Title:

IoT-Based Smart Car Parking System using NodeMCU ESP8266 and Blynk App

Team Members:

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Motivation:

With the increasing urban population, finding parking in busy areas has become a significant challenge. Traditional parking systems often fail to efficiently manage available spaces, leading to wasted time, traffic congestion, and frustration for drivers. Our motivation behind this project is to develop a **smart IoT-based parking system** that optimizes parking space usage, improves convenience for users, and allows for real-time monitoring of parking availability using mobile technology.

Introduction:

This project focuses on creating an **IoT-based car parking system** that leverages the **NodeMCU ESP8266 Wi-Fi module** and the **Blynk mobile app** to monitor and manage parking spaces in real-time. By integrating an **ultrasonic sensor**, the system can detect whether a parking slot is vacant or occupied. The status is then communicated wirelessly to a mobile device using the **Blynk platform**, where users can view the available parking slots through a simple and intuitive interface. This system enhances efficiency by enabling real-time parking management and monitoring from anywhere.

Equipment Details:

1. NodeMCU ESP8266:

- **Description:** A low-cost, Wi-Fi-enabled microcontroller that is based on the ESP8266 Wi-Fi SoC. It is the main processing unit of the system and enables the IoT capabilities of the project by connecting to the internet via Wi-Fi.

- **Key Features:**
    - Built-in Wi-Fi capabilities for wireless communication.
    - 11 GPIO pins for interfacing with sensors, LEDs, and other peripherals.
    - Supports popular communication protocols (I2C, UART, SPI).
    - Operates on 3.3V logic.
    - Compatible with the Arduino IDE for programming.

2. Ultrasonic Sensor (HC-SR04):

- **Description:** This sensor measures the distance to objects using ultrasonic waves. It emits sound waves and measures the time taken for the echo to return, which is used to calculate the distance to the object.
- **Key Features:**
    - Detection range: 2cm to 400cm.
    - Operating voltage: 5V.
    - Accuracy: ±3mm.
    - Used to detect if a vehicle is present in a parking spot by measuring the distance to the ground or object in the parking slot.

3. LEDs (Green and Red):

- **Description:** Standard light-emitting diodes used to visually indicate the status of the parking slots. Green represents a vacant slot, and Red indicates an occupied slot.
- **Key Features:**
    - Operates on low voltage (typically 2-3V).
    - Color-coded indication for quick visual feedback.
    - Long-lasting and energy-efficient.

4. Resistors (220Ω):

- **Description:** These resistors are used to limit the current flowing through the LEDs, protecting them from damage caused by excess current.
- **Key Features:**
    - Rated resistance: 220 ohms.
    - Protects LEDs by controlling the current in the circuit.

5. Breadboard and Jumper Wires:

- **Description:** These components are essential for prototyping the circuit without soldering. The breadboard allows components to be connected securely and jumper wires are used to make the necessary connections between components and the NodeMCU.
- **Key Features:**
    - Breadboard: No-solder, reusable prototyping board for quickly assembling circuits.

- Jumper Wires: Used for connecting various components, such as sensors and LEDs, to the NodeMCU.

6. Power Supply (5V USB):

- **Description:** Provides power to the NodeMCU and its connected components. Typically, a standard USB connection supplies 5V to the NodeMCU, which regulates the power to 3.3V for internal operations.
- **Key Features:**
  - 5V DC output, supplied via micro-USB or external USB power adapter.
  - Powers the NodeMCU and peripheral components like sensors and LEDs.

7. Blynk App (Mobile App):

- **Description:** A user-friendly IoT platform that allows users to create a mobile interface for their hardware projects. The app connects to the NodeMCU through the Blynk cloud, displaying the parking slot status in real-time.
- **Key Features:**
  - Supports iOS and Android devices.
  - Provides an intuitive graphical interface for users to monitor parking slots.
  - Easy integration with NodeMCU via virtual pins.
  - Customizable widgets such as LEDs, tabs, graphs, and notifications.
  - Real-time data updates, enabling users to check parking slot availability remotely from any location.

Project Features:

1. **Real-Time Monitoring:**
   - The system continuously checks the availability of parking spaces using ultrasonic sensors.
   - The data is transmitted to the Blynk cloud via Wi-Fi, enabling users to view parking status in real-time from anywhere.
2. **Blynk App Interface:**
   - Users can view the parking slots categorized under different **Tabs** in the Blynk app, allowing for the management of multiple parking spaces.
   - **LED Widgets** in the Blynk app visually indicate the status of each parking slot (Red for occupied, Green for vacant).
3. **Automation with Sensors:**
   - **Ultrasonic Sensors** detect whether a car is present or absent in a particular spot. The data is processed to control the LEDs both physically (on the parking lot) and virtually (in the app).
4. **Scalability:**

    - The system can be expanded to monitor multiple parking slots by adding more ultrasonic sensors, each linked to different virtual pins in the Blynk app.
5. **Low-Cost Solution:**
    - By using affordable components such as the NodeMCU, ultrasonic sensors, and LEDs, the project offers a low-cost alternative to more complex and expensive commercial parking management systems.

Conclusion:

The **IoT-based Smart Car Parking System** developed using **NodeMCU ESP8266 and the Blynk app** offers a highly efficient and cost-effective solution for parking management. This system allows for real-time monitoring of parking space availability, making it easier for drivers to find parking and reducing the overall congestion in parking lots. The project demonstrates the potential of IoT in everyday life and can be expanded to larger parking lots or even integrated with payment systems for automated parking services.

By offering a user-friendly interface, scalability, and real-time data access, the project provides a sustainable solution for smart city infrastructure.