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BMS with Charge Monitor and Fire Detection

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ABSTRACT

Battery storage forms the most important part of any electric vehicle (EV) as it stores the necessary energy for the operation of Ev-vehicle, in order to extract the maximum o/p of a battery & to ensure its safe operations it is necessary that a efficient battery management system exist is the same. It monitors the Parameters, determine SOC and provide necessary services to ensure safe operation of battery. Hence BMS forms an integral part of any EV and safe guards both the user and the battery by ensuring that the cell operates within its safe operating parameters. The proposed system only monitors the battery and charge it safely but also protect it to avoid accidents from occurring. The proposed model has following functions current, voltage measurement, state of charge (SOC) calculation, protection, battery status detection, liquid crystal display (LCD) etc. Electric vehicles (EVs) are automobiles powered by one or more electric motors, which draw energy from rechargeable batteries instead of relying solely on internal combustion engines (ICEs) that consume fossil fuels. A Battery Management System (BMS) is a critical component in electric vehicles (EVs) and other battery-powered systems. It monitors and controls the operation of the battery pack, ensuring its optimal performance, safety, and longevity. State of Charge (SoC) refers to the measure of the remaining energy in a battery, expressed as a percentage of its total capacity. It indicates how much charge is available in the battery at a given time, allowing users to estimate the remaining range or usage time before recharging is required.

Keywords: Electric vehicle, Battery management system & Fire detection.

1.1 OVERVIEW:

A battery management system (BMS) using typically involves components such as an ESP32 microcontroller, smoke sensor, temperature sensor, LED, buzzer and DC charge socket. The BMS's purpose is to monitor and control the charging, discharging, and overall health of the battery system. The components work together to provide real-time data on the battery's voltage, current, and temperature, enabling efficient and safe operation. The ESP32 microcontroller serves as the central processing unit, collecting data from the sensors and sending it to a remote server or a local display. The voltage sensor measures the battery's voltage level, allowing the BMS to track its state of charge. The current sensor monitors the flow of current in and out of the battery, providing insights into charging and discharging rates. The temperature sensor detects the battery's temperature, which is crucial for ensuring safe operation and preventing overheating. The relay is used to control the charging and discharging circuits based on the BMS's instructions, allowing for optimal battery performance and protection. Overall, the BMS using enables remote monitoring, data analysis, and control of battery systems, enhancing their efficiency, lifespan, and safety.

The following features have been implemented in this project:

- The system can collect data from the BMS Display, and works accordingly with the ESP32Microcontroller.
- It Consists of MQ1 smoke sensor and DHT1 temperature sensor along with Buzzer and LED.
- It Consists of 18650 Battery (3.7V) along with the DC-charge socket to charge the batteries.
- The data can be accessed by users to monitor the health of the battery and to optimize its performance.
- The data is sent back to the main server and keeps showing the continue data online with the help of the IOT based application.

1.2 OBJECTIVES:

• IoT-based battery management systems offer benefits in terms of improving the efficiency and reliability of battery-powered devices.

• These systems can monitor battery health in real-time, optimize charging and discharging cycles, and prevent battery failure and fire

• Data analytics and insights from these systems can help manufacturers improve battery designs and enhance the overall performance of their products.

• IoT-based battery management systems can have a positive impact on the environment by reducing battery waste and promoting sustainable energy use.

• By extending the life of batteries and optimizing their performance, these systems can help reduce the need for frequent battery replacements, minimizing the environmental impact of battery disposal.

• Ongoing advancements in IoT technology and data analytics are expected to make these systems even more effective and widespread in the future.

System Architecture.

SR NO	NAME OF COMPONENTS	QUANTITY
1.	**ESP-32 MICROCONTROLLER**	**1**
2.	**Li-BATTERY (18650-3.7V)**	**3**
3.	**MQ2 SMOKE SENSOR**	**1**
4.	**DHT11 TEMPERATURE SENSOR.**	**1**
5.	**BUZZER**	**1**
6.	**LED**	**1**
7.	**DIGITAL METER**	**1**
8.	**JHD 162A LCD DISPLAY**	**1**

A. Battery Management System to Enhance Battery Life and fire detection

The system typically consists of various components such as microcontrollers, sensors, and relays. These components work together to collect data on battery voltage, current, temperature, and other relevant parameters. This real-time data enables users to gain insights into battery health and make informed decisions to extend battery life. By continuously monitoring battery voltage, the system prevents overcharging and deep discharging, which are common causes of battery degradation. It also detects abnormal charging or discharging rates, enabling users to identify and address any issues that may impact battery performance. Temperature monitoring is another crucial aspect of battery management. Excessive heat or extreme cold accelerate battery aging and reduce its lifespan. As IoT battery management system uses temperature sensors to detect abnormal temperature levels, allowing users to take preventive actions and maintain optimal battery health. Furthermore, as battery management system offers remote control functionality through relays. Users remotely turn on or off the charging process, ensuring that the battery is charged only when necessary. This feature helps prevent overcharging and prolongs battery life. Overall, as battery management system enhances battery life by providing real-time data, remote control, and optimization capabilities. It empowers users to make informed decisions based on battery health information, preventing unnecessary wear and tear and maximizing the longevity of batteries in various applications.

Cell Protection:

The battery management system focuses on enhancing battery life through cell protection measures. These measures include:

- Overcharge protection: The system monitors the battery voltage and prevents it from exceeding safe levels by disconnecting the charging source or limiting the charging current.
- Over-discharge protection: The system monitors the battery voltage and prevents it from dropping below a critical level by disconnecting the load or signaling a low battery condition.
- Temperature monitoring: The system continuously measures the battery temperature and takes appropriate action to prevent overheating, which degrade battery performance and lifespan. ϖ Short-circuit protection: The system includes circuitry that detects and responds to short-circuit events by disconnecting the battery to prevent damage.
- Temperature monitoring: The system continuously measures the battery temperature and takes appropriate action to prevent overheating, which degrade battery performance and lifespan. ϖ Short-circuit protection: The system includes circuitry that detects and responds to short-circuit events by disconnecting the battery to prevent damage.
- Fault detection and diagnostics: The system monitors battery performance and identifies any abnormalities or faults, such as increase in temperature or if any leakage is seen in the batteries, which gives you allowing for timely maintenance or replacement respectively.

Result & Discussion

IoT-based battery management systems have gained significant attention in recent years due to their ability to provide real-time monitoring and control of batteries used in various applications such as electric vehicles, renewable energy systems, and mobile devices. These systems use sensors and communication technologies to collect data about the battery's status and transmit it to a central processing unit for analysis and decision-making. One of the main advantages of an IoT-based battery management system is its ability to optimize battery performance and extend its life span. By monitoring the battery's temperature, voltage, current, and other parameters, the system can identify potential issues and take preventive actions such as adjusting the charging rate or reducing the load on the battery. This not only improves the battery's performance but also reduces the risk of premature failure, which can be costly and dangerous in some applications. Another benefit of an IoT-based battery management system is its ability to enhance safety and security. By detecting and reporting abnormal behavior such as overcharging, overheating, or sudden drops in voltage, the system can alert the user or shut down the battery to prevent accidents or damage to the equipment. Moreover, by tracking the battery's location and usage patterns, the system can prevent theft or misuse and enable remote control and monitoring. However, implementing an IoT-based battery management system also poses some challenges and limitations. One of the main challenges is the cost and complexity of integrating sensors, communication devices, and software into the battery and the host system. This requires expertise in hardware and software design, as well as a reliable and scalable network infrastructure to support the data transfer and processing. Additionally, the system's accuracy and reliability may depend on the quality and calibration of the sensors, as well as the robustness and security of the communication protocols and software algorithms. IoT-based battery management systems have shown great potential in improving the performance, safety, and security of batteries used in various applications. However, their successful implementation requires careful consideration of the technical, economic, and social factors, as well as continuous monitoring and maintenance to ensure their effectiveness and efficiency over time.

Conclusion:

The battery management system has significant benefits in terms of improving the efficiency and reliability of battery-powered devices. With the help of IoT devices, battery management systems can monitor battery health in real-time, optimize charging and discharging cycles, and prevent battery failure. These systems can also provide data analytics and insights that can help manufacturers improve their battery designs and enhance the overall performance of their products. Moreover, IoT-based battery management systems can have a positive impact on the environment by reducing battery waste and promoting sustainable energy use. By extending the life of batteries and optimizing their performance, these systems can help reduce the need for frequent battery replacements, thereby minimizing the environmental impact of battery disposal. Overall, an IoT-based battery management system is a promising technology that can help improve the performance, reliability, and sustainability of battery-powered devices. With ongoing advancements in IoT technology and data analytics, we can expect these systems to become even more effective and widespread in the future. This project has successfully developed a system that can collect data from BMS voltage sensor, current sensor, and temperature sensor and send it to a cloud-based server. The data can then be used to monitor the health of the battery and to optimize its performance.

Future Work:

- ✓ **The system could be expanded to include additional sensors, such as a humidity sensor and a pressure sensor.**
- ✓ **The system could be made more secure by using encryption to protect the data.**

OUTPUT:

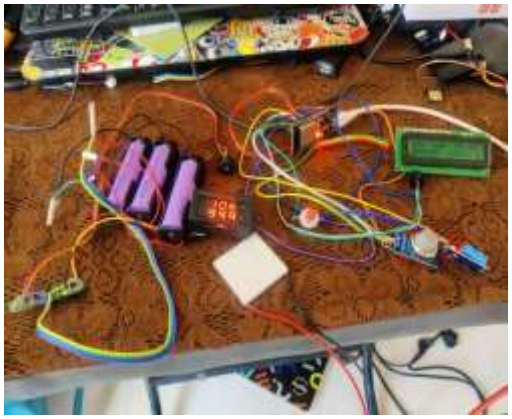

Fig:2.1 -Working Module of BMS in Fire Safety.