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Solar Wireless Electric Charging System

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Abstract- Electric vehicles (EVs) need fast, cost-effective, and reliable charging systems to operate efficiently. Wireless charging eliminates the hassle of physically plugging in a charger, offering a more convenient alternative to traditional wired systems. Additionally, wireless charging is considered environmentally and user-friendly since it removes the need for cables, mechanical connectors, and related infrastructure. This paper explores the fundamental structure, working principles, and unique aspects of wireless EV charging. It first explains the general techniques of wireless power transfer. Then, it categorizes and examines different wireless charging systems for EVs, covering both stationary and dynamic charging methods. A key focus of this study is Dynamic Wireless Charging, an innovative approach that allows EVs to charge while in motion. This system is based on magnetic resonance power transfer, where the transmitting coil selectively turns ON/OFF to supply power only when a vehicle is in range. This prevents energy waste, as the system activates only when the receiver coil aligns with the transmitter. When this happens, the magnetic flux induces voltage in the receiver coil, enabling efficient energy transfer. The paper also discusses the control mechanisms of wireless EV charging systems, summarizes key findings, and offers recommendations for future research.

Index Terms-Wireless Power Transfer (WPT), Solar Energy Harvesting,Electric Vehicles (EVs) Charging, Sustainable Energy Solutions.

INTRODUCTION

Electric vehicles (EVs) are one of the promising solutions to improve economic efficiency and reduce the carbon footprint in the transportation sector.

Earlier research is focused on the plug-in and conductive solutions for charging the EVs and addressed the challenges of integrating this technology into electricity networks. Plug-in EVs have limited travel range and require large and heavy
batteries. Therefore, conductive charging strategies require long waiting time that limits the applicability of EVs compared to gasoline-powered vehicles.

The Solar Wireless Electric Charging System represents a cutting-edge innovation in the realm of sustainable transportation and renewable energy integration. This system is designed to provide an efficient, wireless solution for charging electric vehicles (EVs) using solar energy, eliminating the need for conventional plug-in charging methods. The primary objective is to leverage solar power to wirelessly charge vehicles, reducing dependence on fossil fuels and minimizing the environmental impact of transportation.

In addition to wireless charging, the system incorporates advanced monitoring capabilities. It is equipped with sensors that continuously track the voltage and current being drawn by the
vehicle from the charging station. This data is displayed in real-time on an LCD screen, allowing users to monitor key parameters such as energy consumption, battery status, and overall charging efficiency. The integration of these monitoring features not only enhances user
convenience but also promotes efficient energy management, ensuring that the system operates at optimal performance levels.

By combining wireless charging technology with solar energy and real-time monitoring, this system offers a sustainable, user-friendly, and efficient solution for the future of electric vehicle charging infrastructure.

PROBLEM STATEMENT

With the increasing demand for renewable energy and wireless technology, there is a growing need for an efficient and sustainable method of charging electronic devices and electric vehicles (EVs). Traditional wired charging systems are often inconvenient, require extensive infrastructure, and contribute to wear and tear over time.

Solar energy offers a clean and abundant power source, but integrating it with wireless charging technologies presents several challenges. These include energy conversion inefficiencies, inconsistent power availability due to weather conditions, and limitations in wireless power transmission distance and efficiency.

This research aims to address these challenges by developing a solar-powered wireless charging system that can efficiently harvest solar energy, store it, and transmit power wirelessly to various devices. The goal is to optimize energy conversion, improve power transfer efficiency, and ensure reliable charging performance, even in fluctuating environmental conditions.

LITERATURE REVIEW

Wireless power transfer (WPT) is a technology that allows electrical energy to be transmitted without the need for direct physical contact. Among the various methods, inductive coupling is widely used, especially in consumer electronics and electric vehicle charging. However, it struggles with efficiency over longer distances. Resonant inductive coupling enhances both range and efficiency by utilizing resonant circuits. Capacitive coupling, which relies on electric fields for energy transfer, is less common due to its lower power capacity. Meanwhile, microwave and laser-based power transfer offer long-range solutions but come with challenges such as energy losses and safety concerns.

Solar energy, being one of the most abundant and sustainable power sources, plays a crucial role in wireless charging. Photovoltaic (PV) panels convert sunlight into electricity, which can either be stored in batteries or used directly for charging. Recent advancements in PV technology focus on multi-junction solar cells and perovskite-based materials to improve efficiency. Efficient battery technologies, like lithium-ion and supercapacitors, help stabilize solar power fluctuations, while smart charge controllers and maximum power point tracking (MPPT) algorithms enhance overall energy utilization.

Despite its potential, integrating solar energy with wireless charging presents several challenges. Converting DC power from solar panels into AC for wireless transmission leads to power conversion losses. Solar energy generation also depends on weather conditions, making hybrid energy systems necessary for consistent performance. Additionally, the efficiency of energy transmission in wireless charging decreases with increasing distance and improper alignment between the transmitter and receiver.

Ongoing research and developments in solar wireless charging systems have led to significant advancements in various applications. In the field of electric vehicles, solar-powered wireless charging stations can reduce dependence on conventional grid electricity. For wearable technology and IoT devices, wireless charging through solar energy provides a more convenient and sustainable power solution. Moreover, solar wireless charging can play a crucial role in remote and rural electrification, offering off-grid power solutions to areas where traditional wired infrastructure is unavailable.

METHODOLOGY

1. System Design

• Define Objectives: Establish the primary objectives of the system, which include wireless charging of electric vehicles (EVs) using solar energy, monitoring voltage and current during the charging process, and displaying parameters on an LCD screen.
• Conceptual Design: Create a schematic diagram illustrating the overall system architecture, including the solar panel, wireless charging module, battery storage, microcontroller, voltage/current sensors, and LCD display.

2. Component Selection

• Solar Panels: Choose appropriate solar panels based on the desired charging capacity and efficiency.
• Wireless Charging Module: Select a suitable wireless power transfer technology (e.g., inductive or resonant coupling) that supports the charging requirements of the vehicle.
• Microcontroller: Use a microcontroller (e.g., Arduino or ESP32) to manage data acquisition from sensors, control the charging process, and interface with the LCD.
• Voltage/Current Sensors: Incorporate sensors such as Hall effect sensors or shunt resistors to measure voltage and current accurately.
• LCD Display: Choose an appropriate LCD display (e.g., 16x2 or 20x4) to visualize parameters such as voltage, current, and charging status.

3. Implementation

• Circuit Design and Assembly: Design the circuit using software tools (e.g., Fritzing or KiCAD) and assemble the components on a prototyping board or custom PCB.

• Programming the Microcontroller:
o Write a program to read voltage and current data from the sensors.
o Implement algorithms for calculating charging efficiency and status.
o Program the microcontroller to display real-time data on the LCD.
• Wireless Charging Setup: Integrate the wireless charging module with the solar panel and battery storage, ensuring proper alignment and connection for optimal power transfer.

4. Testing and Calibration
• Initial Testing: Conduct preliminary tests to ensure all components are functioning correctly and that the microcontroller is properly reading sensor data.
• Calibration: Calibrate the voltage and current sensors for accurate measurements, adjusting the code as necessary to account for any discrepancies.
• Performance Evaluation: Test the charging system with different electric vehicles to evaluate the efficiency of the wireless charging process. Measure and record the charging time and efficiency.
• Data Logging: Implement data logging capabilities to store and analyze charging data for further optimization.

5. Integration and Finalization
• System Integration: Combine all components into a cohesive unit, ensuring that the solar panels, charging module, and display are all securely mounted and protected from environmental factors.
• Final Testing: Conduct extensive testing of the complete system to validate performance under various conditions (e.g., different sunlight exposure and vehicle battery states).
• Documentation: Prepare comprehensive documentation, including circuit diagrams, code, and user manuals, detailing the installation, operation, and maintenance of the system.

6. Deployment
• Installation: Install the system in a suitable location for optimal solar exposure, considering factors such as shading and orientation.
• User Training: Provide training for users on how to operate the system, interpret the data displayed on the LCD, and maintain the solar charging station.Existing system
In present scenario the client has to shop for ration the use of ration card from the ration stores. while get commodities from the ration save, client want to post the ration card and similarly sign within the ration card for file the details. In some ration keep rather than signal they'll affirm thru biometric process and quantity of ration will relies upon upon the ration card sorts. After the shopkeeper will problem the ration through weighting system with the help of human intervention. In such instances having drawbacks, first of all is weight of the commodities or grains can be inaccurate in amount due to human errors even as weighting the materials. 2d isn't always keeping data of distributed substances info in the ration save. the store keeper will entries fake or wrong information of allotted substances. Making earnings through selling materials on the market at high charge. Finger print is the final factor to sells the commodities or the cardboard holders. the present device of public distribution system works in a stage in which because the obligations are taken among kingdom and middle government. state government is chargeable for locating bad humans and offering centers to them. but central government is answerable for buying foods or grains at minimal price. The center government will decide the allocation of the material to the each state.

HARDWARE COMPONENTS

1. The Arduino Uno is a microcontroller board built around the ATmega328, designed for ease of use and versatility. It features 14 digital input/output pins, six of which support PWM output, along with six analog inputs. The board operates at 16 MHz and includes essential components such as a USB connection, power jack, ICSP header, and a reset button. It provides all necessary functionality to support the microcontroller and can be powered via a USB cable, AC-to-DC adapter, or battery.
2. The Wireless Power Supply Transmitter Receiver Charging Coil Module is a compact and efficient 12V 2A wireless charging module. It is commonly used for powering small electronic devices and supports

wireless power transmission with high efficiency and ease of use. Its affordability and compact size make it ideal for development and design applications in wireless charging solutions.

3. A relay is an electromechanical switch that enables automatic ON and OFF operations without human intervention. It is widely used when controlling circuits with low-power signals while maintaining electrical isolation between the control and controlled circuits. Relays are particularly useful in applications requiring multiple circuit control through a single signal.
4. A battery is an energy storage device that directly converts chemical energy into electrical energy. It consists of multiple voltaic cells, each comprising two half-cells connected by a conductive electrolyte. One half-cell contains the anode (negative electrode) where anions migrate, while the other half-cell contains the cathode (positive electrode) where cations migrate. This movement of charged ions enables the battery to generate an electrical current, making it an essential component in portable power applications.

FUTURE SCOPE

1. Increased Charging Efficiency: Future iterations could focus on increasing the charging speed and efficiency through advanced wireless charging protocols, reducing charging time for electric vehicles (EVs) and making it more competitive with conventional charging stations.
2. Integration with Smart Grid Systems: By connecting with smart grids, this system could optimize energy use by charging during off-peak hours and supplying excess energy back to the grid, helping balance the power demand and reducing the load on the grid.
3. Enhanced Monitoring and Data Analytics: Improved data analytics could help track energy consumption trends, identify peak usage times, and provide insights to optimize charging operations. This data could be stored and analyzed to improve system performance over time.
4. Battery Health Monitoring: The system could incorporate battery health diagnostics to monitor the vehicle’s battery status and lifespan, allowing predictive maintenance and improving the longevity of EV batteries.
5. Expanded Compatibility for Various Vehicles: The system could be adapted to accommodate different EV types, from smaller personal vehicles to larger commercial EVs, enabling more flexible applications and broader usage.
6. Incorporation of IoT and Remote Monitoring: Through IoT integration, the system could be controlled and monitored remotely via a mobile app, providing users with realtime data on charging status and system performance.
7. Automated Payment and Billing Systems: The charging system could be linked with digital payment systems, allowing for automated billing based on energy consumed, making it convenient for users and enabling public or commercial use in various settings.
8. Environmental Monitoring and Carbon Offset Calculation: The system could incorporate environmental sensors to monitor local conditions, calculating carbon offsets from using renewable energy for charging. This feature would appeal to ecoconscious users and help promote sustainable energy usage.
9. Scalability for Commercial and Urban Infrastructure: As cities move toward electric vehicle adoption, such charging systems could be implemented in public spaces, parking lots, and commercial facilities, providing scalable, sustainable EV infrastructure.
10. Hybrid Renewable Energy Integration: In addition to solar power, future systems might include hybrid renewable energy sources like wind or hydro, increasing reliability and ensuring a consistent power supply even in areas with limited sunlight.

Result

Conclusion

The Solar Wireless Electric Charging System represents a major breakthrough in sustainable energy solutions for electric vehicles. By harnessing solar power, this system enables efficient and hassle-free wireless charging, eliminating the need for conventional plug-in methods. With real-time monitoring capabilities, users can accurately track voltage and current levels, ensuring transparency in energy transfer. The inclusion of an LCD display further enhances the user experience by providing clear visibility of the system's performance, allowing for informed charging decisions.

Beyond its convenience, this system plays a crucial role in reducing reliance on fossil fuels and showcasing the potential of renewable energy in modern transportation. As electric vehicles continue to grow in popularity, the adoption of such advanced charging technologies will be essential in building a more sustainable future, contributing to a cleaner and more efficient transportation network.

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