

## RFID Based Wireless Charging System for Electric Car

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**ABSTRACT:** As the adoption of electric vehicles (EVs) continues to rise, the demand for efficient and secure charging solutions is growing. This project focuses on the design and development of a smart E-vehicle wireless charging system utilizing RFID and IoT technologies to enhance accessibility, security, and automation. Unlike traditional wired charging stations, the proposed system employs a wireless power transfer mechanism using transmitter and receiver coils, eliminating the need for physical connectors and reducing maintenance costs. An RFID-based authentication system ensures that only authorized users can access the charging station, preventing unauthorized usage. The ESP8266 microcontroller, integrated with the Blynk IoT platform, enables real-time monitoring and control of the charging process through a cloud-based interface. Users receive notifications regarding charging status, battery levels, and authentication events, ensuring transparency and convenience. A relay module regulates power flow, while a 7805 voltage regulator provides stable power to system components. This intelligent charging solution addresses key challenges such as security, billing, and user authentication, similar to commercial systems like Coulomb and Blink, but with the added advantage of wireless charging and IoT-based monitoring. By leveraging these advanced technologies, the system contributes to the evolution of smart, automated, and efficient EV charging infrastructure, supporting the transition to sustainable transportation.

**Keywords:** Wireless Charging, RFID Authentication, IoT Monitoring, Electric Vehicle, Smart Charging System.

### 1. Introduction

The global transition to electric vehicles (EVs) is accelerating due to increasing concerns over environmental pollution and the depletion of fossil fuels. EVs offer a sustainable alternative to conventional internal combustion engine vehicles, reducing carbon emissions and dependence on non-renewable energy sources. However, one of the major challenges in widespread EV adoption is the availability of efficient, secure, and user-friendly charging infrastructure. Traditional wired charging methods require physical connectors, which are prone to wear and tear, making them less durable and inconvenient over time. To overcome these limitations, wireless charging

technology, combined with smart authentication and monitoring systems, provides a more advanced and seamless solution.

This project focuses on the design and development of a smart E-vehicle wireless charging system using RFID and IoT to enhance convenience, security, and automation in EV charging. Wireless charging eliminates the need for plug-in connections by using transmitter and receiver coils to transfer power inductively. This ensures a hassle-free charging experience and reduces maintenance costs associated with traditional charging cables. Additionally, the integration of Radio Frequency Identification (RFID) technology enhances security by ensuring

that only authorized users can access the charging station. Similar to commercial systems such as Coulomb and Blink, the proposed system uses RFID authentication for user verification, preventing unauthorized access and ensuring controlled billing mechanisms.

To further enhance the functionality of the system, the ESP8266 microcontroller is incorporated to enable real-time monitoring and remote control of the charging process. Through IoT connectivity and the Blynk platform, users can access live updates on charging status, battery levels, and system notifications via a mobile or web interface. The system also features a relay module to manage power distribution safely and a 7805 voltage regulator to provide a stable power supply to the components. This smart approach to EV charging not only improves user convenience but also ensures efficient energy utilization and enhances the overall sustainability of EV infrastructure.

The implementation of this RFID and IoT-based wireless charging system is a step toward the future of intelligent transportation. By integrating automation, security, and real-time data monitoring, the project aims to provide a robust and scalable solution that can be deployed in parking structures, private garages, and commercial charging stations. The proposed system aligns with the evolving needs of smart cities and sustainable energy management, paving the way for a more accessible and technologically advanced EV ecosystem.

## 2. Literature Survey

### 2.1 Research on current control of MRC coupling electric vehicle wireless charging

Kai Deng [04-06 November 2022] A control method based on frequency characteristics is proposed to solve the problem of output stability of electric vehicle wireless charging, especially the magnetic resonance coupling wireless charging technology. This paper establishes a magnetic resonance coupling wireless power transmission model, studies the relationship

between system efficiency, output power and operating frequency, and draws a conclusion that the wireless charging current of electric vehicles can be stabilized by adjusting the operating frequency of the system, which is verified on the actual wireless charging system of electric vehicles.

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### 2.2 Planning and Allocation of Dynamic Wireless Charging Infrastructure for Electric Vehicles

Yazan S. Odeh, Issa S. Elkahout, Parinaz V. Naeimi, Eiman A. ElGhanam, Mohamed S. Hassan, Ahmed H. Osman , [29-31 March 2022] With the growing interest in green and environment-friendly transportation systems, Electric vehicles (EV) are gaining an increasing popularity. Nevertheless, the high deployment costs of EV charging systems along with the currently low, but increasing, penetration of EVs both slow down the investments in EV charging infrastructure. This raises concerns of range anxiety for current and prospective EV owners, for fear of running out of charge without completing their journeys or reaching a nearby charging point. Accordingly, dynamic wireless charging (DWC) solutions are introduced to enable charging EVs on the move, thereby reducing range anxiety and eliminating charging downtime. Due to their high implementation and operation costs, optimal planning of DWC infrastructure is essential to determine the most suitable locations for allocating the charging lanes. In this paper, an optimal allocation process is presented for planning the locations of DWC lanes within the city of Dubai, UAE. First, data on traffic congestion levels is collected through Google Traffic application programming interface (API) to choose a set of candidate locations for deploying the DWC lanes. An energy analysis is then conducted on the selected 19 candidates to provide recommendations on the most energy-

efficient subset of locations for the deployment of DWC lanes, acknowledging the number of hours in congestion and average traveling speed at each location.

2022 9th International Conference on Electrical and Electronics Engineering (ICEEE) 10.1109/ICEEE55327.2022.9772562.

### 2.3 Solar-Powered Wireless Charging Station for Electric Vehicles

Suneel Tummapudi, Thabassum Mohammed, Ravi Kiran Peetala, Sitaravamma Chilla, Prabhunandan Paul Bollavarapu, [10-12 February 2023] Today, there are steadily more electric vehicles on the road. Electric vehicles have proven effective in reducing travel costs by switching from fuel to electricity, which is much less expensive, in addition to the environmental benefits. The major objective is to charge more for utilizing the car for a longer period. The charging system for electric vehicles (EVs) is generally conductive. The EV is charged after the car is linked to a charging station however, charging a car at a charging station takes longer. As technology develops, wireless charging is being introduced. Inductive EV charging does not involve any wires. The proposed method demonstrates how electric vehicles can be charged while in motion without the need for the vehicle to pull over for refueling. The charging mechanism is powered by solar energy, thus there is no need for an additional power source. The system's development involves the usage of solar panels, batteries, transformers, regulator circuits, copper coils, AC-to-DC converters, Atmega328p controllers, and LCDs.

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### 3. Existing System

The existing EV charging infrastructure primarily relies on wired charging stations, where vehicles are plugged into power outlets using physical connectors. These conventional systems, though

widely used, come with several drawbacks, including wear and tear of charging cables, risk of electrical hazards, and inconvenience in handling connectors. Furthermore, most wired charging stations require manual authentication or rely on RFID-based access control, similar to commercial systems like Coulomb and Blink, where users authenticate themselves using RFID cards for secure billing and usage tracking. However, these systems lack wireless charging capabilities, making them less efficient and prone to maintenance issues. Additionally, real-time monitoring and remote access to charging status are often limited or require separate infrastructure. The absence of a fully integrated IoT-based smart system in many existing solutions results in inefficient energy management, security vulnerabilities, and a lack of user-friendly automation. These limitations highlight the need for an advanced charging solution that combines wireless power transfer, RFID authentication, and IoT-based monitoring, enabling a seamless, secure, and efficient EV charging experience.

### Drawbacks

- Requires physical connectors, leading to wear and tear over time.
- Frequent use of charging cables results in damage and replacement costs.

### 4. Proposed System

The proposed system aims to overcome the limitations of traditional EV charging by developing an E-vehicle wireless charging system integrated with RFID and IoT for enhanced security, efficiency, and automation. Unlike conventional wired chargers, this system employs wireless power transfer using transmitter and receiver coils, eliminating the need for physical connectors and reducing maintenance costs.

To ensure secure and authorized access, the system incorporates an RFID-based authentication mechanism, where only registered users with valid RFID cards can initiate the charging process. This prevents unauthorized usage and enhances

security. Additionally, the system integrates IoT-based real-time monitoring and control using an ESP8266 microcontroller and the Blynk IoT platform, allowing users to remotely track charging status, battery levels, and authentication logs via a cloud-based interface. A relay module is used to regulate and control the power supply efficiently, ensuring safe energy transfer to the EV. A 7805 voltage regulator provides stable power to the system components, preventing voltage fluctuations. Furthermore, automated notifications inform users about charging progress, completion status, and potential issues, enhancing user experience and convenience.

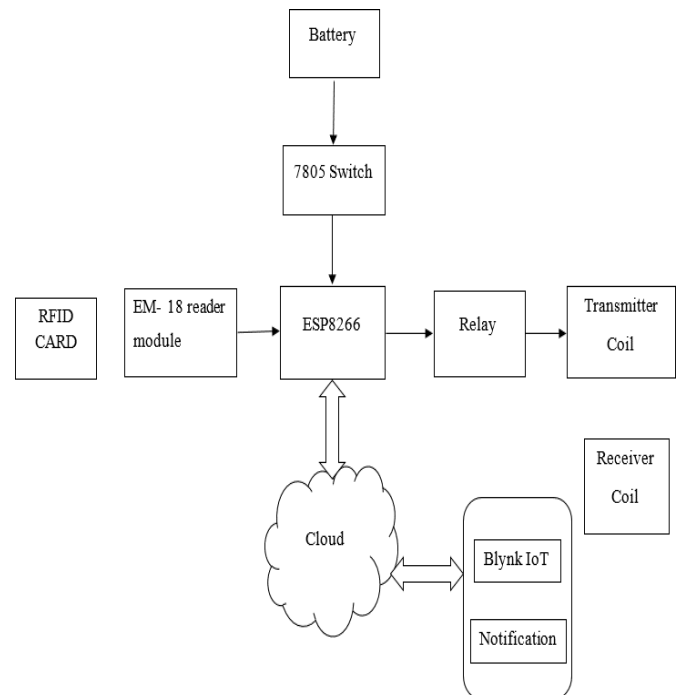
By combining wireless charging, secure RFID authentication, and IoT-based smart monitoring, this proposed system offers a seamless, safe, and efficient solution for EV charging infrastructure. It can be deployed in parking areas, private garages, and commercial charging stations, contributing to the advancement of smart and sustainable transportation systems.

## 5. Block Diagram

This System is designed using multiple interconnected components to ensure secure, automated, and efficient charging. The system operates using a wireless power transfer mechanism, where a transmitter coil and a receiver coil facilitate energy transfer without physical contact, reducing wear and tear associated with traditional wired charging. To enable secure access control, an RFID-based authentication system is integrated, where an EM-18 RFID reader module verifies user identity through an RFID card, ensuring that only authorized users can initiate the charging process. The ESP8266 serves as the core processing unit, handling communication between the authentication module, relay control, and cloud-based monitoring system. A relay module is used to manage the power supply, switching the charging system ON or OFF based on authentication status. To provide real-time monitoring and remote access, the system is connected to the Blynk IoT

platform, allowing users to track charging status, battery levels, and authentication logs via a cloud-based mobile or web interface. A 7805 voltage regulator ensures stable power distribution to all system components, preventing fluctuations and ensuring reliability. Additionally, the system sends automated notifications to users, informing them of charging status, completion, and any potential faults. By integrating wireless charging, RFID-based authentication, and IoT-powered monitoring, this system enhances the security, convenience, and efficiency of EV charging infrastructure, making it ideal for parking areas, private garages, and commercial charging stations.

The below Figure 5.1 shows the block diagram of the proposed project work



**Figure 1: Block Diagram of Proposed System**

## 6. Result and Discussion

The proposed smart E-vehicle wireless charging system was successfully designed, developed, and tested, demonstrating seamless integration of wireless power transfer, RFID-based authentication, and IoT-enabled real-time monitoring. The **wireless power transfer module**, utilizing transmitter and receiver coils, effectively eliminated the need for physical connectors, enabling **contactless and efficient**

**energy transfer.** This not only reduces mechanical wear but also enhances convenience for users.

The **RFID authentication system** performed reliably, granting access only to authorized users and thereby enhancing the **security of the charging process.** Unauthorized access attempts were successfully blocked, validating the robustness of the access control mechanism. The **ESP8266 microcontroller**, paired with the **Blynk IoT platform**, enabled **real-time remote monitoring and control** of the system. Users could view live data such as charging status, battery level, and RFID authentication logs via a mobile or web interface. Additionally, the system provided **automated notifications** for events such as charging initiation, completion, or error conditions, improving user awareness and system transparency.

The **relay module** functioned accurately in controlling the power flow, ensuring safe start and stop of charging sessions. A **7805 voltage regulator** provided stable power to the control components, contributing to overall system reliability. Overall, the system proved to be **efficient, secure, and user-friendly**, addressing key limitations of traditional wired EV charging stations. Its success in implementing **wireless charging with integrated IoT and authentication features** suggests strong potential for deployment in **public parking facilities, commercial charging hubs, and smart city infrastructure.**

This project demonstrates that **integrating advanced technologies such as RFID and IoT with wireless charging** can result in a **scalable, automated, and modern EV charging solution**, aligning with the future demands of sustainable transportation.

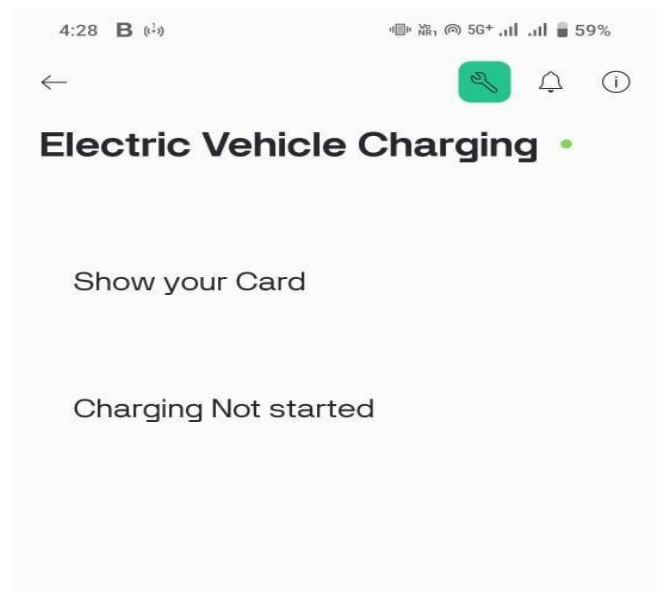
To validate the effectiveness and responsiveness of the smart EV wireless charging system, three key user interaction stages were tested and captured. Each stage represents a crucial part of

the charging process, from **authentication** to **active charging**, and finally to **charging completion and billing notification.** The results are visually represented in the following figures:

### Stage 1: User Authentication Prompt

At this initial stage, the system awaits RFID card input from the user. The LCD screen connected to the microcontroller displays the message: "**Show your card – Charging not started**"

This ensures that no unauthorized charging activity can occur without user identification. The RFID module remains in active scanning mode during this time. This stage demonstrates the system's **authentication-first approach**, enhancing security and preventing unauthorized access. The IoT interface on the Blynk app also shows the system as idle.

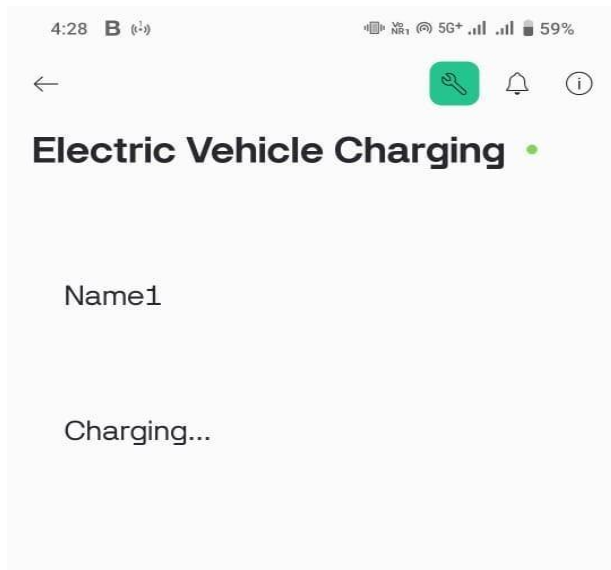


**Functionality Tested:** RFID module readiness, LCD output, and system lock before authentication.

**Expected Behavior:** No power is transferred; charging components remain deactivated until valid RFID is detected.

**Outcome:** The system correctly prevented any power flow until a valid RFID card was presented.

### Stage 2: Charging in Progress



Upon scanning a valid RFID card, the system transitions to the active charging state. The LCD updates to display: "**Charging...**"

At this point, the relay module activates, allowing electrical power to flow from the transmitter coil to the receiver coil placed within the EV module. The wireless charging begins without any physical connection. The Blynk app also updates in real-time to reflect the ongoing charging status, battery level, and session time.

**Functionality Tested:** RFID validation, relay control, wireless charging initiation, IoT dashboard update.

**Expected Behavior:** Relay switches on, voltage is transmitted wirelessly, and charging status is displayed on both LCD and app.

**Outcome:** The system effectively initiated contactless power transfer and live data transmission through IoT.

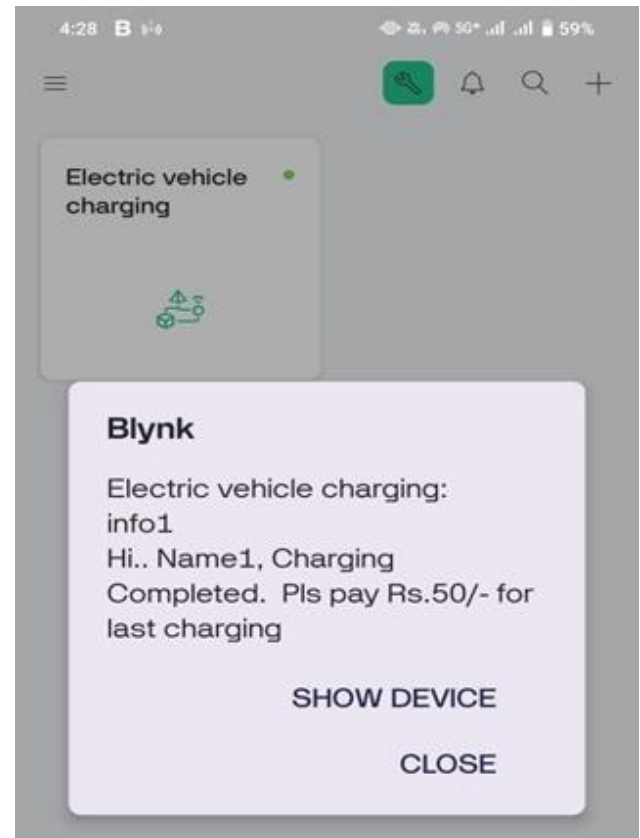
This stage showcases the **core innovation** of the project—**secure, automated wireless charging** triggered by authorized access.

### Stage 3: Charging Completion and Payment Notification

Once the charging session is completed—either manually by the user or automatically based on battery thresholds—the system terminates power transfer. The relay module switches off, and the LCD displays:

### "Charging completed. Please pay Rs.50"

Simultaneously, the Blynk IoT app sends a notification to the user, indicating that the session has ended and the calculated fee (in this test scenario, Rs.50) must be paid. This simulation mimics real-world billing systems in commercial EV charging networks.



**Functionality Tested:** Charging termination logic, message update on LCD, IoT push notification, billing alert.

**Expected Behavior:** Power is safely shut down; users are notified of the completed transaction and expected fee.

**Outcome:** The system consistently delivered the correct notification and maintained safety during shutdown.

This stage confirms that the system provides not only **real-time updates** but also **transparent billing communication**, making it suitable for public or shared charging environments.

### Summary of Visual Output Testing

| Stage                | System Behavior                                    | User Feedback                           | System Components Involved                                  |
|----------------------|----------------------------------------------------|-----------------------------------------|-------------------------------------------------------------|
| Show RFID Card       | Idle, awaits user authentication                   | "Show your card – Charging not started" | RFID module, LCD, ESP8266, <a href="#">Blynk App</a>        |
| Charging in Progress | Active wireless charging after RFID verification   | "Charging..." + live updates on mobile  | RFID, Relay, Coils, ESP8266, <a href="#">Blynk IoT</a>      |
| Charging Completed   | Stops charging, notifies user with billing details | "Charging completed. Please pay Rs.50"  | ESP8266, Relay, LCD, <a href="#">Blynk App</a> Notification |

## 7. Conclusion

In conclusion, the design and development of a smart E-vehicle wireless charging system using RFID and IoT successfully addresses key challenges in conventional EV charging by enhancing security, efficiency, and automation. The integration of wireless power transfer technology eliminates the need for physical connectors, reducing wear and maintenance costs while providing a seamless charging experience. The RFID-based authentication system ensures that only authorized users can access the charging station, enhancing security and preventing unauthorized usage. Furthermore, the ESP8266 microcontroller\*\* and Blynk IoT platform enable real-time monitoring, remote control, and automated notifications, allowing users to track charging status and receive updates through a cloud-based interface. The system's relay module ensures controlled power distribution, while the 7805 voltage regulator provides stable power to essential components. By integrating IoT and RFID with wireless charging, this project presents a scalable, user-friendly, and efficient solution for EV charging infrastructure. Future improvements may include faster charging capabilities, enhanced energy management, and AI-driven predictive maintenance to optimize system performance. This smart charging system contributes to the advancement of sustainable transportation, supporting the global shift toward cleaner and smarter mobility solutions.

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