An App for IoT based Smart Parking System

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Abstract: *The increase in population has resulted in an increase in the number of automobiles. This has made the task of finding a parking spot difficult. According to recent studies, about 40% of the traffic volume is made up of vehicles cruising to find a parking spot. The aimless drive-in search for a parking spot can result in traffic congestion, an increase in air pollution and wastage of time and fuel. As an effective solution to this issue, a mobile application for smart parking system is suggested. Using this app a registered user can check the slot availability, view the occupancy prediction for a parking area or book a slot in advance. By this means, both energy and time are saved and if this parking system is implemented in shopping areas, institutions, and airports it can facilitate hassle free parking*

Keywords: IoT, Android App, Smart Parking.

I. INTRODUCTION

The exponential increase in population has led to increase in the number of automobiles. With the improvement in economy and availability of cheap second-hand vehicles almost everyone owns at least one automobile. This has its own advantages and disadvantages. One of its major advantages is that it allows people to easily travel from one place to another comfortably. The disadvantages include that it has become a reason for traffic congestions, increase in air pollution etc. The increase in the number of vehicles has also made it difficult to find a parking space. The aimless search for a parking space by the people can lead to traffic congestions, increase in pollution and wastage of time and fuel. The proposed solution for this problem is a smart parking system. This may be an app or website which would provide the user the capability to view the parking slots availability in a place or book a slot in advance. Smart parking facilities have always been the core of constructing smart cities. They are an ideal solution for decreasing urban traffic and pollution. Smart parking systems can be implemented in shopping areas, institutions, and airports to facilitate hassle free parking.

II. RELATED WORKS

A smart parking system offers a modern and intelligent approach to parking management, enhancing urban mobility, reducing traffic congestion and improving the overall quality of life in cities. This type of system can be developed in different ways and can be equipped with different functionalities. In [1], smart parking system is in the form of an app. It has been developed to solve the issue of difficulty in finding a parking spot in Istanbul. The data collected is stored in the cloud. LSTM has been used for predicting the occupancy rates for the nearby parking areas. The dataset used to implement the system has been obtained from the Istanbul Metropolitan Municipality (IMM) open data portal which is a free portal where data published from municipalities and surrounding organizations can be accessed. In [2], both an app and a website version of the smart parking system has been developed. The app was developed in Android Studio using java and the website was developed using HTML and CSS. The hardware used to implement the system are: Raspberry Pi 3, Arduino Uno, MFRC522 RFID Reader/Writer and Servo Motors. The details collected during the registration process are stored in a 16GB SD card. RFID tags are used to ensure that the user parks in the right spot. In this system the booking is done by the admin. Google maps has been used for navigation. In [3], the hardware used to implement the system are: Ultrasonic Sensor, Ultrasonic Ranging Module HC-SR04, Arduino and Raspberry Pi. The parking lot information is stored in the Raspberry Pi and it is interfaced with GPS (Global Position system) to give the location of the parking lot. The smart parking system is in the form of an app and has the capability to guide the car to the nearest parking area. Ultrasonic sensors and Ultrasonic Ranging modules are used to detect the cars and for

updating of status of slots. QR codes are used for authentication. This system has the ability to generate bills for the parking area. In [4], to implement the system the hardware used are: GSM Module, IR Sensor, RFID Card, Reader Module, Servo Motor, Arduino Nano and WiFi Module. The IR sensors are used to detect the cars and GSM module is used for communication. The data about the user's activity in the parking space is stored in cloud database. The cloud status is updated every 2 minutes. The WIFI module helps to store all the data in the cloud. It connects the devices with the cloud server. In [5], to implement the system the hardware used are: IR Sensor, WiFi Module, RFID Reader, RFID tag. The smart parking system is in the form of an app and a website. Every user must be registered. Once the user is registered, they can see the slot availability, book a slot and make payment. In [6], to implement this system the hardware used are: Ultrasonic Sensor, Pi Camera, Raspberry Pi. The smart parking system is in the form of an app. The database used is Firebase Real-Time Database. The information collected from the Ultrasonic sensors and Pi camera are used as the input to update the status of the slots. PayPal has been used as medium for the user to make a payment in the mobile application.

III. PROPOSED SYSTEM

A smart parking system is a cutting-edge solution that leverages modern technology to revolutionize the parking experience. It provides a range of features that make parking more convenient, efficient, and user-friendly. With the capability to book a slot, list previous bookings and predict the occupancy rates, the proposed system offers unparalleled convenience to the user. Using this system, drivers can reserve a parking spot at their desired location, eliminating the hassle of searching for a parking space. The system also allows users to view their previous bookings, providing a convenient record of their parking history. In addition to these features, the smart parking system utilizes data analysis to predict parking area's occupancy rates. This helps drivers plan their journeys more effectively and reduces traffic congestion by directing drivers to areas with available parking. Two apps have been created one for the user and the other for the admin. A user will have to be registered to use the services provided by the user app. The system allows a registered user to book a slot, view list of previous bookings and predict the occupancy rate for an upcoming date. The user can book a slot by selecting the desired slot, date for booking, timespan for booking and entering the card details. If the booking is successful then a QR code is generated and the booking details are displayed. This QR code should be shown by the user at the entry gate. By clicking the 'My Bookings' button, the user can view their booking history. By clicking the 'Slot Availability Prediction' button, the user can select a date for which the occupancy rate should be predicted. Upon selecting a date, the occupancy rate prediction for that date will be displayed on screen. In the Admin app, the admin can login using the previously set login details and scan the QR code shown by the user at the gate. The admin app checks if the QR code is valid and if it is valid,it displays the booking details. When the valid QR code is scanned the servo motor is triggered to open the barricade. The user can then enter the parking area and park their vehicle.

IV. IMPLEMENTATION

Both the user app and admin app has been developed in Android Studio using Java and Firebase has been used to store the data. The user app has functionalities such as signup, login, booking a slot, view slot availability prediction and logout. During the registration process details of the user such as username, full name, mail ID and password are collected. Once the user is registered the user can login using the mail ID and password used for registration.If the user has entered valid credentials the user will be taken to another screen where there are buttons such as 'Book Parking Slots', 'My Bookings', 'Slot Availability Prediction'and 'Logout'.

If the user clicks on 'Book Parking Slots' button the user is taken to another screen where the user can select the desired slot from a list of slots. The booked slots are shown in red with the text 'BOOKED' and the available slots are shown in green with the text representing that slot. Upon choosing an available slot the user is taken to another screen where the user can select the date and time span for which the slot is to be booked. The user then has to enter the card details and click on the 'Confirm Booking' button to book that slot for the selected date and time span. If the booking is successful a QR code is generated and the booking details such as booking ID, date and timespan for which the booking was made etc. along with the generated QR code is displayed on the screen. If the user clicks on the 'My Bookings' button the user is taken to a screen which displays all the bookings the user has made.If the user clicks on the 'Slot

Availability Prediction' button the user is taken to a screen where the user has to select a date for which the prediction is to be made. If the selected date is a date in the past or current date then an error message is displayed. If a future date is chosen the occupancy rate prediction for that particular date is displayed on the screen. If the user clicks on the 'Logout' button the user is taken back to the login page.

The admin app has pre-set login credentials. There is no signup functionality in the admin app. Once the admin logs in using the login credentials, the admin can scan the QR codes shown by the user using the QR code scanner. When theAdmin app scans a QR code it checks if that QR code is valid or not. If it is valid the booking details corresponding tothat QR code is displayed on the screen. If the scanned ticket is invalid an error message is shown on screen.In the admin app the admin has the capability to update the status of a ticket. When a user is at the gate and a valid QR code is scanned the admin can update the status to 'IN' as the user enters and when the user exits the parking area the admin can update the status to 'OUT'.

The hardware model has been created to represent a real-life parking area. The hardware used for this are as follows:

- ESP8266 WiFi Module
- Arduino Uno
- IR Sensors
- Servo Motor
- Jumper Wires
- Breadboard
- USB Cable
- Data Cable

The WiFi module has been used to send and receive data over WiFi. The Arduino has been used to read sensor data and to control the actions of the servo motors. The IR sensors have been used to detect the cars in the parking area. The servo motor has been used to open and close the barricade.
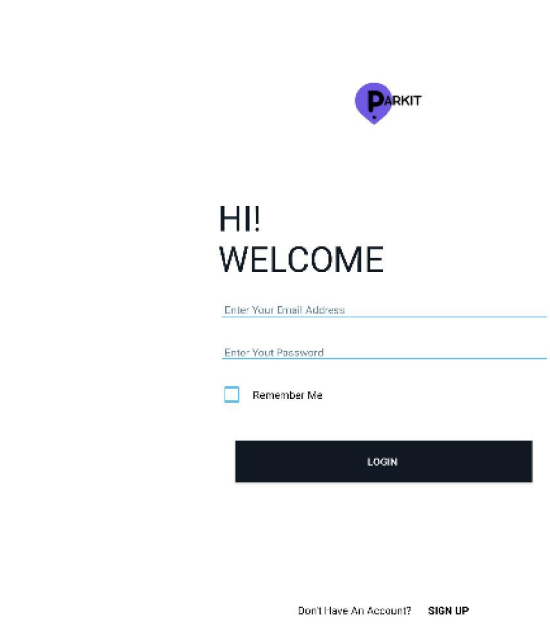
V. RESULTS
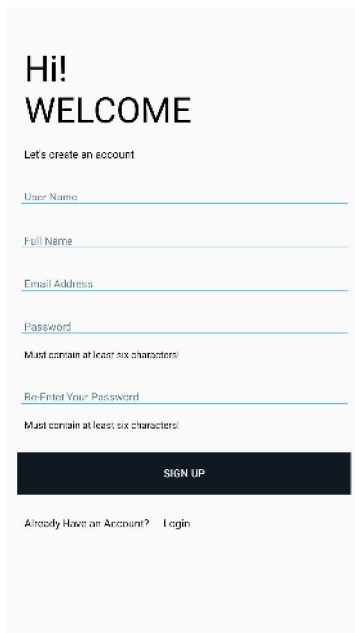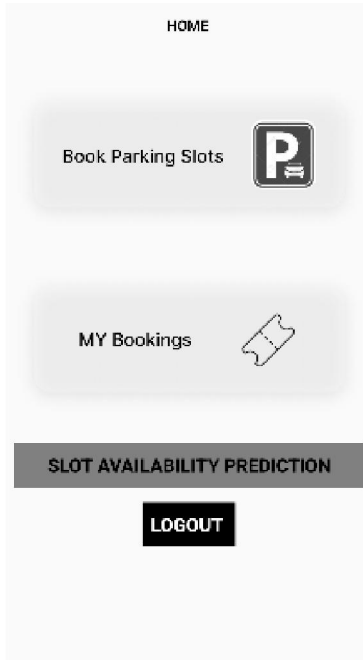

Fig. 1 Sign Up Screen
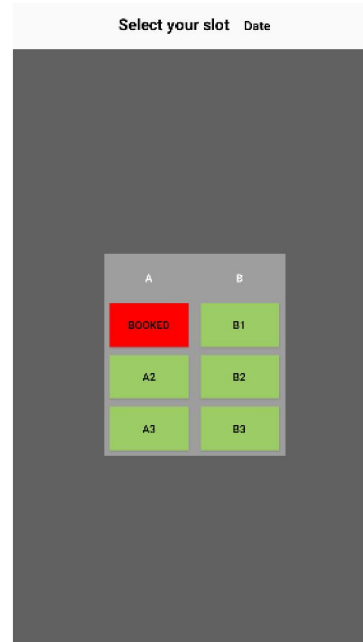

Fig. 2 Login Screen

Fig. 3 Home Screen

Fig. 4 Slot Selection Screen
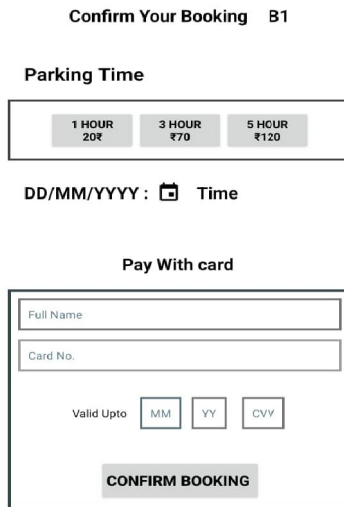

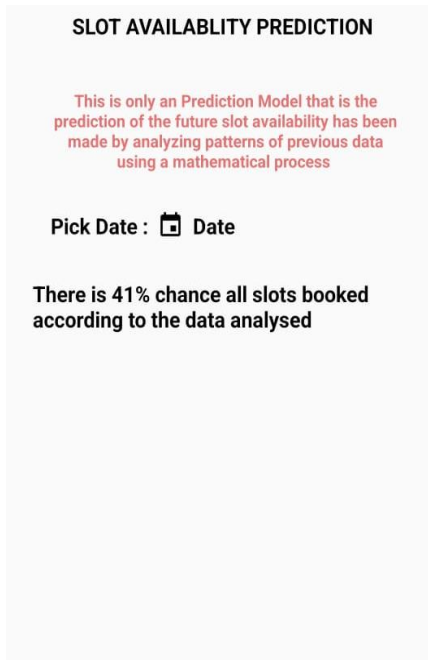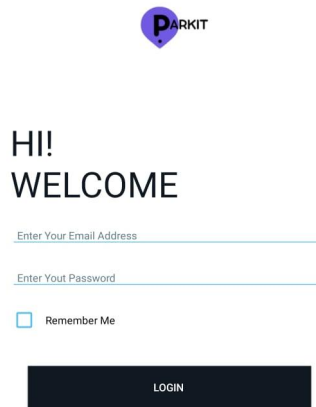Fig.5Booking Details Collection Screen

Fig. 6 QR code Generated Screen

Fig. 7 Slot Availability Prediction Screen

Fig. 8 Admin Login Screen

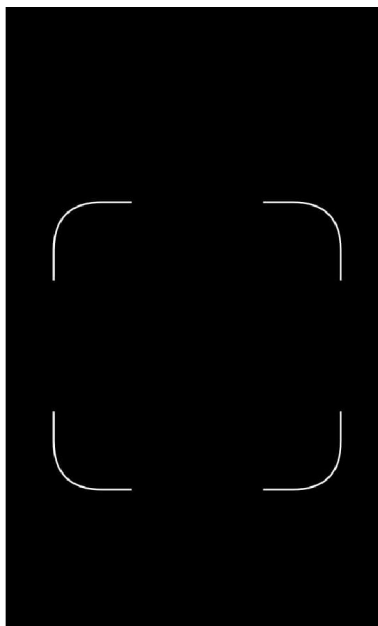Fig.9 QR Code Scanner of Admin App
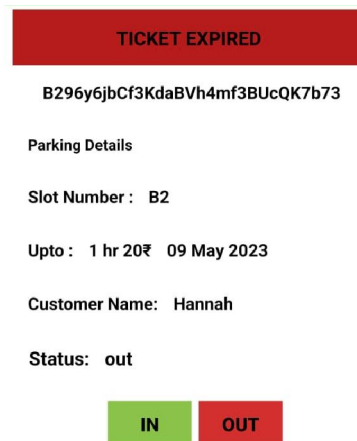
Fig. 10 Screen when an expired QR code is scanned.

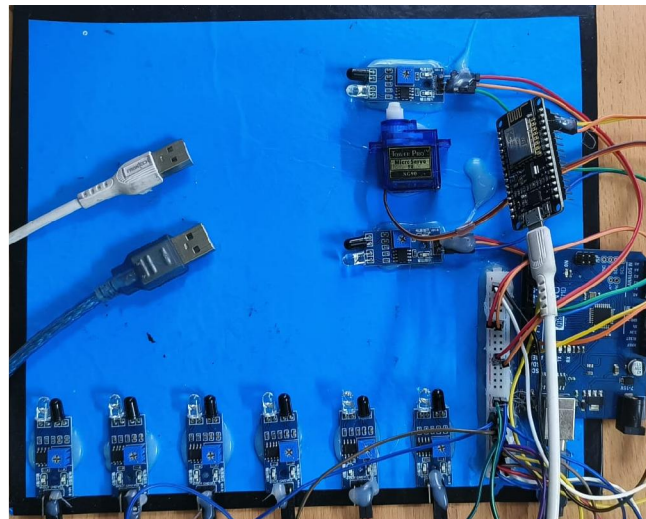Fig.11 Booking Details of Valid Ticket and Status Updating Screen

Fig. 12 Hardware Model

VI. CONCLUSION

In conclusion, a smart parking system is an innovative solution that aims to optimize the use of parking spaces in urban areas. This system leverages modern technologies, such as IoT sensors, mobile applications, and data analytics, to provide real-time information on parking availability, streamline parking operations, and enhance the overall parking experience. The implementation of a smart parking system offers numerous benefits, including reduced traffic congestion, improved air quality, and increased revenue for parking operators. Additionally, it provides convenience and time-saving benefits to drivers, who can easily locate available parking spaces and make payment without the need

for physical cash or tickets. Despite these benefits, the implementation of a smart parking system requires significant investment and may face challenges such as the need for reliable and stable connectivity, the privacy concerns of drivers, and the resistance of traditional parking operators to change. However, these challenges can be overcome with careful planning, stakeholder engagement, and effective communication. A smart parking system is a promising solution for addressing the challenges of parking in urban areas. With its potential to improve efficiency, reduce costs, and enhance the user experience, it is an investment worth considering for cities and parking operators looking to optimize their parking infrastructure

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