

Research and improvement of queuing conditions in amusement parks Final Document

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1. Introduction

This project plans to focus on solving the problem of queuing. Digitizing the opening hours of amusement park entertainment facilities and allowing visitors to reserve entertainment facilities by apply information technology can improve queuing and benefit visitors. This project carrying CRS (Computer Reservation System), real-time firebase, OCR (Optical Character Recognition), QR Code (Quick Response Code), OSM (Open Street Map) and Java, building up an application based on those technologies. The application divided into user section and staff section, application allow user register and login, its functional will help user reservation in amusement parks; for the staff client, application able to help staffs verify user's ticket. User can benefit by using this application because they can book rides online, so they don't need to be queueing, which this save time on buying ticket; staff can benefit on the ticket check efficiency, they can use QR Code service and OCR service to verify user's ticket, which can reduce their mental consumption, avoid being mistake, and save time on verify tickets.

This documentation includes 5 different aspects:

- Literature Review
- Analysis and Design
- Implementation
- Testing & Result
- Conclusion

2. Literature Review

2.1 Introduction

The most obvious problem with queues is that they waste time, and for guests, wasting their limited time during their visit leads to frustration and a lower perceived value of the experience. This feeling is often compounded by ambiguous time estimates and uninspiring queue layouts — a recipe which could result in a negative review.

For attraction operators, queues can be a letdown too. Even though long queues might be a sign that business is good, the more time guests spend tied up in long lines, the less opportunity they have to spend on on-site retail and food offerings. (Virtual queuing - the future of theme park experiences?, 2021)

Everyone hates waiting in a queue. That's not just a generalization – it's psychology. Clever businesses know this and find the latest ways to minimize wait times for customers to create a more positive experience.

A classic example of this is at Houston Airport, where disgruntled travellers would complain about having to wait at the baggage claim. When increasing staff to reduce wait time made zero impact on the number of complaints made, Houston Airport decided to move the baggage claim far away from the terminal. Passengers now had to walk a distance six times longer than before to reach their bags, with shorter queues forming as a result.

Complaints disappeared.

M.I.T researcher Richard Larson is an expert on queueing psychology, and explains that this is because unoccupied time (where people stand around waiting) feels much longer than occupied time (where people are browsing other shops, reading, or enjoying other leisure activities).

Having long queues is a business-killer, whether you're a fashion retailer, a dentist, or a government agency. Without a means of reducing lines and managing customer wait-times, you're at risk of losing customer loyalty – not to mention creating a stressful environment for both customers and staff.

That's why virtual queue systems are so effective and necessary for businesses

around the world. By implementing an intelligent, cloud-based, and automated system that tells your customers their place in the queue and how long they have to wait, businesses are able to reap a number of benefits.

We'll explain how virtual queue software like Skiplino creates so many benefits for businesses and their customers. (13 Benefits Of Virtual Queue Systems, 2023)

These documents all illustrate the shortcomings of the current queuing system and affect the experience of queuing people.

2.2 Abstract

This project plans to focus on solving the problem of queuing. Digitizing the opening hours of amusement park entertainment facilities and allowing visitors to reserve entertainment facilities can improve queuing and benefit visitors. Using QR Code Scan and OCR Scan help staff to verify user's ticket, which can reduce their mental consumption, avoid being mistake, and save time on verify tickets.

2.3 Background

Online reservations have greatly convenience our lives in the present day where practically everyone owns a smartphone. Particularly, reservations at upscale restaurants may demonstrate this, by making reservations in advance, it will be possible to select the preferred seating while also avoiding crowds; and It's possible to reserve taxis in addition to restaurants, making reservations in advance in advance will possible to spend less time waiting for a taxi, and routes are also more flexible and diverse; we can even pre-order items online. The above examples show reserving ahead of time is very convenient. In this case, we can derive that tourists will benefit from the amusement park experience if reservations are researched and explored as a solution to the queueing issue in amusement parks.

2.4 Problem

Queueing is a structured waiting behaviours prevalent across various societal facilities and services, effectively ensuring fairness and order. Participants adhere to the principle of first-come, first-served, waiting at designated locations or in lines until it's their turn to access the desired service or resource.

While traditional queueing practices maintain fairness, they are not without imperfections. During periods of high foot traffic, wait times tend to be longer, which can be relatively intolerable for most individuals. Outdoor queues may subject participants to discomfort or even health issues due to adverse weather conditions. Additionally, queueing may entail disruptions such as line-cutting, disputes, or dissatisfaction, potentially compromising order and harmony.

Every tourist's time should be utilized meaningfully rather than wasted in dull queues. They need a straightforward and practical tool to assist them in avoiding the inconvenience of waiting in lines. The amusement park faces a significant queue problem characterized by long lines and frequent confusion among visitors. Extended wait times at popular attractions lead to decreased overall visitor satisfaction, impacting the park experience negatively. The challenge lies in managing and optimizing queue flow to minimize wait times, enhance guest enjoyment, and streamline the overall park operations. Implementing efficient queueing solutions, such as leveraging technology for ticket checking and reservation systems, becomes crucial to address these issues and improve the overall visitor experience.

2.5 Purpose

The purpose of the project is to utilize the CRS (Computer Reservation System) and QR Code (Quick Response Code) and OCR (Optical Character Recognition) and other useful feature to develop an application that alleviates the existing queuing issues for visitors.

2.6 Aim & Objectives

Build an application that allows visitors login and register, visit and booking entertainment facilities, reminds on appointment time, and helps staff to identify the tickets.

Objectives:

1. Investigate the composition of other amusement park apps.
2. Investigate how to implement the reservation function.
3. Predict the number of visitors and choose the appropriate database to use.
4. Write and classify amusement park entertainment facilities in the database and add their schedules.
5. Implement user registration and reservation functions.
6. Implement the code scanning function for tickets of tourists.

2.7 Outcome

My final delivery should be an application (App), with this outcome considering the three aspects of the audience of smart phone, the advantages of mobile applications, and the functions of ORC features.

According to Statista, in 2023, the current number of smartphone users in the world today is 6.92 billion, meaning 85.74% of the world's population owns a smartphone. This figure is up considerably from 2016, when only 3.668 billion users were 49.40% of that year's global population. (Ash Turner, 2023)

Mobile phones play an integral role in our everyday lives and the benefits that come with the use of these devices is undeniably growing. This is owing to the fact that there's ongoing tremendous transformation of mobile technology, the remarkable communicative interface, and the availability and access to high-speed internet. (ECPI Blog)

OCR Technology became popular in the early 1990s while attempting to digitize historic newspapers. In the early 2000s, OCR became available online as a cloud-based service, accessible via desktop and mobile applications. Today, there's a host of OCR service providers offering technology (often accessible via APIs) capable of recognizing most characters and fonts to a high level of accuracy. (Eden AI)

Using QR codes is a great way to streamline the user experience and ensure customers can access information as quickly and efficiently as possible. By scanning a QR code, customers can go straight to a landing page or check-in at a location without having to speak to a staff member or ask for support. (SpinDogs)

2.8 Existing amusement park Application

Upon analysis of the Apps ‘The official Disneyland Paris mobile app’ and ‘Mobile app Puy du Fou’, certain comparable features have been identified within those Apps, those features include booking function, display schedule’s function, buy ticket function, map function. By contrasting the features of the two aforementioned applications, it is possible to determine that they all share some functionality and are quite comparable, those functionality benefit tourists and has the effect of easing queue congestion. Therefore, choosing these capabilities in the application for this project would be a good choice.

2.9 CRS (Computer Reservation System)

Before the development of CRS, tourists had to depend on the information provided by suppliers through printed brochures, flyers and listings in local and regional travel guides. As a result, the promotional materials were costly, labor-intensive and information remained static when the data needed to be changed frequently.

To facilitate a smooth and dynamic flow of information, the first CRS was introduced as an experiment in the 1960s by airlines to keep track of sold seats. In 1963, SABRE (Semi-Automated Business Research Environment), the world's first CRS was introduced by American Airlines. After that, CRS became the primary means of distributing air travel information and had a major impact on competition within the airline sector. In 1976, travel agencies started using them and henceforth became a universal feature of the tourism industry. (Anjana, 2023)

2.10 Firebase Realtime Database

A real-time database is a type of database that allows information to be stored and retrieved instantly, enabling data to be updated and shared in real time.

While traditional databases contain permanent data that changes infrequently, real-time databases handle data workloads that are continually changing and time sensitive. A real-time database also uses real-time processing to manage its data, meaning that transactions — or units of work performed within the database — are processed quickly enough for organizations or other integrated systems to instantly utilize the data.

Real-time databases are vital tools for many sectors, including eCommerce, energy, fintech, healthcare, high tech, retail, utilities and transportation. For example, an air traffic control system constantly analyzes large numbers of aircraft, keeps track of current values, makes choices regarding incoming flight patterns and calculates the sequence in which aircraft should land based on variables like weather, fuel, altitude and speed. (James Olaogun, 2022)

2.11 OCR (Optical Character Recognition)

Optical character recognition (ORC) is a technology that can convert images of printed, handwritten, or typed text into machine-encoded text that is readable by machines. This eliminates the need for artificial retyping.

Today, many OCR service providers offer this technology, often via APIs. Most applications are now capable of recognising most characters and fonts to a high level of accuracy, and the technology continues to improve. (Steve Britton, 2022)

2.12 QR Code (Quick Respond Code)

A QR code is a two-dimensional graphic composed of black and white squares that stores information through a specific encoding method.

A quick response (QR) code is a type of barcode that can be scanned by a digital device and which stores information as a series of pixels in a square-shaped grid.

QR codes bridge the physical and digital worlds, as people can scan menus and posters for information with their cellphones or off websites.

QR codes are considered an advance over the older, unidimensional barcodes and were approved as an international standard in 2000 by the International Organization for Standardization (ISO). (Adam Hayes, 2024)

2.13 Overview of Section

Comprehending CRS and the obstacles it encounters is crucial for the project as a whole. Since using CRS technology is necessary for the majority of the project. Upon comparing Excel and the database, numerous similarities emerge between the two. This examination has established the foundation for a digital timetable but also enhances the likelihood of success for this project. Through a comparison of distinctions between real-time databases and conventional databases, it becomes evident that opting for a database with real-time responsiveness is more suitable for this project. Additionally, OCR (Optical Character Recognition) and QR Code (Quick Respond Code) holds the potential for utilization in this project. It presents another avenue to address queuing issues by enhancing the ticket verification process. Evidence suggests that the applications developed by various theme parks share certain basic functionalities. These considerations highlight the issue that, with the widespread use of mobile phones and app applications in modern life, queue pressure is possible to be lessened by utilizing the CRS feature in these programs. Finally, using applications to ease line pressure has been justified, according to the findings from the analysis of apps in various amusement parks.

3. Analysis and Design

3.1 Introduction

The objective of this section is to examine the necessary functions and system design elements for the project. These encompass Functional and Non-Functional requirements, Software Design, User Interface Design, and Database Design. The literature review delves into various IT technologies slated for implementation in this project. Additionally, the paragraphs will analyse the advantages and distinctions of comparable applications available in the market.

3.2 Requirement analysis

3.2.1 Existing apps

Pou Du Fou:

Pou Du Fou App serves as a comprehensive amusement park application, offering online reservations for park facilities and services. Additionally, it seamlessly interacts with local hotel services to streamline travel. The app provides features such as sorting attractions in various arrangements to facilitate tourist selection, translation services, and audio assistance for experiencing main performances. While the app informs visitors about the operating hours of entertainment facilities, enhancing the queue experience could be achieved if accurately estimating wait times.

The official Disneyland Paris mobile app

The official Disneyland Paris mobile app is a comprehensive amusement park application facilitating online reservations for amusement park facilities and services. It seamlessly integrates with local hotel services to enhance the travel experience. While the app offers a range of complimentary services catering to most visitor needs, access to exceptionally popular attractions may necessitate the purchase and utilization of Disney Premier Access for expedited entry.

3.2.2 Functional requirements

1. User Register: This function allows the user to register account.
2. User Login: This function allows user to login into the app.
3. User Logout: This function allows the user to logout.
4. View User Detail: This function allows users to view their information.
5. Update User Detail: This function allows user to update personal detail.
6. User Booking: This function allow user to booking entertainment facility.
7. View Booking: This function allow user to view booking.
8. User Cancel Booking: This function allow user to cancel booking.
9. Staff Login: This function allow staff to login.
10. Staff View Booking: This function allow staff to view all booking.
11. Staff Logout: This function allow staff to logout.
12. Scan Code: This function allow staff to verify user's verification code.
13. Scan QR Code: This function allow staff to verify user's QR code.
14. Create QR Code: This function allows user convert ticket to QR code.
15. Map Locate: This function allows user to locate their real-time location.
16. Notification Service: This function will send visitors notifications of their booking and ride reservations.
17. Buy Ticket: This function require user buy a ticket, so system will identification allow user book rides.

3.2.3 Non - Functional requirements

This project utilizes Firebase, and several of its features have been used in this project.

Security

Web Push certificates: Firebase Cloud Messaging can use Application Identity key pairs to connect with external push service.

Performance & Maintainability

Firebase provides real-time data synchronization across clients and devices. This can enhance the maintainability of applications by reducing the need for manual updates and ensuring that all connected clients receive the latest data automatically.

Availability

This project is a mobile application, the functionality of this application closely resembles that of other similar shopping cart applications. This similarity ensures that users can easily navigate and familiarize themselves with the features, thereby enhancing the overall usability of the application.

Reliability

Firebase backup: A backup is a consistent copy of the database at a point in time. The backup contains all data and index configurations at that point in time.

Usability

This application can be used after downloading and only requires registration or login.

3.2.4 Software and Hardware requirements

Hardware requirement

Hardware Specific Technologies						
Hardware	Manufacturer	Quantity	Function	Reason for choosing	Connection	Cost
Mobile Phone Android	Google Pixel 2 XL	1	Run the application and invoke functionalities	Executing functional and text	Internet	N/A
Wi-Fi	Virgin Media	1	Connect to internet	Reliable data transfer	Socket	N/A
Laptop	Dell	1	Run program, write program, managing data	Easy to program	220V Socket	N/A

Table 1. Hardware Specific Technologies

Software Requirements

Software	Manufacturer	Function	Reason for choosing	Cost
Android Studio	Google	Integrated functions	Compatible java and kotlin, reliable	Free
Java	Oracle	Programming language	programme language and has many libraries	Free
Firebase	Google	hosts databases	Instant response to data	Free
Cloud Vision API	Google	Recognizes character	Recognizes necessary data from picture	Free for a limited time
OSM (Open Street Map)	OpenStreetMap Foundation (OSMF)	Map dependencies and Import map functional	Free and reliable, has newer update	free
ZXing	Google & Community	QR Code functional	Efficient on scan and popular, high accuracy	Free

3.3 Software Design

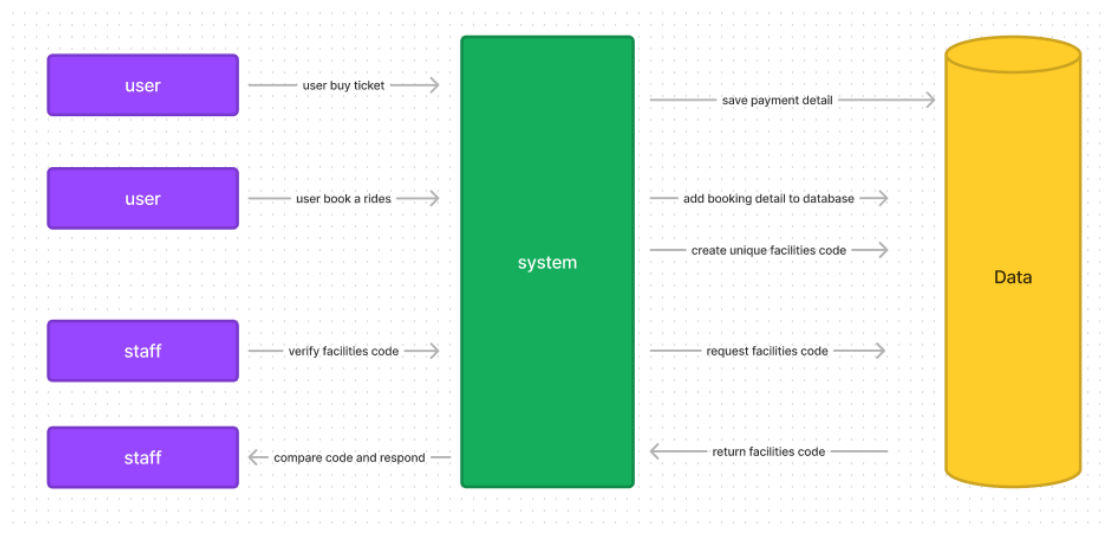


Figure 1. The structure of system design

User must buy ticket as first step, and system will record payment detail and ticket detail to database.

After a user book an entertainment facility, the system captures essential details, including user information for identification, facility details to confirm the reserved facility, and time slot information to ascertain the selected time period. Subsequently, the system generates a facility code, serving as a verification code to ensure the user entering the facility is the correct one. Following this, the system records these details in the database.

When a user enters the entertainment facility, the staff will ask to authenticate the verification code held by the user. The system will use this verification code and queries the database records to authenticate whether the code held by the user is correct. This step is essential to confirm that the user has indeed booked the facility during the recorded time in the database. Following this, the system provides a response upon completing the verification code comparison.

3.4 User Interface Design

3.4.1 Colour scheme

An excessive number of colours can impact the visual coherence of the page and lead to visual fatigue. Choosing yellow and orange as the primary colours would be a wise decision in this project, as they are well-suited to capture the essence and imagery of an amusement park. White serves as a widely used background fill colour. It can establish a sharp contrast with other colours, thereby enhancing the overall visual impact.

3.4.2 Visual accessibility

Excessive use of font styles and content can compromise the overall visual appeal of the page, making it challenging for viewers to comprehend the necessary information. Therefore, opting to only keep essential information and the most commonly used options on the screen would be a wise decision. Minimize purely decorative elements, limiting to three font sizes, three font styles, and three font colours per display. Enhance visual effects by adhering to these regulations and restrictions.

3.4.3 Layout

To accommodate the dimensions of the mobile phone screen, the planned layout size of the application in this project aligns with the size of the mobile phone screen. This application design employs shape frames to group similar elements together and utilizes white space to create separation, guiding the viewer's focus toward the main elements of the application.

3.4.4 Prototypes

Front Page:

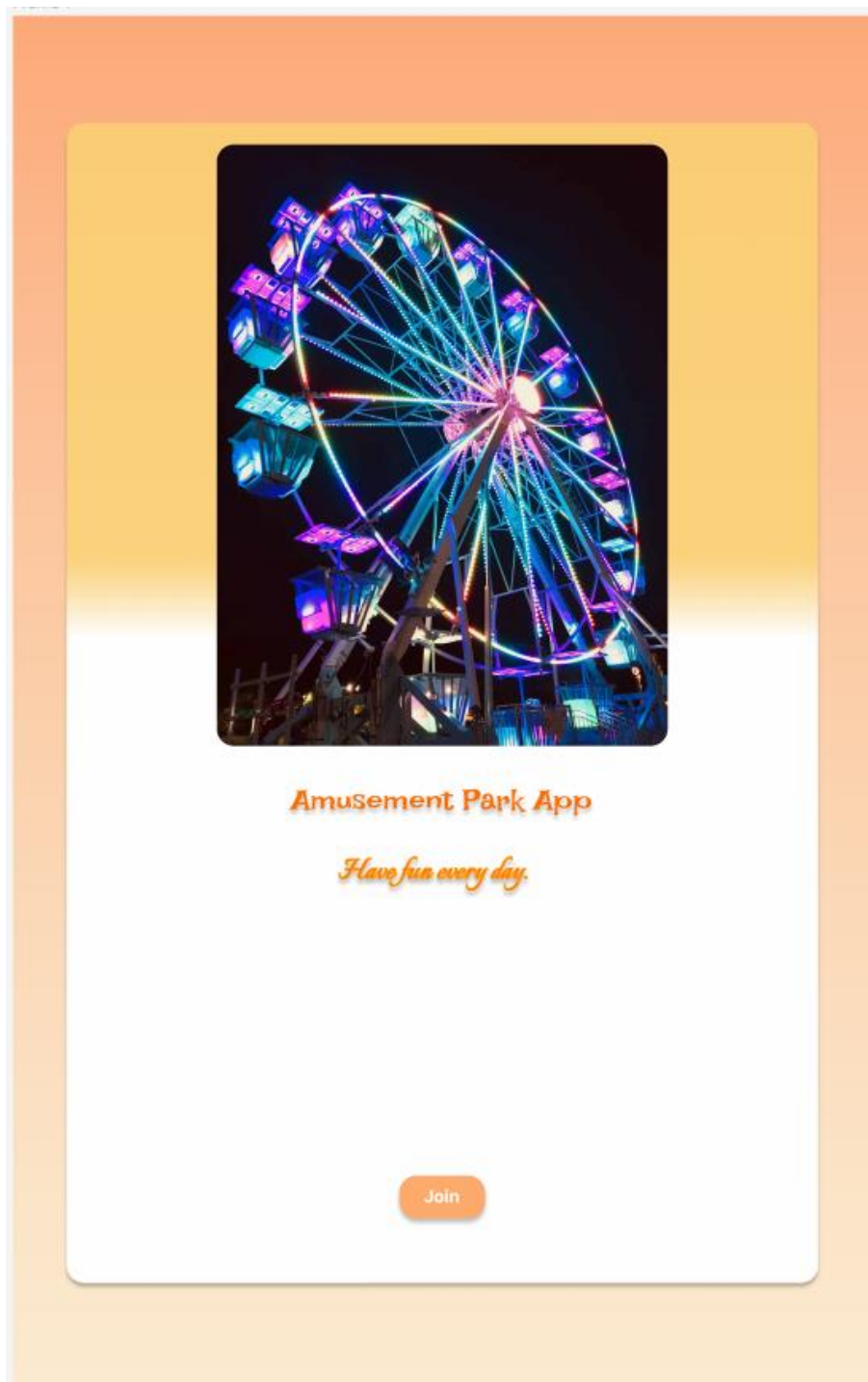


Figure 2. The design of Front Page Interface

Login Page:

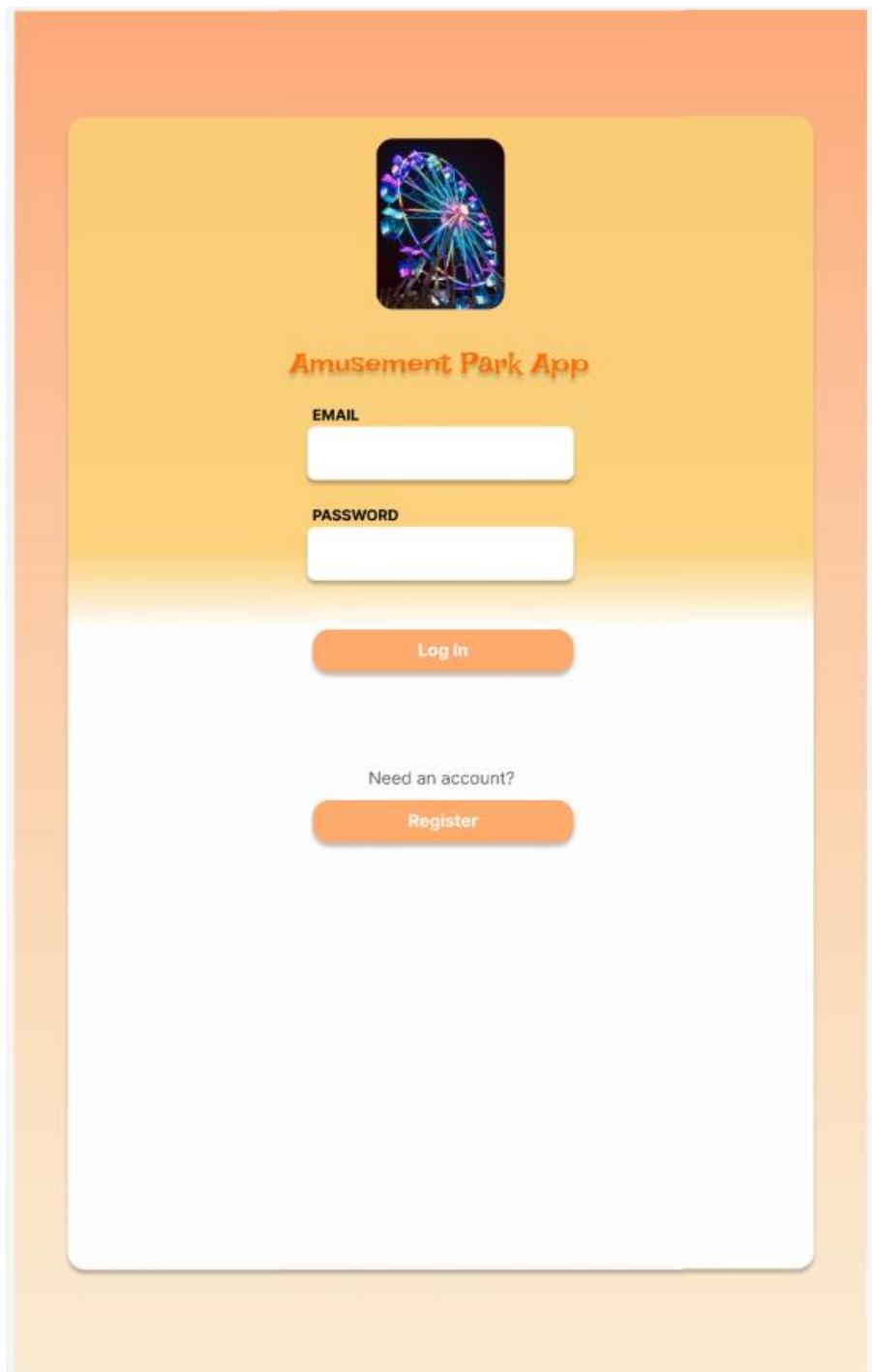


Figure 2.1. The design of Login Page Interface

3.5 Functional Requirements Use Cases

User login

Use Case Name: User login
Use Case Description: This function allows the user to login into the app
Participating Actor(s): user
Entry Conditions: Users download the app and invoke the user login function
Flow of Events: Users enter email and password. System verifies the email and password with database. User successfully login into the app. else system prompts the user to re-enter the valid detail.
Exit Condition (s): The user successfully login.
Alternatives:
Exceptions:

User Register

Use Case Name: User Register
Use Case Description: This function allows the user to register account
Participating Actor(s): user
Entry Conditions: Users download the app and invoke the user register function
Flow of Events: Users enter necessary information. System verifies the email with database. User successfully register and login into the app. else The system requests the user to re-enter a new email as the email entered by the user exists.
Exit Condition (s): The user successfully registers.
Alternatives:
Exceptions:

User Logout

Use Case Name: User Logout
Use Case Description: This function allows the user to logout
Participating Actor(s): user
Entry Conditions: Users download the app while logged in and invoke the user logout function
Flow of Events: Users click the logout button. User successfully logout.
Exit Condition (s): The user successfully logout.
Alternatives:
Exceptions:

View User Detail

Use Case Name: View User Detail
Use Case Description: This function allows users to view their information
Participating Actor(s): user
Entry Conditions:

Users download the app while logged in and invoke the view user detail function
Flow of Events: Users click the view user detail button. User jump to user detail page. User successfully view personal information.
Exit Condition (s): The user successfully goes to user detail page and view personal information.
Alternatives:
Exceptions:

Update User Detail

Use Case Name: Update User Detail
Use Case Description: This function allows user to update personal detail
Participating Actor(s): user
Entry Conditions: Users download the app while logged in and invoke update personal detail function
Flow of Events: User go in user detail page. User update the information other than email.

<p>User click save button.</p> <p>User detail successfully update.</p>
<p>Exit Condition (s):</p> <p>User detail successfully update.</p>
<p>Alternatives:</p>
<p>Exceptions:</p>

User Booking

<p>Use Case Name: User Booking</p>
<p>Use Case Description: This function allow user to booking entertainment facility</p>
<p>Participating Actor(s): user</p>
<p>Entry Conditions:</p> <p>Users download the app while logged in and invoke booking function</p>
<p>Flow of Events:</p> <p>User select a facility from the facilities list.</p> <p>User pick a time period from time slot list.</p> <p>User click booking button.</p> <p>User successfully booking a facility.</p> <p>Else.</p>

The system presents a message to the user indicating that booking has failed due to the maximum limit of bookings being reached for this time period.
Exit Condition (s): User successfully booking a facility.
Alternatives:
Exceptions:

View Booking

Use Case Name: View Booking
Use Case Description: This function allow user to view booking
Participating Actor(s): user
Entry Conditions: Users download the app while logged in and invoke view booking function
Flow of Events: User click view booking button. User jump to the booking list page. User successfully view booking detail.
Exit Condition (s): User successfully view booking detail.

Alternatives:
Exceptions:

User Cancel Booking

Use Case Name: User Cancel Booking
Use Case Description: This function allow user to cancel booking
Participating Actor(s): user
Entry Conditions: Users download the app while logged in and invoke cancel booking function
Flow of Events: User go to the booking list page. User select the booking they want to cancel. User click cancel booking button. User successfully cancel booking.
Exit Condition (s): User successfully cancel booking.
Alternatives:

Exceptions:

Staff Login

Use Case Name: Staff Login**Use Case Description:** This function allow staff to login**Participating Actor(s):** staff**Entry Conditions:**

Staff download the app and invoke staff login function

Flow of Events:

Staff enter email and password.

System verifies the email and password with database.

Staff successfully login into the app.

else

system prompts the staff to re-enter the valid detail.

Exit Condition (s):

Staff successfully login.

Alternatives:**Exceptions:**

Staff Logout

Use Case Name: Staff Logout
Use Case Description: This function allow staff to logout
Participating Actor(s): staff
Entry Conditions: Staff download the app while logged in and invoke logout function
Flow of Events: Staff click the logout button. Staff successfully logout.
Exit Condition (s): Staff successfully logout.
Alternatives:
Exceptions:

Staff View Booking

Use Case Name: Staff View Booking
Use Case Description: This function allow staff to view all booking
Participating Actor(s): staff

Entry Conditions: Staff download the app while logged in and invoke staff view booking function
Flow of Events: Staff click the view booking button. Staff jump to the booking list page. Staff successfully view all user booking details.
Exit Condition (s): Staff successfully go to booking list page and view all user booking details.
Alternatives:
Exceptions:

Scan Code

Use Case Name: Scan Code
Use Case Description: This function allow staff to verify user's verification code
Participating Actor(s): staff
Entry Conditions: Staff download the app while logged in and invoke scan code function
Flow of Events: Staff click the scan code button.

<p>Staff took a picture from the user's verification code.</p> <p>Staff click the confirm button to confirm the code on picture is correct.</p> <p>The system gives feedback on code verification.</p>
<p>Exit Condition (s):</p> <p>System gives feedback on code verification.</p>
<p>Alternatives:</p>
<p>Exceptions:</p>

Scan QR Code

Use Case Name: Scan QR Code
Use Case Description: This function allow staff to verify user's QR code ticket
Participating Actor(s): staff
<p>Entry Conditions:</p> <p>Staff download the app while logged in and invoke scan QR code function</p>
<p>Flow of Events:</p> <p>Staff click the scan QR code button.</p> <p>Staff took a picture from the user's QR code.</p> <p>The system gives feedback on code verification and display QR code content.</p>

Exit Condition (s):

system gives feedback on code verification and display QR code content.

Alternatives:**Exceptions:****Create QR Code****Use Case Name:** Create QR Code**Use Case Description:** This function allows user convert ticket to QR code**Participating Actor(s):** user**Entry Conditions:**

User download the app while logged in and invoke create QR code function

Flow of Events:

User click the QR code button.

The system converts verification code to QR code.

QR code page open and QR Code display.

Exit Condition (s):

QR code page open and QR Code display.

Alternatives:
Exceptions:

Map Locate

Use Case Name: Map Locate
Use Case Description: This function allows user use map service and locate them self
Participating Actor(s): user
Entry Conditions: User download the app while logged in and invoke Map Locate function
Flow of Events: User click the Location button. The system locate user location. Map page open and user location display on map.
Exit Condition (s): Map page open and user location display on map.
Alternatives:

Exceptions:

Notification Service

Use Case Name: Notification Service
Use Case Description: This function will send user notifications of their booking and ride reservations
Participating Actor(s): user
Entry Conditions: User download the app while logged in and invoke main function (Booking, cancel booking)
Flow of Events: User book a ride. The system prepares a notification message and display it when 5 mins before their scheduled reservations comes up. Notification display.
Exit Condition (s): Notification display.
Alternatives:

Exceptions:

Buy Ticket

Use Case Name: Buy Ticket
Use Case Description: This function require user buy a ticket, so system will identification allow user book rides.
Participating Actor(s): user
Entry Conditions: User download the app while logged in and invoke buy ticket function.
Flow of Events: User enter adult amount and children amount. User go in ticket confirm page and aware the total price and click confirm. User go in payment page and click pay. User getting a ticket.
Exit Condition (s): User getting a ticket, this ticket records the people amount of user enter.
Alternatives:
Exceptions:

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3.6 Hardware Design

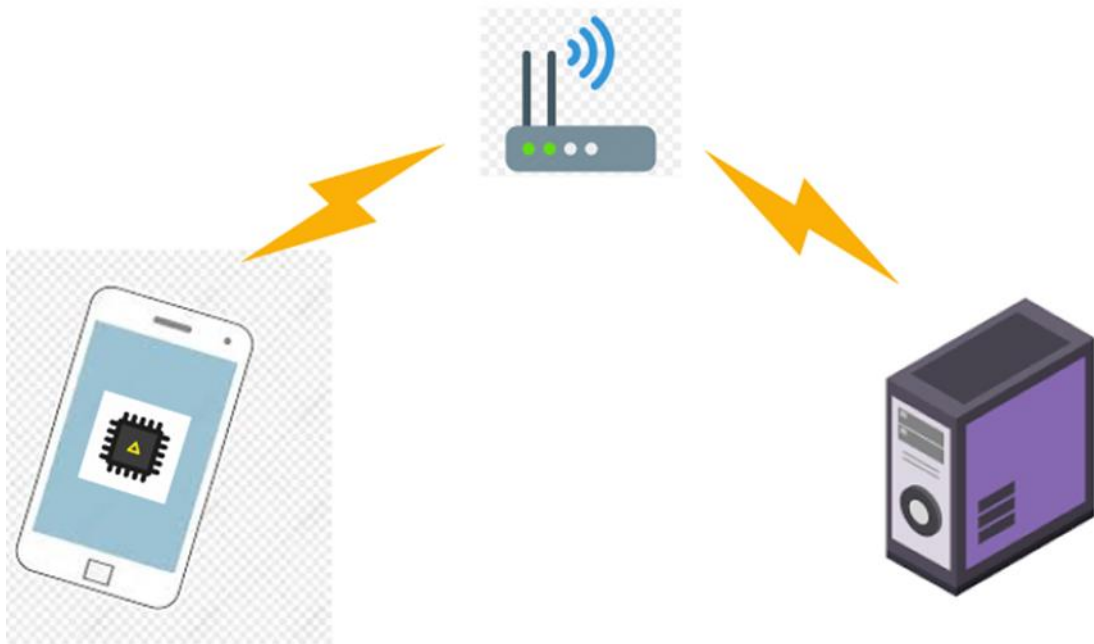


Figure 3. Hardware design

This project will utilize smartphones as the primary platform and device for running applications, as traditional feature phones may lack the requisite functionalities for application execution. Smartphones are distinguished by their graphical user interface, touch screen support, advanced operating systems, robust internet connectivity, high-performance processors, and high-resolution screens. To ensure the seamless operation of the application, this project will leverage Android 6.0 or other comparable versions of the operating system. The smartphone's processor will execute the application and establish an internet connection to interact with the database through the network.

3.7 Database Design

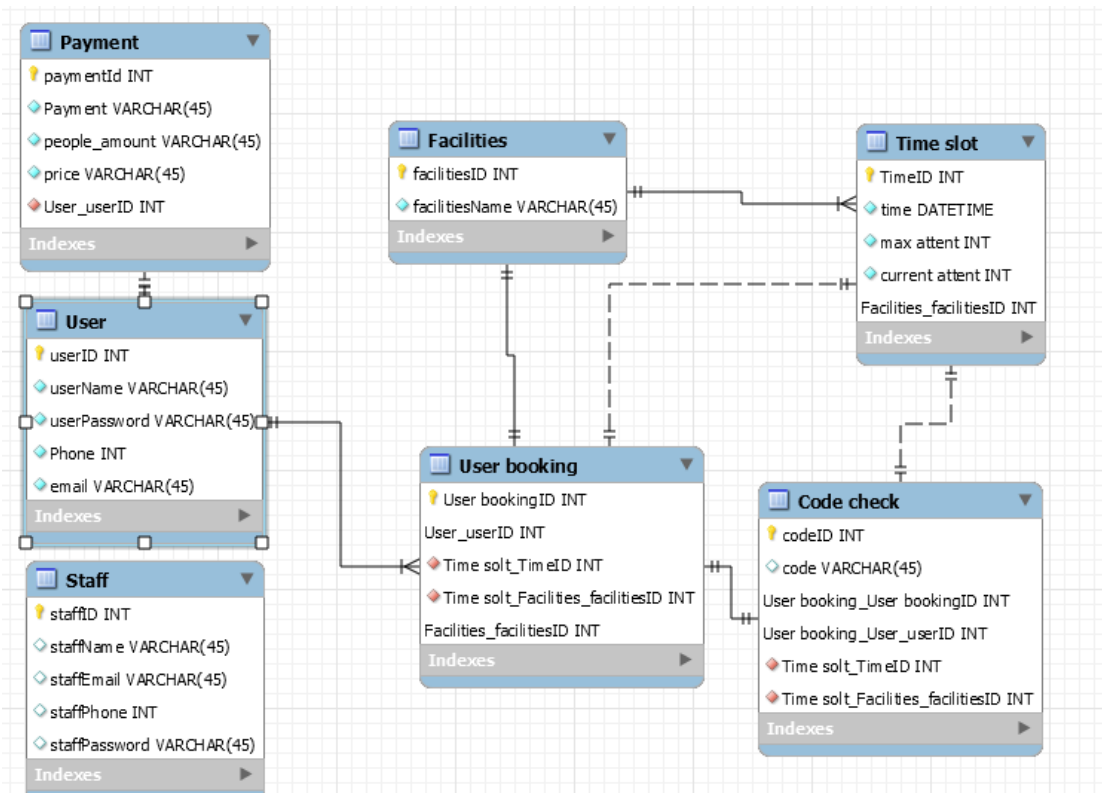


Figure 4. The structure of database design

User Table:

The user table is utilized to store user information, which is derived from user registration. This information is then employed for authenticating individual user details during the login process.

User Booking Table:

The user booking table is employed to store user booking details. It utilizes the userID and facilitiesID to identify the user who has booked the facility, includes time slot details to record the specific period booked by the user, and stores a verification code as evidence of the user's facility reservation.

Code check Table:

The code check table is utilized to store verification codes, primarily serving to restrict users from booking a single period for a facility more than once. Additionally, it records which user has booked which time slot.

Facilities Table:

The facilities table is employed to store the names of entertainment facilities in individual columns. This structure facilitates the provision of detailed information about each entertainment facility to users, enabling them to explicitly select a specific facility.

Time slot Table:

The time slot table is utilized to store schedules for each entertainment facility. Each entertainment facility is assigned a unique schedule to accommodate potential variations in operating hours for different facilities.

Staff Table:

The staff table is utilized to store staff information. This information is then employed for authenticating individual staff details during the login process.

Payment Table:

The payment table is utilized to store user ticket payment information. This ticket means user has buy a ticket and allow to book facility.

4. Implementation

4.1 Android Studio

The project using Android Studio for implement the interface. Android Studio is an integrated development environment (IDE) designed specifically for Android application development. It provides a complete set of tools covering all aspects of Android application development, including interface design, coding and debugging.

4.2 Java

The project using Java as primary programming language. Java is known for its object-oriented programming paradigm, which means that it breaks down problems into objects and solves them through interactions between objects. This approach makes the code easier to understand, maintain, and extend because it encourages modularity and code reuse.

4.3 Firebase

This project uses Firebase to store necessary information. Firebase provides a real-time database and real-time update capabilities, making it easy for developers to achieve data immediacy. With real-time database, developers can store data in the cloud and synchronize it to all connected clients in real time, allowing real-time data updates and synchronization.

4.4 OCR

In order to implement the verify ticket function, OCR is one of the necessary function. Optical character recognition (OCR) technology plays an important role in scanning and converting pictures and documents. OCR technology can scan text in pictures or handwritten documents into electronic text, so that it can be edited, searched, stored and used on a computer.

4.5 QR Code

In order to ensure efficient and accuracy on verification, QR code is one of the necessary functions. QR codes can store and transmit information quickly and conveniently. Business cards, advertisements, and product packaging can all transmit information through 2D codes.

4.6 OSM

In order to ensure user flowing to their favourite rides, location service is one of the necessary functions. OSM service can provide reliable map function, and also provide locate function for locate user's real-time location, therefore, user would not lose their direction.

4.7 Notification

User may forget their scheduled reservations, but notification service can help on it. Notification service able to set timing notification, which means user will be able to aware their favourite events are coming soon. This can prevent them from missing their trip.

5. Testing & Result

5.1 Introduction

This section is utilized to test the functions within the project to ensure they operate as expected. Testing constitutes a systematic evaluation and verification process aimed at ascertaining whether a system, product, or process meets anticipated standards, requirements, or objectives. Furthermore, this chapter will describe the functions' functionalities and the preconditions they require.

Buy ticket

Buy ticket	
Test case ID	1
Priority	High
Executed by	Jiayao Ruan
Date	2024/3/21
Description	This test case is testing method will allow user to buy ticket, and it will saved ticket payment detail to external database (Firestore).
Pre-Condition	User must download and install the application; User need to login into home page.
Test Step	User click Buy ticket button go in ticket page and enter the amount people, than make payment.
Expected result	Application can record user payment and ticket detail and save detail to Firestore.
Post condition	Allow user to book rides, if user didn't have a ticket, user not allow to book rides.
Status	Pass
Note/Comments/Question	n/a
Requirement	n/a
Automation (Yes/No)	No

Scan Code

Scan Code	
Test case ID	2
Priority	High
Executed by	Jiayao Ruan
Date	2024/3/21
Description	This test case is testing that OCR function is working fine.
Pre-Condition	Staff must download and install the application; staff need to login into home page and invoke verify code function.
Test Step	Staff click Camera Verification button, and capture image, then system will give result.
Expected result	System gives out correct result and respond the scanning code is valid or not.
Post condition	Allow user enter facility.
Status	Pass
Note/Comments/Question	Quality and accuracy not very good.
Requirement	n/a
Automation (Yes/No)	No

Notification Service

Notification Service	
Test case ID	3
Priority	High
Executed by	Jiayao Ruan
Date	2024/8/31
Description	This test case is testing that Notification function is working fine.
Pre-Condition	user must download and install the application, also invoke book ride or cancel ride function.
Test Step	User book ride, once ensure to book, timing notification will setup.
Expected result	System gives notification at the time setting.
Post condition	n/a
Status	Pass
Note/Comments/Question	n/a
Requirement	n/a
Automation (Yes/No)	Yes

Map Locate

Map Locate	
Test case ID	4
Priority	High
Executed by	Jiayao Ruan
Date	2024/8/31
Description	This test case is testing that Map Locate function is working fine.
Pre-Condition	User must download and install the application, also invoke Map Locate function.
Test Step	User click Location button in home page, user go in map page, map display, user location display on map.
Expected result	user location display on map.
Post condition	user can location them self on map.
Status	Pass
Note/Comments/Question	n/a
Requirement	n/a
Automation (Yes/No)	No

Scan QR Code

Scan QR Code	
Test case ID	5
Priority	High
Executed by	Jiayao Ruan
Date	2024/8/31
Description	This test case is testing that Scan QR Code function is working fine.
Pre-Condition	Staff must download and install the application, also invoke Scan QR Code function.
Test Step	Staff click Scan QR button in staff home page, staff go in scan QR page, staff click scan QR code, use camera aiming QR code, system display result and QR code valid or not.
Expected result	System displays correct content and QR code valid or not.
Post condition	Staff allow user enter facility.
Status	Pass
Note/Comments/Question	n/a
Requirement	n/a
Automation (Yes/No)	No

Create QR Code

Create QR Code	
Test case ID	6
Priority	High
Executed by	Jiayao Ruan
Date	2024/8/31
Description	This test case is testing that Create QR Code function is working fine.
Pre-Condition	User must download and install the application, also invoke Create QR Code function.
Test Step	User click QR code button in schedule page, system convert verification code to QR code and display in QR code page.
Expected result	QR code display.
Post condition	Staff able to scan this QR code.
Status	Pass
Note/Comments/Question	n/a
Requirement	n/a
Automation (Yes/No)	No

User Register

User Register	
Test case ID	7
Priority	High
Executed by	Jiayao Ruan
Date	2024/8/31
Description	This test case is testing that User Register function is working fine.
Pre-Condition	User must download and install the application, also invoke User Register function.
Test Step	User click register button in login page, user enter correct value and valid email then register, otherwise will failure to register.
Expected result	User has been registered.
Post condition	User can book a ride or buy ticket.
Status	Pass
Note/Comments/Question	n/a
Requirement	n/a
Automation (Yes/No)	No

User Login

User Login	
Test case ID	8
Priority	High
Executed by	Jiayao Ruan
Date	2024/8/31
Description	This test case is testing that User Login function is working fine.
Pre-Condition	User must download and install the application, also invoke User Login function.
Test Step	User go to login page, user enter correct password and email then login, otherwise will failure to login.
Expected result	User success login.
Post condition	User can book a ride or buy ticket.
Status	Pass
Note/Comments/Question	n/a
Requirement	n/a
Automation (Yes/No)	No

User Logout

User Logout	
Test case ID	9
Priority	High
Executed by	Jiayao Ruan
Date	2024/8/31
Description	This test case is testing that User Logout function is working fine.
Pre-Condition	User must download and install the application, also invoke User Logout function.
Test Step	User has login, user click logout button.
Expected result	User success logout.
Post condition	User logout and go to start page.
Status	Pass
Note/Comments/Question	n/a
Requirement	n/a
Automation (Yes/No)	No

View User Detail

View User Detail	
Test case ID	10
Priority	High
Executed by	Jiayao Ruan
Date	2024/8/31
Description	This test case is testing that View User Detail function is working fine.
Pre-Condition	User must download and install the application, also invoke View User Detail function.
Test Step	User has login, user click update user button, user go in user detail page.
Expected result	User detail display.
Post condition	User can update their information.
Status	Pass
Note/Comments/Question	n/a
Requirement	n/a
Automation (Yes/No)	No

Update User Detail

Update User Detail	
Test case ID	11
Priority	High
Executed by	Jiayao Ruan
Date	2024/8/31
Description	This test case is testing that Update User Detail function is working fine.
Pre-Condition	User must download and install the application, also invoke Update User Detail function.
Test Step	User has login, user click update user button, user go in user detail page, user update their information.
Expected result	User detail update.
Post condition	n/a.
Status	Pass
Note/Comments/Question	n/a
Requirement	n/a
Automation (Yes/No)	No

User Booking

User Booking	
Test case ID	12
Priority	High
Executed by	Jiayao Ruan
Date	2024/8/31
Description	This test case is testing that User Booking function is working fine.
Pre-Condition	User must download and install the application, also invoke User Booking function.
Test Step	User has login, user click book raids button, user select the facility and time they prefer, then enter people amount and ensure to book.
Expected result	User has booked a ride.
Post condition	User can enter facility they booked at the right time.
Status	Pass
Note/Comments/Question	n/a
Requirement	n/a
Automation (Yes/No)	No

View Booking

View Booking	
Test case ID	13
Priority	High
Executed by	Jiayao Ruan
Date	2024/8/31
Description	This test case is testing that View Booking function is working fine.
Pre-Condition	User must download and install the application, also invoke View Booking function.
Test Step	User has login, user click schedule button, user go in booking schedule page, and booking detail display.
Expected result	User's booking detail display.
Post condition	User can cancel booking or show QR code to staff.
Status	Pass
Note/Comments/Question	n/a
Requirement	n/a
Automation (Yes/No)	No

User Cancel Booking

User Cancel Booking	
Test case ID	14
Priority	High
Executed by	Jiayao Ruan
Date	2024/8/31
Description	This test case is testing that User Cancel Booking function is working fine.
Pre-Condition	User must download and install the application, also invoke User Cancel Booking function.
Test Step	User has login, user go in schedule page, user click cancel button.
Expected result	User's booking has been cancel, and booking cancel notification display.
Post condition	n/a
Status	Pass
Note/Comments/Question	n/a
Requirement	n/a
Automation (Yes/No)	No

6. Conclusion

From the information I found it's evident that queuing issues are widespread, and most people harbour a dislike towards it. I embarked on analysing, implementing, and testing mobile app solutions aimed at addressing queuing problems. These solutions will leverage the convenience of booking and the accuracy brought by character scanning to tackle queuing issues.

Along the way, some challenges arose due to a lack of skills or time constraints. These include deviations from the initial analysis and design of the project, as well as areas that have yet to be tested.

While working on this project, I also gained new knowledge. I learned about the history and operation of OCR, QR code, OSM, Notification service and Firebase. This knowledge can be used outside of the project.

I believe traditional queuing methods pose problems that can be improved through modern technology. The application of booking and character scanning technologies can also improve other aspects of life, which is something I am keen to further explore.

Bibliography

Virtual queuing - the future of theme park experiences?, 2021. [Online]

Available at: <https://attractions.io/learn/virtual-queuing-the-future-of-theme-park-experiences>

[Accessed 22 April 2024].

13 Benefits Of Virtual Queue Systems, 2023. [Online]

Available at: <https://www.skiplino.com/13-benefits-of-virtual-queue-systems/#:~:text=The%20most%20powerful%20benefit%20of,that%20works%20best%20for%20them.>

[Accessed 22 April 2024].

Ash Turner, 2023. HOW MANY SMARTPHONES ARE IN THE WORLD? [Online]

Available at: <https://www.bankmycell.com/blog/how-many-phones-are-in-the-world#:~:text=How%20Many%20People%20Have%20Smartphones%20In%20The%20World%3F&text=According%20to%20Statista%2C%20in%202023,world's%20population%20owns%20a%20smartphone.>

[Accessed 22 April 2024].

ECPI Blog. Why Are Mobile Apps Important and How Can I Become Part of this Field? [Online]

Available at: <https://www.ecpi.edu/blog/why-are-mobile-apps-important-and-how-can-i-become-part-of-this-field#:~:text=A%20mobile%20app%20is%20an,be%20accessed%20on%20desktop%20computers>

[Accessed 22 April 2024].

Eden AI. TOP 10 Optical Character Recognition (OCR) API. [Online]

Available at: <https://www.edenai.co/post/top-10-optical-character-recognition-ocr-api#:~:text=In%20the%20early%202000s%2C%20OCR,a%20high%20level%20of%20accuracy.>

[Accessed 22 April 2024].

SpinDogs. The importance of QR codes. [Online]

Available at: <https://www.spindogs.co.uk/blog/the-importance-of-qr-codes/>

[Accessed 30 August 2024].

Top 10 Benefits of Using Academic Journals Online for Scholarly Research | APIAR - Blog, 2017. [Online]

Available at: <https://apiar.org.au/blog/top-10-benefits-of-using-academic-journals-online-for-scholarly-research/#:~:text=They%20are%20highly%20credible.&text=This%20makes%20online%20academic%20journals,enriched%20with%20facts%20and%20truths.>

[Accessed 22 April 2024].

Anjana, 2023. Computer Reservation System Guide: CRS in Travel Industry. [Online]

Available at: [https://colorwhistle.com/computer-reservation-system/#:~:text=History%20and%20Evolution%20of%20Computer%20Reservation%20System&text=In%201963%2C%20SABRE%20\(Semi%2D,competition%20with%20the%20airline%20sector.](https://colorwhistle.com/computer-reservation-system/#:~:text=History%20and%20Evolution%20of%20Computer%20Reservation%20System&text=In%201963%2C%20SABRE%20(Semi%2D,competition%20with%20the%20airline%20sector.)

[Accessed 22 April 2024].

James Olaogun, 2022. Comparing Real-Time Databases. [Online]

Available at: <https://www.singlestore.com/blog/comparing-real-time-databases/#:~:text=A%20real%2Dtime%20database%20is,is%20missed%2C%20data%20becomes%20obsolete.>

[Accessed 22 April 2024].

Steve Britton, 2022. Optical character recognition (OCR) technology: A brief history. [Online]

Available at: <https://www.oneadvanced.com/news-and-opinion/optical-character-recognition-ocr-technology-a-brief-history/#:~:text=OCR%20technology%20traces%20its%20roots,form%20of%20optical%20character%20recognition.>

[Accessed 22 April 2024].

Adam Hayes, 2024. Quick Response (QR) Code: Definition and How QR Codes Work.
[Online]

Available at: <https://www.investopedia.com/terms/q/quick-response-qr-code.asp>.

[Accessed 30 August 2024].