Original Article

Authentication Of Vehicle In Parking Using Flutter And Firebase

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DOI: 10.47750/pnr.2022.13.S10.674

Abstract

Traffic congestion and long queues of vehicles is the common sight near parking spaces, which results in wastage of time and burning of fuel because of manual checking done at parking areas.
This manual checking has loop holes such as no record of vehicles entering and exiting, no concrete process for authentication of vehicle and authorization of its owner and other security concerns amidst the absence of proper security surveillance. Therefore, designing an android application that is cost-effective and efficient to improve the parking security. The android application is built in Flutter and Firebase for robust architecture. For this application, QR-code scanner technology is used for converting data into two-dimensional format in a compact size by using Flutter qr-code library. The test results comparing the old and new systems Show that there is an increase in efficiency of 62%.

Keywords Parking Security Traffic-Congestion Authentication QR-code Cost-effective.

Introduction

It is evident that with rising use of technology in the public and private sector, digitalization has become a means to manage and automate tasks that require manual checking. Similarly, the parking system in the university needs to be improvised with a proper management system. For instance, most of the universities rely on manual checking of the vehicles parked in and that revolves on a ticket- collecting system. In this system, a ticket is given to the driver on which the vehicle number is mentioned (of the vehicle that the driver has parked) by the security guard and later while checking out, that ticket serves as assurance for the vehicle and the owner of the vehicle.
There is no guarantee that the man taking out the vehicle from the parking lot is the actual owner of the vehicle. The ticket can be lost by the owner anywhere within or outside the campus [1][2][3].
Since the ticket is made of paper, it is prone to wear and tear along with a lot of paper wastage and littering in the parking lot. There is no data available for the incoming and outgoing vehicles in the parking lot. Common problems with the parking system are related to security issues and long queue waiting times when exiting the parking lot [4][5].
This brings security concerns and needs a robust solution to authenticate the vehicle.
To counter this problem, an android application can be designed where the user can register himself and his vehicle on the application. With the help of this application, the security can verify the owner and the vehicle by scanning the Qr-code of the registered user uniquely generated by the application. With the help of Quick Response Code (Qr-code), we can embed the data in the series of pixels in a square-shaped grid that can help in identifying the vehicles as Qr-codes have the capability to store any numeric, binary data and alphanumeric characters etc.

Using Qr-code it helps us in coming up with a solution at low cost and provides an efficient and fast solution to us [6][7].

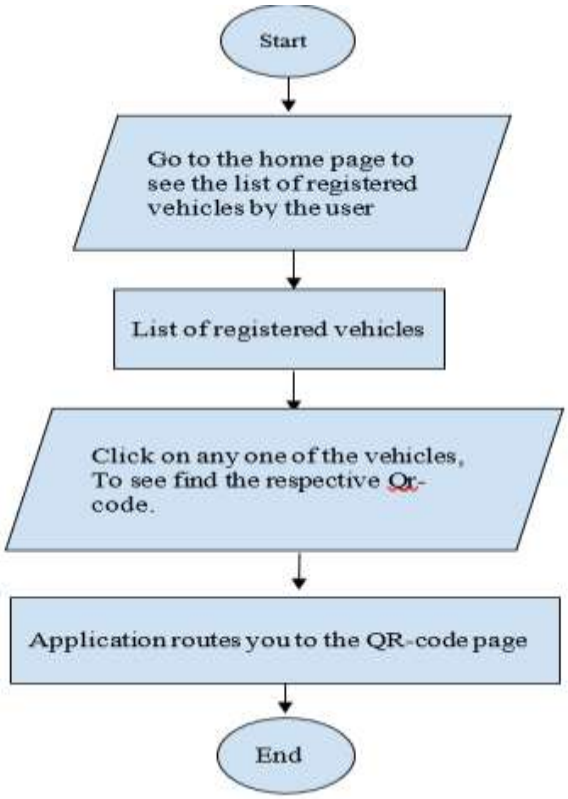
Literature Review

In this section, some of the background work done on the parking system is discussed. An IoT based solution was proposed to resolve the parking problem. [1] The Smart Parking Management System (SPMS), which is based on IoT and is dependent on Arduino components and Android applications, is proposed in this paper. IR sensors were used to check the availability of empty spaces in the parking area. With the help of Wi-fi module data is sent to the server and the result is displayed on the mobile application with services that lets the user check reservation details. With the help of IoT based technology, availability of parking locations can be spotted easily as the parking system becomes wireless.[2] This paper uses QR code (Quick Response Code) and face identification is done by Histogram of Oriented Gradient (HOG) method. HOG is a feature extraction i.e., used for face identification based upon gradient magnitude with the help of Dlib library. [3] The development and application of a reservation-based smart parking system (RSPS) that enables vehicles to locate available parking spots and pre-register those places is discussed in this paper. Cluster based algorithm is used to get the parking status data timely provided by the sensor networks present in the parking spaces. [4] Another IoT based solution combined with web application and mobile the monitoring of parking space availability, real-time invoice generation, a payment system, and parking management spots are all services served by this application. Other technologies, including a GPS-GSM module, an image processing technique, and others, were also incorporated. [5] Automating parking with a Smart Parking System (SPS) increases efficiency and minimizes waiting time. [6] This paper proposes an online digital parking application with a Quick Response (QR) code to reduce workforce in parking areas and ensure authorization and safety. [7] The demand for vehicles has increased significantly, making it difficult to find an appropriate parking space. The problem can be solved and the payment process made simpler and faster with the aid of a highly developed parking ecosystem. [8] Parking spaces can be reserved in advance and on-the-spot using a smart parking system that uses a Raspberry Pi and an Android app and store user information in a database to reduce traffic congestion.

Proposed Methodology

Architecture Design

At first, the user has to install the application on his smartphone and follow the signup flow by providing the user credentials first. The user has to provide their username and password along with other data fields such as college roll number, gender etc. and upload their photograph and click on submit button to register themselves in the Firebase Database. To see the workflow of the signup [8][9][10].

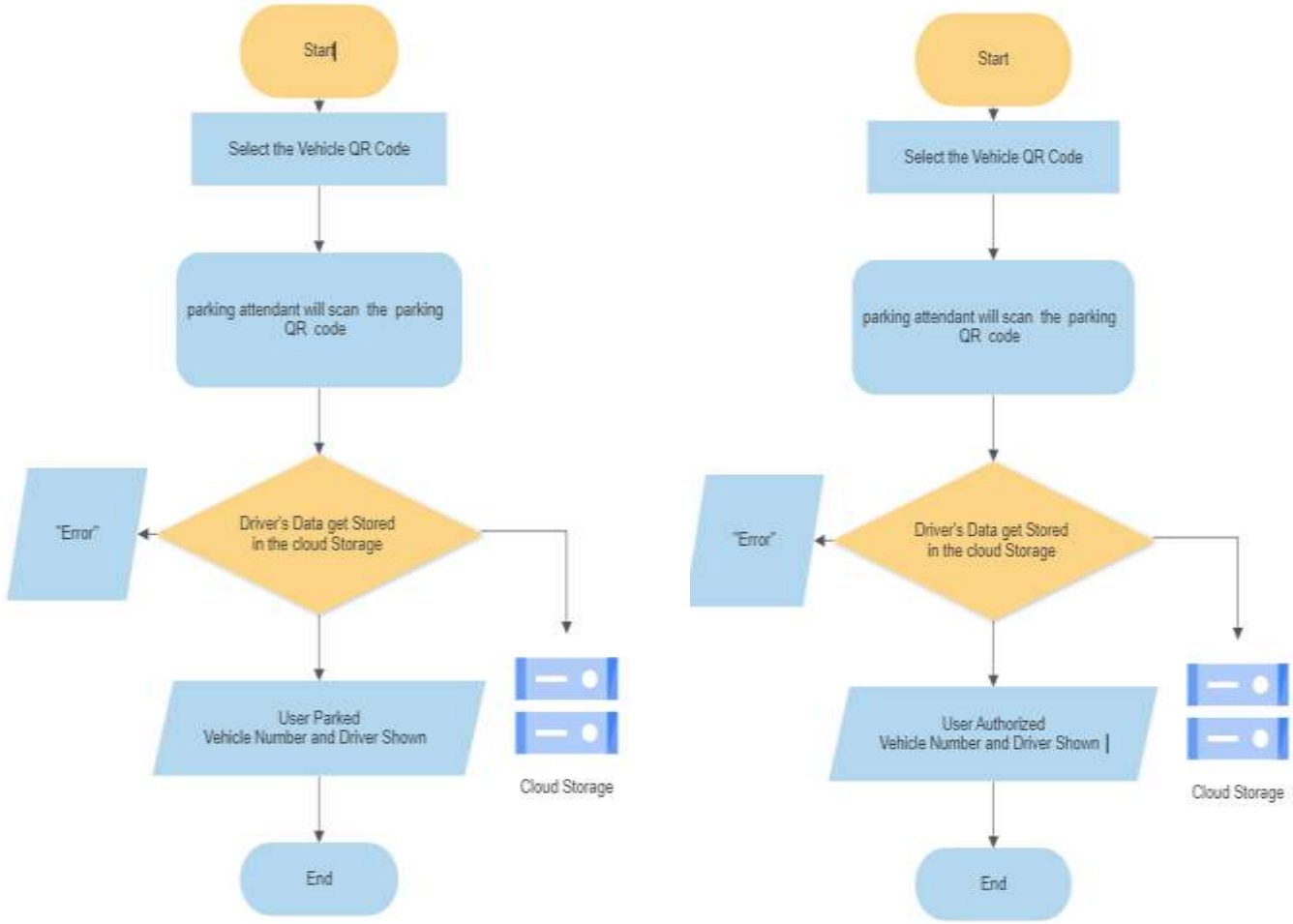


After signing in, the user can log-in into the application by entering the User Id and password. Then the user needs to register their vehicle that they are going to use for commuting. For registration of the vehicle, the user needs to provide the necessary details such as the Vehicle Name, Vehicle Type i.e. bike or scooter , Vehicle Color , Vehicle Number Plate and click on the submit button to register the vehicle in the Firebase Database [11][12][13].

After registration of the vehicle, the user can see the list of registered vehicles on the home page. In order to generate the Qr-code of the vehicle, users can click on any of the registered vehicles and find the Qr-code containing the vehicle information that will be used for authenticating the vehicle and the vehicle's owner. Figure 1 explains the Qr-code flow [14][15][16].

Implementation of Parking Lot Entry System Design

The system workflow process when the driver has entered a pre-designed parking space. This process is carried out by the driver using a user application as shown in the figure 2. After the user enters the parking space, the attendant can scan parking QR code available at the parking location. However, before scanning the parking QR code, the driver must select the vehicle number plate. When the scanned QR code is not a registered QR code or another QR code, the application will give a notification that the QR code is incorrect else it scans the QR code successfully [17][18][19].



Implementation of Parking Lot Exit System Design

When the driver leaves the parking lot the process of scanning the vehicle is carried out by the parking attendant as shown in figure 3 through the admin application with an accordingly designed process flow [20][21][22].

The officer can scan the vehicle's QR code that has been affixed to the vehicle, if the vehicle's QR code has not been affixed to the vehicle, the officer can ask the driver to show the QR code through the application. On successful scanning of the QR - code the vehicle number is shown that can be verified by the parking attendant [23][24].

QRCode

qr_code_scanner (pub.dev)

A QR code reader plugin that is natively included in Flutter and supports both iOS and Android. The seamless connection makes running the scan in Flutter far more advantageous than doing so in a native Activity or ViewController.

Firebase Services

Firebase Authentication

firebase_auth(pub.dev)

Firebase Auth enables Android and iOS authentication using passwords, phone numbers, OTP and identity providers like Google, Facebook and Twitter [25].

firebase_core(pub.dev)

Connecting to various Firebase apps is made possible through the Flutter plugin for Firebase Core [26].

Firebase Firestore
cloud_firestore(pub.dev)

It is a noSQL cloud database which provides live sync and allows offline use on Android and iOS and is available as a Flutter plugin [27].

Result Screens

As we can see in the image, the parking attendant scans the QR-code of the specific vehicle. And the vehicle data is stored in the cloud storage. If the driver is parking the vehicle the lot the attendant will see the Parked message on the screen as shown in the image 1 along with vehicle number. If the driver is taking out the vehicle from the lot the attendant will see the User Authorized message on the screen as shown in the image 2 along with vehicle number [28].

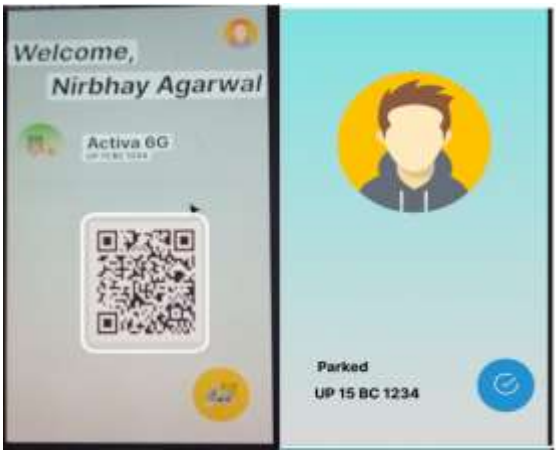


Image 1 Arrival Interface

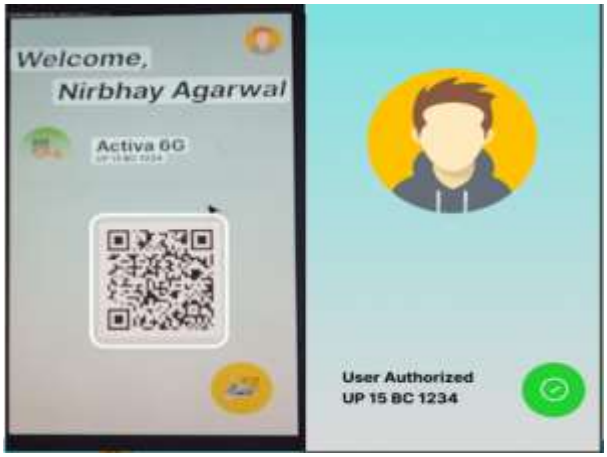


Image 2 Departure Interface

As we can see in the image 3, the user can register the vehicle by first clicking on register icon. Then the user has to fill the details of the vehicle like plate number, model and color. After all this the registered vehicle will be visible on the home screen. As shown in image 4(a) the user has to sign in for the application by the user credentials. Image 4(b) shows the sign-up page in which the user can sign up for by providing Username, Email id and password.

Image 3 Vehicle Registration

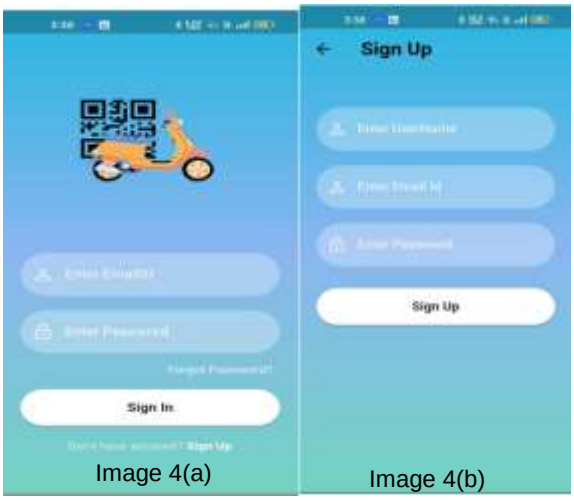


Image 4(a) Image 4(b)

Image 4 Sign in And Sign Up

Experimental Result Analysis

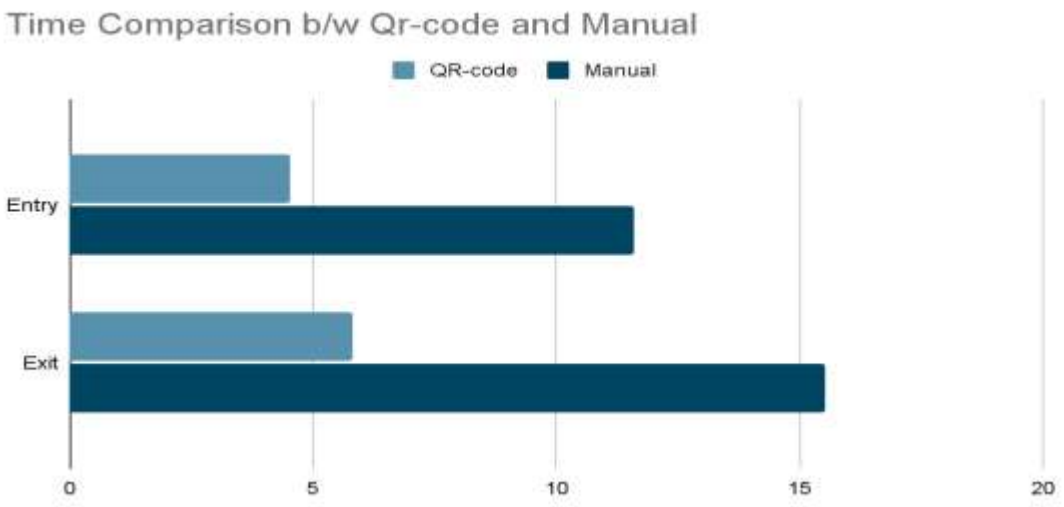
In Table 1, the data represented is the time of entry and exit of vehicle in parking by Manual Process in seconds. Estimated mean of Entry Time for Manual Process is 174 divided by 15 that is 11.60 seconds and estimated mean of Exit Time for Manual Process is 233 divided by 15 that is 15.53 seconds. In Table 2, the data represented is the time of entry and exit of vehicle in parking by Scanning Qr-code in seconds. Estimated mean of Entry Time for Scanning Qr-code is 68 divided by 15 that is 4.53 seconds and estimated mean of Exit Time for Scanning Qr-code is 87 divided by 15 that is 5.8 seconds.

Sno.	Entry	Exit
1	10	14
2	12	17
3	12	14
4	14	16
5	9	16
6	11	15
7	12	15
8	14	17
9	10	14
10	10	15
11	14	15
12	11	17
13	12	16
14	12	17
15	11	15
Total	**174**	**233**

Table 1 Old Process

Sno.	Entry	Exit
1	5	5
2	5	7
3	4	5
4	5	5
5	5	6
6	5	7
7	4	6
8	4	6
9	5	7
10	4	5
11	4	7
12	5	5
13	5	5
14	4	5
15	4	6
Total	**68**	**87**

Table 2 New Process



Graph 1 Comparison between old and new system

As we can see in the above Graph 1 the comparison between QR-code and Manual the new QR system has much better results than manual old system. The absolute difference of total time between the two process is the total time taken by Manual Process (27.19) subtracting it with the total time taken by QR-code Scan (10.33). That would be **16.86 seconds**

The efficiency(%) of the Qr-code is the difference of the two process divided by the total time taken by manual Process and that is **62%**

Conclusion

A college parking application for vehicle authentication and user authorization is implemented and discussed in the research paper. With the help of Quick Response Code (QR-code) provided by the Flutter library i.e. qr-code, the verification of the vehicle and its owner takes place where the data is stored in the Firebase. Efficiency testing showed an increase of **62**% from the old system. For Future, Data Analytics can be applied on the available data where the traffic can be regulated with the real-time data. With the help of Analytical tools, a weekly or monthly report can be generated to regulate the traffic. A payment gateway can be designed to promote cashless transactions.

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