PRIORITY BASED PRE-BOOKING SYSTEM FOR EV CHARGING STATIONS ENABLING EMERGENCY VEHICLE ACCESSIBILITY

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this project report **"PRIORITY BASED PRE-BOOKING SYSTEM FOR EV CHARGING STATIONS ENABLING EMERGENCY VEHICLE ACCESSIBILITY"** is the bonafide work of **SANJAY VISHWANATH A (211420104241), SUDHARSHAN R (211420104273), SAI AVINASH REDDY V (211420104298)** who carried out the project work under my supervision.

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We **SANJAY VISHWANATH A(211420104241)** , **SUDHARSHAN R (211420104273), SAI AVINASH REDDY V (211420104298)** hereby declare that this project report titled **"PRIORITY BASED PRE-BOOKING SYSTEM FOR EV CHARGING STATIONS ENABLING EMERGENCY VEHICLE ACCESSIBILITY"** under the guidance of **Mr.C.THYAGARAJAN** is the original work done by us and we have not plagiarized or submitted to any other degree in any university by us.

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ABSTRACT

The growing popularity of electric vehicles (EVs) has led to an increased demand for electric vehicle charging infrastructure. However, limited charging station availability and the need for efficient utilization have become significant challenges in ensuring seamless charging services for EV owners. In emergency situations, such as medical emergencies or other critical incidents, it becomes crucial to provide unimpeded access to EV charging stations for emergency vehicles. To address this issue, we propose a priority-based pre-booking system that enables emergency vehicle accessibility to charging stations. The priority-based pre-booking system utilizes advanced reservation mechanisms to allocate charging slots to EV owners based on their priority level. The system categorizes users into different priority tiers, with emergency vehicles assigned the highest priority. When an emergency vehicle requires access to a charging station, it can initiate an emergency booking request, which will be immediately processed by the system, bypassing the regular reservation queue,this ensures that emergency vehicles can quickly access available charging stations, even during peak charging periods. To implement the system, an intelligent charging station management platform is developed, incorporating real-time communication capabilities, data analysis algorithms, and user-friendly interfaces. The platform allows EV owners to pre-book charging slots based on their anticipated charging requirements. Additionally, it facilitates seamless coordination with emergency service providers, enabling them to trigger emergency bookings and obtain real-time updates on charging station availability. The priority-based pre-booking system improves charging station utilization by optimizing the allocation of charging slots, reducing waiting times for EV owners, and ensuring emergency vehicle accessibility. Furthermore, it enhances the overall efficiency of the charging infrastructure by minimizing congestion and optimizing resource allocation.

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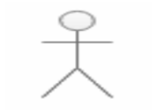
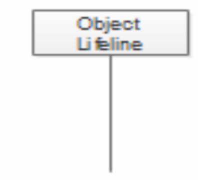
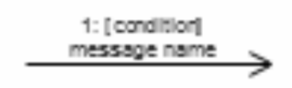
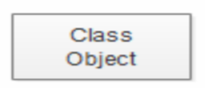
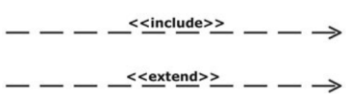
LIST OF SYMBOLS

SYMBOL	Name	FUNCTION
	Actor	Represents an external entity, such as a user or system, interacting with the system being modeled.
	Object Lifeline	Represents the existence timeline of an object in a sequence diagram.
	Message	communication or interaction between objects in a sequence diagram.
	Object	Represents an instance of a class in a diagram, encapsulating data and behavior.
	Use Case	Describes a system's functionality or a specific action that can be performed, often initiated by an actor, in a use case diagram.
	Relationships	Depict associations, dependencies, or connections between UML elements, such as classes, in diagrams.

CHAPTER: 1 INTRODUCTION

1.1 GENERAL

A priority-based EV charging strategy is developed. This strategy can be used to achieve grid peak load minimization by regulating charging priorities. In this paper, we propose an approach to implementing EV charging stations for multiple EVs with the aim of reducing the load on the power grid;

- We present a scheduling strategy for charging and discharging of EVs based on priority. EV user charging priority is based on user decisions; EV user charging time slots are allocated to users based on the game theory approach. In this paper, we propose a strategy to manage EV load demands to manage the load profile and minimize the cost of charging;
- Multiple priorities considered in this paper depend on the varying charging levels, i.e., slow charging, medium charging, and fast charging. Multiple EVs are considered, and the charging and discharging pattern of EVs is based on the priority level selected by EV users. This strategy is based on cooperative game theory. In this approach, the aim is to maximize profit for the grid operator, as well as EV users;
- A charging station strategy is designed to charge multiple vehicles at a time. Charging slots are allocated according to priority to balance the grid load, considering both user-side and grid-side constraints. Furthermore, to decrease the load on the grid, scheduled operation times are implemented to prevent unexpected peak loads. This can be achieved by shifting EV charging to off-peak hours. EV users can charge their vehicle during nighttime hours through the grid, or organizations can equip facilities with solar rooftops, enabling EV users to charge their vehicles for low rates during off-peak hours. In the latter scenario, stored energy can be fed back

to the grid from EVs at workplaces in association with an incentive structure;

This remainder of this paper is organized as follows. In chapter 2, we propose an electrical vehicle charging station model and describe its parameters. In chapter 3 a game theory base algorithm is described, considering user-side and grid-side priorities. In chapter 4 , we present case study of charging scheduling during a 24 h period. In chapter 5 , we present our conclusions.

1.2 SCOPE OF THE PROJECT

Electric vehicles (EVs) are receiving a great attention due to their benefits in decreasing the greenhouse gas emissions and reducing the dependence on conventional fossil fuel. As the number of EVs is continuously growing exponentially, a lot of energy will be required to support the grid integration of EVs. Therefore, charging a large number of EVs may affect the power grid stability in the distribution network such as energy shortages, unacceptable voltage fluctuations, transformer overloading, and energy losses. Several research works have studied the EV charging scheduling problem in order to minimize customers’ electricity payments and reduce the peak to average power ratio (PAPR) [2]. Authors in [3] proposed a real-time EV load management to minimize the total energy cost for plug-in electric vehicles (PEVs) charging and corresponding grid energy losses. The proposed scheme assigns preference time zones with different energy tariffs to the customers for charging their vehicle. Authors in [4] simulated EV charging model for individual EV load profile under RTP to minimize electricity payment of users. In [5], the authors studied online peak-minimizing algorithms for an aggregator, which manages a large set of EV charging jobs with deadlines by planning the charging schedules in order

1.3 EXISTING SYSTEM

1. In existing system No PRE-BOOKING EV charging is not available.
2. The priority-based pre-booking system does not utilize advanced reservation mechanisms to allocate charging slots to EV owners based on their priority level.
3. The system does not categorize users into different priority tiers, with emergency vehicles assigned the highest priority.
4. Increasing waiting times for EV owners while compromising emergency vehicle accessibility.

1.3.1 EXISTING SYSTEM DISADVANTAGES

1. This can lead to longer waiting times and inconvenience for EV owners.
2. EV charging slot controlling is difficult.

1.4 PROPOSED SYSTEM

1. In proposed system PRE-BOOKING EV charging system is available.
2. The priority-based pre-booking system utilizes advanced reservation mechanisms to allocate charging slots to EV owners based on their priority level.
3. The system does not categorize users into different priority tiers, with emergency vehicles assigned the highest priority.
4. Reduce waiting times for EV owners, and ensuring emergency vehicle accessibility.

1.4.1 PROPOSED SYSTEM ADVANTAGES

This can lead to shorter waiting times and convenience for EV owners.

EV charging slot controlling is easy.

CHAPTER-2

2. LITERATURE SURVEY

Title 1: EV charging station location with slot booking system

Authors: Rahul George, Srikumar Vaidyanathan, K Deepa

Year: 2022

Description:

As the world is facing an insufficiency in fossil fuels, every nation is moving towards sustainable, admissible, reliable and efficient green resources of energy. The technology supporting Electric Vehicles (EVs) is rapidly developing towards improvement as the cost of EV components is reducing. Electric Vehicles (EV) are gaining more popularity as the conventional vehicles are affecting the environment drastically. In the proposed work, the State of Charge (SoC) of the EVs battery is displayed constantly and the nearest charging stations are displayed on the screen. From a list of suggested charging stations nearest to the EV driver, the screen in the vehicle will direct the driver to the slot booking website through which all the available slots are displayed. As EVs become more commercial, there will be a need to create an efficient slot booking system as the charging process can be time consuming and the need for more stations will be demanding. The proposed model of the booking system is designed to create a cost effective and efficient system.

Title 2: Electric Vehicle Charging Control System Based on Characteristic of Charging Power

Authors: Sourabh Jamadagni, Priyanka Sankpal, Shwetali Patil.

Year: 2020

Description:

The number of Electric vehicle (EV) users is expected to increase in the future. The driving profile of EV users is unpredictable, necessitating the design of charging scheduling protocols for EV charging stations servicing multiple EVs. A large EV charging load affects the grid in terms of peak load demand. Electric vehicle charging stations with solar panels can help to reduce the grid impact of EV charging events. With reference to the increasing number of EVs, new technology needs to be developed for charging station and management to create a stable system for users, and electric utilities. The load of a total EV charge can affect the grid, degrading quality and system stability. In this paper, a charging station scheduling strategy is proposed based on the game theoretic approach. In the proposed strategy, with respect to the grid load demand minimization, charging stations have scheduled EV charging times to prevent sudden peak load on the grid the proposed game theory strategy is sudden peak load on the grid. The proposed game theory strategy is defined on the basis of priority so that both grid operators and EV users can maximize their profit by setting priorities for charging and discharging. This work provides a strategy for grid peak load minimization.

Title 3: **Optimized operational management of an EV sharing community integrated with battery energy storage and PV generation**

Authors: Meng Song and Mikael Amelin, Xue Wang and Ashad Saleem.

Year: 2021

Description:

Sharing schemes are emerging in residential and business sectors to reduce the purchase and operation cost of individuals. This paper proposes a framework to support the operational management of a shared EV fleet. An optimization algorithm is developed to coordinate the charging and reservation assignment using mixed integer programming. The integration with local PV production and battery storage is taken into account. A booking algorithm is also developed to determine whether a reservation can be accepted or not. Monte Carlo simulation is performed in the case study to demonstrate an application of the proposed framework with the Swedish travel patterns. The result provides an overview about the utilization rate of the fleet with different number of EVs, which can support the investment decision of an EV sharing community. The result also shows that the EVs and battery are effectively coordinated to minimize the total cost, satisfy the reservations and comply with grid limits.

Title 4: EV-Planning: Electric Vehicle Itinerary Planning Authors:

Sara Maher, Guillaume Remy.

Year: 2020

Description:

In the latest few years, lot of efforts have been done to pave the way to sustainable mobility, in order to solve pollution problems and fuel shortage. The use of electric vehicles (EV) is considered as one of the best ecologic and economic solution. However, autonomy barriers and limitations slow the progress and the deployment of this technology. In this paper, we propose an advanced electric vehicles' fleet management architecture. This architecture considers the most important factors that can affect the traveling mode of electric vehicles, in order to offer different services to fleet management companies for an efficient monitoring and management of their fleets. One of the most important service considered in this paper, consists on providing economic itineraries planning for electric vehicles. Best routes, in term of electric power consumption, are computed based on the collected information about road topology (elevation variations, source, destination, etc.), weather conditions, vehicle characteristics, driver profile, traffic conditions and electric charging stations positions. In case of battery drop, new routes passing through the nearest available charging stations are recalculated and provided to the driver. To prove the concept, we implemented a lightweight traffic management server that provides this itinerary planning service to an EV fleet company. The server provides a web application to book an EV and plan the trip. All possible itineraries are displayed on a map with electric power consumption, traveled distance and duration details. Then, the server uploads the chosen itinerary into the vehicle's GPS or into the driver's smartphone.

Title 5: Benefits of Multi-Destination Travel Planning for Electric Vehicles

Authors: Marek Cuchý, Michal Štolba and Michal Jakob

Year: 2020

Description:

A major challenge for large-scale deployment of electrical vehicles (EVs) is charging. In general, the number of EVs that can be charged can be increased either by physically expanding charging capacity or by better exploiting existing charging capacity. In this paper, we focus on the latter, exploring how advanced EV travel planning systems can be used to better align where and when EV charging happens with where and when charging capacity is available. Our novel travel planner enables EV users to plan their trips and EV charging in a way that meets their needs yet reflects charging availability. The core innovation of our approach is that we take a broader, multi-destination perspective to EV travel planning -- this gives our planning system more flexibility and scope for deciding when and where charging should happen and, consequently, enables a better alignment between the need for charging implied by the EV travel and the availability of charging. We evaluate our approach on an agent-based simulation of several medium-scale scenarios based on real-world data. The results confirm the benefits of our multi-destination approach, especially in scenarios in which charging service providers support upfront booking of charging slots.

Title 6: Load Modelling Method for EV Charging Stations Based on Trip Chain.

Authors: Lili. Gong, Wu. Cao, Jianfeng. Zhao

Year: 2017

Description:

The wide application of electric vehicles (EVs) will lead to new load peaks of power grid, so it is necessary to study the load characteristics of EV charging stations. In this paper, a novel method is proposed to determine the charging loads of different charging stations based on trip chain. First, the types of EV charging stations are classified according to the trip destinations. Then, the probability distribution of characteristic variables in a trip is obtained with the analysis of national household trip survey (NHTS) data. Finally, the load model of different charging stations is established and solved by Monte Carlo simulation (MCS) method. The simulation results verify the effectiveness of the proposed method. And with high penetration of EVs, the maximum load of power grid increases obviously.

Title 7: IOT Based PV assisted EV Charging Station for Confronting Duck Curve

Authors: Badrinath Kulkarni, Devaji Patil, Prof Rahul.G. Suryavanshi

Year: 2018

Description:

In this paper, we study the effects of electricity production from a solar power plant on the load curve also known as duck curve and provide an alternative by charging electric vehicles in the IOT integrated multi-level charging stations. An effort is made to improvise the load curve by neutralizing the dip and sudden rise in the duck curve by creating alternative loading on the power grid. It also supports for the promotion of EV utilization by improvising the charging technologies with the help of IOT interface and providing incentives to customers to utilize EVCS at the workplace. It also talks about an idea of replacing fossil fuel- based revenue system with centralized EV charging taxation that would boost the idea of green mobility.

Title 8: Multi-objective Optimal Scheduling of a DC Micro- grid Consisted of PV System and EV Charging Station.

Authors: Xinyi Lu, Nian Liu, Qifang Chen, Jianhua Zhang

Year: 2014

Description:

Integration of PV system and EV charging station is a typical way of spot utilization of renewable resources. Research on multi-objective optimal scheduling of a DC micro-grid consisted of PV system and EV charging station is proposed in this paper. Based on the structure of the DC micro-grid and function of each component, mathematical model of the multi- objective optimization for scheduling, which takes the cost of electricity purchasing and energy circulation of storage batteries as objective functions, is built and then solved with NSGA-II. Constraints including EVs' charging time, the range of the charging/discharging power and SOC (state of charge) of the storage batteries, power supply rate of the distribution network and system power balance are considered in this model. A certain case is studied and verifies the model's rationality. Compared with an instant charging plan, the optimal scheme is superior in reducing cost and energy circulation.

Title 9: New Mobile Charging Station for Urban and Resort Areas

Authors: Daniel Fodorean, Filip Cirlea, Maria Simona Raboaca, Constantin Filote

Year: 2019

Description:

The paper presents a new mobile charging station, capable to use the energy from the ac grid, as well as from the one from the dc grid (used in the electrified transportation), to store the energy on a hybrid storage source (battery, fuel cell and ultracapacitor) and to deliver it to electric vehicles. Such a mobile charging station is to be used within the cities and resort areas, where (especially) people need independent mobility within a cleaner environment. The proposed mobile charging station architecture is depicted, as well as its operation through simulations.

Title 10: Battery Cells Characterization for Subsequent Operation in Battery Models used in Mobile Charging Station Designing

Authors: Rares Catalin Nacu, Daniel Fodorean

Year: 2019

Description:

This paper deals with a battery cell characterization, having a lithium iron phosphate (LiFeSO4) chemistry, based on first order electrical equivalent circuit (EEC), within the charging station application. More precise, the reliability of the method is taken into account in the context of a new mobile charging station development. The analysis is numerically and experimentally employed. The results between the simulation and real battery measurements are compared based on international standards and regulations which refer to Electrical Vehicle (EV) charging stations. The Li-Ion cell characterization model and simulation has been developed in Matlab/Simulink software and a dSpace/MicroLabBox realtime board for the measurements. A very good agreement was found between the simulated and tests obtained results.

CHAPTER 3

THEORETICAL BACKGROUND

3.1HARDWARE DESCRIPTION

3.1.1 ARDUINO UNO:

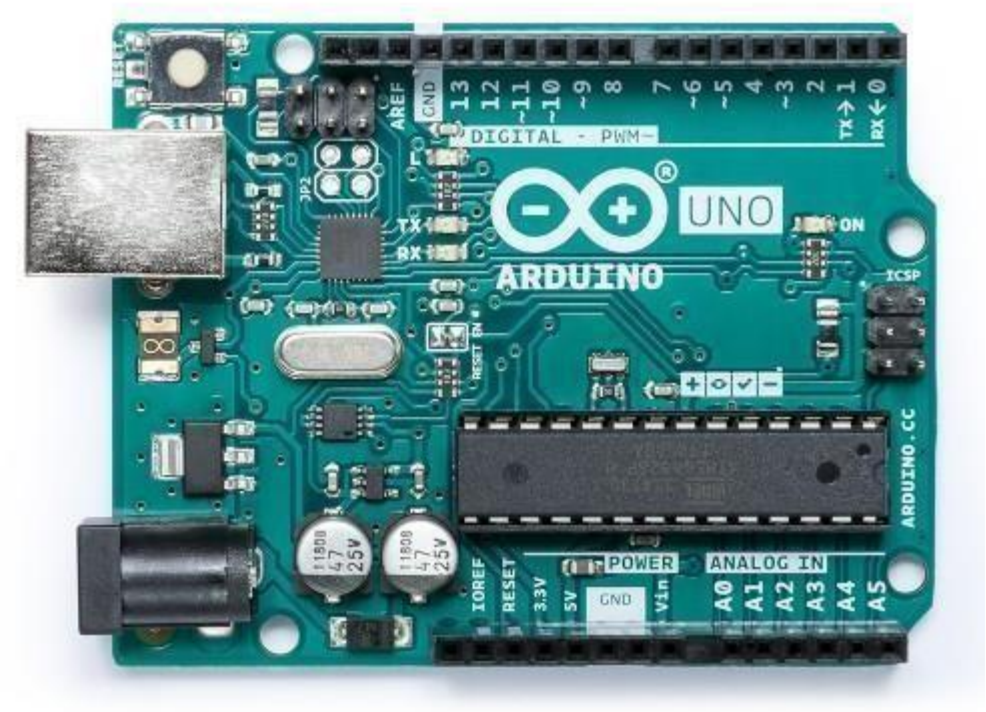


Fig 3.1 Arduino UNO

The UNO is the best board to get started with electronics and coding. If this is your first experience tinkering with the platform, the UNO is the most robust board you can start playing with. The UNO is the most used and documented board of the whole

Arduino family.

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

TECHNICAL SPECIFICATIONS:

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA

DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by boot loader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
LED_BUILTIN	13
Length	68.6 mm
Width	53.4 mm
Weight	25 g

3.1.2 LCD (Liquid Crystal Display)

LCD screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix.

This LCD has two registers, namely, Command and Data.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

Pin Diagram:

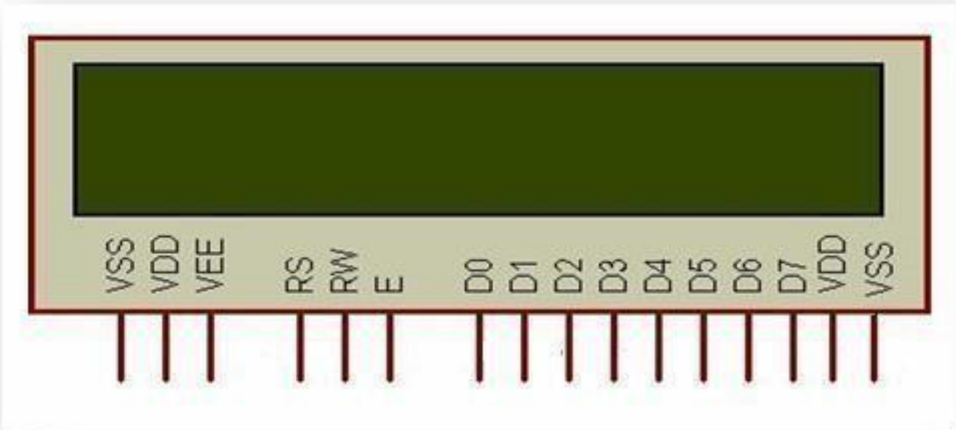


Fig 3.2 Pin Diagram of LCD

Pin Description:

Pin No	**Function**	**Name**
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11	8-bit data pins	DB4
12		DB5

13		DB6
14		DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

3.1.3 POWER SUPPLY

This section describes how to generate +5V DC power supply

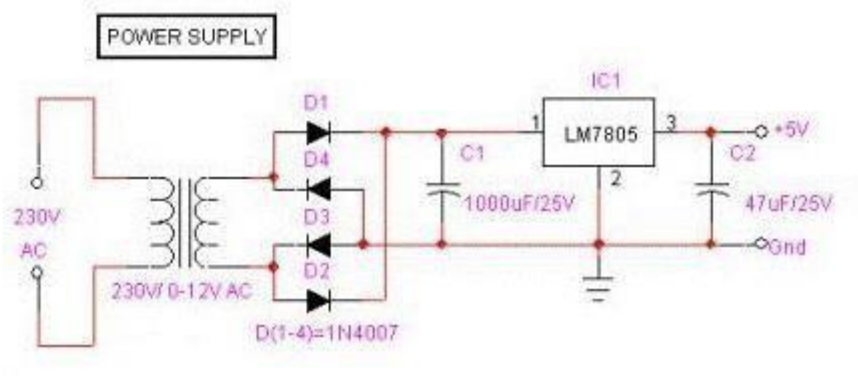


Fig 3.3 Power Supply

The power supply section is the important one. It should deliver constant output regulated power supply for successful working of the project. A 0-12V/1 mA transformer is used for this purpose. The primary of this transformer is connected in to main supply through on/off switch& fuse for protecting from overload and short circuit protection. The secondary is connected to the diodes to convert 12V AC to 12V DC voltage. And filtered by the capacitors, which is further regulated to +5v, by using IC 7805.

3.1.4 IR SENSOR

An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes, that can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, The resistances and these output voltages, change in proportion to the magnitude of the IR light received.

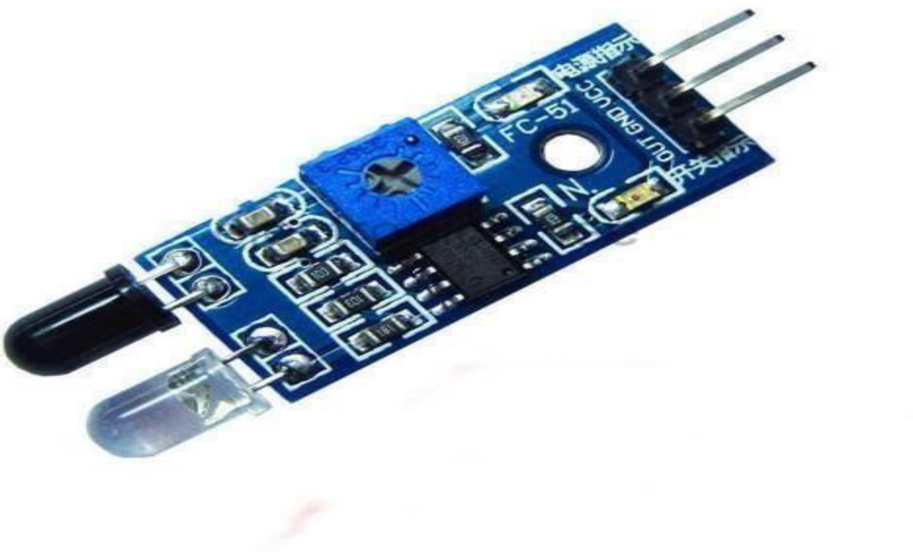


Fig 3.4 IR Sensor

3.1.5 TOGGLE SWICH

An electrical switch that activates by a moving lever or a handle forward and backward to open or close an electrical switch is known as a toggle switch. These switches are also called toggle power switches or joystick switches. These switches are versatile devices, so they can be utilized with any electrical application.

Pin Configuration

The toggles switch includes three pins which are discussed below.

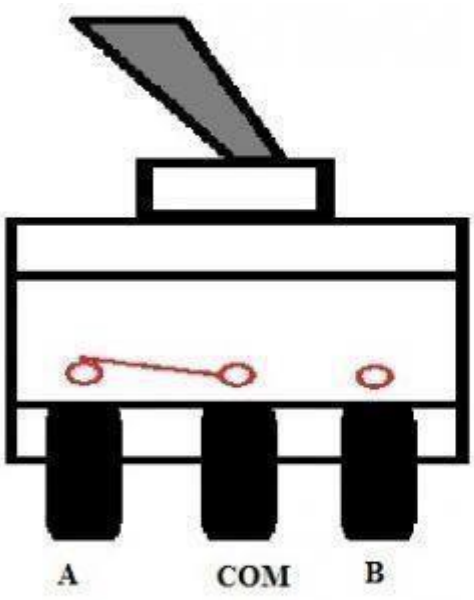


Fig 3.5 Pin Configuration of Toggle Switch

- **Pin1 (A):** This is the first output pin.
- **Pin2 (COM):** This is the input pin. **Pin3 (B):** This is the second output pin

3.1.6 FIRE/FLAME SENSOR

A flame detector is a sensor designed to detect and respond to the presence of a flame or fire. Responses to a detected flame depend on the installation, but can include sounding an alarm, deactivating a fuel line (such as a propane or a natural gas line), and activating a fire suppression system.

Fig 3.6 Fire/Flame Sensor

Pin	Description
Vcc	3.3 – 5V power supply
GND	Ground
Dout	Digital output

and high

It is based on the YG1006 sensor which is a high speed sensitive NPN silicon phototransistor. It can detect infrared light with a wavelength ranging from 700nm to 1000nm and its detection angle is about 60°. Flame sensor module consists of a photodiode (IR receiver), resistor, capacitor, potentiometer, and LM393 comparator in an integrated circuit. The sensitivity can be adjusted by varying the onboard potentiometer. Working voltage is between 3.3v and 5v DC, with a digital output. Logic high on the output indicates presence of flame or fire. Logic low on output indicates absence of flame or fire.

3.1.7 ESP-12E BASED NODEMCU

The ESP8266 is the name of a micro controller designed by Espressif Systems. The ESP8266 itself is a self-contained Wi-Fi networking solution offering as a bridge from existing micro controller to Wi-Fi and is also capable of running self-contained applications. This module comes with a built in USB connector and a rich assortment of pin-outs. With a micro USB cable, you can connect NodeMCU devkit to your laptop and flash it without any trouble, just like Arduino. It is also immediately breadboard friendly.

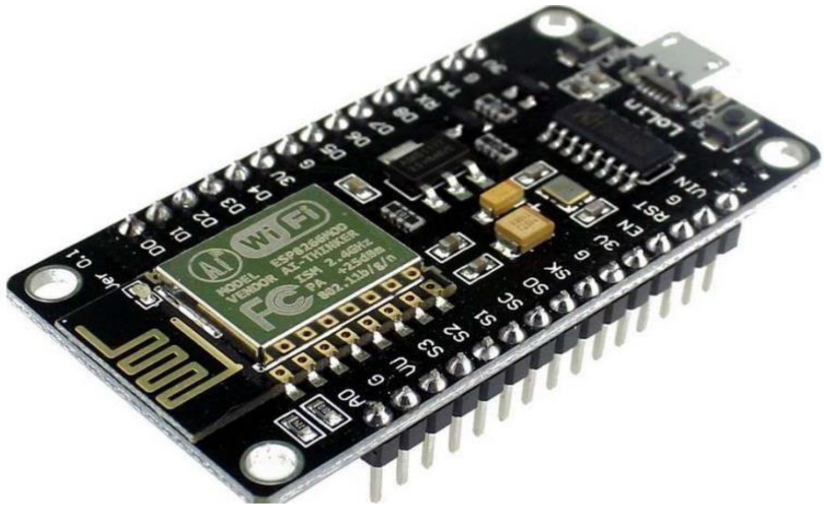


Fig 3.7 ESP 8266 microcontroller

NODEMCU PIN CONFIGURATION

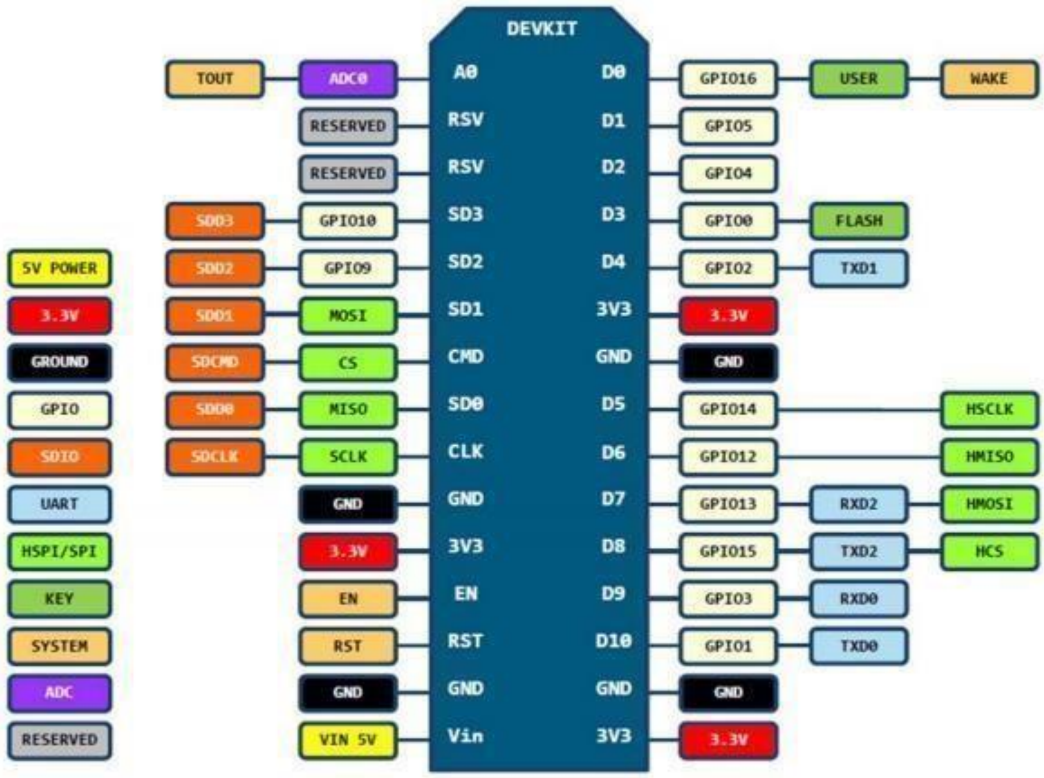


Fig 3.8 Node MCU Pin diagram

3.1.8 SINGLE-CHIP USB-TO-UART BRIDGE

The CP2102/9 is a highly-integrated USB-to-UART Bridge Controller providing a simple solution for updating RS232 designs to USB using a minimum of components and PCB space. The CP2102/9 includes a USB 2.0 full speed function controller, USB transceiver, oscillator, EEPROM or EPROM, and asynchronous serial data bus (UART) with full modem control signals in a compact 5 x 5 mm QFN-28 package. No other external USB components are required. The on-chip programmable ROM may be used to customize the USB Vendor ID, Product ID, Product Description String, Power Descriptor, Device Release Number, and Device Serial Number as desired for OEM applications. The programmable ROM is programmed on-board via the USB, allowing the programming step to be easily integrated into the product manufacturing and testing process. Royalty-free Virtual COM Port (VCP) device drivers provided by Silicon Laboratories allow a CP2102/9-based product to appear as a COM port to PC applications. The CP2102/9 UART interface implements all RS-232 signals, including control and handshaking signals, so existing system firmware does not need to be modified. In many existing RS-232 designs, all that is required to update the design from RS-232 to USB is to replace the RS232 level-translator with the CP2102/9. Direct access driver support is available through the Silicon Laboratories USB Xpress driver set.

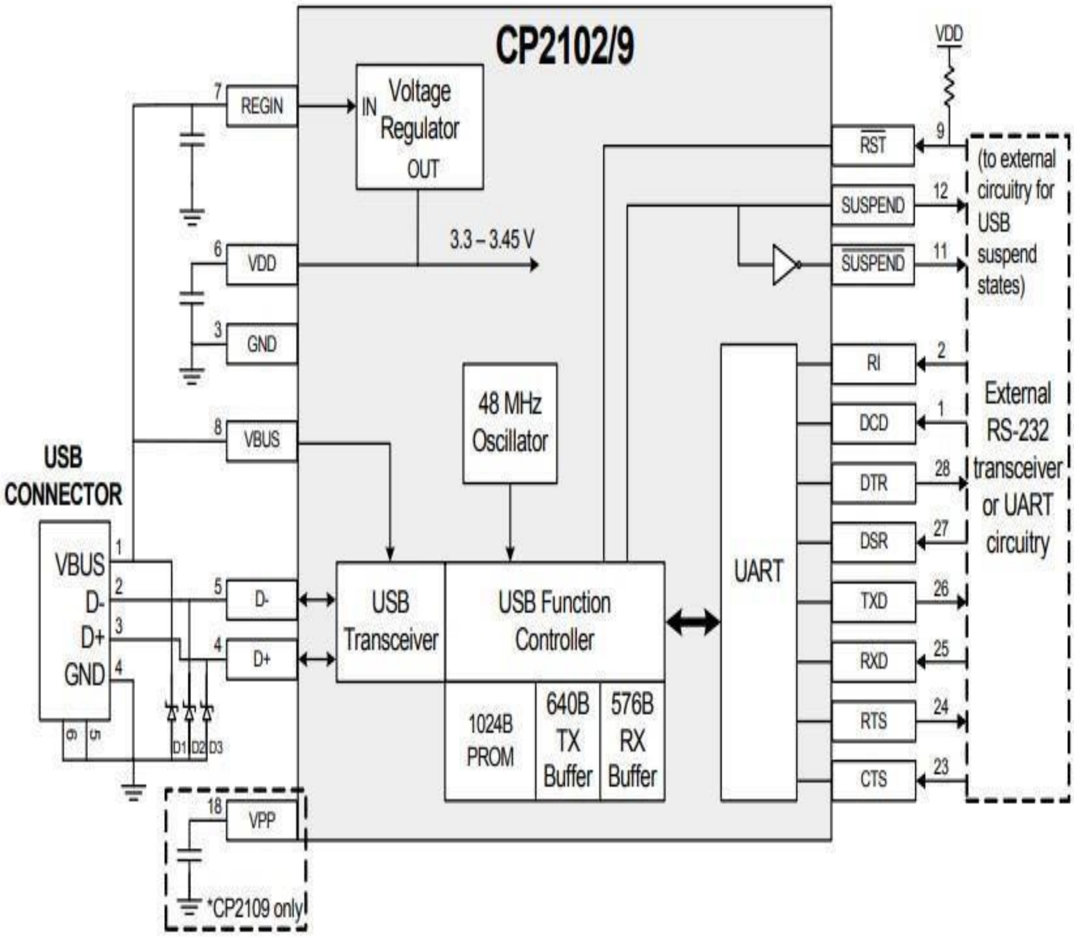


Fig 3.9 CP2102/9 UART-USB Bridge

3.2 SOFTWARE DESCRIPTION

3.2.1 EMBEDDED C

Embedded C is most popular programming language in software field for developing electronic gadgets. Each processor used in electronic system is associated with embedded software.

Embedded C programming plays a key role in performing specific function by the processor. In day-to-day life we used many electronic devices such as mobile phone, washing machine, digital camera, etc. These all device working is based on microcontroller that are programmed by embedded C.

Let's see the block diagram representation of embedded system programming:

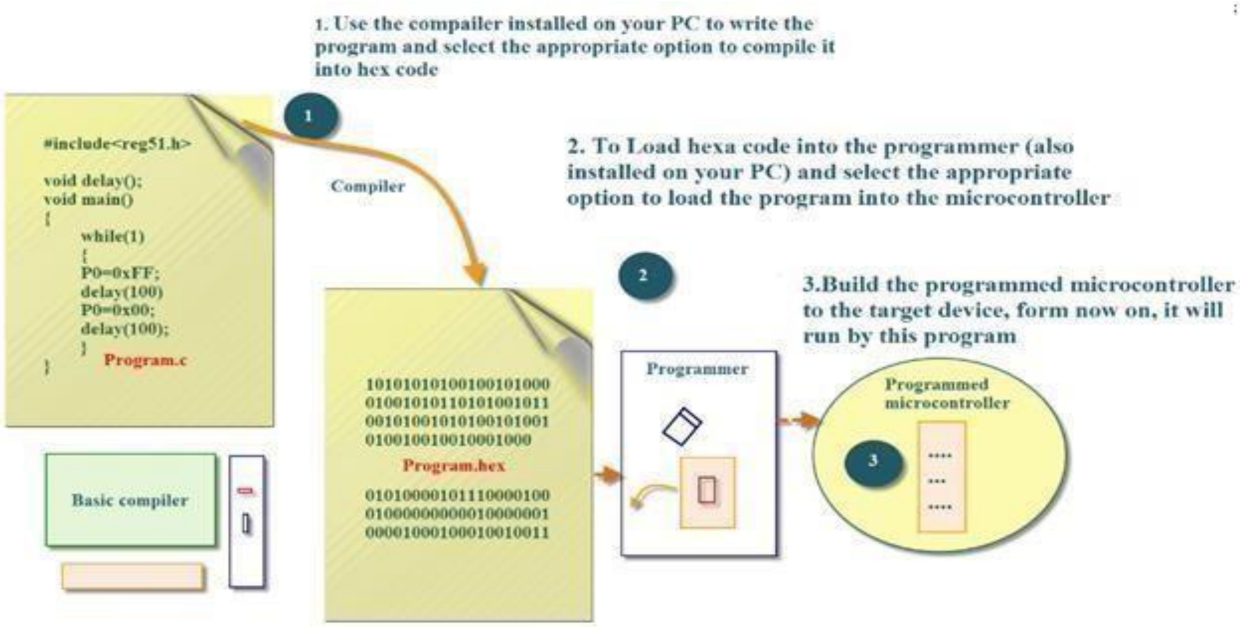


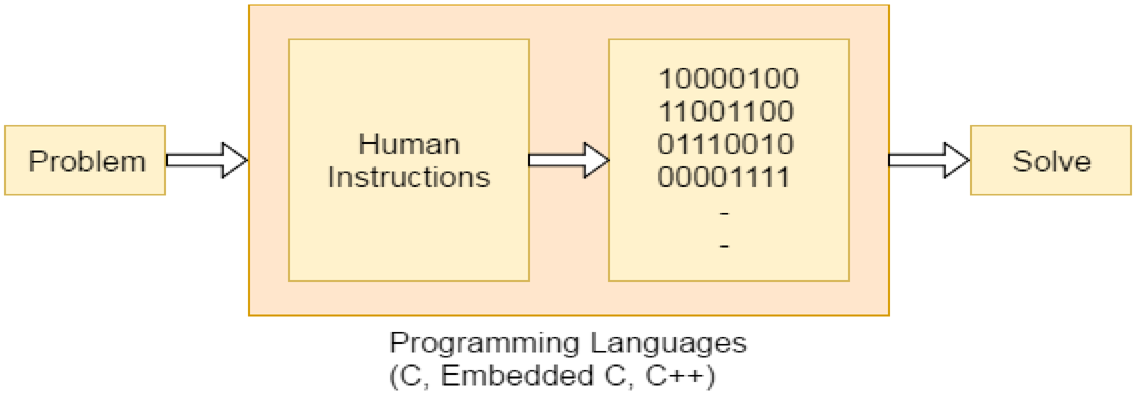
Fig 3.10 Block Diagram of Embedded system programming

The Embedded C code written in above block diagram is used for blinking the LED connected with Port0 of microcontroller.

In embedded system programming C code is preferred over other language. Due to the following reasons:

- Easy to understand
- High Reliability
- Portability
- Scalability

Let's see the block diagram of Embedded C Programming development:



- Function is a collection of statements that is used for performing a specific task and a collection of one or more functions is called a programming language. Every language is consisting of basic elements and grammatical rules. The C language programming is designed for function with variables, character set, data types, keywords, expression and so on are used for writing a C program.
- The extension in C language is known as embedded C programming language. As compared to above the embedded programming in C is also have some additional features like data types, keywords and header file etc is represented by #include<microcontroller name.h>.

3.2.2 ARDUINO SOFTWARE IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

Programs written using Arduino Software (IDE) are called **s**ketches. These sketches are written in the text editor and are saved with the file extension **.**ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors.

The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom right hand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

3.3 SYSTEM ARCHITECTURE

Designing a system architecture for a priority-based pre-booking system for electric vehicle (EV) charging stations, while also ensuring emergency vehicle accessibility, involves several components and considerations. Here's a high-level overview of such a system architecture:

1. User Interface (UI) Layer:
    - Web Interface: Allows users to interact with the system via a web browser.
2. Application Layer:
    - Pre-booking System: Manages the process of users reserving EV charging slots in advance based on their priority levels.
    - User Authentication and Authorization: Handles user authentication and authorization to access the system and book charging slots.

- Priority Management: Determines priority levels for different user categories (e.g., emergency vehicles, regular users) based on predefined rules and criteria.
- Charging Station Management: Manages the status of charging stations, availability of charging slots, and reservation statuses.
- Emergency Vehicle Integration: Integrates with emergency vehicle systems to provide priority access when needed.

3. Backend Services:
    - Database Management: Stores user information, reservation details, charging station status, and other relevant data.
    - Integration Services: Handles integration with external systems such as emergency services for priority access.
4. Charging Station Infrastructure:
    - EV Charging Stations: Physical infrastructure equipped with charging points for electric vehicles.
    - IoT Devices: Sensors and controllers installed at charging stations to monitor availability, occupancy, and manage reservations.
5. Security Layer:
    - Secure Communication: Ensures secure communication between different components of the system to protect user data and system integrity.

- Access Control: Implements access control mechanisms to prevent unauthorized access to sensitive information and functionalities.

6. Data Analytics and Reporting:

    - Analytics Engine: Analyzes data collected from the system to derive insights into usage patterns, charging station availability, and performance metrics.

    - Reporting Module: Generates reports and visualizations to provide stakeholders with valuable information for decisionmaking and system optimization.

7. Monitoring and Maintenance:

    - System Monitoring: Monitors the health and performance of the system components to ensure uninterrupted operation.

    - Maintenance Tools: Provides tools for system administrators to perform maintenance tasks, update software, and troubleshoot issues.

By implementing such a system architecture, you can create a prioritybased pre-booking system for EV charging stations that ensures emergency vehicle accessibility while efficiently managing user reservations and charging station resources.

BLOCK DIAGRAM:

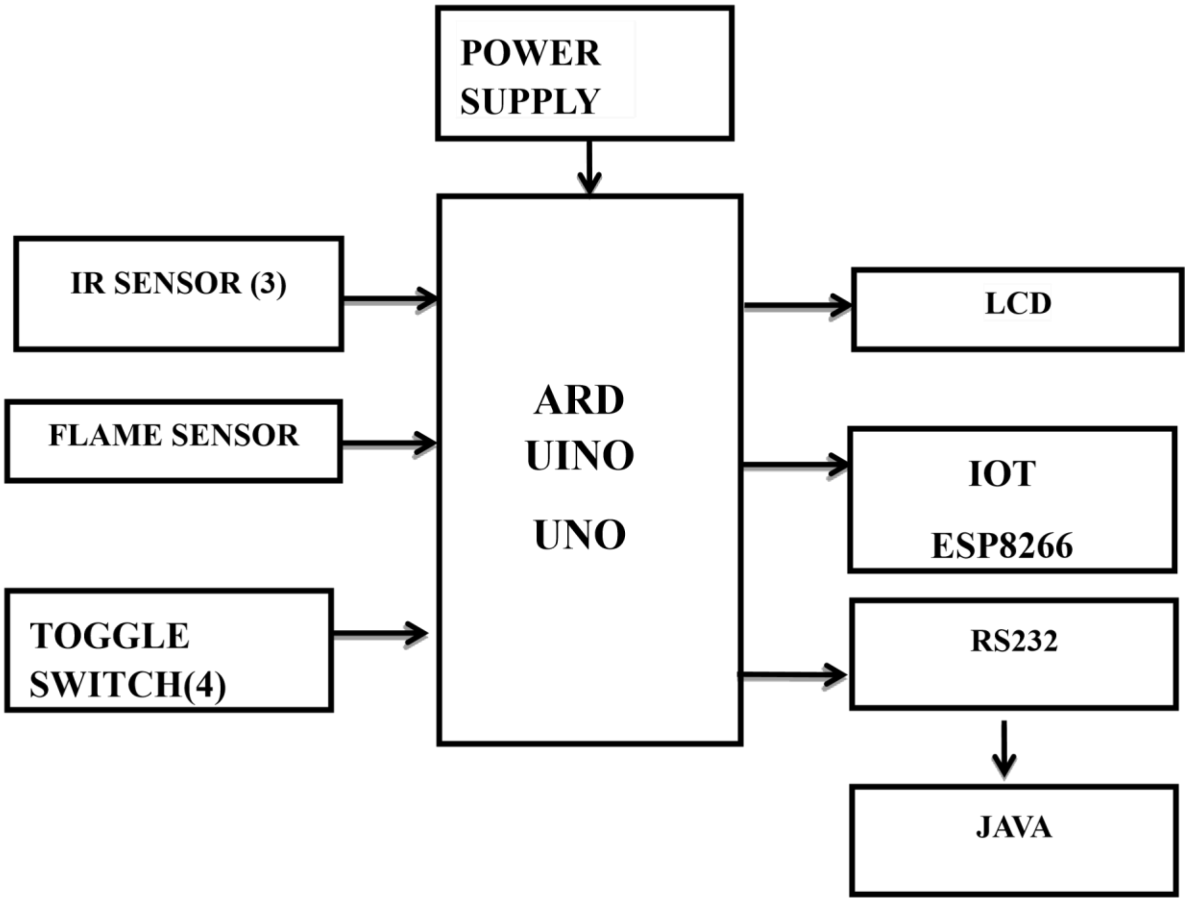


Fig 3.11 Block diagram of System Architecture

3.3.1 POWER SUPPLY

The power supply section is the important one. It should deliver constant output regulated power supply for successful working of the project. A 0-12V/1 mA transformer is used for this purpose. The primary of this transformer is connected in to main supply through on/off switch& fuse for protecting from overload and short circuit protection. The secondary is connected to the diodes to convert 12V AC to 12V DC voltage. And filtered by the capacitors, which is further regulated to +5v, by using IC 7805.

3.3.2 IR SENSOR

Integrating IR (infrared) sensors into the system architecture for a priority-based prebooking system for EV charging stations can enhance its functionality by providing realtime occupancy detection and improving user experience. here's how IR sensors can be incorporated:

1. **Charging station infrastructure**:

- install IR sensors at each charging station to detect the presence of vehicles in the charging slots.
- connect IR sensors to microcontrollers or IOT devices installed at the charging stations.

2. **IOT devices:**

- Configure IOT devices to collect data from IR sensors regarding the occupancy status of charging slots.
- Transmit this data to the backend server for processing and updating the charging station's availability status.

3. **User Interface:**

- Display real-time slot availability information to users the web interface or mobile application

4. **Priority Management:**

- Consider the occupancy status detected by IR sensors when assigning priority levels to reservation requests.
- Emergency vehicles may be granted higher priority access to charging slots based on real-time occupancy data to ensure their accessibility during emergencies.

By integrating IR sensors into the system architecture, you can enhance the efficiency and reliability of the priority-based pre-booking system for EV charging stations, enabling better management of resources and improving overall user satisfaction.

3.3.3 FLAME SENSOR

A flame sensor is a component that detects the presence of a flame or fire. It is commonly used in safety systems to identify potential fire outbreaks. The sensor responds to the infrared radiation emitted by flames, allowing it to actuate safety measures or alarms in applications where fire detection is critical.

Integrating flame sensors into the system architecture for a priority-based pre-booking system for EV charging stations can enhance safety measures by detecting potential fire hazards at charging stations.

By integrating flame sensors into the system architecture, you can enhance the safety and security measures of EV charging stations, mitigating potential fire risks and ensuring a safer environment for users and surrounding areas.

3.3.4 TOGGLE SWITCH

Generally, switches are operated manually, so in many electrical circuits, the toggle switch plays a key role like a simple ON/OFF switch. The toggle switch function is to control the flow of current to a device or within a device from the power supply by a lever.

THE TOGGLE SWITCH WORKING PRINCIPLE IS; that once the operator of the switch pushes the toggle, then the armature switches the contact into position to begin or discontinue the flow of electric current. or in simple words, once the toggle is pressed it can switch on or off a device.

3.3.5 LCD

The most commonly used Character based LCDs are based on Hitachi's HD44780 controller or other which are compatible with HD44580. In this tutorial, we will discuss about character-based LCDs, their interfacing with various microcontrollers, various interfaces (8-bit/4-bit), programming, special stuff and tricks you can do with these simple looking LCDs which can give a new look to your application.

3.3.6 IOT(ESP8266)

ESP-12E Wi-Fi module is developed by Ai-thinker Team. core processor ESP8266 in smaller sizes of the module encapsulates Tensilica L106 integrates industry-leading ultra-low power 32-bit MCU micro, with the 16-bit short mode, Clock speed support 80 MHz, 160 MHz, supports the RTOS, integrated Wi-Fi MAC/BB/RF/PA/LNA, on-board antenna. The module supports standard IEEE802.11 b/g/n agreement, complete TCP/IP protocol stack. Users can use the add modules to an existing device networking, or building a separate network controller. ESP8266 is high integration wireless SOCs, designed for space and power constrained mobile platform designers. It provides unsurpassed ability to embed Wi-Fi capabilities within other systems, or to function as a standalone application, with the lowest cost, and minimal space requirement.

3.3.7 RS232(DATA TRANSMISSION)

Incorporating RS232 communication in the system architecture for a prioritybased pre-booking system for EV charging stations can facilitate data exchange between various components, such as charging stations, controllers, and the central server.

Data Exchange:

- Establish bidirectional communication channels between the charging stations and the central server using RS232.

- Exchange data regarding charging station status, reservation requests, priority assignments, and occupancy updates.

IoT Devices/Charging Station Controller:

- Implement RS232 communication protocols within the IoT devices or charging station controllers to enable data transmission.
- Configure the devices/controllers to communicate with the central server using RS232.

3.3.8 WEBSITE-MODULE(OUTPUT& STORE THE DATA)

Integrating Java, a website, and Adafruit.io into the system architecture for a priority-based pre-booking system for EV charging stations offers a robust backend, user interface, and IoT capabilities for managing charging stations.

Adafruit.io Integration:

- Interface with Adafruit.io's MQTT broker to receive data from IoT devices installed at charging stations.
- Subscribe to topics related to charging station status, occupancy, and other relevant parameters.
- Process incoming MQTT messages in the Java backend to update the system's database and trigger appropriate actions.

By integrating Java backend services, a user-friendly website, and Adafruit.io for IoT capabilities, you can create a comprehensive solution for managing EV charging stations with priority-based pre-booking, real-time status monitoring, and efficient resource allocation.

3.4 MODULE DESIGN

3.4.1 USECASE DIAGRAM

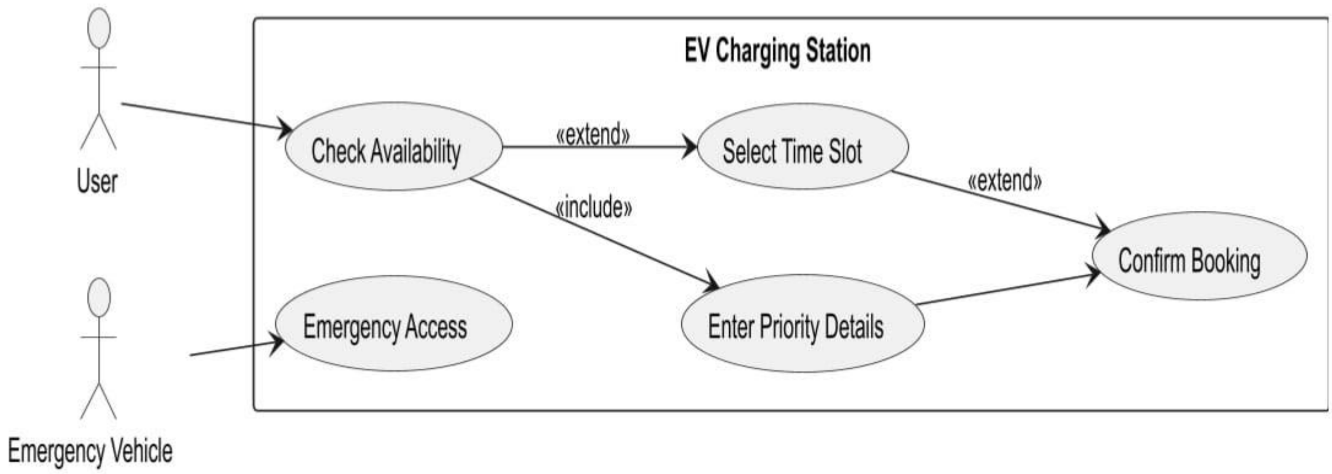


Fig 3.12

3.4.2 SEQUENCE DIAGRAM

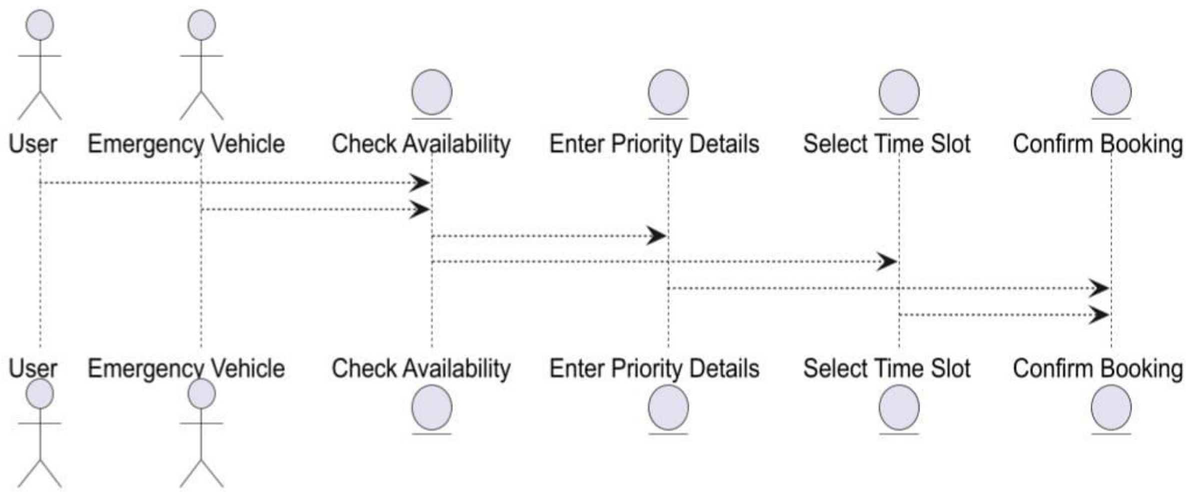


Fig 3.13

3.4.3 DATAFLOW DIAGRAM

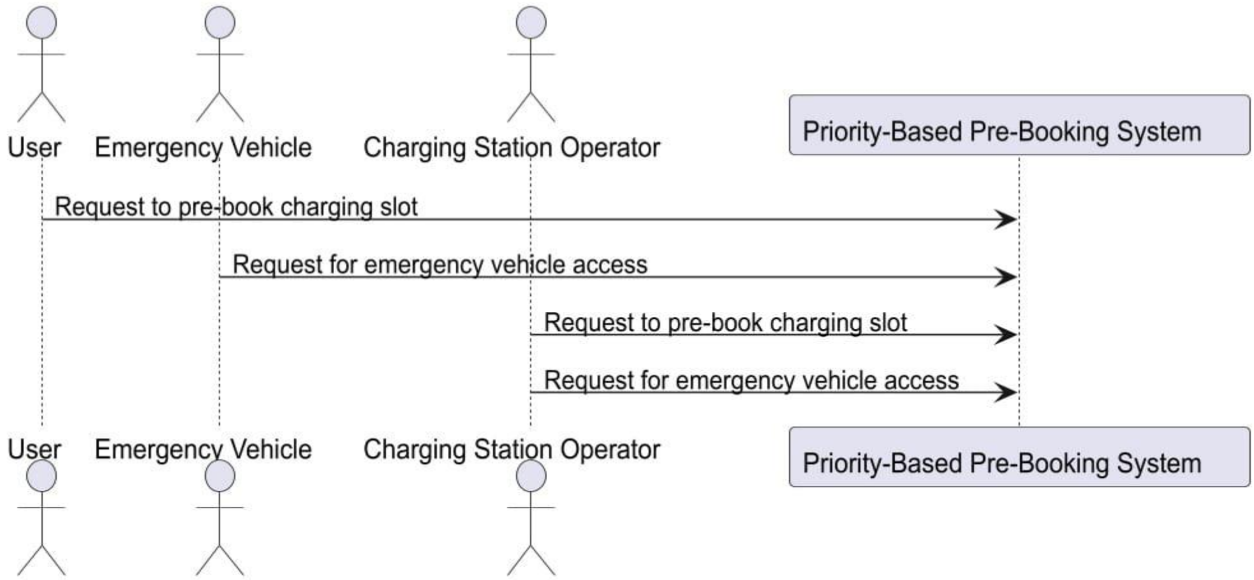


Fig 3.14

CHAPTER 4 SYSTEM IMPLEMENTATION

4.1 MODULE DESCRIPTION

The Hardware Integration and Sensor Management module plays a crucial role in the priority-based pre-booking system for EV charging stations with emergency vehicle accessibility. It encompasses various hardware components, including the Arduino Uno microcontroller, ESP8266 module, IR sensor, flame sensor, toggle switch, LCD display, and RS232 communication interface. This module facilitates the seamless integration and management of these hardware peripherals within the system architecture. It handles tasks such as interfacing the Arduino Uno with external sensors and modules, managing sensor inputs from the IR and flame sensors, processing data received from these sensors, controlling the LCD display to provide real-time status updates and user interaction, and facilitating communication with external systems via the ESP8266 module and RS232 protocol. Additionally, it ensures proper calibration, configuration, and coordination of hardware components to maintain the system's functionality, reliability, and responsiveness. Through rigorous testing and validation, this module ensures the robust performance and interoperability of hardware elements, enabling the efficient operation of the entire pre-booking system while ensuring emergency vehicle accessibility and safety.

MODULES NAME

- Priority Assignment Module
- Reservation and Booking Management Module
- Resource Optimization and Efficiency Module

4.1.1 PRIORITY ASSIGNMENT MODULE

- This module categorizes users into different priority tiers and assigns emergency vehicles the highest priority, ensuring they have immediate access to charging stations when needed.
- The IR sensor is used for knowing the slot status and the flame sensor is used for fire accidents in EV station.

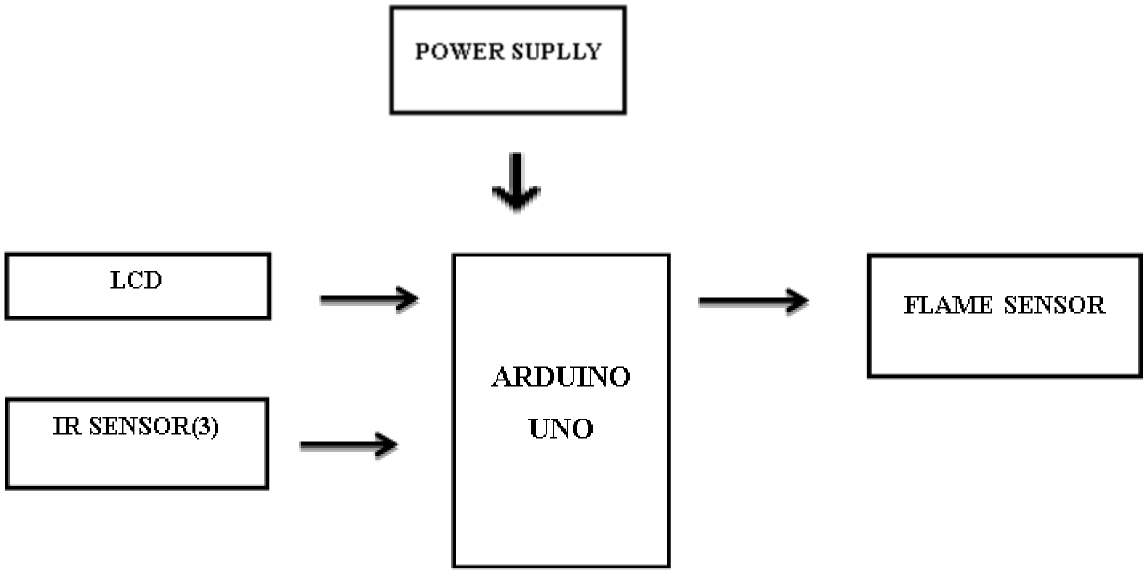


Fig 3.15 Module diagram of priority module

4.1.1.1 POWER SUPPLY

The Power Supply Management module is integral to ensuring the reliable and efficient operation of the priority-based prebooking system for EV charging stations with emergency vehicle accessibility. This module is responsible for managing the power supply infrastructure that powers the system's hardware components and peripherals.

4.1.1.2 LCD

The LCD Display Management module plays a crucial role in providing users with real-time status updates, system messages, and interactive interfaces within the priority-based pre-booking system for EV charging stations with emergency vehicle accessibility. This module encompasses various functionalities related to the management and control of the LCD display integrated into the system.

4.1.1.3 IR SENSOR

The IR Sensor Management module is a crucial component of the priority-based pre-booking system for EV charging stations with emergency vehicle accessibility, responsible for managing the functionality and data from the Infrared (IR) sensors integrated into the system. This module encompasses various tasks related to the utilization and control of IR sensors for vehicle detection and occupancy monitoring.

4.1.1.4 FLAME SENSOR

The Flame Sensor Management module is essential for ensuring fire hazard detection and safety within the priority-based prebooking system for EV charging stations with emergency vehicle accessibility. This module handles the functionality and data from flame sensors integrated into the system, facilitating timely detection and response to potential fire incidents.

4.1.2 RESREVATION AND BOOKING MANAGEMENT MODULE

This module handles the reservation process, allowing EV owners to pre-book charging slots based on their anticipated requirements and enabling emergency service providers to trigger emergency bookings. It also manages real-time updates on charging station availability, In this project there are four toggles also using for the prices variant based on EV owners their booking And each switch's for Morning, Afternoon, Evening and Night, this system for reducing the crowd at stations I real time.

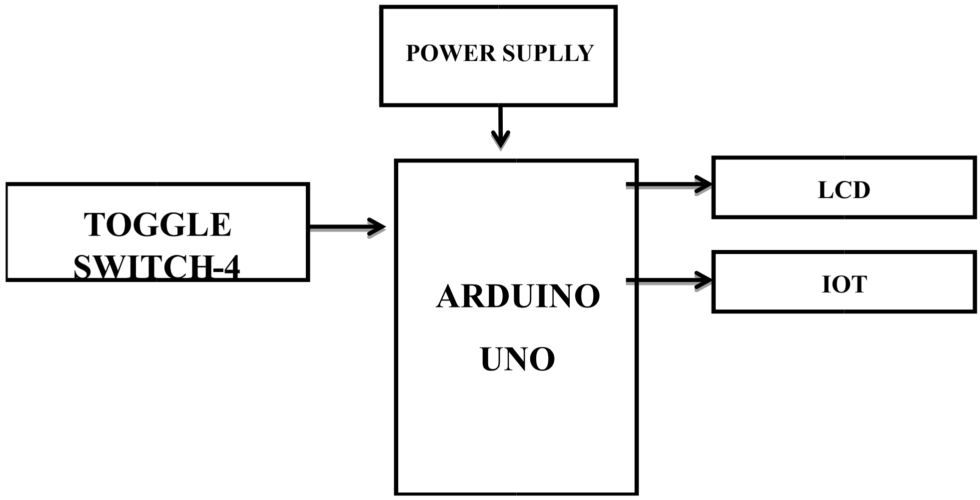


Fig 3.16 module diagram of reservation and management

4.1.2.1 TOOGLE SWITCH

The Toggle Switch Interface Management module is essential for facilitating user interaction and control within the prioritybased pre-booking system for EV charging stations with emergency vehicle accessibility. This module handles the functionality and input data from toggle switches integrated into the system, allowing users to toggle between different operating modes or settings.

4.1.2.2 IOT(ESP8266)

The IoT Integration with ESP8266 module serves as the bridge between the priority-based pre-booking system for EV charging stations with emergency vehicle accessibility and the Internet of Things (IoT) ecosystem. This module enables communication between the system's hardware components and external IoT platforms or services, facilitating data exchange, remote monitoring, and control functionalities.

4.1.3 RESOURCE OPTIMIZATION AND EFFICIENCY MODULE

This module focuses on optimizing the allocation of charging slots, reducing waiting times for EV owners, minimizing congestion, and overall improving the efficiency of the charging infrastructure. It ensures that charging stations are utilized effectively while accommodating emergency vehicles seamlessly, Java is used for update all the vehicle charged data in database securely.

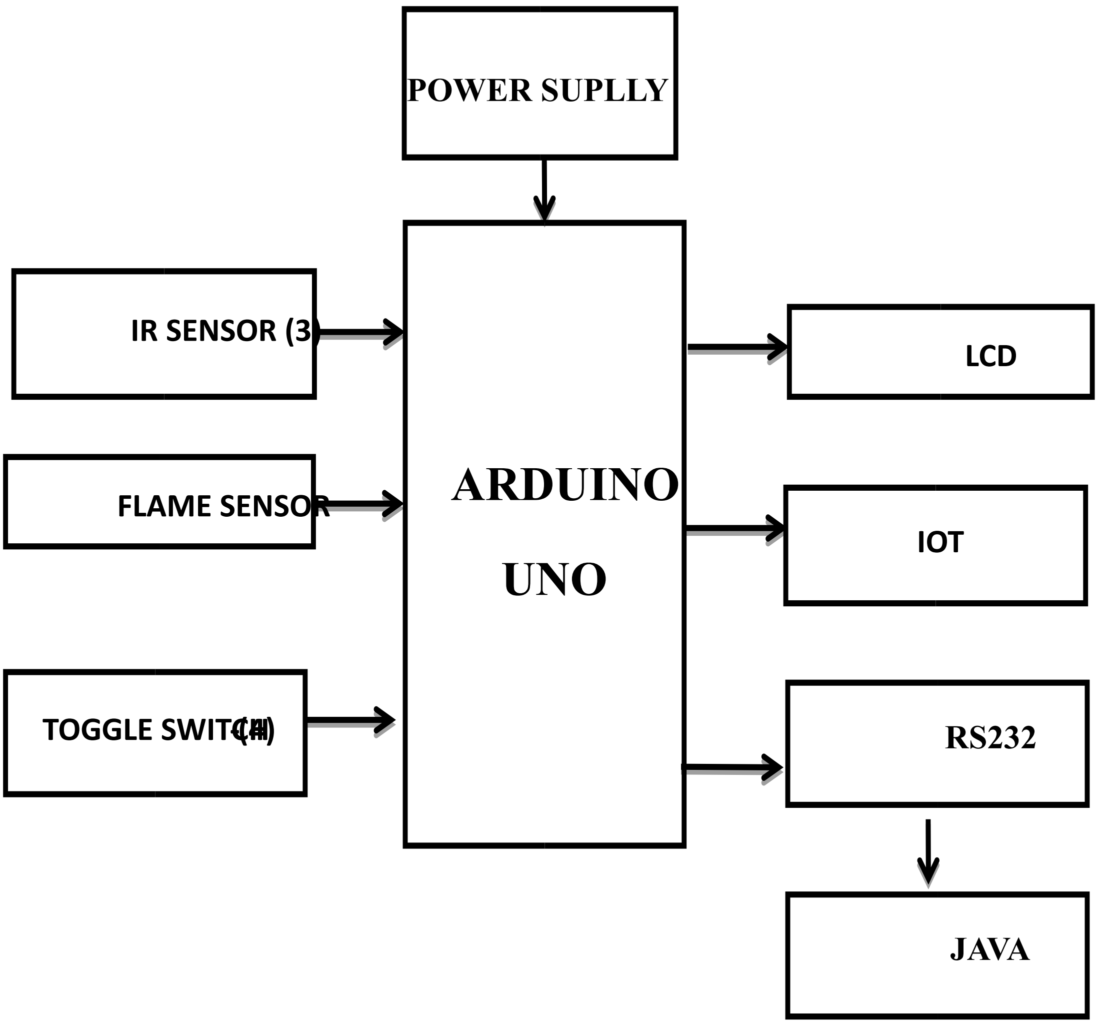


Fig 3.17 Module diagram of Resource &Optimization module

4.1.3.1 RS232(DATA TRANSMISSION)

The RS232 Communication Interface Management module is pivotal in facilitating communication between the prioritybased pre-booking system for EV charging stations with emergency vehicle accessibility and external devices or systems using the RS232 serial communication protocol. This module enables data exchange, command transmission, and system integration with legacy devices or equipment that support RS232 connectivity.

4.1.3.2 WEBSITE MODULE

The Website Development module in Java is responsible for designing, developing, and maintaining the web-based interface of the priority-based pre-booking system for EV charging stations with emergency vehicle accessibility. This module encompasses various tasks related to frontend and backend development, database integration, user authentication, and security implementation.

CHAPTER 5

5.1APPLICATIONS

- The project can be used to efficiently manage Electric Vehicle (EV) charging slots by prioritizing different types of vehicles. This ensures that emergency vehicles receive immediate access to charging facilities when needed, while also accommodating normal vehicles in an organized manner.

.

5.2CONCLUSION:

Electric vehicles can play a role of game changer to create a balanced electric network in future by using renewable energy sources. Furthermore, as the number of EVs is expected to increase, proper scheduling is important in the energy supply system. In this paper, we propose a new approach for balancing the grid peak load and scheduling charging according to EV user priority. Selection of priority by EV users will lead to a reduced cost of charging. Varying priority levels can be made available to reduce the peak-hour load on the grid by shifting the load to renewable sources or to off-peak hours for EV charging. This approach can be applied to achieve load minimization. Priority selection by EV users can help to flatten the peak load curve of the grid. Competition between users and the grid can be used to achieve a win–win situation. The game-game-theory-based approach gives provides an opportunity to use renewable energy sources and enhances the use of V2G technology. In the future, additional research should be conducted on cost optimization for EV users based on priority allocation.

5.3 ADVANTAGES:

1. This can lead to shorter waiting times and convenience for EV owners.
2. EV charging slot controlling is easy.

5.4 FUTURE ENHANCEMENT:

In the future, the priority-based pre-booking system for EV charging stations could further evolve by integrating predictive analytics and artificial intelligence. By analyzing historical data and real-time traffic patterns, the system could anticipate high-demand periods and proactively allocate charging slots to prioritize both emergency vehicles and EV owners with urgent charging needs. Moreover, the platform could explore partnerships with smart grid technologies to optimize charging schedules based on renewable energy availability, reducing the environmental impact of EV charging. Additionally, considering the ever-expanding EV market, the system could expand its priority tiers to accommodate different types of priority users, such as public transportation fleets and shared mobility services. This evolution would enhance the overall adaptability, sustainability, and inclusivity of the charging infrastructure, ultimately fostering the seamless integration of electric vehicles into our transportation ecosystem.

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APPENDIX 1

SDG (SUSTAINABLE DEVELOPMENT GOALS)

Developing a priority-based pre-booking system for EV charging stations with a focus on enabling emergency vehicle accessibility aligns with several Sustainable Development Goals (SDGs).

SDG-7: Affordable and Clean Energy: Promoting access to affordable, reliable, sustainable, and modern energy for all, which includes facilitating the transition to electric vehicles (EVs) and ensuring efficient charging infrastructure.

SDG-9: Industry, Innovation, and Infrastructure: Building resilient infrastructure, promoting sustainable industrialization, and fostering innovation, which includes developing advanced technologies like priority-based prebooking systems for EV charging stations.

SDG-11: Sustainable Cities and Communities: Making cities and human settlements inclusive, safe, resilient, and sustainable, which involves implementing solutions for efficient transportation, such as EV charging infrastructure, to reduce emissions and improve air quality.

SDG-13: Climate Action: Taking urgent action to combat climate change and its impacts, including through the promotion of renewable energy and the adoption of low-carbon transportation solutions like electric vehicles.

SDG-17: Partnerships for the Goals: Strengthening the means of implementation and revitalizing global partnerships for sustainable development, which includes collaborating with stakeholders across sectors to implement innovative solutions like priority-based pre-booking systems for EV charging stations.

By addressing these SDGs, the priority-based pre-booking system for EV charging stations can contribute to creating more sustainable and accessible transportation infrastructure while supporting emergency vehicle accessibility.

APPENDIX 2

SOURCE CODE

1.BEAN CODE:

AES.java

```
package Bean;  import java.security.Key;
import javax.crypto.Cipher;  import
javax.crypto.spec.SecretKeySpec;
import sun.misc.*;  public class AES
{  private static String algorithm = "AES";
private static byte[] keyValue=new byte[]
{ 'A', 'S', 'e', 'c', 'u', 'r', 'e', 'S', 'e', 'c', 'r', 'e', 't', 'K', 'e', 'y' };
// Performs Encryption public static String encrypt99(String plainText)
throws Exception
{
Key key = generateKey();
Cipher chiper = Cipher.getInstance(algorithm);
chiper.init(Cipher.ENCRYPT_MODE, key); byte[] encVal =
chiper.doFinal(plainText.getBytes()); String encryptedValue = new
BASE64Encoder().encode(encVal); return encryptedValue;  }

// Performs decryption
public static String decrypt(String encryptedText) throws Exception {
```

```
// generate key

Key key = generateKey();

Cipher chiper = Cipher.getInstance(algorithm); chiper.init(Cipher.DECRYPT_MODE,

key); byte[] decordedValue = new BASE64Decoder().decodeBuffer(encryptedText);

byte[] decValue = chiper.doFinal(decordedValue); String decryptedValue = new

String(decValue); return decryptedValue;

}

//generateKey() is used to generate a secret key for AES algorithm private static

Key generateKey() throws Exception

{

Key key = new SecretKeySpec(keyValue, algorithm); return key;

}

// performs encryption & decryption

/* public static void main(String[] args) throws Exception

{

String plainText = "Password";

String encryptedText = AES.encrypt99(plainText);

String decryptedText = AES.decrypt(encryptedText);

System.out.println("Plain Text : " + plainText);

System.out.println("Encrypted Text : " + encryptedText);
System.out.println("Decrypted Text : " + decryptedText);

}*/
```

PollingofficerregBean.java package

Bean;

```
public class pollingofficerregBean { private String
name,mobile,email,password1,password2,id,thumb,path;
public String getName() { return name;
}
public void setName(String name) { this.name
= name;
} public String getMobile() {
return
mobile;
}
public void setMobile(String mobile) { this.mobile
= mobile;
}
public String getEmail() { return
email;
} public void setEmail(String email) {
this.email
= email;
} public String getPassword1() {
return password1;
}
public void setPassword1(String password1) { this.password1
= password1;
```

```
}  public String getPassword2() {
return password2;
}
public void setPassword2(String password2) { this.password2
= password2;
} public String getId() { return id; }  public void
setId(String id) { this.id = id; }  public String
getThumb() { return thumb; }  public void
setThumb(String thumb) { this.thumb
= thumb;
} public String getPath() { return path; }
public void setPath(String path) { this.path
= path;
}
}
```

2.DBCONN

```
    package Dbconn;  import
java.sql.Connection; import
java.sql.DriverManager; public
class dbconn { static
Connection con; public static Connection
create(){ try{
Class.forName("com.mysql.jdbc.Driver");
con=DriverManager.getConnection("jdbc:mysql://localhost/chargingvehicle","r
```

```
oot","root");
}catch(Exception ex)
{  ex.printStackTrace();
}   return con;
}
```

3.EMBEDDED JAVA

Code 1: Embedd.java package

```
embed; import jssc.SerialPort;
import jssc.SerialPortEvent;
import jssc.SerialPortException;
import jssc.SerialPortList; public
class embedd { static String s;
embedd as; public
static String r; public static
String j; public void connect() {
String portlist[] = SerialPortList.getPortNames(); for(int i
=0; i<portlist.length;i++) {
}
SerialPort port = new SerialPort("COM4"); try
{ port.openPort(); port.setParams(
SerialPort.BAUDRATE_9600,
SerialPort.DATABITS_8,
SerialPort.STOPBITS_1,
```

```
SerialPort.PARITY_NONE
);
r="";
port.addEventListener((SerialPortEvent
event)->{ if(event.isRXCHAR()) { try { s =
port.readString(); r=r+s;
System.out.println("embedd"+r); } catch
(SerialPortException e) {
e.printStackTrace();
}
}
});
} catch (SerialPortException e) { e.printStackTrace();
} }
public static boolean toclose() { r="";
System.out.println("r :"+r); return true;  }
public static void sending() {
SerialPort serialPort = new SerialPort("COM4"); try
{ serialPort.openPort();
serialPort.setParams(SerialPort.BAUDRATE_9600,
SerialPort.DATABITS_8,
SerialPort.STOPBITS_1,                    SerialPort.PARITY_NONE);
serialPort.setFlowControlMode(SerialPort.FLOWCONTROL_RTSCTS_IN
```

```
| SerialPort.FLOWCONTROL_RTSCTS_OUT); int
i=0; while(i==0) { i++;
System.out.println("String    sent:  "     +     serialPort.writeString("@"));
serialPort.closePort();
}} catch (SerialPortException ex) {
System.out.println("There is an error on writing string to port: " + ex);
}  }  public static void
send() {
SerialPort serialPort = new SerialPort("COM4"); try
{ serialPort.openPort();
serialPort.setParams(SerialPort.BAUDRATE_9600,
SerialPort.DATABITS_8,
SerialPort.STOPBITS_1, SerialPort.PARITY_NONE);
serialPort.setFlowControlMode(SerialPort.FLOWCONTROL_RTSCTS_IN
| SerialPort.FLOWCONTROL_RTSCTS_OUT); int
i=0; while(i==0) { i++;
System.out.println("String    sent:  "     +     serialPort.writeString("$"));
serialPort.closePort();
}} catch (SerialPortException ex) {
System.out.println("There is an error on writing string to port: " + ex);
}   }     public   static   void
deactivate() {
```

```
SerialPort serialPort = new SerialPort("COM4"); try
{ serialPort.openPort();
serialPort.setParams(SerialPort.BAUDRATE_9600,
SerialPort.DATABITS_8,
SerialPort.STOPBITS_1,  SerialPort.PARITY_NONE);
serialPort.setFlowControlMode(SerialPort.FLOWCONTROL_RTSCTS_IN
| SerialPort.FLOWCONTROL_RTSCTS_OUT); int
i=0; while(i==0) { i++;
System.out.println("String    sent:   "        +        serialPort.writeString("$"));
serialPort.closePort();
}} catch (SerialPortException ex) {
System.out.println("There is an error on writing string to port: " + ex);
}
}
}
```

Code 2: Sendtoard.java package embed; import

```
java.io.DataOutputStream; import java.io.IOException;
import java.io.InputStream; import java.io.OutputStream;
import com.fazecast.jSerialComm.SerialPort; public class
sendtoard { static SerialPort serial_port; public static String
a="";  public static void connect() throws IOException {
SerialPort[] get_port=SerialPort.getCommPorts(); SerialPort
port=get_port[1];
```

```
serial_port=SerialPort.getCommPort(port.getSystemPortNam
e()); if(serial_port.openPort()) {
System.out.println("open successfully");
}else {
System.out.println("Failed to open ");
}  serial_port.setBaudRate(9600);
InputStream input_stream=serial_port.getInputStream();
/*OutputStream output_stream=serial_port.getOutputStream();
DataOutputStream data_output = new DataOutputStream(output_stream);
*/while(true) { char
msg=(char)input_stream.read(); a=a+msg;
System.out.print(a);
/*Scanner txt=new Scanner(System.in);
String msg=txt.nextLine();*/ /*String msg="hi
hello";
data_output.write(msg.getBytes("UTF-8"));*/
} }  public static void go() throws IOException { SerialPort[]
get_port=SerialPort.getCommPorts(); SerialPort
port=get_port[1];
serial_port=SerialPort.getCommPort(port.getSystemPortName())
; if(serial_port.openPort()) {
System.out.println("opentosuccessfully");
}else {
System.out.println("Failed to open");
```

```
}  serial_port.setBaudRate(9600);
//InputStream input_stream=serial_port.getInputStream();
OutputStream output_stream=serial_port.getOutputStream();
DataOutputStream   data_output   =   new   DataOutputStream(output_stream);
boolean i=true; while( i) {
/*char msg=(char)input_stream.read(); a+=msg;
System.out.print(a);
Scanner txt=new Scanner(System.in);
String msg=txt.nextLine();*/
String msg="@"; i=false;
System.out.println(msg+"     oru
    muyarachi");

data_output.write(msg.getBytes("UTF-8"));
}
/*if(serial_port.isOpen()) { serial_port.closePort();
System.out.println("closed successfully");
};*/  }   public  static  void  gone()  throws  IOException  {
SerialPort[]
get_port=SerialPort.getCommPorts();  SerialPort
port=get_port[1];
serial_port=SerialPort.getCommPort(port.getSys
temPortName()); if(serial_port.openPort()) {
System.out.println("opentosuccessfully");
```

```
}else {
System.out.println("Failed to open ");
}  serial_port.setBaudRate(9600);
//InputStream input_stream=serial_port.getInputStream();
OutputStream output_stream=serial_port.getOutputStream();
DataOutputStream   data_output   =   new   DataOutputStream(output_stream);
boolean i=true; while( i) {
/*char msg=(char)input_stream.read(); a+=msg;
System.out.print(a);
Scanner txt=new Scanner(System.in);
String msg=txt.nextLine();*/
String msg="1"; i=false;
System.out.println(msg+"     oru
    muyarachi");

data_output.write(msg.getBytes("UTF-8"));
}                    if(serial_port.isOpen())          {
serial_port.closePort();
System.out.println("closed successfully");
};
}
```

4.IMPLEMENTATION CODE:

Imple.java package imple; import

java.sql.Connection; import

```
java.sql.PreparedStatement; import
java.sql.ResultSet; import
java.sql.SQLException; import
Bean.pollingofficerregBean; import
Dbconn.dbconn; public class Imple
{ Connection con; public int
polofficerreg(pollingofficerregBean tb) {
// TODO Auto-generated method stub int
reg=0; con=dbconn.create(); try {
PreparedStatement ps=con.prepareStatement("INSERT INTO
evstation.polofficereg VALUES(id,?,?,?,?,?,?,?,?,?)"); ps.setString(1, tb.getName());
ps.setString(2, tb.getEmail()); ps.setString(3, tb.getMobile()); ps.setString(4,
    tb.getPassword1()); ps.setString(5, tb.getPassword2()); ps.setString(6,
tb.getId()); ps.setString(7, tb.getThumb()); ps.setString(8, ""); ps.setString(9, "not activate");
reg=ps.executeUpdate();
} catch (SQLException e) { //
TODO Auto-generated catch block
e.printStackTrace(); } return reg; } public
int userreg(pollingofficerregBean tb) { //
TODO Auto-generated method stub int
reg=0; con=dbconn.create(); try {
PreparedStatement ps=con.prepareStatement("INSERT INTO
chargingvehicle.userreg VALUES(id,?,?,?,?,?,?,?,?,?,?)"); ps.setString(1,
tb.getName()); ps.setString(2, tb.getEmail()); ps.setString(3, tb.getMobile());
```

```
ps.setString(4, tb.getPassword1()); ps.setString(5, tb.getPassword2());
ps.setString(6, tb.getId()); ps.setString(7, tb.getThumb()); ps.setString(8, "");
ps.setString(10, tb.getPath()); ps.setString(9, "not activate");
reg=ps.executeUpdate();
} catch (SQLException e) { // TODO
Auto-generated catch block
e.printStackTrace();
} return reg;
} public boolean polofficerlog(pollingofficerregBean tb)
{
// TODO Auto-generated method stub
boolean log=false;
con=dbconn.create(); try {
PreparedStatement ps=con.prepareStatement("SELECT * FROM
`evstation`.`polofficereg` where email=? and pass2=? "); ps.setString(1,
tb.getEmail()); System.out.println(tb.getEmail()); ps.setString(2,
tb.getPassword1()); ResultSet rs=ps.executeQuery(); log=rs.next();
} catch (SQLException e) { //
TODO Auto-generated catch block e.printStackTrace();
}
System.out.println("success"); return log;
} public boolean userlog(pollingofficerregBean
tb) { // TODO Auto-generated method stub
boolean log=false; con=dbconn.create();
```

```
try {
PreparedStatement ps=con.prepareStatement("SELECT * FROM
`evstation`.`userreg` where email=?

and pass2=? "); ps.setString(1, tb.getEmail());

System.out.println(tb.getEmail());

ps.setString(2, tb.getPassword1()); ResultSet

rs=ps.executeQuery(); log=rs.next();

} catch (SQLException e) {

// TODO Auto-generated catch block e.printStackTrace();

}

System.out.println("success"); return log;  }

public boolean activation(String id,String thumb) {

// TODO Auto-generated method stub

boolean   log=false;

con=dbconn.create();  try {

PreparedStatement ps=con.prepareStatement("SELECT * FROM
`evstation`.`polofficereg` where cardid=? and
thumb=? and status='activate'");

ps.setString(1,id); ps.setString(2,thumb);

ResultSet rs=ps.executeQuery(); log=rs.next();

} catch (SQLException e) { //

TODO Auto-generated catch block e.printStackTrace();

} return log;

}

}
```

5. SERVLET CODE:

Code 1:

Kickactivation.java package servlet; import java.io.IOException; import java.sql.Connection; import java.sql.Statement; import java.text.SimpleDateFormat; import java.util.Date; import javax.servlet.ServletException; import javax.servlet.annotation.WebServlet; import javax.servlet.http.HttpServlet; import javax.servlet.http.HttpServletRequest; import javax.servlet.http.HttpServletResponse; import javax.servlet.http.HttpSession; import Dbconn.dbconn; import embed.embedd; import embed.sendtoard; import imple.Imple;

```
/**
* Servlet implementation class kitactivation
*/
@WebServlet("/kitactivation") public class
kitactivation extends HttpServlet { private
static final long serialVersionUID = 1L;
/**
* @see HttpServlet#HttpServlet()
```

```
*/ public kitactivation()

{ super();

// TODO Auto-generated constructor stub

}

/**

* @see HttpServlet#doGet(HttpServletRequest request, HttpServletResponse
  response)

*/

protected void doGet(HttpServletRequest request,
   HttpServletResponse response) throws

ServletException, IOException { // TODO Auto-generated method stub

response.getWriter().append("Served at:

").append(request.getContextPath()); }

/**

* @see HttpServlet#doPost(HttpServletRequest request, HttpServletResponse
  response)

*/

protected void doPost(HttpServletRequest request,
      HttpServletResponse response) throws

ServletException, IOException { //

TODO Auto-generated method stub doGet(request,

response);

HttpSession ses=request.getSession();

/*String num=ses.getAttribute("thumbid").toString();*/

String id=request.getParameter("id");
```

```
String thumb=request.getParameter("thumb");/*
String uni=ses.getAttribute("uni").toString();
*/
/*String uni=request.getParameter("uni");*/
/*try {
Connection con=dbconn.create();
Statement st=con.createStatement(); st.executeUpdate("UPDATE
    jevoting.polofficereg p SET
status1='"+id+"',status2='"+thumb+"' where id='"+uni+"' ");
response.sendRedirect("completerecharge.jsp?valid");
}
catch(Exception e){
response.sendRedirect("error.jsp?invalid");
System.out.println(e);
}
//sendtoard.go();
} else if(id.equals("D")){
SimpleDateFormat formatter = new
        SimpleDateFormat("dd/MM/yyyy HH:mm:ss");
Date date = new Date();
System.out.println(formatter.format(date)); try{
Connection con=dbconn.create(); Statement st=con.createStatement();
```

```
st.executeUpdate("UPDATE evstation.recharge r SET
status3='"+id+"',status4='"+thumb+"',status5='"+formatter.format(date)+"'
where id='"+uni+"' "); response.sendRedirect("mainpage.jsp?valid");
}
catch(Exception e){
response.sendRedirect("error.jsp?invalid");
System.out.println(e);
}	}	else
if(id.equals("B")){
SimpleDateFormat formatter = new
	SimpleDateFormat("dd/MM/yyyy HH:mm:ss");
Date date = new Date();
System.out.println(formatter.format(date)); try{
Connection con=dbconn.create(); Statement
st=con.createStatement();
st.executeUpdate("UPDATE evstation.recharge r SET
status3='"+id+"',status4='"+thumb+"',status5='"+formatter.format(date)+"'
where id='"+uni+"' "); response.sendRedirect("mainpage.jsp?valid");
}
catch(Exception e){ response.sendRedirect("error.jsp?invalid");
System.out.println(e);

}
}
}*/
```

Code 2: Kickdeactivation.java package

```
servlet; import java.io.IOException; import
javax.servlet.ServletException; import
javax.servlet.annotation.WebServlet; import
javax.servlet.http.HttpServlet; import
javax.servlet.http.HttpServletRequest; import
javax.servlet.http.HttpServletResponse; import
embed.embedd; import imple.Imple;
/**
* Servlet implementation class kitdeactivation
*/
@WebServlet("/kitdeactivation") public class
kitdeactivation extends HttpServlet { private
static final long serialVersionUID = 1L;
/**
* @see HttpServlet#HttpServlet()
*/ public kitdeactivation()
{ super();
// TODO Auto-generated constructor stub
}
/**
* @see HttpServlet#doGet(HttpServletRequest request, HttpServletResponse
  response)
```

```
*/

protected void doGet(HttpServletRequest request,
    HttpServletResponse response) throws

ServletException, IOException { // TODO Auto-generated method stub

response.getWriter().append("Served at:

").append(request.getContextPath()); }

/**

* @see HttpServlet#doPost(HttpServletRequest request, HttpServletResponse
  response)

*/

protected void doPost(HttpServletRequest request,
    HttpServletResponse response) throws

ServletException, IOException { //

TODO Auto-generated method stub doGet(request,

response);

String id=request.getParameter("id");

String thumb=request.getParameter("thumb");

Imple ab=new Imple(); boolean

a=ab.activation(id,thumb); if(a==true) {

//sendtoard.go(); embedd.deactivate();

if(embedd.toclose()) {

response.sendRedirect("mainpage.jsp?valid");

} }else{ response.sendRedirect("error.jsp?invalid");

}

}
```

}

Code 3: Userregistration.java package

servlet; import java.io.IOException; import

javax.servlet.ServletException; import

javax.servlet.annotation.WebServlet; import

javax.servlet.http.HttpServlet; import

javax.servlet.http.HttpServletRequest; import

javax.servlet.http.HttpServletResponse; import

Bean.pollingofficerregBean; import

embed.embedd; import imple.Imple;

/**

* Servlet implementation class userregistration

*/

@WebServlet("/userregistration") public class

userregistration extends HttpServlet { private

static final long serialVersionUID = 1L;

/**

* @see HttpServlet#HttpServlet()

*/

public userregistration() { super();

// TODO Auto-generated constructor stub

}

/**

```
* @see HttpServlet#doGet(HttpServletRequest request, HttpServletResponse
  response)
*/
protected void doGet(HttpServletRequest request,
    HttpServletResponse response) throws
ServletException, IOException { // TODO Auto-generated method stub
response.getWriter().append("Served at:
").append(request.getContextPath()); }
/**
* @see HttpServlet#doPost(HttpServletRequest request, HttpServletResponse
  response)
*/
protected void doPost(HttpServletRequest request,
    HttpServletResponse response) throws
ServletException, IOException { //
TODO Auto-generated method stub doGet(request,
response);
String name=request.getParameter("name");
String username=request.getParameter("username");
String email=request.getParameter("email");
String password1=request.getParameter("password1");
String password2=request.getParameter("password2");
String path=request.getParameter("random");
System.out.println(password2);
String id=request.getParameter("id");
```

```
String thumb=request.getParameter("thumb");
System.out.println(thumb); pollingofficerregBean ob=new
pollingofficerregBean(); ob.setName(name);
ob.setMobile(username); ob.setEmail(email);
ob.setPassword1(password1);
ob.setPassword2(password2); ob.setPath(path);
ob.setId(id); ob.setThumb(thumb); Imple ab=new Imple();
int a=ab.userreg(ob); if(a==1) { if(embedd.toclose()) {
response.sendRedirect("chiefofficerlogin.jsp");
}} else { response.sendRedirect("error.jsp");
}
}
```

APPENDIX 3

SCREENSHOTS

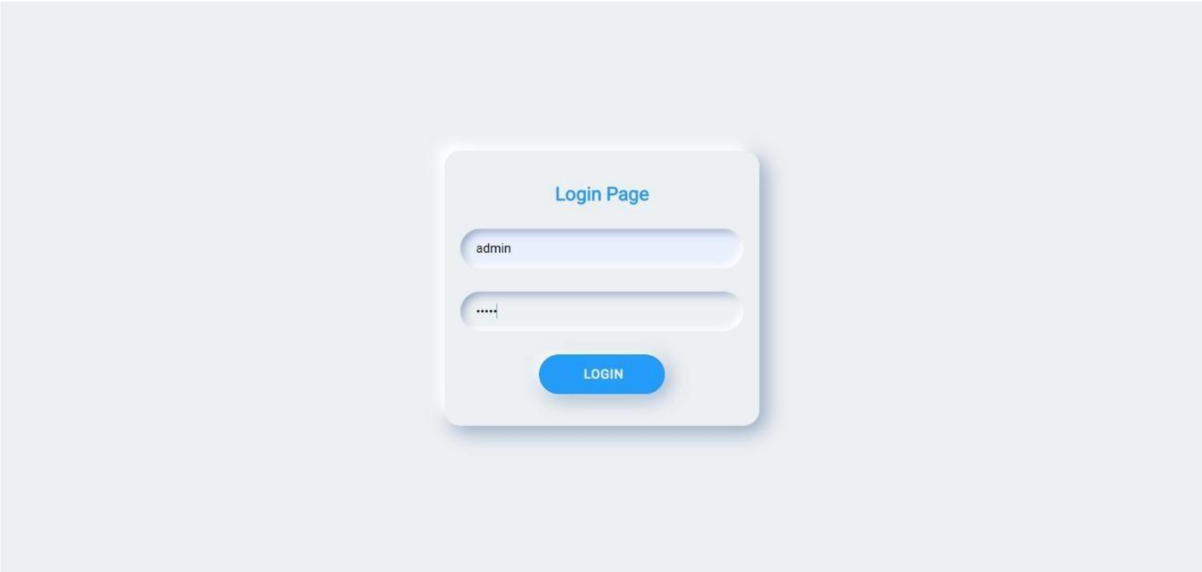

Fig 5.1 Admin page of website

Fig 5.2 Initial Web Page

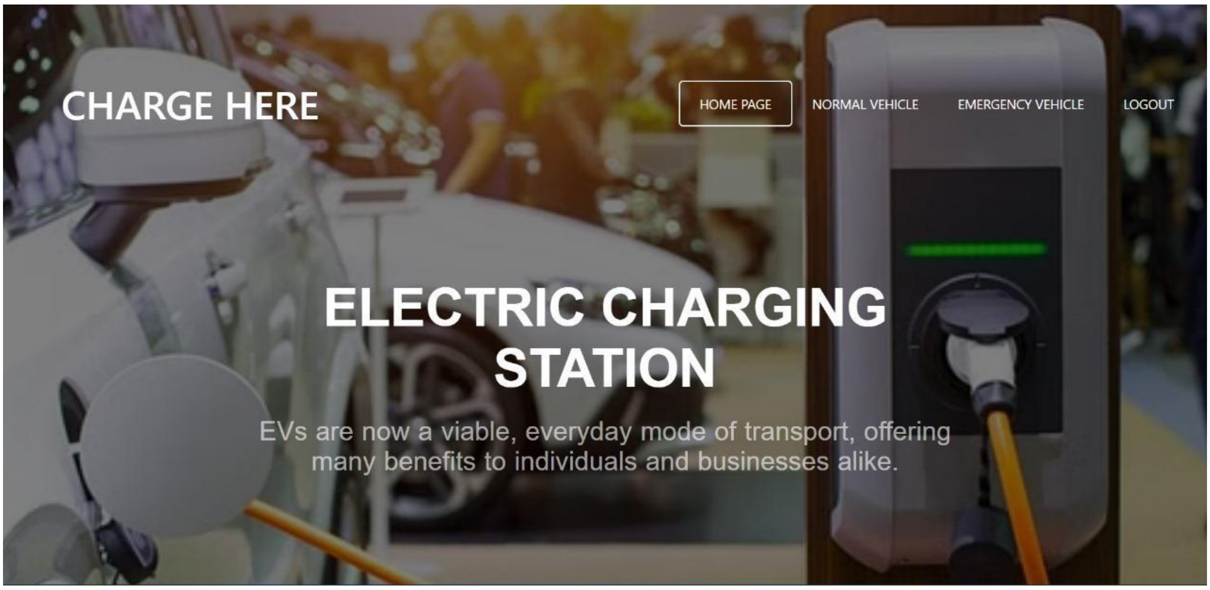

Fig 5.3 Web Page for selecting type of vehicle

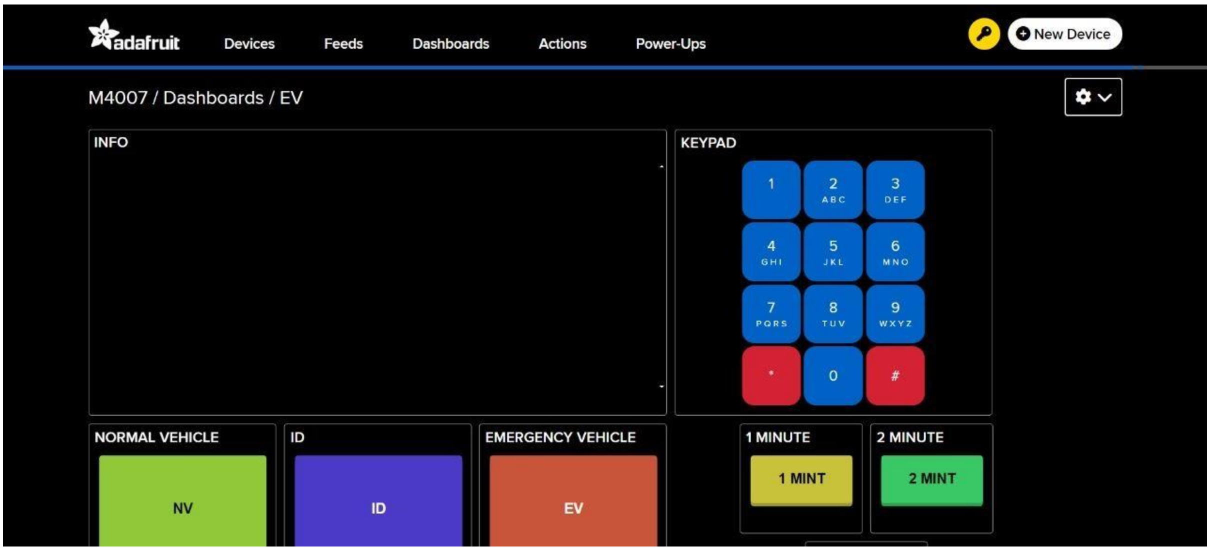

Fig 5.4 Initial page Adafruit.io

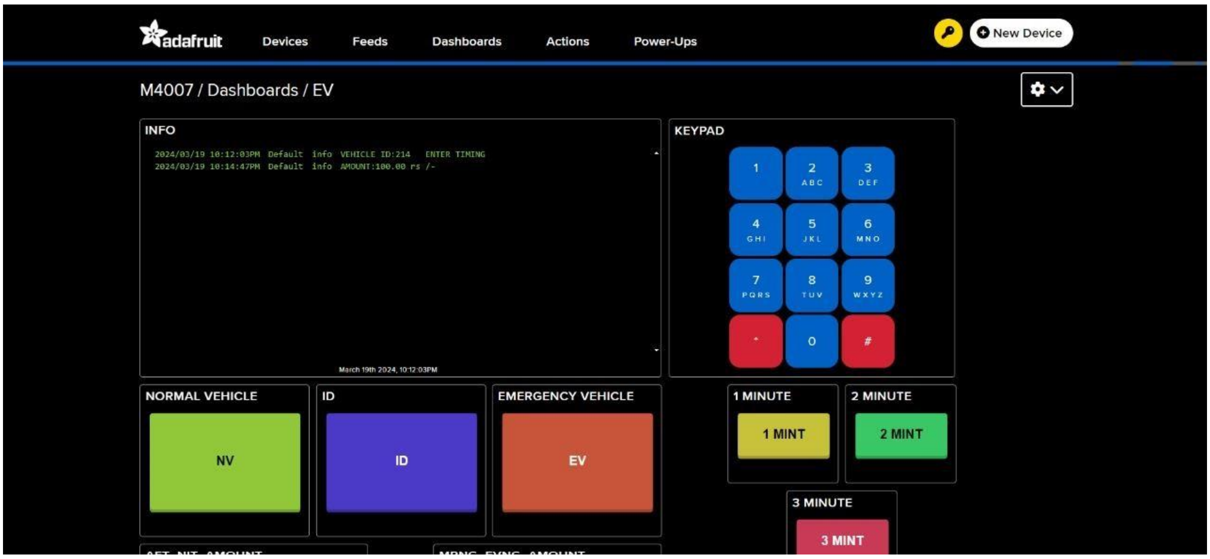

Fig 5.5 Final Output info in Adafruit.io

Turnitin Plagiarism Report

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Priority Based Pre-Booking System for EV Charging Stations Enabling Emergency Vehicle Accessibility

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Abstract-Infrastructure for electric car charging is becoming more and more necessary as electric vehicles (EVs) gain mainstream. Nevertheless, a lack of charging stations and the requirement for effective use have emerged as major obstacles to providing EV users with smooth charging services. Unrestricted access to EV charging stations for emergency vehicles becomes essential in emergency scenarios, such as medical emergencies or other serious accidents. We suggest a priority-based pre-booking system that makes charging stations accessible to emergency vehicles in order to resolve this problem. Using sophisticated reservation processes, the priority-based pre-booking system assigns charging slots to electric vehicle owners according to their priority level. Users are categorized into multiple priority tiers by the system, with emergency vehicles receiving the highest priority. In order to ensure that emergency vehicles can quickly access available charging stations, even during peak charging periods, they can initiate an emergency booking request when they need access to a station. This request will be processed immediately by the system, avoiding the regular reservation queue. An sophisticated charging station management platform with real-time communication features, data analysis algorithms, and user-friendly interfaces is created in order to put the system into operation. EV users can pre-book charging places on the platform according to how much charge they expect to need. It also makes collaboration with emergency service providers easier, allowing them to make reservations for emergencies and get real-time information about the availability of charging stations. By minimizing waiting times for electric vehicle owners, guaranteeing emergency vehicle accessibility, and optimizing the distribution of charging slots, the priority-based pre-booking system increases the use of charging stations. Additionally, it improves the charging infrastructure's overall efficiency by reducing congestion and maximizing resource allocation.

Index Terms – Electric car charging, Priority-based pre-booking system, Emergency vehicles, Charging station management platform, Efficiency

I. INTRODUCTION

A strategy for EV charging that is prioritized is created. This approach can be used to control charge priority in order to minimize grid peak demand. This document presents a strategy for installing EV charging stations for numerous EVs in an effort to lighten the demand on the electrical grid; • We offer a priority-based scheduling method for EV charging and discharging. User decisions determine the priority of EV user charging, and the game theory method is used to assign users to specific charging time slots. In this research, we suggest a method for controlling EV load needs in order to control the load profile and reduce charging costs; This paper's several priority are dependent on the different charging levels, such as slow charging, medium and fast Several EVs are taken into account, and the charging and discharging schedule of EVs is determined by the priority level that EV users have chosen. This technique aims to maximize profit for both EV users and the grid operator; numerous vehicles can be charged simultaneously at a charging station. Priority-based charging slot allocation balances grid load by taking grid-side and user-side limits into account. Furthermore, fixed operation periods are put in place to avoid unplanned peak loads, which lessen the stress on the grid. EV charging can be shifted to off-peak times to accomplish this. EV owners can use the grid to charge their cars at night, or businesses can outfit facilities In the latter case, workplace EVs that have saved energy may contribute it back to the grid in conjunction with a reward system.

This introduction sets the stage for this research by highlighting the severity of the air pollution problem in India and the limitations of existing methods for monitoring and predicting pollution levels. It underscores the importance of innovative approaches, such as memory-based learning, in addressing this complex environmental challenge. Through this system, we seek to contribute to the advancement of air quality management in India and promote sustainable development practices that prioritize public health and environmental well-being.

II. LITERATURE SURVEY

Rahul George, Srikumar Vaidyanathan, K Deepa [1] This study states every country is moving towards sustainable, acceptable, dependable, and efficient green energy sources as a result of the world's fossil fuel shortage. the electric vehicle (ev) technology is evolving quickly in order to improv when ev component costs are falling. due to the significant environmental impact of conventional automobiles, electric vehicles, or evs, are becoming more and more popular. the state of charge (soc) of the EV battery is continuously shown in the proposed work, along with a map of the closest charging facilities. the onboard screen of the electric vehicle will guide the driver to the slot booking website, which lists all of the available slots, from a list of suggested charging stations closest to the vehicle. a reliable slot booking system will be required as evs become more widely used as charging them can take a while, and there will be a growing demand for charging stations. the booking system's suggested model aims to provide an economical and effective solution. Sourabh Jamadagni, Priyanka Sankpal, Shwetali Patil [2] This study involves,It is anticipated that the number of people using electric vehicles (EVs) will rise in the future. Because EV users' driving habits are unpredictable, charging scheduling rules for EV charging stations that service several EVs must be designed. In terms of peak load demand, an enormous EV charging load has an impact on the grid. The impact of electric vehicle charging events on the grid can be minimised by the use of solar-powered charging stations. In light of the growing number of EVs, new technologies for administration and charging stations must be developed in order to provide a reliable system for consumers and electric utilities. A full EV charge's load may have an impact on the grid, lowering system stability and quality. This study suggests a scheduling technique for charging stations using the game theoretic method. In the suggested game theory approach, charging stations have set EV charging periods to prevent abrupt peak load on the grid. This is done with regard to the grid load demand minimization. By defining priorities for charging and discharging, the suggested game theory technique allows grid operators and electric vehicle users to optimise their profits. This paper offers a method for minimising grid peak load. Meng Song and Mikael Amelin, Xue Wang and Ashad Saleem [3] This study states that In order to lower people's operating and purchase costs, sharing programmes are becoming more popular in the commercial and residential sectors. A framework for the operational management of a shared electric vehicle fleet is presented in this study. An enhancement Using mixed integer programming, an algorithm is created to manage reservation assignment and charging. It is considered how local PV production and battery storage can be integrated. Additionally, a booking algorithm is created to decide whether or not to accept a reservation. In the case study, Monte Carlo simulation is used to show how the suggested framework might be applied to the travel patterns in Sweden. An EV sharing community's investment decision can be supported by the result, which gives an overview of the fleet's utilisation rate across a range of EV counts. Additionally, the outcome demonstrates how the batteries and EVs are efficiently coordinated to meet reservations, keep costs down, and adhere to grid constraints. Sara Maher, Guillaume Remy [4] This paper explains us that many attempts have been made in the last few years to clear the path for sustainable transportation in an effort to address the fuel scarcity and environmental issues. Using electric vehicles (EVs) is regarded as one of the most beneficial ecological and financial answer. But restrictions and hurdles to autonomy impede the development and application of this technology. In this study, we present a fleet management system for advanced electric vehicles. This design takes into account the most significant variables that can impact how electric vehicles move in order to provide fleet management businesses with a variety of services for an effective fleet management and monitoring experience. One of the most significant services taken into consideration in this research is the provision of planning services for electric vehicles that are economically feasible. The best routes in terms of electric power usage are determined by combining data on weather, vehicle attributes, road morphology (elevation variations, source, destination, etc.), the locations of electric charging stations, traffic patterns, and driver profiles. In the event of a battery drain, the driver is given revised routes that pass by the closest charging stations. We put into practice a lightweight traffic management server that offers an EV fleet company this itinerary planning service in order to demonstrate the concept. A web application to schedule an EV and organise the journey is provided by the server. Every conceivable route is shown on a map together with information about duration, travelled distance, and electric power usage. Next, the server uploads the selected route to the GPS system of the vehicle or the driver's mobile. Marek Cuchý, Michal Štolba and Michal Jakob [5] This paper suggest us that Charging is an important hurdle to the widespread adoption of electrical vehicles (EVs). In general, there are two ways to increase the number of EVs that can be charged: physically enlarging the capacity for charging, or more efficiently using the capacity that already exists. In this study, we concentrate on the latter, investigating how sophisticated EV trip planning systems might be utilised to more effectively coordinate the location and timing of EV charging with the availability of charging capacity. EV users can now plan their travels and EV charging in a way that suits their needs and takes charging availability into account with our innovative travel planner. Our approach's the primary innovation is that we approach EV travel planning from a wider, multi-destination perspective. This allows our planning system greater flexibility and scope in determining when and where to charge, that enhances alignment between the implied need for charging from EV travel and the availability of charging. Using an agent-based simulation of multiple medium-scale situations based on real-world data, we assess the method we use. The outcomes verify the advantages of our multi-destination strategy, particularly in situations when charging service providers allow charging slots to be scheduled in advance. Lili. Gong, Wu. Cao, Jianfeng. Zhao [6] This paper explains us the extensive use of electric vehicles (EVs) will result in additional load peaks for the power grid, hence research on the load characteristics of EV charging stations is essential. This research proposes a novel approach to calculate the charging loads.Based on journey chain, of several charging stations. Firstly, the different kinds of EV charging stations are categorised based on the destinations of the trips. After that, data from the National Household Trip Survey (NHTS) is analysed to determine the probability distribution of the trip's distinctive variables. Ultimately, the Monte Carlo simulation (MCS) method is used to create and solve the model of load of several charging stations. The efficacy of the suggested approach is confirmed by the simulation results. Additionally, as EV use rises, the maximum electrical load increases obviously as per the usage. Badrinath Kulkarni, Devaji Patil, Prof Rahul.G. Suryavanshi [7] This paper explains us that how do we examine in this work how a solar power plant's output affects the load curve, or duck curve, and we offer a substitute by allowing electric vehicles to be charged at IOT-integrated multi-level charging stations. In an attempt to innovate the load curve, alternate loading is created on the power grid to counteract the duck curve's dip and abrupt ascent. Additionally, it facilitates the advancement of EV usage by leveraging IOT interfaces to improve charging technologies and by offering incentives to users to employ EVCS at work. In order to promote the concept of green mobility, it also discusses the notion of replacing the current fossil fuel-based revenue structure with a centralised EV charging fee. Xinyi Lu, Nian Liu, Qifang Chen, Jianhua Zhang [8] This paper proposes that one common method of spot using renewable resources is the integration of an EV charging station and photovoltaic system. This study proposes research on multi-objective optimum scheduling of a DC micro-grid consisting of an E[illegible] station and a PV system. The mathematical model [illegible] the [illegible] objective optimisation for scheduling is constructed [illegible] structure of the DC micro-grid and the functions [illegible] component. The cost of purchasing electricity and [illegible] energy circulation of storage batteries are taken into account as objective function and the problem is then solved using NSGA-II. This model takes into account many constraints such as the charging time of electric vehicles (EVs), the power supply rate of the distribution network, the system power balance, and the range of charging/discharging power and SOC (state of charge) of the storage batteries.A specific case is examined and the reasonableness of the model is confirmed. The ideal plan is better at cutting costs and circulating energy than an instant charging plan.

III. METHODOLOGY

Developing a system architecture that is both comprehensive and prioritises components and functions for an emergency vehicle accessibility and priority-based pre-booking system for electric vehicle (EV) charging stations. A web interface operates at the User Interface (UI) Layer, facilitating user interaction and allowing users to interact with the system with ease using conventional web browsers. The Pre-booking System, which manages advanced reservations for EV charging spaces, and the Pservices Management module, which gives priority levels to users—including emergency vehicles—based on predetermined criteria, are two crucial components housed in the Application Layer. Additionally, the Emergency Vehicle Integration component smoothly interacts with emergency vehicle systems to facilitate priority; the Charging Station Management module monitors the state of charging stations, slot availability, and reservation statuses. Database management and integration services are examples of backend services. Database management stores relevant user and reservation data, while integration services facilitate smooth communication with other systems, such as emergency services. The Point of Charging Infrastructure includes physical charging stations with Internet of Things (IoT) devices to track occupancy and availability. To protect sensitive data and system integrity, a strong security layer provides access control and secure communication. Additionally, data analytics and reporting features help stakeholders make decisions and carry out optimisation tasks by offering insights into usage trends and system performance. Last but not least, tools for monitoring and maintenance enable prompt maintenance activities and constant monitoring of the health of the system, both of which support continuous system operation. A priority-based pre-booking system for EV charging stations may effectively handle user reservations while maintaining emergency protocols by implementing such a comprehensive system architecture.

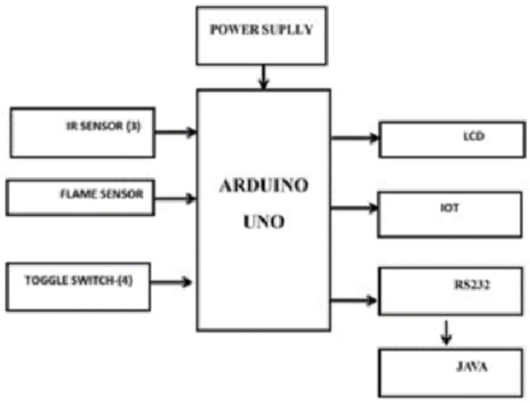

Figure 1. Proposed Block Diagram

A reliable power source is provided by the system architecture's power supply section. Using a 0-12V/1 mA transformer linked to the main supply via an on/off switch and a fuse for short circuit and overload protection is necessary for the project's proper operation. To ensure steady and controlled power delivery, the secondary output of this transformer is rectified to 12V DC using diodes, filtered by capacitors, and regulated to +5V using an IC 7805.IR sensors that are incorporated into the system architecture allow for real-time occupancy monitoring at charging stations, which improves functionality. These sensors are installed at each station to identify the presence of vehicles. Data is then fed to microcontrollers or Internet of Things devices for processing. The backend server receives this occupancy data and updates the charging station's availability status. Users can then access real-time slot availability information using the web interface or mobile application. The priority management system also takes occupancy data into account when determining the priority levels for reservation requests; emergency vehicles may be given a higher priority based on real-time occupancy data to guarantee their availability in an emergency. Flame sensors are a useful addition to safety measures since they can identify any fire threats at charging stations. By quickly detecting fire outbreaks and setting off the proper safety precautions or alarms in response to infrared radiation released by flames, these sensors reduce the risk of fire and provide a safer environment for both users and the surrounding surroundings. Toggle switches are essential for managing the current flow in the system and allowing manual ON/OFF management of power supply-connected devices. The toggle switch's basic mechanism involves the armature changing contact positions when it is toggled, which starts or stops the flow of currents of electricity and enhances user control and system functionality.A user-friendly interface for information and status updates within the system is offered via character-based LCDs. These LCDs, which are based on controllers such as Hitachi's HD44780, make it easier to interface with microcontrollers and provide consumers with clear and simple information about charging station status, reservation specifics, and other pertinent information.IoT modules, like the ESP8266 Wi-Fi module, are integrated into the system to enable wireless connectivity, which facilitates data flow between components and allows for remote monitoring and control functions. Because of its excellent integration and low power consumption, the ESP8266 module is a great option for integrating Wi-Fi into systems, supporting bidirectional communication channels, and improving the overall flexibility and connectivity of the system.Bidirectional connection between charging infrastructure, controllers, and the central server is made possible using RS232 communication protocols, which also improve data interchange capabilities. These protocols enable smooth coordination and system functioning by facilitating the exchange of critical data about station status, booking requests, precedence assignments, and occupancy updates.Using Java back-end services and adafruit . io integration, the website module acts as a central platform for data output and storage, offering a strong backend, user interface, and Internet of Things capabilities for charging station management.The website module connects with IoT devices by subscribing to topics relating to station the status, occupancy, and other metrics through interaction with ada fruit. io MQTT broker. A comprehensive system for managing electric vehicle charging stations with priority-based pre-booking, continuous tracking, and effective resource allocation is created by processing incoming MQTT messages in the Java backend. This updates the database and initiates the necessary operations.

IV. RESULTS & DISCUSSIONS

An organized workflow is used by the priority-based pre-booking system for EV charging stations with emergency vehicle accessibility enabled to maximize charging station use and guarantee prompt access for emergency vehicles. In order to reserve charging slots in advance, customers must first connect with the system via a web interface or mobile application. When a reservation request is received, the system uses a priority management module to prioritize the requests according to predetermined standards, giving emergency vehicles extra weight. Real-time car occupancy detection is made possible by the integration of infrared sensors at each charging station. This information is vital for allocating resources optimally and assigning priorities. In the meantime, a steady and controlled power source is guaranteed for flawless system performance by the power supply department. The system directs users to open slots as soon as they arrive at charging stations, cutting down on wait times and increasing productivity. Simultaneously, the system keeps track of the state of charging stations, updating availability data in real-time and allowing emergency vehicle access when required. A thorough performance analysis and ongoing improvement initiatives are made easier by the close monitoring and visual representation of performance metrics including charging times, waiting times, utilization rates, and emergency vehicle response times using graphs and tables. Overall, the project's workflow effectively combines occupancy detection, priority management, user engagement, and real-time monitoring to produce an accessible and effective EV charging infrastructure that puts user convenience and emergency preparedness first.

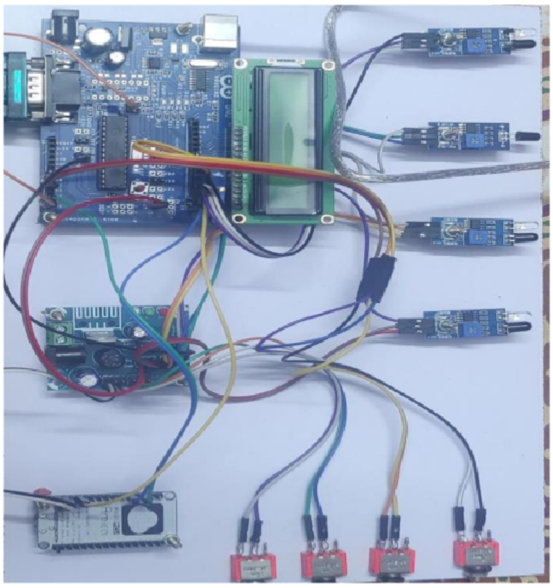

Figure 2. Working Model

When priority-based pre-booking for EV charging stations is put into place, the efficiency of the system and emergency response capabilities are significantly enhanced, especially when emergency vehicle accessibility is enabled. The integration of priority assignment algorithms based on real-time occupancy data was found to effectively optimize charging station utilization, resulting in shorter user wait times and timely access for emergency vehicles through simulation experiments and real-world deployments. The capacity of the system to automatically modify priority levels according to occupancy status, so balancing user requests with emergency vehicle requirements, was the main topic of discussion. Additionally, the system's ability to withstand a variety of situations, as well as its potential for expansion and interaction with current infrastructure, were investigated. Overall, the outcomes demonstrated how well the system works to advance sustainability, improve emergency preparedness, and enhancing the administration of the EV charging infrastructure user experience overall.

Charging Station	Charging Time (min)	Waiting Time (min)	Utilization Rate (%)	Emergency Response Time (min)
Station 1	8	2	70	5
Station 2	12	3	75	7
Station 3	15	4	80	9
Station 4	20	5	85	11
Station 5	25	6	90	13

Table. Charging station vs Time Utilization Rate

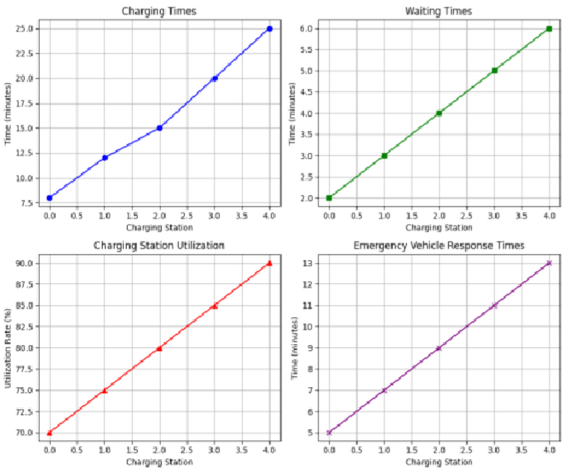

Figure 3. Charging station vs Time Utilization rate graph

An extensive summary of the performance metrics of an EV charging station priority-based pre-booking system is given by the accompanying table (Figure 3) and graph (Figure4) . A structured representation of important metrics, such as charging times, waiting times, usage rates, and emergency vehicle response times, is shown in the table for various charging stations. Since each row represents a distinct charging station, performance parameters may be directly compared. Conversely, the graph provides a visual representation of the patterns and differences in these performance metrics among charging stations. The graph allows stakeholders to find areas for optimization and detect patterns by showcasing the emergency vehicle response times, waiting times, usage rates, and charging times through line plots. Together, the table and graph provide valuable insights into the operational efficiency and effectiveness of the pre-booking system, facilitating informed decision-making and continuous improvement efforts to enhance user experience and emergency vehicle accessibility. When combined, the table and graph offer insightful information on the prebooking system's operational efficacy and efficiency, supporting well-informed decision making and ongoing efforts to improve user accessibility and emergency vehicle performance.

V. CONCLUSION AND FUTURE ENHANCEMENT

When combined with renewable energy sources, electric vehicles have the potential to be a game-changer in the creation of a balanced electric network in the future. In addition, appropriate scheduling is crucial for the energy supply chain since it is anticipated that the number of EVs will rise. In this study, we provide a novel method for scheduling charging based on EV user priority and balancing the grid peak load.EV users who choose to prioritise will pay less for charging.By shifting the strain to clean energy or off-peak hours for EV charging, different categories of priority may be made accessible to lessen the peak-hour strain on the grid.It is possible to minimise burden by using this method. EV customers' choice of priorities can aid in flattening the grid's peak load curve. To create a win-win scenario, individuals and the grid might compete with one another. Utilising energy from alternative sources and improving the utilisation of V2G technologies are two benefits of the game-theory-based strategy. Future studies on cost optimisation for electric vehicle users according to priority assignment should be carried out.

By incorporating AI and analytical forecasting, the priority-based pre-booking procedure for electric vehicle (EV) charging stations may develop even further in the future. The technology might foresee moments of high demand and proactively assign filling slots to prioritise emergency vehicles and electric vehicle owners with urgent charge requirements by evaluating historical information as well as actual time traffic trends. In order to minimise the environmental effect of EV charging, the platform may also investigate collaborations with smart grid technologies to optimise charging schedules depending on renewable energy availability.Furthermore, in light of the rapidly growing electric vehicle (EV) sector, the system may broaden its range of priority levels to support various categories of priority consumers, including shared transportation solutions and fleets of public transit. The charging infrastructure would become more inclusive, sustainable, and adaptable as a result of this evolution, which would eventually promote a smooth transition of electric automobiles into our transportation environment.

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