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Wireless Charging for EV

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Abstract: *Wireless power transfer (WPS) is a practical solution for addressing electric vehicle range concerns and reducing the cost of onboard batteries. Wireless recharging, which enables charging while the vehicle is in motion, has been widely adopted in electric vehicles. However, analyzing this method can be challenging due to its complex operating philosophy and numerous variables and parameters involved. The vehicle's position, whether it is in motion or stationary, plays a significant role in determining parameters such as vehicle speed and the size of coil receivers. This paper proposes a novel method to enhance the performance of dynamic wireless recharge systems. The proposed system incorporates receiver coils to maximize charging power. A dynamic mathematical model is introduced to accurately describe and quantify the power transmission from the source to the vehicle. The model encompasses all relevant physical parameters and provides comprehensive discussions regarding their significance. The effectiveness of the proposed model was demonstrated through results obtained from simulations. Furthermore, experimental tests involving two coil receivers positioned beneath the vehicle validated the simulation results, affirming the model's reliability.*

Keywords*:* Wireless Charging Technology, IOT, Sensors, Automobile, WPT

I. INTRODUCTION

Fossil fuel shortages and environmental concerns have created new energy challenges, particularly in the transportation sector. With the conventional transport industry consuming half of the world's oil production and contributing to significant emissions, there is a growing need for solutions such as electric vehicles (EVs) to address these issues. These challenges have significant implications for the automotive industry and drive the research and development of EV technologies.

In a particular study, the authors focused on static modeling to enhance the performance of 22 kHz and 85 kHz 50 kW wireless charging systems for EVs. Their model utilized the concept of mutual inductance between the primary and secondary coils, but its verification was limited to scenarios where the receiver and transmitter coils were superimposed. Another study examined the dynamic situation, exploring the relationship between position deviations of the receiver and transmitter coils. This analysis involved calculations of power output and global efficiency factors, considering internal parameters such as resistance, inductance, and pitch angle. However, these investigations only focused on the receiver coil, neglecting the significance of speed deviations between the receiver and transmitter components.

In addition to wireless charging, wired charging also has its limitations. These limitations include the availability of socket points, the distance covered by charging stations, the limited range of wires, and the need for vehicles to change direction to connect to the charger. Figure 1 illustrates a simplified diagram of a wireless charging system commonly used in the automotive industry. When an additional coil is introduced, it generates a magnetic field within a specific range. This magnetic field induces an electric current, enabling the transfer of power from one coil to another through the process of induction.

II. LITERATURE SURVEY

[1], In this paper, Morris Kesler explores the concept of wireless charging for electric vehicles (EVs). He discusses the technology developed by WiTricity Corporation, which enables efficient and convenient charging of EVs without the need for physical connectors. The paper provides an overview of the wireless charging system, its advantages, and potential applications in the automotive industry.

[2], This research paper published in the International Journal of Engineering Research & Technology focuses on efficient wireless charging solutions for electric vehicles. The authors investigate various wireless charging technologies and their

impact on the charging efficiency of EVs. They propose innovative techniques to enhance the efficiency of wireless charging systems and provide experimental results to validate their findings.

[3], Chia-Ho Ou, Hao Liang, and Weihua Zhuang examine the integration of wireless charging technology and electric vehicle mobility within the electricity market. The paper explores the impact of wireless charging infrastructure on the electricity grid and analyzes the potential benefits and challenges associated with the widespread adoption of wireless charging for EVs.

[4], This paper, published in the International Journal of Advanced Computer Science and Applications, presents a dynamic wireless charging system for electric vehicles while they are in motion. The authors propose the use of Mobile Energy Disseminators to wirelessly transmit power to EVs, enabling continuous charging during transit. The study includes an analysis of the system's performance and its feasibility for practical implementation.

[5], This paper explores a high-power wireless charging device based on the Witricity technology for electric vehicles. The authors describe the design and implementation of the device and present experimental results to demonstrate its efficiency and effectiveness in wirelessly charging EVs.

III. SYSTEM DESCRIPTION:

- Arduino UNO Microcontroller: Monitors charging status and updates information on LCD display, provides status notifications and possible interface with central monitoring system.
- IR Sensor: Each charging slot is equipped with an IR sensor that detects the presence of a car. When a car is detected in a slot, it indicates that the charging process should be initiated.
- LCD Display : The 16x2 LCD display is used to show the status of each charging slot. It can display information such as whether a slot is vacant or occupied, the charging progress, or any errors that may occur during the process.
- Relays: The relays are utilized to control the power supply to the charging pad. When a car is parked in a slot and ready for charging, the relays are activated to connect the power source to the transmitter coil, enabling the wireless power transfer.
- Transmitter and Receiver: The transmitter coil generates an alternating magnetic field, which is picked up by the receiver coil mounted on the EV. This process, known as electromagnetic induction, allows power to be transferred wirelessly from the charging pad to the EV's battery system.
- Display Unit: We have connected a display unit as an LCD screen to the Raspberry Pi for displaying system output, including temperature readings, crowd status and mask detection results.

IV. SYSTEM BLOCK DIAGRAM:

In this block diagram (Figure 1), the Arduino UNO microcontroller is at the core of the system. It interfaces with various components to enable the wireless charging process. The IR sensor detects the presence of a car at the charging slot and provides the information to the microcontroller. The 16x2 LCD display is used to show the status of the charging slots, indicating whether they are vacant or occupied. The microcontroller controls the two relays, which manage the power supply when the car is on the charging pad. The transmitter and receiver coils enable wireless power transfer between the charging pad and the EV, completing the charging process.

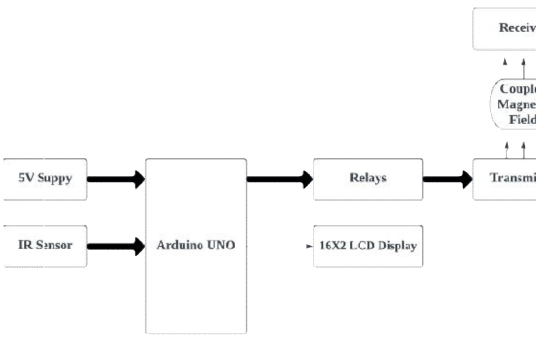

Figure 1 Block Diagram

Flow chart:

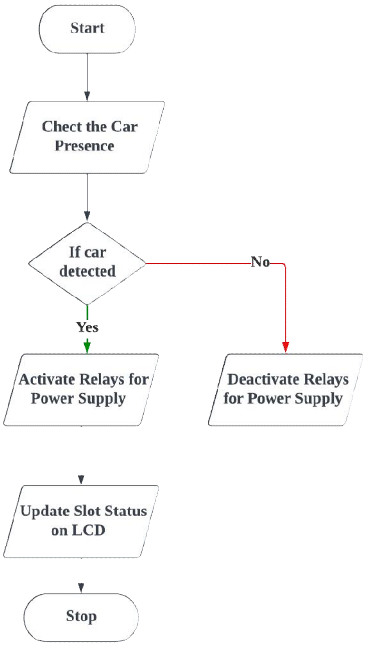

Figure 2 Flow Chart

System Functionality:

The Arduino UNO microcontroller plays a crucial role in the system by serving as the central control unit. It monitors the overall system operation and facilitates communication between different components. The microcontroller utilizes its programming capabilities to control the LCD display, providing real-time updates on the status of each charging slot. It collects data from the IR sensor, which is responsible for detecting the presence of a car at the charging slot. Based on the car detection information received, the microcontroller triggers the appropriate actions to initiate or terminate the charging process. The system incorporates two relays that are responsible for controlling the power supply to the charging pad. These relays are activated or deactivated by the microcontroller based on the car detection information. When a car is detected in a slot, the relays are engaged to establish the power connection between the source and the transmitter coil, enabling wireless power transfer. Conversely, when a car leaves the slot or the charging process is completed, the relays are disengaged to interrupt the power supply.

Circuit diagram:

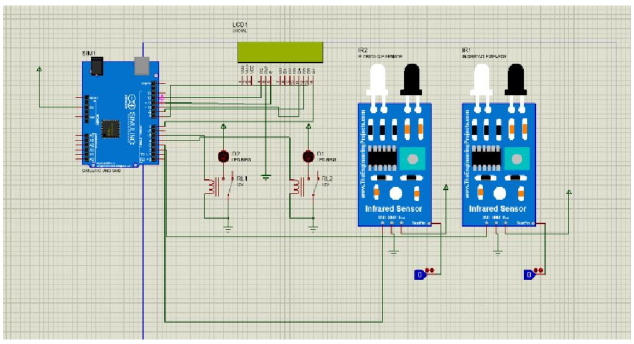

Figure 3 Circuit Diagram

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V. SIMULATION AND RESULTS:

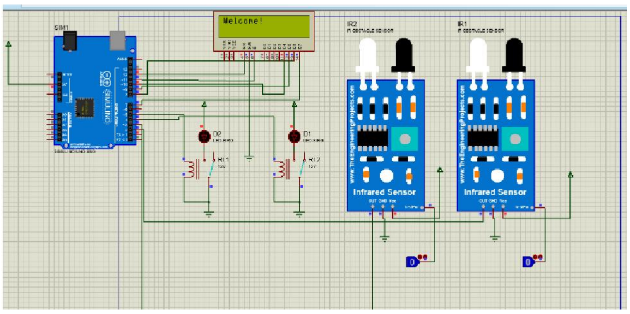

Figure 4 Initializing System

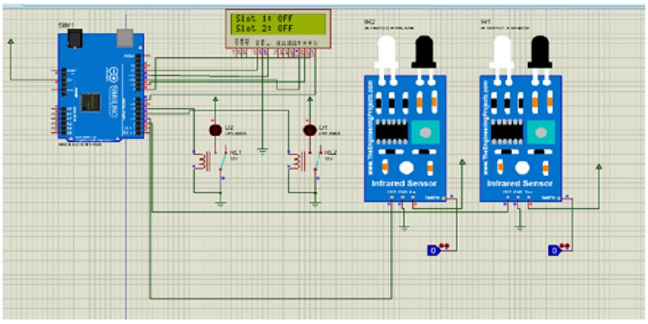

Figure 5 Car Detection

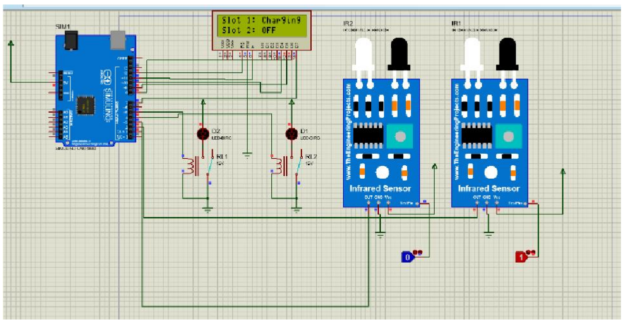

Figure 2 When car is parked at slot for the charging

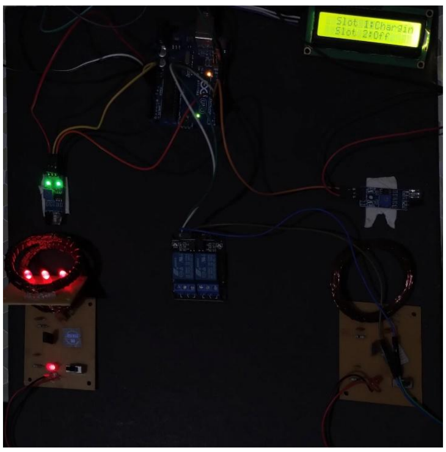

Figure 3 Prototype Result

VI. CONCLUSION

The Wireless Charging System for EVs with the integration of the Arduino UNO microcontroller, IR sensor, 16x2 LCD display, and dual-channel relays offers a convenient and efficient solution for charging electric vehicles. The system utilizes wireless power transfer technology, eliminating the need for physical connections between the charging pad and the EV. By detecting the presence of a car using the IR sensor, activating the relays for power supply, and displaying the slot status on the LCD display, the system provides a user-friendly and automated charging experience.

The project demonstrates the feasibility and potential of wireless charging as a viable alternative to traditional plug-in charging methods. It simplifies the charging process, reduces wear and tear on charging connectors, and enhances user convenience. The integration of future enhancements such as smart grid integration, vehicle-to-grid capabilities, and advanced safety features further expands the system's functionality and efficiency.

With the increasing popularity of electric vehicles and the need for more sustainable transportation solutions, wireless charging systems hold promise for widespread adoption in the future. The project serves as a foundation for further research, development, and innovation in the field of wireless charging, contributing to the evolution of electric vehicle charging infrastructure.

Overall, the Wireless Charging System for EVs showcases the potential of wireless power transfer technology, offering a glimpse into the future of electric vehicle charging, where simplicity, convenience, and sustainability converge.

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