A Mini Project Report on

Smart Parking System

B.E. - I.T   Engineering

Submitted By

Harmi Mathukiya	**21104044**
Avantika More	**21104033**
Atharva Mohape	**21104121**

Under The Guidance Of

Prof.Selvin Furtado

DEPARTMENT OF INFORMATION TECHNOLOGY

A.P.SHAH   INSTITUTE OF TECHNOLOGY

G.B. Road,Kasarvadavali, Thane (W), Mumbai-400615

UNIVERSITY OF MUMBAI

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CERTIFICATE

This to certify that the Mini Project report on **Smart Parking System** has been submitted by Harmi Mathukiya(21104044), Avantika More(21104033) and Atharva Mohape(21104121) who are a bonafide students of A. P. Shah Institute of Technology, Thane, Mumbai, as a partial fulfilment of the requirement for the degree in **Information Technology**, during the academic year **2024-2025** in the satisfactory manner as per the curriculum laid down by University of Mumbai.

Prof. Sonal Jain
Subject In-charge

Prof. Kiran Deshpande
Head Department of
Information Technology

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Chapter 1

Introduction

As urban populations continue to grow, the demand for efficient parking solutions has become increasingly critical. Traditional parking systems often struggle with issues such as limited space, time-consuming searches for available spots, and inefficient payment processes. A smart parking system leverages advanced technologies like IoT, mobile applications, and data analytics to address these challenges. By utilizing real-time data to monitor parking availability, these systems provide drivers with instant information about vacant spaces, enabling them to save time and reduce frustration. Additionally, smart parking solutions can help optimize the use of existing parking facilities, thereby reducing traffic congestion and contributing to a more sustainable urban environment.

The integration of smart parking technologies not only enhances the convenience for drivers but also offers significant benefits for city planners and parking facility operators. With features such as automated payment systems, digital signage, and predictive analytics, smart parking systems streamline the overall parking experience while enabling better management of parking resources. Moreover, the data collected from these systems can be analyzed to gain insights into parking patterns, peak usage times, and overall demand, allowing for informed decision-making regarding urban planning and resource allocation. As cities continue to evolve, adopting smart parking solutions will be essential in creating efficient, user-friendly environments that cater to the needs of both residents and visitors.

In addition to enhancing convenience and efficiency, smart parking systems contribute to environmental sustainability by reducing the carbon footprint associated with vehicle emissions. By minimizing the time drivers spend searching for parking, these systems decrease unnecessary idling and congestion, leading to lower air pollution levels. Furthermore, many smart parking solutions incorporate eco-friendly practices, such as promoting electric vehicle (EV) charging stations and incentivizing the use of alternative transportation modes. As cities strive to become more sustainable, the implementation of smart parking technologies will play a vital role in creating greener urban landscapes and improving the overall quality of life for their inhabitants.

Chapter 2

Review Of Literature

Title	Author	Year	Description
Smart Parking System Based on Internet of Things (IoT) Technology	A. Sharma, R. Sharma, & S. Sharma	2022	This paper presents a comprehensive overview of smart parking systems leveraging IoT technology. The authors explore various algorithms used for parking space detection and occupancy prediction, emphasizing the benefits of real-time data processing and user convenience.
An Intelligent Parking Management System Using Machine Learning Techniques	Y. Zhang, H. Li, & K. Chen	2023	This paper proposes an intelligent parking management system that employs machine learning algorithms for predicting parking space availability. The study includes a performance analysis of various machine learning techniques, demonstrating the system's ability to enhance user experience by minimizing search times for available parking.
Smart Parking Solutions: A Survey of Technologies, Challenges, and Future Directions	L. K. Singh, R. Kumar, & P. Patel	2023	This survey examines the technological landscape of smart parking solutions, detailing the various technologies employed, including IoT, AI, and data analytics. The paper also discusses future trends, such as the integration of autonomous vehicles,etc.

Chapter 3

Problem Statement

The rapid growth of urban populations and the corresponding increase in vehicle ownership have led to significant challenges in parking management. Traditional parking systems often result in inefficient use of space, increased traffic congestion due to drivers searching for parking spots, and heightened frustration among users. This situation not only affects individual drivers but also contributes to broader issues such as environmental pollution and urban traffic jams.

a. Motivation:

The motivation for developing a smart parking system lies in the need to address these pressing urban challenges effectively. By leveraging advanced technologies such as IoT, machine learning, and real-time data analytics, a smart parking solution can optimize parking space utilization, reduce the time spent searching for available spots, and improve overall user satisfaction. Additionally, implementing such a system can lead to decreased traffic congestion, reduced carbon emissions, and enhanced urban mobility, ultimately contributing to the sustainability and livability of cities.

b. Objectives:

1. To provide users with real-time information about available parking spaces, thereby significantly reducing the time spent searching for a spot.
2. To automate the payment process for parking reservations, enhancing convenience and streamlining the user experience.
3. To develop a user-friendly mobile application that facilitates easy reservations, status updates, and notifications, ensuring a seamless user experience.
4. To decrease traffic congestion in urban areas by optimizing parking space usage, ultimately contributing to smoother traffic flow and improved urban mobility.

Chapter 4

System Architecture

a. State Diagram/Worflow:

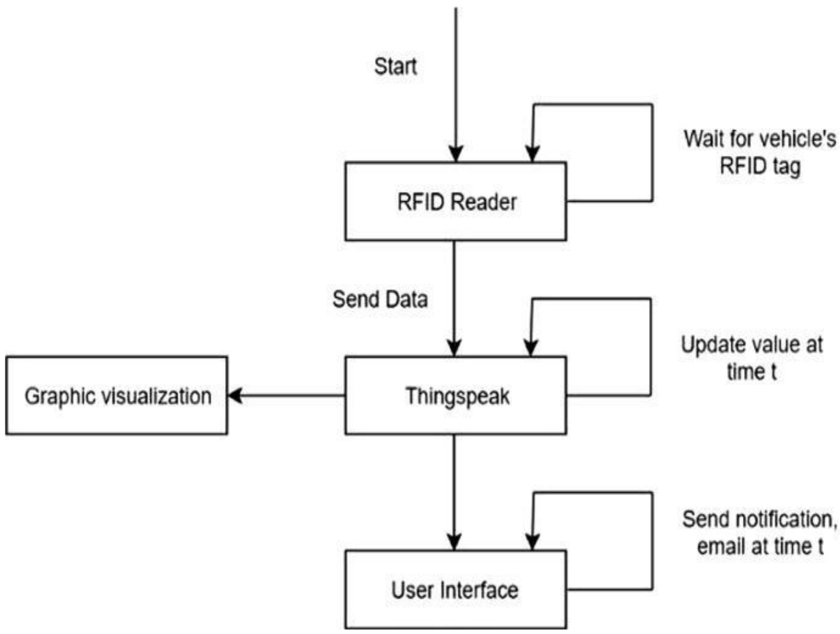

Figure 4.1.a : Smart Parking System

b. Circuit Diagram:

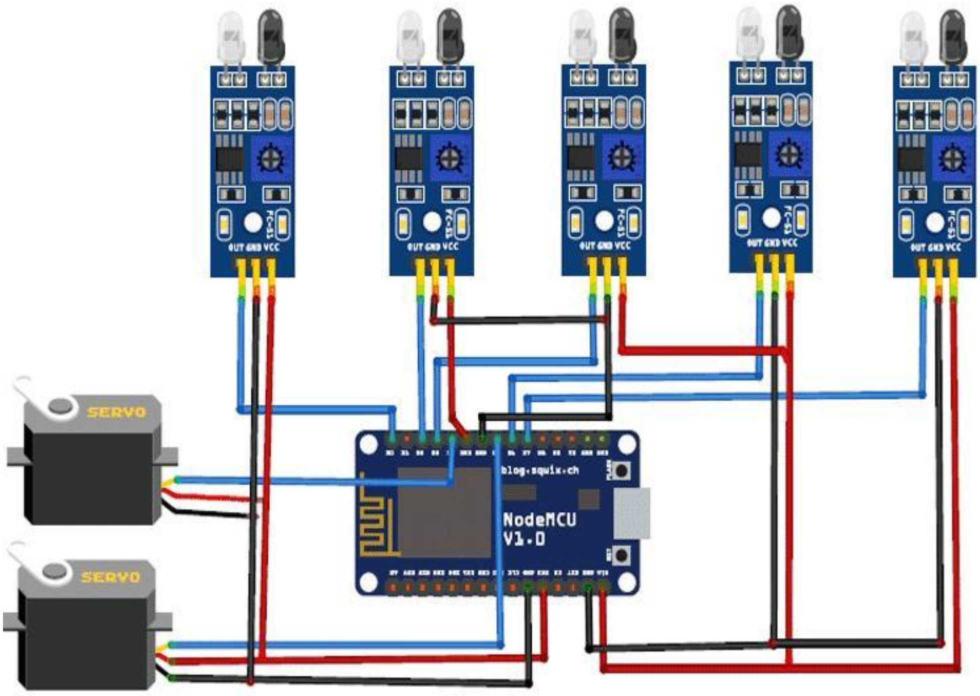

Figure 4.1.b : Circuit Diagram

Chapter 5

Project Timeline

Sr no.	Work to be done	Duration
1.	Literature Review and Documentation	10th August to 30th August
2.	Completion of Hardware	1st September to 20th September
3.	Working on dashboard	21st September to 10th October
4.	Integration of IoT model with Website (Through HTML,CSS)	11th October 30th October

Chapter 6

Implementation

a. Hardware and Software Requirements:

Hardware Requirements

a. NodeMCU ESP8266

b. IR Sensor (5)

c. Servo Motor (2)

d. Breadboard

e. Male-to-male connectors

Software Requirements

a. ThingSpeak

b. Arduino IDE

c. Principle and Working of Project:

Code:

```
#include <ESP8266WiFi.h>

#include <Servo.h>

// WiFi credentials (if required for ThingSpeak)

const char* ssid = "abhishekmore";

const char* password = "8652681877";
```

}

```
// Servo objects for controlling barriers
Servo servo1; // Servo for Slot 1
Servo servo2; // Servo for Slot 2
// IR sensor pins
const int irPin1 = D1; // IR sensor for Slot 1
const int irPin2 = D2; // IR sensor for Slot 2
// Servo signal pins
const int servoPin1 = D6; // Servo 1 signal pin
const int servoPin2 = D7; // Servo 2 signal pin
void setup() {
 // Initialize serial communication
 Serial.begin(115200);
// Set up Wi-Fi connection (if using ThingSpeak)
  WiFi.begin(ssid, password);
  while (WiFi.status() != WL_CONNECTED) {
    delay(1000);
    Serial.println("Connecting to WiFi...");
  }
  Serial.println("Connected to WiFi");
// Attach servos to NodeMCU pins
  servo1.attach(servoPin1); // Attach Servo 1 to D6
  servo2.attach(servoPin2); // Attach Servo 2 to D7
// Set IR sensor pins as input
  pinMode(irPin1, INPUT);
  pinMode(irPin2, INPUT);
}
```

```
void loop() {
  // Read IR sensor values (detect whether slot is occupied)
  int slot1Occupied = digitalRead(irPin1);
  int slot2Occupied = digitalRead(irPin2);
// Control Servo 1 based on Slot 1 occupancy
  if (slot1Occupied == LOW) {
    // Slot 1 is occupied, close the barrier (set servo to 0 degrees)
    servo1.write(0);
    Serial.println("Slot 1: Occupied - Barrier Closed");
  } else {
    // Slot 1 is available, open the barrier (set servo to 90 degrees)
    servo1.write(90);
    Serial.println("Slot 1: Available - Barrier Open");
  }
 // Control Servo 2 based on Slot 2 occupancy
  if (slot2Occupied == LOW) {
    // Slot 2 is occupied, close the barrier (set servo to 0 degrees)
    servo2.write(0);
    Serial.println("Slot 2: Occupied - Barrier Closed");
  } else {
    // Slot 2 is available, open the barrier (set servo to 90 degrees)
    servo2.write(90);
    Serial.println("Slot 2: Available - Barrier Open");
  }
// Wait for a short time before the next update
  delay(2000);
```

}

Working of the project:

Parking Slot Monitoring (IR Sensors and NodeMCU)

IR Sensors: Each parking slot has an Infrared (IR) sensor installed. These sensors are used to detect whether a parking spot is occupied or free. When a car is parked in the spot, the sensor detects the presence of the vehicle.

NodeMCU (ESP8266): The NodeMCU is a Wi-Fi-enabled microcontroller that reads the input from the IR sensors. It acts as the main controller that collects the sensor data and sends it to the cloud for storage and further processing.

Data Transmission to Cloud (ThingSpeak)

Wi-Fi Connectivity: The NodeMCU is connected to the internet via Wi-Fi. Using its wireless connectivity, it sends the sensor data to a cloud platform.

Thing Speak: In this project, the **ThingSpeak** platform is used as the cloud service. The sensor data from the NodeMCU is transmitted to ThingSpeak, where it is stored and visualized. The data is sent using HTTP requests (GET/POST) that communicate with ThingSpeak's REST API.

Real-Time Data Processing

Data Visualization on ThingSpeak: ThingSpeak receives the data (whether a parking spot is occupied or free) and updates the corresponding fields in real-time. ThingSpeak allows users to create visual dashboards that display the parking space status (e.g., green for free, red for occupied).

Alerts/Notifications: If needed, the system can be extended to send notifications or alerts via email or SMS to inform drivers about parking availability using services like IFTTT (If This Then That) integrated with ThingSpeak.

Actuation (Servo Motors for Barrier Control)

Servo Motors: If your system includes automated barriers for controlling vehicle entry, servo motors can be connected to the NodeMCU. Based on the parking spot availability, the servo motors are actuated to raise or lower the barrier.

Parking Slot Allocation: If a vehicle enters and a free slot is detected, the servo motor can be activated to open the barrier automatically, granting access to the parking lot.

User Interface (Mobile/Web App)

Real-Time Parking Availability: The system can be extended to a mobile app or web application where users can view the real-time status of parking spaces. The data stored on ThingSpeak can be fetched using API calls to display the parking availability on the user interface.

Booking/Reservation (Optional): Additional features can be implemented to allow users to book or reserve parking slots in advance through the app.

Chapter 7

Conclusion

The development of a smart parking system presents a transformative approach to urban parking challenges, addressing the pressing issues of traffic congestion and inefficient use of parking spaces. By leveraging real-time data and advanced technologies, the system can significantly streamline the parking process, providing users with timely information on available spots and facilitating hassle-free reservations and payments. This not only enhances user satisfaction but also contributes to a more organized and efficient urban environment. Moreover, with the integration of mobile applications, users are empowered with tools that enable them to navigate the parking landscape with ease, thus fostering a more sustainable urban ecosystem.

Furthermore, the smart parking system serves as a vital resource for urban planners and policymakers by generating valuable data on parking trends and behaviors. This data can inform strategic decisions, leading to better allocation of resources and infrastructure improvements that cater to the evolving needs of the city. As cities continue to grow and evolve, embracing smart technologies like the proposed parking system will be essential in creating livable, efficient, and environmentally friendly urban spaces. Ultimately, the successful implementation of this system has the potential to revolutionize parking management, improve urban mobility, and enhance the overall quality of life for residents and visitors alike.

Future Scope

The future of smart parking systems is poised for significant advancements, driven by ongoing technological developments and the increasing demand for sustainable urban solutions. One of the primary areas of growth is the integration of artificial intelligence (AI) and machine learning algorithms, which can further enhance the system's ability to predict parking availability based on historical data and real-time patterns. This predictive capability could enable users to plan their trips more efficiently and reduce the time spent searching for parking. Additionally, the incorporation of Internet of Things (IoT) devices can facilitate seamless communication between vehicles, parking infrastructure, and mobile applications, allowing for a more connected and user-centric experience.

Moreover, as cities continue to explore smart city initiatives, smart parking systems can evolve to include features such as dynamic pricing based on demand, integration with public transportation options, and automated parking solutions. These advancements can optimize space utilization and enhance overall traffic management. Furthermore, collaboration with electric vehicle (EV) charging networks can make smart parking areas more attractive to EV users, promoting sustainable transportation choices. As the landscape of urban mobility continues to change, the future of smart parking systems will likely include innovative features that not only improve parking efficiency but also contribute to broader environmental goals and smart city frameworks. This holistic approach will ensure that smart parking systems remain relevant and beneficial in the years to come, creating a more sustainable and efficient urban environment.

References

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