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RESEARCH ARTICLE

Solar drive-in EV charging hub

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Abstract – While electric vehicles are generally seen as clean vehicles, The concept of using solar power to charge electric vehicles is a significant step towards achieving a truly sustainable and environmentally friendly transportation system. While electric vehicles themselves are cleaner than those powered by fossil fuels, the production of electricity used to charge them can still result in emissions. The current solar energy ecosystem in India is not well-structured, with numerous solar power plants operating independently without any means of analytical analysis. However, advancements in sensor technology make it possible to connect these systems to the GSM and carry out analytical operations to improve efficiency. By connecting solar-powered electric vehicle charging stations to the GSM, users can receive messages about the performance, productivity, and efficiency of the stations. This information can then be used to optimize the use of solar power and increase efficiency, ensuring that solar power is maximized in charging electric vehicles.

Index Terms – EV Charging, GSM, Electric vehicles , charging hub

I. INTRODUCTION

The over-reliance on fossil fuels as the primary source of energy can lead to a scarcity of these resources in the future. To overcome this problem, several ways has been proposed, including designing more energy- efficientsystems that consume less fuel, transitioning to alternative sources of energy with storage such as hydrogen or battery, and promoting the use of electric cars that consume clean and alternative fuels. Innovative solutions such as mobile solar car park roofs, solar car parks that are mobile grid-connected solar systems, and mobile multifunctional solar charge stations that allow direct DC charging from the solar panel to vehicle traction batteries can help to promote utilizing sustainable energy sources and reduce our dependence on fossil fuels.

Furthermore, the latest developments in micro-electronics and the Internet of Things have made it possible to connect the entire infrastructure to the internet at a significantly low power consumption and cheaper price. This connectivity can help to optimize the use of energy and improve the efficiency of energy systems. To ensure a sustainable future and reduce our reliance on non-

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renewable resources such as fossil fuels, it is essential to invest in renewable energy and enhance energy efficiency. Implementing innovative solutions that promote the use of renewable energy, such as mobile solar car park roofs and solar car parks, can make a significant impact. Additionally, the latest developments in micro-electronics and the Internet of Things can further advance these solutions and address the challenge of non-renewable fuels scarcity. By taking such measures, we can move towards a cleaner and greener future.

Overview of The Project

The project of a solar-powered EV charging station using Internet of Things (IoT) is an innovative solution that combines renewable energy and IoT technology to promote the use of electric cars and reduce our dependence on fossil fuels. The charging station consists of a solar panel system that generates electricity from the sun and stores it in a battery bank. The electricity is then used to charge electric cars through a charging station that is connected to the internet via IoT technology as shown in figure 1.

Fig. 1: Solar Panels Deployment

The IoT technology will help in remote monitoring and management of the charging station, providing real- time information on the performance and energy usage of the system. This information can be used to optimize the use of energy and improve the efficiency of the charging station. The solar-powered EV charging station using IoT has several merits when compared to traditional way of charging stations. It is environmentally friendly and promotes the use of renewable energy. It is also cost- effective, as it reduces the reliance on expensive and polluting fossil fuels. Additionally, it provides a convenient and efficient way to charge electric cars, reducing the dependence on gasoline and improving air quality.

Overall, the project of a solar-powered EV charging station using IoT is an innovative solution that addresses the challenge of fossil fuel scarcity and promotes a more sustainable future.

Need for a Solar Drive-In EV Charging Hub

The growing concern about the adverse effects of fossil fuels on the environment has led

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to the need for cleaner and renewable sources of energy, including solar-powered EV charging stations using IoT. The transportation sector is a significant contributor to greenhouse gas emissions, and adopting electric cars powered by renewable energy can help reduce these emissions. However, the adoption of electric cars is limited by the availability and convenience of charging stations. The conventional charging stations that use fossil fuels for electricity are expensive and polluting, necessitating more sustainable and cost-effective solutions.

The solar-powered EV charging station using IoT offers an innovative solution that addresses these challenges. The project reduces reliance on fossil fuels by using solar energy to power the charging station and promotes the use of renewable energy sources. Moreover, the IoT technology used to manage and monitor the charging station provides a more efficient and cost-effective way to charge electric cars. In conclusion, the solar-powered EV charging station using IoT is a response to the need for cleaner and more sustainable sources of energy, reduced greenhouse gas emissions, and the promotion of electric car adoption.

II. LITERATURE SURVEY

Charging Station for E-Vehicle using Solar with IOT by Akhila .A, et.al (2019). This paper focuses on using IoT technology to provide real-time information about the availability Intended for the purpose of recharging electric vehicles to users through a webpage. The webpage is designed using normal HTML method for the clear and easy usage of information provided. The webpage includes a graph of battery voltage and time and also the location tracked for charging station as similar to the Google map. The system requires a 24/7 network and browser to load data using a URL address. Solar powered electric car battery monitoring System by Shirish Man Shakya[] (2018). This paper describes a system that charges the battery of an electric car using solar panels as the car moves. The battery gets charged by the solar panels, and the system shows the total distance the car can travel with its available battery. This system requires sunlight always.

Solar Powered Electric Vehicle by Vijay Prathap,.This paper describes the design of a solar-powered electric vehicle. The vehicle is made up of an electric battery board, storage, and a motor, and it runs on solar power. The vehicle's speed exceeds 60-70 km/h, and the aerodynamic shift will provide the most driving resistance in comparison to the other resistance for the standard car. The two research papers mentioned here provide detailed information on the design and development of solar-powered electric vehicles and charging stations. One of the papers talks about an experimental solar-based charging station that uses solar panels to recharge a stationary battery. The charging process is regulated by a classical charge controller and a converter that is regulated by a specially developed PIC microcontroller. To ensure efficient charging, the photovoltaic panel number, battery capacity, and electronic components calibration have to be accurately calculated based on the expected power and the utilization ratio of the charging station.

The second paper discusses the design of a solar-powered electric hybrid vehicle that can also be charged using an adapter with AC current. The vehicle operates on solar power and has a minimum efficiency due to the absence of a tilt angle. Both papers offer valuable insights into the current state-of-the-art in the field of solar-powered electric vehicles and charging stations, and can

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be used to conduct literature surveys for technical papers.

III. TOOLS REQUIRED

RL 78 Renesas Microcontroller

The RL78 is a microcontroller unit (MCU) manufactured by Renesas Electronics. It is based on the 16-bit RL78 CPU core and is widely used in embedded systems due to its low power consumption, high performance, and rich set of peripherals. The RL78 MCU family includes a wide range of products that are suitable for various applications, including home appliances, automotive systems, industrial equipment, and healthcare devices. The RL78 Renesas board is a development board that is designed to evaluate and develop applications using the RL78 MCU. It includes a variety of features such as an onboard debugger, LCD display, Ethernet connectivity, and various sensors. The board also has a USB port for easy programming and debugging, and it is compatible with a variety of integrated development environments (IDEs) and compilers. The RL78 Renesas board is a powerful tool for prototyping and developing embedded systems applications using the RL78 MCU. It allows developers to quickly test and evaluate their designs, and it provides a convenient platform for developing new features and functions.

Transformer

Transformers are electronic devices that use electromagnetic induction to transfer electrical energy from one circuit to another. They come in various sizes and are widely used in different applications such as power supplies, communication devices, and audio systems. Transformers can be small in size but can handle power ratings ranging from a few milliwatts to several hundred watts. They are commonly used to step up or step down voltage levels, isolate circuits from one another, and provide impedance matching. Depending on the specific requirements of the application, transformers can be designed using different core materials, such as laminated iron, ferrite, and powdered iron. Small transformers are particularly popular in electronic circuits because of their high efficiency, low cost, and compact size. They have proven to be a reliable and versatile solution for a wide range of electronic

Android App

The key features of an EV charging app, including user login, admin login, and details about the charge and the user. The user login feature is an essential component of an EV charging app, as it allows EV owners to access the app and use its features. The user login screen usually requires the user to enter their email address or username and password. Once logged in, the user can access features such as finding nearby charging stations, reserving charging spots, and making payments. The admin login feature is designed for charging station operators or owners who manage the charging stations. The admin login screen typically requires the user to enter their username and password. Once logged in, the admin can view and manage charging stations, monitor usage and revenue, and generate reports. The details about the charge feature provides EV owners

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with information about the charging process, including the charging rate, estimated charging time, and cost. This feature allows users to plan their charging sessions in advance and estimate the cost of charging their EV. Some apps also allow users to set charging reminders, so they receive notifications when their EV battery is fully charged.

The details about the user feature provides EV owners with information about their account, including their charging history, payment history, and account balance. This feature enables users to track their charging and payment activities and manage their account balance. An EV charging app is a convenient and user-friendly tool that allows EV owners to locate and access charging stations. The app provides a range of features, including user login, admin login, details about the charge, and details about the user. These features enable users to manage their charging sessions, track their charging and payment activities, and manage their account balance. EV charging apps are an essentialcomponent

IV. METHODOLOGY

This project aims to create a solar-powered electric vehicle (EV) charging station that is easy to use and can be monitored remotely. The first step is to create a block diagram of the system, which will serve as a guide for the project. The diagram includes components such as a solar panel, battery, transformer, relay, voltage controller, microcontroller, LCD display, keys, GSM modem, and Android app. Next, individual printed circuit boards (PCBs) are designed for each interface according to the block diagram. These PCBs will be connected to create a prototype module for the project. The Renesas microcontroller is used to control all the operations in the project, which involves programming the microcontroller to perform various functions such as controlling the relay, displaying voltage readings on the LCD, and sending SMS alerts via the GSM modem.

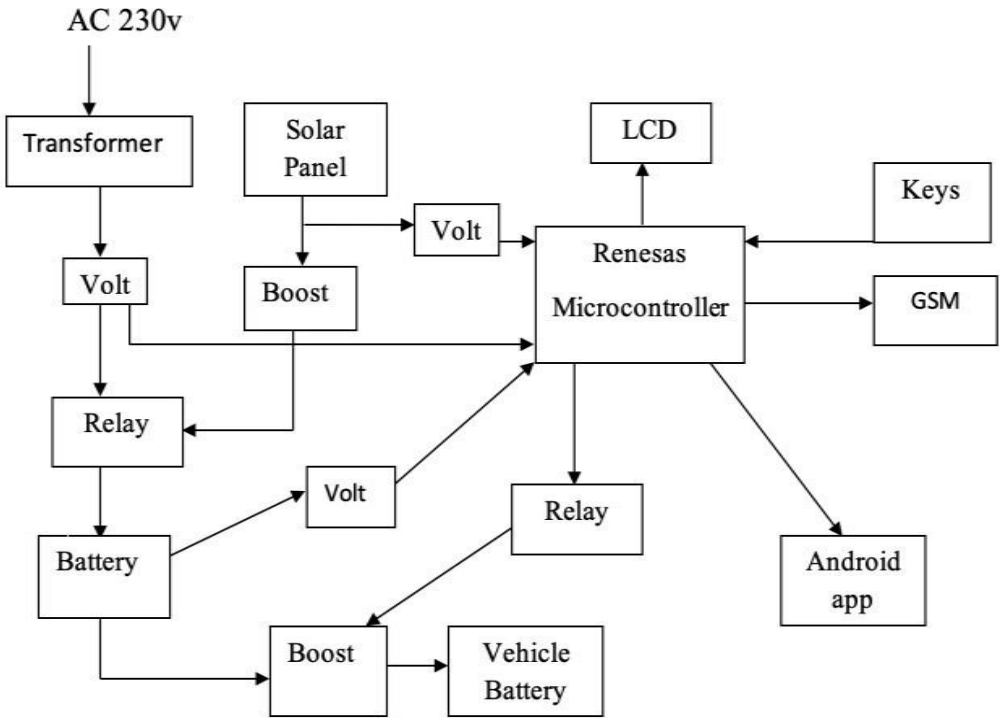

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Fig. 2: Methodology of proposed technique

The LCD display is used to show all the operations that are going on inside the microcontroller, including voltage readings, charging status, and battery level. The solar panel and transformer are connected to a relay through a voltage controller board, which controls the voltage and current flowing from the solar panel and transformer to the battery. The relay is used to switch between the solar panel and transformer based on the availability of sunlight.

For EV charging, the priority is given to the solar panel, and the microcontroller controls the charging process accordingly. Once charging is complete, a GSM modem is used to send an SMS alert to the user indicating thatthe charging is done. An Android app is developed to track the status of the charging station and the EV, allowing users to monitor the charging process remotely. In summary, the project involves integrating various components to create a solar-powered EV charging station that is easy to use and can be monitored remotely.

V. WORKING OF SOLAR POWER STATION

A solar-based EV charging station is made up of three key components: solar panels, batteries, and a charging controller. The solar panels generate electricity from the sun, which is then stored in batteries or sent directly to the power grid. The charging controller manages the flow of electricity from the solar panels or battery to the EV battery, making sure it is charged safely and efficiently. When an EV is plugged into a solar-based charging station, the charging process begins. First, the user is authenticated and the charging process is initiated through a mobile app or RFID card. Then, the charging controller sends a signal to the EV to begin charging. The charging controller makes sure the voltage and current are within the safe range set by the manufacturer and monitors the temperature to prevent overheating, which could cause permanent damage to the battery.

Efficiency and safety are important considerations during the charging process. The charging controller ensures that the electricity is delivered to the EV battery as efficiently as possible, minimizing charging time and reducing energy waste. It also prevents overcharging, undercharging, and protects against power surges, short circuits, and other electrical faults that could harm the EV battery or the charging station. Solar-based EV charging stations are environmentally friendly and sustainable. They are managed by a charging controller, which guarantees that the EV battery is charged safely and efficiently. As more people switch to electric vehicles, solar-based EV charging stations will play an increasingly important role in our transportation infrastructure.

VI. CONCLUSIONS

The use of Internet of Things (IoT) technology in battery monitoring systems for managing energy storage in vehicles is an exciting development. This technology allows real-time monitoring of the battery's status, and the data is sent to a cloud platform for easy management. With the help of IoT sensors, vehicle users can conveniently check the battery's condition and determine if they need to find a charging station. They can also keep track of how much battery power is being used,

which helps them better understand their energy consumption. To ensure data availability, the system stores information in an Arduino even if the battery fails to charge. This allows for analyzing past battery performance and identifying any potential issues or trends. Furthermore, the system can store and update multiple user profiles in a database. This feature enables monitoring and distribution of energy to different users of electric vehicles at charging stations. It helps optimize energy allocation and ensures that charging stations can accommodate multiple users effectively.

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