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IoT-Enabled Smart Parking System for Real-Time Space Monitoring and Guidance System

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Abstract: *This paper presents the design and implementation of an IoT-based smart parking detection and access control system using the ESP32 microcontroller. The system addresses common urban challenges such as inefficient parking management, traffic congestion, and user inconvenience by enabling real-time monitoring, space navigation, and automated gate control. The ESP32 serves as the central hub, integrating multiple input devices, including a GPS module for location tracking and infrared (IR) sensors for vehicle presence detection. Based on the collected sensor data, the ESP32 processes occupancy information, updates a visual display, and controls output devices such as servo motors for barrier operation and LEDs for status indication. The system provides seamless interaction by guiding users to available spaces, granting access when conditions are met, and continuously updating the parking status through visual and cloud-based interfaces. Through Wi-Fi connectivity, the system enables remote monitoring, mobile app integration, and real- time notifications to users and facility operators, enhancing overall efficiency and user experience. The proposed smart parking system demonstrates improved space utilization, reduced search time for parking, automated access management, and offers a scalable solution for modern urban environments where smart city initiatives are increasingly critical*

Keywords: Smart Parking System, IoT, ESP32 Microcontroller, Infrared Sensors, Access Control

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