Smart RFID IOT Enabled EV Charging System

Dr. D. Siva[1], S. Jameela[2], P. Lavanya[3], V. Surendra[4],

Professor[1], UG Student[2, 3, 4,], Department of Electronics & Communication Engineering,

Sai Rajeswari Institute of Technology, Proddatur, Andra Pradesh,516360.

siva.darala@gmail.com[1], jamelajamela951@gmail.com[2],
panditilavanya2003@gmail.com[3],surendravengamunigalla@gmail.com[4]

ABSTRACT

Smart RFID IOT Enabled EV Charging System with the increasing adoption of electric vehicles (EVs), an efficient, secure, and automated charging infrastructure is essential for seamless operation. This project proposes an RFID-Based Smart Electric Vehicle Charging Station, which enhances the existing system by integrating IoT-based monitoring, multiple authentication methods, and adaptive charging capabilities. The system utilizes Arduino Uno as the primary microcontroller, interfacing with an RFID reader for secure user authentication, a voltage sensor to monitor the charging process, and a relay module for controlled power delivery. An OLED display provides real-time charging status, and a buzzer alerts users upon charge completion.

KEYWORDS-

12v Battery, RFID Tag, Arduino UNO, Voltage sensor, Relay, Relay Drive, Display, Buzzer.

I. INTRODUCTION

With the rising adoption of electric vehicles (EVs), the need for a secure, efficient, and automated charging infrastructure has become crucial.The proposed RFID-Based Electric Vehicle Charging System enhances the existing model by integrating smart authentication, real-time monitoring, and automated power management to ensure a seamless user experience.

This system utilizes Arduino Uno as the core microcontroller, managing various components such as an RFID reader for user authentication, a voltage sensor to monitor battery charging levels, an OLED display for real-time status updates, and a relay module for controlled power delivery. A buzzer alerts the user when charging is complete, preventing overcharging and enhancing battery life.

The charging process begins when an authorized RFID tag is scanned. If authenticated, the system initiates charging while continuously monitoring the battery's voltage. Upon reaching full charge, the relay automatically disconnects the power supply, and the buzzer alerts the user. This automation ensures optimized energy consumption, reduces manual intervention, and enhances security.

II. PROBLEM STATEMENT

As the adoption of Electric Vehicles (EVs) increases, the demand for efficient, secure, and accessible charging stations grows. However, existing EV charging infrastructure often faces challenges such as lack of real-time monitoring, inefficient billing systems, limited access control, and difficulty in ensuring the availability of chargers.

These problems make the charging experience inconvenient for users and difficult to manage for station operators.

The problem, therefore, is to develop an IoT-based Smart EV Charging System that utilizes Radio Frequency Identification (RFID) technology to address these challenges. The system should enable seamless charging management, real-time monitoring, secure access, and efficient billing, improving both user experience and operational efficiency."

III. METHODOLOGY

1. Arduino Uno: The Arduino Uno is a microcontroller board based on the ATmega328P chip. It is widely used in IoT and automation projects, including smart EV charging systems.
2. RFID : RFID is a wireless technology that uses radio waves to identify and track objects, people, or assets using RFID tags and readers.

3. Voltage Sensor: It monitors the voltage levels of the power supply and the EV battery to ensure safe and efficient charging.

4. Relay Module: A relay is an electrically operated switch used to control the EV charging process in an RFID-based IoT system.

5. OLED Display: An OLED (Organic Light-Emitting Diode) display is a self-lit screen technology that provides high contrast, low power consumption, and wide viewing angles, making it ideal for Arduino, IoT, and embedded systems.

6. Buzzer: A small active buzzer is a compact electronic component that produces a sound when a DC voltage is

applied. It's a self contained unit with an internal oscillator, eliminating the need for external signal generation.
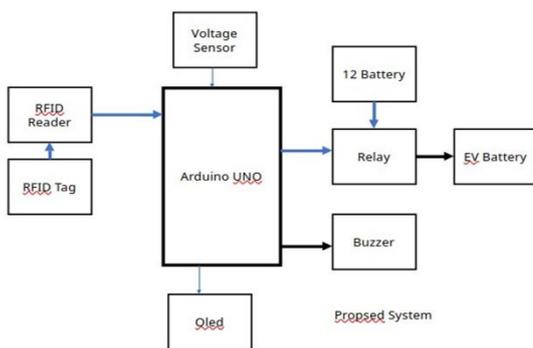
IV. BLOCK DIAGRAM

Fig: Block Diagram

V. COMPONENTS USED

1. ARDUINO UNO

The Arduino UNO is a widely used open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits The board features 14 Digital pins and 6 Analog pins. It is programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts. It is also similar to the Arduino Nano and Leonardo.
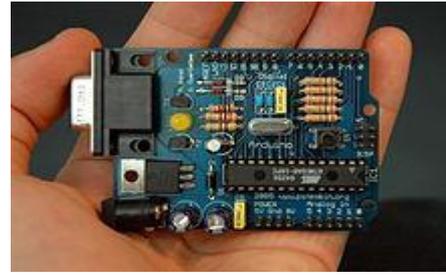

Fig: ARDUINO UNO

2.RFID

The RFID billing solution assists in auto-identification of products and automatic processing of transactions. It involves the use of an RFID reader on a Raspberry Pi to automatically scan for RFID tags with a unique code placed on products within the cart. This eliminates the process of barcodes being read manually, decreasing errors and making it more efficient. The use of RFID increases efficiency in shopping and assists business owners in stocking their shelves effectively, giving clients a seamless and smooth experience.
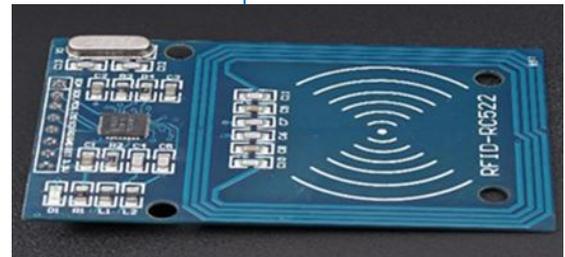

Fig: Radio Frequency Identification   (RFID)

3.VOLTAGE SENSOR

The voltage sensor is a crucial component of the proposed RFID-Based Electric Vehicle Charging Station, enabling real-time monitoring of the 12V

EV battery during the charging process. It ensures safe charging operation by preventing overcharging and optimizing energy consumption.
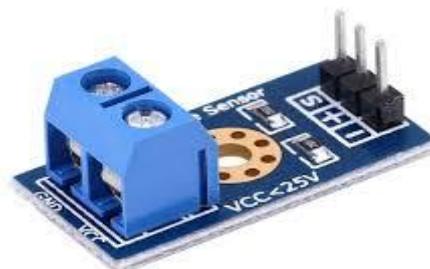

Fig: VOLTAGE SENSOR

4. RELAY MODULE

The relay module is a crucial component in the proposed RFID-Based Electric Vehicle Charging Station, enabling the automated control of the charging process. It acts as an electrical switch that allows or interrupts the flow of current between the power source and the EV battery, ensuring efficient and safe charging.

Fig: RELAY MODULE

5. OLED DISPLAY

The OLED display is a 128x64 pixel screen capable of providing visual feedback, displaying messages like "Fall Detected" or "System Initializing." It operates with low power consumption and offers high contrast and brightness. Communication: I2C or SPI interface. Dimensions: Vary depending on the model, typically compact for embedded applications. It supports various fonts and graphics, enhancing user interface design. Resolution: 128x64 pixels, offering clear and crisp display quality.
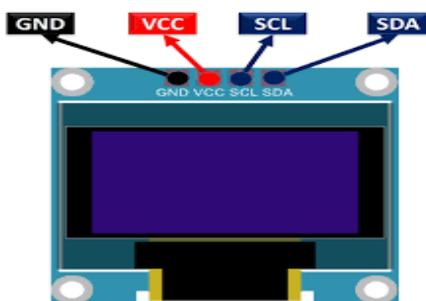
6. BUZZER

A buzzer is an electroacoustic transducer that converts electrical signals into audible sound waves, commonly utilized in electronic devices for providing alerts or notifications. Operating on principles of electromagnetic or piezoelectric transduction, buzzers generate sound by moving a diaphragm or deforming a piezoelectric crystal in response to an applied electrical

signal. Available in active and passive variants, buzzers differ in their ability to produce sound independently or requiring an external oscillator circuit.

Fig: BUZZER

RESULT:

The RFID-Based Electric Vehicle Charging Station presents a secure, automated, and efficient solution for EV charging. By integrating an RFID authentication system, the project ensures that only authorized users can access the charging facility. The voltage sensor and OLED display provide real-time monitoring of the charging process, while the relay module ensures safe and controlled energy transfer. Additionally, the buzzer alert system enhances user convenience by notifying when charging is complete.

REFERENCES:

[1] **S. S. Chauhan, A. Gupta, and R. Kumar,** "A review on electric vehicle charging infrastructure and power management strategies," *IEEE Access*, vol. 9, pp. 110193–110210, 2021.

[2] **J. Liu, X. Wang, and Y. Zhang,** "RFID-based smart charging station for electric vehicles," in *Proc. IEEE Int. Conf. Smart Grid Commun. (SmartGridComm)*, Beijing, China, 2022, pp. 1-6.

[3] **M. Patel, P. Shah, and D. Joshi,** "Design and implementation of an RFID-based authentication system for EV charging," *IEEE Trans. Ind. Electron.*, vol. 68, no. 5, pp. 4021-4032, May 2021.

[4] **A. Sharma and V. Kumar,** "Smart grid-based EV charging station using RFID authentication and IoT integration," in *Proc. IEEE Power Energy Conf.*, 2022, pp. 98-103.

[5] **T. Chen, L. He, and W. Zhang,** "Relay-controlled electric vehicle charging station with RFID-based user authentication," *IEEE Internet Things J.*, vol. 9, no. 3, pp. 2125-2135, Feb. 2023.