

SMART PARKING MANAGEMENT SYSTEM

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree in Electronics and Communication Engineering

by

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SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
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APRIL 2024



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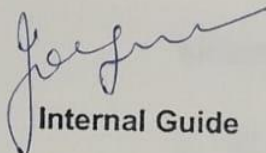
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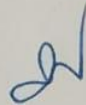
BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **DHINAKARAN S(40130048)** and **ANAND A R (40130012)** who carried out the Project entitled **"SMART PARKING MANAGEMENT SYSTEM"** under our supervision from November 2023 to April 2024.



Internal Guide

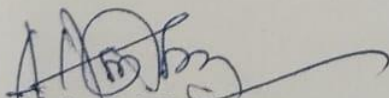
Dr.R.M.JOANY, M.E.,Ph.D.,



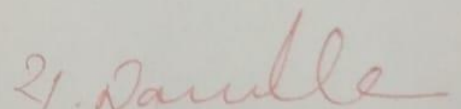
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DECLARATION

We Dhinakaran S(40130048) , Anand A R (40130012) hereby declare that the Project Report entitled "**SMART PARKING MANAGEMENT SYSTEM**" done by us under the guidance of Dr.R.M.JOANY, M.E.,Ph.D., Dept. of Electronics and Communication Engineering, SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY, CHENNAI is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

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ABSTRACT

Smart Parking Management System is a groundbreaking project that combines self-driving cars with digital parking assistance to revolutionise the utilization of parking space in an area. Basically, this system uses a group of autonomous vehicles which have been fitted with advanced sensors and mapping technologies. These vehicles traverse the parking lot continuously taking real-time data on available spaces then transmitting it to one central server. Consequently, a user-friendly website interacts with it, hence delivering prompt information concerning availability of car parks across drivers thereby minimizing time wastage for searching them as well as reducing traffic congestion.

The technology employs advanced algorithms and predictive analysis that help in determining space availability using past and present usage trends including factors like events and peak hours among others. This therefore enables drivers to plan ahead for their parking thus improving the overall efficiency and convenience of the system. Additionally, through its web-based dashboard, operators can access comprehensive insights into analytics thereby making informed decisions about resource distribution and management.

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LIST OF ABBREVIATIONS

SMPS	Smart Parking Management System
IR	Infrared
LCD	Liquid Crystal Display
IOT	Internet Of Things

CHAPTER 1

INTRODUCTION

In urban environments worldwide, parking congestion remains a persistent challenge, contributing to traffic congestion, air pollution, and wasted time for drivers. Traditional parking management systems often rely on manual processes, leading to inefficiencies and frustrations for both drivers and operators. However, with the rapid advancement of technology, there lies a tremendous opportunity to revolutionize parking management and enhance the urban mobility experience. The Smart Parking Management System represents a groundbreaking solution to address the complexities of parking space utilization in urban areas. By leveraging cutting-edge technologies such as autonomous vehicles, Internet of Things (IoT) sensors, and predictive analytics, this project aims to transform the way parking is managed and accessed.

The primary objective of this project is to develop an intelligent parking management system that optimizes the allocation of parking spaces, reduces traffic congestion, and improves overall efficiency. Through the integration of autonomous vehicles equipped with advanced sensors and mapping technologies, real-time data on parking space availability will be continuously collected and transmitted to a central server. This system operates on the premise of automating the parking process, thereby minimizing the time wasted by drivers searching for parking spots and alleviating traffic congestion in urban areas. By providing drivers with up-to-date information on available parking spaces through a user-friendly web platform, the Smart Parking Management System empowers users to make informed decisions and plan their parking in advance. Furthermore, the system incorporates advanced algorithms and predictive analytics to analyze past and present usage trends, as well as factors such as events and peak hours. This enables the system to forecast parking space availability with accuracy, facilitating efficient resource allocation and enhancing the overall parking experience for users.

In addition to benefiting drivers, the Smart Parking Management System offers significant advantages for parking operators and urban planners. Through a web-based dashboard, operators can access comprehensive insights and analytics,

allowing them to make informed decisions regarding resource distribution and management. This empowers operators to optimize parking space utilization, improve operational efficiency, and enhance the overall management of parking facilities. Moreover, the system promotes sustainability by reducing the environmental impact of parking-related activities. By minimizing the time spent circling for parking and optimizing parking space allocation, the system helps reduce carbon emissions and alleviate environmental pollution associated with urban transportation.

The implementation of the Smart Parking Management System is not only technologically innovative but also economically viable. Unlike traditional parking management systems that may require costly hardware or infrastructure, our system leverages existing technologies and infrastructure, making it cost-effective and straightforward to implement. Overall, the Smart Parking Management System represents a paradigm shift in the way parking is managed and accessed in urban environments. By harnessing the power of technology, this project aims to optimize parking space utilization, reduce traffic congestion, enhance urban mobility, and promote environmental sustainability. Through collaboration with stakeholders and continuous innovation, we strive to create a smarter, more efficient, and user-friendly parking management solution for cities of the future.

1.1 OVERVIEW OF THE PROJECT

With a rapid increase in the vehicle usage in the recent past, finding and reaching a free parking slot has become time consuming and tedious, especially in the metro cities. This creates a necessity to introduce an automated system that allows users to book their spot just by making a few clicks! And with the advent of newer and newer technologies this has been made possible; with the help of a mobile-based app that helps you in locating a free parking slot and then guiding you all the way to the empty slot found, also eliminating the conventional physical currency payment; rather making the payment through an easy-to-use mobile application.

This project describes in detail how such a system can be implemented. It does not make use of any sophisticated devices or gadgets thereby ensuring it is economical to implement at a larger scale too! The prime aim of this research is to develop an application that allows the user to book a parking slot for him using his smart-phone and also make the payment online using internet banking. Besides this system would be very handy for large parking systems where it is difficult to locate the allotted slot; the user can see the shortest route to the allotted slot on the mobile app itself and hence reach there easily. The best part of the system lies in the fact that the entire system is connected to the cloud, so user can access the database, know the current status of the parking and book a slot for him accordingly from anywhere in the world. Also, the database keeps track of the frequent users and accordingly offers discounts and offers.

1.2 MOTIVATION OF THE PROJECT

The motivation behind the Smart Parking Management System project stems from the pressing need to address the pervasive challenges associated with parking in urban environments. As cities continue to grow and urbanization rates increase, the demand for parking spaces escalates, leading to congestion, pollution, and frustration among drivers. One of the primary motivations for this project is to alleviate the significant burden placed on urban infrastructure and transportation systems by inefficient parking management practices. Traditional parking systems often rely on manual processes, resulting in time-consuming searches for parking spaces and exacerbating traffic congestion. This not only contributes to environmental pollution but also poses safety risks and hampers overall urban mobility.

Moreover, the advent of new technologies, such as autonomous vehicles, IoT sensors, and predictive analytics, presents a unique opportunity to revolutionize parking management and enhance the urban mobility experience. The prospect of leveraging these technologies to develop an intelligent parking management system that streamlines the parking process, optimizes resource allocation, and improves operational efficiency is a compelling driving force behind this project. Furthermore, the motivation to develop the Smart Parking Management System also stems from

the desire to create sustainable and livable cities for future generations. By promoting the efficient use of parking spaces, reducing traffic congestion, and minimizing environmental impact, the project aligns with broader sustainability goals aimed at fostering greener, more resilient urban environments. Overall, the motivation for the Smart Parking Management System project lies in its potential to address critical urban challenges, leverage emerging technologies for positive societal impact, and contribute to the creation of smarter, more sustainable cities. Through innovation, collaboration, and a commitment to excellence, we aim to make significant strides towards enhancing the urban mobility experience and shaping the cities of tomorrow.

1.3 PROBLEM STATEMENT

In urban areas worldwide, parking congestion remains a significant challenge, leading to traffic congestion, air pollution, and wasted time for drivers. Traditional parking management systems often rely on manual processes, resulting in inefficiencies, inconsistencies, and frustrations for both drivers and operators. The lack of real-time information on parking availability exacerbates the problem, leading to prolonged search times and increased vehicle emissions. Furthermore, the exponential growth of urban populations and the proliferation of vehicles exacerbate the challenges associated with parking management. Limited parking spaces, inadequate infrastructure, and inefficient resource allocation further compound the issue, making it increasingly difficult to meet the parking needs of urban residents and visitors.

Moreover, the current approach to parking management fails to leverage advancements in technology, such as autonomous vehicles, IoT sensors, and predictive analytics, to address these challenges effectively. The absence of intelligent, data-driven solutions hampers efforts to optimize parking space utilization, reduce traffic congestion, and enhance urban mobility. Therefore, there is a pressing need to develop a Smart Parking Management System that leverages cutting-edge technologies to revolutionize parking management in urban areas. This system should provide real-time information on parking availability, streamline the

parking process, optimize resource allocation, and promote sustainability. By addressing these challenges, the Smart Parking Management System aims to enhance the urban mobility experience, alleviate congestion, and create more livable and sustainable cities for all stakeholders.

CHAPTER 2

LITERATURE SURVEY

**1. "Cross Platform Smart Reservation Based Parking System" Azhar Somani
Department of Computer Engineering, UCOE, Vasai, India; Shubham Periwai;
Kesha Patel; Pranit Gaikwad,2018.**

The Proposed system focuses on two sections, one the user side where amenities that are provided to the user and developer side who controls and monitors various sections of the system. Using sensors like UHF and Infrared, the accuracy of the parking is maintained and is updated on the server in Real-time. This is gradually decrease the traffic time and congestions simultaneously and helps to improve the surroundings. Making the city smart and in good condition. The future of the smart parking is expected to be significantly influenced by the arrival of automated vehicles.

**2. "IOT Based Smart Parking System With E-Ticketing" Chinnabattuni
Avinash; Gaddam Rohit; Chintakrindhi Rajesh; Aala Suresh; Sunil
Chinnadurai,2022.**

Designed a smart parking system using IoT with the help of RFID technology and making sure that it is user friendly. , Easy and fast E-ticketing process without any human intervention. , Displayed the vacant parking slot for the users. Proposed system: Ticketing done pre-parking via RFID cards for efficiency. E-Ticket sent to user's mobile with fare details. Blynk App displays parking slots, easing congestion and offering user-friendly access.

**3. "ParkSmart: Smart Parking Payment System" Wong Jin Wah; Sathiapriya
Ramiah; Intan Farahana Kamsin,2022.**

The paper examines parking challenges, current systems, and proposes smart solutions due to rising vehicle numbers, especially in dense cities. Utilizing questionnaires, researchers gauged existing system efficiency and acceptance levels towards a new smart parking approach. Analysis reveals positive responses, suggesting potential efficacy in addressing parking issues. The study provides

thorough research on project background, literature review, methodology, and results. Background study outlines project issues, while literature review offers diverse perspectives and system comparisons. Questionnaire-based data gathering facilitates understanding user opinions and experiences, with analysis guiding decision-making for project success.

4. "IoT Based Smart Parking System for Large Parking Lot" Manickam Ramasamy; Sunil Govinda Solanki; Elango Natarajan; Tham Mun Keat,2018.

This paper introduces an IoT-based smart parking system for urban areas facing limited parking spots. It utilizes a mobile application to guide users to available parking slots, aiming to reduce congestion. The cloud-based solution employs Internet of Things (IoT) technology to efficiently manage parking, improving overall system effectiveness. The IoT Smart Parking System efficiently manages parking by providing information on the nearest available slot, reducing congestion. Implementable in shopping malls, universities, or airports, it saves time for parking seekers. Future enhancements may include linking the mobile app to GPS for navigation and developing algorithms for pre-booking parking slots.

5. "Smart parking system with pre & post reservation, billing and traffic app" Gayatri N. Hainalkar; Mousami S. Vanjale,2017.

Smart parking enhances urban transportation efficiency and sustainability by leveraging technology to manage resources. This overview covers sensors, data analysis, occupancy detection, and dynamic pricing in smart parking systems, addressing implementation challenges and opportunities in various cities. It concludes by discussing the future of smart parking and its role in smart city development. Smart parking plays a crucial role in smart cities, integrating various sensors and technologies like machine learning to optimize limited parking resources. Historical development and case studies illustrate its benefits, though challenges such as privacy and security must be addressed for future studies in smart city planning.

2.1 EXISTING SYSTEM

The existing parking management systems typically rely on manual processes and traditional methods for monitoring and allocating parking spaces. These systems often involve physical attendants or signage to guide drivers to available spots, leading to inefficiencies, inaccuracies, and frustrations for both drivers and operators. Additionally, information on parking availability may not be readily accessible or updated in real-time, leading to time wasted in searching for parking and contributing to traffic congestion. Furthermore, conventional systems may lack the capability to analyze parking usage trends or provide comprehensive insights for optimizing resource allocation. Overall, the existing systems face limitations in terms of scalability, adaptability to dynamic parking demands, and enhancing the overall parking experience for users. Therefore, there is a clear need for a more innovative and technologically advanced solution like the Smart Parking Management System to address these shortcomings and revolutionize parking space utilization.

CHAPTER 3

AIM AND SCOPE

3.1 AIM

The aim of the Smart Parking Management System project is to revolutionize parking space utilization through the integration of autonomous vehicles, IoT sensors, and predictive analytics. By leveraging advanced technologies, the project seeks to provide drivers with real-time information about parking availability, thereby minimizing time wasted searching for parking and reducing traffic congestion. Additionally, the project aims to enhance overall efficiency and convenience by enabling drivers to plan ahead for parking and providing operators with comprehensive insights for better resource distribution and management. Ultimately, the project strives to optimize the use of parking spaces, improve urban mobility, and enhance the overall parking experience for drivers.

3.2 SCOPE

The scope of the Smart Parking Management System encompasses the development and implementation of an innovative solution that integrates autonomous vehicles, IoT sensors, and predictive analytics to optimize parking space utilization. The project will involve designing and deploying a fleet of autonomous vehicles equipped with advanced sensors for real-time data collection. Additionally, it will include the development of a user-friendly website and dashboard for accessing parking availability information. The system will utilize advanced algorithms to analyze past and present usage trends, enabling drivers to efficiently locate parking spaces and reducing traffic congestion. Furthermore, the project will focus on providing comprehensive insights for operators to enhance resource management and decision-making processes.

3.3 OBJECTIVE

The objectives of the Smart Parking Management System project are multi-faceted, aiming to address various challenges associated with parking in urban areas. Firstly, the project seeks to develop and deploy a fleet of autonomous vehicles equipped with advanced sensors and mapping technologies to continuously collect real-time

data on parking space availability. Secondly, it aims to create a user-friendly web platform that interacts with the central server to provide drivers with prompt and accurate information about available parking spaces. Thirdly, the project endeavors to employ advanced algorithms and predictive analysis to determine space availability based on past and present usage trends, events, and peak hours. Additionally, it aims to enhance overall efficiency and convenience for drivers by enabling them to plan ahead for parking. Moreover, the project strives to provide operators with comprehensive insights through a web-based dashboard for informed decision-making regarding resource distribution and management. Overall, the project aims to optimize parking space utilization, reduce traffic congestion, and improve the urban mobility experience.

CHAPTER 4

REQUIREMENT SPECIFICATION

4.1 HARDWARE SPECIFICATION

- Hard disk: 250GB or above
- Processor: i3 or above
- Ram: 4GB or above
- Arduino uno
- (20x4) Digital LCD display
- I2C LCD Module
- IR Sensor
- Mini Servo Motor SG-90
- (5v) 2Amp power adapter
- Female DC Power Jack
- Female Header

4.2 SOFTWARE SPECIFICATION

- Operating system: windows 7 or above (64bit)
- HTML
- CSS
- JAVASCRIPT
- C – PROGRAMMING
- ARDUINO – IDE

4.3 ADVANTAGES

Some advantages are:

- Real-time Information: Provides drivers with up-to-date information on parking space availability, reducing search time.
- Traffic Congestion Reduction: Efficiently guides drivers to available parking spaces, contributing to reduced traffic congestion.
- Optimal Resource Utilization: Utilizes advanced algorithms and predictive analytics to maximize parking space usage, improving resource efficiency.
- Enhanced Urban Mobility: Facilitates smoother traffic flow and quicker parking, enhancing overall urban mobility.
- Informed Decision-making: Empowers operators with comprehensive insights and analytics for better management and resource allocation.

- **Improved User Experience:** Offers a seamless and convenient parking experience for drivers, leading to increased satisfaction.
- **Environmental Benefits:** Reduces carbon emissions associated with circling for parking, contributing to environmental sustainability.
- **Scalability:** Can be scaled up to accommodate larger parking areas and increasing demand, ensuring adaptability to future needs.

4.4 DISADVANTAGES

- High initial investment costs.
- Technological dependencies pose risks of failures.
- Privacy concerns regarding location tracking.
- Accessibility challenges for users without smartphones or internet access.
- Susceptibility to cyberattacks and security breaches.

4.5 PROPOSED SYSTEM

The proposed Smart Parking Management System introduces a revolutionary approach to parking space management by leveraging cutting-edge technologies such as autonomous vehicles, IoT sensors, and predictive analytics. Unlike traditional systems, this proposed system operates autonomously, eliminating the need for manual intervention and providing real-time data on parking space availability. A fleet of autonomous vehicles equipped with advanced sensors continuously traverses the parking area, collecting and transmitting data to a central server.

A user-friendly web platform interacts with the server, allowing drivers to access up-to-date information on available parking spaces in their vicinity. Advanced algorithms and predictive analysis techniques are employed to forecast parking space availability based on historical data, events, and peak hours. This enables drivers to plan their parking in advance, reducing search time and alleviating traffic congestion.

Moreover, the proposed system includes a web-based dashboard for operators to access comprehensive insights and analytics. This empowers operators to make

informed decisions regarding resource allocation, optimizing parking space utilization and improving overall efficiency. By combining autonomous vehicles, IoT sensors, and predictive analytics, the proposed Smart Parking Management System offers a transformative solution to the challenges of parking management, enhancing urban mobility and the overall parking experience for drivers.

4.6 MODULE DESCRIPTION

- Registration
- Admin
- Availability status
- Web service

4.6.1 REGISTRATION

Initially, the user has to register his details with the application for the first time. This is a onetime registration. The user has to enter details like username, gender, phone number and email-id. All this data will be stored on server. Booking for slots mandatorily has to be done four hours prior to arrival.

4.6.2 ADMIN

Whenever a new user registers with the application, the record will be stored in the server-side database. When the registered user selects the location, immediately server receives the client's request. After receiving the request for the desired location, server processes the related information and responds accordingly. Furthermore, the administrator has direct option to view user details and slot details stored on the server direct via the application.

4.6.3 AVAILABILITY STATUS

Slots Based on the vehicle selected availability of the empty slots will be displayed along with the total slots reserved for that vehicle type. Color coding is used to indicate empty v/s reserved slots. Green indicates empty slots and Red indicates that currently there are no empty slots for reservation.

4.6.4 WEB SERVICE

Web service is like connecting android application and server. Server should run 24 hours and it has to give all the details to database which data's we are getting from users. Then using SOAP protocol, we can connect android application to server. If we are using SOAP protocol, it will collect all the details from android application and it will send to server.

4.7 ARCHITECTURE DIAGRAM

The architecture diagram for the Smart Parking Management System illustrates the system's components and their interactions. It typically includes autonomous vehicles equipped with sensors, IoT infrastructure for data transmission, a central server for data processing and storage, a user-friendly web platform for drivers, and a web-based dashboard for operators. The diagram visually represents how data flows from the vehicles to the server, is processed and analyzed, and then made accessible to users through the web platform. This architecture ensures real-time parking information is available to drivers while providing operators with insights for effective management.

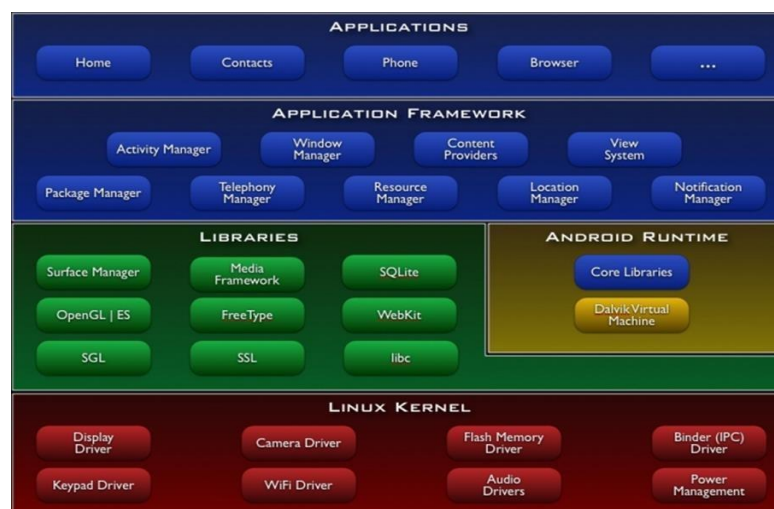


Fig. 4.1 Architecture of smart parking system

4.8 BLOCK DIAGRAM

User authentication is one of the prime factors of our Proposed system. To make sure the user is authentic; we will use their mobile numbers to register. As, we all know in Bangladesh, all the mobile numbers are being verified by the National ID. So, once the owners install the APK _les of the system to their Android phones, they need to register him with their phone numbers. After giving phone number, a 6digit code will be given to a user for further process. The user needs to add the other information like his/her name Email Address, Car Number, Parking Slot Number. A user can register himself as a car owner, a parking slot owner or both.

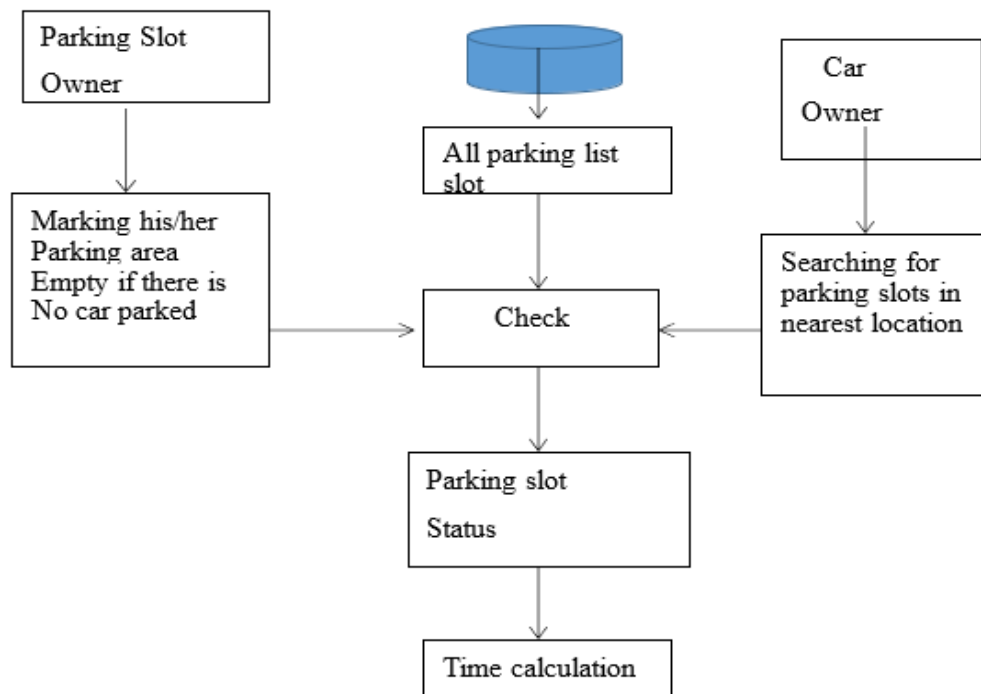


Fig. 4.2 Block diagram of the project

4.9 DATA FLOW DIAGRAM

LEVEL 1:

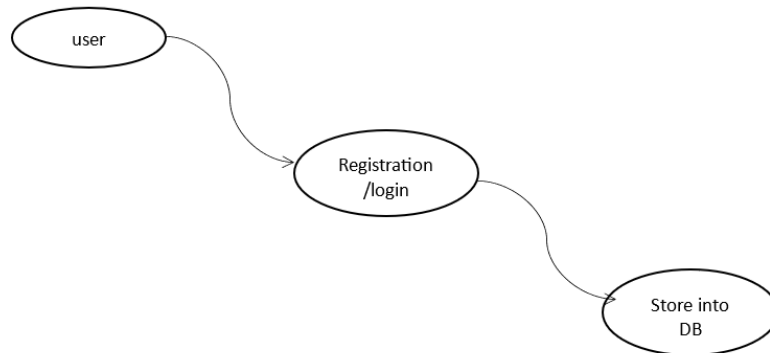


Fig 4.3 User side working diagram

LEVEL 2:

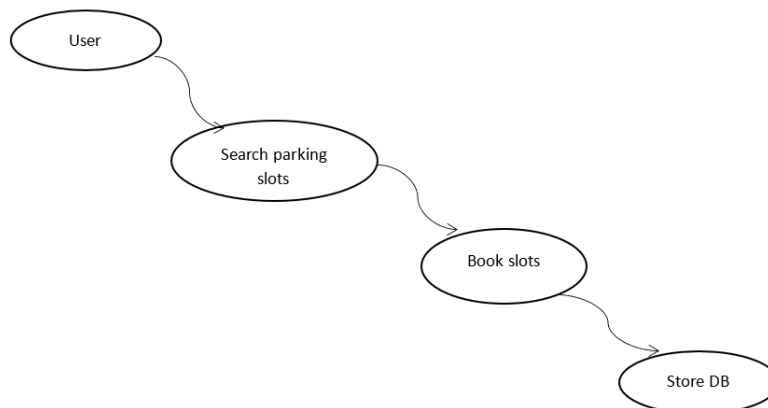


Fig. 4.4 User to process of booking slots

LEVEL 3:

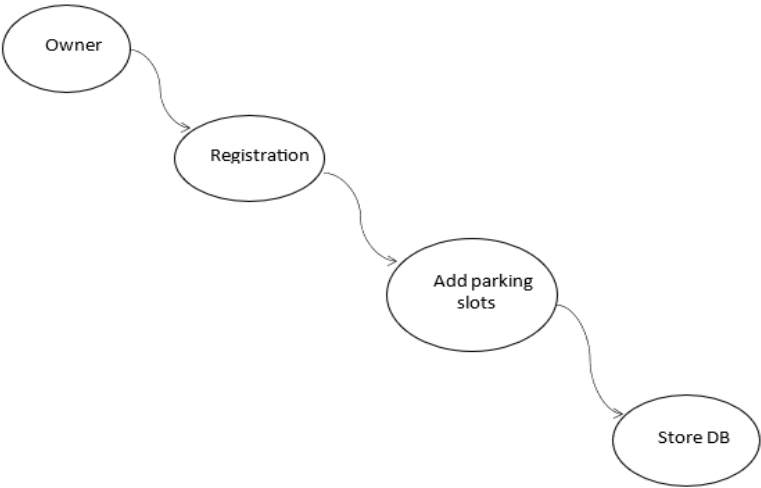


Fig. 4.5 Registration process

4.10 UML DIAGRAMS

4.10.1 USE CASE DIAGRAM

The use case diagram for the Smart Parking Management System illustrates the system's functionalities from the perspective of its users. Actors, such as "Driver" and "Parking Operator," interact with the system through various use cases. Key use cases include "Check Parking Availability," "Reserve Parking Spot," "View Parking History," and "Manage Parking Resources." These use cases represent the actions that users can perform within the system to achieve their goals, such as finding available parking spaces, making reservations, and accessing parking usage data. The use case diagram provides a clear overview of the system's features and user interactions, aiding in requirements analysis and system design.

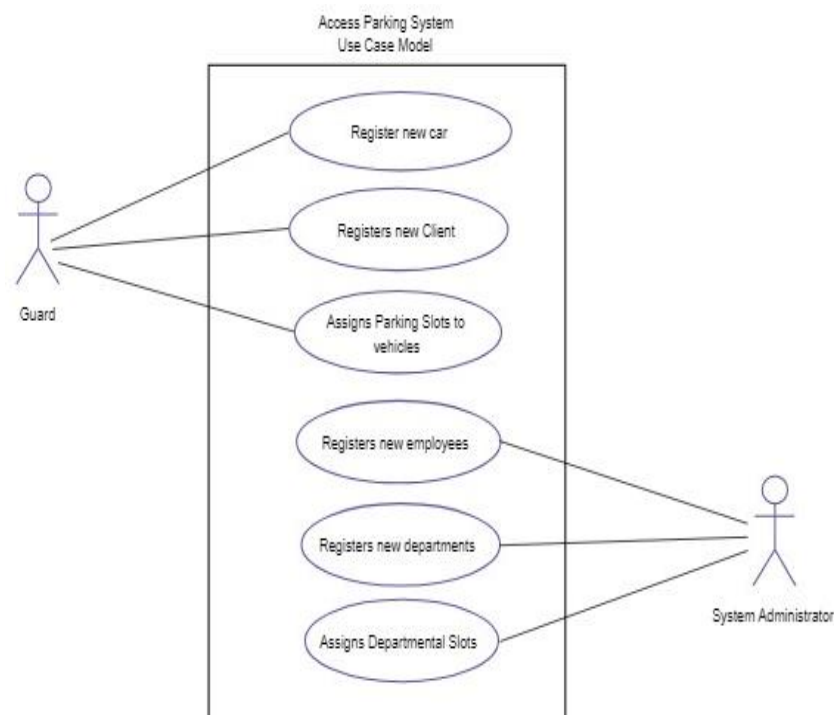


Fig. 4.6 Assigning slots Diagram

4.10.2 CLASS DIAGRAM

The class diagram for the Smart Parking Management System represents the system's structure by depicting classes, attributes, methods, and their relationships. Key classes include "AutonomousVehicle" with attributes such as "ID" and "Location," "ParkingSpace" with attributes like "ID" and "Availability," and "UserInterface" for interactions with drivers. Relationships such as "has-a" and "uses" illustrate how classes interact within the system. For instance, the "UserInterface" class may have associations with "AutonomousVehicle" and "ParkingSpace" classes to facilitate real-time data presentation to users. Overall, the class diagram provides a visual blueprint of the system's architecture, aiding in its design and implementation.

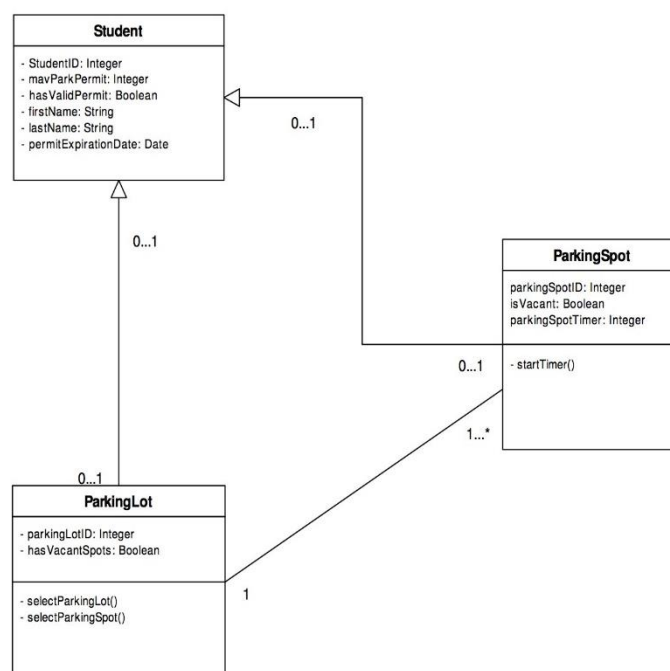


Fig. 4.7 Flowchart for class Diagram

4.10.3 SEQUENCE DIAGRAM

The sequence diagram for the Smart Parking Management System depicts the interactions between different components or objects in the system over time. It shows the flow of messages exchanged between these components to accomplish specific tasks or functionalities. For example, a sequence diagram might illustrate the process of a driver checking parking availability through the user interface. It would show the sequence of events, such as the user inputting their location, the system processing the request, querying available parking spaces, and returning the results to the user interface for display. This diagram helps visualize the dynamic behavior of the system and the sequence of actions involved in its operation.

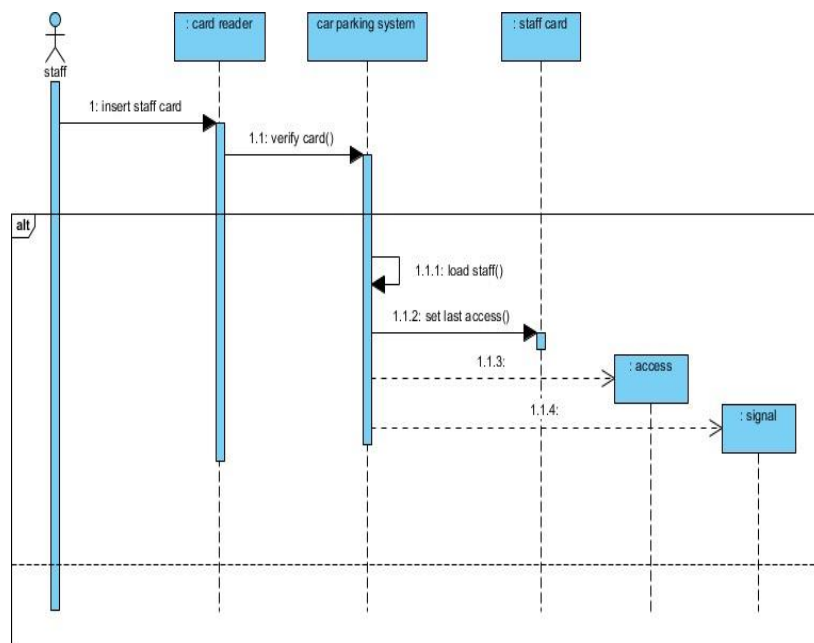


Fig. 4.8 Sequence diagram for smart parking system

4.11 SOURCE CODE FOR WEBSITE

```
<!DOCTYPE html>
<html lang="en">
<head>
<meta charset="UTF-8">
<meta name="viewport" content="width=device-width, initial-scale=1.0">
<title>Smart Parking Management System</title>
<style>
body {
  font-family: 'Arial', sans-serif;
  background-color: #1a1a1a;
  color: #ffffff;
  margin: 0;
  padding: 0;
  display: flex;
  justify-content: center;
  align-items: center;
  min-height: 100vh;
  overflow: hidden;
}

.container {
  background-color: rgba(0, 0, 0, 0.8);
  padding: 30px;
  border-radius: 20px;
  box-shadow: 0 0 20px rgba(255, 255, 255, 0.1);
  text-align: center;
  max-width: 1050px;
  height: auto;
  min-height: 550px;
  position: relative;
  overflow: hidden;
```

```
    position: relative;
}
```

```
h1 {
    font-family: 'Roboto', sans-serif;
    font-size: 36px;
    margin-bottom: 20px;
    letter-spacing: 3px;
    color: #fff;
}
```

```
.parking-slot {
    width: 150px;
    height: 40px;
    background-color: #1eb300;
    border: 3px solid #fff;
    margin: 20px;
    line-height: 20px;
    font-size: 18px;
    display: inline-block;
    position: relative;
    overflow: hidden;
    border-radius: 15px;
    cursor: pointer;
    transition: background-color 0.3s, border-color 0.3s;
}
```

```
.parking-slot:hover {
    background-color: #007bff;
    border-color: #007bff;
}
```

```
.parked {
```

```
background-color: #FFA200;
border-color: #FFA200;
}
```

```
.exit-block {
display: none;
position: absolute;
bottom: 20px;
right: 20px;
background-color: rgba(0, 0, 0, 0.8);
padding: 20px;
border-radius: 10px;
box-shadow: 0 0 10px rgba(255, 255, 255, 0.3);
}
```

```
.exit-button {
padding: 10px 20px;
border: none;
border-radius: 5px;
background-color: #dc3545;
color: #ffffff;
font-size: 16px;
cursor: pointer;
transition: background-color 0.3s;
margin-top: 20px; /* Adjust the margin-top value to move the button down */
}
```

```
.exit-button:hover {
background-color: #c82333;
}
```

```
.exit-matrix {
display: none;
```

```
position: absolute;
bottom: 60px;
right: 20px;
display: grid;
grid-template-columns: repeat(20, 1fr);
grid-template-rows: repeat(20, 1fr);
grid-gap: 5px;
width: 250px;
height: 250px;
z-index: 1;
}
```

```
.exit-slot {
background-color: #FFBF00;
border: none;
cursor: pointer;
}
```

```
.input-group {
margin-bottom: 20px;
display: flex;
flex-direction: column;
}
```

```
.input-group input {
padding: 10px;
width: calc(100% - 20px);
border: none;
border-radius: 5px;
background-color: #333;
color: #fff;
font-size: 16px;
}
```

```
.input-group input:focus {  
  background-color: #555;  
  outline: none;  
}
```

```
.input-group input::placeholder {  
  color: #888;  
}
```

```
.action-buttons {  
  display: flex;  
  justify-content: center;  
  align-items: center;  
  gap: 20px;  
}
```

```
.action-buttons button {  
  padding: 10px 20px;  
  border: none;  
  border-radius: 5px;  
  background-color: #007bff;  
  color: #fff;  
  font-size: 16px;  
  cursor: pointer;  
}
```

```
.action-buttons button:hover {  
  background-color: #0056b3;  
}
```

```
.action-buttons button:disabled {  
  background-color: #888;
```

```

    cursor: not-allowed;
}

.action-buttons button:disabled:hover {
    background-color: #888;
}

/* Digital display box styles */
.digital-display {
    width: 400px;
    height: 50px;
    background-color: #696969;
    border: 2px solid #fff;
    border-radius: 10px;
    margin: 20px auto;
    overflow: hidden;
    position: relative;
}

.digital-display-content {
    position: absolute;
    top: 50%;
    left: 50%;
    transform: translate(-50%, -50%);
    font-size: 24px;
    color: #fff;
    text-align: center;
    white-space: nowrap; /* Ensure text stays on a single line */
}
</style>
</head>
<body>

```

```

<div class="container">
<h1>Smart Parking Management System</h1>

<div id="parking-status">
<div class="parking-slot empty" onclick="toggleParkingSlot(0)">Slot 1</div>
<div class="parking-slot empty" onclick="toggleParkingSlot(1)">Slot 2</div>
<div class="parking-slot empty" onclick="toggleParkingSlot(2)">Slot 3</div>
<div class="parking-slot empty" onclick="toggleParkingSlot(3)">Slot 4</div>
<div class="parking-slot empty" onclick="toggleParkingSlot(4)">Slot 5</div>
<div class="parking-slot empty" onclick="toggleParkingSlot(5)">Slot 6</div>
</div>

<div class="car-details" style="display: none;">
<div class="input-group">
<input type="text" id="car-brand" placeholder="Car Brand"
onkeydown="if(event.keyCode==13) document.getElementById('car-
model').focus();">
</div>
<div class="input-group">
<input type="text" id="car-model" placeholder="Car Model"
onkeydown="if(event.keyCode==13) document.getElementById('car-
number').focus();">
</div>
<div class="input-group">
<input type="text" id="car-number" placeholder="Car Number"
onkeydown="if(event.keyCode==13) enterCar();">
</div>
<div class="action-buttons">
<button onclick="enterCar()">Enter</button>
</div>
</div>

<div class="exit-block" id="exitBlock">

```

```

<div class="exit-matrix">
  <button class="exit-slot" onclick="exitParking(0)">S1</button>
  <button class="exit-slot" onclick="exitParking(1)">S2</button>
  <button class="exit-slot" onclick="exitParking(2)">S3</button>
  <button class="exit-slot" onclick="exitParking(3)">S4</button>
  <button class="exit-slot" onclick="exitParking(4)">S5</button>
  <button class="exit-slot" onclick="exitParking(5)">S6</button>
</div>

<button class="exit-button" onclick="hideExitBlock()">Close Exit</button>
</div>

<button class="exit-button" onclick="showExitBlock()">Click Here to Exit</button>

<!-- Digital display box -->
<div class="digital-display">
  <div class="digital-display-content" id="digitalDisplayContent">
    Choose your slot
  </div>
</div>

</div>

<script>
var parkingStatus = [0, 0, 0, 0, 0, 0]; // 0 indicates empty, 1 indicates parked
var selectedSlotIndex = -1; // Initialize selected slot index to -1, indicating no slot
selected initially

function updateParkingStatus() {
  var parkingSlots = document.querySelectorAll('.parking-slot');
  for (var i = 0; i < parkingStatus.length; i++) {
    if (parkingStatus[i] === 1) {
      parkingSlots[i].classList.add('parked');
    } else {

```

```

parkingSlots[i].classList.remove('parked');
}
}
}

```

```

function toggleParkingSlot(index) {
  selectedSlotIndex = index; // Update the selected slot index
  if (parkingStatus[index] === 0) {
    document.querySelector('.car-details').style.display = 'block';
    document.querySelector('.action-buttons').style.display = 'flex';
    document.getElementById('car-brand').focus();
  }
}

```

```

function enterCar() {
  var carBrand = document.getElementById("car-brand").value.trim();
  var carModel = document.getElementById("car-model").value.trim();
  var carNumber = document.getElementById("car-number").value.trim();
  if (carBrand === "" || carModel === "" || carNumber === "") {
    alert("Please enter car brand, model, and number.");
    return;
  }
}

```

```

if (selectedSlotIndex !== -1) {
  parkingStatus[selectedSlotIndex] = 1;
  updateParkingStatus();
  var slotElement = document.querySelectorAll('.parking-slot')[selectedSlotIndex];
  slotElement.textContent = carBrand + " " + carModel;
  var carNumberElement = document.createElement('div');
  carNumberElement.textContent = "(" + carNumber + ")";
  carNumberElement.style.fontSize = '14px';
  carNumberElement.style.color = '#ccc';
  slotElement.appendChild(carNumberElement);
}

```

```

slotElement.classList.add('parked');
document.querySelector('.car-details').style.display = 'none';
document.querySelector('.action-buttons').style.display = 'none';
document.getElementById('car-brand').value = "";
document.getElementById('car-model').value = "";
document.getElementById('car-number').value = "";
selectedSlotIndex = -1; // Reset selected slot index after entering car details
document.getElementById('digitalDisplayContent').textContent = 'Thank you for
choosing';
setTimeout(function() {
document.getElementById('digitalDisplayContent').textContent = 'Choose your slot';
}, 3000); // Revert back to default message after 3 seconds
} else {
alert("Please select a parking slot.");
}
}

```

```

function showExitBlock() {
document.getElementById('exitBlock').style.display = 'block';
document.getElementById('digitalDisplayContent').textContent = 'Choose your slot
I\'D to exit';
}

```

```

function hideExitBlock() {
document.getElementById('exitBlock').style.display = 'none';
document.querySelector('.exit-button').style.display = 'block'; // Show the exit button
document.getElementById('digitalDisplayContent').textContent = 'Choose your slot';
}

```

```

function exitParking(index) {
parkingStatus[index] = 0;
updateParkingStatus();
var slotElement = document.querySelectorAll('.parking-slot')[index];

```

```
slotElement.textContent = 'Slot ' + (index + 1);  
}  
</script>  
  
</body>  
</html>
```

SOURCE CODE FOR ARDUINO

```
#include <Servo.h> //includes the servo library

#include <Wire.h>

#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x27, 20, 4); // Adjust parameters based on your LCD size

Servo myservo;


#define ir_enter 11

#define ir_back 12

#define ir_car1 5

#define ir_car2 6


#define ir_car3 7

#define ir_car4 8

#define ir_car5 9

#define ir_car6 10


int S1 = 0, S2 = 0, S3 = 0, S4 = 0, S5 = 0, S6 = 0;

int flag1 = 0, flag2 = 0;

int slot = 6;


void setup(){
```

```
Serial.begin(9600);

pinMode(ir_car1, INPUT);

pinMode(ir_car2, INPUT);

pinMode(ir_car3, INPUT);

pinMode(ir_car4, INPUT);

pinMode(ir_car5, INPUT);

pinMode(ir_car6, INPUT);

pinMode(ir_enter, INPUT);

pinMode(ir_back, INPUT);


myservo.attach(3);

myservo.write(90);


lcd.init(); // Initialize the LCD

lcd.backlight(); // Turn on backlight


lcd.setCursor(0, 1);

lcd.print("  Car parking ");

lcd.setCursor(0, 2);

lcd.print("    System    ");

delay(2000);

lcd.clear();
```

```
Read_Sensor();

int total = S1 + S2 + S3 + S4 + S5 + S6;

slot = slot - total;

}
```

```
void loop(){

  Read_Sensor();


  lcd.setCursor(0, 0);

  lcd.print(" Available Slots: ");

  lcd.print(slot);

  lcd.print("  ");


  lcd.setCursor(0, 1);

  if(S1 == 1){lcd.print("S1:Fill ");}

  else{lcd.print("S1:Empty");}


  lcd.setCursor(10, 1);

  if(S2 == 1){lcd.print("S2:Fill ");}

  else{lcd.print("S2:Empty");}
```

```
lcd.setCursor(0, 2);

if(S3 == 1){lcd.print("S3:Fill ");}

else{lcd.print("S3:Empty");}
```

```
lcd.setCursor(10, 2);

if(S4 == 1){lcd.print("S4:Fill ");}

else{lcd.print("S4:Empty");}
```

```
lcd.setCursor(0, 3);

if(S5 == 1){lcd.print("S5:Fill ");}

else{lcd.print("S5:Empty");}
```

```
lcd.setCursor(10, 3);

if(S6 == 1){lcd.print("S6:Fill ");}

else{lcd.print("S6:Empty");}
```

```
if(digitalRead(ir_enter) == 0 && flag1 == 0){

    if(slot > 0){

        flag1 = 1;

        if(flag2 == 0){

            myservo.write(180);

            slot = slot - 1;
```

```

    }

    } else {

        lcd.setCursor(0, 0);

        lcd.print(" Sorry Parking Full ");

        delay(1500);

    }

}

if(digitalRead(ir_back) == 0 && flag2 == 0){

    flag2 = 1;

    if(flag1 == 0){

        myservo.write(180);

        slot = slot + 1;

    }

}

if(flag1 == 1 && flag2 == 1){

    delay(1000);

    myservo.write(90);

    flag1 = 0;

    flag2 = 0;

}

```

```
    delay(10001);  
}  
  
void Read_Sensor(){  
    S1 = 0, S2 = 0, S3 = 0, S4 = 0, S5 = 0, S6 = 0;  
    if(digitalRead(ir_car1) == 0){S1 = 1;}  
    if(digitalRead(ir_car2) == 0){S2 = 1;}  
    if(digitalRead(ir_car3) == 0){S3 = 1;}  
    if(digitalRead(ir_car4) == 0){S4 = 1;}  
    if(digitalRead(ir_car5) == 0){S5 = 1;}  
    if(digitalRead(ir_car6) == 0){S6 = 1;}  
}
```

CHAPTER 5

RESULTS AND DISCUSSION

5.1 RESULTS

5.1.1 BRIEF EXPLANATION OF HARDWARE WORKING

The Smart Parking System utilizing Arduino, IR sensors, and an LCD display provides efficient management of parking spaces by offering real-time availability information to users. The system employs IR sensors strategically placed in parking spots to detect the presence of vehicles. When a vehicle enters or leaves a spot, the corresponding sensor relays this information to the Arduino microcontroller.

The Arduino processes this data and updates the status of the parking spot, displaying it on the LCD screen. Users can easily identify available parking spots through the displayed information, reducing the time spent searching for parking.

One significant result of this project is the optimization of parking space utilization. By providing real-time information about available spots, the system minimizes the time spent circling around parking lots, ultimately reducing traffic congestion and fuel consumption.

Additionally, the Smart Parking System enhances user convenience and satisfaction by offering a hassle-free parking experience. Users can quickly locate vacant spots without the frustration of aimlessly searching.

Moreover, this project serves as a prototype for scalable smart parking solutions that can be implemented in various settings such as shopping malls, office complexes, and urban areas, contributing to improved urban mobility and efficiency. Overall, the Smart Parking System showcases the practical application of Arduino and sensor technology in enhancing everyday experiences.

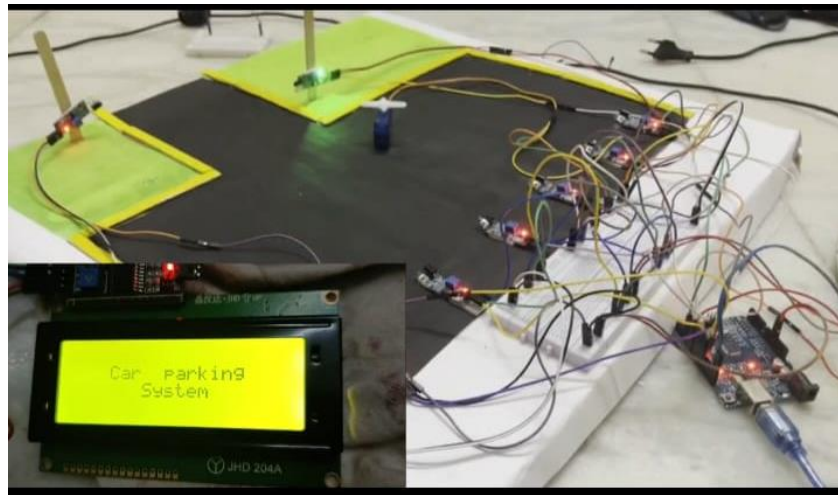


Fig. 5.1 Displaying the parking system

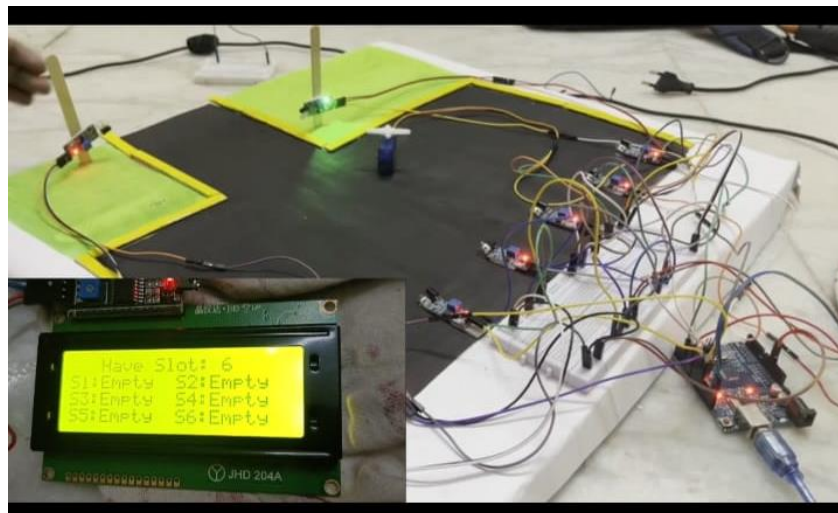


Fig. 5.2 Result for Displaying empty slots

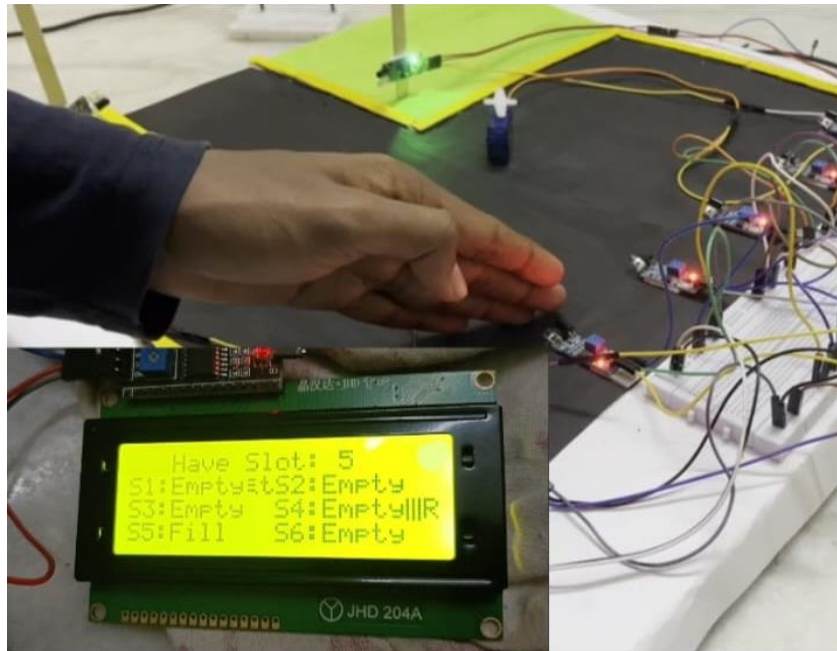


Fig. 5.3 Result for displaying Filled slots

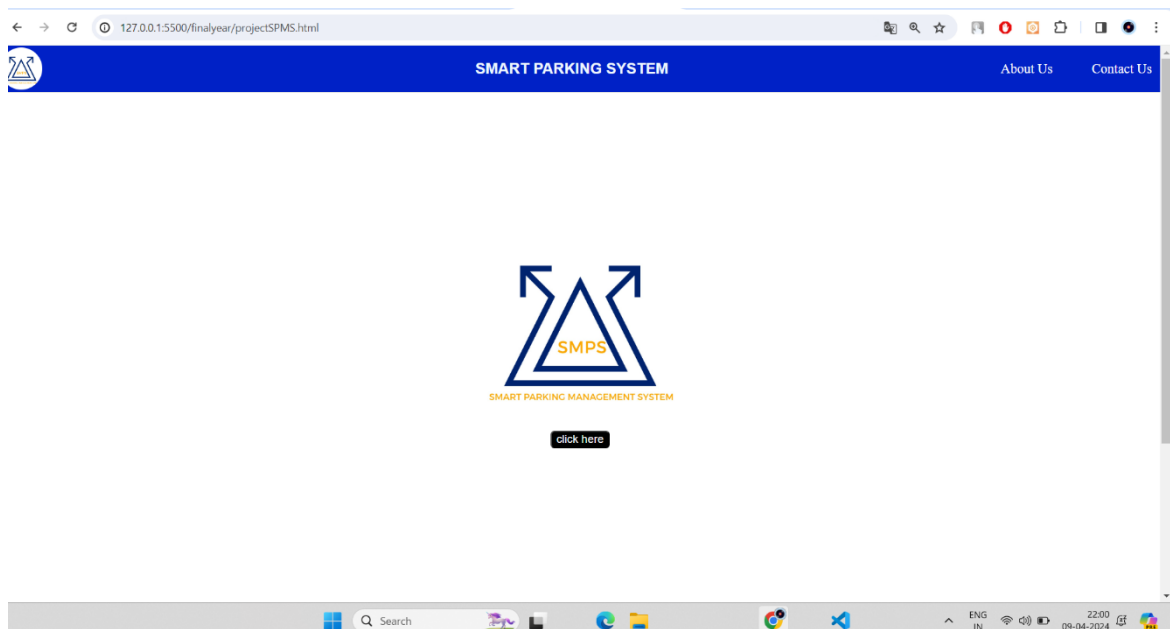


Fig. 5.4 Website for Smart Parking First Page



Fig.5.5 Page for assigning slot to the vehicle



Fig. 5.6 Webpage which shows way for the slot

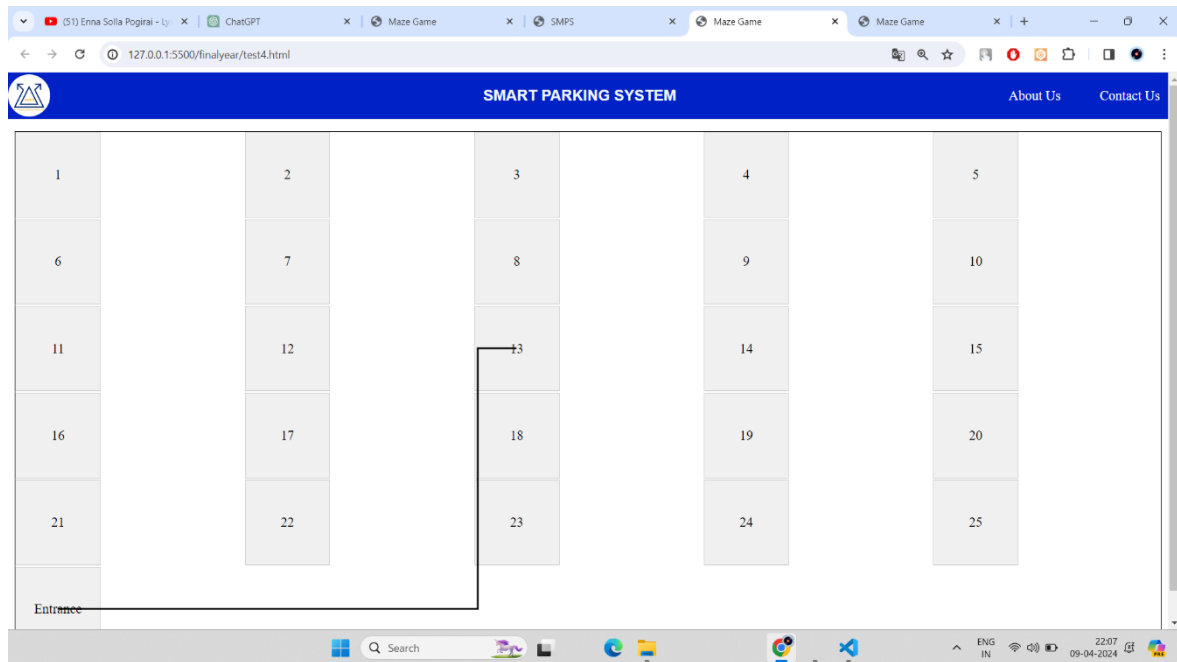


Fig. 5.7 Map while returning to the slot

5.1.2 BREIF EXPLANATION OF WEBSITE WORKING

ENTRANCE AND PATHFINDING:

The inclusion of `<div class="cell entrance">Entrance</div>` designates the starting point for users entering the parking lot. When a user clicks on a parking space (cell), the JavaScript function `drawLineAroundCells()` is invoked to visually depict the path from the entrance to the selected parking space. This simulates the pathfinding process that drivers undertake to locate an available parking spot within the parking lot.

VISUALIZATION OF PARKING AVAILABILITY:

By extending the code to incorporate dynamic updates of cell colors or visual indicators (such as icons) to denote the availability of parking spaces, the system can provide real-time information to users regarding vacant parking spots. This visual representation enhances user experience by enabling users to quickly identify and navigate to available parking spaces, reducing the time spent searching for parking.

INTEGRATION WITH BACKEND SYSTEMS:

To operationalize the smart parking system, it must be integrated with backend systems. These backend systems typically comprise sensors installed in parking spaces to detect occupancy, a database to store parking availability data, and APIs to facilitate communication between the frontend interface and the backend infrastructure. Integration with backend systems enables the frontend interface to display accurate and up-to-date information on parking space availability to users.

USER INTERFACE ENHANCEMENTS:

Further enhancements to the user interface can include features such as filtering parking spaces by availability (e.g., displaying only vacant spaces), providing navigation instructions to guide users to available parking spots efficiently, and implementing responsive design principles to ensure compatibility across various devices. These enhancements contribute to an intuitive and user-friendly interface, enhancing user satisfaction and usability.

DATA ANALYTICS AND OPTIMIZATION:

The data collected from the smart parking system, including information on parking space occupancy and user interactions, can be subjected to data analytics techniques to identify patterns and trends. Analysis of this data can yield insights into peak usage times, popular parking areas, and traffic flow patterns within the parking lot. These insights can inform decision-making processes related to parking lot layout optimization, traffic management strategies, and dynamic pricing mechanisms, ultimately improving overall system efficiency and user experience.

CHAPTER 6

CONCLUSION AND FUTURE ENHANCEMENT

6.1 CONCLUSION

In this project , an application-based parking reservation system, revolutionizing parking space utilization. By harnessing autonomous vehicles, IoT sensors, and predictive analytics, our system optimizes resource allocation, reduces traffic congestion, and enhances urban mobility. Users benefit from streamlined parking slot reservation, facilitated by features like locating the nearest available spot and QR code scanning for consistency. The integration of an online payment gateway eliminates manual intervention, rendering the system truly automated. Furthermore, our solution proves cost-effective and straightforward to implement, circumventing the need for expensive hardware. This underscores its viability as a practical and accessible solution for modern parking management challenges, demonstrating the transformative potential of technology in enhancing the urban landscape.

6.2 SUMMARY

6.2.1 STANDARDS

Smart parking management systems adhere to a variety of standards to ensure seamless operation and compatibility across different components. Interoperability standards like OCPP and MQTT facilitate communication among various parts of the system, ensuring efficient coordination. Sensors utilized for vehicle detection typically conform to standards such as IEEE 802.15.4 or LoRaWAN, enabling reliable data collection. Data exchange follows protocols like JSON or XML, while API standards like RESTful APIs or GraphQL facilitate interaction between software components. Security standards such as TLS encryption and OAuth authentication safeguard data privacy and system integrity. Accessibility standards like WCAG and ADA ensure inclusivity for all users. Geospatial standards such as GeoJSON and WGS84 aid in representing and processing location data. User interface design principles outlined in ISO 9241 guide the creation of intuitive interfaces. Compliance with regulations like GDPR and ADAAG ensures legal and ethical operation. Finally, adherence to environmental standards promotes sustainability in deployment and

operation. By integrating these standards, smart parking systems can deliver optimal performance while meeting regulatory requirements and user needs.

6.2.2 CONSTRIANTS

The implementation of a smart parking management system is constrained by various factors that impact its design, deployment, and operation. Financial limitations dictate the available resources and may influence technology choices and project scope. Technical constraints encompass compatibility issues with existing infrastructure, sensor limitations, and network connectivity challenges. Space constraints, such as parking space availability and zoning regulations, shape the system's physical deployment. Data privacy and security constraints mandate compliance with regulations and the implementation of robust security measures. Integration challenges arise from the need to interface with existing systems and ensure interoperability with other smart city initiatives. User acceptance constraints necessitate the system's alignment with user needs and preferences to ensure adoption. Operational constraints include maintenance requirements, reliability, scalability, and energy efficiency considerations. Environmental constraints emphasize the need to minimize environmental impact and promote sustainability. Regulatory compliance constraints encompass adherence to local laws, building codes, and standards. Lastly, stakeholder management constraints involve addressing the expectations and requirements of various stakeholders, including government agencies, businesses, residents, and community groups, throughout the project lifecycle. Effective management of these constraints is vital for the successful implementation and operation of a smart parking management system.

6.1.3 TRADE OFFS

Balancing cost with features is crucial, deciding between investing in advanced functionalities or sticking to a budget-friendly approach. Choosing between high-accuracy but expensive sensors and lower-cost alternatives affects the system's precision and cost-effectiveness. Scalability considerations need to be weighed against system complexity, determining how expandable the system needs to be without overly complicating its structure. Ensuring user privacy while collecting

sufficient data for optimization poses a challenge, requiring careful data handling measures. Enhancing user experience with real-time information must be weighed against the infrastructure needed to support it. Reliability considerations must balance cost with the risk of downtime and user dissatisfaction. Deciding between customization and standardization affects system complexity and adaptability. Energy efficiency optimizations must be balanced with performance requirements to meet user demand without excessive energy consumption. Integrating with other initiatives offers enhanced functionality but adds complexity and potential dependencies. Finally, allocating resources for ongoing maintenance versus initial implementation affects the system's long-term viability. By considering these trade-offs, stakeholders can make informed decisions to create an effective smart parking management system tailored to their needs and constraints.

6.3 FUTURE ENHANCEMENT

Future works for the Smart Parking Management System could focus on further enhancing its capabilities and addressing emerging challenges in parking management. One avenue for improvement could involve integrating machine learning algorithms to continuously optimize parking space allocation based on real-time data and user preferences. Additionally, incorporating advanced sensor technologies, such as lidar or radar, could improve the accuracy of parking space detection and increase the system's reliability in complex environments. Furthermore, exploring the integration of alternative transportation modes, such as electric vehicle charging stations or bike-sharing services, could expand the system's utility and promote sustainable urban mobility. Overall, future developments in the Smart Parking Management System should prioritize innovation, sustainability, and scalability to meet the evolving needs of urban transportation.

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