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Android Based Smart Vehicle Parking System Using IoT

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ABSTRACT*:* In today's urban areas, managing parking systems has become a crucial task due to the increasing number of vehicles and the limited availability of parking spots. To address these parking challenges, this paper introduces an android based smart vehicle parking system that leverages IoT (Internet of Things) technology. This innovative system aims to enhance the parking experience by incorporating real-time monitoring, reservation capabilities, and automated payment processing. The proposed smart parking system relies on a combination of Android devices, IoT sensors, and cloud connectivity. Each parking space is equipped with IoT sensors to constantly monitor occupancy levels, and this data is transmitted in real-time to a cloud platform. Through a user-friendly Android smartphone application, drivers can conveniently access the system to check parking space availability, reserve parking spots, and make payments. The Android-based smart vehicle parking system using IoT presents a practical and efficient solution for managing parking spaces. by offering real-time tracking, reservation options, and automated payment processing, it streamlines parking operations, enhances the overall user experience, and optimizes the utilization of parking resources in busy urban environments. This approach addresses the growing parking issues, making parking more accessible and convenient for drivers in metropolitan areas.

KEYWORDS*:* Parking Systems, Smart Parking, IoT (Internet of Things), Cloud Connectivity, Parking Spot Reservation.

I. INTRODUCTION

In today's bustling metropolitan areas, managing parking spaces has become a pressing challenge. The traditional parking systems are struggling to keep up with the increasing number of vehicles and the limited availability of parking spots. To address these issues, this paper introduces an Android-based smart vehicle parking system powered by IoT (Internet of Things) technologies [1]. This smart parking system revolutionizes parking space management by integrating Android smartphones, IoT sensors, and cloud connectivity [2-4]. By leveraging IoT capabilities, the system offers real-time monitoring, reservation options, and automatic payment processing, providing users with a convenient and efficient parking experience [5]. Ultrasonic sensors are installed in each parking spot to accurately determine occupancy status. These sensors continuously collect real-time data, which is then sent to a cloud platform for analysis [6]. Through the Android smartphone application, drivers can access the cloud platform to check parking availability in real-time. This empowers users to make informed decisions and quickly find open parking spaces, saving time and frustration spent searching for parking.

Reservation functionality is a key feature of the Android-based smart vehicle parking system. Drivers can reserve parking spaces in advance through the smartphone app, ensuring availability upon arrival. After making a reservation, users receive a unique QR code generated by the app [7]. This QR code acts as a digital ticket, facilitating a hassle-free check-in process at the parking facility. By simply scanning the QR code with their smartphones, users can easily access their reserved parking spaces, expediting the overall parking process. The system also offers automated and simplified payment processing, providing users with flexibility and convenience [8]. It supports Unified payment interface (UPI) payment method and calculates parking fees based on the duration of the stay, ensuring accuracy and fairness. With automated payment processing through the smartphone app, there is no need for manual payment handling or cash transaction [9]. Additionally, the Android-based smart vehicle parking system incorporates a servo motor mechanism for controlling the parking gate. The servo motor plays a crucial role in automating the gate's opening and closing process, further enhancing the convenience and efficiency of the parking system [10]. When a driver successfully reserves a parking space through the smartphone app or approaches the entrance, the system signals

the servo motor to open the gate automatically. This eliminates the need for manual gate operation and reduces the waiting time for drivers entering or exiting the parking facility.

II. LITERATURE SURVEY

Nor Bakiah Abd Warif, Mohd Izzat Syahmi Saiful Azman, Nor-Syahidatul N Ismail, and Muhammad Akmal Remli focus on integrating hardware connections, a database, and a mobile application for their IoT-based Smart Parking System using an Android Application[1]. Users can use their smartphones to find and reserve available parking lots utilizing the technology. Real-time information on parking availability is offered by utilizing IoT technologies. Abhirup Khanna and Rishi Anand's IoT-based Smart Parking System[2], which was presented at the 2016 International Conference on Internet of Things and Applications, is centered around an application that offers real-time parking availability data. Through a mobile application, users can easily reserve parking places. The study emphasizes the use of IoT technology and how it could help with parking management and general parking experience.

The project presented by Rifqi Muhammad Fikri and Mintae Hwang at IoTaIS 2019 focuses on a Smart Parking Area Management System for the Disabled[3]. It addresses the problem of unauthorized parking in spots designated for people with disabilities. The proposed solution utilizes IoT technology and a mobile application, integrating identification techniques, reservation systems, and an alarm system. The aim is to prevent infractions and enhance the quality of life for individuals with disabilities. The paper by Venkatesh Bharti, Vishal Sharma, Krishna Sureka, and Rashmi Agarwal presents a novel Smart Parking System using IoT technology[4]. It was presented at the conference on Machine Learning, Big Data, Cloud, and Parallel Computing in 2022. The system allows users to check real-time parking space availability through a smartphone application. The framework aims to reduce fuel consumption and environmental pollution, utilizing components like RFID Tag, RFID Scanner, and a Mobile Application to create an efficient Smart Parking System (NOSP).

The authors of the paper "IoT-based Smart Parking System"[5] by Umang Shah, Punit Ratnani, and Yash Agarwal present an IoT system in ICICCS 2021. Through a smartphone app, it allows users to locate open parking spaces and uses IR sensors, RFID, and Arduino to process reservations, payments, and real-time availability. An IoT platform-based smart parking guidance system[6] is presented in the article by Dae-hyun Kim, Sung-hyun Park, Seungwoon Lee, and Byeong-hee Roh that was presented at ISCIT 2018. The system incorporates parking information display with reservation, accident prevention, and shortest way navigation. To determine how well the method worked, the researchers ran tests in a small parking lot. With the suggested method, parking navigation will be improved, collisions will be avoided, and parking will be more enjoyable overall.

The paper by Prof. Denis Ashok, Akshat Tiwari, and Vipul Jirge presented at IC-ETITE 2020 introduces a Smart Parking System utilizing IoT technology[7]. The system is designed for multi-storied office parking areas. It incorporates advanced Honeywell sensors and controllers to create a systematic parking solution. The cloud-based storage of occupied parking spaces enables efficient allocation of available spaces for incoming cars.

An IoT-based Smart Parking System[8] is described in the work by Yash Agarwal, Prof. Punit Ratnani, Umang Shah, and Puru Jain that was presented at ICICCS 2021. Users of the system can find open parking spaces in a specific location. For increased effectiveness and dependability, it integrates a mobile app with Internet of Things sensors. Wi-Fi and RFID technologies are used in the solution to provide smooth parking management. In their work at ICACCS 2022, Gunanandhini S, Monisha K, Kaviya E, Gokul R, and Lishanthini V introduce a Smart Parking system using an Internet of Things (IoT) surveillance system[9]. The suggested method makes use of IoT modules to keep track of and take pictures of the vehicles in the reservation application. Users of mobile or desktop applications can access real-time parking availability status and barcodes link the application to particular parking locations. The paper by Md. Mahmudul Kabir Peyal, Anirudha Barman, Tashfia Tahiat, Quazi Md. Ahnaf Ul Haque, Anindya Bal, and Sharif Ahmed presented at ISAMSR 2021 proposes an IoT-based affordable auto parking management system for metropolitan areas[10]. The system focuses on the difficulty of locating parking spaces in Dhaka. Photoresistors are linked to a mobile app using low-cost technology and real-time IoT communication. The cost-effective method aims to reduce traffic congestion and maximize traveler time.

III. **SYSTEM DESIGN**

The Android-Based Smart Vehicle Parking System utilizes IoT technology and is designed to simplify and optimize the parking process. The parking space is equipped with ultrasonic sensors integrated into each slot, enabling the system to detect the presence or absence of vehicles in real-time. These sensors constantly monitor the occupancy status of the parking slots. The data collected by the ultrasonic sensors is then forwarded to an embedded system, Raspberry Pi, which acts as the central processing unit for the parking system. Raspberry Pi processes the incoming signals and determines the availability of parking slots based on the information received from the sensors. Subsequently, this vacancy data is updated and stored in a cloud database. To facilitate seamless access to parking information for users, the system incorporates a mobile application. Through the mobile app, users can effortlessly check the availability of parking slots in the designated area. The application's user interface automatically updates in real-time as changes occur in the database, ensuring that users are promptly informed about the current parking slot availability (Fig. 1).

The Smart Vehicle Parking System using IoT, as represented in Fig. 2, is an Android-based solution that incorporates ultrasonic sensors to efficiently manage parking spaces. Through the Android application, users can easily interact with the system using their mobile devices. Once the users logged in, users can effortlessly navigate, book parking spaces in advance, and complete digital payments, receiving instant booking confirmations. This integrated approach optimizes the parking experience, ensuring efficient utilization of parking spaces and offering a user-friendly solution for parking management.
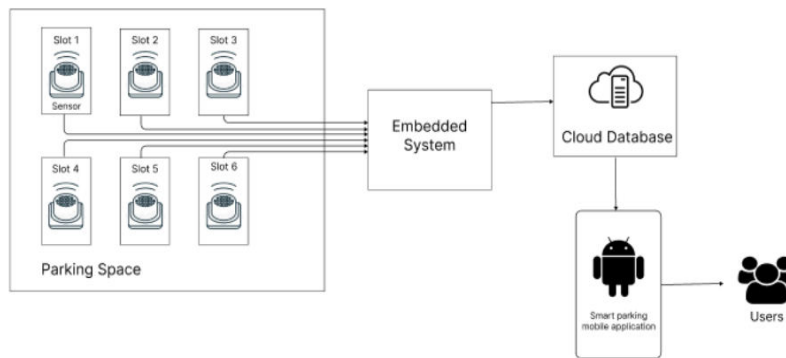

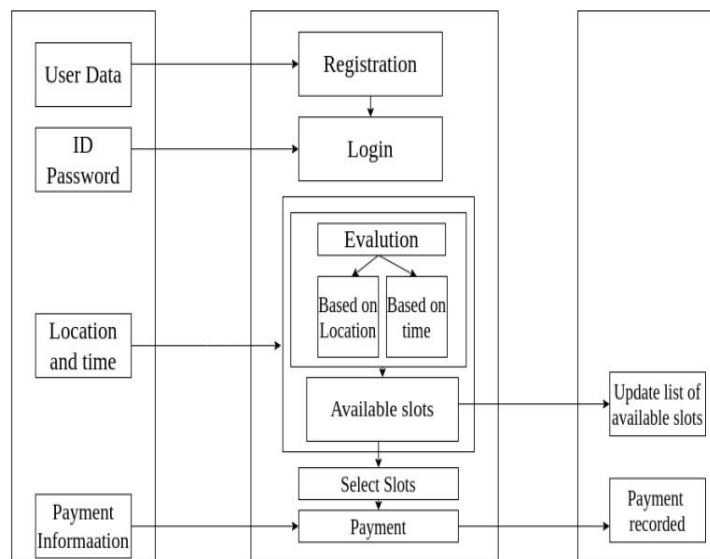Fig. 1. Architecture Design for Android Based Smart Vehicle Parking System using IoT

Fig. 2. Block Diagram for Android Based Smart Vehicle Parking System using IoT

Fig. 3 displays the schematic diagram of the Android-Based Smart Vehicle Parking System prototype, outlining the connections and data flow among its components. Ultrasonic sensors detect vehicle presence, and the data is forwarded to the Raspberry Pi for processing. The Raspberry Pi controls the servo motor, which operates the parking area gates. This dynamic interaction provides users with real-time parking availability information.

Fig. 3. Schematic Diagram for Android Based Smart Vehicle Parking System using IoT

IV. **IMPLEMENTATION AND RESULT**

The Android application is developed using the Flutter framework [11], allowing users to locate and reserve parking slots for their vehicles. Users are required to register and log in to the application to reserve their parking slots. They can select the parking timings and duration, and provide their vehicle information and valid details to make a payment for the reservation of the parking slot. When users open the application, they will need to register (Fig. 5) and log in (Fig. 6). After a successful login, the user will be able to view all the nearby parking areas. The users need to select a parking area. In the parking area, there will be two types of parking spaces available: opened and covered parking areas. The application will display details related to the parking area, including parking slot availability (Fig. 7). Once the user selects a parking area, they will need to choose the duration for parking their vehicle (Fig. 8). Next, they need to provide valid information to reserve their parking slot and make the payment (Fig. 9 and Fig. 10). After a successful payment, the user will receive a payment successful alert along with a QR code (Fig. 11). In case of a payment failure, the user will receive a payment failed alert (Fig. 12).
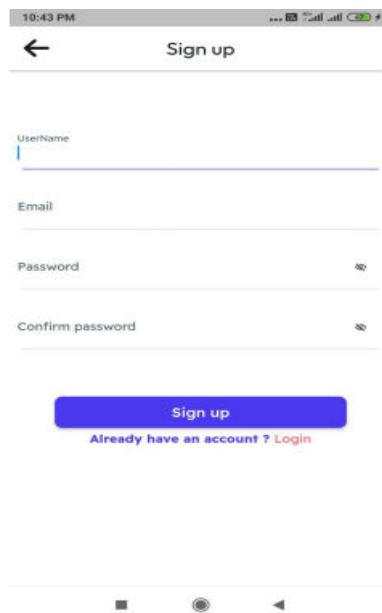

Fig. 4. Landing Screen

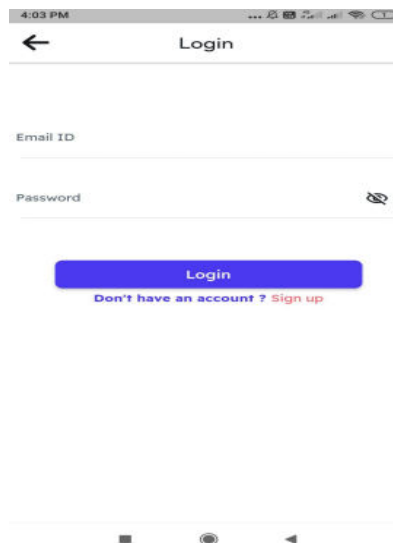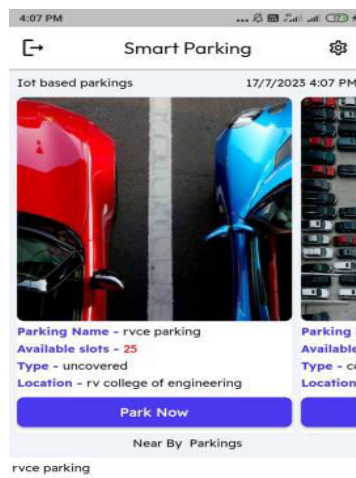Fig. 5. Registration Screen

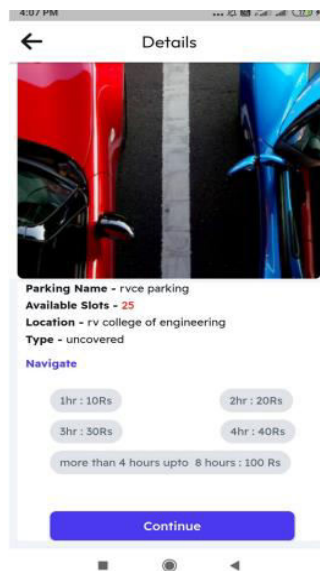Fig. 6. Login Screen

Fig. 7. Parking Area Screen

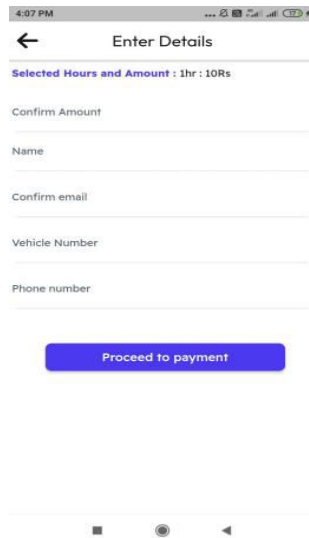Fig. 8. Duration selection Screen

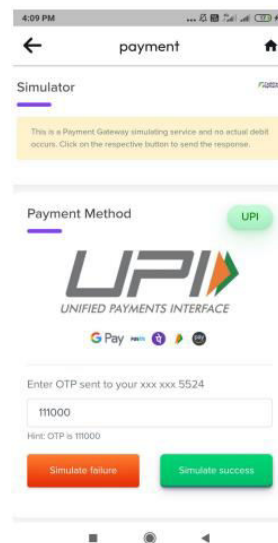Fig. 9. Reservation Screen

Fig. 10. Payment Screen

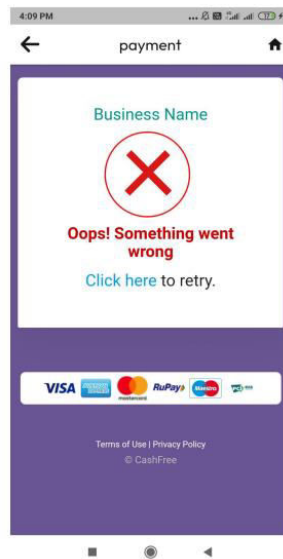Fig. 11. Payment Successful Screen

Fig. 12. Payment Fail Screen

V. CONCLUSIONS

The Android-based smart vehicle parking system using IoT is a revolutionary solution for urban parking management. By leveraging IoT sensors, it offers real-time monitoring and reservation capabilities, greatly enhancing the overall user experience. The servo motor technology automates gate control, ensuring a smooth and secure entry and exit process. With cloud connectivity, the system enables remote monitoring for added security and quick issue resolution. The automated payment processing supports various methods, providing convenience for users. Overall, it streamlines parking operations, optimizes resource utilization, and offers a hassle-free parking experience for both drivers and operators. This intelligent parking solution effectively addresses the challenges associated with urban parking, delivering a seamless and efficient parking service.

ACKNOWLEDGMENT

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