EV BMS WITH CHARGE MONITOR AND FIRE PROTECTION

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ABSTRACT:

As our energy needs grow, we face challenges in ensuring continuous power supply everywhere. Energy storage devices become crucial for storing energy and using it in areas where the supply is unreliable. To keep stored energy safe and easy to use, we rely on battery management systems (BMS). These systems monitor energy storage, protect against issues like overload and overheating, and simplify charging and discharging.
Lithium-ion batteries dominate 90% of the battery market due to their efficiency and versatility. However, they pose risks of explosion if they overheat or experience faults. To safeguard against such accidents and extend battery life, BMS plays a vital role in monitoring conditions like charging, discharging, and preventing overcharging.

Key Words: Energy Consumption, Battery, Temperature sensor, State of Charge Etc.

1. INTRODUCTION

Electric vehicles (EVs) use electric motors powered by battery packs instead of traditional internal combustion engines (ICEs). This shift offers numerous advantages, including reduced emissions, quieter operation, and decreased reliance on fossil fuels. EVs also tend to have lower operational costs due to the efficiency of electric motors and the lower cost of electricity compared to gasoline.
A battery management system (BMS) is a device that controls and monitors rechargeable batteries, such as those used in renewable energy systems and electric cars. By regulating charging and discharging, monitoring battery health and state of charge, and protecting against damage from overcharging or overheating, BMS ensures the safe and efficient operation of batteries.

2. LITERATURE REVIEW

2.1 EXISTING SYSTEMS:

Vehicles that emit harmful compounds like organic compounds, nitrogen oxide, and carbon monoxide contribute significantly to air pollution. As the world population grows rapidly, vehicle usage also increases. However, fossil fuels, the main energy source for these vehicles, are running out. Estimates suggest that petroleum and natural gas reserves will be depleted by 2042.
Electric vehicles (EVs) have a long history, dating back to the late 1800s with the invention of lead-acid batteries and electric motors. They were quite popular in the early 1900s, known as the golden period of electric vehicles. However, the advent of gasoline-powered vehicles led to the decline of electric vehicles due to limitations such as range, charging time, weight, and battery durability issues.
In response to gas emission regulations and air pollution concerns, automobile manufacturers are now increasingly producing low-carbon emission vehicles, leading to a resurgence in electric vehicle manufacturing. EVs offer numerous advantages, including low noise and zero emissions, making them ideal for urban environments where compactness and efficiency are valued.
Electric vehicles operate similarly to internal combustion vehicles, with components like electric motors, batteries, battery management systems, chargers, and cooling/heating systems. There are two main types of electric motors used: AC motors and DC motors. DC motors are easier to control and less expensive, although they are larger and heavier than AC motors. Electric vehicles also feature regenerative braking, allowing them to generate electricity from kinetic energy, which can be stored for later use. Sales of electric vehicles are rapidly increasing, indicating a growing demand for cleaner transportation options. With this surge in demand, more research and development are needed to further advance EV technology.

3. Design Overview

A Battery Management System (BMS) is crucial for monitoring and managing the performance of rechargeable batteries. While there are many ways to design a BMS, here's a basic list of components you might need if you're considering using Arduino for your BMS project:

1. **Arduino Board:** This is the heart of your BMS. Arduino Uno or Arduino Mega are common choices due to their simplicity and availability of resources.
2. **Voltage Measurement Circuit:**
   You'll need circuits to measure the voltage of each cell in the battery pack. This typically involves voltage dividers or specialized ICs like the Analog Devices AD7416.
3. **Current Measurement Circuit:** Monitoring the current flowing in and out of the battery is essential for managing its state of charge. You can use a current sensor like the ACS712 for this purpose.
4. **Temperature Sensors:** Temperature monitoring helps prevent overheating and ensures safe operation. DS18B20 temperature sensors are commonly used with Arduino for temperature measurement.
5. **Relays:** These components are used to control charging and discharging of the battery, providing safety features like overcharge and over-discharge protection.
6. **Display Module:** An LCD display can be used to show battery parameters such as voltage, current, and temperature, as well as system status.
7. **Power Supply:** Ensure you have a stable power supply to power the Arduino and other components. This could be from a USB connection, a battery, or a separate power supply unit.
8. **Protection Circuitry:** It's crucial to include protection circuitry like fuses and reverse polarity protection to safeguard your BMS and the battery pack.
9. **Lithium ion battery:** The rechargeable lithium-ion battery is made of one or more power-generating compartments called cells. Each cell has essentially three components. - positive electrode, negative electrode and electrolyte. A **positive electrode** connects to the battery's positive or + terminal. A **negative electrode** connects to the negative or − terminal. And a chemical called an **electrolyte** in between them.
10. **DC Adapter:** DC power supplies are power supplies which produce an output DC voltage. Power supplies are devices that deliver electric power to one or several loads. They generate the output power by converting an input signal into an output signal (in this case, a DC output)
11. **Programming Cable and Software:** Don't forget the USB cable for programming your Arduino, and you'll need the Arduino IDE for writing and uploading code.

4. Circuit Diagram

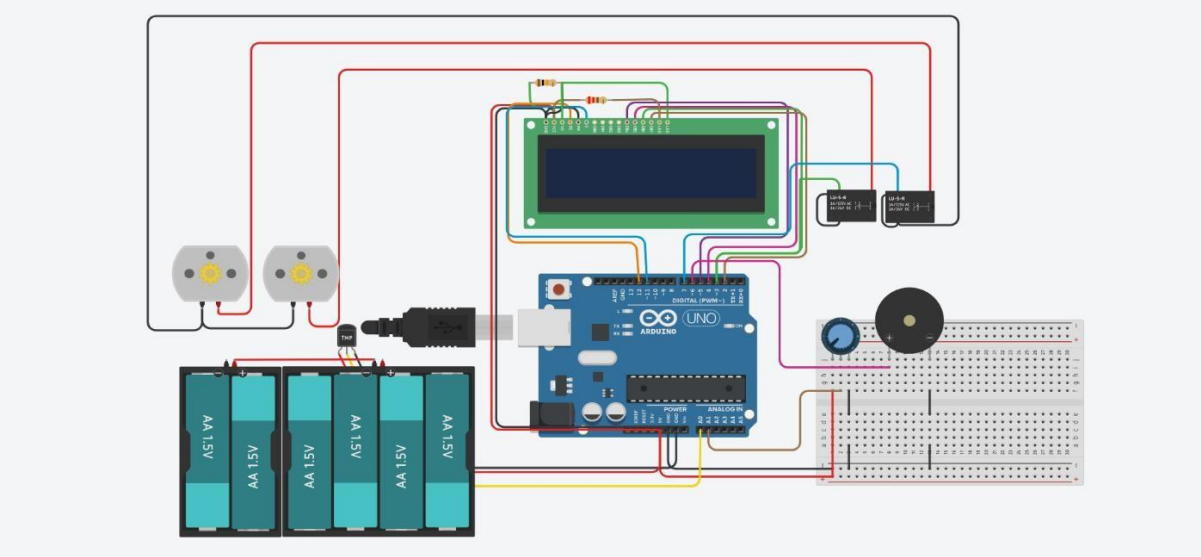

Fig -1: Battery Management System

5. Working

In this system, the Arduino serves as the central control unit. Two relays are employed to manage the charging supply of the battery, serving as protection and overcharging prevention mechanisms. Various components such as relays, Arduino, battery modules, and sensors are utilized.

Initially, the system checks the voltage and temperature of each battery in the battery pack. If any battery's voltage is low, a relay connected to that battery is activated. A DHT11 temperature sensor is utilized to monitor the battery temperature, ensuring it remains within a safe range. If the battery temperature rises excessively, the BMS may adjust the charging rate or even halt charging altogether to prevent damage. Additionally, a fan may be employed to cool down the battery if necessary.

To safeguard the battery, a BMS typically protects against various potential hazards, including

I. **Optimizing Battery Energy usage:** The BMS ensures that the battery's energy is used efficiently to power the intended device or system.

II. **Minimizing Battery Damage Risk:** It works to minimize the risk of damaging the battery, thus prolonging its lifespan and maintaining its performance.
III. **Monitoring and controlling charge/discharging:** The BMS oversees the charging and discharging processes of the battery, ensuring they occur within safe parameters.

A Battery Management System (BMS) has several key functions, regardless of its specific application:

I. **Over-Current**: Preventing excessive current flow that could damage the battery or connected components.
II. **Over- Voltage:** Ensuring that the battery voltage does not exceed safe levels, which could lead to overheating or other issues.
III. **Under-Voltage:** Monitoring and preventing the battery voltage from dropping below a safe threshold, which could damage the battery or result in insufficient power delivery.
IV. **Over-Temperature:** Monitoring and controlling the battery temperature to prevent overheating, which can degrade battery performance and lead to safety hazards.

Overall, a BMS plays a critical role in ensuring the safe and effective operation of rechargeable battery systems, contributing to their longevity and reliability.

6. ADVANTAGES:

- It boosts battery performance.
- It extends the battery's lifespan.
- It manages charging, discharging, and temperature within safe ranges.

7. APPLICATION:

- Electric Vehicles (EVs)
- Portable Electronics
- Renewable Energy Systems
- Uninterruptible Power Supplies (UPS)

8. FUTURE SCOPE:

- Integration of Advanced Energy Storage Systems
- Improved Efficiency and Performance
- Focus on Safety and Reliability
- Aim to reduce performance degradation and potential hazards.

9. CONCLUSION:

In conclusion, EV BMS projects aim to ensure the safety, durability, and effectiveness of EV batteries, improving the overall driving experience. Through sophisticated monitoring, control algorithms, and safety measures, EV BMS projects mitigate risks like overcharging, over-discharging, and thermal issues.

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