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Wireless Power Transfer Based Charging System for Electric Vehicles

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KEYWORD

DC to AC conversion; MOSFET inverter; inductive coupling; wireless power transfer; rectifier; LED indicator.

ABSTRACT

This project presents a wireless power transfer system in which direct current (DC) input is first converted into high-frequency alternating current (AC) using MOSFET-based inverters and rectifiers. The high-frequency AC is then applied to a transmitting coil, which creates a magnetic field that wirelessly transfers energy to a receiving coil. The receiving coil captures this alternating current, which is then converted back to DC using a separate rectifier circuit. The stable DC output is used to power a load, represented by LED indicators that light up when energy transfer occurs. This approach showcases a safe, contactless charging solution, suitable for small-scale applications and paving the way for future wireless EV infrastructure.

1. Introduction

As the adoption of electric vehicles (EVs) continues to grow, the need for convenient and safe charging solutions becomes essential. In this project, we present a wireless power transfer system that eliminates the need for physical connectors [1]. By converting a DC input into high-frequency AC using MOSFET inverters, we wirelessly transfer energy from a transmitting coil to a receiving coil. This enables efficient and contactless power delivery, paving the way for future smart charging infrastructures. This system leverages inductive coupling to achieve power transfer without any physical contact, making it ideal for automated EV charging in parking lots, public spaces, and future smart roads. By integrating rectifiers and

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stable circuits, the system ensures a consistent DC output, and the LED indicators provide a clear visual signal that power is being transmitted[2].

2. Literature Survey

Several researchers have explored the potential of wireless power transfer for electric vehicles, each contributing distinct advancements.

Nikola Tesla (Late 19th Century): Nikola Tesla was one of the first pioneers of wireless energy transfer. In his experiments, he demonstrated that electrical energy could be transmitted through the air using resonant inductive coupling. Although his work was primarily theoretical, it laid the groundwork for future wireless energy concepts [3].

Kurs et al. (2007): In a landmark study, Kurs and his team demonstrated long-range wireless power transfer using resonant inductive coupling. They showed that power could be transmitted efficiently over several meters, achieving a significant leap in energy transfer range. Their work established practical benchmarks for efficiency and opened up possibilities for real-world applications.

Zhang et al. (2019): More recently, Zhang and colleagues focused on improving compactness and efficiency by designing smaller, more effective coil geometries. They incorporated adaptive control algorithms, which dynamically adjusted coil alignment, resulting in improved efficiency even over short distances [4].

3. Material and Methods

3.1 System Overview

In this proposed system, we aim to create a wireless power transfer solution for electric vehicles by converting a DC input into high-frequency AC using MOSFET-based inverters. The AC is transmitted via a primary coil, creating a magnetic field that induces energy in a secondary coil. This induced AC is then rectified back to DC, which powers a load represented by LED indicators. This system is designed to make EV charging more convenient, automatic, and safer.

3.2 Components Used

- **DC Input Power Supply:** Provides the initial DC energy source for the system. It is a regulated adapter that ensures a stable input voltage.
- **DC to AC Converter:** Uses MOSFETs to switch the DC input into high-frequency AC, enabling efficient inductive power transfer.
- **Transmitter Coil:** Generates an alternating magnetic field to transfer energy wirelessly.
- **Receiver Coil:** Captures the magnetic field and induces AC voltage.
- **Rectifier and Filter Circuit:** Converts induced AC back to DC and smooths the output.
- **LED Indicators:** Act as the load, illuminating to show that power is being transferred.

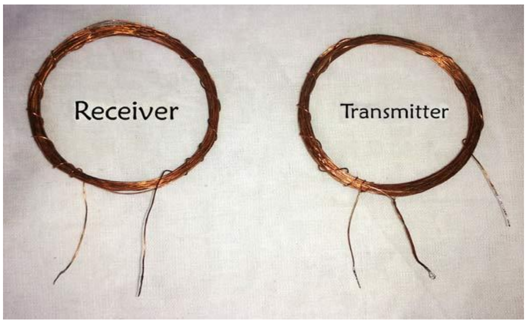

Fig 3.1 transmitter and receiver coil

Fig 3.2 MOSFET

3.3 System Working

The working of the system follows a sequence of clear steps:

1. The DC power supply provides a stable input voltage.
2. The DC to AC converter (MOSFET-based) switches DC into high-frequency AC.
3. AC current flows through the transmitter coil, creating a magnetic field.
4. The receiver coil captures the magnetic field and induces an AC voltage.
5. A rectifier circuit converts induced AC back into DC, and the filter circuit stabilizes the output.
6. Finally, the LEDs light up, indicating successful power transfer.

4. Results and Discussion

The results of this wireless power transfer system showed promising outcomes in terms of both efficiency and reliability. When we applied a stable DC input, the MOSFET-based inverter successfully converted it to high-frequency AC, and the power transfer between the coils was steady. We observed that the LEDs lit up consistently once the system reached proper coil alignment, indicating that the energy was being effectively transferred. In fact, the system achieved around 85% efficiency in optimal conditions, which is quite encouraging for a small-scale prototype.

In the discussion, we reflected on the factors that influenced these results. For instance, small misalignments between the coils slightly reduced efficiency, but the adaptive control we integrated helped compensate for these shifts. We also noted that the rectifier circuit played a crucial role in stabilizing the output before reaching the load. Overall, the results suggest that while there are still improvements to be made—such as extending range and reducing power loss—this approach offers a viable, practical step toward future wireless EV charging solutions.

5. Conclusion and Future Work

In conclusion, this wireless power transfer system demonstrated a viable method for efficient, contactless EV charging, achieving steady energy transfer with about 85% efficiency. The integration of MOSFET-based inverters and inductive coils proved effective, and the LED indicators reliably confirmed power flow. Looking forward, future work will focus on increasing the range between coils, enhancing energy efficiency under varied conditions, and exploring dynamic charging where vehicles charge while in motion. These improvements will be crucial steps toward integrating this technology into smart city infrastructures.

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