OPTIMIZED FAST CHARGING FOR ELECTRIC VEHICLE AND ECO FRIENDLY DRIVING

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ABSTRACT

The increasing global shift towards electric vehicles (EVs) demands innovative solutions for efficient, sustainable, and user-friendly charging infrastructure. This project presents a comprehensive, IoT-enabled, wireless charging system designed to optimize fast charging and promote eco-friendly driving practices. The proposed system integrates various components including the ESP32 microcontroller, RFID authentication, infrared (IR) sensors, transmitter and receiver coils, relay modules, and an LCD display to create a fully automated and intelligent EV charging platform.At the core of this system lies the ESP32 microcontroller, which facilitates real-time monitoring and remote access through wireless communication protocols. By leveraging this technology, users are able to track the status of their vehicle charging, energy consumption, and efficiency metrics through cloud-connected platforms. This transparency empowers users with control, convenience, and insight into their charging patterns, promoting responsible energy use.

The IR sensors are strategically used to detect and assist in vehicle alignment over the wireless charging pad, thereby minimizing misalignment issues that commonly lead to energy loss. This feature significantly enhances power transfer efficiency and ensures a seamless charging experience. The RFID module plays a crucial role in maintaining security and access control. Only vehicles equipped with authorized RFID tags are granted charging privileges, mitigating unauthorized use and improving system safety.Power is transferred wirelessly using a pair of transmitter and receiver coils. When a vehicle is correctly positioned, the relay module activates the charging process. This eliminates the need for physical plug-in cables, reducing wear and tear and the risks associated with manual connection. This contactless approach not only simplifies the user experience but also increases the longevity and reliability of the system.The LCD display provides visual updates to the driver on current charging status, estimated time to full charge, and system health alerts. This ensures that the user remains informed without the need for a smartphone or other external devices. In combination with IoT capabilities, the system is designed for smart cities and can be easily deployed across commercial parking lots, residential garages, and highway rest stations.

Key words :

Microcontroller,RFID Reader,IRSensor,wireless Ev charging,Eco friendly

INTRODUCTION

The rapid global transition toward electric mobility has sparked significant interest in the development of innovative, efficient, and user-friendly charging infrastructure. As the adoption of electric vehicles (EVs) continues to rise, one of the critical challenges lies in creating charging systems that are not only fast and effective but also environmentally sustainable. Traditional EV charging methods often rely on manual cable connections, which are prone to inefficiencies, wear and tear, and user inconvenience. Moreover, these systems generally lack real-time monitoring, automated alignment, and intelligent control capabilities—key aspects that are essential in modern, smart transportation networks.

To address these limitations, this project introduces a novel, IoT-enabled wireless charging system that automates and optimizes the EV charging process while promoting eco-friendly driving practices. The system is designed to eliminate the need for physical connectors by leveraging wireless power transfer (WPT) technology through inductive coupling. Key hardware components such as infrared (IR) sensors, RFID-based authentication, transmitter and receiver coils, a relay module, and an ESP32 microcontroller are integrated to provide a secure, intelligent, and fully automated charging experience.The IR sensors are employed to guide and position the vehicle accurately over the charging pad, ensuring optimal energy transfer and minimizing misalignment losses. RFID authentication ensures that only authorized EVs can access the charging system, improving both security and resource management. The ESP32 microcontroller, equipped with built-in Wi-Fi capabilities, plays a central role in enabling Internet of Things (IoT) functionality by allowing real-time data tracking, remote monitoring, and system control via cloud-based platforms and mobile applications.

By incorporating these smart features, the system not only enhances user convenience but also contributes to energy conservation and reduced environmental impact. It supports low-maintenance operation, minimizes energy waste during idle periods, and integrates seamlessly with smart grid and urban mobility infrastructure. Additionally, the use of a wireless interface reduces physical wear on charging equipment, thereby increasing system reliability and lifespan.

This report provides a comprehensive overview of the conceptualization, design, and implementation of the proposed wireless EV charging system. It covers system specifications, hardware and software architecture, design methodologies, experimental results, and a comparative analysis with existing technologies. The project aims to set a new benchmark for next-generation EV infrastructure that is secure, sustainable, and aligned with the vision of smart, eco-conscious urban development.

1. MAIN SECTION- I

1.1EXISTING SYSTEM

The current electric vehicle (EV) charging infrastructure primarily relies on manual plug-in systems and basic RFID-based smart parking solutions. In such systems, EV users are required to physically connect their vehicle to a charging station using cables, which introduces several limitations in terms of user convenience, safety, and long-term reliability. These conventional systems lack intelligent automation, real-time monitoring, and secure access control, making them less efficient in dynamic and high-traffic environments.RFID-based smart parking systems are often deployed to manage vehicle access and track parking slot availability. In this setup, registered vehicles are assigned unique RFID tags that are scanned by readers at the entrance and exit of parking areas. Microcontrollers such as Arduino are used to log vehicle entry and exit data, which is then transmitted to a central database through a Wi-Fi module. While this method improves parking management, it does not offer any integration with charging mechanisms.Furthermore, the charging process itself is entirely manual. Once a vehicle is parked, the user must manually plug in the charging cable, initiate the charging session, and monitor the status either physically or through limited interface options. This process is not only time-consuming but also susceptible to human error, connector damage, and safety hazards in adverse weather conditions.

Another significant drawback of the existing system is the lack of automated vehicle alignment mechanisms. Proper alignment between the vehicle and the charging pad is critical for efficient wireless power transfer, but most systems do not offer any assistance or feedback for alignment. This results in energy losses due to misalignment, reducing the overall efficiency of the charging process.Additionally, there is minimal or no provision for real-time data tracking, remote control, or user notifications. Most users are unable to monitor battery levels, charging progress, or estimated completion time from a remote location, limiting the practicality and flexibility of the system.The absence of smart grid integration is another shortcoming of traditional EV charging infrastructures. Without load balancing, dynamic scheduling, or energy feedback mechanisms, these systems can strain local power grids and contribute to inefficient energy usage.

2. MAIN SECTION- II

2.1 PROPOSED METHODOLOGY

The proposed system introduces an IoT-enabled, wireless charging infrastructure for electric vehicles (EVs) that eliminates the need for physical connectors, enhances energy efficiency, and promotes eco-friendly driving through intelligent automation and monitoring. The methodology integrates hardware and software components to provide a seamless, secure, and user-centric EV charging experience.

1. System Overview

At the core of the proposed methodology is the ESP32 microcontroller, which acts as the central processing unit and IoT interface. It controls all the peripheral components and enables real-time communication with cloud platforms for remote monitoring and control.The system is built around a wireless charging pad that utilizes inductive power transfer (IPT). This allows energy to be transferred from the transmitter coil embedded in the pad to the receiver coil in the vehicle without any physical contact.

2. Vehicle Detection and Alignment

To ensure efficient energy transfer, infrared (IR) sensors are used to detect the presence and position of the vehicle. These sensors help guide the vehicle into the correct alignment over the charging pad, reducing energy losses caused by misalignment.

3. Secure Access via RFID Authentication

Before charging is initiated, the system verifies the identity of the vehicle using RFID technology. Each authorized vehicle is assigned a unique RFID tag. When the tag is scanned by the RFID reader, the system validates the identity and grants access to the charging function. This ensures that only registered users can utilize the charging facility.

4. Wireless Power Transfer Activation

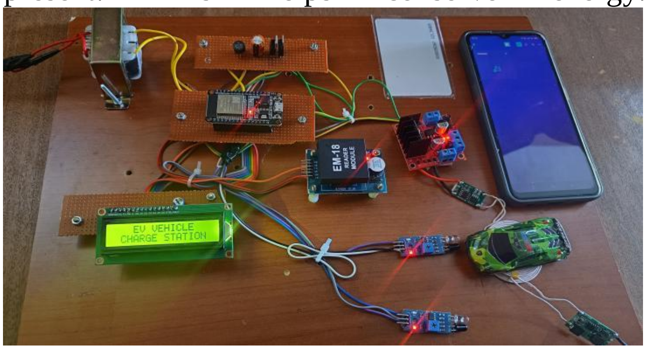
Once the vehicle is correctly positioned and authenticated, the relay module is activated to allow power flow between the transmitter and receiver coils. The system uses relay switching to ensure that charging starts only when the vehicle is correctly parked and ends immediately upon disconnection or misalignment.

5. Real-Time Monitoring and Feedback

The ESP32 microcontroller gathers data such as vehicle alignment status, energy consumption, and charging progress. This data is sent to a cloud-based IoT platform (e.g., Blynk) via Wi-Fi, where it is accessible to users through a mobile application. Users can monitor charging status, battery level, and session history in real-time.An LCD display is also integrated into the system to provide live feedback on charging progress, alignment status, and system alerts directly to the driver on-site.

6. Energy Efficiency and Standby Management

To reduce unnecessary power consumption, the system remains in a low-power standby mode when no vehicle is detected. Power is only supplied to the charging circuit when an authenticated and properly aligned vehicle is present. This helps conserve energy.



SYSTEM IMPLEMENTATION

(i) Hardware Requirement:

- Microcontroller
- IR Sensor
- RFID Reader
- LCD Display

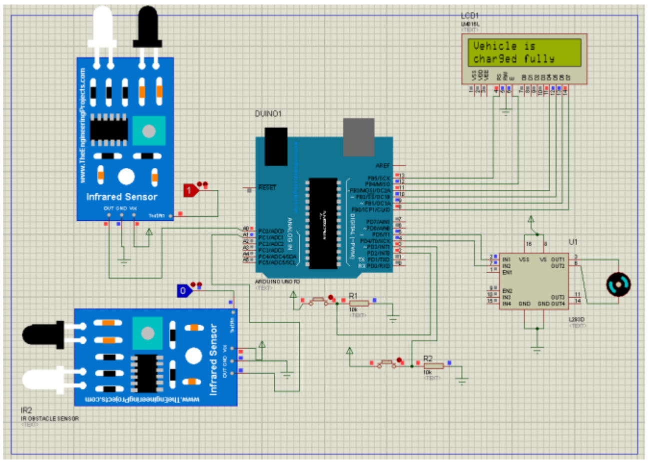
(ii) Software Requirement:

- Operating System

3. SOFTWARE RESULT:

The software component of the proposed IoT-enabled wireless EV charging system was developed and tested using platforms such as Arduino IDE, Blynk IoT, and Proteus simulation. These tools enabled the development, simulation, monitoring, and validation of the core functionalities of the system before hardware implementation.

3.1 SAMPLE SCREENSHOT



CONCLUSION

he project "Optimized Fast Charging for Electric Vehicle and Eco-Friendly Driving" successfully demonstrates the design and implementation of an intelligent, IoT-enabled wireless charging system tailored for modern electric vehicles (EVs). The primary objective of this system is to simplify the EV charging process while enhancing energy efficiency, security, and user convenience.

By integrating key technologies such as the ESP32 microcontroller, RFID authentication, infrared sensors, relay switching, and wireless power transfer, the system effectively eliminates the need for physical cables and manual intervention. This not only reduces wear and tear but also ensures safer, faster, and more reliable charging experiences. The inclusion of IoT features via Blynk enables remote monitoring and real-time feedback, empowering users with full visibility and control over the charging process.

The system's ability to automatically detect vehicle presence, align it accurately using sensors, and begin charging only upon authentication enhances both operational efficiency and security. In addition, the LCD display offers real-time status updates, and the system's low-power standby mode contributes to sustainable energy practices.

Software simulations using Proteus, coding through Arduino IDE, and the integration with Blynk IoT platform have validated the logical and functional correctness of the system. Real-time testing confirmed that all components work together seamlessly to achieve the intended results.

In conclusion, the proposed wireless charging solution stands as a promising advancement in the field of EV infrastructure. It addresses several limitations found in conventional systems and paves the way for smart, secure, scalable, and eco-friendly EV charging in both urban and highway environments. This project contributes meaningfully to the evolution of sustainable transportation and supports the global transition toward cleaner energy solutions.

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