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IoT Based Hybrid Battery Charging and Monitoring System for Electric Vehicles

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Abstract: Electric vehicles (EVs) are an innovative technology that could transform the transportation industry, and they are seen as a crucial step towards achieving a sustainable transport sector. EVs have become known for producing low carbon dioxide, low noise, high efficiency, and flexibility in grid operations and integration. Despite these benefits, the adoption of the delayed adoption of EVs is a result of inadequate charging infrastructure and extended charging periods. To overcome this challenge, hybrid charging mechanisms that utilize wind and solar power are developed to improve the charging while also monitoring the battery. The management and monitoring system of EVs is an IoT-based solution that provides real-time data on the battery's status, capacity, and charging and consuming current. This information is made available to users through an application, allowing them to make knowledgeable choices on how to charge their automobiles. Moreover, during the mobility of vehicles, the energy generated by solar and wind power used to charge the battery. This results in a sustainable charging process that uses green energy and complements the existing charging infrastructure. Overall, hybrid charging mechanisms that utilize wind and solar power, along with the IoT-based management and monitoring system, could help overcome the challenges facing the adoption of EVs. By utilizing more green energy and offering efficient charging, these mechanisms can help shift leading to a sustainable future where EVs play a central role in the transportation sector.

Keywords: Electric vehicles, sustainable transport, IoT-based solution, hybrid charging, green energy, sustainable charging.

I. INTRODUCTION

Electric vehicles (EVs) are increasingly recognized as a key part of a low-zero carbon society in smart cities. However, emerging nations like India confront unique challenges in terms of insufficient charging infrastructure and essential barriers to EV adoption. The Indian government recognizes the importance of sustainable mobility solutions to reduce dependence on imported energy sources, lower greenhouse gas emissions, and mitigate transportation-related impacts such as global warming. To encourage developing countries to choose EVs, alternative charging solutions like hybrid charging using viable sources like solar panels and wind turbines can be implemented. These solutions can help EVs get charged while in motion or stationery. It is essential to control the battery of EVs, giving prospects details about the battery's instance, capacity, and charging and consuming currents. A battery charging and monitoring system used to achieve this. This hybrid charging and mechanism system serves as a backup when the battery is fully discharged, ensuring that it is not entirely empty. This would enable emerging nations to rely more on EVs and overcome the barriers to EV adoption. Compared to other electric vehicle technologies, EVs have longer electric driving ranges, making them an attractive option for sustainable transportation.

II. METHODOLOGY

An electric vehicle relies an energy-intensive electric drive that gets charge from a battery, which can be recharged using viable energy sources like solar and wind power. The battery is mounted at the back of the vehicle, acting as the energy storing device. A solar panel mounted on the roof of an electric vehicle and a wind turbine can also be integrated at the rear of an electric vehicle which can then be used to recharge the vehicle's battery. The wind-blown through the turbine while the vehicle is moving down the hill can significantly increase the efficiency of the battery and extend its life. The

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Blynk IoT app and Arduino IoT Cloud are utilized to monitor and manage the vehicle's battery status. These systems enable remote access to the battery's status, allowing for control of the vehicle from anywhere in the world. This design is environmentally friendly, producing no emissions and operating noiselessly.

III. OBJECTIVE

An IoT-based hybrid battery charging and monitoring system has the intent of controlling and monitoring the charging of EV's batteries embracing viable energy sources such as solar and wind power. The system aims to reduce the carbon footprint of EVs and make them more sustainable by utilizing smart charging control and battery monitoring. The gadgets can turn off the charging current when the battery is fully charged or as often there a risk of overcharging, and it can collect data on the battery's state of charge, voltage, and current to transmit it wirelessly to a cloud-based platform for remote monitoring and analysis. Overall, the objective is to foster the usage of green cars by addressing key barriers like insufficient charging infrastructure and limited battery range while contributing on creating a sustainable future by boosting the viable energy sources while dropping greenhouse gas emissions.

IV. WORKING

A hybrid-based EV charging module with ESP, TP4056, and motor driver typically works in the following way:

1. Input power: The module receives input power from an external source, such as a wall outlet or solar panel.
2. TP4056 Charging: The TP4056 is a lithium-ion battery charger that regulates the charging of the battery. It monitors the battery voltage and current to ensure safe and efficient charging.
3. Battery storage: The charged battery is used to store the energy for the EV charging process.
4. Motor driver: The motor driver is used to control the motor that drives the EV charging system. It receives input from the ESP and sends signals to the motor to control its speed and direction.
5. ESP controller: The ESP is a microcontroller that serves as the brain of the charging module. It communicates with the motor driver to control the motor, monitors the battery status, and interacts with outside devices such as a smartphone or web server.
6. EV charging process: The motor driver controls the speed and the EV charging system's direction to ensure that the EV is charged efficiently and safely.
7. Monitoring and reporting: The ESP continuously monitor the battery status, charging process, and other parameters and sends updates to the user through an app or web interface.

Overall, the hybrid-based EV charging module with ESP, TP4056, and motor driver provides an efficient and safe way to charge EVs using renewable energy sources. The module can be easily integrated into existing charging infrastructure and can be controlled remotely, making it a convenient solution for EV owners.

Fig. 1 Hybrid Vehicle

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V. ARDUINO IOT CLOUD

With the help of the cloud-based Arduino IoT Cloud service, you can control your IoT gadgets at any time and from any location. You may use the Arduino IoT Cloud to create applications that may be fit the bill remotely control and monitor various IoT devices. This includes real-time data and graphical representation of batteries voltage and percentage. To visualize the battery voltage and percentage, a graph is created. The graph can be set up to display the voltage and percentage over time, As the battery discharges, the voltage and the percentage will decrease and vice versa, allowing you to control the battery's health and estimate its remaining lifespan. This could be especially useful in remote or inaccessible locations where battery replacement or recharging may be difficult or impossible.

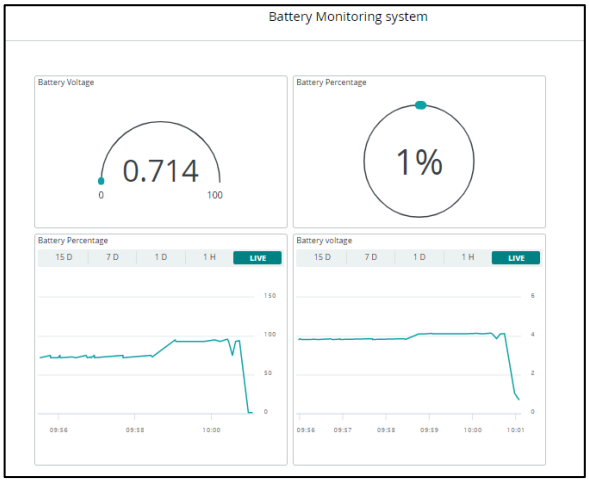

Fig. 2 Before Charging

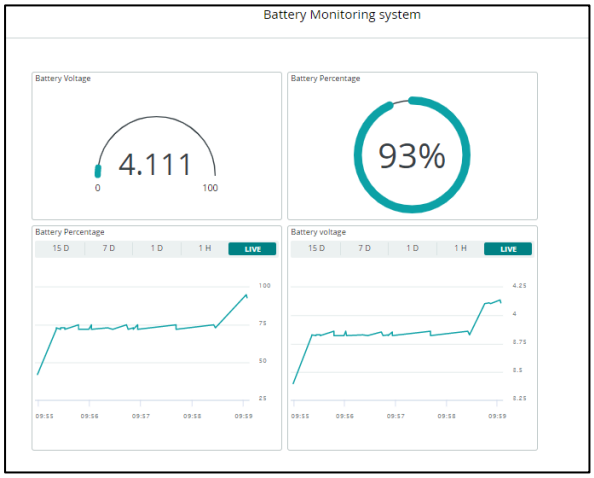

Fig. 3 After Charging

VI. LOCAL & GLOBAL CONTROL

A. Local controlled machine

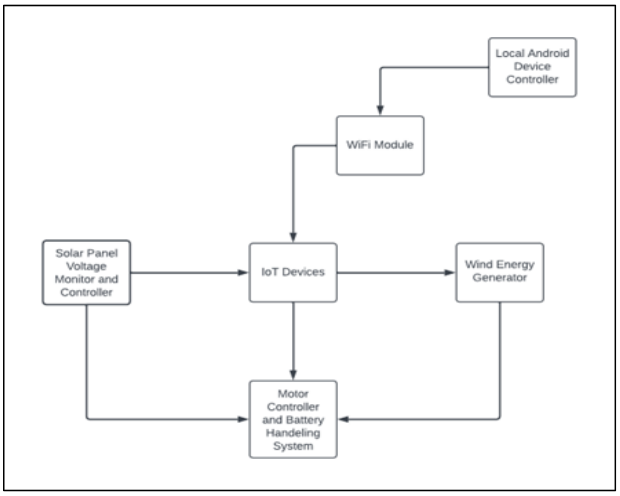

Fig. 4 Block diagram of Local controlled machine

The purpose of the project was to develop a hybrid battery charging and monitoring system for electric vehicles that could be controlled both locally and globally. The conventional IoT devices usually rely on internet connectivity and cloud-based systems to function. However, this project aimed to overcome the challenges of connectivity in remote areas by focusing on locally controlling the devices. The project team built an Android app that could send control commands from an Android device to any connected device via Wi-Fi. This app facilitated controlling the charging and monitoring

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of the electric vehicle batteries through a local network without relying on internet connectivity. This local control feature was deemed critical because electric vehicles may travel through areas without internet connectivity.

Additionally, the project team implemented a data storage system to store locally acquired data and commands when the device was disconnected from the internet. This system ensured that the locally stored data and commands were later sent to the globally controlled devices once the device was reconnected to the internet.

Overall, this project not only provided an efficient solution for charging and monitoring electric vehicle batteries but also addressed the challenge of connectivity in remote areas. The project's approach to locally controlling devices without relying on internet connectivity can potentially pave the way for the development of IoT devices that function without internet connectivity in areas where internet connectivity is unavailable or unreliable.

B. Global controlled machine

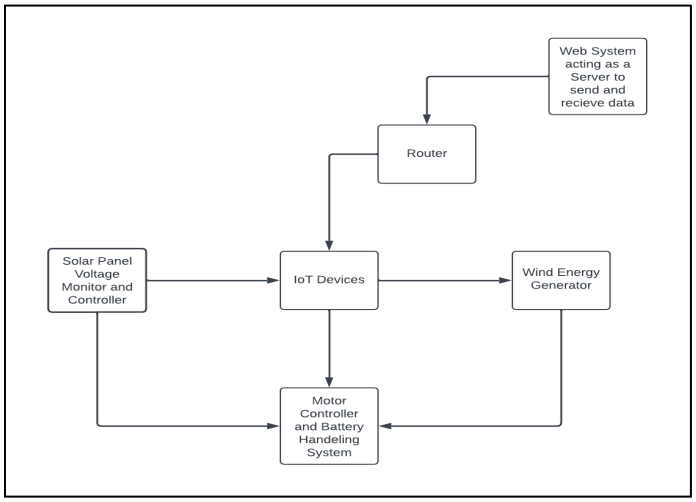

Fig. 5: Block diagram of Global controlled machine

Server-based or web-based control using the Blynk app is a popular method for remotely controlling IoT devices. The Blynk app is a web-based platform that offers a range of widgets to create customized user interfaces for controlling and monitoring IoT devices. The app connects to a Blynk server that communicates with the IoT device, allowing users to control it from their smartphone. To use Blynk for server-based or web-based control, the first step is to set up a Blynk server. Once the server is established, the Blynk app connects to the server and the IoT device. This enables users to remotely control the IoT device, which sends control signals to the Blynk server. The server then forwards the signal to the device, enabling it to carry out the desired action. Blynk is a versatile platform that supports a wide range of IoT devices and can be used with different programming languages. Additionally, Blynk offers a user-friendly interface that simplifies the process of creating custom user interfaces. The drag-and-drop feature of the platform allows users to create customized interfaces that enable them to control their IoT devices more effectively.

In conclusion, Blynk is an effective method for remotely controlling IoT devices using a server-based or web-based approach. Its versatility, user-friendly interface, and compatibility with different programming languages make it a popular choice for IoT enthusiasts and developers alike.

VII. CONCLUSION

IoT based hybrid charging and monitoring system provides an eco-friendly and cost-effective solution for travel requirements as it uses viable energy sources like wind and solar energy. It also lessens our reliance on non-renewable sources but also helps in extending the battery life and increasing its efficiency while the vehicle is in motion. Moreover, the remote monitoring feature of the system through Blynk IoT allows us to keep track of the battery status from any location on the earth.

This feature is particularly useful if there is any emergency or when the vehicle is parked at a distant location. Overall, the IoT based hybrid charging and monitoring system is a game-changer in the field of electric vehicles, providing an eco-friendly and cost-effective solution to the problem of charging and battery maintenance.

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