

Wireless Charging of an Electric Vehicle Using Solar and Wind Power

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ABSTRACT

The increasing adoption of electric vehicles (EVs) has created a need for convenient, sustainable, and reliable charging infrastructure. Conventional plug-in charging systems depend primarily on grid electricity and require physical connectors, which can limit accessibility and convenience. This paper presents a prototype wireless charging system for an electric vehicle powered by solar and wind energy. The proposed system integrates renewable energy generation, battery storage, high-frequency power conversion, and resonant wireless power transfer. Solar and wind energy are rectified and filtered before being combined and stored in a 12-V rechargeable battery. The stored energy is converted into high-frequency pulses using a MOSFET-based switching circuit and supplied to a transmitting copper coil. A receiving coil mounted on the vehicle captures the electromagnetic energy through resonant inductive coupling. The received AC voltage is rectified and filtered before being supplied to the vehicle battery. The developed prototype operates with a pulse frequency of approximately 100 kHz and demonstrates wireless energy transfer over a distance of about 10 cm. The system provides a proof-of-concept for renewable-energy-powered wireless EV charging, particularly for off-grid, residential, public and remote charging applications.

Keywords— Electric vehicle, wireless power transfer, solar energy, wind energy, resonant inductive coupling, renewable energy, EV charging.

INTRODUCTION

The rapid growth of electric vehicles has increased the demand for efficient and convenient charging infrastructure. Conventional EV charging generally requires a physical connection between the vehicle and charging station. Such systems can be inconvenient for users and remain dependent on the availability of suitable electrical infrastructure. The project reported in the source document addresses these challenges by combining wireless power transfer with renewable energy sources. The proposed system uses solar and wind energy to generate and store electrical energy, which is subsequently transferred wirelessly to an electric vehicle.

Wireless power transfer enables electrical energy to be transmitted from a source to a load without a conductive physical connection. In the proposed system, two copper coils form the principal wireless power-transfer interface. The transmitter coil is excited using a high-frequency signal, producing an alternating magnetic field. The receiver coil, positioned on the vehicle, receives the energy through electromagnetic induction. Resonant operation between the coils is used to improve the transfer of energy across the air gap.

Renewable energy integration provides an additional advantage by reducing dependence on conventional grid electricity. The system combines solar and wind sources so that the two sources can complement each other under changing environmental conditions. The generated energy is rectified, filtered and stored in a rechargeable battery before being used for wireless transmission. This approach is particularly relevant to remote and off-grid locations where conventional charging infrastructure may be difficult to establish.

The developed prototype therefore focuses on three major aspects: renewable energy-based power generation, wireless transfer of electrical energy, and battery-powered vehicle operation. The project uses a 100-kHz pulse generator,

MOSFET switching, copper coils, rectification and filtering circuits to demonstrate the proposed concept. The resulting prototype establishes the feasibility of combining renewable energy generation and wireless EV charging in a compact system.

LITERATURE SURVEY

Cheng and Li [1] reviewed wireless power transfer (WPT) technologies, applications, and future trends, highlighting the importance of efficient and reliable wireless energy transmission for modern applications. Singh *et al.* [2] discussed wind-solar hybrid renewable energy systems and emphasized their potential for sustainable power generation by combining two complementary renewable sources. Zhao *et al.* [3] investigated recent developments and challenges in near-field wireless power transfer systems, with particular emphasis on resonant coupling, transmission distance, coil alignment, and transfer efficiency. Ahmed *et al.* [4] studied the integration of wireless power transfer with photovoltaic systems and discussed the role of power-electronic converters in transferring renewable energy to wireless charging systems. These studies demonstrate the potential of combining renewable energy sources with wireless power-transfer technology for sustainable electric vehicle charging.

Li and Mi [5] presented a comprehensive review of wireless power transfer technologies for electric vehicles, including inductive and resonant coupling methods, and identified transfer efficiency and charging distance as important design considerations. The reviewed studies indicate that wireless charging can improve user convenience by eliminating physical connectors, while renewable energy sources can reduce dependence on conventional grid power. Based on these findings, the proposed system integrates solar and wind energy with battery storage and resonant wireless power transfer. The developed prototype uses a high-frequency switching circuit and copper coils to transfer energy wirelessly to the vehicle, followed by rectification and battery charging. Thus, the proposed approach combines sustainable energy generation and convenient wireless charging to provide a potential solution for future electric vehicle charging infrastructure.

PROBLEM STATEMENT

Conventional EV charging systems depend substantially on grid electricity and require physical connectors. Such charging infrastructure may be inconvenient and difficult to deploy in remote or off-grid areas. Furthermore, dependence on conventional electricity generation can increase environmental impact. Therefore, there is a need for a charging system that combines renewable energy generation with convenient wireless power transfer. The proposed project addresses this requirement by developing a solar- and wind-powered wireless EV charging system.

OBJECTIVES

The major objectives of the proposed system are:

1. To develop a renewable-energy-based power-generation and storage system using solar and wind energy for EV charging.
2. To implement wireless power transfer using resonant copper coils for charging the EV battery without a physical electrical connection.

PROPOSED SYSTEM

The proposed system integrates solar energy, wind energy, battery storage, and wireless power transfer to provide a sustainable charging solution for an electric vehicle. Solar panels and a wind turbine generate electrical energy, which is rectified, filtered, and combined using suitable diodes before being stored in a 12-V rechargeable battery. The stored DC power is supplied to a high-frequency pulse-generation and MOSFET switching circuit. The switching circuit produces approximately 100-kHz pulses that energize the transmitting copper coil and generate an alternating magnetic field. This arrangement enables renewable energy generated from solar and wind sources to be utilized for wireless vehicle charging.

On the vehicle side, a receiving copper coil is positioned opposite the transmitting coil to capture the transmitted electromagnetic energy. The induced AC voltage is converted into DC using a bridge rectifier and filtering capacitor, and the resulting DC power is supplied to the rechargeable battery. The battery subsequently provides power to the motor driver and DC motors for vehicle operation. The developed prototype demonstrates wireless power transfer over a distance of approximately 10 cm. The proposed system therefore combines renewable energy generation, energy storage, high-frequency power conversion, and wireless charging into a single system, reducing the requirement for physical charging connections.

BLOCK DIAGRAM

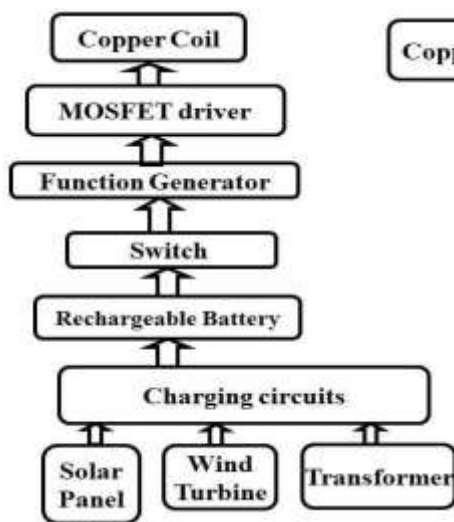


Fig 1 Block diagram of Station

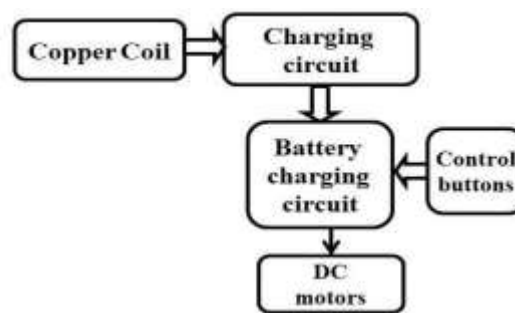


Fig 2 Block diagram of vehicle

Circuit Diagram

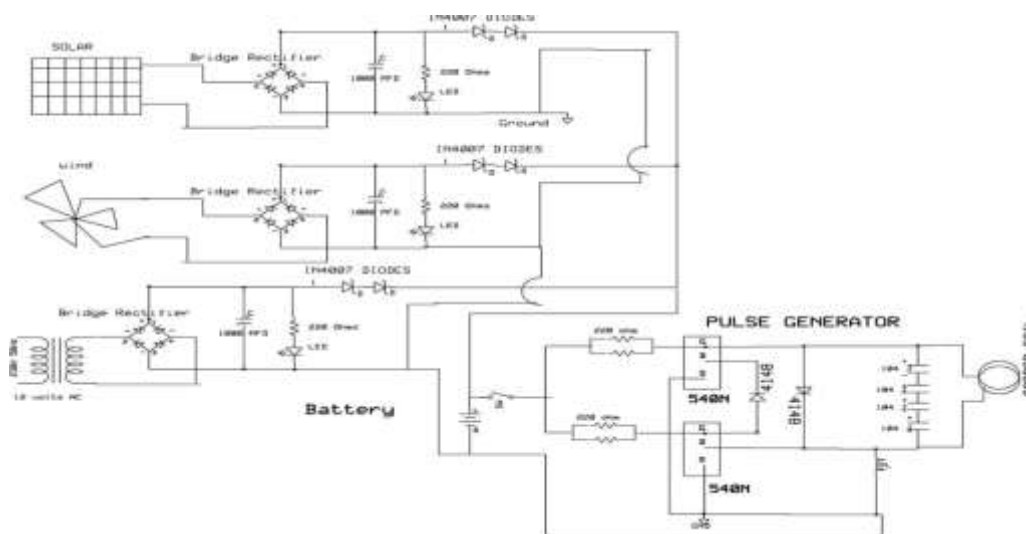


Fig.3 Circuit diagram(Transmitter side)

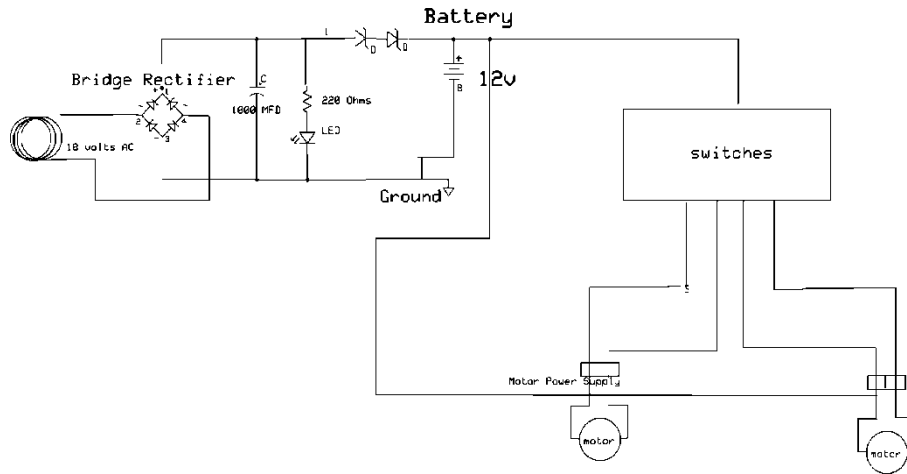


Fig 4 Vehicle circuit diagram(receiver side)

METHODOLOGY

The proposed system begins with the generation of electrical energy from **solar and wind sources**. The outputs of the solar panel and wind turbine are processed through rectification and filtering circuits to obtain a suitable DC supply. The renewable energy sources are integrated using diodes to prevent reverse current flow, and the generated energy is stored in a **12-V rechargeable battery**. The stored DC power is then supplied to a high-frequency pulse-generation circuit. A MOSFET-based switching circuit converts the DC supply into high-frequency pulses of approximately **100 kHz**, which are applied to the transmitting copper coil.

The high-frequency current flowing through the transmitting coil produces an alternating magnetic field, which induces voltage in the receiving copper coil placed on the vehicle. The received AC voltage is converted into DC using a **bridge rectifier and filtering capacitor** and is supplied to the vehicle battery for charging. The charged battery provides power to the motor driver and DC motors, enabling vehicle movement. The prototype demonstrates wireless power transfer at an approximate distance of **10 cm**, with coil alignment and separation being important factors affecting the transfer performance.

RESULTS AND DISCUSSION

The developed prototype successfully integrates solar energy, wind energy, and a transformer-based supply to charge the battery used for powering the transmitting coil. The vehicle acts as the receiving unit and receives electrical energy wirelessly from the transmitting coil through copper coils. The vehicle is powered by a battery connected to DC motors, and its movement is controlled using control buttons. This arrangement demonstrates the feasibility of combining renewable energy sources with wireless power transfer for electric vehicle charging.

The experimental system achieved wireless power transfer over a distance of approximately **10 cm**. A pulse generator operating at **100 kHz** was used in the transmitter circuit to generate the required high-frequency signal. The transmitting coil transfers electrical energy to the receiving coil through electromagnetic coupling. The received AC voltage is then supplied to a rectifier, which converts it into DC voltage for charging the vehicle battery. The charged battery subsequently supplies power to the DC motors, enabling vehicle operation. The prototype therefore demonstrates the basic functionality of renewable-energy-powered wireless charging for an electric vehicle.

Fig5 Hardware setup



Fig 6 charging battery from solar panel



Fig 7 charging battery from wind turbine

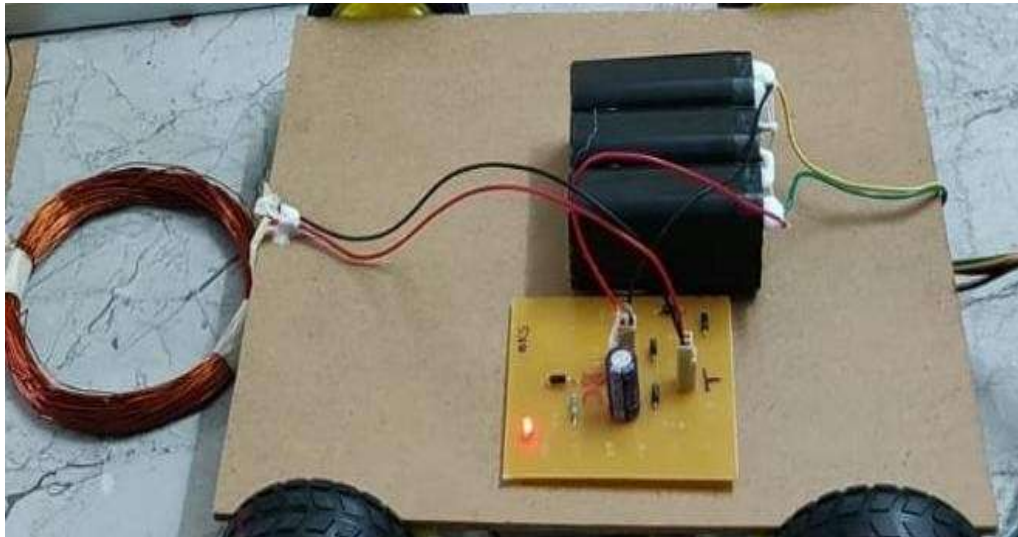


Fig 8 charging vehicle

CONCLUSION

The proposed system successfully integrates solar and wind energy with wireless power transfer for electric vehicle charging. The developed prototype combines renewable energy generation, battery storage, high-frequency switching, and copper-coil-based wireless power transfer to charge the vehicle battery without a physical connection. The system uses a 100-kHz pulse generator at the transmitter and achieves wireless energy transfer over an approximate distance of 10 cm.

The experimental implementation demonstrates the feasibility of using renewable energy sources for wireless EV charging and vehicle operation. The received AC power is rectified and converted into DC power for charging the vehicle battery, which subsequently drives the DC motors. The integration of solar and wind energy with wireless charging provides a sustainable and convenient approach for future EV charging applications, particularly in locations where reducing dependence on conventional grid power is desirable.

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