Smart Parking System Using IoT

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Team ID	**670**
Team Name	**Proj_223439_Team_2**
Project Name	**Smart Parking System Using IoT**

Problem Statement:

Objective: Develop a IOT model that can provide parking slots in nearby area with a high level of accuracy.

Problem Identified:

A smart parking system is an advanced technology-driven solution designed to optimize and enhance the parking experience for both drivers and parking facility operators. It utilizes various senors to collect data, cameras, hardware and software to efficiently manage parking spaces, provide real-time information to drivers, and streamline the overall parking process**.**

Introduction:

In response to the growing challenges of urban congestion and limited parking availability, our project, the "Smart Car Parking System using IoT," aims to revolutionize the way we approach parking in urban areas. This innovative system leverages Internet of Things (IoT) technology to create a practical and efficient solution for both drivers and city planners.

Our project begins by addressing the core issue of parking space management in urban environments. Finding a parking spot in a crowded city can be a time-consuming and frustrating experience. Traditional parking systems often lack the flexibility and real-time information that modern urban dwellers need. To tackle this problem, we turn to IoT, a technology that offers the promise of smart, data-driven parking solutions.

Our smart car parking system focuses on a well-structured process that spans from sensor deployment and data collection to real-time monitoring and user-friendly applications. We employ a network of sensors and IoT devices to track parking space availability and provide users with up-to-the-minute information on open spots. The ultimate goal is to create a system that not only reduces traffic congestion but also enhances the overall parking experience for drivers.

In the following sections, we will delve into the intricacies of our project, describing the methods, IoT devices, and data analytics tools we utilize to build a robust and efficient smart car parking system. We aim to address a pressing issue in urban transportation, making cities more livable and accessible for everyone.

LITERATURE SURVEY

1. Iot Based Smart Parking System, P. Sesha Sravani, P. Pushpa Rani, B. Satyanarayana, M. Venkat, D. Venkata Ramana [2022]

Nowadays, finding a secure parking lot in modern cities deemed as very hard and time-consuming task. Leaving negative implications on traffic congestion, air pollutions, climate changes, etc. are also creating difficult situations to find the secure parking lot on required time. Thus, Smart Parking System (SPS) deemed inevitable option to solve those issues and build a comprehensive smart transportation system. Toward this end, this paper aims to design a secure and smart parking monitoring, controlling and management solutions based on the integration of Sensors, Network (WiFi) and Internet of Things (IoT). The proposed model provides real-time information about detecting the vacant parking slot in real time. In this project we will use Infrared Sensors to detect the parking lot is empty or not? We will use automatic gate at the entrance to detect the vehicle and any parking slot is empty or available then only the gate will be open. If no slots are available then the gate won't open and the alarm will sound. The data will be updated to the web portal using WiFi module. From anywhere in the world, if we have internet connection, we can monitor the parking slots availability through internet connectivity. This project focuses on implementation of car parking place detection using internet of things. The system benefits of smart parking go well beyond avoiding time wasting. Developing a smart parking solutions with in a city solves the pollution problem. The concepts of smart cities have always been a dream. There have been advancements made from the past couple of years to make smart city dream to reality. The advancement of internet of things and cloud technologies has given rise to the new possibilities in terms of smart cities. Smart parking facilities have always been the core of constructing smart cities. The system provides a real time process and information of the parking slots. This paper enhances the performance of saving users time to locate an appropriate parking space. It helps to resolve the growing problem of traffic congestion. As for the future work the users can book a parking space from a remote location.GPS, reservation facilities and license plate scanner can be included in the future.

2. Iot Based Smart Parking System, Yashwant Gowda, Venkatesh B, Pavan U, Sanjay L [2022]

These technologies include RFID controllers, RFID readers, RFID writers, RFID barcode readers, and RFID smart sensors. In this study, a technological fix for the issues with parking management systems was offered RFID. The major RFID technology components include RFID readers, RFID tags, computers, barriers, and software. Parking lots spread throughout the city were administered using the program for management, control, transaction reporting, and operation. Use of RFID readers, tags, and barriers will be used to regulate check-in and check-out procedures. These technological advancements will result in a huge decrease in staff costs. It will be feasible to observe unattended, secure, and atomized parking lots using RFID technology in the future. To prevent problems with traffic jams during check-in and check-out, these processes will be completed rapidly without requiring the automobiles to stop. Traffic

lights won't require drivers to stop, and parking penalties will be invalid when guests check in and out. Additionally, issues with ticket stuffing won't arise with ticket processing devices. Faster traffic will be feasible since vehicle owners won't have to pay every time they leave, and since there won't be any lines at check-in and check-out, gas formation resignation won't occur. A more advanced and quick parking system has been designed in place of parking cars on the streets. The many systems that are based on the parking system are being observed in this study. After reviewing the study papers, we found that we wanted to create a smart parking system with suitable identification and authorisation. The system requires IOT (Internet of Things), the fastest-growing technology.

3. Iot Based Smart Parking System, Joel Charles, Aniket Dhage, Gayatri Bodele, Trupti Bargat [2022]

The objective of this project, titled "SMART PARKING SYSTEM USING IOT," is to provide automobile owners with access to cost-free parking places while lowering traffic. Rapid urbanization creates issues for cities. By using RFID technology, an early slot reservation option, and a modern smart parking website, this problem can be resolved. An ESP WROOM 32 microcontroller is used to control every aspect of the smart parking system's operation. To determine if a vehicle is in or out of the slot, sensors that employ infrared can be used. Smart parking involves utilizing low-cost sensors, real-time data, and software that enables users to keep track of available and unavailable parking spaces. The goal is to automate and reduce the amount of time spent manually searching for the ideal parking floor, spot, or even lot. Users can monitor content availability and unavailability The networking of physical objects with electronics built into their design in order to communicate and detect interactions with one another or the world around them is known as the Internet of Things (IOT). Future IOT-based technologies will offer more sophisticated services and fundamentally change how individuals go about living their daily lives. This can be observed in a variety of fields, including advances in medicine, technology, gene therapies, agriculture, smart cities, and smart homes. By establishing our smart parking system in significant cities, we can double the organization's earnings. Keeping track of all parking activity is incredibly easy for the end users. The approach we propose provides real-time information on the number of parking spots that are open at a parking facility.

4. Iot Based Smart Parking System, Dr V Sindhu, Jaanvi, Vishal kumar singh, Maroof Hassan Khan, [2023]

A multi-level parking system that uses real-time data from cameras and sensors to guide vehicles to available parking spaces was proposed by Huang et al. (2019). Quantity and placement of sensors, communication protocols, and user interface design are some of the aspects to take into account while creating a smart parking system. In order to improve the placement of sensors in a parking lot, Wang et al. (2020) suggested a novel sensor placement technique that makes use of a genetic algorithm. As compared to conventional sensor placement techniques, the proposed strategy produced a parking system that was more precise and effective, according to this study. The number of vehicles is rising along with the population, which is doing so quickly every day. Therefore, the main issue brought on by the

rise in vehicles in major cities is traffic congestion. The purpose of this paper is to use IoT to find a solution to the parking system's problem. In search of a vacant space in a designated parking area, the user typically wastes his time and effort. In this paper, we present an Internet of Things (IoT) based car parking system that makes use of a variety of sensors, cameras, and communication tools to show drivers available parking spaces and provide real-time information on their location. The user receives the parking information via notification. As a result, the user's waiting time while looking for a parking spot is minimized. Better environmental sustainability, less congested traffic, and more efficient use of parking spaces may be the outcomes of the implementation of smart parking systems using IoT technology. Because this topic has so much potential for the future of urban transportation, we should expect to see continued growth and innovation over the next years.

5. Iot Based Smart Parking System, Kirubhakaran T, Sabarish K, Nishanth KS Nithish kumar S [2020]

Since there are few parking spaces available and a high level of traffic congestion in this area, there is a low demand from customers. Smart parking is a good example of how the Internet of Things (IoT) will be widely adopted in our daily living environments to different users; as a result, the proposed idea is to make parking easier by detecting and monitoring, security, locating, and reserving parking lots using IoT, then displaying the result. The automatic parking system control by using codes is the foundation of an Arduino Mega, with affordable and effective technology. The smart parking system's suggestion is to use a website to find out about available parking spaces, reserve them, and tag them. When a vehicle enters that specific parking space, the sensor picks up the information and sends it to the parking lot's main gate, where it is then displayed on an LCD and the tag is scanned by an RFID tag reader. Therefore, that specific vehicle gets inspected and parked in that specific lot. The Node MCU, which works with the Arduino IDE software, enables the development of straightforward yet effective programs for WIFI modules in IoT products. The key benefits include cost effectiveness, security control, and a reduction in parking time. Parking in populated areas has become challenged, so requirement of smart technologies in order to assist the user in finding parking solutions to shorten the time necessary for parking. In this way we can decrease the traffic congestion, and to improve the everyday life of parking solutions.

Design and Innovation Strategies

Sensor Selection and Placement:

Innovation: Use advanced sensors such as ultrasonic or infrared sensors to accurately detect vehicle presence and occupancy.

Action: Strategically place sensors in parking spaces to cover the entire parking area,

ensuring minimal blind spots**.**

IoT Hardware and Connectivity:

Innovation: Utilize low-power IoT devices with long battery life to reduce maintenance overhead.

Action: Choose wireless communication protocols like LoRaWAN or NB-IoT for efficient data transmission between sensors and the central system.

Resilience and Redundancy:

Innovation: Design the system with redundancy in mind, including backup power sources, multiple data paths, and failover mechanisms.

Action: Conduct regular maintenance and testing to ensure the system's reliability during emergencies.

Predictive Analytics:

Innovation: Incorporate machine learning algorithms to predict parking space availability based on historical data and trends.

Action: Develop predictive models that consider factors like time of day, day of the week, and special events.

Reservation System:

Innovation: Implement a dynamic pricing model that adjusts parking rates based on demand and availability.

Action: Enable users to reserve parking spaces in advance through the mobile app, ensuring a guaranteed spot.

Data Visualization and Reporting:

Innovation: Develop interactive dashboards with data visualization tools like Power BI or Tableau for parking operators to monitor and analyze trends.

Action: Provide detailed reports on parking utilization, revenue, and user behavior.

Scalability and Modular Design:

Innovation: Build a modular system that allows for easy scalability by adding more sensors and parking lots as needed.

Action: Use standardized interfaces and protocols to facilitate the integration of new components and expansion into different locations.

Project Overview

1. Optimizing Parking Space Management:

The primary objective of this project is to develop a smart parking system that efficiently manages and optimizes parking spaces in urban areas. This includes reducing congestion, minimizing the time it takes for drivers to find parking, and maximizing space utilization.

2. Real-Time Parking Information:

Implementing a network of IoT sensors and devices to collect real-time data on parking space availability. This data will be accessible to drivers through mobile apps, websites, and digital displays, enabling them to locate and reserve parking spots conveniently.

3. Traffic Flow Improvement:

By reducing the time spent searching for parking, this system contributes to improved traffic flow and reduced emissions, making urban areas more sustainable and eco-friendlier.

4. Enhanced User Experience:

Creating a user-friendly interface that allows drivers to effortlessly find, reserve, and pay for parking spaces through mobile apps or web platforms.

5. Data Analytics and Insights:

Utilizing data analytics to gain insights into parking patterns, usage trends, and peak hours, which can inform urban planning and optimize resource allocation.

IoT Device Setup

IoT devices play a crucial role in a smart parking system by providing real-time data on parking space availability and enabling various functionalities. Here are some of the key IoT devices commonly used in a smart parking system:

Components:

1.Arudino Board
2. Servo Motor (my servo1)
3. Smoke Detector
4. Buzzer
5. Liquid Crystal Display (16*12C)

Steps:

1. ARUDINO BOARD:

Connection:

This is not explicitly mentioned in the code, but the code is written for an Arduino board. The specific model is not mentioned, but it's assumed to be an Arduino board.

2. SERVO MOTOR:

Connection:

A servo motor is connected to pin 3 on the Arduino. It's used to control a barrier or gate in the parking system.

3. SMOKE DETECTOR:

Connection:

The smoke detector input is connected to pin 6 on the Arduino. This pin is used to interface with the smoke detector and detect the presence of smoke or smoke-related signals.

4. BUZZER:

Connection:

A buzzer is connected to pin 7 on the Arduino. It's used to produce an audible alert in case of smoke detection.

5. LIQUID CRYSTAL DISPLAY

Connection:

This display is connected to the Arduino via I2C communication with the address 0x27. It's used to show messages such as "ARDUINO" and "PARKING SYSTEM."

Platform Development

Software component:

1. Web Interface:

- HTML: Create an HTML file for the user interface to interact with the smart parking system.

- JavaScript: Utilize JavaScript to handle user interactions, request parking information, and display real-time data updates.

2. Cloud Platform:

Utilize a cloud-based platform to store, process, and analyze the data collected by IoT devices. Choose a cloud provider like Amazon Web Services (AWS), Google Cloud Platform (GCP), or Microsoft Azure for scalable and secure data management.

Hardware component:

1. IoT Devices and Sensors:

- Deploy IoT sensors (e.g., ultrasonic, magnetic, camera-based) to monitor parking space occupancy.

- Use IoT development platforms like Raspberry Pi or Arduino for sensor integration.

2. Communication:

- Establish communication protocols, such as LoRa, Wi-Fi, or cellular networks, to connect IoT devices to the server.

3. Sensor Data Transmission:

- Send sensor data (parking space occupancy, availability) from IoT devices to the server for real-time updates.

Overall workflow:

1. User Interfaces:

- Users interact with the HTML interface to access parking information, make reservations, and process payments.

- JavaScript handles user inputs, sends requests to the server, and updates the UI with parking data.

2.ESP32:

Receives commands from the server, controls the fountain components, and sends sensor data to the server.

3. Server:

- The server communicates with IoT devices, processes user requests, and manages the parking system.

- It also stores and analyzes data collected from sensors.

4. IoT Devices:

IoT devices receive commands from the server, control access to parking spaces, and send real-time sensor data.

Code Implementation

Source Code:

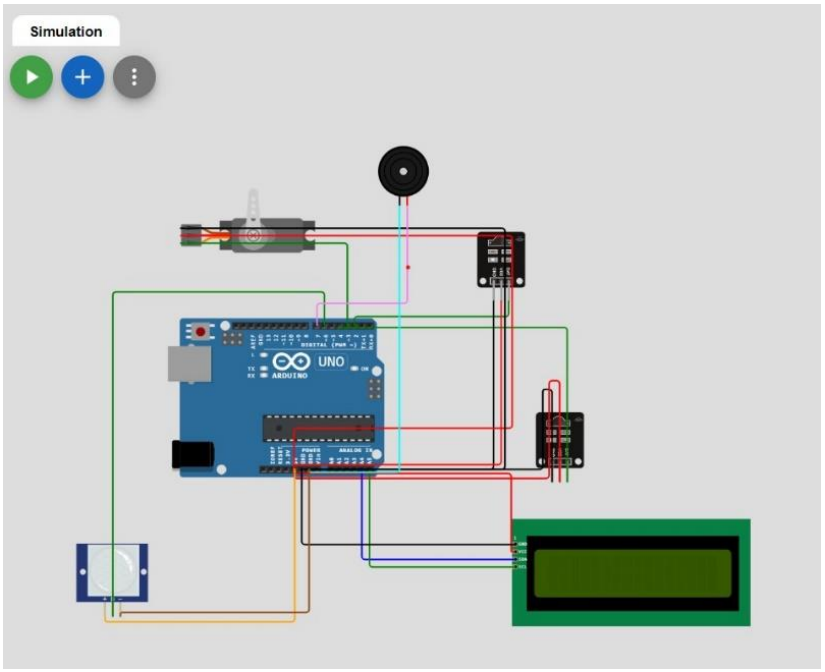
```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd (0x27, 16, 2);

#include <Servo.h>
Servo myservo1;

int IR1 = 2;
int IR2 = 4;
```

```
int SmokeDetectorPin = 6;
int BuzzerPin = 7;
int Slot = 4;

bool flag1 = false;
bool flag2 = false;

unsigned long lastLcdUpdate = 0;
unsigned long lcdUpdateInterval = 1000;

void setup () {
  lcd. begin (16, 2);
  lcd. backlight ();
  pinMode (IR1, INPUT);
  pinMode (IR2, INPUT);
  pinMode (SmokeDetectorPin, INPUT);
  pinMode (BuzzerPin, OUTPUT);

  myservo1.attach(3);
  myservo1.write(100);

  lcd. setCursor (0, 0);
  lcd.print ("     ARDUINO    ");
  lcd. setCursor (0, 1);
  lcd.print (" PARKING SYSTEM ");
  delay (2000);
  lcd. clear ();

  Serial.begin(9600);
}

void loop () {
  if (digitalRead (IR1) == LOW &&! flag1) {
    if (Slot > 0) {
      flag1 = true;
      if (! flag2) {
        myservo1.write(0);
        Slot--;
      }
    } else {
      displayMessage ("    SORRY :(    ", “Parking Full “);
    }
  }

  if (digitalRead (IR2) == LOW &&! flag2) {
    flag2 = true;
    if (! flag1) {
      myservo1.write(0);
```

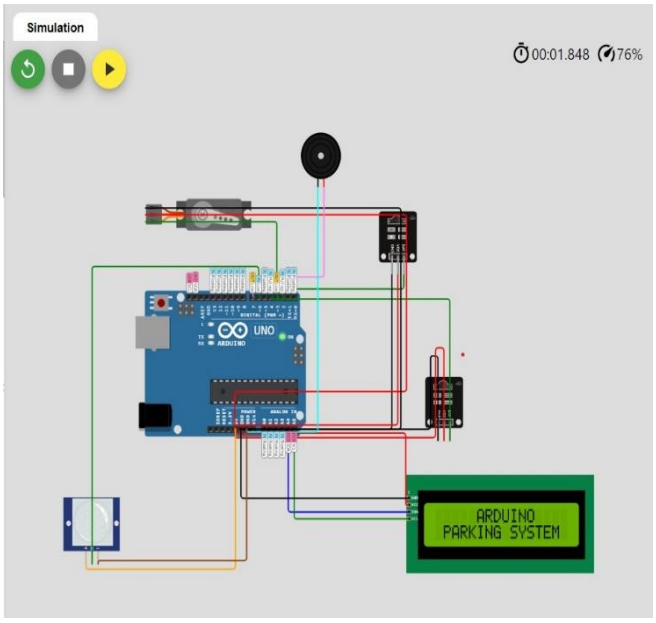
```
      Slot++;
    }
  }

  if (flag1 && flag2) {
    delay (1000);
    myservo1.write(100);
    Serial.println("Servo returned to initial position.");
    flag1 = false;
    flag2 = false;
  }

  if (millis () - lastLcdUpdate >= lcdUpdateInterval) {
    updateLcdDisplay ();
    lastLcdUpdate = millis ();
  }
}

void updateLcdDisplay () {
  if (digitalRead (SmokeDetectorPin) == HIGH) {
    displayMessage ("   WARNING!   ", " Smoke Detected ");
    digitalWrite (BuzzerPin, HIGH);
  } else {
    displayMessage ("    WELCOME!    ", "Slot Left: " + String (Slot));
    digitalWrite (BuzzerPin, LOW);
  }
}
void displayMessage (const char *line1, const String &line2) {
  lcd. clear ();
  lcd. setCursor (0, 0);
  lcd.print(line1);
  lcd. setCursor (0, 1);
  lcd.print(line2);
}
```

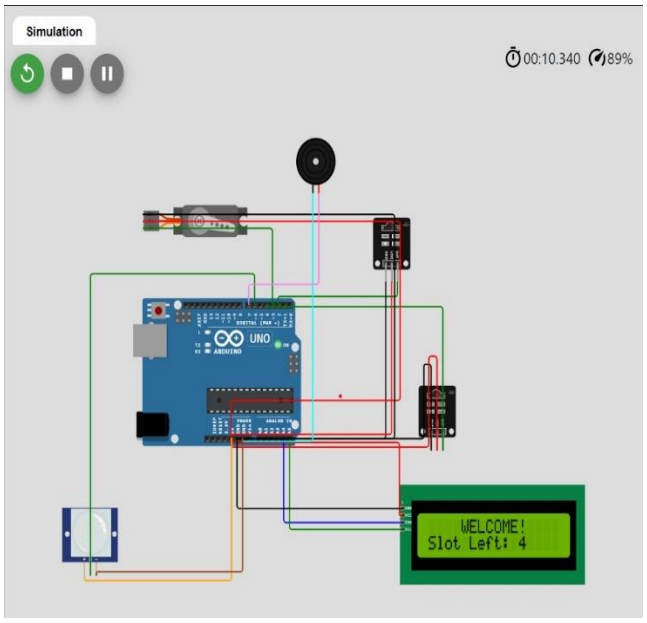
Circuit Diagram:

Before simulation:



After Simulation:





Web Development Platform:

Html:

<!DOCTYPE html>

<html>

```
<head>
  <link rel="stylesheet" type="text/css" href="style.css">
</head>
<body>
  <div class="container">
    <h1 class="title">Parking System</h1>
    <div class="parking-info">
      <p>Slots Left: <span id="slotCount">0</span></p>
    </div>
    <div class="sensors">
      <div class="sensor">
        <p>IR Sensor 1</p>
        <button id="irSensor1Button" class="sensor-button">Vacant</button>
      </div>
      <div class="sensor">
        <p>IR Sensor 2</p>
        <button id="irSensor2Button" class="sensor-button">Vacant</button>
      </div>
    </div>
    <div class="smoke-sensor">
      <p>Smoke Detector</p>
      <button id="smokeSensorButton" class="sensor-button">OK</button>
    </div>
  </div>
  <script src="script.js"></script>
</body>
</html>
```

Css:

```
body {
  font-f
amily: Arial, sans-serif;
}
```

```
.container {
  text-align: center;
  margin: 20px;
}
. title {
  font-size: 24px;
}
. parking-info {
  font-size: 18px;
}
. sensors {
  display: flex;
  justify-content: space-around;
  margin-top: 20px;
}
. sensor {
  border: 1px solid #333;
  padding: 10px;
  margin: 10px;
}
. sensor-button {
  width: 100px;
  height: 40px;
  background-color: lightgreen;
  font-size: 16px;
  cursor: pointer;
}
. smoke-sensor {
  margin-top: 20px;
}
. sensor-button. ok {
  background-color: lightgreen;
}
. sensor-button. alert {
```

```
background-color: red;
}
```

Javascript:

```
let slotCount = 0;
let irSensor1Occupied = false;
let irSensor2Occupied = false;
let smokeDetectorOk = true;
function updateDisplay () {
  document. getElementById("slotCount"). textContent = slotCount;
  document. getElementById("irSensor1Button"). textContent = irSensor1Occupied? "Occupied”: "Vacant";
  document. getElementById("irSensor2Button"). textContent = irSensor2Occupied? "Occupied”: "Vacant";
  document. getElementById("smokeSensorButton"). className = smokeDetectorOk? "Sensor-button ok”: "sensor-button alert";
  document. getElementById("smokeSensorButton"). textContent = smokeDetectorOk? "OK”: "Smoke Detected";
}
document. getElementById("irSensor1Button"). addEventListener ("click", function () {
  if (! irSensor1Occupied) {
    irSensor1Occupied = true;
    slotCount--;
  } else {
    irSensor1Occupied = false;
    slotCount++;
  }
  updateDisplay ();
});
document. getElementById("irSensor2Button"). addEventListener ("click", function () {
  if (! irSensor2Occupied) {
    irSensor2Occupied = true;
    slotCount--;
```

```
  } else {
    irSensor2Occupied = false;
    slotCount++;
  }
  updateDisplay ();
});
document. getElementById("smokeSensorButton"). addEventListener ("click", function () {
  if (smokeDetectorOk) {
    smokeDetectorOk = false;
} else {
    smokeDetectorOk = true;
  }
  updateDisplay ();
});
updateDisplay ();
```

Output:

Conclusion:

The implementation of a smart parking system using IoT represents a significant leap in urban mobility and parking management. This innovative solution leverages the power of the Internet of Things (IoT) to address the challenges of parking space availability, traffic congestion, and user convenience in densely populated urban areas. Moreover, the data collected by this smart parking system offers valuable insights into parking usage patterns, peak hours, and resource allocation, which can inform city planners and parking facility operators. By creating a scalable and efficient solution, the smart parking system using IoT makes urban spaces more accessible, sustainable, and user-centric. As cities continue to grow, such innovative solutions are crucial for mitigating the challenges of parking and transportation. The smart parking system using IoT exemplifies the transformative potential of technology in shaping the future of urban mobility, making cities more livable, efficient, and environmentally conscious.