"RFID Based EV Charging Station"

A

Project Report

Submitted in the partial fulfillment of the requirements

For the Degree of

Bachelor of Engineering

In

Electrical (Electronics & Power)

By

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DEPARTMENT OF ELECTRICAL ENGINEERING

SHRI SANT GAJANAN MAHARAJ COLLEGE OF ENGINEERING

SHEGAON 444 203 M.S (INDIA)

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DEPARTMENT OF ELECTRICAL ENGINEERING
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2022-23

CERTIFICATE

Certified that the project report entitled, **"RFID Based EV Charging Station"** *is a bonafied work done under my guidance by*

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In partial fulfillment of the requirements for the award of degree of Bachelor of Engineering in Electrical (Electronics & Power).

Date: 13/05/23

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ABSTRACT

An electric vehicle is a new and upcoming technology in the transportation and power sector that have many benefits in terms of economic and environmental. A comprehensive review and evaluation of various types of electric vehicles and its associated equipment in particular battery charger and charging station is presented. A comparison is made on the commercial and prototype electric vehicles in terms of electric range, battery size, charger power and charging time. The various types of charging stations and standards used for charging electric vehicles have been outlined and the impact of electric vehicle charging on utility distribution system is also discussed. This project explains the system which is capable of automatically deducing the dispensed amount to charge a vehicle battery from user prepaid card (i.e., RFID card) and that deduced amount information and remaining balance of the card is send to the Google sheet of costumers laptop or mobile IOT technology and even that deduced amount information is send to the web server using Wi-Fi technology.

Keywords: *Battery charger, charging station, electric vehicle, RFID, Google sheet.*

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CHAPTER 1

INTRODUCTION

1.1 Motivation

An electric vehicle charging station is equipment that connects an electric vehicle (EV) to a source of electricity to recharge electric cars, neighborhood electric vehicles and plug-in hybrids.[1] Some charging stations have advanced features such as smart metering, cellular capability and network connectivity, while others are more basic. Charging stations are also called electric vehicle supply equipment (EVSE) and are provided in municipal parking locations by electric utility companies or at retail shopping centers by private companies. These stations provide special connectors that conform to the variety of electric charging connector standards. Fees for using EVSE vary from monthly or yearly flat rates to per-kWh to hourly rates. Charging stations can be free and are usually subsidized by the local government. Different types of EVSE provide different speeds of charging. Level 1 charging stations use a 120 volt (V), alternating-current (AC) plug and require a dedicated circuit, offering about 5 miles of range for every hour of charging. Level 2 stations charge through a 240V, AC plug and require home charging or public charging equipment to be installed. Level 2 stations provide 10 to 20 miles of range for every hour of charging . Level 2 chargers are the most common and charge at approximately the same rate as a home system. Level 3 chargers are also known as DC fast chargers. Level 3 uses a 480V, direct-current (DC) plug. They bypass the onboard charger and provide DC electricity to the battery via a special charging port. DC Fast Chargers provide up to 40 miles of range for every 10 minutes of charging but are not compatible with all vehicles. Additionally, some propriety charging stations, such as the Tesla Supercharger, are designed for significantly higher-speed charging. As demand grows for more publicly accessible charging stations, there is a greater need for equipment that supports faster charging at higher voltages and currents that are not currently available from residential ESVE. Globally, the number of electric vehicle networks is increasing to provide a system of publicly accessible charging stations for EV recharging. Governments, automakers and charging infrastructure providers have forged agreements to create these networks.

Energy in the form of electricity plays a very important role in our day to day life. Electricity is one of the greatest wonders of science. Next to man, it is the most important and revolutionary creation in this world of ours. The gradual but excessive use of electricity has come to bring about remarkable changes in industry. Computers as calculators sum up totals and make other calculations with the utmost accuracy. Newspapers and books are printed in millions overnight. There is not a single phase of human life that is not indebted to electricity for its progress. The modern age has, therefore, been truly called the “age of electricity.”
The infrastructure element that provides the crucial link between an Electric Vehicle (EV) with a depleted battery and the electrical source that will recharge those batteries is the Electric Vehicle Supply Equipment or EVSE.

Problem statement:

The aim of RFID based EV Charging station is that, the system exploits opportunities of connectivity to computation capabilities of big data (because we are using google sheet for store 4the information). Firstly, a source data to support defining use cases that represent driving patterns and functionality. Second, connection to big data and computation capabilities in cloud enables optimizing the EV energy which leads to a reliable range prediction, eco-driving, eco-routing as well as novel functionalities like smart fast charging and assured charging.

1.2 Literature survey

1..RFID (Radio Frequency Identification) technology is commonly used in Electric Vehicle (EV) charging stations to authenticate and authorize users. A literature survey of RFID-based EV charging station research is provided below:

2. " SMART E-VEHICLE CHARGING SYSTEM USING RFID”, 2018 Engineering Science and Technology (Volume: 10, Issue: 2, March 2020). In this paper, authors have been proposed Different strategies for the deployment and integration of public fast charging, emphasizing on the power quality aspects and charging load management techniques**.**

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3. " Fast EV charging station integration with grid ensuring optimal and quality power exchange. “ , 2018 Engineering Science and Technology. The proposed algorithm aims at maximally reducing the customer satisfaction-involved operational cost considering the potential uncertainties, while balancing the real-time supply and demand by adjusting the optimally scheduled charging/discharging of EV mobile/local battery storage, grid supply, and deferrable load**.**

4. " Solar Based Fast Tag Charger for Electrical Vehicle”, IEEE transactions on industrial electronics 2021. In this paper, authors have designed and developed a solar charger for electric vehicle with RFID implementation. A dc-dc boost converter is employed to boost the solar panel voltage to station battery voltage with one level of voltage.

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5. "An Intelligent Electric Vehicle Charging System Based on RFID Technology" by Liu et al. (2019) proposes an intelligent EV charging system that uses RFID technology for user identification and payment. The proposed system is tested on a hardware platform and shows improved efficiency and user-friendliness.

6. "A Smart RFID-Based Electric Vehicle Charging System Using Renewable Energy Sources" by Hamid et al. (2020) proposes a smart EV charging system that uses RFID technology for user identification and renewable energy sources for power generation. The proposed system is simulated and shows improved sustainability.

7. "Design and Implementation of an RFID-based Electric Vehicle Charging System" by Alotaibi

et al. (2021) proposes an RFID-based EV charging system that includes user authentication, billing, and monitoring features. The proposed system is implemented on a hardware platform and shows improved reliability and user-friendliness. In conclusion, RFID-based EV charging systems have been widely researched in recent years, and the proposed systems show improved efficiency, security, and user-friendliness. However, more research is needed to address the challenges of scalability and interoperability in RFID-based EV charging systems.

Literature survey with information of Literature identified for project

SN	Title of Paper	Details of Publication with Date and Year	Literature Identified for Project
1.	Solar Based Fast Tag Charger for Electrical Vehicle	IEEE transactions on industrial electronics 2021.	In this paper, authors have designed and developed a solar charger for electric vehicle with RFID implementation. A dc-dc boost converter is employed to boost the solar panel voltage to station battery voltage with one level of voltage.
2.	SMART E-VEHICLE CHARGING SYSTEM USING RFID	2018 Engineering Science and Technology (Volume: 10, Issue: 2, March 2020)	In this paper, authors have been proposed Different strategies for the deployment and integration of public fast charging, emphasizing on the power quality aspects and charging load management techniques.

3	Fast EV charging station integration with grid ensuring optimal and quality power exchange	2018 Engineering Science and Technology	The proposed algorithm aims at maximally reducing the customer satisfaction-involved operational cost considering the potential uncertainties, while balancing the real-time supply and demand by adjusting the optimally scheduled charging/discharging of EV mobile/local battery storage, grid supply, and deferrable load.
4.	Design and development of electric vehicle charging station equipped with RFID	2016	In paper, the fast charging of electronic vehicle is explained.The versatile converter topology is based on the concept of the power electronic transformer. For the direct transformer-less coupling to the medium-voltage grid, a cascaded H-bridge (CHB) converter is utilized.
5.	A Smart RFID based EV charging station using renewable energy	2020 Engineering Science and Technology by Hamid et al	proposes a smart EV charging system that uses RFID technology for user identification and renewable energy sources for power generation. The proposed system is simulated and shows improved sustainability
6.	7."Design and Implementation of an RFID-based Electric Vehicle Charging System	2021	In paper, proposes an RFID-based EV charging system that includes user authentication, billing, and monitoring features. The proposed system is implemented on a hardware platform and shows improved reliability and user-friendliness .

1.3 Objective

The objective of an RFID-based EV charging station can include:

1. Secure authentication: The RFID technology allows for secure authentication of the EV owner, ensuring that only authorized users can access the charging station and use the charging services.

2. Efficient charging: The charging process can be optimized with the help of RFID technology. The RFID system can communicate with the charging station and provide information on the type of EV and the charging requirements, allowing for efficient charging and avoiding overcharging or undercharging.

3. Payment processing: RFID technology can be used to enable easy and secure payment processing for charging services. The EV owner can simply swipe their RFID card or tag to initiate the charging process and pay for the service.

4. Data collection and analysis: The RFID system can collect data on charging usage, EV type, and charging patterns, which can be analyzed to optimize the charging services and improve the overall user experience.

5. Remote monitoring and control: The RFID system can enable remote monitoring and control of the charging station, allowing operators to monitor charging usage, troubleshoot issues, and make necessary adjustments to the charging services.

CHAPTER -2

CONVENTIONAL EV CHARGING STATION

2.1 Introduction

A conventional charging station is a facility that provides electric vehicle (EV) owners with a source of power to recharge the batteries of their vehicles. These charging stations typically use conventional electrical outlets, such as Level 1 charging stations that use a standard 120V outlet or Level 2 charging stations that use a 240V outlet, to deliver electricity to the EV's battery.

Conventional charging stations are commonly found in homes, workplaces, and public areas, such as shopping centers and parking lots. They provide a convenient and accessible way for EV owners to charge their vehicles, especially for those who do not have access to home charging facilities.

However, conventional charging stations have some limitations, including slower charging rates, limited range, and the need for more charging infrastructure to support the growing number of EVs on the road. To address these challenges, new and more advanced charging technologies, such as DC fast charging stations and wireless charging, are being developed and deployed to improve the charging experience for EV owners and promote the wider adoption of electric vehicles

2.2 Difference between RFID and conventional charging station

The main difference between a conventional EV charging station and an RFID-based EV charging station lies in the authentication and payment processes. Here are some key differences:

Authentication: Conventional EV charging stations typically require users to manually enter a code or swipe a credit card to initiate the charging process. In contrast, RFID-based charging stations use RFID technology to authenticate the EV owner and ensure that only authorized users can access the charging services.

Payment: Conventional charging stations may require users to pay with a credit card or a mobile payment app, which can be time-consuming and may require the user to have a credit card or mobile device. In contrast, RFID-based charging stations enable easy and secure payment processing by allowing users to simply swipe their RFID card or tag to initiate the charging process and pay for the service.

Data collection and analysis: RFID-based charging stations can collect data on charging usage, EV type, and charging patterns, which can be analyzed to optimize the charging services and improve the overall user experience. This data may not be as readily available with conventional charging stations.

Remote monitoring and control: RFID-based charging stations can enable remote monitoring and control of the charging station, allowing operators to monitor charging usage, troubleshoot issues, and make necessary adjustments to the charging services. This may not be possible with conventional charging stations.

Overall, RFID-based charging stations offer a more streamlined and secure charging experience for EV owners, while also providing operators with valuable data and remote monitoring capabilities.

2.3 Limitations of conventional charging station

Some limitations of conventional EV charging stations include:

Limited charging speed: Conventional EV charging stations typically offer Level 2 charging, which provides charging speeds of up to 240 volts and 30 amps. This is slower than Level 3 DC fast charging, which can charge an EV to 80% capacity in 30 minutes or less.

Limited availability: Conventional charging stations may not be as widely available as gasoline stations, and they may be clustered in certain areas. This can make it challenging for EV owners to find a charging station when they need one, particularly on long trips.

Inconvenience: Conventional charging stations may require EV owners to manually enter a code or swipe a credit card to initiate the charging process, which can be inconvenient and time-consuming.

Lack of integration: Conventional charging stations may not be integrated with other EV charging networks or services, making it difficult for EV owners to access.

Chapter- 3

RFID based EV charging station

3.1 Methodology

RFID authentication: The EV owner swipes their RFID card or tag on the charging station reader to initiate the charging process. The charging station reader reads the RFID information and verifies the user's identity.

Charging information retrieval: The charging station reader retrieves information about the EV type, battery capacity, and charging requirements from the RFID system. This information is used to optimize the charging process and ensure efficient charging.

Charging initiation: Once the user is authenticated and the charging information is retrieved, the charging process can be initiated. The charging station communicates with the EV's onboard charging system and begins charging the battery.

Payment processing: The RFID system can be used to enable easy and secure payment processing for the charging services. The EV owner's payment information is stored in the RFID system, and the charging fees are automatically deducted from the user's account.

Data collection and analysis: The RFID system can collect data on charging usage, EV type, and charging patterns, which can be analyzed to optimize the charging services and improve the overall user experience.

Remote monitoring and control: The RFID system can enable remote monitoring and control of the charging station, allowing operators to monitor charging usage, troubleshoot issues, and make necessary adjustments to the charging services.

3.2 Block Diagram

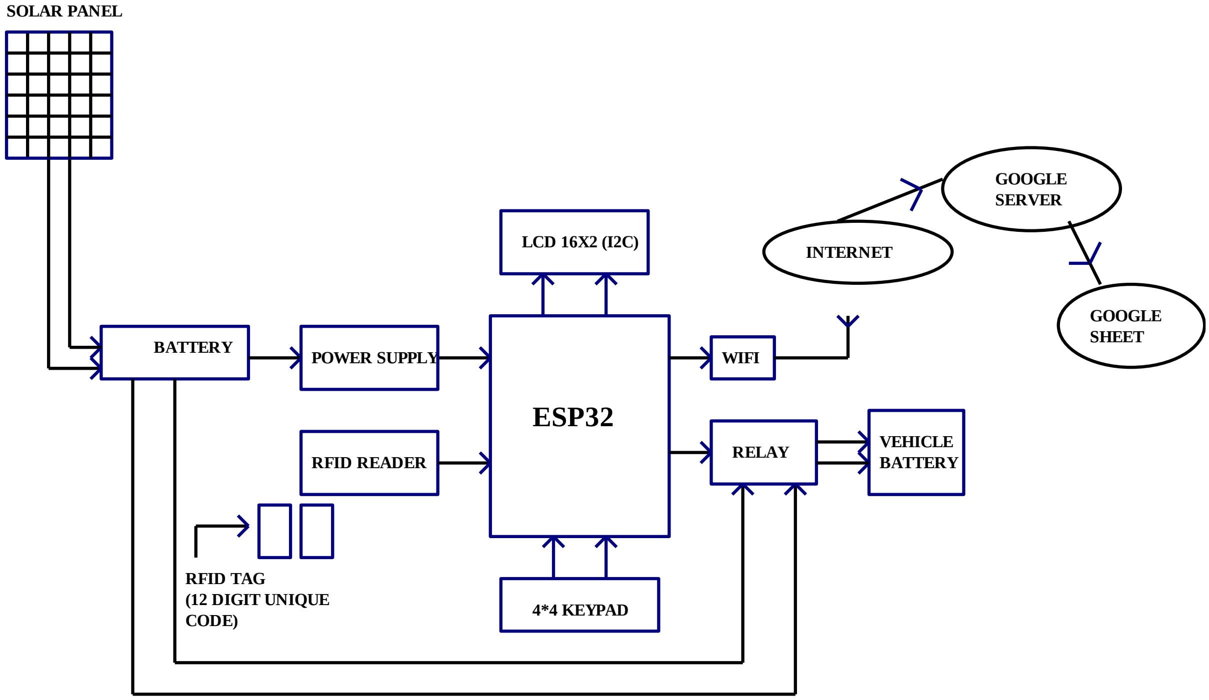


Figure 3.1: Block Diagram

The prototype of EV charging station is proposed such that it uses the renewable energy (Solar Energy). An electrical vehicle battery recharging system composed of photovoltaic solar panel connected to the electrical power grid. With the help of Solar panel, energy will be stored into the battery. Here we are providing RFID card to each customer with which customer can access petrol at the charging stations. Before using this card we have to recharge it like a prepaid card. Whenever we want to charge the vehicle battery, just we have to enter required amount and place the RFID card near the RFID reader. Then microcontroller reads the data from the RFID reader and performs the action according to the customer. This system also provides the security for the customers for vehicle battery charging at the EV charging stations by avoiding the involvement of human beings, so to avoid the risk of carrying money every time and charge the battery on hours basis as well whenever required. All the data is display on LCD 16x2 and saved in Google sheet. When vehicle is parked at the charging station, vehicle battery will be charged by charging station battery.

3.3 Calculation for Component

Overall system design involves following steps:

- Power Supply Design
- Interfacing various modules to micro-controller

- PCB designing

The following information must be available to the designer of the transformer.

- Power output.
- Operating voltage.
- Frequency range.
- Efficiency and regulation.

Size of core is one of the first consideration in regard of weight and volume of a transformer. This depends on type of core and winding configuration used. Generally following formula is used to find Area or Size of the Core.

$$Ai = \sqrt{Wp} / 0.87$$

Where Ai = Area of cross section in square cm.

Wp = Primary Wattage.

For our project we require +5V output, so transformer secondary winding rating is 9V, 500mA.

So secondary power wattage is,

$$P2 = 9 * 500mA$$

$$= 4.5Watt$$

So,

$$Ai = \sqrt{4.5} / 0.87$$

$$= 2.43$$

Generally 10% of area should be added to the core.

So,

$$Ai = 2.673$$

a) Turns per volt:- Turns per volt of transformer are given by relation.

$$\text{Turns per volt} = 100000 / 4.44\, f * Bm * Ai$$

Where,

F = Frequency in Hz.

Bm = Density in Wb / Square meter.

Ai = Net area of the cross section.

Following table gives the value of turns per volt for 50 Hz frequency.

Flux density 0.76 Wb /sq m	1.14	1.01	0.91	0.83
Turns per Volt 45 / Ai	40 / Ai	45 / Ai	50 / Ai	55 / Ai

Generally lower the flux density better the quality of transformer. For our project we have taken the turns per volt is 0.91 Wb / sq.m from above table.

Turns per volt = 50 / Ai

= 50 / 2.673

= 18.7055

Thus the turns for the primary winding is,

230 * 18.7055 = 4302.265

And for secondary winding,

9 * 18.7055 =168.3495

b) wire size :- As stated above the size is depends upon the current to be carried out by winding which depends upon current density. For our transformer one tie can safely use current density of 3.1 Amp / sq.mm.

for less copper loss 1.6Amp/sq.mm or 2.4sq.mm may be used generally even size gauge of wire are used.

R.M.S secondary voltage at secondary to transformer is 9V. so maximum voltage Vm(Vp) across secondary is

$VP= Vrms \times \sqrt{2}$

$Vrms=VP / \sqrt{2}$

= 9 / 1.141

= 7.88

D.C output voltage Vm across secondary is,

Vdc = 2 * 7.88/pi

= 2 * 7.88/3.14

= 5.02 V

P.I.V rating of each diode is

PIV = 2Vdc

= 2 * 5.02

= 10.04 V

Maximum forward current, which flow from each diode is 500 mA. So from above parameter, we select diode 1N4007 from the diode selection manual.

B) Design of filter capacitor:-

Formula for calculating filter capacitor is

$C = ¼ \sqrt{3}\ r * F * R1$

Where,

r = ripple present at output of rectifier, which is maximum 0.1 for full wave rectifier.

F = frequency of AC main.

R1 = input impedance of voltage regulator IC

$C = 1/(4 *(\sqrt{3} * 0.1 * 50 * 28))$

= 1030 µf

= 1000 uF

Voltage rating of filter capacitor should be greater than the i/p Vdc i.e. rectifier output which is 5.02 V so we choose 1000µf / 25V filter capacitor.

3.4 Working

Authentication: The EV owner swipes their RFID card or tag on the charging station reader to initiate the charging process. The charging station reader reads the RFID information and verifies the user's identity.

Charging information retrieval: The charging station reader retrieves information about the EV type, battery capacity, and charging requirements from the RFID system. This information is used to optimize the charging process and ensure efficient charging.

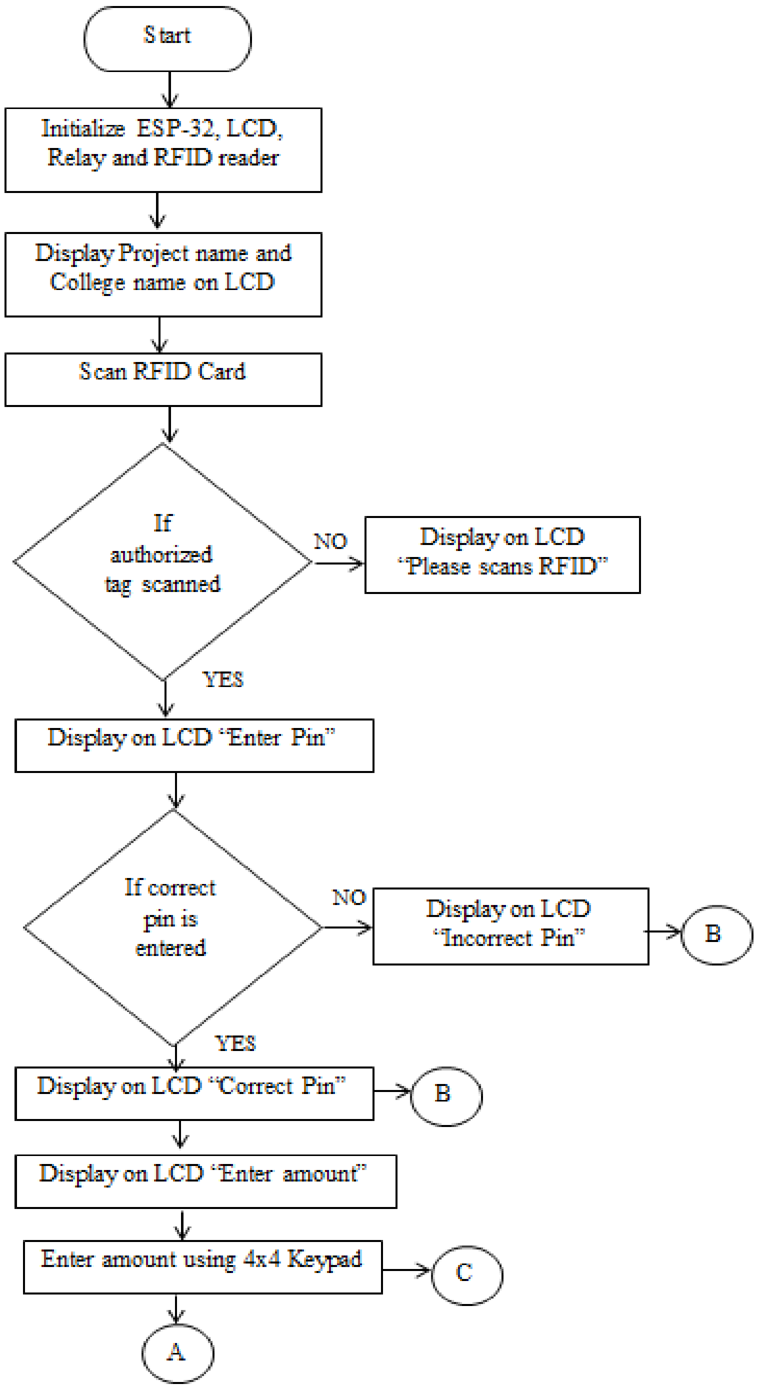
Charging initiation: Once the user is authenticated and the charging information is retrieved, the charging process can be initiated. The charging station communicates with the EV's onboard charging system and begins charging the battery.

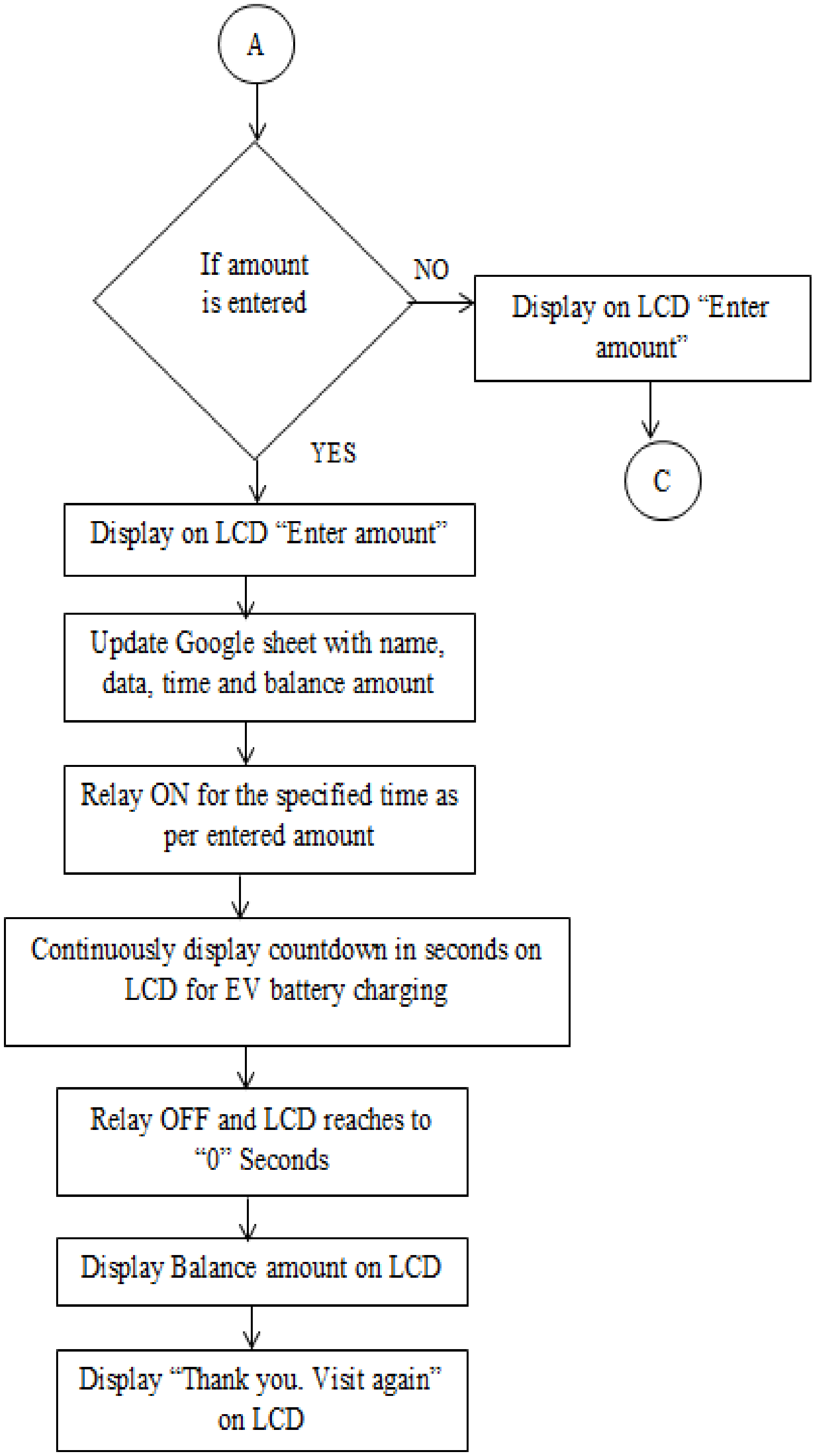
Payment processing: The RFID system can be used to enable easy and secure payment processing for the charging services. The EV owner's payment information is stored in the RFID system, and the charging fees are automatically deducted from the user's account.

Data collection and analysis: The RFID system can collect data on charging usage, EV type, and charging patterns, which can be analyzed to optimize the charging services and improve the overall user experience.

Remote monitoring and control: The RFID system can enable remote monitoring and control of the charging station, allowing operators to monitor charging usage, troubleshoot issues, and make necessary adjustments to the charging services

3.5 Flow Chart




A
If amount is entered
NO
Display on LCD "Enter amount"
C
YES
Display on LCD "Enter amount"
Update Google sheet with name, data, time and balance amount
Relay ON for the specified time as per entered amount
Continuously display countdown in seconds on LCD for EV battery charging
Relay OFF and LCD reaches to "0" Seconds
Display Balance amount on LCD
Display "Thank you. Visit again" on LCD

Chapter No – 4
Components

Hardware Requirement

Sr. No	Hardware Name	Description
1	ESP -32 Microcontroller	It will use as microcontroller
2	RFID Tags	It will store the information along with tags
3	Solar Panel	It will store the energy of Solar
4	RFID Reader	To read the information provided by RFID Tags
5	LCD with I2C module	To display the result
6	Keypad	For enrolling the new person with the system

Table 3.1: Hardware Requirements

The specifications and the snap of each component is provided in the next section:

4.1 ESP 32 micro-controller

4.1.1 Introduction

This is the latest generation of ESP32 IoT development module. This development board breaks out all ESP32 modules pins into 0.1" header and also provides a 3.3 Volt power regulator, Reset and programming button and an onboard CP2102 USB to TTL converter for programming directly via USB port. At the core of this module is the ESP32 chip, which is designed to be scalable and adaptive. ESP32 integrates a rich set of peripherals, ranging from capacitive touch sensors, Hall sensors, low-noise sense amplifiers; SD card interface, Ethernet, high-speed SDIO/SPI, UART, and I²C.Using Bluetooth, users can connect to their phone or broadcast low energy beacons for its detection. The use of Wi-Fi enables a large physical range, as well as a direct connection to the internet via a Wi-Fi router. Perfect for wearable electronic or battery powered applications, the ESP32 chip uses less than 5µA.

Figure 3.3: ESP-32 Microcontroller

4.1.2 Feature of Microcontroller ESP 32

Dual-core processing: The ESP32 has two Tensilica Xtensa LX6 microprocessors, which allows it to handle multiple tasks at once and improves its overall performance.

Wi-Fi and Bluetooth connectivity: The ESP32 has built-in Wi-Fi and Bluetooth connectivity, making it easy to connect to the internet and other devices.

Low power consumption: The ESP32 is designed to consume very little power, which makes it ideal for battery-powered devices.

Rich peripheral set: The ESP32 has a rich set of peripheral interfaces, including ADCs, DACs, I2C, SPI, UART, PWM, and more, making it highly versatile.

Security features: The ESP32 has built-in security features such as Secure Boot, Flash Encryption, and Cryptographic Hardware Acceleration, making it ideal for applications that require secure communications and data storage.

Support for multiple programming languages: The ESP32 can be programmed using several programming languages such as C, C++, MicroPython, and Arduino IDE, making it accessible to a wide range of developers.

Built-in memory: The ESP32 has built-in flash memory and RAM, which makes it easy to store and access data

4.2 RFID Tags

This basic RFID tag works in the 125kHz RF range and comes with a unique 32-bit ID. It is not re-programmable. This blank, smooth, and mildly flexible RFID tag, is ready for your logo.

Figure 3.4: RFID

4.2.1 Features of RFID Tag:

- EM4001 ISO based RFID IC
- 125kHz Carrier
- 2kbps ASK
- Manchester encoding
- 32-bit unique ID
- 64-bit data stream [Header+ID+Data+Parity]

4.3 Solar Panel

Figure 3.5: Solar Panel

4.3.1 Features of Solar Panel:

- Voltage : 12 Volts
- Current : 0.4167 Amp
- Power : 5 Watt

- Size : 29 cm x 18.5 cm x 1.7 cm

4.4 RFID Reader

RC522-A module uses Philips MFRC522 original chip design circuit card reader, easy to use, low cost, and suitable for equipment development, the development of advanced applications reader users, the need for RF card terminal design / production users. This module can be directly loaded into the variety of reader molds. Module uses voltage of 3.3V, simple few lines through the SPI interface directly with any user CPU board is connected to the communication module can guarantee stable and reliable work, reader distance.

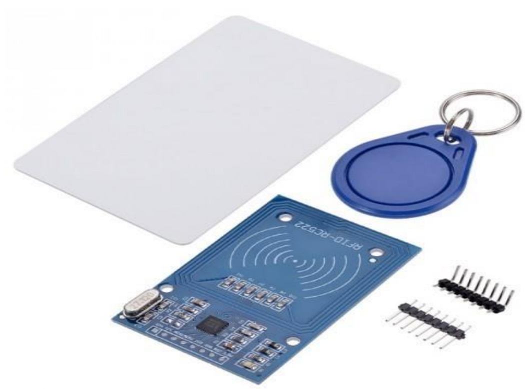


Figure 3.6: RFID Reader

Specification of RF522 Mifare Reader/Writer

- Module Name : MFRC522-ED
- Working current : 13—26mA/ DC 3.3V
- Standby current : 10-13mA/DC 3.3V
- sleeping current : <80uA
- peak current : <30mA
- Working frequency : 13.56MHz
- Card reading distance : 0～60mm（mifare1 card）

- Protocol : SPI
- data communication speed : Maximum 10Mbit/s Card types supported: mifare1 S50、mifare1 S70、mifare UltraLight、mifare Pro、mifare Desfire
- Dimension : 40mm×60mm
- Working temperature : -20—80 degree
- Storage temperature : -40—85 degree
- Humidity : relevant humidity 5%—95%
- Max SPI speed : 10Mbit/s

4.5 LCD Display with I2C Module

This board has a PCF8574 I2C chip that converts I2C serial data to parallel data for the LCD display. The I2C address is 0x3F by default, but this can be changed via 3 solder jumpers provided on the board. This allows up to 3 LCD displays to be controlled via a single I2C bus (giving each one it's own address).

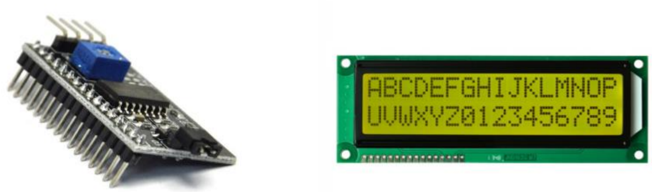


Figure 3.7: LCD Display with I2C Module

4.5.2 Features of I2C Module for 16X2 LCD:

- 5V power supply
- Serial I2C control of LCD display using PCF8574

- Back-light can be enabled or disabled via a jumper on the board
- Contrast control via a potentiometer
- Can have 8 modules on a single I2C bus (change address via solder jumpers)address, allowing
- Size : 41.6mm x 19.2mm

4.6 Keypad

Figure 3.8: Keypad

4.6.1 Features of keypad:

- This is a Low cost 4X3 Matrix Keypad with 12 Membrane Switches
- 4 x 3 Matrix Membrane Keypad
- 7 pin connector
- Adhesive mounting (sticker on the back side)
- Operation Temperature: 0 to +60 centigrade
- Humidity: 40 centigrade, 90%-95%, 240 hours
- Fexible Circuit Length: Approx. 3.3 inch / 83 mm

RFID Reader will read the RFID Tags for the specific person Identification. The signal goes to ESP32 microcontroller and LCD Display 16 X 2 will display the code assigned to the RFID Tag. The entry of this event occurred is done in the Google sheet through wi-fi connectivity of ESP32 microcontroller. For prototype we have kept Rs 1/- deduction for each second of charging at the station.

Software Requirements

Sr. No	**Software Name**	**Description**
1	Arduino IDE	For programming on ESP-32 Microcontroller
2	Proteus	For simulation purpose

CHAPTER- 5
Experimental setup for RFID Based EV Charging Station

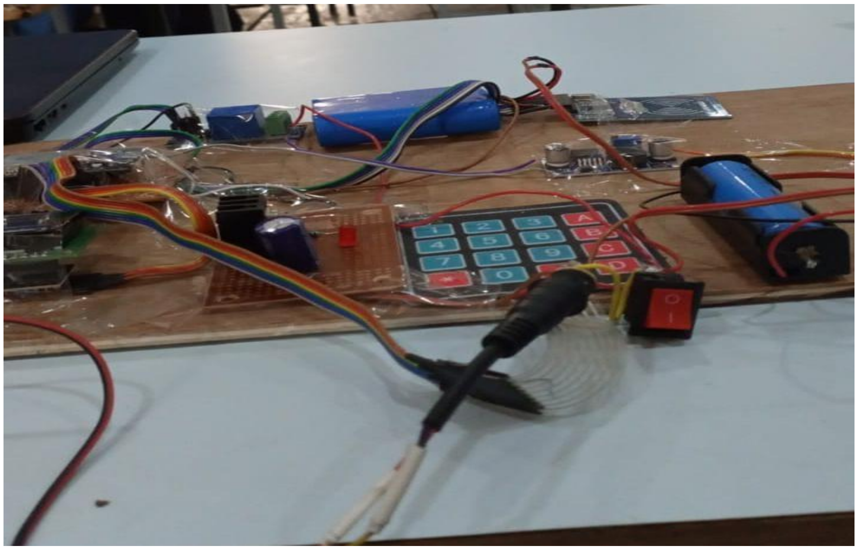


Fig 5.1 Project model

5.1 Procedure for making RFID based EV charging station

Gather materials: The first step is to gather all the necessary materials, including an RFID reader and antenna, an EV charging station, a microcontroller such as an Arduino or ESP32, power supply, cables, and other hardware components.

Design the circuit: The next step is to design the circuit that will connect the RFID reader, charging station, and microcontroller. This circuit should also include any necessary power regulation and filtering components.

Assemble the hardware: Once the circuit is designed, the next step is to assemble the hardware components. This may involve soldering components onto a PCB or breadboard, wiring the components together, and mounting the charging station and RFID reader.

Program the microcontroller: The microcontroller should be programmed with the necessary software to read the RFID tags, authenticate users, initiate the charging process, and handle payment processing.

Test the system: After assembling the hardware and programming the microcontroller, the system should be tested to ensure that it functions correctly. This may involve testing the RFID authentication, charging initiation, payment processing, and remote monitoring and control features.

Install and maintain the charging station: Once the system is tested and working correctly, the charging station can be installed in its intended location. Ongoing maintenance should also be performed, including regular testing and maintenance of the hardware components, updating software, and monitoring usage data.

5.2 **Working:**

The working process of an RFID-based EV charging station project with updating Google Sheet can be divided into the following steps:

Install the necessary hardware components: This includes an RFID reader, an antenna, and a microcontroller (such as an ESP32).

Program the microcontroller: The microcontroller will communicate with the RFID reader to detect the presence of an RFID tag and the charging status of the EV. The microcontroller will also communicate with the Wi-Fi module to update the Google Sheet.

Set up the Google Sheet: Create a Google Sheet that will be used to store and display charging data. Define the necessary columns and headings, such as RFID tag ID, start time, end time, charging duration, and charging cost.

Configure the Google Sheet API: Set up the Google Sheet API to allow the microcontroller to access and update the sheet.

Test the system: Test the system by charging an EV and verifying that the charging data is being updated in the Google Sheet. Verify that the charging data is accurate and complete.

Chapter -6
Result

Result

Improved user experience: RFID-based authentication and payment processing can offer a faster and more convenient charging experience for EV owners.

Enhanced security: RFID-based authentication can help prevent unauthorized access to the charging station and reduce the risk of theft or vandalism.

Efficient charging: The RFID system can retrieve information about the EV's battery capacity and charging requirements, enabling more efficient charging and reducing the risk of overcharging or undercharging.

Remote monitoring and control: The RFID system can enable remote monitoring and control of the charging station, allowing operators to monitor charging usage, troubleshoot issues, and make necessary adjustments to the charging services.

Valuable data collection: The RFID system can collect data on charging usage, EV type, and charging patterns, on google sheet which can be analyzed to optimize the charging services and improve the overall user experience. Google sheet output can be shown in fig 6.1.

In summary, RFID-based EV charging stations offer several advantages over traditional charging stations, including enhanced security, improved user experience, and more efficient charging, among others. The specific results of an experiment may vary depending on the parameters and conditions of the study, but these benefits have been observed in various implementations of RFID-based EV charging stations.

Google sheet output:

	A	B	C	D	E	F
1	December 5, 2022 at 12:04PM	rfid			5	
2	December 5, 2022 at 12:04PM	rfid		4995		
3	December 5, 2022 at 12:05PM	rfid	ID2			
4	December 5, 2022 at 12:05PM	rfid		4995		
5	December 5, 2022 at 12:05PM	rfid			5	
6	December 5, 2022 at 12:23PM	rfid	ID1			
7	December 5, 2022 at 12:23PM	rfid		4995		
8	December 5, 2022 at 12:23PM	rfid			5	
9	December 5, 2022 at 12:25PM	rfid	ID1			
10	December 5, 2022 at 12:25PM	rfid		4993		
11	December 5, 2022 at 12:25PM	rfid			7	
12	December 5, 2022 at 12:25PM	rfid	ID2			
13	December 5, 2022 at 12:25PM	rfid		4994		
14	December 5, 2022 at 12:26PM	rfid			6	
15	December 5, 2022 at 03:20PM	rfid	ID1			
16	December 5, 2022 at 03:20PM	rfid		4995		
17	December 5, 2022 at 03:20PM	rfid			5	
18	December 5, 2022 at 03:22PM	rfid	ID1			
19	December 5, 2022 at 03:22PM	rfid		4995		
20	December 5, 2022 at 03:22PM	rfid			5	
21	December 5, 2022 at 03:23PM	rfid	ID2			
22	December 5, 2022 at 03:23PM	rfid		4996		
23	December 5, 2022 at 03:23PM	rfid			4	
24	January 5, 2023 at 09:04AM	rfid	ID2			
25	[illegible]	[illegible]		[illegible]		

Fig 6.1

Chapter -7
Advantages And Challenges

7.1 **Advantages**

Faster and more convenient charging: With RFID-based authentication and payment processing, EV owners can easily access the charging station and initiate the charging process without the need for physical keys or credit cards.

Enhanced security: RFID-based authentication helps prevent unauthorized access to the charging station, reducing the risk of theft or vandalism. This also provides a secure and tamper-proof method of payment processing.

Improved charging efficiency: The RFID system can retrieve information about the EV's battery capacity and charging requirements, enabling more efficient charging and reducing the risk of overcharging or undercharging.

Valuable data collection: The RFID system can collect data on charging usage, EV type, and charging patterns, which can be analyzed to optimize the charging services and improve the overall user experience.

Remote monitoring and control: The RFID system can enable remote monitoring and control of the charging station, allowing operators to monitor charging usage, troubleshoot issues, and make necessary adjustments to the charging services.

Scalability: RFID-based charging stations can be easily scaled to accommodate more charging stations and users without the need for significant infrastructure upgrades.

7.2 **Challenges**

Some of the challenges that may be faced in a RFID-based EV charging station project include:

Integration with existing infrastructure: Retrofitting RFID-based charging systems into existing charging infrastructure can be a complex and costly process, requiring careful planning and coordination.

Compatibility issues: Some older EV models may not be compatible with RFID-based charging stations, which can limit the adoption of the technology.

Privacy concerns: Collecting and storing personal information, such as charging usage data, through RFID-based systems can raise privacy concerns among some users.

Technical issues: RFID technology can be subject to interference and environmental factors, which can affect the reliability and accuracy of charging transactions.

Cost: Implementing an RFID-based charging system can be more expensive than traditional charging systems, due to the cost of RFID readers, antennas, and software.

User acceptance: Users may have concerns about the complexity and reliability of RFID-based charging systems, which could affect their willingness to adopt the technology.

Maintenance and support: RFID-based charging systems can be more complex to install and maintain than traditional systems, requiring specialized expertise and support.

To mitigate these challenges, it is important to carefully plan and execute the project, including conducting a thorough needs assessment, selecting appropriate technology and vendors, and providing training and support to users and maintenance staff.

Chapter -8
Conclusion

Conclusion

The prototype of EV charging station with renewable energy source is successfully implemented. The project shows how we can have the accounting facility for EV charging station with Google sheets. The usage of microcontroller with RFID module helps the accounting process for smoother operation. The take away part of the project is microcontroller programming, power supply design and the PCB design. The operation of the opto-coupler in the high and low voltage separation can be easily understood by this process. Hence using the regular components, the prototype of EV charging station is implemented through this project.

Chapter -9
Future Scope

Future Scope

- The prototype can be converted to the actual project in existence like the solar panel of 12V and 5 watt can be replaced with higher configuration solar panel.
- The more sophisticated microcontroller and Human Machine Interface (HMI) options can be utilized for the controlling process of the EV charging station.
- RFID modules can be replaced by Wi-Fi cards technology used in ATMs or Credit cards.

Chapter -10
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