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RFID Based Smart EV Charging and Gate Control System

Dr. N. L Aravinda[1] and Pittala Nikitha[2]
[1]Associate Professor, ECE (Embedded Systems) Department
[2]MTech Student, ECE (Embedded Systems) Department
Malla Reddy Engineering College for Women's, Maisammaguda, Telangana, India.
aravindanl@gmail.com[1], pittalanikhithapatel@gmail.com[2]

Abstract: *Infrastructure for safe, effective, and automatic charging of electrical cars (EVs) is vital because of their developing popularity. In order to assure that simplest authorized users can access charging stations and constrained areas, this inspiration indicates an RFID-based smart EV charging and gate control machine. The era acknowledges people through RFID tags, opens the gate, and mechanically permits access to the charging station. The manage logic and authentication are managed the use of an Arduino microcontroller. The machine initiates the billing technique and logs the consultation after the user has been authenticated. Access is refused to unauthorized users, ensuring safety and averting abuse. The system may be installation in public charging stations, enterprise campuses, or residential neighbourhoods. It will increase safety, complements strength management, and lessens the want for human involvement. The assignment gives a scalable, inexpensive solution through integrating automation, IoT, and sustainable strength support.*

Keywords: RFID Authentication, Smart EV Charging, Gate Automation, Arduino-based Control, RFID Reader and Tags, Microcontroller Automation

I. INTRODUCTION

Access is refused to unauthorized customers, making certain protection and warding off abuse. The gadget may be installation in public charging stations, enterprise campuses, or residential neighborhoods. It will increase protection, complements power management, and lessens the want for human involvement. The venture gives a scalable, cheap answer through integrating automation, IoT, and sustainable power support.The want for secure and handy charging infrastructure is growing fast as electric powered cars (EVs) retain to advantage popularity [1]. Because identification verification isn't always utilized in conventional charging arrangements, they may be vulnerable to undesirable access. Including wise get admission to manipulate structures can enhance operational effectiveness and protection [2]. For person authentication, RFID [3] era gives an inexpensive option. Only legal RFID customers might be capable of liberate the access gate and make use of the charging station way to the system`s architecture. The Arduino-based controller turns on the charging port and starts the gate mechanism whilst a valid RFID tag is scanned [4]. This eliminates the want for supervision and guide labor. The EV infrastructure is covered from abuse through denying get right of entry to to unauthorized users. The device may be utilized in public charging stations, workplaces, or residences.

The growing call for automated, safe, and powerful EV charging answers is supported with the aid of using the mixing of this sort of system [5]. RFID generation ensures speedy authentication and easy consumer administration. Automation additionally lowers the want for human intervention and will increase strength efficiency. As a part of modern urban planning, the initiative encourages smart infrastructure and mobility. Additionally, it lays the basis for upcoming integration with mobile apps and cloud systems.

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II. OBJECTIVES

- To offer a secure EV charging system that verifies customers the usage of RFID generation earlier than granting them get right of entry to to the charging station.
- Using an Arduino-based system, automate gate manipulate in order that best authorised EV customers can enter.
- To limit unapproved use of EV charging infrastructure through installing vicinity a reliable get right of entry to manipulate system.
- For person clarity, real-time repute updates (which include get right of entry to granted/denied or charging began) ought to be proven on an LCD.
- To design a cost-effective and scalable solution that can be implemented in homes, offices, and public charging stations.

III. LITERATURE SURVEY

Recent advancements in electric vehicle (EV) technology have emphasized the need for intelligent and secure charging systems. Traditional EV charging setups lack access control, making them vulnerable to misuse, especially in public or shared environments. Researchers have proposed IoT-based solutions for monitoring and billing, but many do not address user authentication. RFID technology has been identified as a low-cost, efficient solution for secure user identification. Studies show that RFID systems can be easily integrated with microcontrollers like Arduino for smart control applications [6] .

Several projects have implemented RFID for secure access in parking systems, but limited work has been done on integrating gate automation with EV charging. A 2021 study explored automated EV charging using GSM [7] and sensors, yet lacked localized access control features. Another project applied RFID in building access, demonstrating fast authentication and scalability [8]. These systems highlight the effectiveness of RFID in identity verification and automation. However, integrating RFID with EV charging and gate control as a single system is still an emerging concept.

Existing literature also points to the growing demand for smart infrastructure in urban mobility. Researchers advocate for embedded systems that combine renewable energy sources, mobile apps, and automation[9] for future-ready EV stations [10]. This project builds on those ideas by using RFID for both entry control and energy management. It leverages open-source hardware to keep implementation affordable and accessible.

IV. METHODOLOGY

The methodology of the proposed system involves the integration of RFID authentication, Arduino-based control, and automated gate and charging activation. Initially, every user is provided with a unique RFID tag. When the RFID tag is brought near the RFID reader, it reads the unique ID and transmits it to the Arduino microcontroller. The Arduino then compares the received ID against a preloaded database of authorized users.

If the tag is recognized as valid, the Arduino sends signals to a relay module which activates the EV charging circuit and simultaneously triggers a motor or servo that controls the entry gate. The user receives feedback through an LCD display, which shows messages like "Access Granted" or "Charging Started".

If an unauthorized RFID tag is scanned, the Arduino blocks access, displays "Access Denied", and keeps both the gate and charging port disabled. The system is designed to work in real-time with fast response and minimal latency. It reduces manual intervention, secures the charging infrastructure, and ensures that only registered users can access EV charging resources. The technique locations a sturdy emphasis on automation, affordability, and scalability for applications in homes and smart cities.

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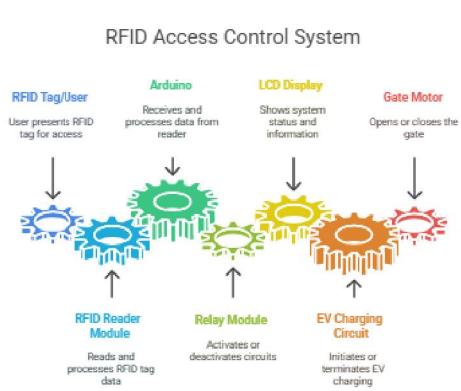

Figure 1: RFID Access Control system

V. RESULTS AND DISCUSSION

Ten simulated RFID experiment attempts, alternating among accredited and unlawful customers, have been used to assess the machine. As visible in figure 2, the graph illustrates how the Arduino changed into capable of efficiently allow EV charging completely for recognized RFID tags. Red bars characterize refused access, at the same time as inexperienced bars display a success charge. This demonstrates that the gate machine and relay module react as it should be to authentication. With each try, the LCD show gave clean feedback. System protection changed into maintained through stopping unauthorized customers from commencing the gate or having access to charges. The RFID reader confirmed tags in much less than a second with accuracy and occasional latency. Simultaneous duties like charging activation and gate manage have been treated successfully through the Arduino logic. Findings suggest that the machine is reliable for realistic implementation.

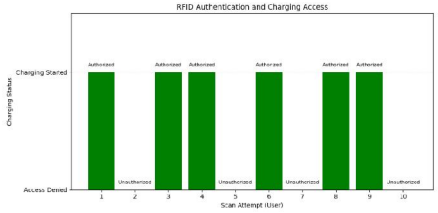

Figure 4: RFID Authentication and Charging Access

VI. CONCLUSION

An automatic and secure manner to govern strength distribution and electric powered automobile access is the usage of the RFID-Based Smart EV Charging and Gate Control System. The generation makes certain that most effective legal users can get admission to access gates and begin charging through using RFID authentication. This encourages strength efficiency, improves safety, and prevents illegal use. Gate control, strength delivery, and consumer verification are all correctly coordinated through the Arduino microcontroller. LCD real-time comments ensures consumer readability and usability. The generation is suitable for public, commercial, and domestic charging stations because it lessens the want for human supervision. High accuracy and quick response instances in consumer authentication and relay control had been demonstrated through testing. Additionally, it establishes the framework for incorporating IoT functionalities like information analytics and cell control. The machine promotes clever transportation withinside the destiny with its scalable layout and occasional cost. All matters considered, it is a beneficial step towards secure and smart EV infrastructure.

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