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SPLIT BATTERY MANAGEMENT SYSTEM BY USING IOT

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Abstract: **An Electric Vehicle Battery Management System (BMS) is used to monitor and control the charging and discharging of rechargeable batteries. It helps improve battery safety, reliability, efficiency, and lifetime. The system continuously monitors battery parameters such as voltage, current, and temperature using analog and digital sensors with microcontrollers. BMS also evaluates important battery conditions like State of Charge (SOC), State of Health (SOH), and State of Life (SOL). These monitoring methods protect the battery from damage and improve overall vehicle performance. The proposed system is mainly designed for Hybrid Electric Vehicles (HEV). It supports proper battery operation by controlling charging and discharging rates. The battery capacity in electric vehicles generally ranges from 30 kWh to 100 kWh or more. The developed monitoring system provides accurate battery condition analysis and efficient energy management. Thus, the BMS increases battery life and ensures safe vehicle operation.**

I. INTRODUCTION

Hybrid Electric Vehicles (HEV) are important because they reduce harmful gas emissions and use energy efficiently. These vehicles use many battery cells, so an effective Battery Management System (BMS) is required. The battery should provide both long-lasting energy and high power output. Commonly used traction batteries are Lead-acid, Lithium-ion, and Metal Hydride batteries. Among them, Lithium-ion batteries are widely used due to their better performance and advantages. The battery capacity of electric vehicles generally ranges from 30 kWh to 100 kWh or more. The BMS monitors charging and discharging rates, voltage, current, temperature, State of Charge (SOC), and State of Health (SOH). In this project, a monitoring system for battery-powered HEVs is designed using analog and digital sensors with microcontrollers. The system also monitors battery temperature for safety. An Android application is developed to continuously monitor battery parameters and improve the overall performance and safety of the electric vehicle.

II. PROPOSED SYSTEM

In the Existing Project, the charging rate and discharging rate of batteries are calculated by using coulomb counting. BMS is also equipped with temperature sensor to determine if the battery has reached over heating state.

So, the battery can be monitoring and protected from over charging (or) over discharge and also over heating condition. Fuzzy logic is a compact representation of Human knowledge, it used to consider an air temperature measuring sensor.

The microcontroller processes the sensed data and makes decisions based on predefined conditions. It controls the relay module to switch between two batteries. If one battery's voltage drops below a threshold or certain conditions are met, the system automatically switches to the other battery to maintain uninterrupted power supply to the load.

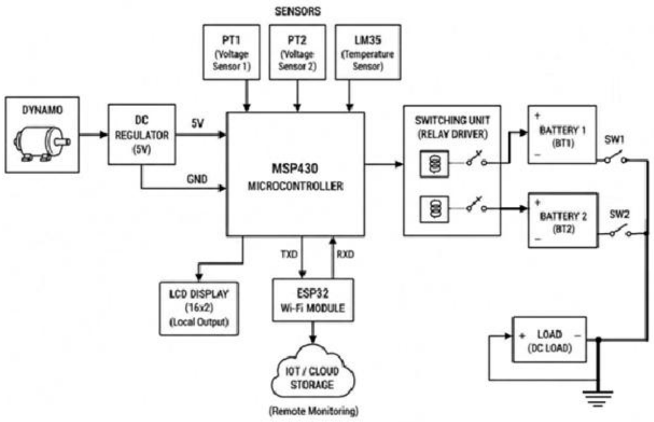

Fig.1.Proposed System Block Diagram

ADVANTAGES OF PROPOSED SYSTEM

- Automatic monitoring through IoT sensors,
- Remote monitoring via Internet / mobile app
- Provides real-time data on voltage, current, and temperature
- Early fault detection through continuous IoT monitoring
- Sends alerts or notifications via IoT when abnormal conditions occur
- Easy monitoring and maintenance of multiple batteries remotely
- IoT system stores and analyzes data for performance tracking
- Improved safety, reliability, and efficiency with IoT integration

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- Uses Wi-Fi/Bluetooth for wireless data transfer

III. HARDWARE REQUIREMENTS

THE MAIN COMPONENTS OF THIS SYSTEM ARE,

1) Dynamo
2) DC Regulator
3) Battery
4) MSP430 CONTROLLER
5) ESP32 WIFI Module
6) Potential Transformer
7) LM35
8) Relay
9) LCD Display

DYNAMO

Dynamo is a device that converts mechanical energy into electrical energy. It is an electrical generator that creates direct current using a commutator. The function of the dynamo is to change mechanical energy into electricity.

The control gear associated with the dynamo regulates the current output according to the demands on the electric system and the state of the battery. In vehicles, boats, and off-grid power setups.

Fig.2. Dynamo

It acts as a DC generator that converts mechanical energy from the engine into electrical energy used to charge the batteries.

In a split battery configuration, there are usually two batteries a **starter battery**, which provides power for engine ignition, and an **auxiliary battery**, which runs accessories or auxiliary loads.

The dynamo supplies current to both batteries through a **split charging system,** typically managed by a **voltage-sensitive relay** or a **battery isolator**. When the engine is running and the starter battery reaches a preset voltage, the relay connects the auxiliary battery, allowing it to charge simultaneously.

This system ensures efficient energy distribution and reliable operation of both batteries, maintaining power availability for both starting and auxiliary functions.

DC REGULATOR

A DC regulator in a BMS is typically a power supply module that regulates the direct current (DC) voltage provided by the battery to meet the required operating voltage for various parts of the system.

1. **Buck Converter**: This type of DC regulator reduces the voltage from the battery to a lower voltage level required for other components.
2. **Boost Converter**: If the battery voltage is too low, a boost converter can step up the voltage to meet the system's needs.
3. **Load Balancing**: The DC regulator can help balance the load between different segments of the split battery, ensuring that power is distributed efficiently.

The DC regulators in the split BMS ensure each segment's energy supply is managed independently, while still contributing to the total system performance.

BATTERY

These are the devices that store energy and then discharge it by converting chemical energy into electricity. Lithium-ion batteries have higher energy densities than lead-acid batteries or nickel-metal hydride batteries, so it is possible to make the battery size smaller than others while retaining the same storage capacity.

Nissan's Lithium-ion battery technology uses materials which allow a higher density of lithium ions to be stored. This results in an increase in travel distance.

MSP430 CONTROLLER

The MSP430 microcontroller, developed by Texas Instruments, is a powerful and energy-efficient 16-bit RISC-based device designed for low-power and portable applications. It operates at low voltages (typically 1.8V to 3.6V) and offers multiple low-power modes, making it ideal for battery-operated systems.

Fig.3.MSP430 CONTROLLER

The MSP430 includes essential peripherals such as analog-to-digital converters, timers, serial communication interfaces, and digital input/output ports, allowing it to interface with sensors, actuators, and other devices.

ESP32 WIFI MODULE

The ESP32 Wi-Fi Module acts as a communication bridge between the MSP430 microcontroller and the IoT/Cloud platform for remote monitoring.

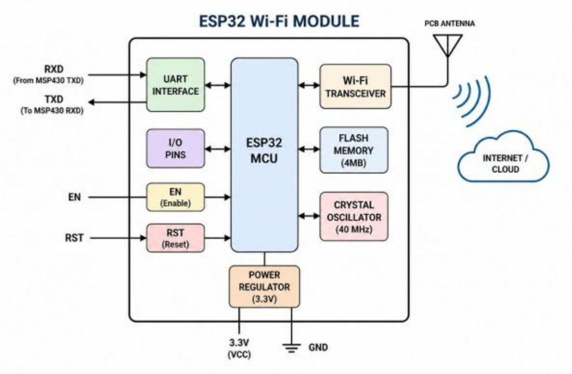

Fig.4 ESP32 WIFI MODULE

POTENTIAL TRANSFORMER

Potential Transformer (PT) (also called a Voltage Transformer) is an instrument transformer used to step down high voltage to a lower, measurable value for protection and metering.

A Potential Transformer is an electrical device that converts high voltage (HV) into a proportional low voltage (LV) suitable for instruments like voltmeters, energy meters, and relays.

LM 35

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature, the LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling.

The LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full -55 to +150°C temperature range.

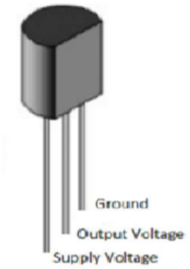

Fig.5 LM 35

Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy.

It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35D is rated to operate over a 0° to +100°C temperature range. Outputs 10mV per Degree.

RELAY

A relay is an electromagnetic switch that is used to turn on and turn off a circuit by a low power signal or where several circuits must be controlled by one signal

Fig.6 Relay

We know that most of the high end industrial application devices have relays for their effective working .Relays are simple switches which are operated both electrically and mechanism is carried out with the help of the electromagnet. There are also other operating principles for its working .But they differ according to their applications .Most of the device have the application of relays.

LCD Display

LCD is a type of display used in digital watches and many portable computers. LCD displays utilize to sheets of polarizing material with a liquid crystal solution between them.

The most commonly used Character based LCDs are based on Hitachi's HD44780 controller or other which are compatible with HD44580.

Fig.7 LCD

We will discuss about character based LCDs, their interfacing with various microcontrollers, various interfaces (8-bit/4-bit), programming, special stuff and tricks you can do with these simple looking.

IV. CIRCUIT DIAGRAM

The system operates by generating electrical energy using a dynamo and converting it into a stable DC supply through a voltage regulation stage. The raw output from the dynamo is filtered using capacitors and regulated to a constant +5V using a voltage regulator, ensuring reliable operation of all electronic components.

The regulated power is supplied to the microcontroller and associated modules. Voltage sensors continuously monitor the voltage levels from different sources, while the temperature sensor measures the system temperature.

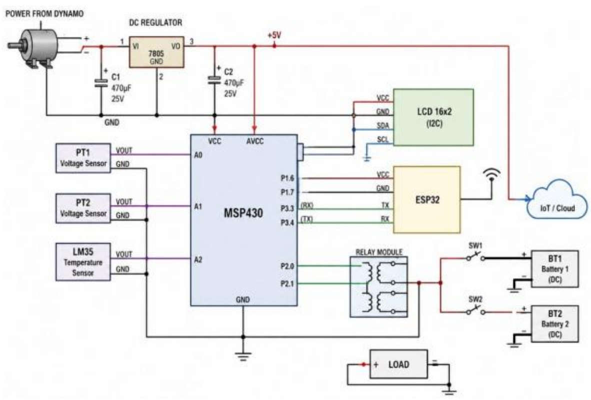

Fig.8 CIRCUIT DIAGRAM

These analog signals are fed into the microcontroller, where they are converted into digital values using an internal analog-to-digital converter (ADC).

The microcontroller processes the sensed data and makes decisions based on predefined conditions. It controls the relay module to switch between two batteries. If one battery's voltage drops below a threshold or certain conditions are met, the system automatically switches to the other battery to maintain uninterrupted power supply to the load.

Simultaneously, the processed data such as voltage and temperature are displayed on a 16×2 LCD using I2C communication. The same data is also transmitted to the ESP32 module through serial communication (UART).

Thus, the system ensures continuous power delivery, real-time monitoring, and intelligent battery management through automated control and wireless communication.

V. CONCLUSION

In this system model for battery management in electric vehicle by controlling the crucial parameters such as voltage, current, state of charge, state of health, state of life, temperature.

It is every important that the BMS should be well maintained with battery reliability and safety. This present project focus season the study of BMS and optimizes the power performances of electric vehicles.

The proposed Battery Management System (BMS) for electric vehicles plays an important role in improving battery performance, reliability, and safety. The system continuously monitors crucial parameters such as voltage, current, temperature, State of Charge (SOC), State of Health (SOH), and State of Life (SOL). By maintaining these parameters within safe limits, the BMS helps to prevent overcharging, overheating, and deep discharge conditions.

This increases the efficiency and lifetime of the battery pack used in electric vehicles. The project also helps in achieving better energy utilization and stable vehicle performance. Proper monitoring and control improve the safety of both the battery and the vehicle users.

The study of BMS provides a better understanding of battery protection and power management techniques. The proposed system can reduce maintenance issues and improve the overall reliability of electric vehicles. Hence, the developed BMS is an effective solution for enhancing the performance and safety of modern electric vehicle systems.

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