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SMART ELECTRIC VEHICLE CHARGING STATION USING RFID

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ABSTRACT

This project aims to design and develop smart electric charging station which gives smart payment option and also provides all the user data to google sheet via RFID. For IOT purpose we are using ESP32 Wifi module to access data of users through online mode. Develop a reliable and secure method for user identification and authentication using RFID technology.

Keywords: EV charging, RFID technology, Smart Payment method, Wifi, IOT

1.INTRODUCTION

The adoption of electric vehicles (EVs) has been steadily increasing as a sustainable transportation solution. To support this trend, it's essential to create an efficient and eco-friendly EV charging infrastructure. This project aims to address the need for an EV charging station that not only provides fast and reliable charging but also incorporates a battery control system to enhance its sustainability and energy efficiency. Current charging stations often lack the integration of advanced technologies to streamline user authentication, payment processes, and overall user experience. The traditional methods of charging and billing are often cumbersome, leading to inefficiencies and potential security concerns

2. PROBLEM STATEMENT

Electric Vehicle (EV) usage is increasing rapidly, and the need for efficient and secure charging stations is growing. To facilitate easy access and secure transactions, an RFID-based system is being developed for EV charging stations.

3. LITERATURE REVIEW

In the literature many solutions were found that RFID technology plays a pivotal role in the identification and authentication process at smart charging stations. RFID tags attached to EVs enable seamless communication between the vehicle and the charging infrastructure. Studies highlight the advantages of RFID, including quick and contactless identification, enhancing user convenience and reducing the risk of errors in billing.

Also for power distribution among different energy sources, ranging from rule-based through stochastic methods up to complex methods. However, none of the described methods improve the thermal stability and reliability of the batteries. Thus more focus should be given for the improve user experience smart charging and payment options and thermal control.

4. DESIGN AND OBJECTIVES

- **DESIGN**

Design part of the prototype mainly includes the circuit diagram and all the major parts that are integrated together to form the final circuit.
The circuit diagram mainly includes 7 major parts which are as follows

1. Microcontroller Atmega 16A

fig.1 Atmega 16A

Microcontroller used in the project is Atmega 16a because of its compatibility and suitability to the project. The microcontroller mainly does the job of processing all the data that is fetched from all the major parts of the
circuit and then providing it to the LCD display.
The ATmega16A features an 8-bit AVR microcontroller, has 16KB of Flash program memory,1KB of EEPROM, and 1KB of SRAM for temporary data storage. It also has a 16 bit timer/counter along with various peripherals like GPIO pins
USART,SPI and I2C.

2. Current sensing and signal conditioning
This part of the circuit mainly includes LM358P which is a differential amplifier and a potentiometer to adjust the potential in the circuit and some resistor and capacitors. The main purpose of this part is to sense the amount of
current that is flowing through to the battery of the vehicle.

3. Voltage sensing and signal conditioning
This part of the circuit mainly includes mainly a potentiometer to adjust the potential in the circuit and some resistor and capacitors. The main purpose of this part is to sense the amount of voltage that is flowing through
to the battery of the vehicle.

4. Battery charging control unit
This unit is mainly used to control the charging of the battery and thus turn it on and off whenever required. Thus mainly relay is used in this circuit which uses the principle of magnetic field to induce the coil and thus act as a
switch.

5. WIFI module

fig.2 WIFI Module ESP32

Wifi module used is ESP32 and the major purpose is to access data of users through the internet. Develop a reliable and secure method for user identification and authentication.

6. RFID

fig.3 RFID

RFID is one of the most important part of this circuit and this is mainly used for the purpose of scanning the unique identification card if the user and thus fetching all the required details along with enabling it for automatic and

secure payment. In this case we have used mainly EM-18 reader module to scan the card of the user and fetch all the details which will be displayed on the LCD display and also to enable payment from the prepaid balancew into the card.

7. 16*2 LCD Unit

fig.4 LCD 16*2

LCD Unit is mainly used to display all the data that has been provided on the screen. This display mainly has read and write pins and many data pins for fetching the data from microcontroller. LCD Display unit also requires a 5V power

supply for its functioning.

- **OBJECTIVES**

Major objectives of the project are as follows

1. To assess the usability and user experience of RFID-based payment systems at EV charging stations:
This objective involves evaluating the ease of use, convenience, and overall satisfaction of EV owners using RFID technology for payments at charging stations.

2. To integrate an efficient payment method along with the objective of securing required user data using the ease of RFID and thus to complete multiple functions simultaneously.

3. To examine the security and privacy implications of RFID-based payment systems:
This objective involves assessing the security measures implemented in RFID payment systems at EV charging stations and evaluating the level of user trust in the security and privacy of their payment information

4. This project aims to assess how the adoption of RFID technology for payments affects the efficiency, accessibility, and scalability of the EV charging network, as well as its potential role in promoting the widespread adoption of electric vehicles.

5. This objective focuses on identifying technical issues or limitations associated with RFID technology in the context of EV charging payments and exploring potential solutions or enhancements to improve system performance and reliability.

5. METHODOLOGY

To develop a smart vehicle charging station. we are using AVR microcontroller for this project as a controller. ESP8266 Is used for whatever data is used during charging like voltage, current, Power bill etc. are access throughout it and see the data on Google sheet.
The main and important feature of this project is RFID in RFID. There are one RFID radar and RFID tag every user, which comes for vehicle charging, having the unique tag with unique ID.
RFID tag is on powered and when it comes in a contact with RF ID radar, which is powered it send The unique ID to the microcontroller, then micro controller, check the code and identify the user
Once the user is identified, the system fetches the user data also shows the user balance in users account. We are using relay to on and off the charging. Also it can start charging after scanning the RFID tag and turn off as well in the circuit diagram. We are using the shunt register for current measurement and voltage measurement, we can use voltage divider circuit.
We are using 15 V adapter for power supply and consider 12.6 V lithium ion battery as electric vehicle battery. When the user is identified and Wi-Fi is connected, then charging is starting whatever the units are consumed by user. According to the bill is debited from account. If account is having not enough balance, then recharge system is provided to recharge the account.
Throughout Wi-Fi module, all the data of user, such as name, unit consumed voltage, current and bill is displayed on Google sheet.

6. BLOCK DIAGRAM

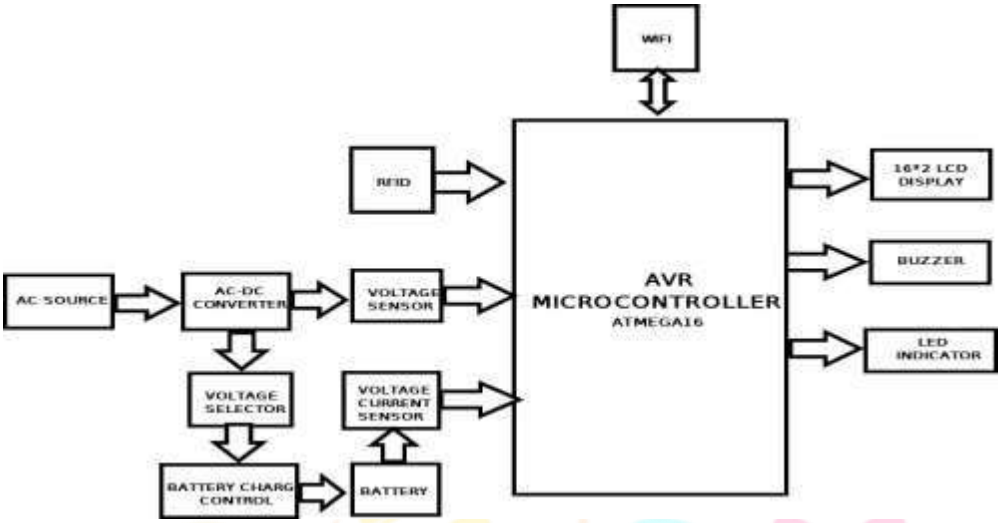
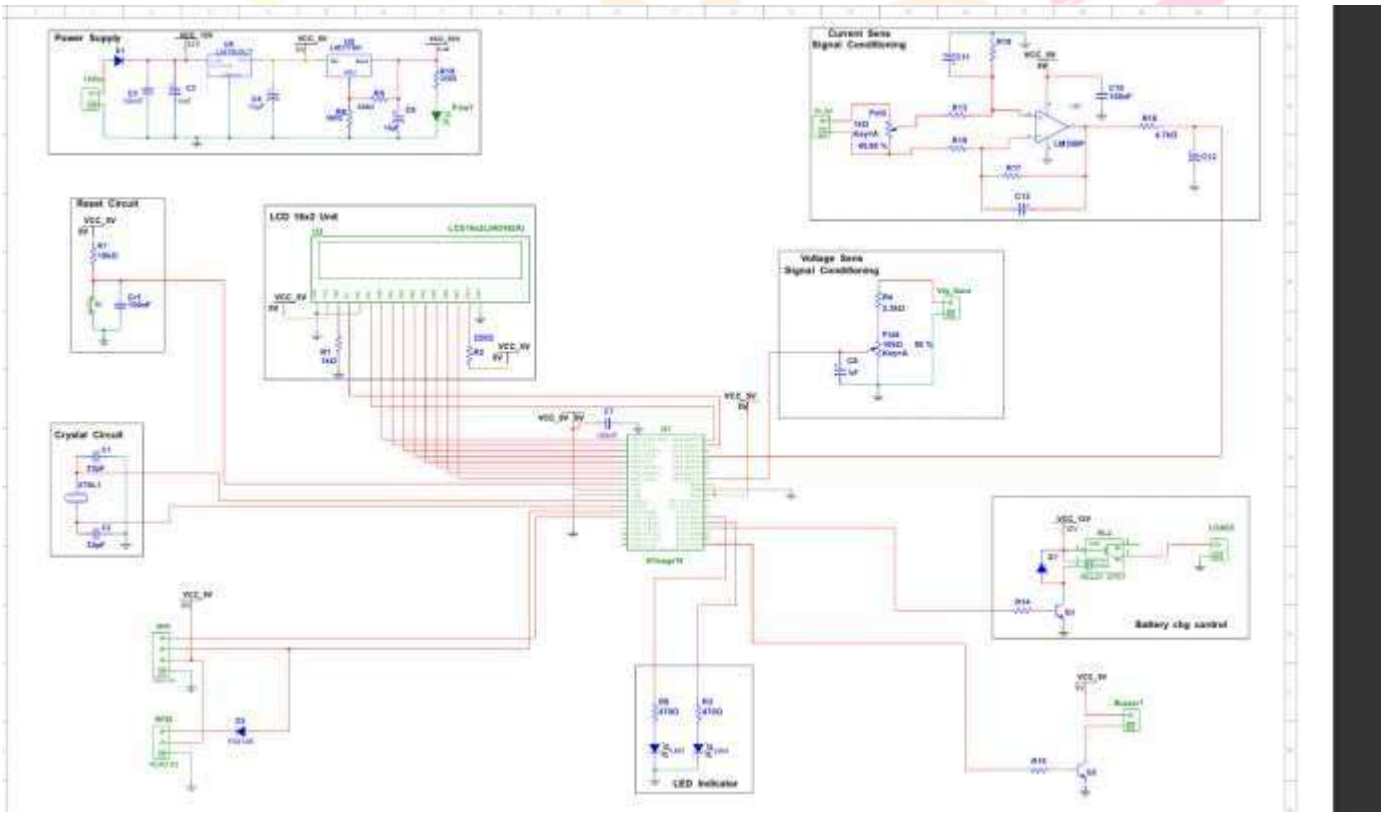


fig.5 Block diagram

6. CIRCUIT DIAGRAM



7. COMPONENT LIST

1. AVR Microcontroller ATmega16
2. BJT_NPN, BC547A
3. CAP_ELECTROLIT, 1µF
4. CAP_ELECTROLIT, 1mF
5. CAP_ELECTROLIT, 10µF
6. CAPACITOR, 100nF

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fig.6 Circuit Diagram

7. CAPACITOR, 100nF
8. DIODE, 1N4007
9. Buzzer
10. AC-DC Adapter 12V, 2A
11. Li Ion Battery 11.4V
12. Current sensor
13. Relays
14. LCD, LCD16x2(JHD162A)
15. LED, LED_3
16. OPAMP, LM358P
17. Tactile switches
18. POTENTIOMETER, 1kΩ
19. POTENTIOMETER, 10kΩ
20. Relay, RELAY SPDT
21. RESISTOR, 1kΩ
22. RESISTOR, 2.2kΩ
23. RESISTOR, 3.3kΩ
24. RESISTOR, 4.7kΩ
25. RESISTOR, 10kΩ
26. RESISTOR, 10kΩ
27. RESISTOR, 22kΩ
28. RESISTOR, 220Ω
29. RESISTOR, 330Ω

8. FLOWCHART

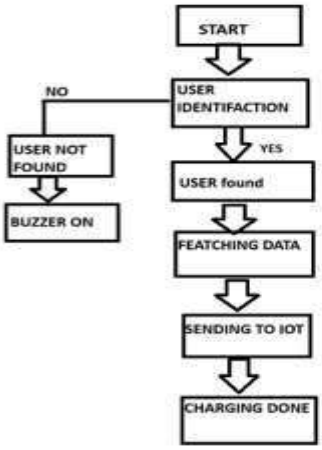


fig.7 Flowchart

9. RESULTS AND DISCUSSION

The performance and requirement of project smart EV charging station using RFID has been fulfilled. ATmega 16 controller unit has been tested on the identification of the user RFID. The controller was worked properly on identified user and also able to transmit the data to cloud and we can see the user's unit consummation ,voltage ,battery percentage values .overall this charging station is more efficient to use .

The successful implementation of RFID technology for access control in EV charging stations offers significant advantages over traditional authentication methods. By leveraging RFID, charging station operators can enhance security, streamline operations, and improve user experience.

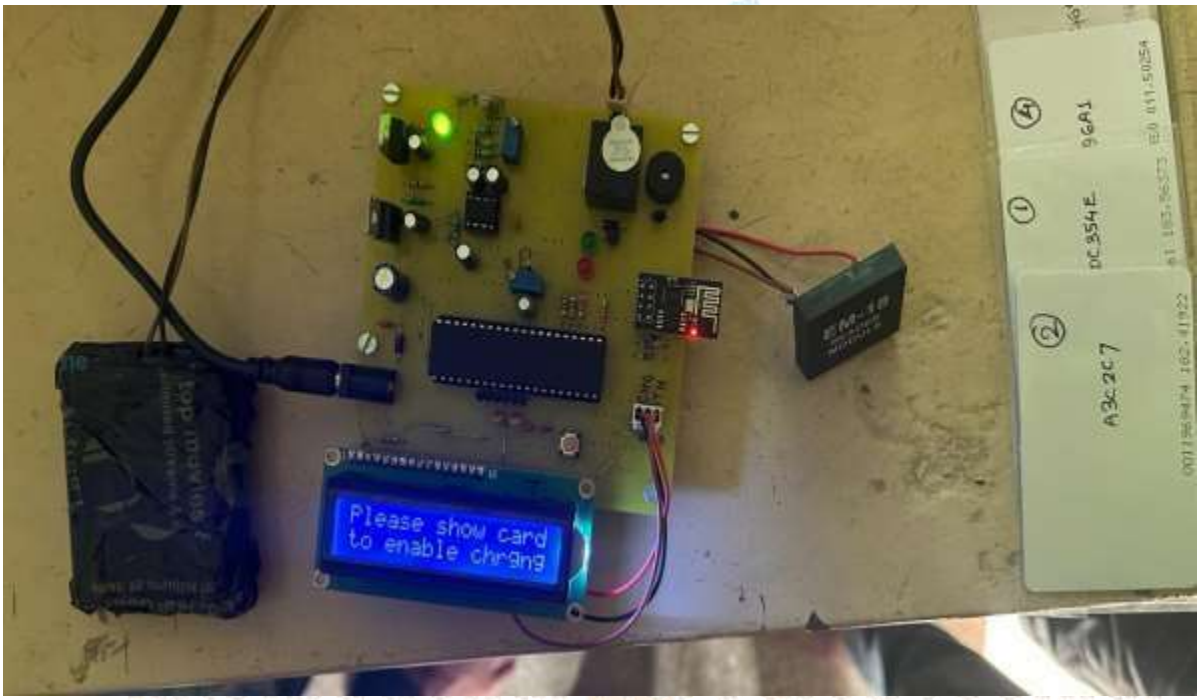
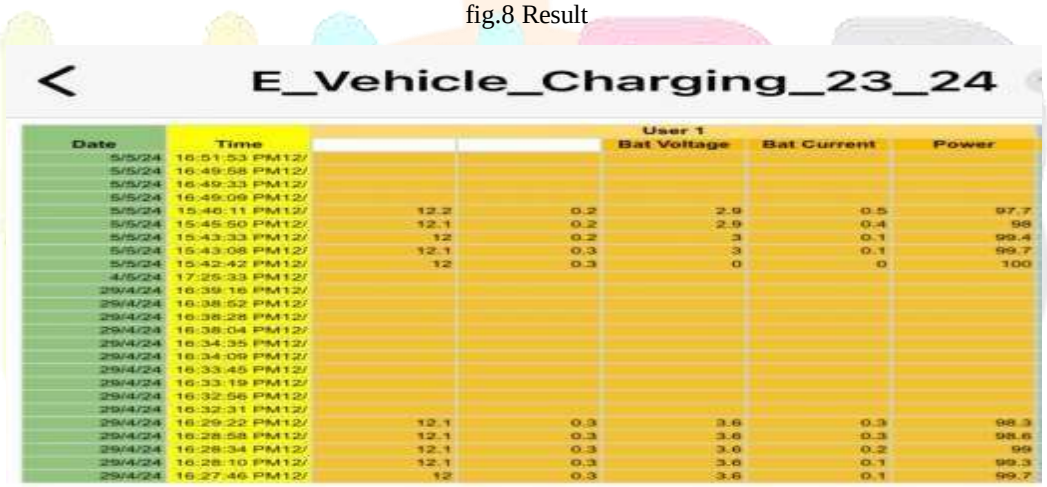


fig.8 Result



E_Vehicle_Charging_23_24

Date	Time			User 1 Bat Voltage	Bat Current	Power
5/5/24	16:51:53 PM12/					
5/5/24	16:49:58 PM12/					
5/5/24	16:49:33 PM12/					
5/5/24	16:49:09 PM12/					
5/5/24	15:46:11 PM12/	12.2	0.2	2.9	0.5	97.7
5/5/24	15:45:50 PM12/	12.1	0.2	2.9	0.4	98
5/5/24	15:43:33 PM12/	12	0.2	3	0.1	99.4
5/5/24	15:43:09 PM12/	12.1	0.3	3	0.1	99.7
5/5/24	15:42:42 PM12/	12	0.3	0	0	100
4/5/24	17:25:33 PM12/					
29/4/24	16:39:16 PM12/					
29/4/24	16:38:52 PM12/					
29/4/24	16:38:28 PM12/					
29/4/24	16:38:04 PM12/					
29/4/24	16:34:35 PM12/					
29/4/24	16:34:09 PM12/					
29/4/24	16:33:45 PM12/					
29/4/24	16:33:19 PM12/					
29/4/24	16:32:56 PM12/					
29/4/24	16:32:31 PM12/					
29/4/24	16:29:22 PM12/	12.1	0.3	3.6	0.3	98.3
29/4/24	16:28:58 PM12/	12.1	0.3	3.6	0.3	98.6
29/4/24	16:28:34 PM12/	12.1	0.3	3.6	0.2	99
29/4/24	16:28:10 PM12/	12.1	0.3	3.6	0.1	99.3
29/4/24	16:27:46 PM12/	12	0.3	3.6	0.1	99.7

fig.9 Google Sheet Snap

10. CONCLUSION

The integration of RFID technology with electric vehicle charging stations offers a seamless and efficient solution for user authentication and data tracking. By utilizing RFID cards or tags, users can easily access charging facilities, streamlining the charging process and enhancing user experience.

Overall, the combination of RFID technology and Wi-Fi connectivity significantly enhances the functionality and management of electric vehicle charging stations, contributing to the widespread adoption of sustainable transportation solutions.

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