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# AutoSpot: An Android-Integrated IoT-Based Smart Car Parking System with Real-Time Slot Availability, RFID Authentication, and GSM Notifications

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**ABSTRACT:** The AutoSpot system is an IoT-based smart car parking solution that integrates Android technology, realtime slot monitoring, RFID authentication, and GSM notifications to enhance parking management efficiency. The system consists of an Arduino Uno microcontroller that coordinates communication between various components, including infrared (IR) sensors, an RFID reader, an LCD screen, and a GSM module. Users can access the system through an Android app, allowing them to check real-time parking slot availability, reserve spaces, and receive instant confirmation. IR sensors continuously monitor parking slots for occupancy, and when a vehicle enters the parking lot, the RFID reader scans a unique tag attached to the vehicle for authentication, ensuring secure access. Payment details are displayed on an LCD screen at the entry gate, providing users with transparency regarding parking fees. Upon exit, another IR sensor detects when the vehicle leaves, updating the slot availability in real-time. Additionally, the GSM module is used to send SMS alerts and call notifications to the registered vehicle owner, informing them about the booking status, entry, and exit. This integration of hardware and software optimizes parking space usage, improves security through RFID authentication, and prevents unauthorized access. The system enhances the user experience by automating parking management processes and offering timely notifications, thereby reducing congestion and making parking experience while improving overall parking lot management.

**KEYWORDS**: AutoSpot, Andoid technology, RFID Authentication, GSM, Arduino UNO, IR Sensor, LCD, SMS Alert, Parking space optimization, Congestion reduction

#### I. INTRODUCTION

The AutoSpot system is an innovative, IoT-based smart car parking solution designed to optimize parking management in commercial and public spaces. Utilizing an Android app, the system provides real-time parking slot availability, reservation capabilities, and instant booking confirmations for users. At its core, the system is powered by an Arduino Uno microcontroller, which coordinates the interaction between various components, including infrared (IR) sensors, an RFID reader, an LCD screen, and a GSM module. The IR sensors monitor parking slot occupancy, ensuring that realtime space availability is reflected on the app. Upon entry, an RFID reader scans a unique tag attached to the vehicle, allowing secure access to the parking lot. Payment details are displayed on an LCD screen at the entry gate, providing users with clear information about parking fees. Upon exit, another IR sensor detects the vehicle's departure, updating the slot status accordingly. To enhance communication, the GSM module sends SMS alerts and call notifications to registered vehicle owners, updating them on their booking status, entry, and exit. This integrated system reduces manual intervention, prevents unauthorized access, and ensures optimal space utilization, creating a seamless parking experience.

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#### **II. LITERATURE SURVEY**

#### [1] IoT Based Economic Smart Vehicle Parking System

In the current decade we are facing parking problem with the advancement in the technology. The population in urban cities is dense due to which lots of vehicles are running on road leads to parking problem, traffic problem. World is facing new challenge of Car parking. It is observed that one million of vehicles consumes oil on daily basis. In this paper, An automatic real-time system for automated car parking is proposed. This system is implemented with the help of internet of things (IOTs). IOT generally exchanges information or data between the two physical devices.

#### [2] Machine Learning for Object Prediction in Stationof-Things Environment

This paper put forwards the concept of Station-of Things (SoT) for identifying different vehicles types which are present in parking slot using Machine Learning (ML). The study in this paper uses the concept of Internet-of-Things (IoT) to represent a station (parking lot) containing a thing of interest (car) which can be homogeneous or heterogeneous, and is termed as SoT. Advanced research in communication, computation and sensors innovation has enabled to build intelligent SoT environment. SoT environment refers to a station containing an object or a thing of interest. This can be anything from occupancy of chairs in a study hall, vacant seats in auditorium, cars parked in parking-lot, books on a bookshelf, and so forth. Similarly identifying different objects like vehicles in parking slot, goods in warehouse, different furniture in furniture showroom, in above three mention situation different objects are of different dimensions but same system can be applied for prediction of objects by changing the dimensions of object in database of ML toolkit.

[3] Dynamic Reservation of Edge Servers via Deep Reinforcement Learning for Connected Vehicles Edge computing is promising for connected vehicles. As vehicles move, their resource demands for edge servers vary. Thus, it is necessary to reserve edge resource demands. Thus, the actions in DRL (i.e., reservation decisions) can adapt to future demands.

#### [4] Innovation Architecture Smart Car Parking System with Wireless Sensor Networks

Nowadays, the number of cars is increasing every year, with the number of cars increasing, the parking areas will be limited. If parking areas can take more space in a town/place, it will be good for the town itself because nowadays the problem is either no parking space or too much parking space which is not suitable for human space. Moreover, because our population keeps going up and space is reducing even, we have to cut the forest to make space for parking lots, which is not suitable for our ecosystem. The number of cars itself also increasing each year, which is so problematic in road and infrastructure management. To fix this, we need to have a sound management system for maximizing the use of available space in town and minimizing the traffic in the road. The problem nowadays is a roaming car that searching for parking space and making road traffic and making massive pollution for the town. When a car searching for a parking slot inside a building that is crowded, it will go around the parking lot, and there will be traffic inside the parking lot because many cars will queue searching for empty parking slots.

#### [5] A Hybrid VLC/RF Parking Automation System

This paper proposes an innovative and integrated parking automation system based on visible light communication (VLC) and radio frequency (RF) wireless technologies. The VLC and RF are used for vehicle-to-infrastructure communication, infrastructure-to-vehicle communication, indoor localization, and wireless mesh networks. modulation scheme in VLCbased transactions. Using the ParkLight software package consisting of an Android, Django, and LabVIEW PC-based applications.

We have introduced a VLC-based two-factor authentication and a charging payment system for installation at the gate barrier. An experimental evaluation of the proposed system is conducted under both day and night conditions in terms of optical interference cancellation, angular displacement, and the transmission link range

#### **III. COMPONENTS USED**

#### A. ARDUINO UNO:

This is the microcontroller board that serves as the brain of the system. It coordinates communication between the various components, processes data from the sensors, and controls the output signals.

#### B. INFRARED (IR) SENSORS:

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These sensors are used to detect the presence or absence of a vehicle in a parking slot. They provide real-time data on slot occupancy, which is crucial for monitoring parking availability.

#### C. RFID READER:

This device is used to scan the RFID tags attached to vehicles for authentication. It ensures that only authorized vehicles are allowed to access the parking facility, enhancing security.

#### D. RFID TAG:

A unique tag assigned to each registered vehicle. When scanned by the RFID reader, it allows the system to authenticate the vehicle.

#### E. GSM MODULE:

This module is used to send SMS alerts and call notifications to vehicle owners. It provides updates on booking status, entry/exit confirmations, and other relevant information.

#### F. LCD SCREEN:

This screen is used to display payment details and other relevant information to users at the entry gate. It provides transparency and clarity on parking fees and booking status.

#### G. ANDRIOD APP:

This mobile application allows users to interact with the parking system. It provides features such as real-time parking slot availability, reservation options, and instant booking confirmations.

#### H. POWER SUPPLY:

The power supply unit provides the necessary power to the system to ensure uninterrupted operation of all the components.

#### **IV. WORKING**

AutoSpot operates through the integration of several key components: Infrared sensors detect vehicle presence in parking slots, RFID technology authenticates vehicles for entry, and an Arduino Uno microcontroller coordinates these processes. Real-time slot availability is communicated to users via an Android application, which also facilitates reservations, while a GSM module sends SMS notifications for booking confirmations and other alerts. This system automates parking management by monitoring slot occupancy, controlling access, and providing user communication, ultimately enhancing efficiency and convenience.





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The AutoSpot system operates through a coordinated interplay of several components to automate and manage the parking process efficiently. Infrared (IR) sensors, installed at each parking slot, continuously monitor occupancy by detecting the presence or absence of vehicles, transmitting this real-time data to the Arduino Uno microcontroller. This microcontroller acts as the system's central hub, processing the data from the IR sensors to maintain up-to-date information on slot availability. Simultaneously, Radio Frequency Identification (RFID) technology enhances security by authenticating vehicles; authorized vehicles carry RFID tags that are read by a reader at the entry point, with the Arduino verifying these tags against a database to grant or deny access. User interaction is facilitated through an Android application, providing users with real-time slot availability, reservation capabilities, and booking confirmations. In addition, a GSM module enables the system to send SMS notifications to users, delivering booking status updates, entry/exit confirmations, and payment details. Overall, AutoSpot integrates these technologies to streamline parking, enhance security, and improve the user experience.





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V. RESULTS

#### 1. System Implementation and Functionality

- Real-time slot monitoring: Explain how you used IR sensors to monitor parking slot occupancy and maintain real-time updates.
- RFID authentication: Detail the implementation of RFID for secure vehicle access, including the hardware and authentication process.
- User interaction: Describe the Android application, emphasizing its features for slot availability, reservation, and user notifications.
- GSM notifications: Explain how GSM technology is used to send SMS alerts for booking status, entry/exit confirmations, and payment details.

#### 2. Hardware and Software Implementation

- Arduino Uno: Provide details on why you chose Arduino Uno, its specifications, and its role in the system.
- IoT integration: Elaborate on the role of IoT in your system, focusing on how it facilitates data exchange and remote monitoring.
- Software environment: Describe the embedded C programming, Arduino IDE, and any other software tools used in the project

#### VI. DISCUSSION

The AutoSpot project offers a compelling platform for discussion, centered around its innovative approach to modern parking management. By integrating diverse technologies, it presents a microcosm of the potential within smart city initiatives. The system's core functionality revolves around enhancing efficiency and convenience for both users and operators of parking facilities. Real-time slot availability, facilitated by IoT sensors, directly addresses the frustration of drivers searching for parking, minimizing wasted time and fuel consumption. The Android application extends this convenience by enabling users to reserve slots and receive instant booking confirmations, streamlining the parking process from start to finish. Security is significantly improved through RFID authentication, ensuring that only authorized vehicles gain access, a crucial aspect in any controlled parking environment. Furthermore, AutoSpot exemplifies the power of automation in optimizing operational processes. The system automates slot monitoring, access control, and user communication, reducing the need for manual intervention and freeing up personnel for other tasks. This automation not only increases efficiency but also minimizes the potential for human error. The project's design for commercial and public parking areas raises important questions about scalability and applicability. How easily can such a system be adapted to different sizes and types of parking facilities? What are the implications for urban planning and traffic management in smart cities? Comparing AutoSpot with traditional parking methods highlights its advancements in terms of user experience, security, and operational effectiveness. It prompts us to consider the ongoing evolution of parking solutions and the increasing role of technology in creating more sustainable, efficient, and user-friendly urban spaces. In essence, AutoSpot serves as a valuable case study for exploring the intersection of technology, urban planning, and everyday life, sparking discussions about the future of smart cities and the transformative power of IoT.

#### VII. CONCLUSION

AutoSpot delivers a robust solution to the challenges of modern parking management. By integrating IoT-based monitoring with RFID authentication and real-time user communication via an Android application, the system optimizes parking space utilization and reduces congestion effectively. AutoSpot enhances security through automated authentication and provides a seamless parking experience for users with real-time slot availability and reservation options. The system's automated features streamline operations, improve efficiency, and increase user convenience in commercial and public parking facilities. Ultimately, AutoSpot offers a comprehensive approach that not only simplifies the parking process for users but also ensures efficient management and operation of parking spaces, making it a valuable asset for modern urban environments. Additionally, the use of IR sensors and RFID technology ensures accurate tracking of parking space occupancy, preventing unauthorized access and improving security. The incorporation of an LCD screen at the entry gate provides transparency in payment details, enhancing the system's user-friendliness. Moreover, the system optimizes space utilization, reduce congestion.

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#### **VIII. FUTURE WORKS**

The future enhancements of the AutoSpot system aim to further improve efficiency, security, and user experience through advanced technologies. One key enhancement is the integration of AI-based predictive analytics, which will analyze historical parking data to forecast demand and suggest optimal parking slots, reducing congestion. Additionally, automatic number plate recognition (ANPR) can replace RFID authentication, eliminating the need for physical tags and enhancing security. The system can also incorporate automated payment gateways with digital wallets and UPI integration for seamless, contactless transactions. Another improvement is vehicle guidance systems using LED indicators or voice navigation to direct drivers to their reserved slots, minimizing search time. Further, solar-powered IoT sensors can make the system more energy-efficient and sustainable. Expanding AutoSpot's capabilities to support multi-level parking structures and integrating it with smart city initiatives will ensure broader adoption, making urban parking more intelligent, efficient, and user-friendly in the future.

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