

EV BMS With Charge Monitor and Fire Protection

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Abstract—The rapid growth of Electric Vehicles (EVs) has increased the demand for efficient energy storage systems and advanced battery safety technologies. Lithium-ion batteries are widely used in EV applications because of their high energy density, lightweight structure, and long cycle life. However, these batteries are highly sensitive to operating conditions such as overcharging, deep discharge, overheating, overcurrent, and short circuits. Improper battery management may lead to reduced battery efficiency, permanent damage, thermal runaway, or even fire accidents. Therefore, a reliable Battery Management System (BMS) is essential for ensuring safe and efficient battery operation in EVs. This project presents the design and implementation of an Electric Vehicle Battery Management System (EV BMS) with Charge Monitoring and Fire Protection. The proposed system is developed to continuously monitor battery parameters, maintain battery safety, and provide automatic protection during abnormal operating conditions. The system mainly focuses on battery voltage monitoring, current sensing, temperature monitoring, charge status indication, and fire hazard prevention.

Index Terms— Arduino UNO, Li-ion Battery, Charge Monitor and Fire Protection

I. INTRODUCTION

Electric vehicles surely are the future of transportation, but ev technology has not been fully developed with respect to efficiency and safety as of 2022. We come across electric vehicle battery fire and similar incidents as the EV market expands. Most electric vehicle fire incidents occur due to battery blast or fire. So here we attempt to solve the problem by using some sensors and battery pack-based system powered by an STM32 controller. The system is designed to protect batteries from various parameters that may incite a fire.

The system is designed to constantly monitor battery voltage current temperature and instantly cut off the

input or output from battery as soon as any unusual behavior is detected.

This System provides the following advantages:

- Battery Status Monitoring and Display
- Charging of Battery as per required input parameters
- Temperature monitoring with auto cutoff

The system makes use of a li ion Battery, Battery charging and monitor system, Push Buttons, LCD Display, current sensor, voltage sensor, temperature sensor to develop this system. The system monitors as well as protects an EV battery at all times.

We here develop the system as per a 3S li ion battery. The system we design will not only monitor the battery and charge it safely but also protect it to avoid accidents from occurring. The system when turned on uses its charging and monitoring circuitry that allows user to safely charge the 3S battery.

While charging the voltage sensor is used to check voltage and limit the flow of current too to the battery using charging circuitry. The LCD display also displays the current voltage level of battery. As soon as the battery is fully charged, the system cuts off the supply and displays Battery fully charged on LCD Display.

When connected to a load the current sensor keeps track of current drawn from battery and displays the parameter on LCD Display. The temperature sensor is used to monitor temperature of battery while charging as well as discharging.

If the battery temperature is observed to deviate from standard values, the system automatically cuts off input as well as output supply and displays the temperature as well as a buzzer alert on the LCD display. Thus, the system allows for a smart and efficient battery charging as well as protection system Therefore, the EV BMS with charge monitoring and fire protection system enhances battery safety,

improves charging efficiency, increases battery lifespan, and provides reliable operation of electric vehicles.

II. LITERATURE SURVEY

[1] “Using Li-ion Battery”, International Journal of Engineering Trends & Technology (IJETT), Volume 4, Issued 7-July 2013. The project main goal was to reduces the EV vehicle Charging related problems and Fire Protection.

[2] Battery Management System (BMS)- Researchers have explained that the Battery Management System is one of the most important components in electric vehicles. According to various studies, the BMS monitors battery voltage, current, temperature, and State of Charge (SOC) to ensure safe operation of lithium-ion batteries. Proper battery monitoring helps improve battery lifespan and efficiency.

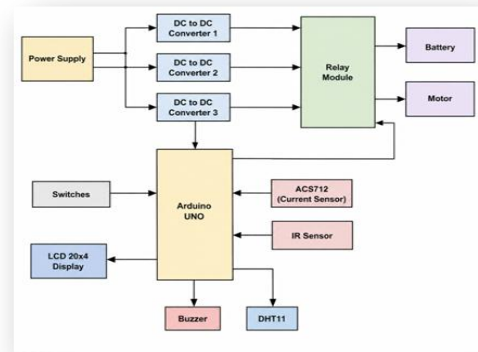
Charge Monitoring Techniques- Many studies focused on charge monitoring systems for EV batteries. Researchers developed systems that display:

- Battery percentage
- Charging status
- Voltage and current values
- Remaining battery backup

III. OBJECTIVE

1. To monitor battery parameters such as voltage, current, temperature, and State of Charge (SOC) in real time.
2. To develop a charge monitoring system that displays battery charge level, charging status, and battery health information.
3. To protect the battery from unsafe conditions such as:
 - Overcharging
 - Deep discharge
 - Overcurrent
 - Short circuit
4. To implement temperature monitoring for detecting overheating conditions in the battery pack.
5. To provide fire protection mechanisms by activating alarms, cooling systems, or automatic battery disconnection during abnormal temperature rise.

IV.METHODOLOGY



Block Diagram

Arduino UNO: Arduino Uno is an open-source microcontroller board based on the ATmega328P microcontroller. It is widely used in electronics and embedded system projects for controlling sensors, motors, LEDs, and other devices. The board can be programmed using the Arduino IDE through a USB cable.

Temperature Sensor: A temperature sensor is an electronic device used to measure temperature and convert it into an electrical signal. It is widely used in industrial systems, medical devices, automobiles, and embedded projects such as Battery Management Systems (BMS). Temperature sensors help monitor overheating and maintain safe operating conditions in electronic equipment and batteries.

Voltage Sensor: A voltage sensor is an important component in a Battery Management system (BMS). It is used to measure the voltage of individual battery cells or the entire battery pack. The sensor sends voltage data to the microcontroller, such as an STM 32 controller, for monitoring and protection.

Current Sensor: A current sensor is an important device used in a Battery Management System (BMS) To measure the charging and discharging current of a battery.

LCD Display: An LCD (Liquid Crystal Display) is an electronic display device used to show text, numbers, and graphics. It works by using liquid crystals that control light passing through the display panel. LCDs

are widely used in electronic devices because they consume less power and provide clear visibility.

Li-ion Battery (12V/7A): A Lithium-ion (Li-ion) battery is a rechargeable battery widely used in electronic devices and electric vehicles due to its high energy density, lightweight design, and long-life cycle. It stores and supplies electrical energy through the movement of lithium ions between the positive and negative electrodes.

Switches: A switch is an electrical or electronic device used to open or close an electrical circuit. It controls the flow of electric current by turning a device ON or OFF. Switches are important components in electrical and electronic systems.

LED's: An LED (Light Emitting Diode) is a semiconductor electronic device that emits light when electric current passes through it. LEDs are widely used in electronic circuits for indication, lighting, and display purposes because they consume very little power and have a long operating life.

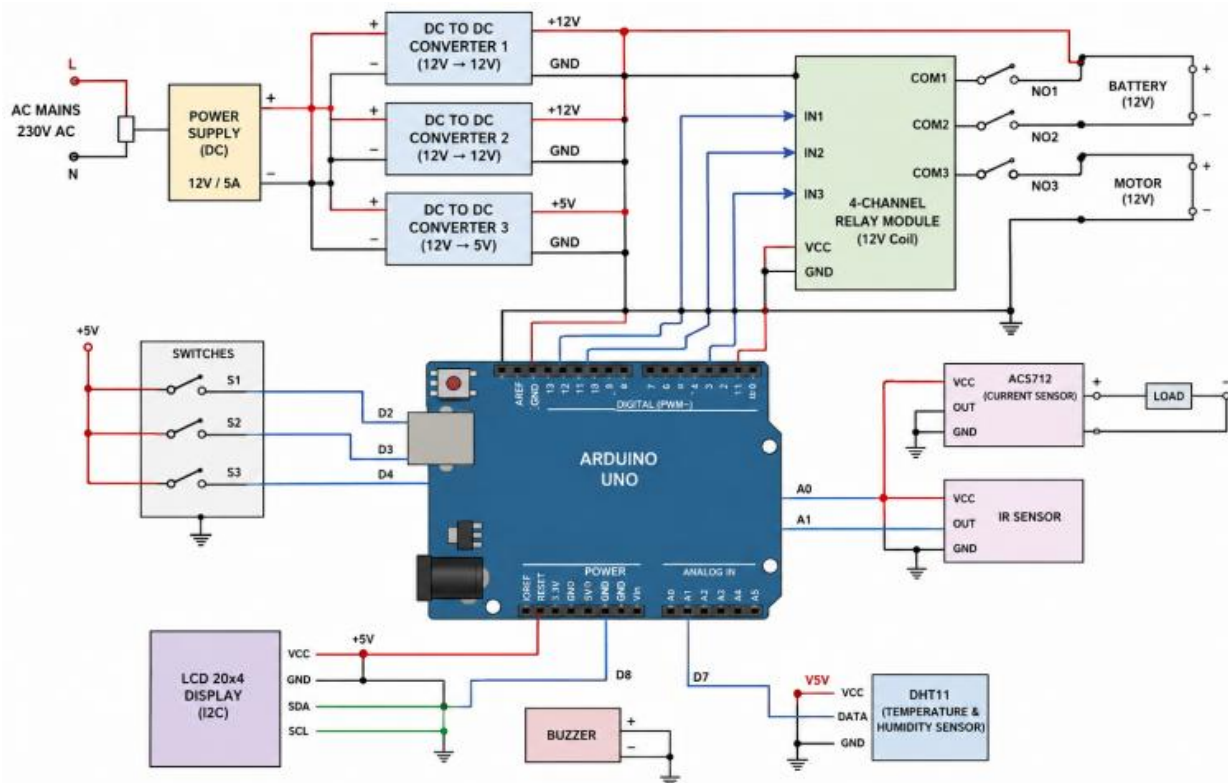
PCB Board: A PCB (Printed Circuit Board) is a board used to mechanically support and electrically connect electronic components using conductive copper tracks and pathways. It is the basic platform for assembling electronic circuits in electronic devices and systems.

Resistors: A resistor is a passive electronic component used to limit or control the flow of electric current in an electrical circuit. It provides resistance to the current and helps protect electronic components from excessive current flow.

Capacitors: A capacitor is a passive electronic component used to store electrical energy in the form of an electric field. It consists of two conductive plates separated by an insulating material called a dielectric.

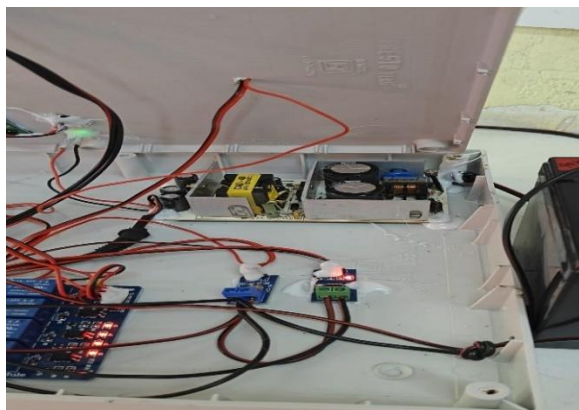
Transistors: A transistor is a semiconductor electronic device used for switching and amplification of electrical signals. It is one of the most important components in modern electronic circuits and systems.

V.CIRCUIT DIAGRAM



Circuit Diagram

VI. RESULT AND MODEL



The developed EV Battery Management System (BMS) with Charge Monitoring and Fire Protection was successfully designed and tested. The system continuously monitored important battery parameters such as voltage, current, temperature, and charging status in real time. The charge monitoring unit accurately displayed battery condition and charging information using sensors and an LCD display. The system effectively prevented overcharging, over-discharging, and abnormal current conditions, which improved battery performance and lifespan. The fire protection system successfully detected overheating and unsafe conditions using temperature and smoke sensors. During abnormal conditions, the system activated alarms and disconnected the battery supply to reduce the risk of fire and battery damage.

VII. CONCLUSION

The EV Battery Management System (BMS) with Charge Monitoring and Fire Protection project was successfully designed and implemented to improve the safety, efficiency, and reliability of electric vehicle battery systems. The system continuously monitored important battery parameters such as voltage, current, temperature, and charging status using various sensors and a microcontroller. The charge monitoring feature helped in maintaining proper charging and discharging conditions, which improved battery performance and increased battery life. The fire protection system effectively detected overheating and abnormal conditions and activated safety measures such as alarms and battery disconnection to prevent fire hazards and battery damage.

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