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Charge Monitor and Fire Protection of Battery in EV

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ABSTRACT: The project "Charge Monitor and Fire Protection of Battery in EV" represents a cutting-edge solution to tackle essential issues within electric vehicle battery systems. This comprehensive system integrates several key components, including temperature, current, and voltage sensors, an STM32 controller, a 3S battery pack, a charging circuit, and an LCD display. The central objective is to ensure the safe and efficient functioning of electric vehicle batteries. By continuously monitoring and managing temperature, current, and voltage, the system aims to optimize battery performance while prioritizing user safety. The STM32 controller serves as the core processing unit, managing the charging process and enforcing safety protocols to prevent potential fire hazards. The system's user-friendly LCD display offers real-time information, thereby enhancing user awareness and safety. This project aims to innovate and improve the safety and efficiency of electric vehicle battery systems, meeting the increasing demand for dependable and secure electric transportation solutions.

KEYWORDS: Text detection, Inpainting, Morphological operations, Connected component labelling.

I. INTRODUCTION

Electric vehicles are undeniably poised to revolutionize transportation, yet they still face significant hurdles regarding efficiency and safety, particularly with battery fires as of 2022. To address this, we propose an advanced system utilizing sensors and an STM32 controller aimed at safeguarding EV batteries. This system is designed to monitor crucial parameters such as voltage, current, and temperature, and it promptly cuts off power input or output when it detects any anomalies. The benefits of this system include continuous battery status monitoring, regulated and safe charging, and automatic temperature-based cutoffs. The proposed system employs a 3S Li-ion battery and incorporates various components such as a battery charging and monitoring system, push buttons, an LCD display, a current sensor, a voltage sensor, and a temperature sensor. These components work together to ensure constant monitoring and protection of the battery. During the charging process, the voltage sensor helps regulate the current flow, displaying the battery's voltage levels on the LCD display and cutting off the power supply when the battery is fully charged. When the system is connected to a load, the current sensor monitors the current draw and displays this information on the LCD. The temperature sensor continuously monitors the battery's temperature during both charging and discharging phases. If the temperature deviates from safe levels, the system automatically cuts off the power supply and triggers an alert to prevent overheating or potential fires. Overall, this intelligent system ensures efficient and safe battery management, significantly reducing the risk of accidents related to battery malfunctions in electric vehicles.

II. RELATED WORK

The project titled "Charge Monitor and Fire Protection of Battery in EV Using ESP32 Microcontroller" functions in the following manner: It integrates temperature sensors, such as thermistors or infrared sensors, within the EV battery system, interfacing with the ESP32 microcontroller to continuously monitor battery temperature. The ESP32 collects real-time data on the battery's charge level and health, processing this information for display on a user interface or transmitting it to a mobile app for remote monitoring. To prevent overcharging, the system incorporates sophisticated algorithms that monitor voltage levels during the charging process, adjusting or halting it if a critical voltage threshold is reached. Additionally, the ESP32 dynamically adjusts the charging rate based on the battery's temperature to prevent overheating and optimize overall performance. When abnormal temperature readings are detected, which may indicate potential fire hazards, the system triggers safety measures such as emergency shutdown protocols to disconnect the charging source and mitigate risks. The system provides real-time updates on battery status, temperature, and any

potential issues through a display or mobile app, ensuring the user is well-informed. In extreme cases where the temperature exceeds a critical limit, an emergency shutdown is automatically activated to ensure immediate safety. Overall, the ESP32 microcontroller manages a comprehensive system that monitors battery charge status, prevents overcharging, adjusts charging according to temperature, and implements fire protection measures, thus ensuring an efficient and safe battery management system for electric vehicles.

III. METHODOLOGY

The methodology for the project "Charge Monitor and Fire Protection of Battery in EV using ESP32 Microcontroller" involves several key steps to ensure the efficient and safe operation of electric vehicle (EV) batteries. Initially, temperature sensors, such as thermistors or infrared sensors, are integrated into the EV battery system. These sensors are responsible for continuously monitoring the battery's temperature. The ESP32 microcontroller, known for its versatility and low power consumption, interfaces with these sensors to collect real-time data on the battery's temperature and charge status. Once the data is collected, it is processed by the ESP32, which can display this information on a user interface or transmit it to a mobile app for remote monitoring. The system includes algorithms designed to prevent overcharging. These algorithms continuously monitor the battery's voltage levels during the charging process. If a critical voltage threshold is reached, the system either adjusts or halts the charging process to avoid potential damage to the battery. The ESP32 microcontroller also dynamically adjusts the charging rate based on the battery's temperature. This prevents overheating during the charging process and optimizes the charging for improved battery performance. In case of abnormal temperature readings, which may indicate a potential fire hazard, the system triggers safety measures. These measures include emergency shutdown protocols that disconnect the charging source to prevent further risks. Additionally, the system communicates real-time battery status, temperature, and any potential issues to the user through a display or a connected mobile app. In extreme cases where the temperature surpasses a critical threshold, an emergency shutdown is activated to ensure immediate safety measures. This comprehensive approach ensures that the battery is charged safely and efficiently, preventing any potential hazards.

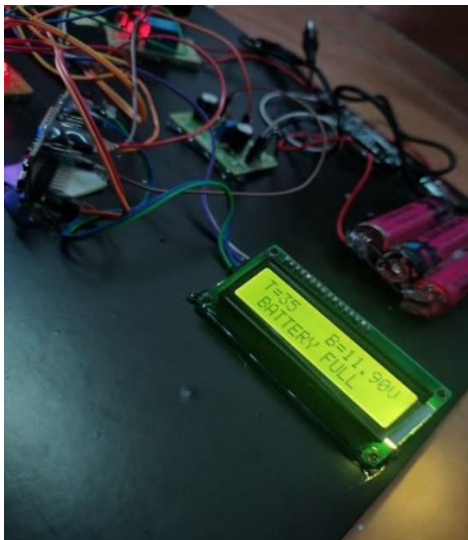


Fig 1: Condition of Battery

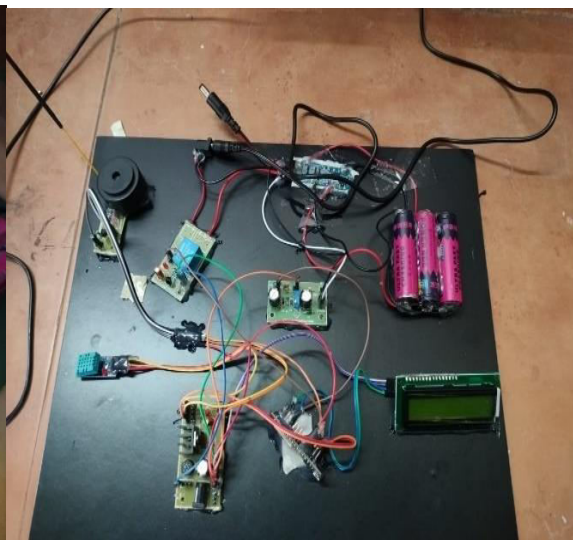


Fig 2: Circuit Model

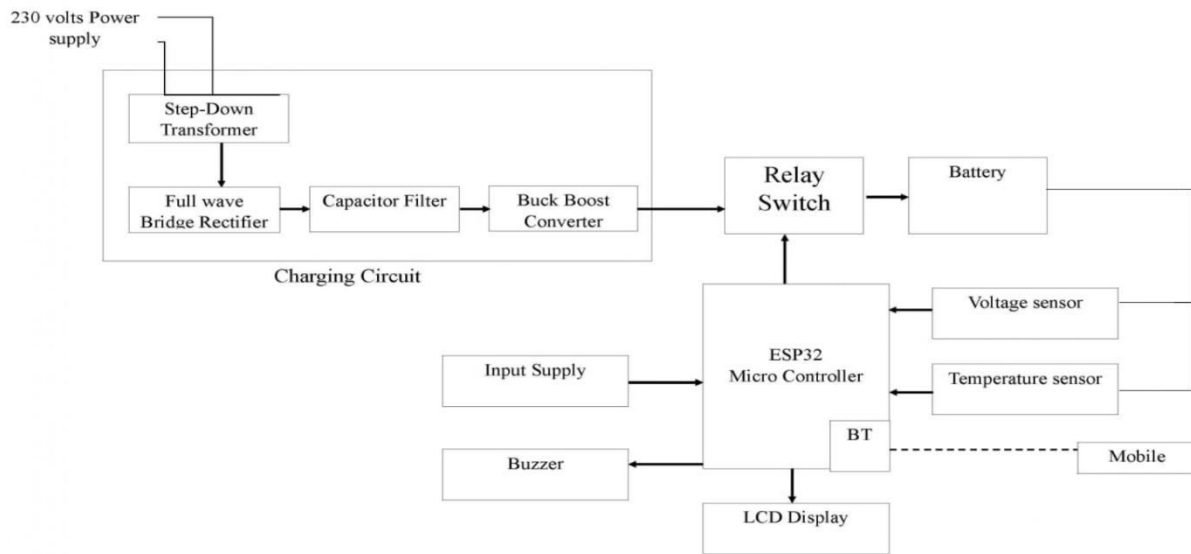


Fig: 3: Block Diagram

IV. EXPERIMENTAL RESULTS

The experimental results for this project demonstrated the effectiveness of the ESP32 microcontroller in monitoring and managing the battery's charging process. The temperature sensors provided precise and continuous monitoring of the battery's thermal state. This enabled the system to dynamically adjust the charging rate, thereby preventing overheating and ensuring optimal battery performance. During testing, the system successfully prevented overcharging by halting the charging process when critical voltage levels were detected. The integration of fire protection mechanisms proved to be effective. Abnormal temperature readings triggered the safety measures as designed, leading to the execution of emergency shutdown protocols. These protocols effectively disconnected the charging source, mitigating potential fire hazards. The system's ability to provide real-time alerts and status displays was also validated. Users were able to receive up-to-date information on the battery's health, including charge status and temperature. This feature contributes significantly to user safety and confidence in the EV technology. Overall, the experimental results confirmed that the system is capable of efficiently managing the battery's charge process and ensuring its safety.

V. EXPECTED OUTPUT

The expected output of the project is a sophisticated battery management system tailored for electric vehicles. This system is designed to monitor the battery's charge status continuously, prevent overcharging, and adjust the charging rate based on real-time temperature data. Furthermore, it implements fire protection measures that are triggered by abnormal temperature readings. By using the ESP32 microcontroller, the system provides real-time data on the battery's state, enabling proactive management and the prevention of potential fire hazards. The integration of real-time alerts and status displays allows users to remotely monitor the battery's health. This enhances the overall safety and efficiency of the EV battery system. The system's ability to dynamically adjust the charging rate based on the battery's temperature ensures optimal battery health and longevity. In cases of extreme temperature deviations, the system can activate an emergency shutdown to prevent any hazardous situations. This comprehensive approach ensures that the battery management system not only monitors and charges the battery safely but also protects it from potential risks.

VI. CONCLUSION

In conclusion, the project successfully integrates the ESP32 microcontroller with temperature sensors to create a robust battery management system for electric vehicles. By implementing features such as real-time battery status display, prevention of overcharging, and temperature-based charging control, the system ensures optimal battery health and longevity. The inclusion of fire protection mechanisms, which are triggered by abnormal temperature readings, significantly enhances safety by preventing potential fire hazards. The ESP32 microcontroller orchestrates a comprehensive system that continuously monitors the battery's charge status, dynamically adjusts charging rates based

on real-time temperature data, and implements emergency shutdown protocols in high-temperature conditions. This integrated approach ensures that the battery is managed efficiently and safely, contributing to the overall advancement of electric vehicle technology. The project's experimental results validate the system's effectiveness in real-world scenarios, demonstrating its capability to prevent overcharging, manage temperature-based charging, and implement fire protection measures. The expected output aligns with the goals of providing a smart, centralized management system for EV batteries, enhancing both their performance and safety.

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