IoT-enabled smart parking system

A

IoT Design Lab (IS3230) Report

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His insights and expertise have been instrumental in shaping this work, and his mentorship has significantly contributed to my learning and growth. I also extend my appreciation to the faculty and staff of the Department of IoT and Intelligent Systems for their support and cooperation.

ABSTRACT

This project aims to develop a smart parking system using Internet of Things (IoT) technology. The system uses five infrared (IR) sensors to monitor the availability of parking slots. These sensors are interfaced with an Arduino microcontroller and an ESP8266 module, which connects to the Blynk cloud. A mobile application displays real-time information about parking slot availability using coloured LEDs: green for available and red for occupied. The app also shows the total number of free slots. The system is designed for real-time monitoring, easy scalability, and improved urban mobility.

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INTRODUCTION

The increasing number of vehicles in urban areas has led to critical parking issues, especially in high-density regions. Traditional parking systems lack real-time information and often result in wasted time, fuel, and increased congestion. IoT-based smart parking systems aim to resolve these issues by providing real-time monitoring, status updates, and efficient management of parking spaces.

LITERATURE REVIEW

Several smart parking systems have been proposed in recent years using various technologies such as ultrasonic sensors, cameras, RFID, and IoT. Research by Sharma et al. (2022) demonstrated the effectiveness of using IR sensors in cost-effective and space-constrained applications. Blynk has been widely adopted for cloud-based IoT monitoring due to its ease of use and compatibility with multiple platforms. This project builds on such approaches by integrating IR sensors with ESP8266 and visualizing the data in a mobile application.

PROBLEM STATEMENT

To address the inefficiencies in traditional parking management systems by designing a real-time, automated, and user-friendly smart parking system that displays the availability of parking spaces using a mobile application.

OBJECTIVES

The primary objectives of this project are as follows:

- To design and implement a smart parking system using IR sensors and IoT.
- To monitor the occupancy status of parking slots in real-time.
- To display the availability of slots via a mobile application.
- To reduce parking time and traffic congestion.

METHODOLOGY

The methodology adopted for this project is systematic and comprises the following stages:

1. **Sensors:** Five IR sensors are used to detect vehicle presence in each slot.
2. **Controller**: Arduino reads the sensor data.
3. **Communication Module**: ESP8266 sends data to the cloud.
4. **Cloud Platform:** Blynk Cloud stores and forwards the data.
5. **Mobile App:** Blynk app displays the slot status using LEDs.

MODEL ARCHITECTURE

Block Diagram:

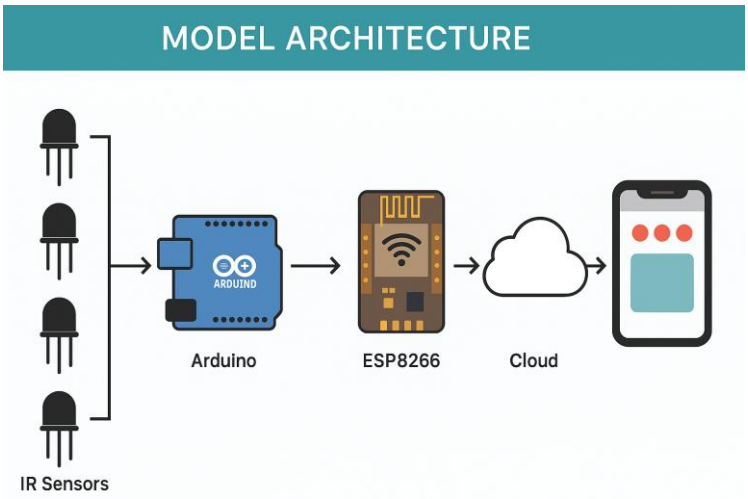

Fig 1.1 Model architecture

Wiring:

- Each IR sensor output is connected to a digital pin on the Arduino.
- The Arduino communicates with the ESP8266 via serial/UART.
- ESP8266 connects to Wi-Fi and pushes sensor data to Blynk.

Fig 1.2 Snapshot of ESP8266 while uploading code

RESULTS

- The system accurately detects and updates the parking status of each slot.
- The mobile app reflects changes in real-time with a maximum delay of 1 second.
- The user interface is intuitive, with clear LED indicators and an availability counter.

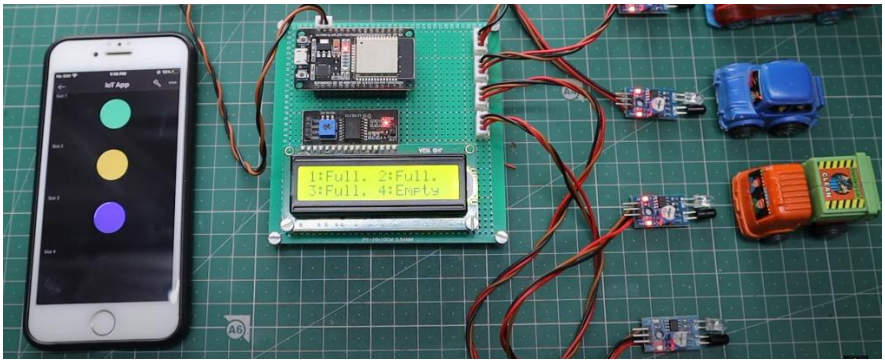

Fig 2.1 Snapshot of the complete working model displaying the occupied/empty parking space

PROJECT SNAPSHOTS

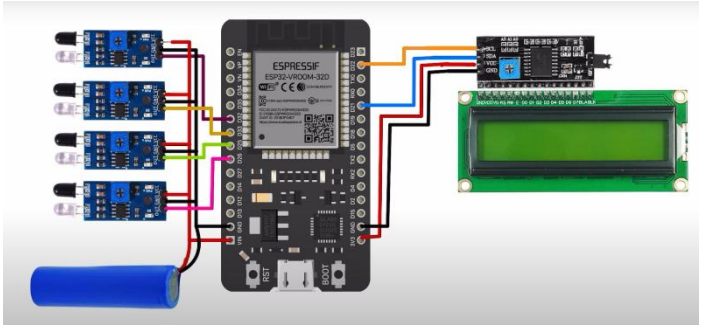

Fig 3.1 Circuit diagram of ESP8266 and IR sensors

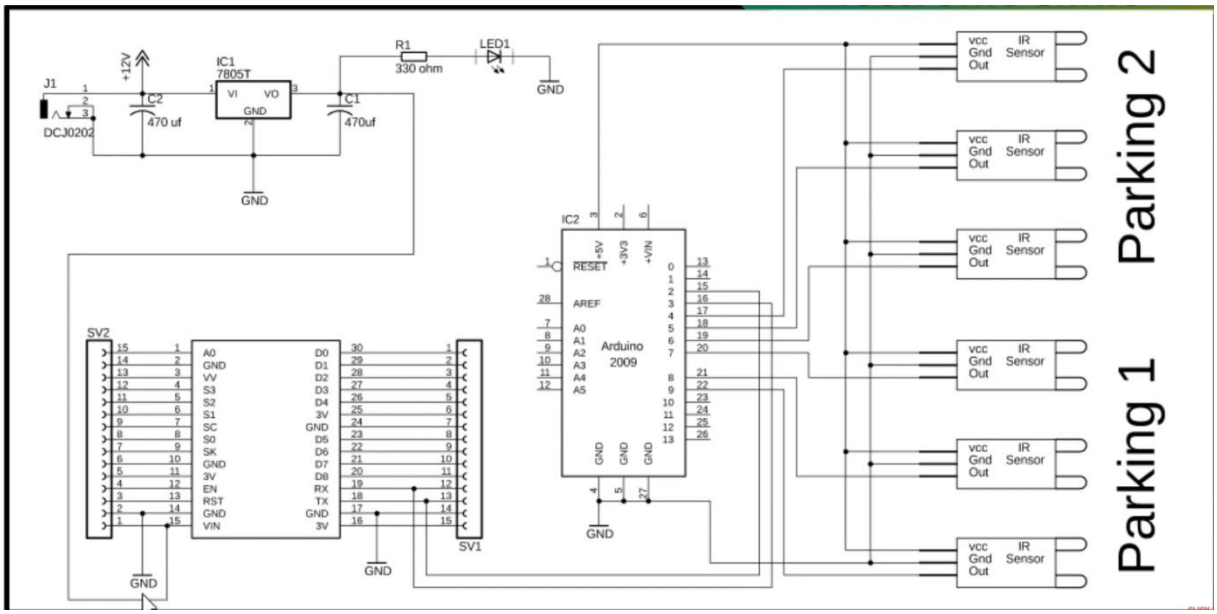

Fig 3.2 Circuit diagram

CONCLUSION

This project successfully demonstrates a scalable, real-time smart parking system using IR sensors and IoT technology. The integration of the Blynk platform allows seamless communication and monitoring through a user-friendly mobile app. The system addresses modern urban challenges by improving parking efficiency and reducing vehicle congestion.

LIMITATIONS AND FUTURE WORK

Limitations:

- IR sensors may be affected by ambient light or dust.
- Range is limited to close-proximity detection.

Future Work:

- Implement image processing or ultrasonic sensors for enhanced accuracy.
- Include booking and navigation features in the mobile app.
- Enable analytics and reporting via cloud dashboard.

CONTRIBUTIONS

This project has made several notable contributions:

- Hardware Setup: Assembled and connected IR sensors, Arduino, and ESP8266.
- Firmware Development: Programmed Arduino to detect slot status.
- IoT Integration: Configured Blynk with ESP8266 for cloud communication.
- UI/UX Design: Designed Blynk app interface for slot visualization.
- Testing & Validation: Verified system accuracy under various scenarios.

BIBLIOGRAPHY

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5. Open-source IR sensor module tutorials and community posts (Instructables, Hackster.io).