IJARETY

International Journal of Advanced Research in Education and TechnologY (IJARETY)

Volume 11, Issue 2, March 2024

Impact Factor: 7.394

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

INNO SPACE
SJIF Scientific Journal Impact Factor

doi crossref

निस्केयर NISCAIR

International Journal of Advanced Research in Education and TechnologY(IJARETY)

| ISSN: 2394-2975 | www.ijarety.in| | Impact Factor: 7.394| A Bi-Monthly, Double-Blind Peer Reviewed & Referred Journal |

|| Volume 11, Issue 2, March 2024 ||

DOI:10.15680/IJARETY.2024.1102021

Design and Implementation of EV Vehicle Battery Monitoring and Protection System

[1]K. SANTHI, [2]M. KUSUMA, [3]P. MAHESH BABU, [4]N. SOMA SEKHAR, [5]M. V. SAI KIRAN, [6]K. GANESH KUMAR

[1]Assistant Professor, Department of Electrical & Electronics Engineering, Usha Rama College of Engineering & Technology, Krishna, Andhra Pradesh, India.

[2,3,4,5,6]U.G. Students, Department of Electrical & Electronics Engineering, Usha Rama College of Engineering & Technology, Krishna, Andhra Pradesh, India.

ABSTRACT: The most crucial component of any electric vehicle (EV) is its battery storage, which holds the energy required for the vehicle to run. Therefore, an effective battery management system must exist in order to maximize a battery's output and guarantee its safe functioning. It checks the parameters, calculates the state of charge, and offers the required services to guarantee the battery operates safely. Therefore, BMS is a crucial component of every electric vehicle (EV) and ensures that the cell runs within its safe operating parameters, protecting both the user and the battery. Not only would the suggested system safely monitor and charge the battery, but it will also safeguard it to prevent mishaps. The functions of the suggested model include voltage measurement, current measurement, Liquid crystal display (LCD), protection, battery status detection, state of charge (SOC) computation, etc. Automobiles with one or more electric motors that get their power from rechargeable batteries as opposed to internal combustion engines (ICEs) that run exclusively on fossil fuels are known as electric vehicles (EVs). An essential part of electric cars (EVs) and other battery-powered devices is a battery management system (BMS). It keeps an eye on and regulates the battery pack's functioning to guarantee lifespan, safety, and peak performance. State of Charge (SoC) is the percentage of a battery's overall capacity that represents the amount of energy left in the battery. It helps users estimate how much range or usage time is left in the battery before recharging is necessary by showing how much charge is available in the battery at any given time.

KEYWORDS: Electric vehicle, Battery management, State of charge.

I. INTRODUCTION

An electric car Vehicles classified as EVs are those that are propelled by one or more electric motors. An electric vehicle (EV) uses an electric motor to spin its wheels rather than an internal combustion engine (ICE) that burns fuel. This is accomplished by storing electrical energy in a battery pack. Electric vehicles (EVs) provide several advantages over internal combustion engine (ICE) vehicles. These advantages include less pollutants, quieter operation, and a reduced need on fossil fuels. Electric motors often have lower operating expenditures than internal combustion engines (ICEs) since they are more efficient than ICEs and energy is frequently less expensive than gasoline. EVs are becoming more and more popular as the world transitions to a cleaner, more sustainable future. Governments everywhere are offering incentives to encourage the use of electric vehicles (EVs), and several automakers are already offering a range of EV models for sale. Apart from its advantages, internal cell shorts that can cause thermal runaway are a prevalent issue with EVs. Usually, overheating is the cause of an EV fire. The battery of the electric car warms up, and when that heat reacts with gasoline that has leaked, the battery just burns. A battery management system (BMS) typically comprises of multiple components, including sensors to measure the battery's temperature, voltage, and current, and control circuits to regulate the battery's charging and discharging behavior under different situations.

| ISSN: 2394-2975 | www.ijarety.in| | Impact Factor: 7.394| A Bi-Monthly, Double-Blind Peer Reviewed & Referred Journal |

|| Volume 11, Issue 2, March 2024 ||

DOI:10.15680/IJARETY.2024.1102021

II.PROPOSED RESEARCH WORK

A. BLOCK DIAGRAM

The Arduino microcontroller in this suggested system is connected to an Android app via a Bluetooth module. A two-cell Li-ion battery charging circuit is used to balance charge the Li-ion battery. An Arduino's analog pin is connected to an LM35 temperature sensor, which measures the battery's temperature. A voltage sensor is used to measure the battery voltage, and the app displays the data.When an overheat is detected, a 5 volt relay connected to pin 8 of the Arduino Uno is activated, thereby turning off the battery's power. A fire sensor is connected to the Arduino Uno; if there is a fire, the sensor will detect it and cut off the battery's electricity.

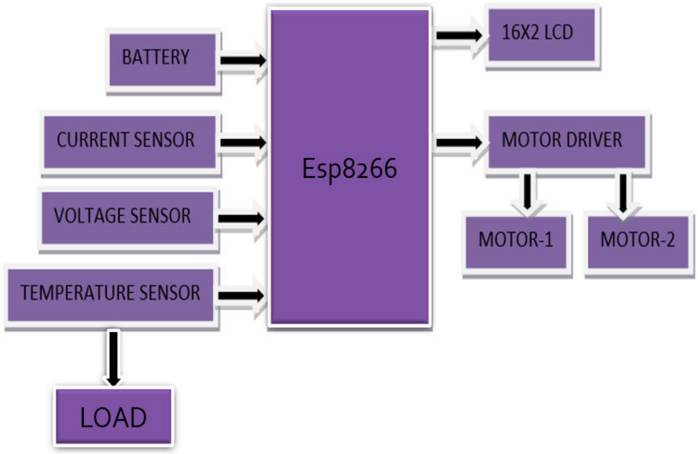

Figure:1 BLOCK DIAGRAM OF EV BMS WITH CHARGE MONITOR & FIRE PROTECTION

B. COMPONENTS

(i) ARDUNIO UNO

The Arduino Uno is a versatile and easy-to-use platform for creating a wide range of projects, from simple blinking LED experiments to more complex robotics and IoT applications. Its extensive community support and vast array of libraries and tutorials make it an excellent choice for both beginners and experienced hobbyists.

(ii) LI-ION BATTERY

A lithium-ion (Li-ion) battery is a type of rechargeable battery that uses lithium ions as the primary component of its electrochemistry. Li-ion batteries are widely used in portable electronic devices, electric vehicles (EVs), and energy storage systems due to their high energy density, relatively low self-discharge rate, and lightweight nature compared to other rechargeable battery chemistries.

(iii) MOTOR DRIVE

A motor drive is a device or circuitry that controls the speed, direction, and torque of an electric motor. The controller interprets signals from a microcontroller, sensors, or other inputs, and adjusts the power stage to regulate the motor's operation.

(iv) DC MOTOR

It operates using the principle of electromagnetism, where the interaction between magnetic fields and electric currents generates rotational motion. DC motors are widely used in various applications due to their simplicity, controllability, and reliability.

| ISSN: 2394-2975 | www.ijarety.in| | Impact Factor: 7.394| A Bi-Monthly, Double-Blind Peer Reviewed & Referred Journal |

IJARETY

|| Volume 11, Issue 2, March 2024 ||

DOI:10.15680/IJARETY.2024.1102021

(v) BLUETOOTH HC-05

The HC-05 is a commonly used Bluetooth module that enables wireless communication between electronic devices over short distances. It is particularly popular among hobbyists, makers, and electronics enthusiasts due to its ease of use and versatility.

(vi) IR SENSOR

Infrared (IR) sensors are devices that detect infrared radiation (IR) emitted or reflected by objects in their vicinity. They are commonly used in various applications for object detection, proximity sensing, motion detection, and remote control systems.

(vii) LCD DISPLAY

LCD (Liquid Crystal Display) screens are commonly used in Electric Vehicles (EVs) for providing essential information to the driver and passengers, displaying data related to vehicle status, navigation, entertainment, and more.

(viii) CURRENT SENSOR

A current sensor is a device used to measure the flow of electric current in a circuit or system. It provides valuable information about the amount of current passing through a conductor, allowing for monitoring, control, and protection in various applications.

(ix) VOLTAGE SENSOR

A voltage sensor is a device used to measure the voltage (electrical potential difference) between two points in an electrical circuit or system. Voltage sensors provide valuable information about the voltage levels present in a circuit, allowing for monitoring, control, and protection in various applications.

(x) RELAY MODULE

A relay module is an electromechanical device used for switching electrical circuits on or off based on a control signal. It consists of a relay, which is a type of switch operated by an electromagnet, and additional circuitry to interface the relay with external devices.

III. PROJECT MODEL

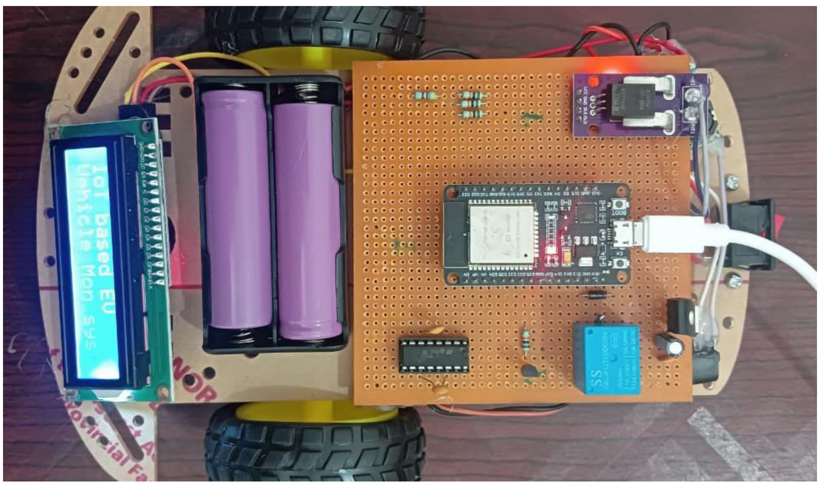

Figure 2: Hardware Kit of EV Vehicle Battery Monitoring And Protection System

| ISSN: 2394-2975 | www.ijarety.in| | Impact Factor: 7.394| A Bi-Monthly, Double-Blind Peer Reviewed & Referred Journal |

|| Volume 11, Issue 2, March 2024 ||

DOI:10.15680/IJARETY.2024.1102021

When the system is turned on, the user can safely charge the 3S battery by using its charging and monitoring circuits. Voltage sensors are used during battery charging to monitor voltage and control current flow to the battery through the use of charging circuitry. Additionally, the battery's current voltage level is shown on the LCD display.

IV. CODE

```
#define BLYNK_TEMPLATE_ID "TMPLR7op9aiv"

#define BLYNK_TEMPLATE_NAME "TEST3"

//#define BLYNK_AUTH_TOKEN "aPJtDS5GUC-mM3APhA8T6Qf89GhTIzac"

#define BLYNK_PRINT Serial

#include <Arduino.h>

#include <WiFi.h>

#include <WiFiClient.h>

#include <PubSubClient.h>

#include <BlynkSimpleEsp32.h>

#include <Wire.h>

#include <LiquidCrystal_I2C.h>

#include "ThingSpeak.h"

#include <Wire.h>

#include <LiquidCrystal_I2C.h>

#define r1 19

#define r2 18

#define r3 5

#define r4 17

#define relay 23

LiquidCrystal_I2C lcd(0x27, 16, 2);

WiFiClient  client;

unsigned long myChannelNumber = 2482243;

const char * myWriteAPIKey = "5ZVS6HWQ36N48SBB";

BlynkTimer timer;
```

| ISSN: 2394-2975 | www.ijarety.in| | Impact Factor: 7.394| A Bi-Monthly, Double-Blind Peer Reviewed & Referred Journal |

|| Volume 11, Issue 2, March 2024 ||

DOI:10.15680/IJARETY.2024.1102021

```
char auth[] = "aPJtDS5GUC-mM3APhA8T6Qf89GhTIzac";
char ssid[] = "HAVASYA";
char pass[] = "Havasya_9";
BLYNK_WRITE(V0) {
  int button = param.asInt();
  if(button==1){
    digitalWrite(r1,HIGH);
    digitalWrite(r2,LOW);
    digitalWrite(r3,HIGH);
    digitalWrite(r4,LOW);
  }
  else
  {
   digitalWrite(r1,LOW)
   digitalWrite(r2,LOW);
   digitalWrite(r3,LOW);
   digitalWrite(r4,LOW);
    }
}
BLYNK_WRITE(V1) {
  int button = param.asInt();
  if(button==1){
   digitalWrite(r1,LOW);
   digitalWrite(r2,HIGH);
   digitalWrite(r3,LOW);
   digitalWrite(r4,HIGH);
  }
```

| ISSN: 2394-2975 | www.ijarety.in| | Impact Factor: 7.394| A Bi-Monthly, Double-Blind Peer Reviewed & Referred Journal |

|| Volume 11, Issue 2, March 2024 ||

DOI:10.15680/IJARETY.2024.1102021

```
 else
 {
 digitalWrite(r1,LOW);
 digitalWrite(r2,LOW);
 digitalWrite(r3,LOW);
 digitalWrite(r4,LOW);
 }
}
BLYNK_WRITE(V2) {
 int button = param.asInt();
 if(button==1){
   digitalWrite(r1,HIGH);
   digitalWrite(r2,LOW);
   digitalWrite(r3,LOW);
   digitalWrite(r4,HIGH);
 }
 else
 {
   digitalWrite(r1,LOW);
   digitalWrite(r2,LOW);
   digitalWrite(r3,LOW);
   digitalWrite(r4,LOW);
   }
}
BLYNK_WRITE(V3) {
 int button = param.asInt();
 if(button==1){
```

| ISSN: 2394-2975 | www.ijarety.in| | Impact Factor: 7.394| A Bi-Monthly, Double-Blind Peer Reviewed & Referred Journal |

|| Volume 11, Issue 2, March 2024 ||

DOI:10.15680/IJARETY.2024.1102021

```
  digitalWrite(r1,LOW);
  digitalWrite(r2,HIGH);
  digitalWrite(r3,HIGH);
  digitalWrite(r4,LOW);
 }
 else
 {
  digitalWrite(r1,LOW);
  digitalWrite(r2,LOW);
  digitalWrite(r3,LOW);
  digitalWrite(r4,LOW);
 }
}
void updateThingSpeak()
{
   ThingSpeak.setField(1, random(0,100));
   ThingSpeak.setField(2, random(10,100));
   ThingSpeak.writeFields(myChannelNumber, myWriteAPIKey);
}
void initWiFi() {
 WiFi.mode(WIFI_STA);
 WiFi.begin(ssid, pass);
  while (WiFi.status() != WL_CONNECTED) {
  Serial.print('.');
  delay(100);
 }
 }
```

| ISSN: 2394-2975 | www.ijarety.in| | Impact Factor: 7.394| A Bi-Monthly, Double-Blind Peer Reviewed & Referred Journal |

|| Volume 11, Issue 2, March 2024 ||

DOI:10.15680/IJARETY.2024.1102021

```
/* void SensorReading()
{
  gas = map(analogRead(gasSensor),0,4096,100,0);
  if(gas>90){digitalWrite(fan,HIGH);digitalWrite(buzzer,HIGH);}
  else{digitalWrite(fan,LOW);digitalWrite(buzzer,LOW);}
  lcd.clear();
  lcd.print("T:");
  lcd.setCursor(2,0);
  lcd.print(temp);
  lcd.setCursor(0,1);
  lcd.print("H:");
  lcd.setCursor(2,1);
  lcd.print(hum);
  lcd.setCursor(8,0);
  lcd.print("GAS:");
  lcd.setCursor(12,0);
  lcd.print(gas);
}*/
void setup()
{
 Serial.begin(115200);
 pinMode(r1,OUTPUT);
 pinMode(r2,OUTPUT);
 pinMode(r3,OUTPUT);
 pinMode(r4,OUTPUT);
 pinMode(relay,OUTPUT);
 digitalWrite(r1,LOW);
```

| ISSN: 2394-2975 | www.ijarety.in| | Impact Factor: 7.394| A Bi-Monthly, Double-Blind Peer Reviewed & Referred Journal |

|| Volume 11, Issue 2, March 2024 ||

DOI:10.15680/IJARETY.2024.1102021

```
 digitalWrite(r2,LOW);
 digitalWrite(r3,LOW);
 digitalWrite(r4,LOW);
 digitalWrite(relay,LOW);
 lcd.begin();
 lcd.backlight();
 lcd.print("Connecting Wi-Fi");
 initWiFi();
 Blynk.begin(auth, ssid, pass);
 delay(1000);
 lcd.clear();
 lcd.print("Wi-Fi Connected");
 delay(1000);
 lcd.clear();
 lcd.print("IoT based Gas");
 lcd.setCursor(0,1);
 lcd.print("Monitoring Systm");
 delay(1000);
 ThingSpeak.begin(client);
// timer.setInterval(2000L, SensorReading);
 //timer.setInterval(20000L,updateThingSpeak);
}
void loop()
{
 Blynk.run();
 //timer.run();
}
```

| ISSN: 2394-2975 | www.ijarety.in| | Impact Factor: 7.394| A Bi-Monthly, Double-Blind Peer Reviewed & Referred Journal |

|| Volume 11, Issue 2, March 2024 ||

DOI:10.15680/IJARETY.2024.1102021

V. RESULT

The usage of EV BMS with charge monitor and fire prevention has greatly increased the safety and efficiency of electric vehicles. First and foremost, the battery monitoring and cell balancing capabilities have ensured that the battery pack operates within safe bounds and that every cell is charged and discharged evenly, preventing individual cell overcharging or undercharging. The performance and longevity of the battery pack have consequently significantly improved, enabling the electric car to travel longer between charges.

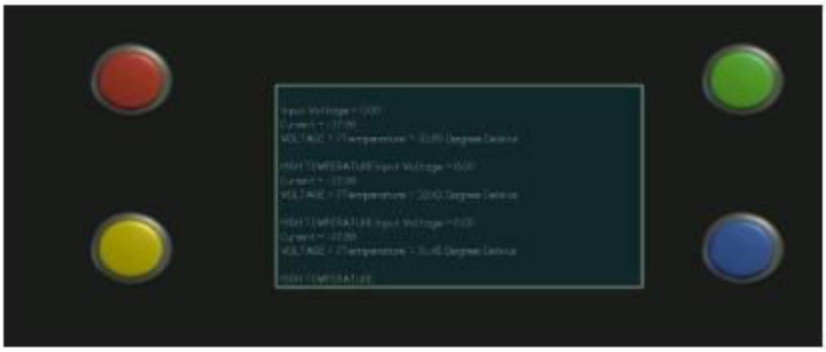

Figure: 3 High Temperature is detected

Thirdly, the temperature control mechanism keeps the battery pack operating within a safe temperature range, avoiding overheating, which could damage the battery and reduce its lifespan. Additionally, this feature ensures that the cooling system runs well, which reduces energy consumption and increases the efficiency of the electric car.

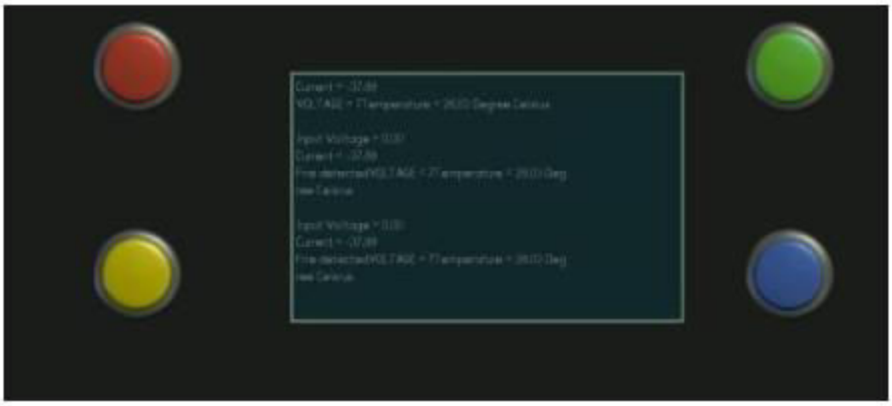

Figure: 4 Flame is detected

VI. CONCLUSION

In conclusion, the EV BMS with charge monitor and fire prevention is a crucial component of electric vehicles that ensures the safety, dependability, and longevity of the battery pack. Through the provision of essential safety features including as temperature management, defect detection, cell balancing, and fire prevention, the system reduces the likelihood of battery fires and improves the vehicle's overall efficiency. Further research and development can be conducted to enhance the features and capabilities of the EV BMS with charge monitor and fire protection. Improving the accuracy and dependability of battery monitoring systems to provide more precise and timely data regarding the charge, health, and function of the battery pack is one possible topic of future work.

| ISSN: 2394-2975 | www.ijarety.in| | Impact Factor: 7.394| A Bi-Monthly, Double-Blind Peer Reviewed & Referred Journal |

|| Volume 11, Issue 2, March 2024 ||

DOI:10.15680/IJARETY.2024.1102021

REFERENCES

1. Y. Liu, X. Qian, and H. Guan, "Development of electric vehicle battery management system with charge balance control," IEEE Transactions on Power Electronics, vol. 28, no. 6, pp. 2901-2908, Jun. 2013.
2. D. Chao, C. Shen, and K. S. Low, "Real-time state-of-charge estimation for electric vehicle batteries using a coupled electrochemical-thermal model," Journal of Power Sources, vol. 329, pp. 261-268, Jan. 2017.
3. J. Li, J. Fan, and J. Li, "A novel active cell balancing scheme for series-connected battery packs of electric vehicles," IEEE Transactions on Vehicular Technology, vol. 68, no. 5, pp. 4138-4148, May 2019.
4. D. Wang, Z. Xu, and L. Xu, "An integrated thermal management system for lithium-ion battery pack in electric vehicles," Journal of Power Sources, vol. 329, pp. 337-348, Jan. 2017.
5. H. Guo, M. H. Ang, and Y. Cheng, "Development of a fire detection system for lithium-ion battery in electric vehicles," Journal of Power Sources, vol. 325, pp. 405-412, Nov. 2016.
6. W. Cheng, X. Luo, and B. Yang, "Online fault diagnosis for lithium-ion batteries in electric vehicles using neural network ensemble," IEEE Transactions on Industrial Informatics, vol. 14, no. 4, pp. 1735-1744, Apr. 2018.
7. Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, "Electron spectroscopy studies on magneto-optical media and plastic substrate interfaces(Translation Journals style)," *IEEE Transl. J. Magn.Jpn.*, vol. 2, Aug. 1987, pp. 740–741 [*Dig. 9th Annu. Conf. Magnetics* Japan, 1982, p. 301].
8. M. Young, *The Techincal Writers Handbook.* Mill Valley, CA: University Science, 1989.
9. J. Jones. (1991, May 10). Networks (2nd ed.) [Online]. Available: http://www.atm.com

IJARETY

INNO SPACE
SJIF Scientific Journal Impact Factor

doi crossref

निस्केयर
NISCAIR

International Journal of Advanced Research in Education and Technology

ISSN: 2394-2975 Impact Factor: 7.394

www.ijarety.in editor.ijarety@gmail.com