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Reengineering Knowledge and Creativity for Global Excellence

Copy Editors:

Nor Azrina Mohd Yusof (Dr.)
Lee Chai Chuen
Juaini Jamaludin
Normaziana Hassan

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Copy Editors/Layout :Nor Azrina Mohd Yusof (Dr.)
Lee Chai Chuen
Juaini Jamaludin
Normaziana Hassan

Cover Design :Asrol Hasan

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Foreword

The papers compiled in these e-proceedings are papers presented online at Technology, Science, Social Sciences and Humanities International Conference 2022 (TeSSHI 2022) held on 30 June 2022 at Universiti Teknologi MARA (UiTM) Cawangan Kedah, Kedah, Malaysia. With the theme, ***Reengineering Knowledge and Creativity for Global Excellence****,* the conference has brought together presenters of diverse background who shared their conceptual and empirical papers in broad areas that are subsumed under the fields of Technology, Science, Social Sciences and Humanities. These e-proceedings comprise current researches that were undertaken with the rigorous endeavour of knowledge enhancement to ensure that the world of academia will continue to flourish. It is thus hoped that readers will significantly benefit from knowledge contained in these proceedings.

TeSSHI 2022 and these e-proceedings would not have been possible without the great efforts from the presenters, and the generous support from the TeSSHI 2022 committee members and the Rector of UiTM Cawangan Kedah, Prof. Dr. Mohamad Abdullah Hemdi. A heartfelt gratitude is extended to all involved. It is hoped that these e-proceedings will be an impetus to stimulate futher studies and research that benefit the society at large.

TABLE OF CONTENTS

IPQUEUE: Indoor Premises Control Using Quick Response (QR) Code for Covid-19 Pandemic

Mohd Suffian Sulaiman
Faculty of Computer & Mathematical Sciences,
Universiti Teknologi MARA, Shah Alam, Malaysia
suffian@tmsk.uitm.edu.my

Zuraidah Derasit
Faculty of Computer & Mathematical Sciences,
Universiti Teknologi MARA, Shah Alam, Malaysia
zuraidah.derasit@tmsk.uitm.edu.my

Sharizah Shahar
Faculty of Computer & Mathematical Sciences,
Universiti Teknologi MARA, Shah Alam, Malaysia
ayjaz1u@gmail.com

ABSTRACT

Most queue or crowd management is done manually. Due to the COVID-19 pandemic, lack of technique that employing a system number or traffic control to assure visitors' admission based on the minimum limit set for the control measure. Furthermore, manual approach control results in an inefficient and the visitor need to write their data in book record by touching it. Therefore, an IPQueue as indoor premises controls mobile application is proposed to optimise human handling using QR codes. By using IPQueue, visitors must scan the QR code displayed in front of the premises. The IPQueue will recognize and authenticate the visitor's presence and then join the queue. The visitors' data will be captured and stored in the database and the queue number will be increased and displayed on the screen monitor and apps. If the queue number is not over the limit, the visitor can enter the premises. Otherwise, the visitor need to queue until the existing visitor exit the premises. The visitors who want to leave the premises need to click the check/queue out button to make sure the visitor's reminder number will be added in the IPQueue. The IPQueue also has a feature to generate QR codes for the premises owner. The results show that the IPQueue can speed up and save time on the queue process and implement the contactless approach successfully. The creation of IPQueue during the pandemic era will improve and optimise the efficiency of premises operation, especially for the well-being of people in monitoring and complying with COVID-19 standard operating procedure.

Key Words: quick response (QR) code, COVID-19, queue number, indoor premises control.

INTRODUCTION

The world was rocked by the COVID-19 or coronavirus endemic, which spread globally after the first case was discovered in Wuhan, Hubei, China, in mid-December 2019 and was eventually recognised as a pandemic by the World Health Organization (WHO) in March 2020 (Jamie, 2020). The greatest cluster in Malaysia was later linked to a religious gathering in late February, resulting in a major surge in local cases as well as cases being exported from neighbouring countries. As a result of the tremendous increase in cases, the Movement Control Order (MCO) was implemented (Malaysian National Security Council, 2020). MCO uses specialized laws to prevent epidemics from spreading, including a complete ban on people's mobility and assembly in the country. Public

markets, grocery stores, convenience stores, and supermarkets that sell everyday essentials are allowed.

Following this, the Malaysian Ministry of Health (MOH) implemented social distance as one of the strategies to mitigate the pandemic's effects, as recommended by the World Health Organization (WHO) (World Health Organization, 2022) and introduce MySejahtera, an app that uses the QR code as the primary medium to track COVID-19 by encouraging users to identify their COVID-19-related health concerns (Government of Malaysia, 2020) by automatically registering visitors for contact tracing tracking records.

The introduction of movement control restrictions and social distancing intended at decreasing interactions between people in the larger community (Wilder-Smith & Freedman, 2020), however, did not control visitors' admission into the small premises in an organised and uniform manner. Visitors are manually entered into a queue and must wait their turn. As a result, a proper mechanism for controlling guest admission is practically required.

Being in premises with a crowded situation is an issue with new norms where social distancing is emphasized in almost all places in society with the minimum limit of visitors has been enforced. The immense problems are the use of check-in through the existing application, MySejahtera, which is only intended to record the presence of visitors but does not control the turn or entry of visitors. Most premises still using a manual approach to give a turn to visitors by providing a number card or tag as traffic controller to ensure the entry of visitors is based on the minimum limit that has been set for the control measure. This approach has not yet fully adopted social distancing or contactless as expected. As a result, the solution proposed in this paper is to create a robust queue system using existing technology, such as QR Code technology, that can increase the efficiency in controlling visitor movement and making each business premise more organised and manageable.

RELATED WORKS

Barcode technologies have become a popular and efficient method of encoding machine-readable data. As an optical imaging device is equipped with a smartphone camera, today's technologies can grow with smartphone camera technology that can read the barcode. Several barcode symbologies, such as numeric-only barcodes, alpha-numeric barcodes, and two-dimensional (2D) barcodes, can be grouped into one of a few primary kinds. In this project, 2D barcodes will be examined in further depth.

Two-dimensional (2D) Barcodes

Two-dimensional (2D) barcodes use symbols and two-dimensional structures to represent data. They're like linear 1D barcodes, except they can display more data per unit area. 2D barcodes have some of the newest barcode types, including the PDF417 and the QR code. Another significant benefit of 2D barcodes is their bug-defeating formula. These codes are meant to keep data intact and scannable even if they are broken, damaged, or corrupted. 2D barcodes are suited for more intensive, fast-paced scanning applications because of their capabilities. In this case, the focus is on the QR code in greater depth.

A. Quick Response Code

The Quick Response Code (QR code) is a two-dimensional (2D) barcode that visually displays features in the shape of a bar and spaces in two forms of the model. Model 1 is the root QR code, with 14 (73 × 73 modules) being the largest type of QR code, capable of storing up to 1,167 numbers, while Model 2 is a variation of Model 1 with 40 (177 x 177 modules) capable of storing up to 7,089 numbers (Rajesh et al., 2018). The barcode reader must be used to read the barcode, but now it can be read using the camera on any smartphone available. Toyota's Denso Wave division invented the QR code in 1994, and it was first used to track inventories in automotive components production (Denso Wave Incorporated, 2022). QR codes are also employed in a variety of other industries, such

as commercial tracking, entertainment, and in-store product labelling, all of which are geared at smartphone users as shown in Figure 1.

Figure 1 Example of QR Code

B. Datamatrix Code

Datamatrix code is commonly used to label small objects, items, and records. It is ideal for minimal logistical and industrial products due to its small size. It is comparable to QR codes in that it has a high fault tolerance and fast readability. Datamatrix assures that it will take up less inventory and asset space because of its high data density. Furthermore, datamatrix can be read at low resolution or in precise scan places. Datamatrix codes, like most other 2D bar codes, have a high fault tolerance (Schmidmayr et al., 2008) as shown in Figure 2.

Figure 2 Example of Datamatrix Code

C. Maxi Code

UPS invented the Maxi Code, a barcode with a fixed size 2D symbology, in 1992. It was defined under ISO/IEC 16023 and is used to track and manage package shipments. The encoding of a Structured Carrier Message or data in extended ASCII is supported by Maxi code. It uses the same Reed-Solomon error correction as QR Codes (Schmidmayr et al., 2008) as shown in Figure 3.

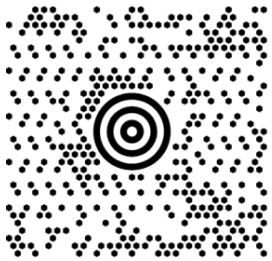


Figure 3 Example of Maxi Code

D. PDF 417

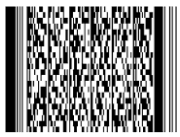
PDF417 codes are used for services that require a huge number of documents, such as pictures, fingerprints, and signatures. They can process more than 1.1 kilobytes of computer-readable data, making them significantly more useful than conventional 2D barcodes. Public domains, like QR codes, are PDF417 bar codes that can be viewed for free. PDF417 codes can be used for a wide range of applications, including transportation and product control, depending on the data content. These barcodes are also ideally suited for the creation of paper boarding permits and state ID cards (Deineko et al., 2022) as shown in Figure 4.

Figure 4 Example of PDF 417

QR codes are now widely used in e-marketing. The majority of businesses place QR codes next to their products to attract customers. The QR code can be scanned and linked to a website where viewers can immediately read product information if they are interested. QR codes may deliver a wealth of product information and settings in a matter of seconds. Here's how a QR code is utilised in businesses such as online account authentication, Wi-Fi authentication, e-ticketing applications, and intelligent advertising.

QR codes combine the advantages of various two-dimensional (2D) barcodes, such as PDF 417, which has a big data capacity, Data Matrix, which saves space printing, and Maxi Code, which provides high-speed readings (M et al., 2014). Table 1 illustrates the comparison for all the 2D barcodes.

Table 1 Comparison of other 2D Barcode with QR code

Symbology	QR Code	PDF 417	DataMatrix	Maxi Code
Example				
Type	Matrix	Stacked	Matrix	Matrix
Alphanumeric Capacity	4296	1850	2355	93
Numeric Capacity	7089	2710	3116	138
Main characteristic	High scan speed, large capacity and small print size	Large capacity	Small print size	High scan speed

Based on the comparison table of other 2D barcodes and QR codes, the data capacity numeric function is an important feature for this project because the enormous data capacity is useful for keeping digital identity information. Under matrix symbology type, QR code, matrix data and maxi

code have a similarity. In this project, the QR code is chosen due to its advantage of having all the other 2D code features as its main characteristic.

Queue

Queues can be implemented as data structures with access routines, abstract data structures, or classes in an object-oriented programming language. Queues allow numerous items to be stored and held for later processing, such as data, objects, people, or events. The queue serves as a buffer for the data. Circular buffers and linked lists are two examples of common applications. A queue is also known as a First-In-First-Out (FIFO) data structure. FIFO refers to how data is handled and manipulated in relation to time and priority (Knuth, 1997). Escalators, coin dispensers, and vending machines are some instances of real-world queues. The person or thing at the front of the line was the first to enter in each case, while the person or object at the back of the line was the last to enter. Every time another person or object enters or departs the queue line, this reflects the enqueue and dequeue functions. Figure 5 shows a queue with FIFO structure.

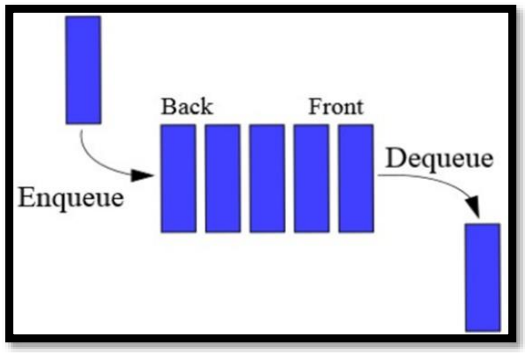


Figure 5 Queue with FIFO structure

According to the FIFO principle, each object can only be handled in the order in which it arrives. While some objects are being processed, others are being queued, and the first object should be served first. The array-based queue and the linked queue are two techniques to implement the FIFO mechanism. To solve the previously problems mentioned, all queue components should be pushed to the first array position. The suggestion for this project is to employ a circular array with the front queue pointing to the lower-numbered spots in the array and the back queue pointing to the higher-numbered positions.

Existing Applications

The emerging COVID-19 epidemic is causing chaos on human health, as well as social and economic life. Reducing people's relationships through social distance is an effective and widely used method of reducing the danger of infection and virus transmission throughout the population. According to current research, technical advancements in many countries have demonstrated that this step can be complemented by mobile apps (Kaspar, 2020).

A. MySejahtera Check-in

In response to the COVID-19 outbreak in Malaysia, MySejahtera Check-In is an extension of the MySejahtera apps in which all types of premises are empowered to follow the government's standard operating procedures (SOPs). This application manages and records the entry of guests into a facility in a uniform and orderly manner. Visitors must utilise the MySejahtera QR Code scanner offered by this programme before visiting any premises. However, this application does not have a function for joining a queue as it has been developed only for contact tracing purposes.

B. WaitQ

WaitQ is a mobile application that aims to achieve a social distance goal in public spaces, retail stores, and other places. During COVID 19, professionals from the Indian Vorfreude Community from diverse sectors came together to give a technical solution to social distance. To apply, the business owner must first register by providing phone numbers and registering the location or shop profile, after which the application owner must validate the registration and obtain a QR code that is used to track consumers in line. However, there is no indicator of footfall notifications in this programme to alert the user. The user can only see how long they have to wait in line without knowing when their turn will come.

C. QueueBee Mobile Queue

QueueBee Mobile Queue application allows customers to monitor and track the status of several queues from a single smartphone without being physically tied to the waiting situation at the customer service location. The goal of the real-time queue status on the smartphone in this application is to allow customers to keep their line intact from a distance and to ensure that the user does not miss the queue. Queuebee Solution Sdn Bhd, a Malaysian firm, was responsible for the development of this app.

Table 2 shows the comparison of existing application and summarises the features of various mobile applications, which are then compared to the intended project mobile app, IPQueue.

Table 2 Comparison of Existing Application

System / **Features**	**MySejahtera Check-In**	**WaitQ**	**QueueBee Mobile Queue**	**IPQueue**
Registration Method	By user	By owner of premise	By user	By user and owner of premise
QR Code Premises Check-In	X	X	X	/
Joining Queue	X	/	/	/
Queue Status Display	X	/	/	/
Stop Queue	X	/	/	/
Tracking Visit	/	X	/	/
Type of Mobile App Development	Native	Native	Native	Progressive Web App (PWA)

There is limited information regarding the specific specification of a similar system based on the comparison in Table 2. As a result, the comparison table was created using features that can be collected with the naked eye and manually tested. As seen in the comparison table, the check-in function is critical for reducing social isolation caused by the COVID-19 epidemic.

The QR code, which has been utilised for a similar approach, is more for assisting in joining the queue at the site of the premises. Notification of footfall in the premises is also important and relevant data to display, as it informs users of the current condition of the queue in real-time. The IPQueue system will keep track of visits, like the QueueBee Mobile Queue system, and will allow users to join queues, like the WaitQ system.

PWA was used in the creation of IPQueue because it allows web apps to look and feel like native mobile apps by leveraging device functionalities such as the camera and geolocation in web

apps that could not be done before. The ability of service workers to create web apps that work without an internet connection is a benefit of using PWA in development. Aside from that, the PWA feature that enables web push notifications can boost user engagement with web apps.

METHODOLOGY

This section focuses on IPQueue's development process. To construct IPQueue, the waterfall model was chosen as the software process model, as shown in Figure 6 (Ismail et al., 2019). This approach was chosen because it is straightforward to comprehend. It's also because of this paradigm that it works effectively for smaller projects with well-defined requirements.

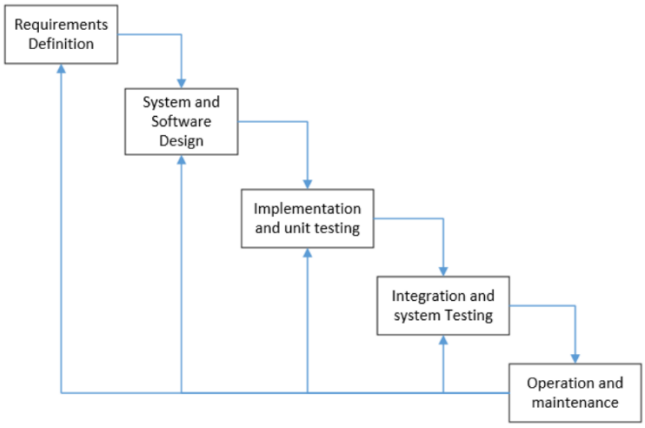


Figure 6 Waterfall model

The requirement definition phase, the system's services, constraints and goals are established by consultation with the system user and literature review. Figure 7 shows the use case diagram representing the functional requirements for IPQueue (Sulaiman & Ghani, 2011). Three identified main users are customer, service provider and admin.

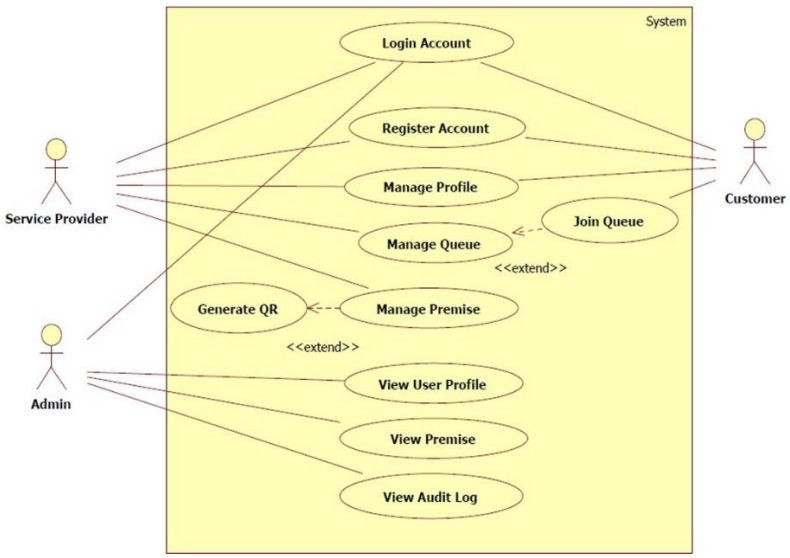


Figure 7 Use Case Diagram for IPQueue

The system and software design, the overall system architecture model is proposed as illustrated in Figure 8. This architecture partitions the requirements into either hardware or software

systems. The customer, service provider and admin can access the application via mobile phone. The application server retrieves data from the database that the users have requested.

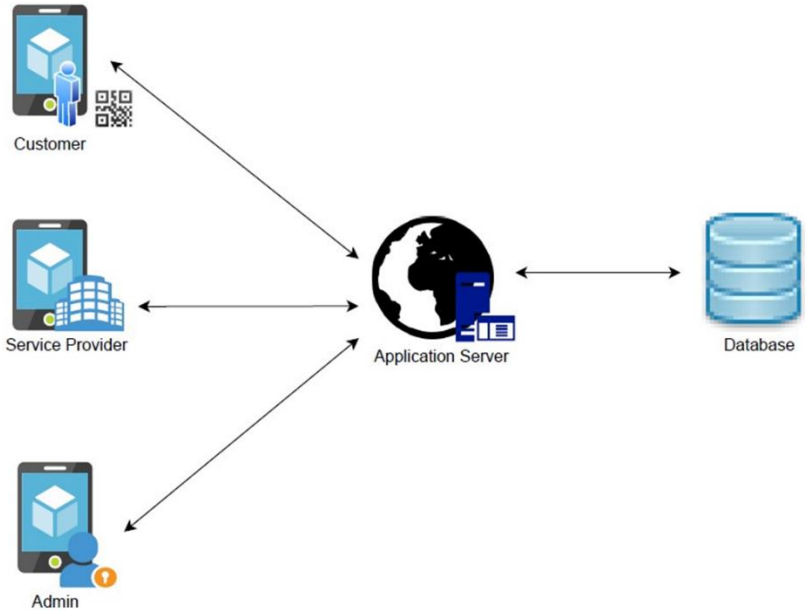


Figure 8 System architecture for IPQueue

In the implementation and unit testing phase, IPQueue is realized by using software and hardware, e.g., Visual Studio Code as an integrated development environment (IDE) and progressive web application (PWA) as a framework. A laptop and a mobile phone are used as development and testing devices. A unit test was then performed to verify that each unit complied with the requirement specification during the initial phase.

In integration and system testing, the individual program units are integrated and tested as a complete system. The purpose is to ensure that the software specifications are met. Since the main goal of this project is to construct a mobile app prototype, the last phase, operation and maintenance, is beyond the scope of our project.

RESULT AND DISCUSSION

The graphical user interface, application features of employing PWA, and QR code implementation for generator and scanner are all discussed in this section.

Login

The login page is the application's first page. This application has three distinct user types: customer as a member, service provider as a premise owner, and administrator. Each type of user logs in via the same page. To login into the application is using the traditional authentication whereby users will use the registered user and password which it will compare with the database. Users are considered authenticated if the username and password match.

User Registration

The user register option is on the same page as the login option, which is a side navigation page embedded on the login page. It's accessible by tapping the text "Not a user yet?" at the bottom of the page. A subpage will display the input fields that users must fill out to register for the application. Name, email address, contact number, and password are required.

Service Provider

The graphical user interface of the main menu for the service provider consists of home, account, premise, about, contact and logout.

A. Premise

The service provider can manage the premise for registration on the premise page. When a premise is registered, it is automatically displayed for customer viewing. The application allows the premise owner to register and delete their premise. Figure 9 depicts an icon that serves as a button to delete the specific premise and a plus button sign for registering the new premises which is a subpage.

Figure 9 Add and delete Icon in My Premise

B. QR Code Generator

To begin, the service provider must create an IPQueue account. The service provider can then generate the QR Code before the customer enters the premise to join the queue. The generated QR code corresponds to the premise's unique ID, which was created at the time of registration. Customers must scan the QR code with their smartphone to join the queue. Figure 10 shows the page for QR code generator.

Figure 10 Add and delete Icon in My Premise

Customer

The graphical user interface of the main menu for customer consists of home, account, premise, history, about, contact and logout.

A. Premise View

The premise page displays all the premises registered in this application with details such as the premise name, category of the premise, category list, company registration number and the capacity limit of a premise. Figure 11 show list of registered premises.

Figure 11 List of Registered Premise

Customers can choose their preferred premise from the list by clicking on the name of the premise. It will be directed to a new page with information such as the current premise capacity number, current customer status, and the current state of the customer queue in the premise.

B. Join Queue

Figure 12(a) shows the queue status before the customer scanned. To join the queue, the customer needs to click on the check/queue in button and the request camera permission will be displayed as shown in Figure 12(b). The user then needs to scan the QR code of the selected premise by the service provider and then the user's turn will be added to the queue process as shown in Figure 12(c).

If the capacity of the premises has exceeded, the customer will automatically be placed in a queue line until the customer who is inside the premises leaves, or the capacity of the premises is not exceeded. Figure 13(a) shows the capacity full premise and Figure 13(b) shows the customer in the queuing line.

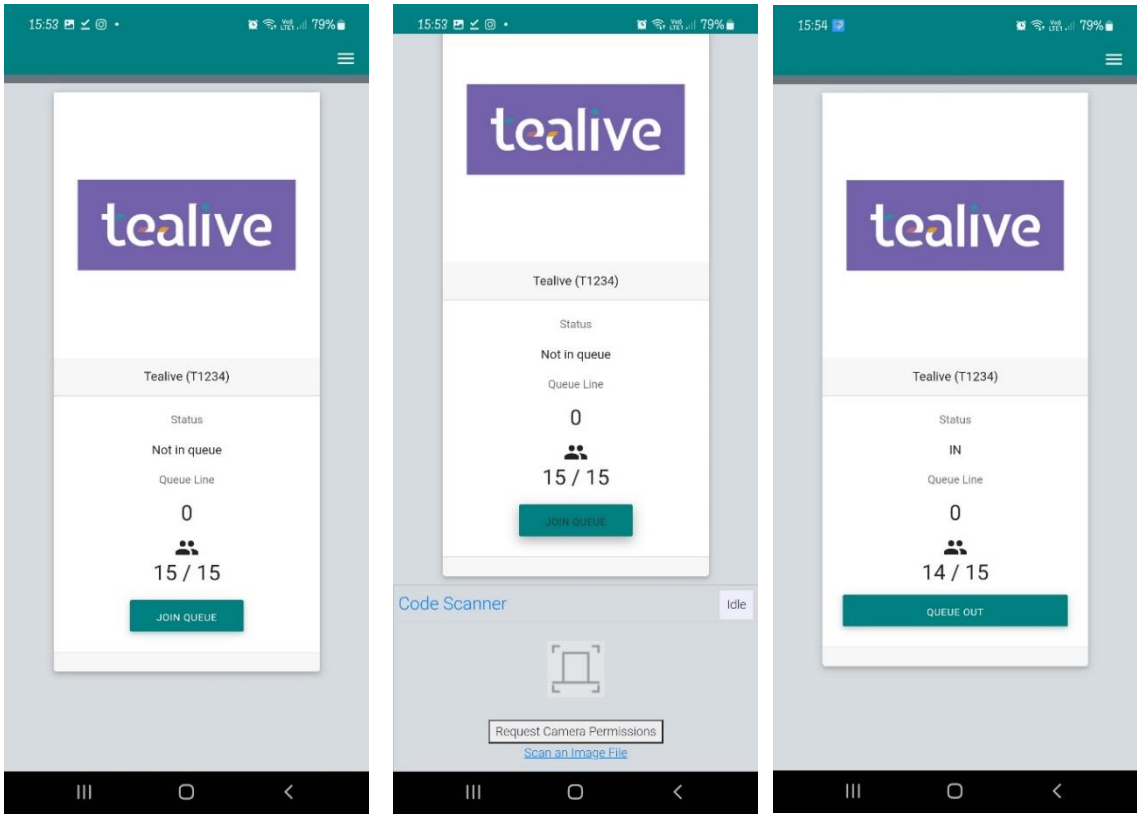


Figure 12(a) Queue status before scanned, 12(b) Camera view for scanner, 12(c) Queue status after scanned

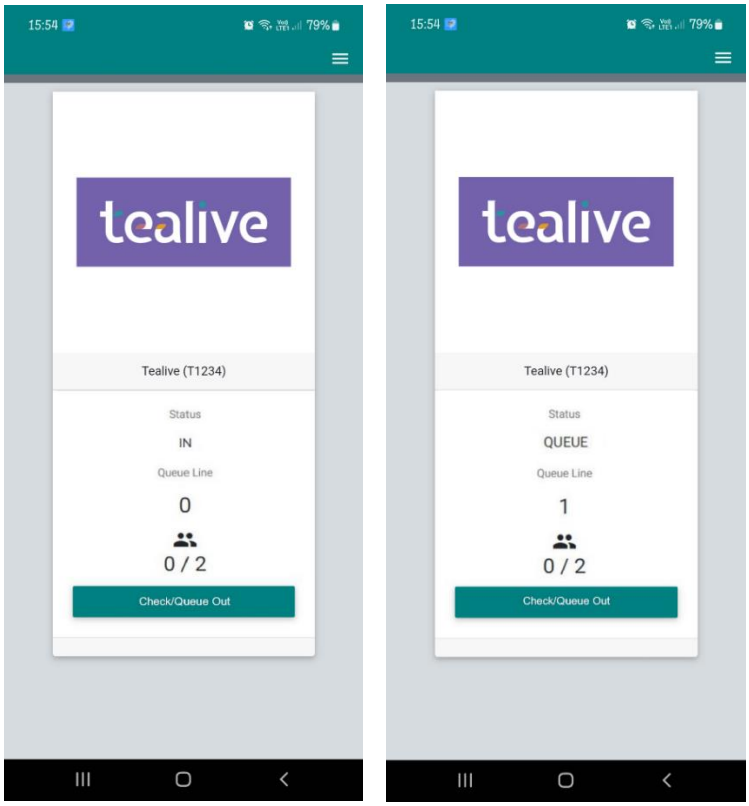


Figure 13(a) Status when full capacity, Figure 13(b) Status when in queue line

Admin

The admin graphical user interface main menu includes home, membership, audit log, and log out. The audit log page is for the admin viewer of the activities of the membership in the application. The activities include login, logout, user registration, and profile editing. List of the table displayed with the information of activities including dates and descriptions. It can be filtered by customers or service providers also by activities. Meanwhile, the search feature is also available, which fastens finding specific members or activities.

Discussion

For this project, implementing the QR code generator and scanner in a PWA environment was a big challenge. It's been difficult to find a decent QR code library that works because most QR code libraries available are more practical for native app development. As a result, the solution is to use the jQuery library for the QR code generator and to incorporate QR codes for scanning in HTML5. Some adjustments were made to this project to assure the use of both matchings with the project purpose, which included the necessity to incorporate ID authentication with the QR code.

Finally, selecting an appropriate database for storing the data for this project is a major challenge as well. Most of the web references combined Cloud Firestore and the PWA. The tough aspect is that Cloud Firestore is a NoSQL database concept that stores data in documents that look a lot like JSON. Setting up the database to use is a vast challenge since it needs some learning, experimentation, and exploration to understand the fundamental of the database.

CONCLUSION

In this paper, the development of IPQueue to replace the existing approach by using mobile technology is presented. The IPQueue can generate the QR code and can control and monitor the capacity of the premise. For future recommendations, the IPQueue can provide the options for users to view or search the premises that are in the user's area more accurately using location and map.

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