

SMART PARKING SYSTEM FOR SMARTCITY AND HIGH-RISE BUILDINGS

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Abstract— Smart cities across the globe are getting wide attention due to promised futuristic life-style enhancing safety, security and saving valuable time in monitoring and tracking the unauthorised access of the premises. The urbanization of the small villages and towns are looking forward to incorporate technology to support day-to-day activities, applications and services. The proposed smart parking system aim at restricting the use of parking spaces secured or owned by particular customers or resident in the high-rise building and apartments. This system enables unauthorised access and use of others parking space thus avoiding inconvenience and situation of conflicts. 8051 microcontroller along with ultrasonic sensor, RFID and buzzer alarm are used to restrict the unauthorized access to the parking spaces. The ultrasonic sensor detects the presence of vehicles within parking spaces. Additionally, RFID technology is employed to identify authorized vehicles. Upon detecting an RFID card, the system activates a motor to open the gate, allowing entry. If an RFID card is not detected and the Ultrasonic Sensor identifies a parked vehicle, indicating a potential unauthorized entry attempt or a filled parking lot, a buzzer alarm is triggered to alert the authorities. The integration of these components facilitates efficient parking management by automating access control and monitoring parking space availability. This project demonstrates a practical solution for enhancing parking safety, security, convenience and efficiency in various application environments, such as commercial parking lots, residential complexes, and institutional facilities.

Keywords: - Smart parking, Sensor, Automation

I. INTRODUCTION

A. Introduction

The ever-growing number of vehicles on the road, coupled with limited parking space, creates a constant struggle for drivers to find convenient parking. This project aims to address this challenge by developing a **smart parking system** that utilizes **Radio Frequency Identification (RFID) technology** and **servo motors** to streamline the parking experience.

This system offers **enhanced security** through RFID tags attached to authorized vehicles, **eliminating the need for manual tickets or interaction with attendants**. The **automated gate control** ensures authorized vehicles receive quick access, while **detering unauthorized entries**. Additionally, the system can be **expanded** to integrate with existing parking management software or further functionalities like **parking space allocation** and **automated payment systems**.

This project provides a **cost-effective and efficient solution** for managing parking spaces, ultimately contributing to a **smoother and more convenient parking experience** for drivers.

B. Problem Statement

Finding available parking space in urban areas is a **persistent challenge** for drivers, leading to:

- **Time wasted:** Drivers spend **excessive time circling and searching** for vacant spots, contributing to traffic congestion and frustration.
- **Inefficient parking management:** Traditional systems with manual ticketing or attendants are **prone to delays and errors**, lacking real-time information on available spaces.
- **Security concerns:** Uncontrolled access can lead to **unauthorized parking**, reducing available spaces for legitimate users and potentially posing security risks.

This **lack of efficiency and security** in conventional parking systems necessitates a solution that addresses these issues and provides a **more streamlined and secure parking experience**.

C. Proposed Solution

This project proposes a **smart parking system** that utilizes **RFID technology** and **servo motors** to address the aforementioned challenges in traditional parking systems. The system offers the following functionalities:

- **RFID-based Access Control:** Authorized vehicles equipped with unique **RFID tags** are identified upon approaching the entrance gate.
- **Secure Gate Control:** Only **valid RFID tags** trigger the **servo-motor controlled gate** to open, granting access to authorized vehicles and deterring unauthorized entries.

- **Real-time Availability Tracking:** The system can be **integrated** with a database (optional) to monitor **real-time parking space availability**, providing valuable information to drivers through displays or mobile applications (optional).

This proposed solution aims to:

- **Reduce search time:** Drivers can quickly locate **available parking spaces** through real-time information (optional) and avoid extensive searching.
- **Enhance efficiency:** Automated access control and real-time data allow for **efficient parking management**, reducing congestion and delays.
- **Increase security:** The system restricts access to authorized vehicles, **improving overall security** and preventing unauthorized parking.

By implementing this smart parking system, we strive to create a **more efficient, secure, and user-friendly** parking experience for both drivers and administrators.

D. Literature Survey for Smart Parking System using RFID and Servo Motor

The growing issue of limited parking space in urban areas has driven research towards **smart parking systems** that utilize various technologies to improve efficiency and user experience. This literature survey explores existing research on smart parking systems with a focus on RFID (Radio Frequency Identification) and servo motor applications.

RFID Technology:

- **A Survey on “Smart Parking” System** (IJRSET, 2015) highlights the use of RFID tags for **vehicle identification and parking reservation**. The study suggests integrating GSM and ZigBee technologies for improved communication and security.
- **A Review on Smart Parking Systems** (IRE Journals, 2019) explores the use of RFID tags for **real-time parking space monitoring**. The authors discuss various RFID reader types and their suitability for different parking environments.

Servo Motor Applications:

- **REVIEW OF SMART PARKING SYSTEM AND DIFFERENT SENSORS** (pep.ijiee.org.in, 2018) emphasizes the use of **servo motors for controlling access barriers** based on authorized identification. The study compares different sensor technologies for parking space detection and highlights the advantages of servo motors for their precise actuation capabilities.
- **Smart Parking Systems: Reviewing the Literature, Architecture and Ways Forward** (ODU Digital Commons, 2018) discusses the integration of **servo motors with various sensors** like magnetic loop detectors and ultrasonic sensors for accurate parking space detection and automated barrier control.

Integration and Additional Functionalities:

- **Literature Review on Parking System** (ResearchGate, 2021) explores the potential of

integrating RFID technology with Internet of Things (IoT) platforms for advanced functionalities like **real-time parking data display, space reservation, and integration with payment systems**.

Limitations and Future Directions:

While existing research demonstrates the effectiveness of **RFID and servo motors in smart parking systems**, some limitations exist:

- **Security concerns:** Secure communication protocols and robust tag authentication methods are crucial to prevent unauthorized access.
- **Scalability considerations:** The cost and complexity of the system might increase with large-scale deployments.
- **Integration challenges:** Seamless integration with existing parking infrastructure and management systems requires careful planning and compatibility considerations.

Future research directions should focus on:

- **Enhancing security features** through advanced encryption and access control mechanisms.
- **Exploring cost-effective and scalable solutions** suitable for diverse parking environments.
- **Developing seamless integration strategies** with existing infrastructure and parking management systems.

By addressing these limitations and exploring new avenues, future smart parking systems can offer even greater efficiency, security, and convenience for drivers and parking management authorities.

II. EASE OF USE

This smart parking system is designed to be **user-friendly and intuitive** for both drivers and administrators. Here's how:

For Drivers:

- **Simple access:** Authorized vehicles with pre-assigned RFID tags simply need to **approach the gate** for automatic identification.
- **No need for intervention:** The system functions **automatically**, eliminating the need for drivers to interact with attendants or complex procedures.
- **Quick entry:** Validated RFID tags result in **rapid gate opening**, minimizing wait times and frustration.

For Administrators:

- **Hassle-free setup:** The system is designed for **straightforward installation and configuration**.
- **Minimal maintenance:** RFID tags are **durable and require minimal upkeep**.
- **Scalability:** The system can be **easily expanded** to accommodate additional parking spaces or integrate with existing infrastructure.

Overall, this smart parking system provides a **seamless and user-friendly experience for both drivers and**

administrators, contributing to a more efficient and manageable parking environment.

COMPONENTS REQUIRED

1. Microprocessor
2. Servo motor
3. RFID
4. Motor driver
5. Battery

E. Working of the Smart Parking System with RFID and Servo Motor

This system utilizes **RFID technology** for secure vehicle identification and **servo motors** for automated gate control, aiming to streamline the parking experience. Here's a breakdown of its operation:

1. Entering the Parking Lot:

- **Driver arrives:** The driver approaches the entrance gate with an **RFID tag** attached to the vehicle (e.g., windshield or license plate).
- **RFID tag detection:** The **RFID reader** at the gate detects the approaching vehicle's RFID tag and transmits the unique identification code to the **microcontroller**.

2. Authorization Check:

- **Microcontroller processing:** The microcontroller **compares the received code** against a pre-defined list of authorized tags (stored in its memory or retrieved from a database, if used).
- **Authorized access:** If the code matches, the microcontroller sends a **control signal** to the **servo motor**.

3. Gate Operation:

- **Gate opening:** Upon receiving the control signal, the **servo motor rotates** to a specific **predefined angle**, **opening the gate** to allow the authorized vehicle to enter the parking lot.
- **Unauthorized access:** If the code doesn't match, the **gate remains closed**, and an **indicator (e.g., LED)** might light up to inform the driver about unauthorized access.

4. Additional Functionality (Optional):

- **Parking space allocation:** The system can be expanded to **track parking space availability** and **assign a specific space** to the entering vehicle (requires additional sensors and database integration).
- **Payment system integration:** The system can be further integrated with a **payment module** to automate parking fee collection based on the duration of stay (requires additional components and software).

5. Exiting the Parking Lot (Optional):

- **Similar to entry:** Upon exiting, the vehicle approaches another gate equipped with an **RFID reader** and a **servo motor**.
- **Authorized exit:** If the exiting vehicle's tag is authorized, the system allows the vehicle to exit after processing the exit time and calculating the parking fee (if applicable).

Benefits of using RFID and Servo Motor:

- **Enhanced security:** Only authorized vehicles with valid RFID tags gain access, deterring unauthorized usage.
- **Increased efficiency:** Automated gate control eliminates wait times and streamlines the parking process.
- **Improved user experience:** Drivers can conveniently enter and exit the parking lot without manual intervention.
- **Scalability:** The system can be expanded to accommodate additional parking spaces and integrate with existing infrastructure.

This smart parking system combines the efficient identification capabilities of RFID with the precise control of servo motors, offering a promising solution for managing parking spaces effectively and improving the overall parking experience.

A. Conclusion

This project proposes a smart parking system utilizing **RFID technology** and **servo motors** to address the challenges of limited parking space and inefficient management. The system offers **enhanced security, improved efficiency, and a smoother user experience** compared to traditional methods.

Key benefits:

- **Reduced search time and frustration** for drivers seeking parking.
- **Increased efficiency** through automated access control and real-time data (optional).
- **Improved security** by restricting access to authorized vehicles only.

Future scope:

- **Integration with existing infrastructure:** Explore seamless integration with **parking management software** and existing parking facilities.
- **Advanced functionalities:** Investigate the potential for **real-time parking space availability display, mobile app integration for reservations, and automated payment systems** through internet connectivity (IoT).
- **Security enhancements:** Implement robust **secure communication protocols and advanced tag authentication methods** to prevent unauthorized access attempts.
- **Scalability improvements:** Develop **cost-effective and scalable solutions** suitable for diverse parking environments and large deployments.

By exploring these future advancements, this smart parking system has the potential to become an even more **comprehensive, secure, and adaptable solution** for managing parking spaces effectively, ultimately contributing

to a **more convenient and efficient parking experience** for users and administrators alike.

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