iJETRM
International Journal of Engineering Technology Research & Management
Published By:
https://www.ijetrm.com/

AN INTELLIGENT ELECTRIC VEHICLE SYSTEM UTILIZING AUTOMATED BATTERY EXCHANGE AND SOLAR-ASSISTED CHARGING

Rhutuja Ghadge, Priyanka Misal, Shubhangi Sonwalkar
Students, Department of Electronics & Telecommunication Engineering,
Sinhgad Academy of Engineering, Kondhwa - 411048

Prof . Rajeshwari Thadi
Assistant Professor, Department of Electronics & Telecommunication Engineering
Sinhgad Academy of Engineering, Kondhwa - 411048

ABSTRACT:
This paper details the development of an intelligent electric vehicle (EV) system engineered to enhance operational efficiency and promote sustainable energy use. The core innovation lies in the system's capacity for automated exchange between two onboard batteries, enabling optimized energy distribution. Furthermore, the integration of a solar panel provides a supplementary charging mechanism. The entire system is monitored and managed through a Blynk IoT application, facilitating remote access and control. A functional prototype was constructed to validate the feasibility of dynamic battery management and its potential to extend EV range while lessening dependence on conventional grid power.

KEYWORDS:
Electric Vehicle, Automated Battery Exchange, Solar Charging Integration, ESP32 Microcontroller, Internet of Things (IoT), Blynk Platform

I. INTRODUCTION:

The increasing global focus on sustainable transportation has positioned electric vehicles (EVs) as a key alternative to traditional combustion engine vehicles. Despite their environmental advantages, challenges such as range anxiety and protracted charging cycles impede widespread EV adoption. This research endeavors to mitigate these limitations through the design and implementation of an intelligent EV system featuring automated battery exchange and solar-assisted charging. The proposed system employs an ESP32 microcontroller to orchestrate the exchange between two batteries, thereby facilitating continuous vehicle operation and the potential for increased operational range. Moreover, the incorporation of a solar panel aims to supplement battery charging, reducing reliance on grid-derived electricity and promoting a more sustainable energy profile. The system's operational parameters can be remotely monitored and controlled via a Blynk IoT application, offering enhanced user interaction and convenience.

The development of efficient Battery Management Systems (BMS) is crucial for optimizing electric vehicle (EV) performance. Research in this area emphasizes the importance of accurate voltage and current sensing, addressing challenges related to battery monitoring, balancing, and thermal management. Estimating the State of Charge (SOC) and State of Health (SOH) is also vital for efficient battery utilization and ensuring safe operation. Studies highlight

iJETRM
International Journal of Engineering Technology Research & Management
Published By:
https://www.ijetrm.com/

that robust BMS solutions are essential for enhancing EV reliability and extending battery lifespan. Integrating solar-powered charging systems offers a promising avenue for improving EV energy efficiency. Research explores various configurations of solar-powered EVs, focusing on the integration of photovoltaic (PV) systems for on-board charging. While challenges related to solar panel efficiency and vehicle integration exist, the potential to supplement grid power and reduce dependency on traditional charging methods is significant. Microcontroller-based vehicle control plays a pivotal role in managing EV operations. Studies demonstrate the effectiveness of ESP32 microcontrollers for real-time monitoring and control of EV parameters. These systems facilitate precise motor control and sensor integration, enabling flexible and reliable vehicle operation. The integration of Internet of Things (IoT) technologies further enhances EV functionality by enabling real-time monitoring and remote control. Platforms like Blynk facilitate data analysis and remote management, providing users with valuable insights into vehicle performance and battery status. IoT-based systems offer the potential for remote diagnostics and over-the-air updates, improving vehicle safety and user experience The effective management of batteries is critical for the operation of electric vehicles (EVs). Battery Management Systems (BMS) are essential to ensure the safety and consistency of battery performance in these vehicles. These systems perform key functions such as monitoring the battery's status, managing its charge and discharge cycles, and balancing the individual cells within the battery pack. Research is being conducted to improve the methods of evaluating battery status, with the goal of predicting and addressing future challenges in BMS design and implementation. Studies also explore the various topologies of BMS and the potential of wireless BMS technologies. Furthermore, microcontrollers, such as the ESP32, play a vital role in the design and construction of BMS for EVs, enabling efficient monitoring and protection of the battery system.

II. SYSTEM SETUP:

System Architecture and Design:

The developed smart EV system incorporates a dual-battery configuration, a solar panel for auxiliary charging, an ESP32 microcontroller serving as the central processing unit, relays to facilitate automated battery exchange, an L298 motor driver to govern the vehicle's locomotion, a DC motor as the driving force, and a Blynk IoT interface for remote interaction. The ESP32 microcontroller is programmed to control the relays, enabling the dynamic exchange between the two batteries. This design ensures that one battery can power the EV while the second battery undergoes charging, either from the solar panel or an external source. Voltage sensors are integrated to monitor the voltage levels of each battery, providing essential feedback to both the ESP32 and the Blynk application. The L298 motor driver regulates the speed of the 55rpm DC motor, which propels the EV. A 16x2 I2C LCD display is included to provide a local interface, presenting pertinent system information and battery status to the user.

Hardware Implementation:

- **ESP32 Microcontroller:** Functions as the system's core controller, managing battery exchange protocols, charging operations, and communication with the IoT platform.
- **Batteries:** The system utilizes two batteries to provide a continuous power source for the EV, with the exchange mechanism mitigating downtime associated with charging.
- **Solar Panel:** Serves as a supplementary charging source, harnessing solar energy to contribute to battery replenishment.
- **Relays:** Electromechanical switches employed to execute the automated exchange between the two batteries.
- **L298 Motor Driver:** An electronic circuit that controls the DC motor's speed and direction.
- **DC Motor (55rpm):** The actuator responsible for providing the driving force to propel the EV.
- **Voltage Sensors:** Devices that measure the voltage levels of the batteries, providing data for monitoring and control.

iJETRM
International Journal of Engineering Technology Research & Management
Published By:
https://www.ijetrm.com/

- **LCD Display (16x2 I2C):** A display module that presents system information to the user.

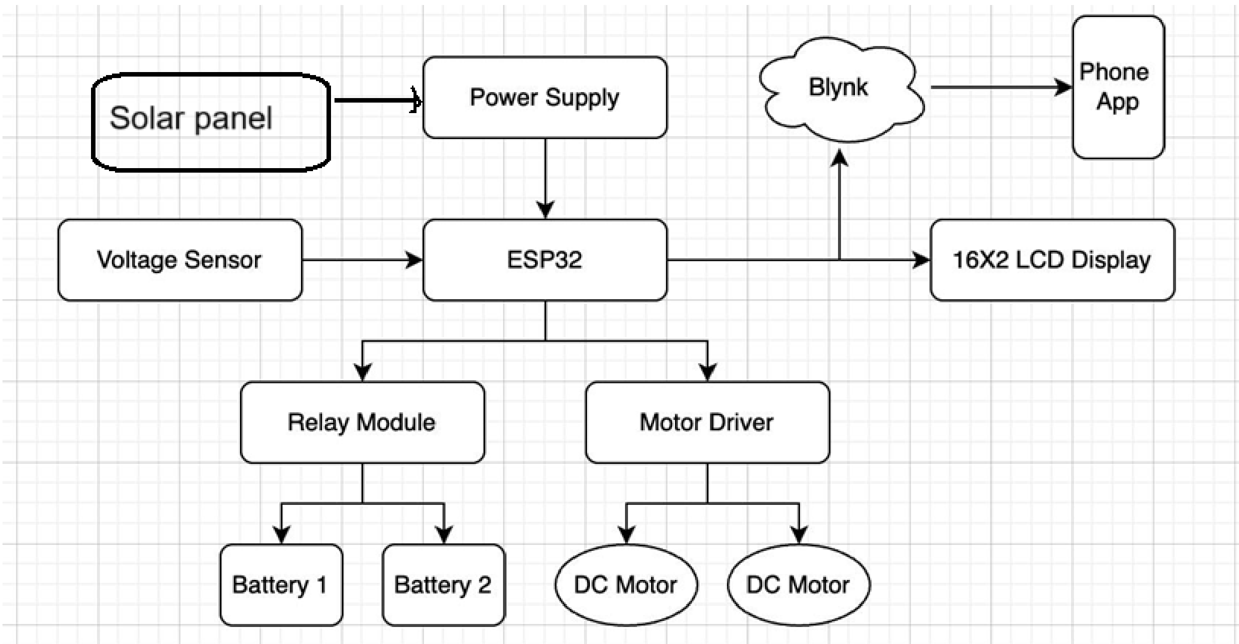

Fig:2.1: System Schematic

III. SOFTWARE AND CONTROL STRATEGIES:

The ESP32 microcontroller is loaded with firmware that governs the battery exchange sequence, solar charging management, and motor speed regulation. The battery exchange algorithm is designed to ensure a seamless transition between batteries, minimizing any disruption to the EV's operation. The solar charging management strategy optimizes the charging process, taking into account factors such as solar energy availability and battery state-of-charge. Motor speed is controlled to allow for variable vehicle speeds. The Blynk application provides a user interface that enables remote monitoring of key system parameters and user control over battery exchange and charging functions.

iJETRM
International Journal of Engineering Technology Research & Management
Published By:
https://www.ijetrm.com/

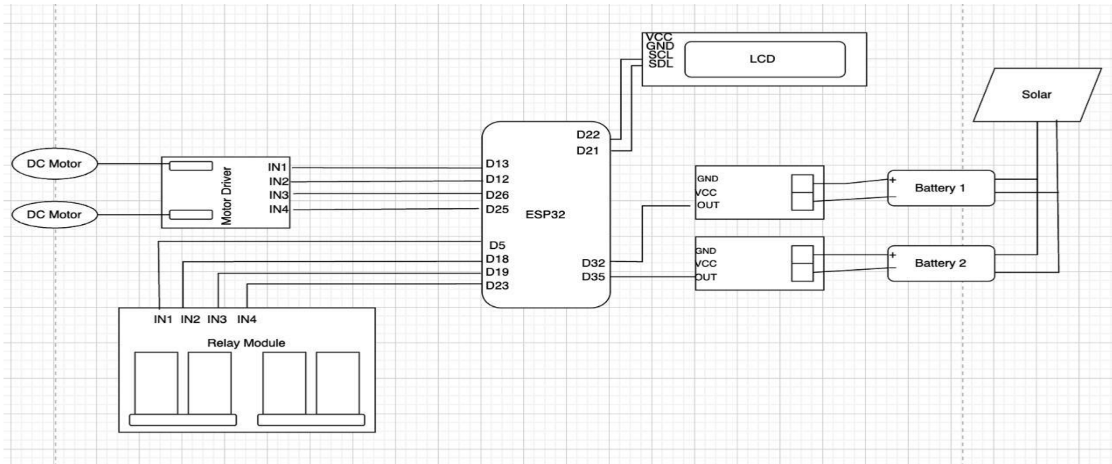

Fig 3.1 : Esp 32 Connection Diagram

IV. IOT INTEGRATION:

The Blynk IoT platform is used to establish remote monitoring and control capabilities for the EV system. Key data, such as battery voltages, are transmitted to the Blynk application, enabling users to remotely monitor the system's status. The Blynk interface also allows users to remotely control battery exchange and charging operations, adding a layer of user convenience and flexibility.

V. RESULTS AND DISCUSSION:

The developed prototype demonstrates the viability of employing automated battery exchange and solar-assisted charging to enhance EV functionality. The battery exchange mechanism effectively supports continuous operation, while the solar panel contributes to charging, reducing reliance on external power sources. The Blynk IoT integration facilitates effective remote monitoring and control. Data gathered from the prototype, including battery voltage profiles and solar charging performance, validates the system's operational effectiveness.

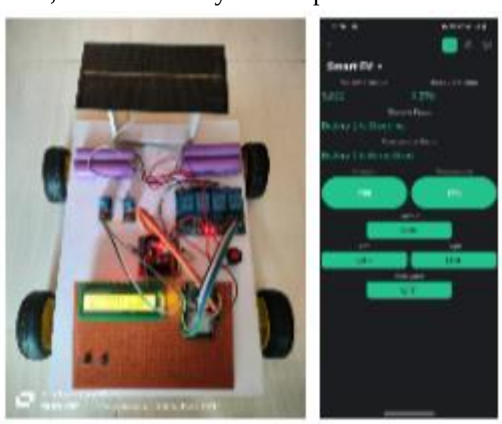

Fig: 5.1 Actual Project Model , Control panel on Smart Phone

VI. REFERENCES:

iJETRM
International Journal of Engineering Technology Research & Management
Published By:
https://www.ijetrm.com/

1. Real-Time Battery Monitoring and Control for EV Applications .Mahesh Ganesh Jalgaonkar1, Dr. Santosh C. Wagaj
2. IoT Based Battery Monitoring and Protection System. Vilas budge , Mrunal deshpande.
3. IoT-Based Electrical Vehicle’s Energy Management and Monitoring System Mahmood H. Qahtan, Emad A. Mohammed, Ahmed J. Ali