IoT Smart Parking System with Live Slot Tracking and Mobile App

Project Abstract Document
A student-oriented IoT-based smart parking management prototype using ESP32, parking slot sensors, display modules, and automated control mechanisms.

Abstract

The IoT Smart Parking System with Live Slot Tracking and Mobile App is designed to demonstrate automated parking space monitoring using embedded systems and IoT concepts. The system detects vehicle occupancy in parking slots using IR sensors, processes the information through an ESP32 controller, and provides real-time availability information through a display and connected mobile interface.

Problem Statement

Finding available parking spaces in crowded areas consumes time and increases vehicle movement inside parking zones. Traditional parking systems often lack real-time visibility of vacant slots, causing inconvenience for drivers.

This project addresses the requirement for an automated parking assistance solution that can monitor slot availability and provide users with updated parking information.

Objectives

• Develop an IoT-enabled parking slot monitoring prototype.
• Detect occupied and available parking spaces automatically.
• Display live parking information locally.
• Demonstrate automated entry barrier control.
• Provide a foundation for mobile-based parking assistance.

System Architecture

The system consists of parking slot detection units using IR sensors connected to an ESP32 microcontroller. The controller processes sensor data and updates the OLED display. The system can communicate parking information to a mobile application through an IoT communication layer depending on the selected implementation.

Technologies Used

ESP32, IR Sensor Modules, Embedded C / Arduino IDE, IoT Communication, OLED Display, Servo Motor Control, Mobile Application Development, LED Indicators.

Working Principle

1. IR sensors monitor individual parking slots.
2. Sensor readings are collected by the ESP32 controller.
3. The controller determines occupied and free slots.
4. Parking status is displayed on the OLED module.
5. Connected applications can receive parking updates.
6. The servo mechanism demonstrates automated entry barrier operation.

Key Features

• Real-time parking slot detection.
• Live availability display.
• IoT-based monitoring concept.
• Automated barrier gate demonstration.
• LED status indication.
• Expandable architecture for additional slots.

Applications

• College and university parking demonstrations.
• Smart city parking research prototypes.
• IoT and embedded systems learning projects.
• Automated parking management concepts.

Prerequisites

Basic knowledge of electronics, ESP32 programming, embedded systems, and IoT concepts is recommended for understanding and operating the prototype.

Limitations

• Prototype accuracy depends on sensor placement and environmental conditions.
• Large-scale deployment requires industrial-grade components.
• Network-dependent features require reliable connectivity.
• Advanced parking features require additional development.

Future Scope

The system can be enhanced with RFID vehicle identification, number plate recognition, cloud analytics, online booking, payment integration, and larger parking infrastructure support.

Conclusion

The IoT Smart Parking System demonstrates how embedded hardware and IoT technologies can be combined to create an automated parking assistance solution. The prototype provides students with practical exposure to sensors, microcontrollers, communication systems, and smart infrastructure concepts.