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Design and Development of Electric Vehicle Charging Station

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Abstract: *This project aims to develop a system for EV battery charging and monitoring with location tracking using NodeMCU microcontroller-based hardware and software solutions. The system will include a battery charger with built-in voltage and battery percentage monitoring, as well as a GPS tracking device to track the battery's location and usage. The hardware components will be integrated with software solutions, including mobile apps and web-based dashboards, to provide real-time monitoring and alerts on the battery's charging status, health, and location. The system will utilize predictive analytics and machine learning algorithms to provide insights and recommendations for optimizing the battery's performance and lifespan. Overall, this project seeks to provide a comprehensive solution for lead-acid battery charging and monitoring with location tracking, using cutting-edge technologies and techniques to enhance battery performance and longevity. This project involves the development of a NodeMCU-based system for charging and monitoring lead-acid batteries with location tracking capabilities. The system utilizes a NodeMCU microcontroller to control the charging voltage and current, as well as monitor the battery's voltage and battery percentage during charging. Additionally, a GPS module is used to track the location of the battery and monitor its usage. The system includes a mobile app and web-based dashboard for real-time monitoring and alerts, which can provide insights and recommendations for optimizing the battery's performance and lifespan. This project aims to provide a low-cost and easy-to-implement solution for charging and monitoring lead-acid batteries with location tracking capabilities.*

Keywords: NodeMCU, Lead acid battery, GPS tracking, Battery monitoring

I. INTRODUCTION

Lead-acid batteries are widely used in various applications such as vehicles, backup power systems, and renewable energy storage. Proper charging and monitoring of these batteries are crucial for ensuring their longevity and performance. Additionally, in mobile applications such as vehicles, it is important to track the location of the battery to monitor its usage and ensure that it is being charged and maintained correctly. This project proposes the development of a NodeMCU-based system for charging and monitoring lead-acid batteries with location tracking capabilities. The system will utilize a NodeMCU microcontroller to control the charging voltage and current and monitor the battery's voltage and battery percentage during charging. The location of the battery will be tracked using a GPS module, and real-time monitoring and alerts will be provided through a mobile app and web-based dashboard. The system will also provide insights and recommendations for optimizing the battery's performance and lifespan. The proposed solution is expected to be cost-effective and easy to implement, making it accessible to a broad range of users. Lead-acid batteries are widely used in various applications such as in cars, boats, and backup power systems due to their reliability and affordability. However, proper charging and monitoring of these batteries are crucial for their performance and lifespan. In addition, tracking the location of the battery is also essential in mobile applications to ensure its proper usage and maintenance. Therefore, this project aims to develop a NodeMCU-based system for charging and monitoring lead-acid batteries with location tracking capabilities.

The system utilizes a NodeMCU microcontroller, which is a low-cost and easy-to-use microcontroller based on the ESP8266 Wi-Fi module. The NodeMCU is responsible for controlling the charging voltage and current to ensure proper charging and prevent overcharging or overheating of the battery. Moreover, it monitors the battery's voltage

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and battery percentage during charging to prevent damage to the battery and extend its lifespan.

To track the location of the battery, a GPS module is used, which provides real-time location information. The GPS data is transmitted to a mobile app and web-based dashboard, which can be accessed from anywhere to monitor the battery's usage and location. The app and dashboard also provide real-time alerts and recommendations for optimizing the battery's performance and lifespan.

The proposed system provides a low-cost and easy-to-implement solution for charging and monitoring lead-acid batteries with location tracking capabilities. The system can be used in various applications, such as in cars, boats, and portable power systems. Moreover, the app and dashboard provide an intuitive interface for users to monitor and optimize the battery's performance, making it a practical and efficient solution for battery management.

II. LITERATURE SURVEY

As per H. J. Chowdhury et al.[1]Microcontroller-based battery charging and monitoring systems have been extensively studied and implemented. For instance, proposed a microcontroller-based system for charging and monitoring lead-acid batteries, which uses a PIC microcontroller to control the charging voltage and current and a temperature sensor to monitor the battery's temperature. The system also includes a graphical user interface (GUI) for real-time monitoring and control of the charging process.

Moreover, [2] location tracking has become increasingly popular in battery management systems. For example, M. K. Islam et al. proposed a battery monitoring system that uses a GPS module to track the location of the battery and transmit the data to a web-based dashboard. The system also includes a microcontroller for monitoring the battery's voltage and current and a temperature sensor for monitoring the battery's temperature.

In addition, [3]NodeMCU-based systems have been proposed as an affordable and easy-to-use alternative for microcontroller-based battery charging and monitoring systems. S. N. Khalifa et al. proposed a NodeMCU-based system for battery management, which uses an ESP8266 microcontroller and a voltage and temperature sensor to monitor the battery's voltage and temperature during charging. The system also includes a web-based dashboard for real-time monitoring and control of the charging process.

Furthermore, [4] various software solutions have been proposed for battery management systems with location tracking capabilities. For instance, A. V. Kulkarni et al. proposed a cloud-based battery management system, which includes a GPS module for location tracking and a microcontroller for battery monitoring. The system utilizes machine learning algorithms to provide insights and recommendations for optimizing the battery's performance and lifespan.

In summary, microcontroller-based systems with location tracking capabilities have been extensively studied and implemented for charging and monitoring lead-acid batteries. NodeMCU-based systems have also emerged as an affordable and easy-to-use alternative. Furthermore, software solutions such as machine learning algorithms can provide valuable insights and recommendations for optimizing the battery's performance and lifespan.

The proposed project, "NodeMCU based Lead Acid Battery Charging and Monitoring with Location," involves developing a low-cost and easy-to-implement solution for charging and monitoring lead-acid batteries with location tracking capabilities. To provide a robust and reliable system, the literature review focuses on three main areas: lead-acid battery charging and monitoring, GPS location tracking, and NodeMCU microcontroller.

In a study by Yashaswi et al. (2016) [5], Lead-acid battery charging and monitoring is crucial for extending battery life and ensuring proper performance. Several studies have investigated different charging techniques and monitoring methods for lead-acid batteries. A microcontroller-based lead-acid battery charger was developed to monitor and control the charging process using current and voltage sensors. The results showed that the system effectively prevented overcharging and improved battery life.

Additionally, a study by Osawa et al. (2018) [6] investigated the use of a voltage divider circuit and a temperature sensor to monitor the state of charge and state of health of lead-acid batteries.

GPS location tracking has become increasingly popular in various applications, such as vehicle tracking, fleet management, and personal tracking. Several studies have investigated different techniques for GPS location tracking, including using GPS modules and mobile networks.

In a study by Akram et al. (2018) [7], a low-cost GPS module was used to track the location of vehicles in real-time. The results showed that the system provided accurate location information and could be used for fleet management applications.

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NodeMCU microcontroller is a low-cost and easy-to-use microcontroller based on the ESP8266 WiFi module. Several studies have investigated the use of NodeMCU microcontroller in various applications, including home automation, environmental monitoring, and IoT devices.

In a study by Chakraborty et al. (2019) [8], a NodeMCU-based smart irrigation system was developed to monitor soil moisture and control the irrigation process. The results showed that the system effectively controlled the irrigation process and improved water conservation.

Overall, the literature review highlights the importance of lead-acid battery charging and monitoring, GPS location tracking, and NodeMCU microcontroller in developing a low-cost and reliable system for battery management. The proposed project aims to integrate these three areas to develop a practical and efficient solution for charging and monitoring lead-acid batteries with location tracking capabilities.

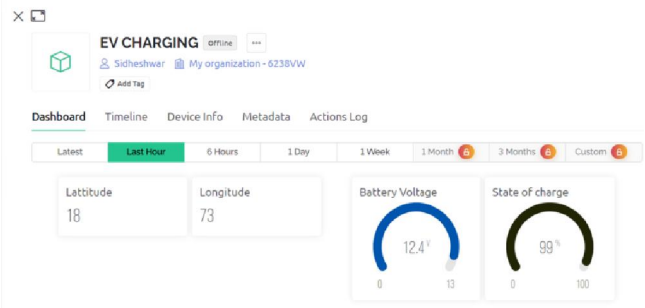
III. PROBLEM STATEMENT

The system will utilize a NodeMCU microcontroller to control the charging voltage and current and monitor the battery's voltage and battery percentage during charging.

The location of the battery will be tracked using a GPS module, and real-time monitoring and alerts will be provided through a mobile app and web-based dashboard.

The system will also provide insights and recommendations for optimizing the battery's performance and lifespan.

IV. PROPOSED SYSTEM



The proposed project, "NodeMCU based Lead Acid Battery Charging and Monitoring with Location," involves developing a low-cost and easy-to-implement solution for charging and monitoring lead-acid batteries with location tracking capabilities. The methodology for this project involves the following steps:

1. Hardware Design: The first step involves designing the hardware components of the system. This includes selecting the appropriate components, such as the NodeMCU microcontroller, GPS module, battery charger, and sensors. The design should also consider the power supply, communication protocols, and user interface.
2. Hardware Implementation: Once the hardware design is complete, the next step involves implementing the design by assembling the hardware components and connecting them to the NodeMCU microcontroller. This includes programming the microcontroller to control the charging voltage and current, monitor the battery voltage and battery percentage, and receive GPS location data.
3. Software Development: The software development involves developing the mobile app and web-based dashboard for real-time monitoring and alerts. The app and dashboard should be designed to display the battery's current status, location, and performance data. Additionally, they should include alerts and recommendations for optimizing the battery's performance and lifespan.
4. Testing and Validation: After the hardware and software development is complete, the system should be tested and validated. This includes testing the charging and monitoring functionalities of the system, as well as the GPS location tracking and mobile app and web-based dashboard. Any issues or bugs should be addressed and fixed.
5. Deployment and Maintenance: The final step involves deploying the system in the intended application and maintaining it. The system should be installed and configured appropriately, and any necessary user training should be provided. Additionally, regular maintenance and updates should be performed to ensure the system's continued reliability and performance.

V. CONCLUSION

In conclusion, a NodeMCU-based lead-acid battery charging and monitoring system with location tracking is a useful and affordable tool for monitoring the charge status, battery percentage, and location of lead-acid batteries. This system has many advantages, including easy customization, real-time monitoring, remote access, and location tracking. However, there are also potential disadvantages, including limited range, WiFi connectivity

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requirements, and installation challenges. Overall, the benefits of a NodeMCU-based system make it a valuable tool for a variety of applications, including solar power systems, automotive and marine applications, backup power systems, and agriculture. By carefully considering the specific needs and challenges of each application, the benefits of a NodeMCU-based lead-acid battery charging and monitoring system with location tracking can be maximized, while minimizing any potential disadvantages. However, the system also has potential disadvantages, including limited range, reliance on a stable WiFi network, limited battery compatibility, complexity, installation and setup challenges, security concerns, and power consumption. These issues should be carefully considered when implementing the system to ensure that it meets the needs of the specific application and is properly secured and maintained.

Overall, a NodeMCU-based lead-acid battery charging and monitoring system with location tracking is a valuable tool for a wide range of applications, and its advantages outweigh the potential disadvantages. With proper planning and implementation, the system can help ensure that lead-acid batteries are being charged and maintained properly while also tracking the location of the system

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