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Wireless Vehicle Charging Station with Solar Panel

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Abstract: *Wireless Power Transfer (WPT) systems transfer electric energy from a source to a load without any wired connection. WPTs are attractive for many industrial applications because of their advantages compared to the wired counterpart, such as no exposed wires, ease of charging, and fearless transmission of power in adverse environmental conditions. Adoption of WPTs to charge the on-board batteries of an electric vehicle (EV) has got attention from some companies, and efforts are being made for development and improvement of the various associated topologies. WPT is achieved through the affordable inductive coupling between two coils termed as transmitter and receiver coil. In EV charging applications, transmitter coils are buried in the road and receiver coils are placed in the vehicle. Inductive WPT of resonant type is commonly used for medium-high power transfer applications like EV charging because it exhibits a greater efficiency. This energy is then stored in the vehicle's battery for later use*

Keywords: Wireless Power Transfer

I. INTRODUCTION

The increasing adoption of electric vehicles (EVs) as a cleaner and more sustainable transportation option has highlighted the need for efficient and convenient charging infrastructure. Traditional charging methods, such as plug-in charging stations, have limitations in terms of user convenience, physical constraints, and the reliance on grid electricity. To address these challenges, wireless vehicle charging technology has emerged as a promising solution. Coupled with the utilization of renewable energy sources, such as solar power, wireless charging stations can provide an environmentally friendly and hassle-free charging experience. The wireless charging system consists of two essential components: a transmitter and a receiver. The transmitter, located within the charging station, generates an alternating magnetic field. This field induces an electric current in the receiver coil, which is installed on the electric vehicle. The receiver coil then converts the magnetic field's energy back into electrical energy, which is used to charge the vehicle's battery. To power the charging station, a solar panel system is integrated into the design. Solar panels are composed of photovoltaic cells that convert sunlight into electricity. This renewable energy source ensures the sustainability and reduced environmental impact of the charging infrastructure. By utilizing solar power, the wireless charging station reduces its reliance on grid electricity, minimizing carbon emissions and operating costs. By combining wireless charging technology with solar energy, this project aims to provide a sustainable and user-friendly solution for electric vehicle charging. The integration of solar panels not only reduces the environmental impact but also enhances the charging station's autonomy and resilience by utilizing renewable energy sources. This project aligns with the global transition towards clean energy and contributes to building a greener and more sustainable future for transportation.

II. LITERATURE SURVEY

Identification of Research Gap: Begin the literature review by identifying the research gap or the specific area of focus within the broader topic. This could include aspects such as wireless power transfer, solar panel integration, charging efficiency, alignment mechanisms, safety protocols, or any other relevant aspects of wireless vehicle charging stations.
Search Strategy: Develop a comprehensive search strategy to identify relevant literature sources. This typically involves searching academic databases, research journals, conference proceedings, industry reports, and relevant websites. Use appropriate keywords and combinations to narrow down the search and retrieve relevant articles.

- Selection Criteria: Establish specific criteria for selecting literature sources. These criteria may include the publication year, relevance to the research topic, credibility of the authors, and the quality and impact factor of the journals or conferences. This step ensures that the selected literature is reliable and contributes to the reasearch objectives
- Literature Evaluation: Conduct a critical evaluation of the selected literature sources. Evaluate the methodology, data collection techniques, and analysis methods employed in each study. Assess the strengths and weaknesses of the research, identify any limitations or gaps in the existing studies, and evaluate the overall quality of the literature.
- Synthesis and Analysis: Synthesize the information from the selected literature and analyze the key findings, methodologies, and outcomes of each study. Look for commonalities, patterns, and contradictions within the literature to gain a comprehensive understanding of the current state of knowledge on the topic.
- Themes and Subtopics: Organize the literature into themes and subtopics based on the research objectives and key areas of interest. This helps in presenting a structured and coherent review of the literature. Grouping the literature under relevant themes allows for easier comparison and identification of trends or gaps in the existing research.
- Critical Discussion: Engage in a critical discussion of the literature. Compare and contrast the findings, methodologies, and conclusions of different studies. Discuss any discrepancies, conflicting results, or areas of consensus among the studies. Highlight the strengths and weaknesses of the existing literature and identify opportunities for further research.
- Citation and Referencing: Properly cite and reference all the literature sources used in the review. Follow the appropriate citation style (e.g., APA, MLA) to ensure accuracy and consistency.

III. BLOCK DIAGRAM

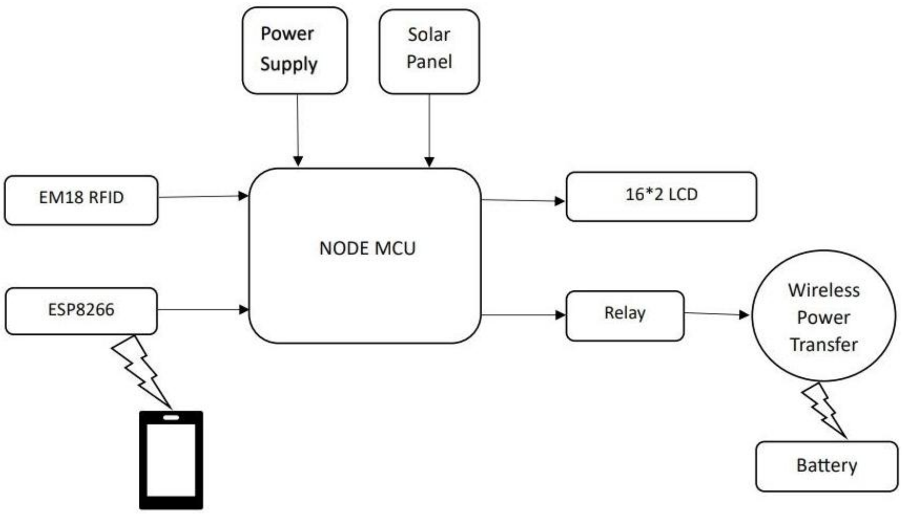

Figure 1: Wireless vehicle charging station with solar panel

NodeMCU: NodeMCU can be used in a wireless charging station. The NodeMCU is an open-source development board based on the ESP8266 microcontroller. It provides Wi-Fi connectivity and is popular for IoT (Internet of Things) projects.

NodeMCU can be used to control the operation of the wireless charging station, such as starting or stopping the charging process, adjusting power levels, or monitoring the charging status. It can communicate with the charging circuitry and sensors to gather data and make decisions based on that information.

NodeMCU can be used to create a user interface for the wireless charging station. It can host a web server to provide a web-based control panel accessible from a smartphone or computer. Users can monitor charging status, set charging parameters, or receive notifications through this interface.

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EM18 RFID: EM18 RFID is a commonly used RFID (Radio Frequency Identification) reader module. It is designed for reading RFID tags at a frequency of 125kHz.The EM18RFID module is primarily used for RFID applications such as access control systems, inventory management, or tracking systems. It operates at a frequency of 125kHz and communicates with compatible RFID tags within its range. The module reads the unique identification number stored on the RFID tag and provides it to the host system.

ESP8266: The ESP8266 is a popular Wi-Fi module commonly used for IoT (Internet of Things) projects. While it is primarily designed for wireless communication and data transfer, it is not suitable for wireless charging on its own.

Wireless charging stations typically rely on technologies such as Qi wireless charging, which use electromagnetic fields to transfer energy between a charging pad (transmitter) and a compatible device (receiver). These charging pads usually require specialized hardware and circuitry to manage the power transfer.

16*2 LCD: A 16*2 LCD (Liquid Crystal Display) is a commonly used alphanumeric display module that consists of 16 columns and 2 rows, allowing for the display of up to 32 characters at a time. These displays are typically used to show simple text-based information and are commonly found in various electronic devices.

Regarding your query about using a 16*2 LCD in a wireless charging station, it's possible to incorporate such a display in the charging station for various purposes.

The LCD can be used to display the charging status of the device being charged. It can show information like the current battery level, charging progress, or any relevant notifications.

Relay: In wireless charging stations, relays are not typically used in the charging process. Wireless charging, also known as inductive charging, relies on the principle of electromagnetic induction to transfer power from the charging station to the device being charged without the need for physical connections.

Relays are electrical switches that are commonly used to control the flow of current in an electrical circuit. They are used to open or close circuits based on electrical signals received from other components or systems. Relays are typically used in applications where electrical isolation or control of high-power devices is required.

Flowchart:

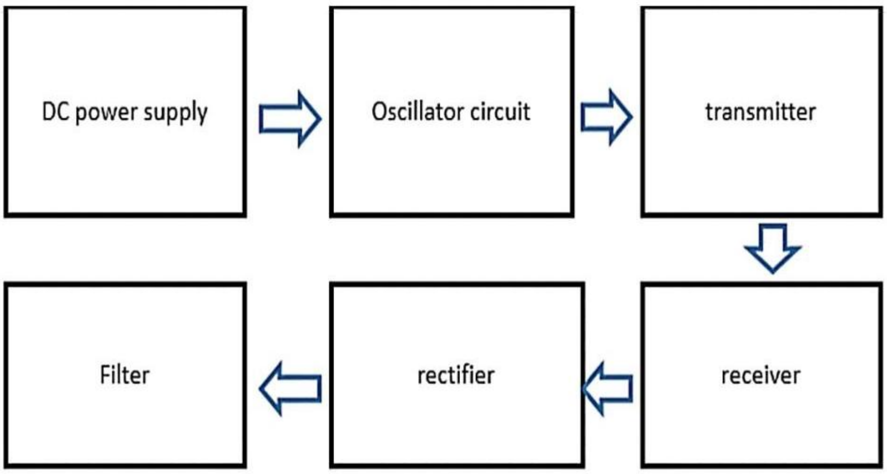

Fig. 2 Flowchart of Wireless charging station.

IV. RESULTS AND DISCUSSION

- Convenience: Wireless charging stations offer a high level of convenience by eliminating the need for cables or adapters. Users can simply place their compatible device on the charging pad, and the charging process begins automatically. This feature is particularly beneficial for individuals who frequently charge their devices or have multiple devices to charge simultaneously.
- Efficiency: Over the years, wireless charging technology has significantly improved in terms of energy transfer efficiency. Modern wireless charging stations can deliver power to devices with minimal energy loss,

ensuring faster charging times compared to previous iterations. However, it is worth noting that charging efficiency may vary based on the specific charging station and the device being charged.

- Compatibility: One area of concern for wireless charging is device compatibility. While many smartphones and other portable devices now support wireless charging, not all devices are compatible with the same charging standard. There are multiple wireless charging standards in the market, such as Qi, Powermat, and PMA (Power Matters Alliance). It is crucial to ensure that the wireless charging station supports the specific standard required by the device for seamless charging.
- Positioning and Alignment: Proper alignment and positioning of the device on the charging pad are essential for efficient charging. Misalignment or obstructions between the charging pad and the device can lead to reduced charging efficiency or even failure to charge. However, advancements in technology, such as multiple coil designs and alignment guides, have improved the ease of alignment and reduced charging interruptions.
- Charging Range: Wireless charging typically requires close proximity between the charging pad and the device. The charging range can vary depending on the specific charging station and the power output. Generally, the charging distance is limited to a few centimeters, ensuring safe and efficient power transfer. It is essential to consider the charging range and placement requirements when selecting a wireless charging station.
- Safety: Wireless charging stations are designed with safety features to prevent overheating, overcharging, and other potential risks. These features include temperature sensors, foreign object detection, and intelligent charging controls. However, it is still important to use certified and reputable charging stations to ensure proper safety measures are in place.

V. CONCLUSION

The project on designing and implementing a wireless vehicle charging station with a solar panel offers sustainable and convenient charging solutions for electric vehicles. The incorporation of various algorithms optimizes power management, alignment, scheduling, safety, grid interaction, and energy monitoring. These algorithms contribute to efficient charging, enhance user experience, promote sustainability, and advance electric vehicle infrastructure. Future developments can focus on further optimizing algorithms for improved performance and reliability. Overall, the project supports the transition towards greener transportation and more sustainable future.

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