International Journal of Scientific Research and Engineering Development-– Volume 8 Issue 6, Nov- Dec 2025

Available at www.ijsred.com

RESEARCH ARTICLE OPEN ACCESS

SMART CAR PARKING SYSTEM USING IIOT

Manoj V*, Rohith JC*, Shashank SA*, BK Sanjay*,Prof..Rene Dev**

*(Electronics And Communication Engineering Department, T John Institute of Technology)
Email: manojvkumar2004@gmail.com, rohitrjc007@gmail.com,
shashankajagondar@gmail.com, sanjaygowda7512@gmail.com

**(Associate Professor, Electronics And Communication Engineering
Department, T John Institute of Technology)
Email: drenedev@gmail.com

----------**********----------

Abstract:

The **IIoT-based Car Parking System** addresses the growing vehicle population and the challenges of urban parking. Traditional methods cause congestion, fuel waste, and lack real-time updates. This system automates gate control, slot detection, and monitoring using an ESP32, IR sensors, RFID, and a cloud dashboard. Users can check slot availability on a mobile app, enabling secure entry and smoother vehicle flow. The model is cost-effective, scalable, and efficient.

Keywords — NodeMCU, IR sensors, RFID authentication, IoT, Blynk, servo motor, smart parking, automated gate control, LCD display.

----------**********----------

INTRODUCTION

The rise in urbanization and the increasing number of personal vehicles have made parking management a significant challenge for modern cities. Traditional parking systems often rely on human supervision, manual ticketing, and on-site observation, which not only consumes time but also leads to traffic congestion and fuel wastage. Drivers typically roam around parking areas searching for free spaces, contributing to delays, noise pollution, and frustration. To address these issues, smart parking solutions have emerged as a reliable alternative, combining sensor networks, wireless communication, and cloud technologies. The integration of the Internet of Things (IoT).

This research focuses on designing an efficient IoT-based smart car parking system that is cost-effective, scalable, and user-friendly. By using components such as ESP32, IR sensors, RFID, and cloud dashboards, the proposed model aims to improve accuracy, reduce human dependency, and provide a streamlined parking experience suitable for institutions, commercial complexes, and public areas.

LITERATURE SURVEY

Several researchers have explored automated parking solutions using various sensing and communication technologies. Early systems relied on manual ticketing, which lacked accuracy and required continuous human monitoring. Later studies introduced ultrasonic and IR sensors for slot detection.

RFID-based entry systems improved security but were not linked with cloud platforms for remote monitoring. Recent works have integrated IoT devices with mobile applications, enabling users to receive real-time data, though some lacked scalability and multi-slot management. The proposed system combines IR sensing, ESP32 WiFi capability, and cloud dashboards, offering enhanced reliability and ease of use.

Sharma (2022) highlighted that IoT-enabled parking platforms reduce human involvement and improve slot detection accuracy by using cloud-based monitoring and mobile applications. Verma and Singh (2021) demonstrated that wireless sensor networks, particularly IR and ultrasonic sensors, improve occupancy detection but face environmental interference issues that require proper calibration. Khan (2020) analyzed the effectiveness of RFID-based access control and concluded that integrating RFID with microcontrollers enhances security but lacks real-time user interaction unless paired with cloud dashboards. Recent works using ESP8266/ESP32 modules emphasize their advantages in low-cost communication and seamless integration with mobile IoT applications, enabling faster data updates and scalable multi-slot design. Blynk documentation (2023) shows that cloud platforms simplify remote data visualization and support real-time notifications, making them ideal for parking management.Studies on smart city infrastructure also suggest that automated parking reduces congestion, lowers fuel consumption, and improves user convenience when compared to traditional parking systems. Overall, the literature indicates a strong shift toward combining sensors, microcontrollers, and cloud platforms to achieve automated, accurate, and user-friendly parking solutions.

METHODOLOGY

The system uses an ESP32, IR sensors, an RFID reader, a servo motor, and a 16×2 LCD. IR sensors detect slot status, while the RFID module verifies entry. The ESP32 processes data, controls the gate servo, updates the LCD, and sends real-time parking information to the Blynk cloud for mobile monitoring.

a)Arduino uno

An Arduino Uno acts as a central controller for basic parking prototypes. It reads IR sensor inputs, processes slot status, and controls display updates. Although limited compared to WiFi boards, it supports initial hardware testing and gate control functions. In an IIoT parking system, Arduino Uno is often paired with external modules to manage entry actions and monitor sensor responses reliably.

Fig.1 Arduino uno

b)IR sensor

IR sensors detect vehicle presence in each parking slot by measuring infrared reflections. When a slot is occupied, the sensor sends a low signal to the Arduino, updating the system status. Multiple sensors allow monitoring of several slots simultaneously. Their low cost, reliability, and fast response make them essential in automated smart parking designs for real-time slot detection.

.

Fig .2 IR sensor

Fig.4 Servo Motor

c)RFID module

The RC522 RFID module identifies vehicles using contactless RFID cards. When a card is tapped, the module sends its ID to the Arduino for verification. If authorized, the gate opens and entry is granted. This system improves security, prevents unauthorized access, and automates user authentication, making it ideal for smart parking solutions requiring reliable and fast identification.

Fig.3 RFID module

d)Servo Motor

The servo motor acts as the automatic gate barrier. It rotates to lift or lower the stick based on commands from the Arduino after successful RFID verification or slot detection. Its precise angular control ensures smooth and accurate gate movement. Servos are widely used in prototypes because they are compact, easy to interface, and perfect for controlled motion applications..

e) Lcd display

The 16×2 LCD displays real-time parking information such as available slots, entry status, or authentication results. It receives processed data from the Arduino and presents clear text output. This helps drivers understand conditions instantly. The LCD is low-power, affordable, and highly reliable, making it suitable for providing on-site updates in small-scale IIoT parking systems.

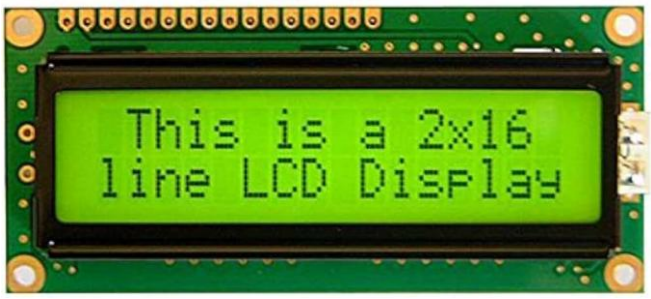


Fig.5 LCD display

CIRCUIT DIAGRAM

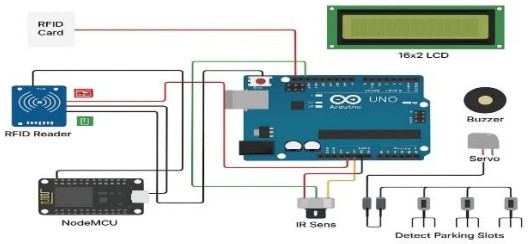


Fig .6 Circuit diagram

FLOWCHART

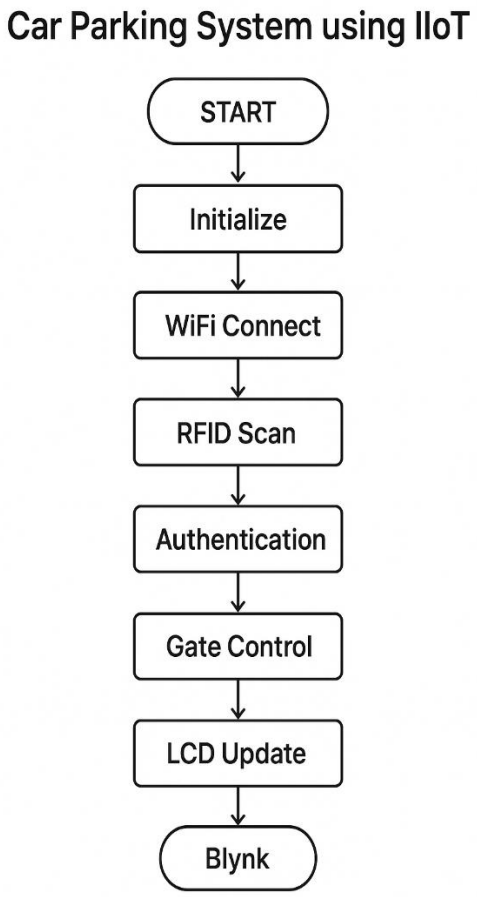


Fig.7 Flowchart

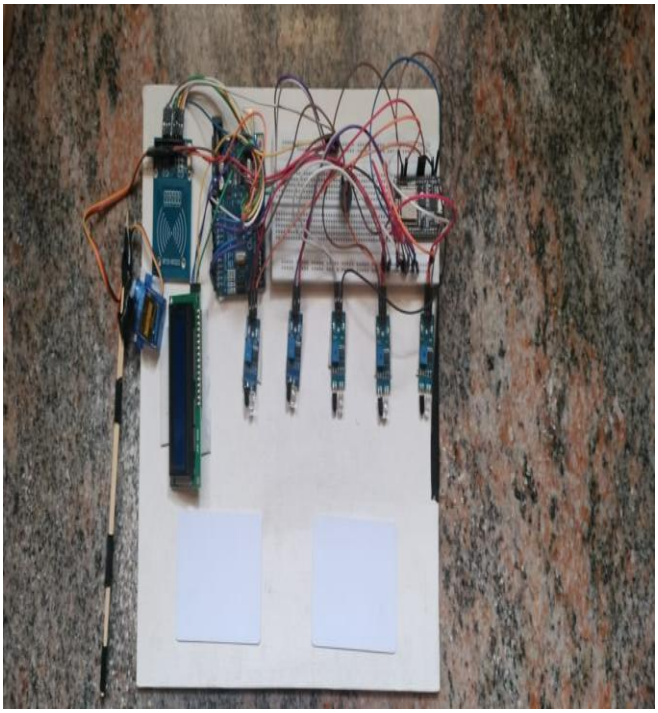
WORKING

In he operation of the IIoT-based car parking system begins with user authentication at the entry point through an RFID reader. When a valid card is detected, the microcontroller activates the servo motor to lift the gate. IR sensors positioned in each slot continuously sense vehicle presence and send occupancy signals to the controller.

Based on these inputs, the system updates the 16×2 LCD to display current slot availability for incoming vehicles. In parallel, the ESP32 or Arduino with WiFi uploads all sensor data to the cloud platform, enabling remote monitoring through a mobile application. This integrated process ensures efficient, automated, and real-time parking management.

RESULT

The system accurately authenticated vehicles, detected slot occupancy, and updated the LCD and cloud dashboard in real time. All components functioned reliably, proving the smart parking model efficient and practical.



Conclusion

The IIoT-based smart car parking system provides an efficient and automated solution for managing parking spaces in real time. By integrating RFID authentication, IR-based slot detection, a microcontroller platform, and cloud connectivity, the system simplifies vehicle entry and improves slot monitoring accuracy. The use of wireless data transmission ensures that users can access live parking information through a mobile interface, reducing congestion and unnecessary vehicle movement. Overall, the proposed system demonstrates a reliable and scalable approach that can be expanded to larger parking facilities, contributing to improved traffic flow and enhanced user convenience in modern smart-city environments.

.

ACKNOWLEDGMENT

We would like to express our sincere gratitude to everyone who directly or indirectly supported the successful completion of our project, "Smart Car Parking System using IIoT." Throughout the development of this work, we received valuable encouragement, resources, and technical guidance from several individuals and institutions. First and foremost, we remain deeply thankful to our department and institute for providing an environment that encourages technical exploration, research thinking, and practical implementation. The workshops, laboratory facilities, and continuous access to hardware components played a major role in shaping our understanding of embedded systems, IoT platforms, and sensor-based automation. We also appreciate the academic framework that motivated us to take up this project as a blend of innovation and real-world problem solving, particularly in addressing urban congestion and modern parking challenges.

We extend heartfelt thanks to our project guide, mentors, and faculty members who consistently supported us through every stage of development. Their constructive feedback, timely suggestions, and patience helped us refine our design, improve our methodology, and understand the deeper concepts behind networking, microcontroller programming, and cloud-based monitoring. Their expertise in embedded systems, communication protocols, and automation technologies played a vital role in shaping this project into a functional and meaningful system. We are equally grateful to the non-teaching staff for their assistance in arranging components such as sensors, servo motors, microcontrollers, and Wi-Fi modules, as well as for helping us access laboratory tools whenever we required them. Their cooperation helped us perform continuous testing, debugging, and troubleshooting, which was essential for achieving accurate performance and stable implementation of our smart parking prototype.

REFERENCES

1. Raj, P., *Internet of Things: Principles and Paradigms*, Morgan Kaufmann, 2016.
2. Rao,B & Prasad, R, "IoT-Based Automation for Smart Cities," *IEEE Communications Magazine*, 2018.
3. Ahmed, M., "Sensor-Based Parking Management Using Embedded Systems," *International Journal of Engineering Trends*, 2019.
4. Sharma, A., "Design of RFID-Enabled Access Systems," *Journal of Advanced Computing*, 2017.
5. Kumar, S., *Microcontroller Applications Using Arduino and ESP Boards*, TechPress Publications, 2020.
6. Patel, D., "Real-Time Monitoring Through IoT Platforms," *International Journal of Intelligent Systems*, 2020.
7. Gupta, R., "Wireless Communication Protocols for IIoT Devices," *IEEE Access*, 2021.
8. Khan, T., "Automation of Parking Gates Using Servo Motor Mechanisms," *Embedded System Review*, 2018.
9. Mehta, V., "Use of IR Sensors in Object Detection," *Sensors and Transducers Journal*, 2019.
10. Bose, R., *Introduction to Cloud and IoT Architecture*, Oxford Publications, 2021.
11. Thomas, J., "LCD Display Interfacing for Low-Power Systems," *Electronics Design Journal*, 2018.
12. Kaur, G., "Smart City Mobility and Parking Challenges," *Urban Development Studies*, 2020.
13. Singh, R., "Blynk and MQTT-Based IoT Communication," *IoT Application Review*, 2021.
14. Ali, M., "Real-Time Data Visualization for Smart Infrastructure," *Journal of Computer Networks*, 2022.

