

**QUEUING SOLUTION WITHOUT APPLICATION INSTALLATION FOR
SERVICE ORIENTED INDUSTRY**

By

Ng Wan Qing

A REPORT

SUBMITTED TO

Universiti Tunku Abdul Rahman

in partial fulfilment of the requirements

for the degree of

BACHELOR OF COMPUTER SCIENCE (HONS)

Faculty of Information and Communication Technology

(Perak Campus)

JANUARY 2019

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DECLARATION OF ORIGINALITY

I declare that this report entitled “**QUEUING SOLUTION WITHOUT APPLICATION INSTALLATION FOR SERVICE ORIENTED INDUSTRY**” is my own work except as cited in the references. The report has not been accepted for any degree and is not being submitted concurrently in candidature for any degree or other award.

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Name : _____

Date : _____

ACKNOWLEDGEMENTS

First of all, I would like to express my sincere thanks and appreciation to my supervisors, Dr. Ooi Boon Yaik who has given me this opportunity to engage in a proven of a queuing solution concept. It is my first time to involve in queuing solution field. A million thanks to you.

Finally, I must say thanks to the special and important person in my life. Thanks to my parents and my family for their love, support and continuous encouragement throughout the course.

ABSTRACT

Queue is highly related to human society and it can be observed in everywhere. A proper queue management system can help to reduce queue length, average waiting time, dropout rate and optimise the usage of the resources. In addition, a queue without a proper queue management system will waste the time of people. This is because people will need to wait in line and do nothing while waiting for their turn. However, queue management system is seldom be used in small business like the hawker and beauty salon due to the high operation and entry cost of the existing queuing solutions. Besides that, most of the existing queuing solutions still need their customers to be physically present. These queuing solutions have no value to small business. Apart from these, most of the existing queue management systems are focus on the large and medium organization, so the prices will be too high for the small business and the system will be too complex or not applicable for the small business. Therefore, a queue management system that can save the time of the customers by allowing them to leave the queuing area and only inform them to come back when their turn is near will be developed at the end. Furthermore, the system must be affordable and suitable for the small business service providers. In a word, this report is about to develop a comprehensive and affordable queuing solution for the small business. In addition, the queuing solution developed in this report also allows the customers to leave the queuing area and make use of the waiting time to do some productive tasks. On the other hand, this queuing solution was tested by using smart phones and computer web browser under the Wi-Fi condition. In conclusion, this report has proven that a queue management system can work without application installation and it can still allow the customers to leave the queuing area and only come back when their service is ready or when their turn is near.

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LIST OF ABBREVIATIONS

GMS	General Microsystems
HTML5	Hypertext Markup Language 5
CSS	Cascading Style Sheets
AWS	Amazon Web Services
QR code	Quick Response Code

CHAPTER 1: INTRODUCTION

1.1 Motivation and Background

A queue is a line of people waiting for their turn to get a service (Oxford Dictionaries | English 2018). Generally speaking, a queue occurs when arrival rate exceeds service rate. Therefore, people have to wait for the service in a queue. Correspondingly, a queue management system is a system that is used to manage a queue. A proper queue management system can help to reduce queue length, average waiting time, dropout rate and optimise the usage of resources. On the other hand, a queue will also reduce the productivity of people. This is because people will need to wait in line and do nothing while waiting for their turn. Therefore, a more effective queuing method should be developed to allow people waiting in line while performing other tasks concurrently. For example, most of the people will go to bank during their lunch time. If they are free to leave the bank while waiting for their turn and only come back when their turn is near, they will be able to go the nearby shop to have their lunch and even go for shopping with minimal mental pressure. Since the queue is highly related to human society, efficient queue management system should be used in everywhere. However, it is seldom be used in small business like the hawker and beauty salon because to the operation and entry cost of the existing queue management systems are too high for the small business. Besides that, most of the existing queuing solutions still require their customers to be physically present in a queuing area. Apart from these, most of the existing queue management systems are focus on the large and medium organizations, so the prices will be too high for the small business and the system will be too complex or not applicable for the small business. While most of the queue management systems are implemented in government organization, hospital, bank and some large private organization. Here comes a question, does the small business needs a queue management system? The answer is yes. Of course they need a queue management system to help them facilitate or improve their business process, customer experience and provide a better service to the customers. Even they are a small business; they will still need to serve a large amount of people per day. Again, why they do not go for it? The main reason is the existing queue management systems normally focus on government organization, hospital, bank, higher education and large private organization. This kind of queue

management systems normally involve many departments, the customers have to go from a department to another department. However, the small business does not need such a complicated system. Since most of the existing queue management systems are focus on the large and medium organization, the prices will be too high for the small business. In addition, those existing queue management systems that are sold in the market normally need a lot of upfront investment. In other words, it requires users to invest a lot of money on it before it can actually benefit or earn money for the users. Likewise, this is also one of the reasons that keep the small business away from the queue management system. As can be seen, the small business like the hawkers and the beauty salon just like a point often overlooked by the existing queue management systems. In summary, none of the existing queue management systems focuses on the needs of the small business.

1.2 Problem statements

- 1) In the existing queuing solutions, customers are needed to be physically present in a queue and are unable to do other task.

Obviously, customers are not allowed to leave the places during the waiting time. They will need to stay in the place to wait for the service. As can be seen, this is wasting the customers' time while they can do something more meaningful instead of waiting in the place and do nothing but to waste their life for waiting.

- 2) High operation and entry cost of existing queuing solution for small business. The existing queuing solutions are not only expensive to small business, it still need their customers to be physically present. Such queuing solutions have no value to small business.

As a matter of fact, the existing queue management systems are too complicated and expensive for the small business. Consequently, the high operation and entry cost keep the small business service providers away. However, with a good queue management solution, small business can enjoy certain level of business optimisation.

1.3 Project Objectives and Scope

The first objective of this project is to allow the customers to leave the place of the service provider and eventually save their time. In other words, the customers will be able to do their own things instead of wasting their time on waiting. Besides that, they will be informed when the requested service is available and go back to the place to get the service.

The second objective of this project is to develop a queue management system which is comprehensive, low-cost and suitable for the small business. For the purpose of improve their business process, help them to manage their business better and provide a better service to the customers. At the same time, they will be able to serve more customers and earn more money.

On the other hand, the QR code generated by the service providers to allow their customers to get into their queue is unique for every customer. This is to prevent the customers abuse the system by taking a photo of the QR code and keep on joining the queue from other places.

Apart from these, this project focuses on develop a comprehensive queue management system which is using the web technology and it is suitable and affordable for the small business. The system is served as a platform to allow the customers to join the queue of the service providers.

1.4 Contributions

- 1) Save the time of the customers by free them up from the queuing area.

In this case, the customers will be able to make use of the waiting time instead of wasting it on waiting.

- 2) Facilitate and improve the business process of the service providers.

This system can help the small business service providers to manage their queue and facilitate the queuing process. In this way, they will have a chance to serve more customers and improve their services. As a result, they will be able to attract more customers and earn more money.

1.5 Report Organization

This report consists of 6 chapters. Chapter 1 contains the motivation and background, problem statement, project objectives and scope, and contributions. In addition, the review of the existing queue management systems is presented in Chapter 2. Chapter 2 will show that the existing solutions are either too expensive or not suitable for small business.

Besides that, the details of the system design are illustrated in Chapter 3. After this, Chapter 4 describes the implementation details of this system. Then the testing performed on this system is shown in Chapter 5. Eventually, the conclusion and future work will be presented in Chapter 6.

CHAPTER 2: LITERATURE REVIEW

In this literature review, only the queue management part of the existing queue management systems will be highlighted. Some features like online appointment, data analysis, predict waiting time and get customers' feedback will not be discussed at here.

First of all, the existing queue management systems that are sold in the market can be categorised into 2 categories. The 2 categories are non-hardware related and hardware related. The non-hardware related queue management systems are mobile application based. These systems will require the customers to download the mobile application from Google Play Shop or Apple App Store in order to join the virtual queue and be informed when it is their turn or near to their turn. For example, the Mobile-Q of Wavetec (Wavetec n.d.) is a queue management application that allows the customers join a queue by using their smartphone. In this case, the customers will not need to travel to a physical location in order to join a queue. After the customers join the queue, the application will assign and display a ticket number to the customers. Besides that, it will give real-time updates of the queuing status to the customers. Moreover, it will also give alerts through the mobile application to the customers when their number is up to make sure they will not miss their turn. On the other hand, some other mobile application based systems like the mobile queue of QueueBee (QueueBee Developers 2018) which does not require the customers to sign up for joining a queue which makes the application become more user friendly.

The hardware related category can be further divide into 5 sub-categories. The first sub-category is hardware based queue management system. These systems are highly related to the hardware infrastructures. By the way, this kind of systems is the most commonly used queue management system in Malaysia. For example, the digital queue management system of PCS VISION (PCS VISION SDN. BHD. n.d.). First, it will provide a self-service kiosk or a terminal to allow the customers get their number and join the queue. Sometimes, this kind of system also allows the customers to select which services they want to request and then the system will join them to the different queue. Apart from this, it provides a digital display screen to display the turn of the customer and the counter number that the customers need to proceed to when there is

more than one counter or more than one service provided. Besides that, it also provides a terminal for the staff to inform the next customer that the counter is available. The second sub-category of the hardware related queue management systems is the integration of hardware and application. This sub-category provides a mobile application to work together with the hardware infrastructure. The QMS700i of the General Microsystems (GMS) (Gms.com.my n.d.) and the skiplino (Skiplino 2018) are the examples of this sub-category. These systems provide a mobile application to allow the customers to join the line remotely, check the number of people waiting for each service before and after they join the queue. In addition, they also will inform the customers when it is their turn or near to their turn. Furthermore, they also allow the customers who do not download the mobile application to get their number by walk in. In this case, the customers can get their number from a ticket printer or a self-service kiosk and wait for their number to be displayed on the screen in a particular area. The third sub-category of the hardware related queue management systems is the integration of hardware and SMS. The examples of this sub-category are Qminder (Qminder n.d.) and QueueRite (Queuerite n.d.). This kind of queue management systems requires the customers go to a physical location in order to join the line through the queuing machine. Besides that, the customers also need to leave their phone number to the machine in order to be informed when their number is near. After this, the customers can choose to leave the physical location and back to the place when their number is near. The only difference between Qminder and QueueRite is the Qminder requires a person to inform or message the customers when their number is near while the queue management system of QueueRite will automatically send out SMS to the customers when their number is near. The fourth sub-category of the hardware related queue management systems is the integration of hardware, SMS and application. The example of this sub-category is the Enterprise Virtual Queue Management System of Wavetec (Wavetec n.d.). This kind of system allows the customers to join a virtual line through the mobile application from a remote or different place. Otherwise, the customers can also choose to join the line through the on-site kiosk. After the customers joined the line, the customers can check the queuing status through the digital display screen at the location or the mobile application. The customers can also get the notifications through SMS when their number is near. The fifth sub-category of the hardware related queue management

systems is the integration of hardware, SMS, application and website. The examples of this sub-category are QLess (QLess n.d.) and WhyQ (Whyq n.d.). This kind of systems is similar to the systems of fourth sub-category. The only difference is the customers are able to join the virtual queue via the website of the user. Other features are exactly the same with the systems of fourth sub-category. The only difference between the QLess and the WhyQ is WhyQ also allows the customers to join the line through SMS.

In the table 2.1, the overview features of the existing queue management systems are shown in term of the categories and sub-categories.

Table 2.1: Overview features of the existing queue management systems.

Features			Join queue from other places	Join queue by going to a location	Know queuing status
Categories and existing systems					
Non-hardware related	Application based	Mobile-Q of Wavetec	X		X
		QueueBee	X		X
Hardware related	Hardware based	digital queue management system of PCS VISION		X	
	Hardware and application	QMS700i of the GMS	X	X	X
		skiplino	X	X	X
	Hardware and SMS	Qminder		X	
		QueueRite	X	X	X
	Hardware, SMS and application	Enterprise Virtual Queue Management System of Wavetec	X	X	X
	Hardware, SMS, application and website	QLess	X	X	X
		WhyQ	X	X	X

The advantage for the mobile application based systems (Mobile-Q of Wavetec (Wavetec n.d.) and QueueBee (QueueBee Developers 2018)) and the second, third, fourth and fifth sub-category integration of hardware and mobile application (QMS700i of the GMS (Gms.com.my n.d.) and skiplino (Skiplino 2018)), integration of hardware and SMS (Qminder (Qminder n.d.) and QueueRite (Queuerite n.d.)), integration of hardware, SMS and mobile application (Enterprise Virtual Queue Management System of Wavetec (Wavetec n.d.)) and integration of hardware, SMS, mobile application and website (QLess (QLess n.d.) and WhyQ (Whyq n.d.)) with compare to the hardware based systems is the customers no need to stay or queue up at a certain place. They can spend their own time on other things at other places and no need to waste their time on waiting at a certain place. After this, they will receive notifications when it is their turn or their turn is near. The disadvantage for the systems stated above is some of them require a person to sit there and communicate with the customers and give some real-time updates to them.

The first strength of the mobile application based queue management system (Mobile-Q of Wavetec (Wavetec n.d.) and QueueBee (QueueBee Developers 2018)) is it requires the least investment. It does not require the users to buy the hardware infrastructures and can perform all the queue management functions by the mobile application that is installed in the customers' smartphone. The second strength is it is environment friendly as no paper is used or needed for assigning number to the customers. The third strength of the mobile application based queue management system is it is easy and convenient to use for the users and also the customers. This is because it does not require any hardware infrastructures so that the users do not need to set up anything in the lobby. Besides that, a mobile application provides a quick access for the customers. Therefore, the customers can join the line easily and conveniently from other places. However, it also has its own weaknesses. The first weakness of the mobile application based queue management system is it is not friendly to the first time visit. This is due to it require the customers to download the mobile application in order to join the virtual queue and be informed or get notification of their queuing status. Moreover, some mobile application based queue management systems also require the customers to sign up before they can actually join the queue which make these systems become much more unfriendly to the first

time visitors. The second weakness is not many customers are willing to install a mobile application in their phone when they are not going to use the application frequently. The third weakness of these systems is they cannot keep the queue management features without the mobile application as they are highly relying on the mobile application. If the customers do not install the mobile application in their phone, there is no queue management system anymore.

The excellent feature of the hardware based queue management systems (digital queue management system of PCS VISION (PCS VISION SDN. BHD. n.d.)) is it does not require the customers to stand in a particular area to queue up. The customers can take a number from the self-service kiosk and sit in the waiting area to wait for their turn and no need to keep on moving their position. However, the weakness of the hardware based queue management systems is the customers still need to stay and waste their time in that particular area to wait for their turn.

The first advantage of the queue management systems that integrate hardware and application (QMS700i of the GMS (Gms.com.my n.d.) and skiplino (Skiplino 2018)) is the customers can get into the line from other places and get the notifications of their queuing status through the mobile application. The second advantage is it can still keep the queue management features without the application installed in the customers' smartphone. On the other hand, it will also gain some disadvantages of the application based queue management system. The first disadvantage is it will gain the first and second weakness of the application based system. The second disadvantage is if the customers do not install the mobile application in their phone, it will lose the first advantage and perform exactly like the hardware based queue management systems.

The first superiority of the queue management systems that integrate hardware and SMS (Qminder (Qminder n.d.) and QueueRite (Queuerite n.d.)) is the customers no need to download a mobile application in order to get the notifications. The second superiority is no data or Wi-Fi is needed in order to perform any operation. However, the first weakness is extra charge for the SMS notifications will be imposed to the user. The second weakness of this kind of systems is the customers still need to go to a physical location in order to join the line. Although the customers can leave the

location after they joined the line, they still need to travel to the location just to get a number.

The first strongpoint of the queue management systems that integrate hardware, SMS and application (Enterprise Virtual Queue Management System of Wavetec (Wavetec n.d.)) is the customers can join the line through the mobile application. In this case, the customers do not need to travel to a physical location just to get a number and join a line. The second strongpoint is the customers will be notified through SMS. Even though the customers do not install the mobile application in their phone, they still can be notified by SMS. Hence, no data or Wi-Fi is needed for the customers. However, the first shortcoming is it will gain the first and second weakness of the application based queue management systems. The second shortcoming is it will lose the first strength of itself if the customers do not have the application in their phone. Then it will perform exactly like the systems that integrate hardware and SMS. In this case, it will also gain the second weakness of the systems that integrate hardware and SMS.

The first attractiveness of the queue management systems that integrate hardware, SMS, application and website (QLess (QLess n.d.) and WhyQ (Whyq n.d.)) is the customers can join the line through the website of the user from other places without travel to a physical location first. In other words, the customers no need to install a mobile application in their phone just to join the line from other places. In addition, it also gains the first and second strength of the systems that integrate hardware, SMS and application. However, some systems (WhyQ (Whyq n.d.)) in this category enable the customers to join the line through SMS which cause the extra charge imposed on the customers.

In summary, the disadvantage of all these queue management systems is the prices of these systems are too expensive for the small business and need a lot of upfront investment or maintenance fees. This is because their target users are the large and medium business. Therefore, these systems are too complex, expansive and not suitable for the small business.

CHAPTER 3: SYSTEM DESIGN

3.1 System Overview

The system overview is shown in Figure 3.1.1. As shown in the figure below, the system is separated into 2 parts which are client-side and server-side. Moreover, the server used in this system is a cloud server. Therefore, this system is a fully cloud based solution as the server and database both are on the cloud. Furthermore, the client-side consists of 2 groups of target user, one is the user or service providers and another one is the customers of the service providers.

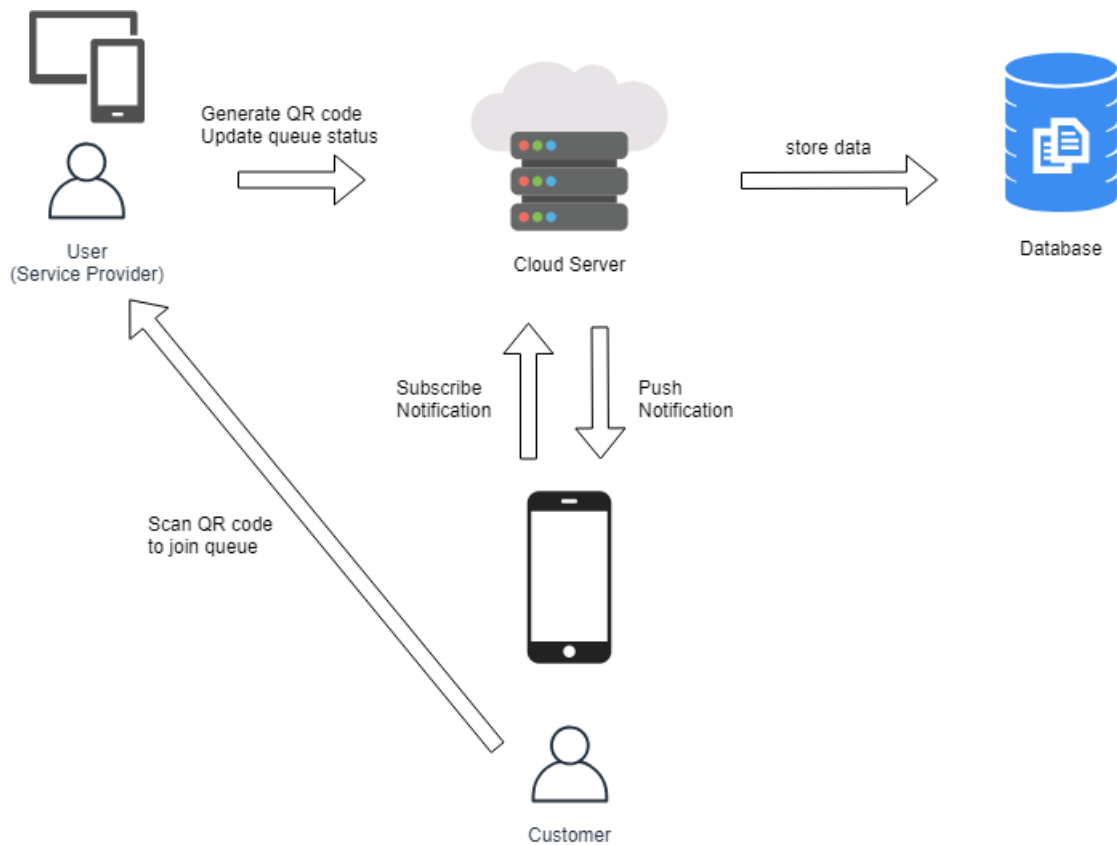


Figure 3.1.1: System overview.

3.2 Use Case Diagram

The use case diagram of this system is shown in Figure 3.2.1. According to the figure below, this system consists of 5 use cases in total. Out of these 5 use cases, 3 of them are for the User and another 2 of them are for the Customer.

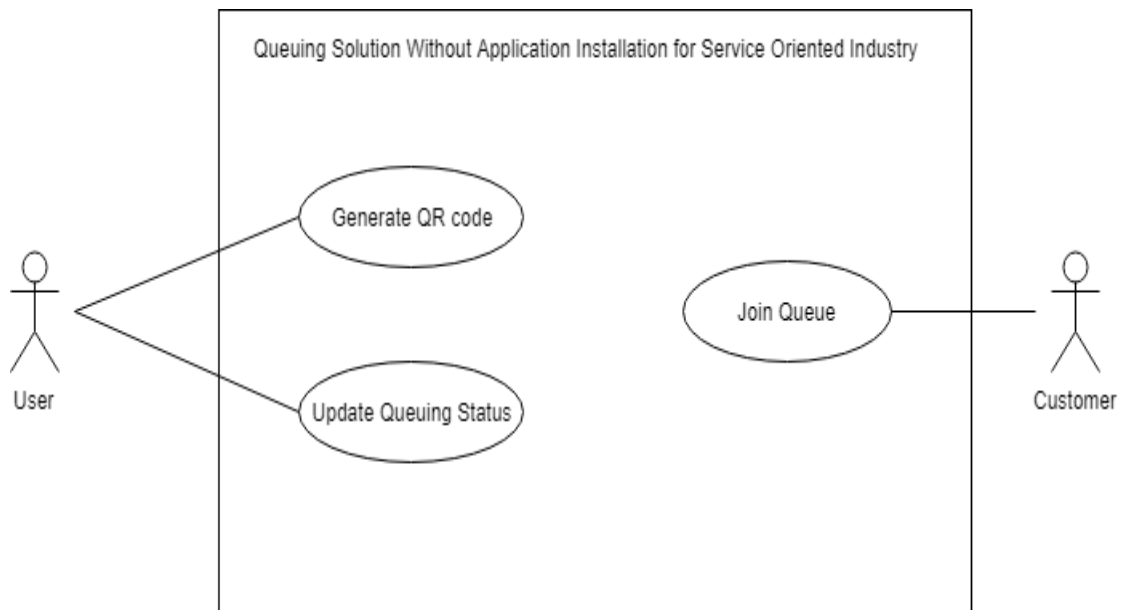


Figure 3.2.1: Use case diagram of this system.

3.2.1 Generate QR Code

The following table (Table 3.2.1.1) shows the details of this feature (Generate QR Code), followed by an activity diagram and sequence diagram to illustrate the flows of this feature.

Table 3.2.1.1: Use Case Description - Generate QR Code.

Use Case ID	UC001	Version	1.0
Use Case	Generate QR code		
Purpose	To allow user to generate QR code.		
Actor	User		
Trigger	User clicks the “Generate QR Code” button.		
Precondition	User has login and at the generate QR code page.		
Scenario Name	Step	Action	
Main Flow	1	User clicks on the “Generate QR Code” button.	
	2	System creates the QR code by using the current timestamp and the user id.	
	3	System displays the QR code on screen.	
Author	Ng Wan Qing		

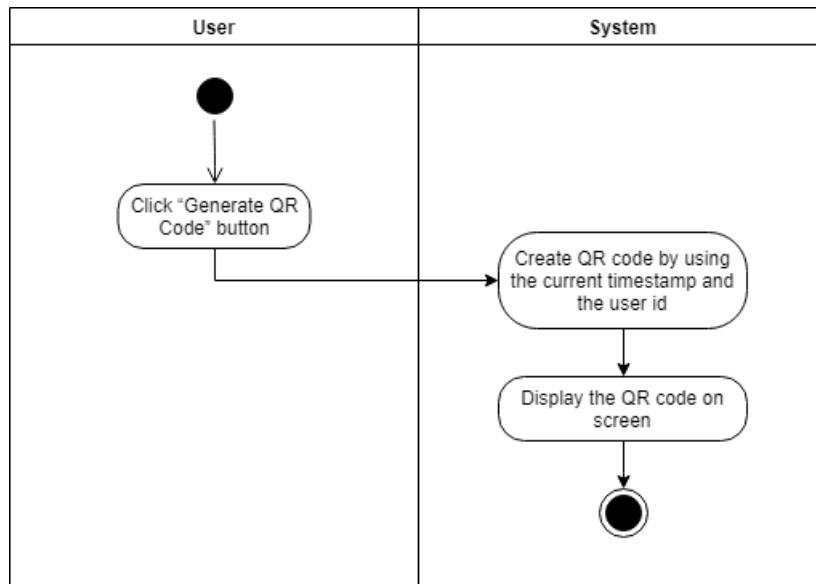


Figure 3.2.1.1: Activity Diagram - Generate QR Code.

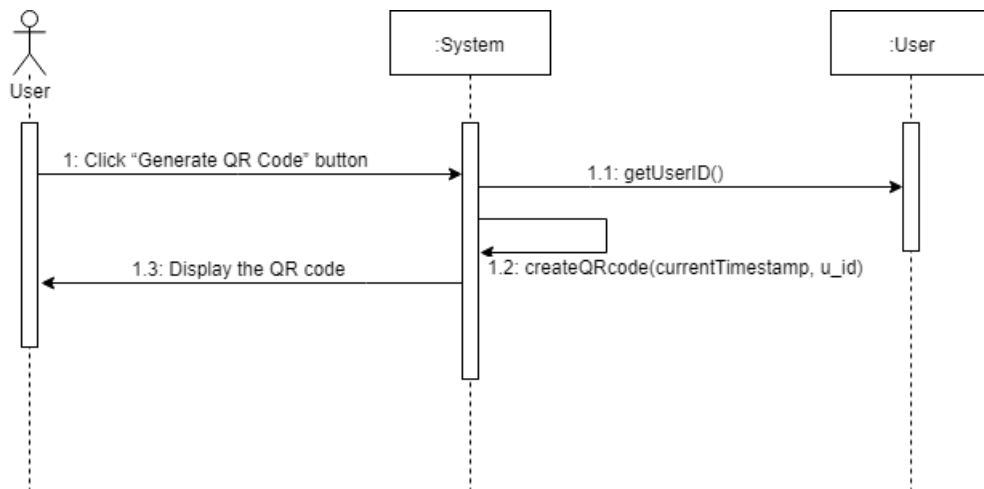


Figure 3.2.1.2: Sequence Diagram - Generate QR Code.

3.2.2 Update Queuing Status

The following table (Table 3.2.2.1) shows the details of this feature (Update Queuing Status), followed by an activity diagram and sequence diagram to illustrate the flows of this feature.

Table 3.2.2.1: Use Case Description - Update Queuing Status.

Use Case ID	UC002	Version	1.0
Use Case	Update Queuing Status		
Purpose	To allow user to get customer out of the queue.		
Actor	User		
Trigger	User clicks the “Next Customer” button.		
Precondition	User has login and at the update queuing status page.		
Scenario Name	Step	Action	
Main Flow	1	User clicks on the “Next Customer” button.	
	2	System gets the first customer in the queue out from the queue.	
	3	System displays the message “Now Serving” and the number of the first customer on the screen.	
Author	Ng Wan Qing		

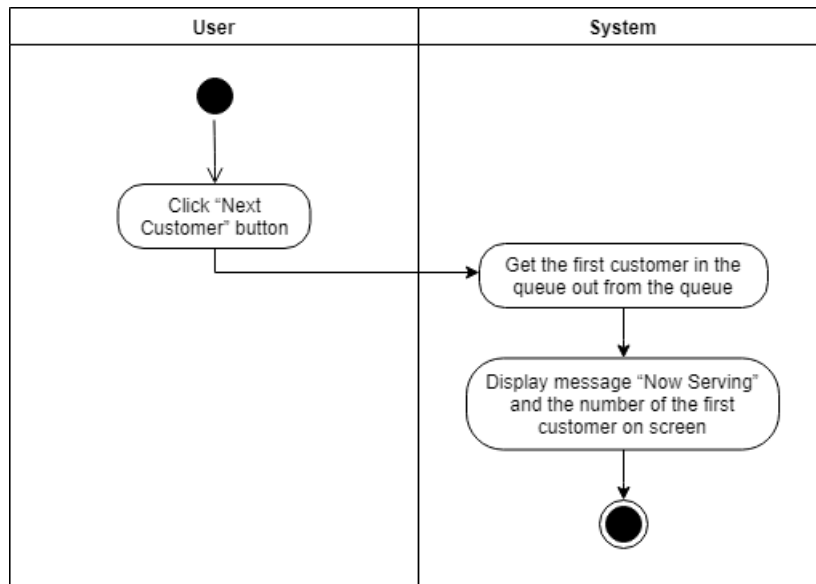


Figure 3.2.2.1: Activity Diagram - Update Queuing Status.

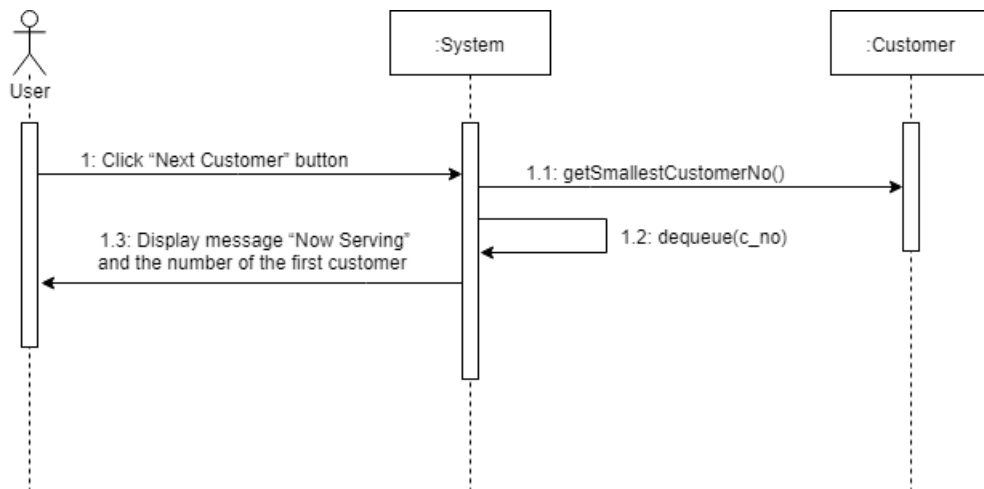


Figure 3.2.2.2: Sequence Diagram - Update Queuing Status.

3.2.3 Join Queue

The following table (Table 3.2.3.1) shows the details of this feature (Join Queue), followed by an activity diagram and sequence diagram to illustrate the flows of this feature.

Table 3.2.3.1: Use Case Description - Join Queue.

Use Case ID	UC003	Version	1.0
Use Case	Join Queue		
Purpose	To allow customer to get into the queue.		
Actor	Customer		
Trigger	Customer scans the QR code generated by the user.		
Precondition	No other people use the same QR code to get into the queue before.		
Scenario Name	Step	Action	
Main Flow	1	Customer scans the QR code shown by the user.	
	2	System displays the number of the customer and the number of the customer that are serving by the user at that time.	
	3	Customer clicks on the “Notify me!” button.	
	4	System notifies the customer when there is people get out from the queue or the service is ready.	
Author	Ng Wan Qing		

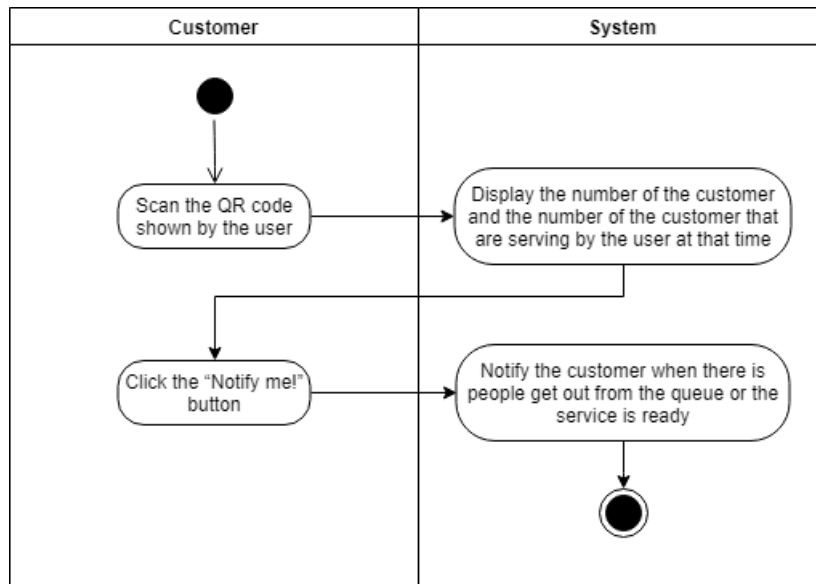


Figure 3.2.3.1: Activity Diagram - Join Queue.

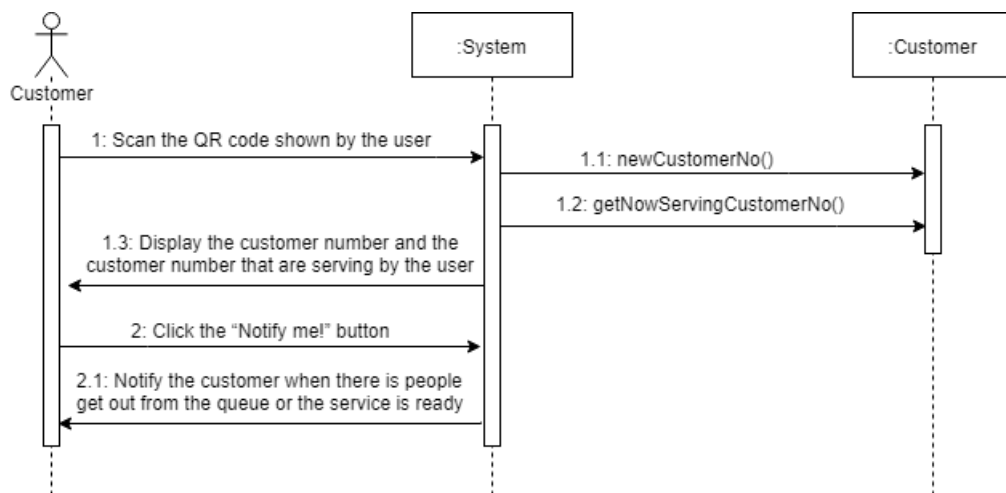


Figure 3.2.3.2: Sequence Diagram - Join Queue.

3.3 Database Design

The data design of the database is shown in Figure 3.3.1. The database used in this system is Cloud Firestore and it is a NoSQL database. As can be seen, the database of the system consists of 2 collections only which are user and customer.

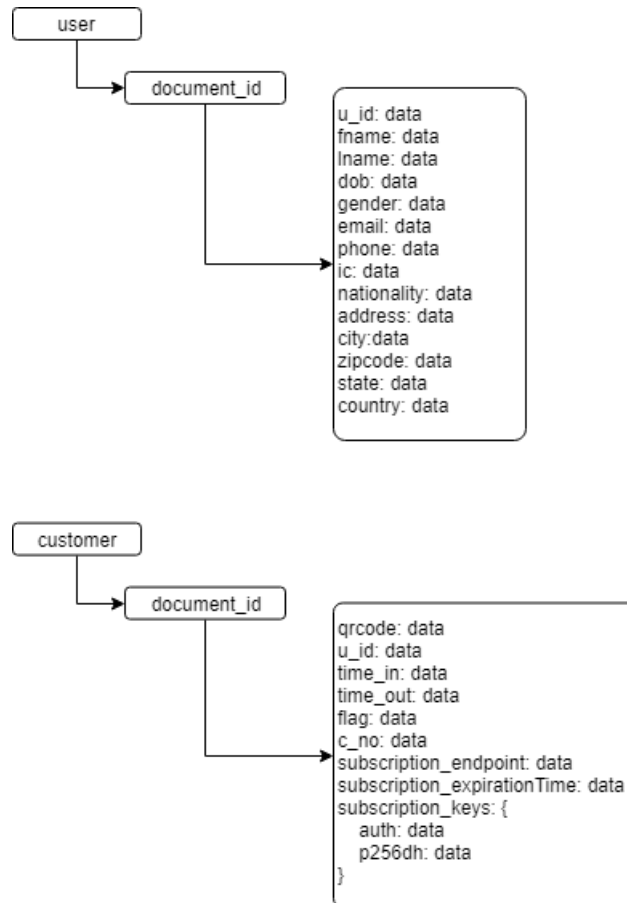


Figure 3.3.1: Database design of this system.

CHAPTER 4: IMPLEMENTATION DETAILS

In the first place, the system is implemented in the way that is shown in the Figure 4.1.

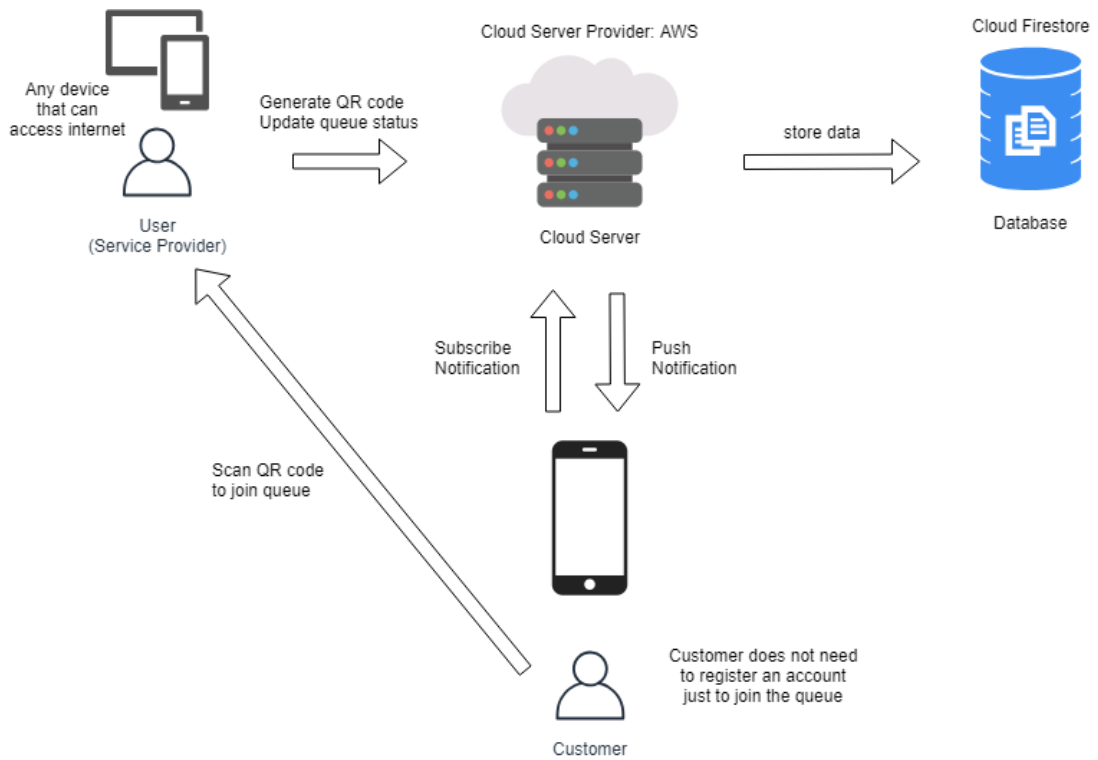


Figure 4.1: Detailed system overview.

In this project, the Hypertext Markup Language 5 (HTML5), Cascading Style Sheets (CSS) and JavaScript will be used to develop the client-side web page. HTML5 is a markup language which can be used to create the structure of the web page and CSS can be used for the web page design. Moreover, the JavaScript will be used to create dynamic web page to allow the users interact with the web page.

Apart from these, the Node.js is used for the server-side scripting. This is because the Node.js is an open source and cross-platform server-side scripting language. It is suitable for dynamic web development as it can run the JavaScript outside of the browser. Besides that, the Cloud Firestore is used to store the data of this system. This is because the Cloud Firestore is a scalable NoSQL database system no matter how many users come in at the same time. Besides that, it allows the system to get the real time update from the database. In other word, it allows the data synchronisation across all the client applications. Furthermore, it also offers an offline support. In this case, the system can be working fine even when the device is offline (Firebase, 2019).

In addition, the cloud provider that is selected to be used in the system is Amazon Web Services (AWS). This is because the AWS is very useful for large storage (Jake 2018). Furthermore, the database of this system will become very huge in the future. This is due to the database needs to store all the queuing status for all the customers of the service providers. Moreover, a service provider will have many customers per day. In this case, the database will need to store many data per day. Hence, it will become a very large database sooner or later.

Generally speaking, the service providers will need to sign up an account on the website first. When their customers want to join the queue, they will need to request a Quick Response Code (QR code) from the system. The system will generate a QR code for them, and the customers will need to scan the QR code from the smart phone or any smart device of the service providers to join the queue. Apart from these, the QR code will only be generated when the service providers request. Moreover, the QR code generated for the service providers each time is unique and can only be used once. Hence, the QR code generated is not reusable. The reason of doing these is to improve the security of the system and to avoid the Denial of Service Attack.

On the other hand, this system also reduces upfront investment for the service providers. When the service providers want to update the queuing status of their queue, all they need to do is to use their smart phone go to the website of this system and then click on the button “Next Customer” to update their queue. However, they will need to prepare a device for this operation. By the way, there is no restriction to the device. Any device that is able to connect to the Internet and access this website will do. When the customers arrive, they will still need to request service from the service provider. Correspondingly, the service provider will request a QR code from the system. Then, the customers will scan the QR code from the smart phone or any smart device of the service provider in order to join the queue. After these, the customers will receive a notification which includes the expected waiting time from the website when there is people get out from the queue. Besides that, the customers will also be informed when the service is available. Other than these, the customer number will not always stick to a customer. This action is for security purpose and prevents the customers being annoyed by the service providers. Besides that, this system also allows the customers to leave the place while waiting for the service. All they need to do is to click the “Notify me!” button before they leave the place. After this, they are free to go anywhere and only come back when the service is available. This is because when the service is available, the service provider will update the queue status. In the meantime, the system will inform the customer that the service is ready so that the customer can go back to the place and get the service. Since the system is on a website, the customers no need to install anything in their phone in order to be informed. For this reason, it is much more user friendly to the first time visit and also the customers who are not going to use this system frequently.

Incidentally, the only change of the business process is to click the number that is displayed on the screen when the service is available. In overall, people do not like any change. Therefore, this system will work without much affect to the business process of the service providers. Apart from these, the customers will still need to go to a physical location in order to join the queue of a service provider. Although this problem can be solved, it will not be solved in this system. This is because the business of the small business is highly related to the human relationships and connections. If this problem is solved, the customers will be able to join the queue

from other places. At the same time, the human relationships and connections will be removed also. This is because the customers do not need to communicate much with the service providers anymore. Normally, it is very hard to build a human relationship or a connection between human with a little bit communication. Hence, the business of the service providers will be affected. Apart from this, the customers are also seeking for the connections between human sometimes. These customers will not want to see the service providers lose this feature. All things considered, the connection between the service providers and the customers is important for both parties. Therefore, it is not a good idea to remove the connection between them.

CHAPTER 5: TESTING

The testing done for this system is dynamic testing. The dynamic testing is to test the functional behaviours of the system by execute the code. In addition, the technique used in this case is black box testing. This is because the black box testing will be focusing on the inputs and outputs of the test object. In this case, the internal structure of the system will not be concerned. On the other hand, the use case testing will be used to test the system. The reason of chosen use case testing is this system never request the user or the customer to input any data. Therefore, the use case testing will be the most suitable testing for this system. This is because the inputs of use case testing will be the flows of the system and not the data input by the user or customer. In short, the testing of this system will focus on the flows of each use cases.

5.1 Use Case Testing for Generate QR Code

The following Table 5.1.1 is the use case description of the use case – generate QR code. The flow stated in the following table will be used to test the system.

Table 5.1.1: Use Case Description - Generate QR Code.

Use Case ID	UC001	Version	1.0
Use Case	Generate QR code		
Purpose	To allow user to generate QR code.		
Actor	User		
Trigger	User clicks the “Generate QR Code” button.		
Precondition	User has login and at the generate QR code page.		
Scenario Name	Step	Action	
Main Flow	1	User clicks on the “Generate QR Code” button.	
	2	System creates the QR code by using the current timestamp and the user id.	
	3	System displays the QR code on screen.	
Author	Ng Wan Qing		

Table 5.1.2: Generate QR Code Use Case Test Condition and Test Coverage.

Test Condition ID	Test Condition	Test Coverage ID	Test Coverage	Test Data
TCON-01-001	Main Flow	TCOV-01-001	Main Flow	Click the “Generate QR Code” button

Table 5.1.3: Generate QR Code Main Flow Test Case

Test Case ID	TC-01-001		
Related Feature ID	F001		
Objective	Generate QR Code Main Flow		
Covered Test Coverage Items	TCOV-01-001		
Input	Expected Result	Special Procedural Requirements	Intercase Dependency
Click the “Generate QR Code” button.	System displays the QR code on screen.	User has login and at the generate QR code page.	None.

Table 5.1.4: Generate QR Code Main Flow Test Procedure

Test Procedure ID	TP-01-001
Objective	Generate QR Code Main Flow
Test Cases To Be Executed	TC-01-001
Set up	<ol style="list-style-type: none"> 1. User clicks on the “Generate QR Code” button. 2. System displays the QR code on screen.
Wrap up	None

Table 5.1.5: Generate QR Code Main Flow Test Log

Test Case ID	Test Procedural ID	Type of Testing	Tool	Pass/Fail	Test Incident Report ID	Remark
TC-01-001	TP-01-001	Functional	Manual	Pass	-	-

5.2 Use Case Testing For Update Queuing Status

The following Table 5.2.1 is the use case description of the use case – update queuing status. The flow stated in the following table will be used to test the system.

Table 5.2.1: Use Case Description - Update Queuing Status.

Use Case ID	UC002	Version	1.0
Use Case	Update Queuing Status		
Purpose	To allow user to get customer out of the queue.		
Actor	User		
Trigger	User clicks the “Next Customer” button.		
Precondition	User has login and at the update queuing status page.		
Scenario Name	Step	Action	
Main Flow	1	User clicks on the “Next Customer” button.	
	2	System gets the first customer in the queue out from the queue.	
	3	System displays the message “Now Serving” and the number of the first customer on the screen.	
Author	Ng Wan Qing		

Table 5.2.2: Update Queuing Status Use Case Test Condition and Test Coverage.

Test Condition ID	Test Condition	Test Coverage ID	Test Coverage	Test Data
TCON-02-001	Main Flow	TCOV-02-001	Main Flow	Click the “Next Customer” button

Table 5.2.3: Update Queuing Status Main Flow Test Case

Test Case ID	TC-02-001		
Related Feature ID	F002		
Objective	Update Queuing Status Main Flow		
Covered Test Coverage Items	TCOV-02-001		
Input	Expected Result	Special Procedural Requirements	Intercase Dependency
Click the “Next Customer” button.	System displays the message “Now Serving” and the number of the first customer.	User has login and at the update queuing status page.	None.

Table 5.2.4: Update Queuing Status Main Flow Test Procedure

Test Procedure ID	TP-02-001
Objective	Generate QR Code Main Flow
Test Cases To Be Executed	TC-02-001
Set up	<ol style="list-style-type: none"> 1. User clicks on the “Next Customer” button. 2. System displays the message “Now Serving” and the number of the first customer.
Wrap up	None

Table 5.2.5: Update Queuing Status Main Flow Test Log

Test Case ID	Test Procedural ID	Type of Testing	Tool	Pass/Fail	Test Incident Report ID	Remark
TC-02-001	TP-02-001	Functional	Manual	Pass	-	-

5.3 Use Case Testing For Join Queue

The following Table 5.3.1 is the use case description of the use case – join queue. The flow stated in the following table will be used to test the system.

Table 5.3.1: Use Case Description - Join Queue.

Use Case ID	UC003	Version	1.0
Use Case	Join Queue		
Purpose	To allow customer to get into the queue.		
Actor	Customer		
Trigger	Customer scans the QR code generated by the user.		
Precondition	No other people use the same QR code to get into the queue before.		
Scenario Name	Step	Action	
Main Flow	1	Customer scans the QR code shown by the user.	
	2	System displays the number of the customer and the number of the customer that are serving by the user at that time.	
	3	Customer clicks on the “Notify me!” button.	
	4	System notifies the customer when there is people get out from the queue or the service is ready.	
Author	Ng Wan Qing		

Table 5.3.2: Join Queue Use Case Test Condition and Test Coverage.

Test Condition ID	Test Condition	Test Coverage ID	Test Coverage	Test Data
TCON-03-001	Main Flow	TCOV-03-001	Main Flow	Scan the QR code generated by the user and then click the “Notify me!” button

Table 5.3.3: Join Queue Main Flow Test Case

Test Case ID	TC-03-001			
Related Feature ID	F003			
Objective	Update Queuing Status Main Flow			
Covered Test Coverage Items	TCOV-03-001			
Input	Expected Result	Special Procedural Requirements	Intercase Dependency	
Scan the QR code generated by the user and then click the “Notify me!” button	System displays the number of the customer and the number of the customer that are serving by the user at that time. System notifies the customer when there is people get out from the queue or the service is ready.	No other people use the same QR code to get into the queue before.	None.	

Table 5.3.4: Join Queue Main Flow Test Procedure

Test Procedure ID	TP-03-001
Objective	Generate QR Code Main Flow
Test Cases To Be Executed	TC-03-001
Set up	<ol style="list-style-type: none"> 1. User clicks on the “Next Customer” button. 2. System displays the message “Now Serving” and the number of the first customer.
Wrap up	None

Table 5.3.5: Join Queue Main Flow Test Log

Test Case ID	Test Procedural ID	Type of Testing	Tool	Pass/Fail	Test Incident Report ID	Remark
TC-03-001	TP-03-001	Functional	Manual	Pass	-	-

CHAPTER 6: CONCLUSION AND FUTURE WORK

6.1 Conclusion

All in all, the customers cannot do tasks or join different queue concurrently without a proper queue management system and the costs needed for a proper queue management system keep the small business away. As can be seen, the customers need to waste their time on queuing when the small business service providers do not have a suitable queue management system. Even so, most of the small business service providers are not able to provide a queue management system to improve their business process for their customers due to the great complexity, high operation and entry costs of it. Therefore, a queue management system that can save the time of the customers by free them up from the queuing area and inform them the expected waiting time when there is people get out from the queue, or inform them when the service is ready is needed for the small business service providers. Furthermore, this system is affordable and suitable for the small business service providers as it does not require upfront investment. Moreover, the operation and entry cost of this system are affordable for the small business service providers.

6.2 Future Work

This system can be improved by integrating with data analysis to help the service providers to predict the abnormal customer arrival rate by using some statistical prediction. In this case, the system can help the service providers to foresee the abnormal high or low arrival rate during certain hours or certain days. Therefore, the service providers can be well-prepared for the abnormal customer arrival rate and maximise their profits eventually.

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POSTER

QUEUING SOLUTION WITHOUT APPLICATION INSTALLATION FOR SERVICE ORIENTED INDUSTRY

Introduction

Queue will reduce the productivity of people

A proper queue management system can help to

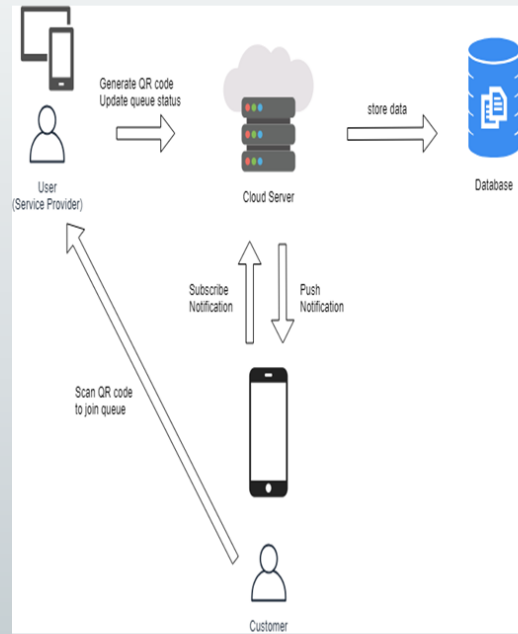
- reduce queue length
- average waiting time
- dropout rate
- optimise the usage of the resources

Most of the existing queue management systems are not suitable for the small business

Objectives

- Allow the customers to leave the place of the service provider
- A simple, low-cost queue management system that is suitable for the small business

Method



Result

Try it out!



Conclusion

- Save the time of the customers
- Free the customers up from the queuing area and inform them to come back
- Simple, affordable and suitable for the small business service providers

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CHAPTER 1: INTRODUCTION

1.1 Motivation and Background

A queue is a line of people waiting for their turn to get a service (Oxford Dictionaries | English 2018). Generally speaking, a queue occurs when arrival rate exceeds service rate. Therefore, people have to wait for the service in a queue. Correspondingly, a queue management system is a system that is used to manage a queue. A proper queue management system can help to reduce queue length, average waiting time, dropout rate and optimise the usage of resources. On the other hand, a queue will also reduce the productivity of people. This is because people will need to wait in line and do nothing while waiting for their turn. Therefore, a more effective queuing method should be developed to allow people waiting in line while performing other tasks

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