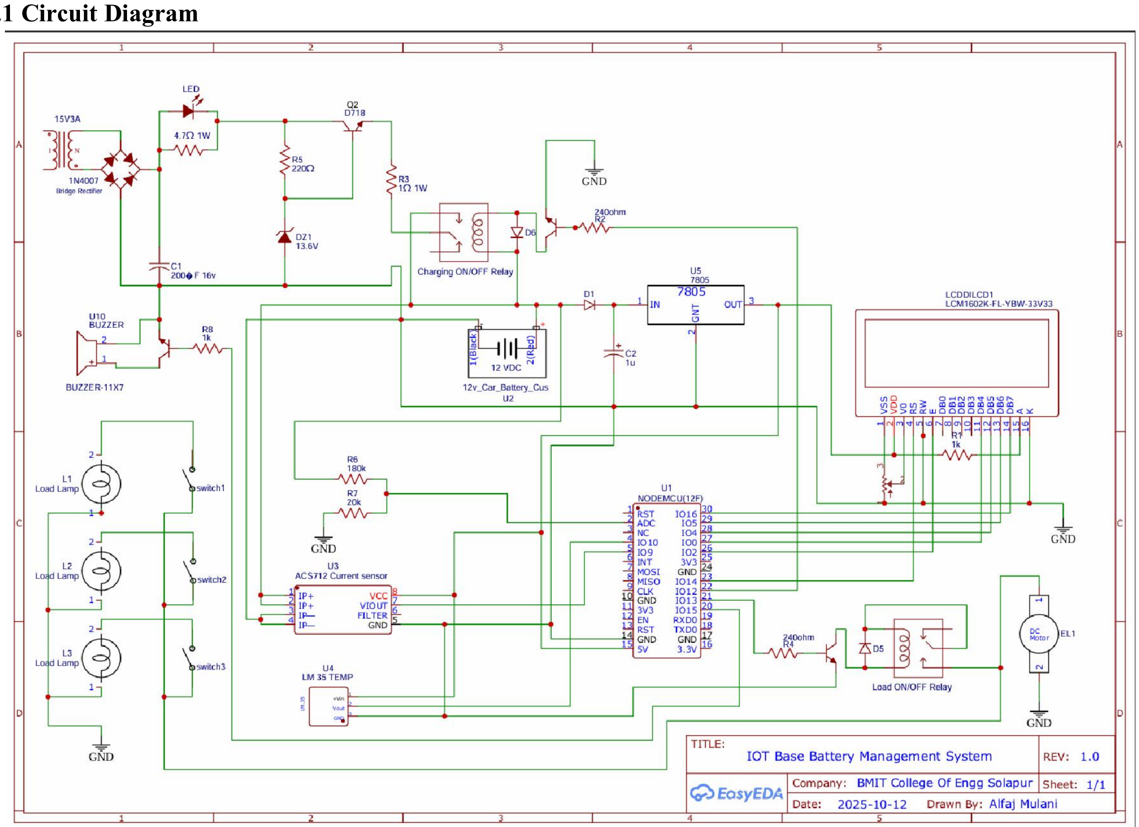

Fig: 4.3.1 Circuit Diagram

Below figure shows the proposed circuit diagram of Advanced BM system. In this we are using Microcontroller, buzzer, LCD, esp8266 wi-fi, temperature sensor, etc. This proposed circuit diagram gives detail structure of system as shown below:

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Working:-

First of all we will connect the ESP8266 with the Microcontroller. ESP8266 runs on 3.3V and if you will give it 5V from the Microcontroller then it won't work properly and it may get damage. Connect the VCC to the 3.3V pin of Microcontroller. The RX pin of ESP8266 works on 3.3V and it will not communicate with the Microcontroller when we will connect it directly to the Microcontroller Connect the TX pin of the ESP8266 to the pin 3 of the Microcontroller and the RX pin of the esp8266 to the pin 4 of Microcontroller.

Connect the LM05 Temperature sensor to the pin 25 of Microcontroller and connect the SCL to the pin 28 and SDA to the pin 27 of Microcontroller.

Connect a buzzer to the pin 13 of the Microcontroller which will start to beep when the condition becomes true.

We will connect LCD with the Microcontroller. The connections of the LCD are as follows

• Connect pin 1 (VEE) to the ground.

• Connect pin 2 (VDD or VCC) to the 5V.

• Connect pin 3 (V0) to the middle pin of the 10K potentiometer and connect the other two ends of the potentiometer to the VCC and the GND. The potentiometer is used to control the screen contrast of the LCD. Potentiometer of values other than 10K will work too.

• Connect pin 4 (RS) to the pin 14 of the Microcontroller.

• Connect pin 5 (Read/Write) to the ground of Microcontroller. This pin is not often used so we will connect it to the ground.

• Connect pin 6 (E) to the pin 15 of the Microcontroller. The RS and E pin are the control pins which are used to send data and characters.

• The following four pins are data pins which are used to communicate with the Microcontroller.

Connect pin 17 (D4) to pin 16 of Microcontroller. Connect pin 16 (D5) to pin 17 of Microcontroller. Connect pin 18 (D6) to pin 18 of Microcontroller. Connect pin 19 (D7) to pin 19 of Microcontroller. Connect pin 15 to the VCC.

Connect pin 16 to the Ground.

At last connect the 5v power supply to the pin 7 and pin 20 of Microcontroller.

V. SOFTWARE IMPLEMENTATION

5.1 Arduino IDE (Programming)

Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software. It consists of a circuit board, which can be programed (referred to as a microcontroller) and a ready- made software called Arduino IDE (Integrated Development Environment), which is used to write and upload the computer code to the physical board. The key features are:

• Arduino boards are able to read analog or digital input signals from different sensors and turn it into an output such as activating a motor, turning LED on/off, connect to the cloud and many other actions.

• You can control your board functions by sending a set of instructions to the microcontroller on the board via Arduino IDE (referred to as uploading software).

• Unlike most previous programmable circuit boards, Arduino does not need an extra piece of hardware (called a programmer) in order to load a new code onto the board. You can simply use a USB cable.

• Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program.

• Finally, Arduino provides a standard form factor that breaks the functions of the microcontroller into a more accessible package.

5.2 PROTEUS Ver 8:

In Proteus we can design up to 16 layers PCB. One is top layer, another one is bottom layer and remaining all are inner layers. The layer selection in Proteus is at left down corner. Each layer will represent in different color. For example bottom layer represented in blue color, top layer represented in red and inner layers are represented in different colors

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5.3 Express PCB (Circuit & layout design)

The main purpose of printed circuit is in the routing of electric currents and signal through a thin copper layer that is bounded firmly to an insulating base material sometimes called the substrate. This base is manufactured with an integrally bounded layer of thin copper foil which has to be partly etched or removed to arrive at a pre-designed pattern to suit the circuit connections or other applications as required.

The term printed circuit board is derived from the original method where a printed pattern is used as the mask over wanted areas of copper. The PCB provides an ideal baseboard upon which to assemble and hold firmly most of the small components. From the constructor's point of view, the main attraction of using PCB is its role as the mechanical support for small components. There is less need for complicated and time consuming metal work of chassis contraception except perhaps in providing the final enclosure. Most straight forward circuit designs can be easily converted in to printed wiring layer the thought required to carry out the inversion cab footed high light an possible error that would otherwise be missed in conventional point to point wiring .The finished project is usually neater and truly a work of art. Actual size PCB layout for the circuit shown is drawn on the copper board. The board is then immersed in FeCl3 solution for 12 hours. In this process only the exposed copper portion is etched out by the solution. Now the petrol washes out the paint and the copper layout on PCB is rubbed with a smooth sand paper slowly and lightly such that only the oxide layers over the Cu are removed.

5.4 Flowchart

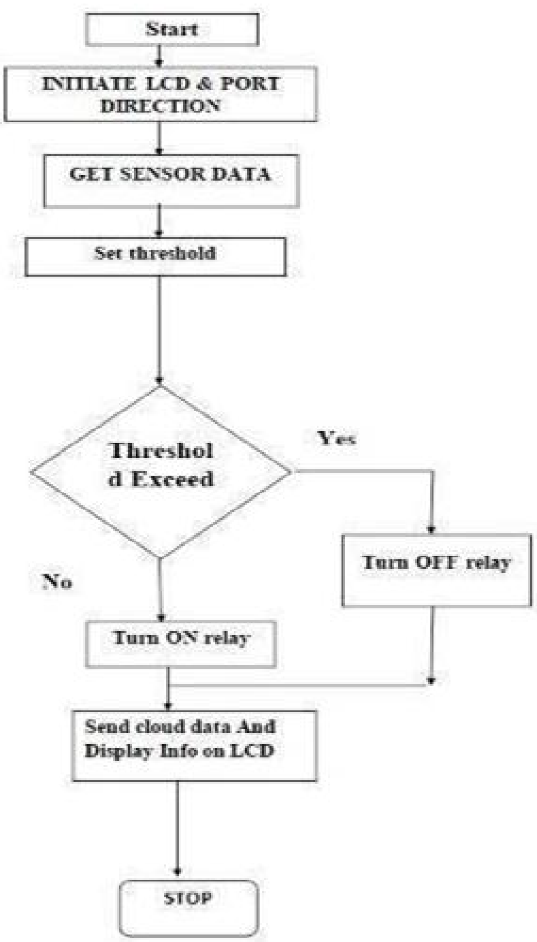

Fig 6.1 Flowchart

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5.5 Algorithm

1) Start.
2) Initiate all Ports.
3) Get sensed data from
4) Set threshold.
5) Threshold exceed
6) Turn on relay
7) Check balance.
8) Send cloud data Display reading on LCD.
9) Stop.

VI. RESULTS & DISCUSSIONS

6.1 Advantages

❖ Real Time Monitoring

❖ Performance-based replacements: Replacement batteries can be plan based on their performance, not on a schedule, allowing significant cost reductions.

❖ Avoid Vehicle burning.

❖ Avoid the Battery over heating

❖ Remaining batterycharging timing.

❖ Auto Cut-Off after full charge.

❖ Real time notification to owner after full charge, discharge or overheating.

❖ Monitor the car/bike further kilometer cover.

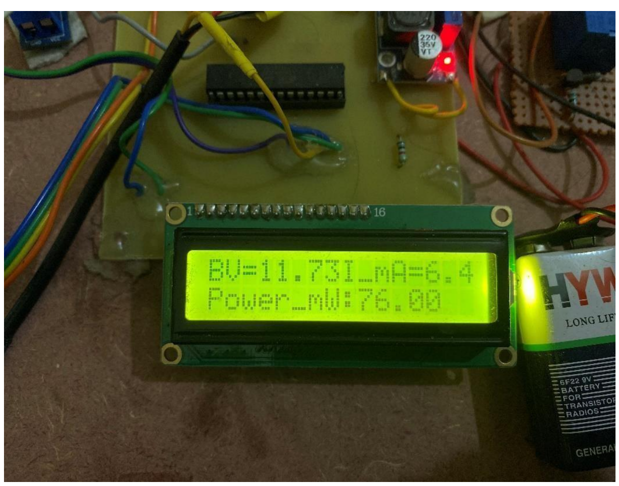
❖ Battery charging percentage.

• Applications

❖ Real time monitoring of Electric Vehicle battery status

❖ Avoid the overheating & fire due battery in vehicle

6.2 Working of Model



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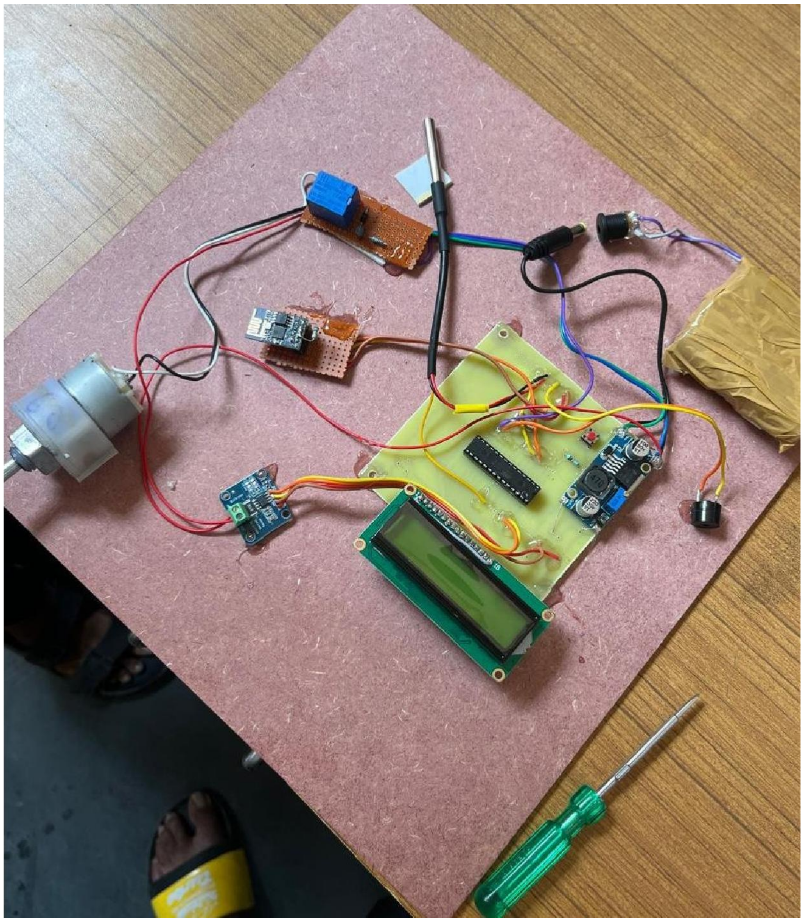
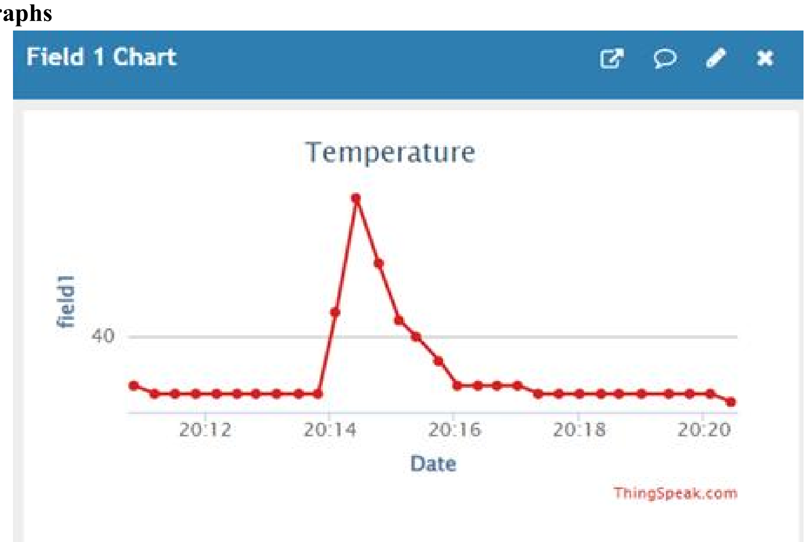


6.3 Results and Graphs



6.3.1 Temperature Graph on IOT cloud

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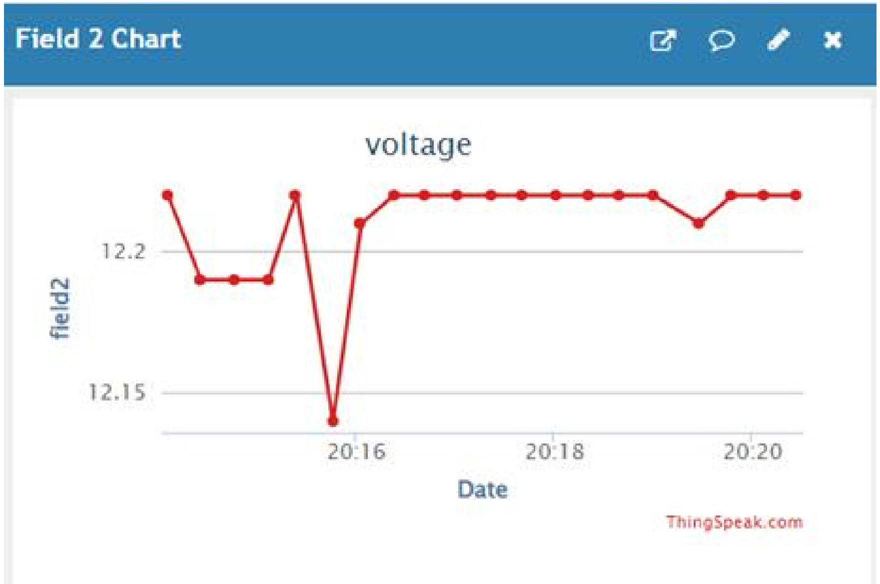
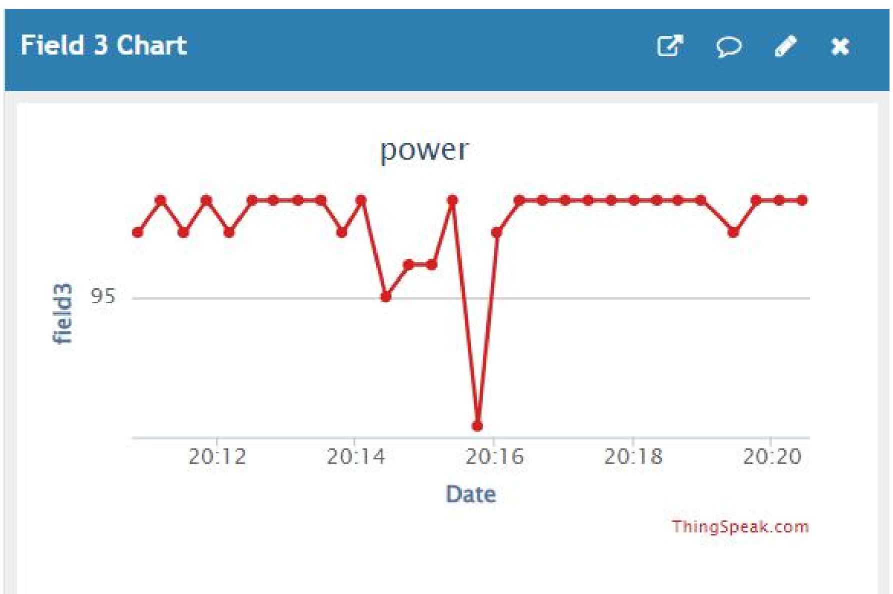


6.3.2 Voltage Graph On IOT Cloud



6.3.3 Power Graph on IOT Cloud

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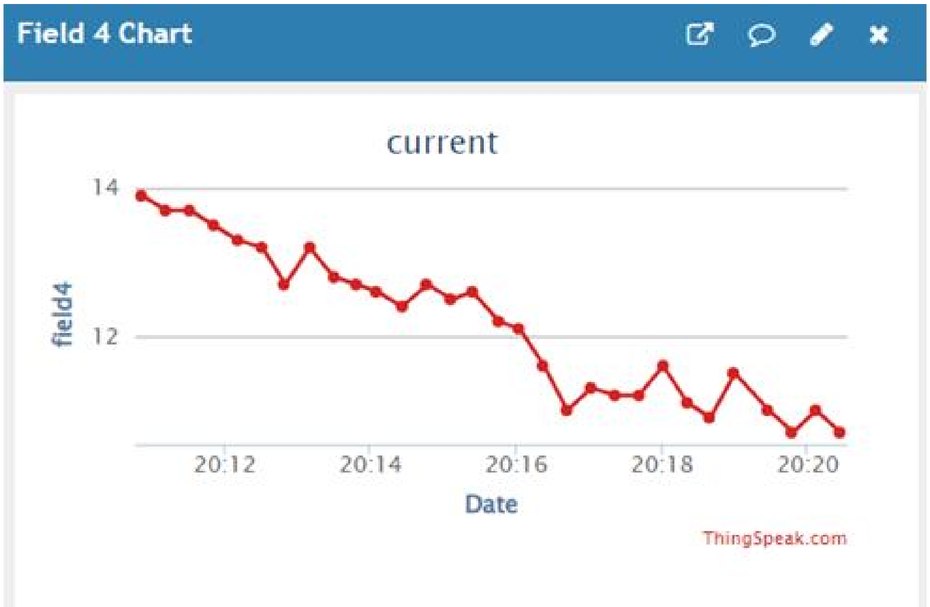

6.3.4 Current Graph on IOT cloud

VII. EXPECTED CONCLUSION

We can monitor the battery condition through the IOT using android phone.
• We can monitor the car further kilometer cover.
• A BMS enhances the life span of the battery cell in EVs.
• It provides stability and reliability.
• This an effective system to measure and control the cell's voltage.
• It monitors the battery cells constantly to avoid the occurrence of failure or explosion.
• It forecasts the battery pack's capabilities in the near future.

7.1 FUTURE SCOPE

• Early Detection: Development of advanced sensors and detection systems that can identify potential fire hazards at an earlier stage.Multi-criteria Detection: Combining various detection methods (smoke, heat, gas) for more reliable and faster fire detection.
• Improved Suppression Systems:Targeted Suppression: Systems that can accurately target and suppress fires in specific battery cells or modules, minimizing damage.New Suppression Agents: Research into more effective fire suppression agents that are environmentally friendly and suitable for use in electric vehicles.
• Integrated Safety Systems:BMS and Fire System Integration: Closer integration between BMS and fire protection systems to allow immediate response to thermal runaway events.Automated Responses: Development of automated response systems that can disconnect the battery or deploy fire suppression autonomously.
• Materials and Design Innovations:Fire-resistant Materials: Use of advanced, fire-resistant materials in battery pack design to contain and slow down fire propagation.Thermal Barriers: Incorporation of thermal barriers and insulation within battery packs to prevent heat transfer between cells.

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