SMART PARKING SYSTEM

Phase 3

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SMART PARKING MANAGEMENT SYSTEM USING IOT

Purpose:

The IoT Smart Parking System is an innovative project aimed at revolutionizing urban parking management. By integrating IoT technology with a Python-based control system, this project addresses the growing challenges of urban congestion and parking inefficiencies.

Program Overview:

The Python program plays a pivotal role in processing and interpreting data received from the sensors. It provides a user-friendly interface for accessing parking availability information in real time. Moreover, it incorporates intelligent algorithms to optimize parking space allocation based on occupancy trends.

Objectives:

The primary objectives of this project are to:

1. Provide accurate and real-time information on parking space availability.

2. Optimize parking space allocation to reduce congestion and enhance user convenience.

3. Facilitate seamless interaction between users and the smart parking system.

Key Features:

- Real-time monitoring of parking space occupancy.

- Dynamic allocation of parking spaces based on user demand.

- Integration with mobile applications for user accessibility.

- Data analytics for trend analysis and optimization.

Design Principles:

The Python program follows a modular design, allowing for easy scalability and maintenance. It adheres to coding best practices to ensure efficiency and reliability in a real-world urban environment.

Design For Smart Parking Management:

Components Required:

Hardware:

→ Node MCU ESP8266
→ IR Sensor- 5 nos
→ Servo Motor-2nos

ESP8266

IR sensor

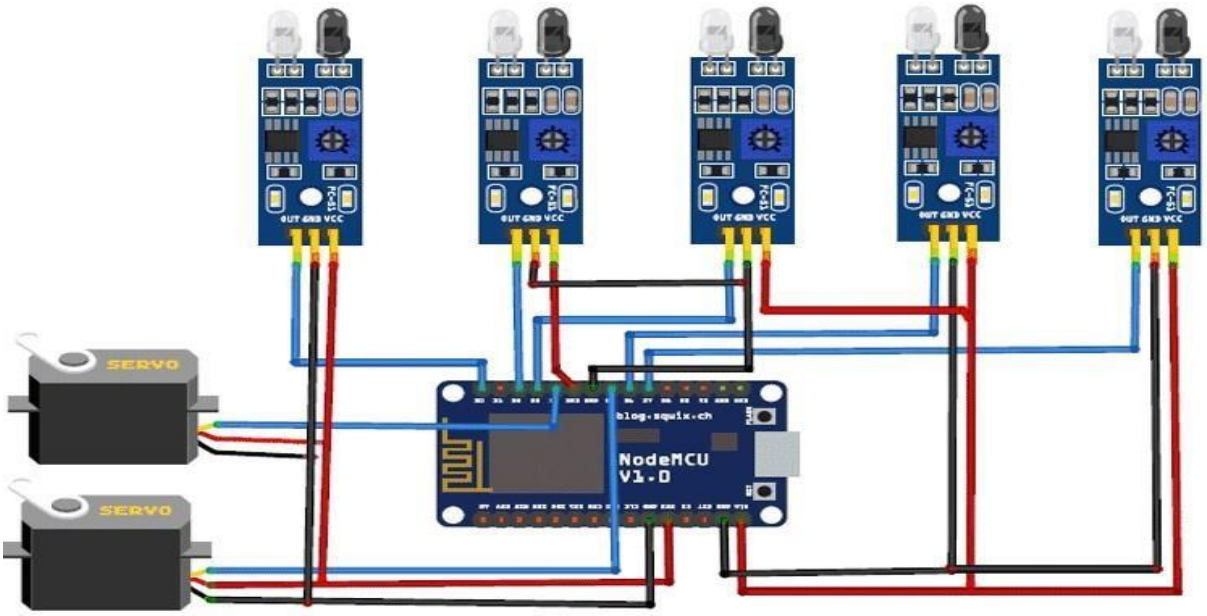
Servo motor

Online Services:

→ ADAFRUIT IO

Circuit Diagram:

The circuit diagram for this **IoT based smart parking system project** is given below.



In this Smart Parking System using IOT, we are using five IR Sensors and two servo motors. IR sensors and Servo motors are connected to the NodeMCU.

NodeMCU controls the complete process and sends the parking availability and parking time information to Adafruit IO so that it can be monitored from anywhere in the world using this platform.

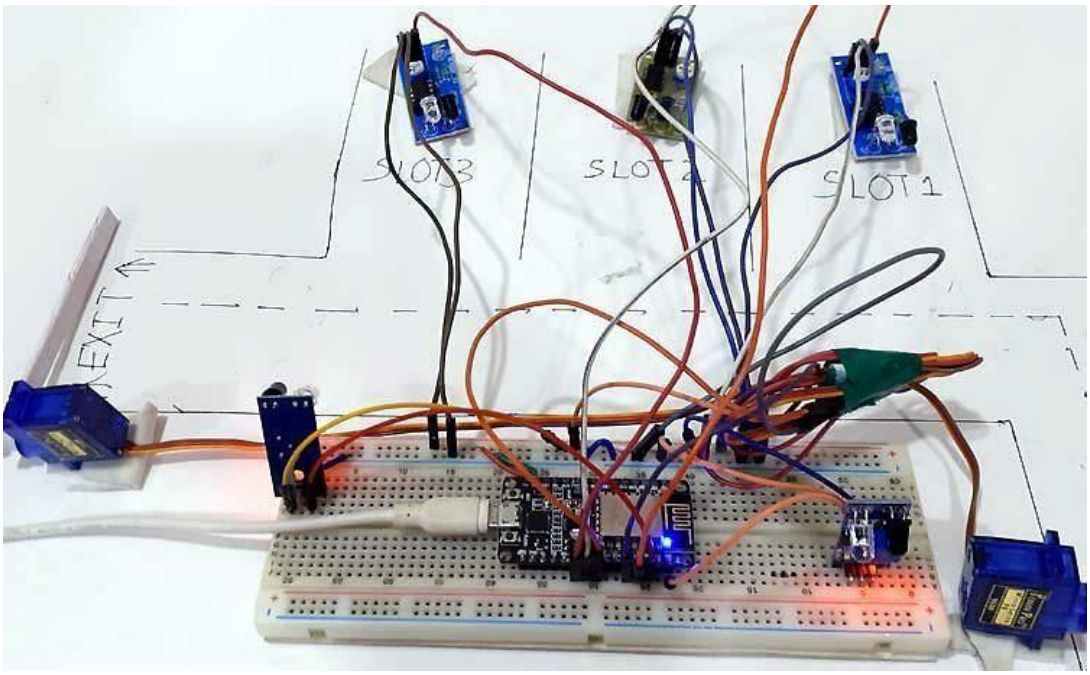
Two IR sensors are used at entry and exit gate so that it can detect the cars at entry and exit gate and automatically open and close the gate.

Two servo motors are used as entry and exit gate, so whenever the IR sensor detects a car, the servo motor automatically rotates from 45° to 140°, and after a delay, it will return to its initial position.

Another three IR sensors are used to detect if the parking slot is available or occupied and send the data to NodeMCU.

Adafruit IO dashboard also has two buttons to manually operate the entry and exit gate.

This is how this complete setup for **Smart Parking System using IOT** will look:



Adafruit IO for IOT Parking System:

Adafruit IO is an open data platform that allows you to **aggregate, visualize, and analyze live data on the cloud**. Using Adafruit IO, you can upload, display, and monitor your data over the internet, and make your project IoT enabled. You can control motors, read sensor data, and make cool IoT applications over the internet using Adafruit IO. For test and try, with some limitation, Adafruit IO is free to use.

To use the adafruit io along with nodeMCU you have create account and create new block for smart parking in adafruit io and also program the nodeMCU in Arduino IDE.

The source code to implement the connection and control over servo motor and IR sensor using nodeMCU ESP8266 with Adafruit IO is given below.

CODE:

```
import time

from machine import Pin, Servo, I2C

from ntptime import settime from

umqtt.robust import MQTTClient


# WiFi and MQTT settings

WIFI_SSID = "YourWiFiSSID"

WIFI_PASSWORD = "YourWiFiPassword"

MQTT_BROKER = "io.adafruit.com"

MQTT_PORT = 1883

MQTT_NAME = "aschoudhary"

MQTT_PASS = "1ac95cb8580b4271bbb6d9f75d0668f1"


# Entry and exit sensors

carEnter = Pin(4, Pin.IN)

carExited = Pin(5, Pin.IN)

entrysensor = False exitsensor

= False
```

```
# Servo configuration servo_gate =
Servo(Pin(16))  # Servo for gate

# Parking slots s1 =
Pin(13, Pin.IN) s2 =
Pin(12, Pin.IN) s3 =
Pin(0, Pin.IN)
s1_occupied = False
s2_occupied = False
s3_occupied = False

# Initialize I2C for OLED display (if used) i2c
= I2C(-1, scl=Pin(22), sda=Pin(21))
# Initialize OLED display and write functions to display data (not shown here)

# MQTT topics
entry_gate_topic = "{}/f/EntryGate".format(MQTT_NAME) exit_gate_topic
= "{}/f/ExitGate".format(MQTT_NAME) cars_parked_topic =
"{}/f/CarsParked".format(MQTT_NAME) # MQTT callback functions (not
shown here)


# Initialize MQTT client
mqtt_client = MQTTClient(MQTT_NAME, MQTT_BROKER, port=MQTT_PORT,
user=MQTT_NAME, password=MQTT_PASS)
mqtt_client.set_callback(sub_cb)

# Main loop while
True:
  # Check entry
and exit sensors
```

```
entrysensor = not
carEnter.value()
exitsensor = not
carExited.value()

    if entrysensor:
        # Car entered
        # Increment count and open gate
count += 1          servo_gate.angle(0)
time.sleep(3)
servo_gate.angle(80)

    if exitsensor:
        # Car exited
        # Decrement count and open gate
count -= 1          servo_gate.angle(0)
time.sleep(3)
servo_gate.angle(80)

    # Publish the number of parked cars to the MQTT topic
mqtt_client.publish(cars_parked_topic, str(count))

    # Check parking slots      if
s1.value() and not s1_occupied:
        # Slot 1 is occupied
s1_occupied = True
        # Publish entry time to the MQTT topic
        mqtt_client.publish(entry_slot1_topic, get_current_time())

    if not s1.value() and s1_occupied:
```

```
        # Slot 1 is available
s1_occupied = False
        # Publish exit time to the MQTT topic
        mqtt_client.publish(exit_slot1_topic, get_current_time())

    # Repeat the same logic for other parking slots (s2 and s3)

    # Handle MQTT subscriptions and messages
mqtt_client.check_msg()

    # Delay for a moment to avoid excessive message publishing
time.sleep(1)
```

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User Interaction:

Users can access the system through a dedicated mobile application. The intuitive interface displays real-time parking availability and allows users to reserve parking spaces in advance.

Expected Outputs:

Upon successful execution, the Python program provides users with up-to-date information on available parking spaces. It also dynamically updates the allocation of spaces as vehicles enter and exit the parking area.

Testing and Validation:

Extensive testing was conducted to validate the accuracy and reliability of the system. Simulated scenarios were used to mimic various parking situations, and the program consistently provided accurate results.

Challenges Faced:

One of the main challenges encountered was optimizing the communication between the microcontroller and Python program to ensure real-time data processing. Additionally, fine-tuning the algorithms for efficient parking space allocation was a critical aspect of the development process.

Output:

After finishing the procedures the final output looks like given below.

So this is how a **Smart Parking System using IoT** can be built. You can add more sensors to increase the parking slots and can also add a payment system to automatically pay the parking fee. Comment below if you have any doubts regarding this project.

CONCLUSION:

The IoT Smart Parking System, with its innovative integration of IoT technology and Python control, presents a forward-thinking solution to urban parking challenges. This project has the potential to revolutionize parking management, reduce congestion, and enhance the overall urban experience.