A NOVEL APPROACH FOR SMART WIRELESS CHARGING SYSTEM FOR ELECTRIC VEHICLES

Smt. Sujata P
Senior Grade Lecturer,
Department of Computer Science & Engineering
Government Polytechnic, Bagalkot-587101

Smt. Rubina
Senior Grade Lecturer
Department of Computer Science & Engineering
Government Polytechnic, Bagalkot-587101

ABSTRACT

The rapid growth of electric vehicles (EVs) has created a strong demand for efficient, user-friendly, and sustainable charging solutions. Conventional plug-in charging methods often lead to long waiting times, inconvenience, and range anxiety, which limit the widespread adoption of EVs. This project presents a **Smart Wireless Charging Road System for Electric Vehicles**, which enables vehicles to charge wirelessly while stationary or in motion using wireless power transfer (WPT) technology.

The proposed system embeds transmitter copper coils beneath the road surface and installs receiver coils within the vehicle. Power is transferred electromagnetically without any physical connection. The system integrates intelligent vehicle detection, real-time power monitoring, automated billing, and secure payment mechanisms. This approach significantly reduces charging downtime, improves driving range, and enhances user convenience. The proposed solution aims to contribute to smart transportation infrastructure and supports the vision of sustainable and carbon-neutral mobility.

Keywords: Electric Vehicles, Wireless Power Transfer, Dynamic Wireless Charging, Smart Roads, Intelligent Charging System, EV Infrastructure.

I. INTRODUCTION

The transportation sector is one of the largest contributors to global energy consumption and greenhouse gas emissions. Dependence on fossil fuels has resulted in environmental degradation, climate change, and increased air pollution. Electric vehicles have emerged as a promising alternative to conventional internal combustion engine vehicles due to their lower emissions, higher energy efficiency, and reduced operating costs.

Despite these advantages, EV adoption faces significant challenges, particularly related to charging infrastructure. Long charging times, limited charging stations, and range anxiety discourage potential users. Although battery technologies have improved, charging methods must also

evolve to support large-scale EV deployment.

Wireless charging technology offers a transformative solution by eliminating physical connectors and enabling continuous energy transfer. Dynamic wireless charging roads allow EVs to charge while driving, reducing dependency on large batteries and minimizing downtime. This project focuses on designing an intelligent wireless charging road system that ensures efficient power transfer, automated operation, and user convenience.

II. LITERATURE SURVEY

Several researchers have explored wireless power transfer technologies for electric vehicles. Dr. K. Shivarama Krishna proposed a wireless power transmission system that efficiently integrates hardware components to achieve stable voltage and current with minimal ripple. The study demonstrated the feasibility of using advanced integrated circuits to improve charging efficiency.

Other studies have reviewed static and dynamic wireless charging systems, highlighting their advantages in reducing range anxiety and improving vehicle usability. Research indicates that proper coil alignment, resonant frequency tuning, and intelligent control systems are critical for maximizing power transfer efficiency. These works provide a strong foundation for the development of smart wireless charging road systems.

III. OBJECTIVES

The main objectives of the proposed Smart Wireless Charging Road System are:

- To design and implement a wireless charging road infrastructure using copper coils.
- To enable contactless power transfer between road-embedded transmitters and vehicle receivers.
- To automate vehicle detection, charging control, and billing processes.
- To maintain stable battery power during vehicle movement.
- To monitor voltage consumption and display charging information in real time.
- To integrate a secure digital payment system for user convenience.
- To allow vehicle exit only after successful payment confirmation.

IV. METHODOLOGY

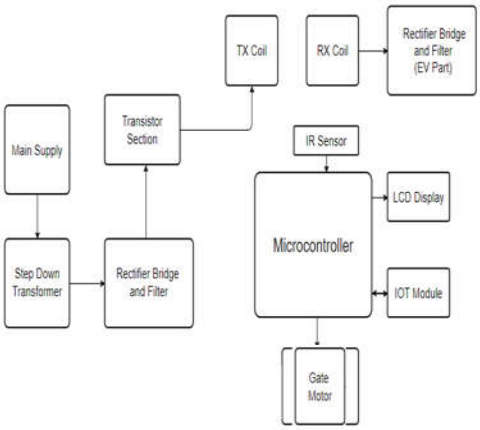
The system operation begins with a regulated power supply that acts as the primary input. This supply is connected to a transistor-based switching circuit, which

generates high-frequency alternating current. The alternating current energizes the transmitter copper coils embedded beneath the road surface.

When an electric vehicle equipped with a receiver coil passes over the charging road, electromagnetic induction enables wireless power transfer between the transmitter and receiver coils. The received power is rectified and regulated to charge the vehicle battery safely.

Infrared (IR) sensors are installed to detect vehicle entry and exit. The system continuously monitors voltage consumption and displays charging information on an LCD screen. Upon reaching the end of the charging lane, the user is prompted to pay the charging amount through a smartphone-based digital payment system. Once payment is verified, the exit gate opens automatically, allowing the vehicle to leave the charging road.

V. BLOCK DIAGRAM



The block diagram consists of the following major components:

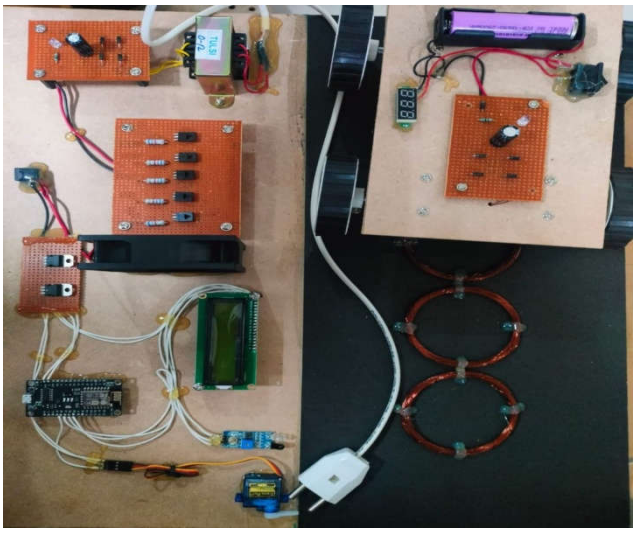
- Power Supply Unit
- Switching Circuit (Transistor-based)
- Transmitter Copper Coils (Road-embedded)
- Receiver Copper Coil (Vehicle-mounted)
- Rectifier and Voltage Regulator
- Microcontroller Unit
- IR Sensors
- LCD Display
- Payment Interface
- Automatic Gate Control

Each block works in coordination to ensure efficient wireless charging, accurate detection, and seamless automation.

VI. RESULTS AND DISCUSSION

The experimental results demonstrate that the proposed system successfully transfers power wirelessly from road-embedded coils to the vehicle receiver. Vehicles were able to receive sufficient power for battery charging without physical connectors.

IR sensors accurately detected vehicles at the exit point, ensuring reliable billing and



access control. The payment process was smooth and user-friendly, with the gate opening immediately after successful transaction confirmation. The system showed minimal power loss and stable voltage output, indicating efficient wireless energy transfer.

Fig 6.1 Hardware Connection

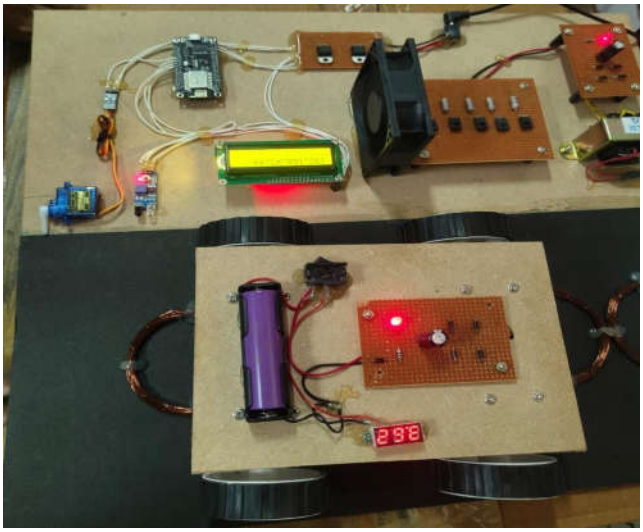


Fig 6.2 Vehicle is Charging

VII. CONCLUSION

This project successfully presents the design and implementation of a Smart Wireless Charging Road System for Electric Vehicles. Wireless charging technology offers significant advantages over conventional wired charging, including enhanced safety, reduced maintenance, and improved user convenience.

Electrified roads with wireless charging capability can play a vital role in large-scale EV adoption by reducing range anxiety and dependency on large batteries. Although further research is required in areas such as power management, safety standards, and large-scale deployment, the proposed system demonstrates strong potential for future smart transportation infrastructure.

VIII. FUTURE SCOPE

There will be always a scope for improvements. Hence, the future enhancements of the system include:

- Improving energy transfer efficiency using advanced coil designs.
- Supporting high-speed dynamic charging for moving vehicles.
- Integrating artificial intelligence to optimize power distribution based on traffic conditions.

- Expanding the system for highways and urban smart roads.
- Enhancing safety standards to meet global regulations.

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