# IoT Based Vehicle Parking System

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# ABSTRACT

The number of vehicles is increasing at a tremendous rate but there are no sufficient parking areas to occupy the growing vehicle population. An IoT based parking management system can be implemented for the efficient utilisation of available parking space. The system utilizes ultrasonic sensors to detect vehicle presence in each parking slot. It offers real-time monitoring of parking slot availability, with users being informed via an Android app and an LCD screen displaying parking slot status. User authentication is done using Radio Frequency Identification (RFID) system that also records the time of vehicle entry and exit to enable collection of parking fare according to the duration of parking. The notification of the bill is sent to the user via SMS. This provides a time efficient and user friendly approach to solve parking crisis.

Keywords: IoT, RFID, Android app

### 1 Introduction

An IoT based vehicle parking system is a modern approach to optimize and manage the process of vehicle parking in a given area. In this system, IoT technology is used to create a network of sensors and other IoT devices that are installed in a parking lot or garage. These devices are connected to a central computer system or cloud platform that enables real-time monitoring and control of the parking process. The main purpose of implementing an IoT-based vehicle parking system is to increase parking efficiency and convenience. It accomplishes this goal by furnishing realtime data on parking space availability and by automating parking fee collection. Bettering driver experience and reducing traffic congestion are additional benefits of the system's implementation. Overall, the system serves to enhance parking efficiency and convenience while addressing safety concerns. The usage of this technology is becoming increasingly common in cities around the world, and it is undoubtedly an effective application of IoT technology.

## 2 Literature Survey

Smart parking systems can be developed using various methods, many of which requires little to no manual intervention for their functioning.

An approach for efficient parking management involves assigning an RFID card to each user entering the parking area. The card is scanned by a reader module to check for parking slot availability [1]. Upon confirmation, the user receives a notification via GSM module.

When a vehicle enters the parking area, the smart parking system scans its RFID tag with a reader and compares the information to a database which contains information of all vehicles [2]. If there is a match, the barrier gate opens; otherwise, an alarm is triggered. This process automates the vehicle check-in and check-out processes and keeps all relevant vehicle information in a centralized location.

Another system involves deploying low-cost wireless sensors in each parking slot which periodically report their occupancy status to a central database that can be accessed by a management system [3].

One of the proposed systems uses an RFID scanner to detect the user's RFID card and trigger an SMS alert to them, while also updating the cloud status during entry and exit of vehicles [4].



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Thus, our aim is to develop an IoT based smart vehicle parking system that helps to minimize human intervention in parking management and to reduce parking crisis especially in crowded areas.

#### 3 Proposed System

This paper describes the proposed architecture of IoT based vehicle parking system. The key objective of this system is to effectively address the issues related to parking management and to deliver a seamless and stress-free parking experience for drivers. To achieve this goal, we have implemented a range of features, such as real-time monitoring of parking slot availability, notifications to users about the status of parking slots via an android application and an advanced Radio Frequency Identification system to authenticate users during entry and exit. The system also includes intelligent billing feature that automatically logs in the time vehicles enter and exit, simplifying the calculation of parking fee depending on the time duration. This system is intended to enhance security in parking areas, reduce human interventions in parking management and provide a hassle-free parking experience for drivers.



Figure 1: A block diagram outlining the proposed system

Figure 1 illustrates the key functional blocks of the intended vehicle parking system. This system employs an Arduino UNO microcontroller as the central unit for controlling and monitoring the parking process. To detect the presence of vehicles in every parking slot, ultrasonic sensors are employed while an LCD screen displays the parking slot's status. At the parking area's entrance, an RFID module verify users and a servo motor-operated gate allows entry only to authorized users. The GSM module is designed to send parking fare notifications to user's mobile devices. A Wi-Fi module is used to link the hardware components to the server, providing the necessary connectivity. The data stored on the server will be displayed through an android app which acts as the user interface.

## 4 Methodology

Figure 2 depicts the blocks of functional components used in the vehicle parking system that operates using IoT technology.

The main functional units of the system are:

- 1) User authentication unit
- 2) Slot status checking unit
- 3) Billing unit

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### 4) Data storage and display unit



Figure 2: Schematic showing the functional blocks of system

# 4.1 User Authentication Unit

This unit consists of a Radio Frequency Identification System, including an RFID reader module and tags. The parking area's entrance has an installed RFID reader that scans RFID cards issued to users upon entry and exit from the parking area.

# 4.2 Slot Status Checking Unit

The parking area is segmented into multiple parking slots and each slot has an ultrasonic sensor to detect the existence of vehicles. This allows us to detect the availability of vacant parking spaces and display their status on the LCD screen.

# 4.3 Billing Unit

When the RFID card is scanned, the entry and exit time of the vehicle is recorded. Based on the duration of parking, the invoice is calculated, and an SMS notification is sent with a GSM module.

# 4.4 Data Storage and Display Unit

The parking slots are continuously monitored in real-time and updates on the slot's availability are made regularly. This information is saved in a server and displayed through an Android app, allowing users a user-friendly interface to monitor parking slot availability ahead of time.

# 5 Implementation

To ensure a secure parking experience, the proposed vehicle parking system will provide each user with an RFID card containing a unique identification number. During the check in process, users will have to scan their RFID card at the entrance gate. Only when the user's card ID in the database matches the identification number, the gate to the parking area will open. The entry time of the user will also be recorded, allowing them to park their car in an available parking slot. The LCD screen indicates the number of vacant parking slots in the parking area. Additionally, users can use the android app to check the parking slot status in advance.

During the check-out process, the user has to scan his RFID card again. The exit time will be recorded, and the parking fare will be calculated and then communicated to the user via SMS. The exit gate will also open, and the user can exit from the parking area.

# 6 Result and Discussion

The proposed system is implemented, and the obtained results are discussed here.



Figure 3: Demonstration of vehicle parking system

Figure 3 shows the demonstration of proposed vehicle parking system. This system addresses the parking crisis by efficiently utilizing available parking areas, minimizing wasted time, and reducing fuel consumption when searching for parking spaces. A smart parking system enables individuals to search for free parking areas and check parking availability in advance, saving their time and effort. Additionally, this system can reduce traffic congestion, improve the overall parking experience for drivers and create a more eco-friendly environment by reducing fuel consumption.



Figure 4: Slot status checking unit

Figure 4 shows the slot status checking unit which consist of ultrasonic sensors that are connected to the microcontroller board. Each parking slot has an ultrasonic sensor to detect whether there are any vehicles parked in them. These sensors use sound waves to detect objects in their range, making it easy to determine the status of a parking slot (whether it is filled or empty). By using this technology, the system provides accurate detection of parking slot status, enabling users to easily find an available parking space



Figure 5: SMS to user's and owner's mobile

Figure 5 shows the SMS notifications received in user's and owner's mobile. When a user scans the RFID card, the gate opens and an SMS is send to his mobile showing the initial entry fee. After parking, the user has to scan his card again to exit from the parking area. The exit time will be noted and a parking fare will be calculated depending on the parking duration. This bill notification is also sent to the user's mobile as SMS. A confirmation message showing the money credited from the user is send to the admin's mobile.



Figure 6: App View

Figure 6 shows the app view of the system. The real-time data obtained from the ultrasonic sensor are stored in a web server and displayed using an app. The app provides good user interface so that user can know about the availability of parking spaces in advance.

## 7 Conclusion

As the population continues to grow, the usage of vehicles increases, creating a need for effective parking management solutions. Our proposed IoT based vehicle parking system highlights the use of advanced technologies, such as ultrasonic sensors, Radio Frequency Identification system (RFID), and an android app, to address these challenges. By avoiding needless searches for available parking slots, our system saves users time and provides a seamless parking experience. The android app acts as a user interface, enabling users to check slot availability in advance, while the RFID

system at the parking entrance ensures secure user authentication. Moreover, our system is user-friendly and costeffective, making it an ideal choice for efficient parking management. With this advanced parking solution, we can reduce traffic congestion, specifically in urban areas, which can result in the reduction of human effort. This system also helps to store a database of vehicles that have entered and parked, along with the parking duration. By implementing these innovative features, our system helps to revolutionize parking management and enables effective parking utilization.

#### 8 Publisher's Note

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