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Wireless Electric Vehicle Charging System

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Abstract : *Modern technology such as the ESP32 microcontroller, RC522 RFID reader, buzzer, I2C LCD, voltage sensor, lead acid battery, wireless charging modules, and relay module are all integrated into the Wireless Electric Vehicle Charging System that is demonstrated in this project. This method makes battery charging and discharging more efficient by utilizing RFID authentication to dynamically activate or deactivate the Relay Module. Additionally, customers may view real-time information on battery percentage and charging progress using an easy-to-use mobile application created with MIT App Inventor. ThingSpeak cloud data storage improves data management and accessibility even further. This creative solution, which seamlessly integrates hardware elements and software interfaces, not only makes charging electric vehicles easier but also highlights the potential of RFID technology to improve user experience and maximize energy efficiency in the context of sustainable transportation.*

IndexTerms **- Radio Frequency Identification, Electrical Vehicle , Battery, Buzzer, ThingSpeak cloud storage, etc.**

I. INTRODUCTION

Modern technology must now be integrated into the automotive sector since we live in a sustainable and innovative age. Among these developments, Wireless Electric Vehicle (EV) Charging Systems based on Radio-Frequency Identification (RFID) mark a paradigm change toward effective and approachable solutions. The system's revolutionary potential is examined in this introduction, which combines RFID technology with a variety of components such as ESP32, RC522 RFID Reader, Buzzer, I2C LCD, Voltage Sensor, Lead Acid Battery, Wireless Charging Modules, Relay Module, and a custom mobile application created with MIT App Inventor in addition to cloud data storage made possible by ThingSpeak.The Wireless Electric Vehicle Charging System uses an easy-to-use authentication system in which authorized users are uniquely identified via RFID tags. The ESP32 microcontroller, which facilitates communication between different components and manages authentication procedures, is the brains behind this system. Through its interaction with the ESP32, the RC522 RFID Reader quickly recognizes RFID tags and, upon successful authentication, starts charging procedures. In addition to improving user experience and guaranteeing authentication acknowledgment, a buzzer emits auditory feedback. By integrating an I2C LCD, customers are provided with actionable insights and may view critical information in real-time, such as battery voltage and charging status. Furthermore, a Voltage Sensor provides accurate battery parameter monitoring, enabling ideal charging schedules and extending battery life. Lead acid batteries are used to provide a dependable power source, while wireless charging modules, which do away with the inconvenience of physical connections and improve user convenience, represent the system's futuristic approach.In addition, a Relay Module smoothly controls power flow by turning on or off charging mechanisms in response to the state of RFID authentication, guaranteeing operating efficiency and safety. In addition to the hardware components, the MIT App Inventor-created mobile application functions as an intuitive user interface by providing detailed information on charging status, battery percentage, and past data. ThingSpeak-enabled cloud data storage not only makes remote monitoring possible, but also makes data analysis and optimization easier, resulting in ongoing system performance improvements. The Wireless Electric Vehicle Charging System essentially breaks through traditional paradigms and provides an early look at sustainable transportation infrastructure in the future. This system perfectly combines cutting-edge technology with user-centered design principles to represent how innovation and sustainability are merging in the automotive industry.

II. REVIEW OF LITERATURE

The majority of vehicles in the transportation sector are fuel-powered. Development of electric vehicles is a crucial step toward lowering emissions of greenhouse gases and reducing reliance on fossil fuels as a result of rising fuel costs and environmental concerns [1]. Over the past ten years, EVs have advanced quickly because to significant regulatory support in certain nations, advancements in battery technology, and other factors [2]. The advancement of electric cars (EVs) has recently helped to lessen the world's energy dilemma and cut CO2 emissions. But it also raises the problem of EV charging. [3]. The expanding number of electric cars is driving up need for creative and user-friendly solutions for the infrastructure supporting charging [4]. Automation is becoming more and more prevalent in both daily life and the global economy. Therefore, this also helps with the planning and execution of the charging station's intelligent vehicle parking system [5]. The ORNL Experience and the Difficulties in EV Adoption with Dynamic Wireless Power Charging [6] P.T. Jones and John M. Miller suggested reducing emissions of greenhouse gases and addressing the effects of global warming. Vehicles that use wireless charging have less space constraints and customers spend less time waiting to refuel. The following are factors that have an impact on wireless charging. What amount of power

demand is anticipated on the grid at certain places, when, and where drivers will use the charging-in-motion services a distribution of electric power with the best working plan to meet demand. The article "Optimal deployment of electric car charging lanes in transportation networks" [7] The system to shorten customers' wait times for automobile charging was suggested by writers Zhibin Chen, Fang He, and Yafeng Yin. The expanded range of electrical vehicles can be attributed for their less energy usage compared to fuel-powered vehicles. However, the pace of charging is influenced by the vehicle's speed. An intricate traffic management system is needed to regulate a growth in the number of cars. The Best Recharging Station Deployment Strategies for Using a genetic programming technique, this system finds a nearly ideal charging station deployment, with a convergence that heavily depends on the original solution. Illhoe Hwang and Young Jae Jang's recharging rate is influenced by the pace at which cars travel.

III. PROPOSED SYSTEM

1. System Design and Component Integration: This stage entails creating the system architecture and integrating parts such the lead-acid battery, relay module, the ESP32 micro microcontroller, RC522 RFID reader, buzzer, I2C LCD, voltage sensor, and wireless charging module.

2. RFID Verification and Relay Control: Write code to connect the ESP32 and RFID reader, enabling authentication of RFID cards. The relay module will be able to control whether to activate or disable the charging process after successful authentication.

3. Real-time Data Monitor and Display: To gather data in real-time from the wireless charging modules and voltage sensors, use the ESP32. Write a program to show this data for nearby monitoring on an I2C LCD panel.

4. Development of Mobile Applications: Use the MIT App Inventor to develop an application for mobile devices which displays the percentage of battery and charging status. To get the real-time data, the application will establish a Wi-Fi connection with the ESP32.

5. Integration of Cloud Data Storage: Set up ThingSpeak to collect and save data from the EV charging station. Write code to communicate with ThingSpeak on occasion by sending packets of data with battery information and the state of the charge.

6. Optimization and Testing: Check the efficiency, dependability, and effectiveness of the entire system. Code and hardware elements should be optimized as needed to guarantee seamless functioning.

7. Presentation and Documentation: Record every step of the development process, including user guides, circuit schematics, and explanations of the code. To highlight the features and functionalities of the project, put up a presentation.

By adhering to this methodology, a robust Wireless Electric Vehicle Charging System is going to be created, incorporating contemporary technology for user identification, data monitoring, and storage on the cloud as well as practical and effective methods of charging for electric vehicles.

IV. WORKING

Recent innovations are used within Wireless Electric Vehicle Charging System to offer an effective and practical way to charge electric vehicles (EVs). The system's primary components for safe verification involve an RC522 RFID reader and ESP32 microcontroller. Let's examine the parts and features of this cutting-edge technology.

An essential component of authentication is the RFID reader, which grants authorized users access to the charging system. A relay module is engaged, allowing power transmission to the wireless charging modules, upon successful RFID verification. These modules effectively transfer electricity to the electric vehicle's battery through the use of cutting-edge inductive charging technology.

A variety of peripherals have been incorporated into the system to improve user experience and offer feedback in real time. After RFID verification, a buzzer sounds to confirm, allowing for a smooth user experience. Visible indication is provided by an I2C LCD display, which shows battery power and charging process. A voltage sensor also makes it possible to keep an eye on battery levels, which guarantees the best possible charging results.

Furthermore, the system's functioning goes beyond only its hardware parts. With the help of an associated smartphone application created with MIT App Inventor, customers can easily check the battery percentage and charging status from a distance. This software improves accessibility by enabling users to monitor the status of their EV's charging from any location.

In addition, the system makes use of ThingSpeak for storage of data in the cloud, which makes charging data logging and analysis easier. Users may analyze trends, keep track of charging history, and adjust charging schedules for maximum efficiency with this connection.

In conclusion, the Wireless Electric Vehicle Charging System provides an all-inclusive electric vehicle charging solutions by fusing software compatibility and hardware elements for improved usability and functionality. The system is a big step forward for electric car infrastructures due to its safe authentication, effective charging technology, and remote monitoring features.

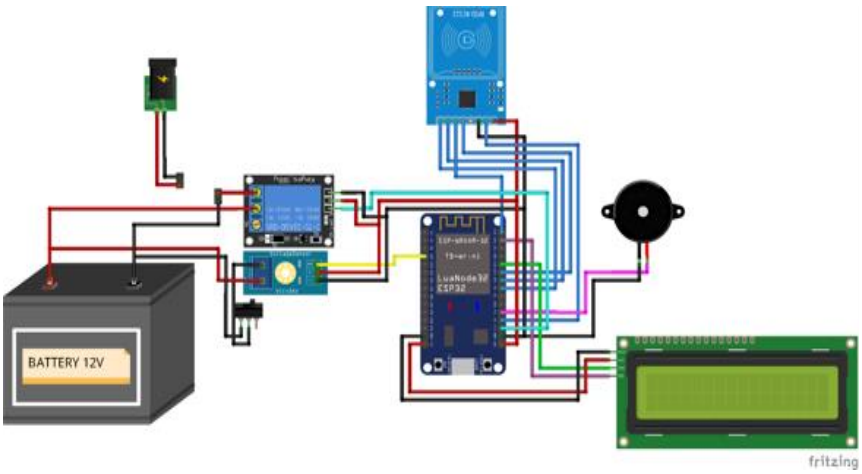

Fig 1 - Circuit Diagram

Fig 2 - Block Diagram

V. RESULT

The transmitter coil of the electric vehicle charging module is linked to the power source when the receiver coil is put on top of it. An RFID module that offers security and authentication is used to turn ON the charging of electric vehicles' batteries. RFID is also used to turn OFF the battery's charging. As a result, the EV is not physically touched throughout the charging process. The LCD screen and mobile application indicate the battery percentage, battery charging status, and amount or balance debited from the e-wallet (payment card).

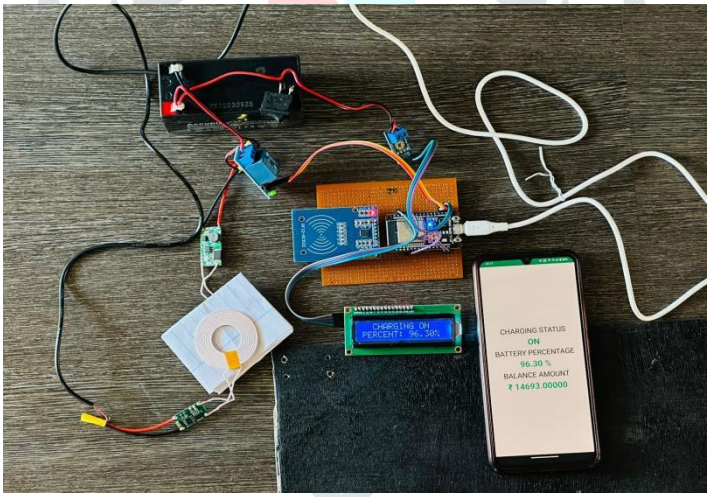

Fig 3 - Working Model

Fig 4 - Working Model (Mobile Application)

VI. CONCLUSION

In conclusion, a state-of-the-art method for effective battery management is presented by the Wireless Electric Vehicle Charging System, that makes use of parts like the ESP32, RC522 RFID Reader, Buzzer, I2C LCD, Voltage Sensor, Lead Acid Battery, Wireless Charging Modules, and Relay Module. By integrating RFID authentication, charging facilities are made secure,

improving user experience and safety. Users' convenience and transparency are promoted by the accompanying smartphone application, which was created using MIT App Inventor and provides real-time monitoring of charging status and battery percentage. Additionally, using ThingSpeak for cloud data storage makes data management and analysis easy, opening the door to possible infrastructure optimizations for charging. This creative system not only demonstrates the state-of-the-art in charging for electric vehicles technology, but it also emphasizes how important IoT and cloud integration will be in determining the direction of sustainable transportation in the future. By constant improvement and implementation, these solutions greatly aid in the development of environmentally sustainable mobility ecosystems.

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