

Smart Airport Car Parking Management System

Abstract

This project aims to mitigate parking congestion and improve the user experience at airports through the integration of IoT and embedded systems. The Smart Airport Car Parking Management System offers real-time updates on parking slot availability, automates parking entry/exit, monitors environmental conditions, and calculates parking charges automatically.

Problem Statement

Airports often face significant parking delays, leading to inconvenience for travelers. To address this, a solution is required that can provide real-time information on parking availability, automate parking processes, and enhance safety with environmental monitoring.

Solution Overview

Features

- **Real-time Slot Detection:**
 - **Distance < 7 cm:** Obstacle present.
 - **Distance between 7-15 cm:** Slot occupied by a vehicle.
 - **Distance > 15 cm:** Slot available.
- **Automated Entry/Exit** using an RFID system.
- **Environmental Monitoring** with DHT11 sensor (temperature and humidity).
- **Fire Detection** alert if the temperature exceeds 70°C.
- **Gate Control** using a servo motor.
- **Parking Charge Calculation:** Automated billing at 1 rupee per minute using RFID entry/exit data.
- **Data Integration** with Firebase for real-time access and remote updates.
- **Status Display** on a 16x2 LCD at the parking entry.
- **Full Parking Prevention:** Restricts entry when all slots are occupied.

System Architecture

Component Functionality

- **Arduino UNO:** Processes data from the sensors and manages the display.
- **NodeMCU ESP8266:** Functions as a gateway for real-time data upload to Firebase.
- **Ultrasonic Sensors:** Detect vehicle presence in parking spots and update status.
- **RFID Module:** Handles entry/exit operations and calculates parking time for billing.
- **DHT11 Sensor:** Monitors temperature and humidity, triggers alerts if the temperature exceeds 70°C.
- **Servo Motor:** Controls the automatic opening and closing of the gate.
- **16x2 LCD with I2C:** Displays available parking slots at the entry.
- **Firebase:** Cloud-based data storage for monitoring and remote management.

Tech Stack

- **Hardware:** Arduino UNO, NodeMCU ESP8266
- **Sensors:** Ultrasonic, RFID, DHT11
- **Actuators:** Servo Motor
- **Display:** 16x2 LCD with I2C
- **Database:** Firebase for cloud data storage

Implementation Details

Hardware Integration

- Ultrasonic sensors are mounted at each parking spot to detect the presence of vehicles.
- RFID readers manage vehicle entry and exit, initiating automated billing.
- The DHT11 sensor monitors environmental conditions for safety alerts.
- The servo motor is programmed to operate the gate mechanism.
- Real-time data is displayed on the LCD at the parking entry for user convenience.

Software Workflow

1. Arduino processes sensor data to determine parking slot status.
2. NodeMCU ESP8266 uploads data to Firebase for remote monitoring.
3. RFID data is processed for entry/exit logging and charge calculation.
4. LCD display shows parking availability at the entrance.
5. System restricts entry when parking is full and triggers fire alerts when needed.

Key Benefits

- **Reduced Search Time:** Provides real-time updates on parking availability.
- **Automated Operations:** Simplifies entry/exit and billing processes.
- **Improved Management:** Utilizes real-time data for efficient parking control.
- **Enhanced Safety:** Monitors temperature and humidity with fire alerts.
- **Entry Restriction:** Prevents new vehicles from entering when parking is full.

Conclusion

This project demonstrates how IoT and embedded systems can effectively address parking challenges in airports. It showcases the integration of sensors, microcontrollers, and cloud services for an intelligent parking solution, all developed within 24 hours.

Contact

I'm passionate about solving real-world problems using embedded systems and IoT. If you would like to discuss this project or explore related topics, feel free to connect with me on [LinkedIn](#).

