

# Casual Dining Restaurant Queue Management System to Optimize Decision Making in Table Seating Arrangement

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## ABSTRACT

Technology has advanced with speed, bringing ease to our daily life activities. Mobile devices have become a need in our daily life, yet we are still faced with the problem of long queues while waiting to be served at the restaurant. This problem can be overcome by having an effective mobile-based queuing mechanism to optimize the processes involved in the food preparation starting from taking orders until cooking in the kitchen. In this paper, we propose Queue Management System for Casual Dining Restaurants to Optimize Table Seating (QMS-OTS) to effectively optimize the queue system by considering the total waiting time in the queue and also the total waiting time for the food to be served. The queuing time is calculated based on the available table capacity to optimize the table seating. The users will be using the mobile-based virtual queue system to queue without the need to reach the destination.

**Keywords:** Queue, Casual Dining, Optimization, Reduce Waiting Time, Virtual Queue System.

## I INTRODUCTION

In the current era, most of the promotions are published through an online platform. Customers find it easier to obtain the promotions right to their mobile devices or even to their social network profiles. Food industry is highly competitive concerning price, value and promotions, service, location, and food quality. It is contended that larger amounts of service quality deliver more elevated amounts of consumer loyalty, which thusly prompt more elevated amounts of client support. Besides that, the food industry is one of the industry which seeks technology advancement assistance to promote or even receive orders. Companies such as pizza have taken a step forward by allowing the customers to make orders from home and request for delivery or also to collect from their shop. Besides pizza, OpenTable.com, themagellannetwork.com, guestbridge.com, avenista.com, and imagicrestaurantsoftware.com are among the food industry which uses technology advancement in their business.

Technology advancement is a particularly needed for queuing process of a good restaurant. The

famous and good quality food restaurants will have a large number of customers who are always waiting to dine in. To ensure the all the customers are given the opportunity to dine in at the same time allow the restaurant to have filled the tables based on the recommended number of seats is something very crucial in every casual dining restaurants. As of now, this is done manually by the waiters by locating the empty tables and the number of places which can accommodate for the specific table.

Based on Ha & Jang (2010), customers' mood is determined by the pre-event such as environment and services before entering a restaurant. Therefore, regardless of the physical environment, providing better quality service and the food is critical to induce customer satisfaction and loyalty. Chow et al. (2007) and Roy et al. (2016) respectively also agreed that high level of service quality is associated with consumer loyalty and additionally visit support.

Recently, Roy et al. (2016) have conducted a survey of 8500 restaurant managers in India and identified 97% of customer's average waiting time is around 23 minutes meanwhile other 8% takes an average of 40 minutes waiting time. According Fox, D. C. (2017).), the casual queue up system which uses sequential order pick up should be eliminated, thus minimizes the unnecessary waiting time. In fact, the waiting for food to be served is dependent on multiple variables such as staffing levels, staff training, inventory on hand, order size and the order complexity. Roy et al (2016) also agreed that using mobile-based wait time it provides more accurate wait time and reduces the service time.

By implementing a systematic queue management system, travelling time, physical travelling distance, and factors like cost can be minimized (Reza, 2010). In restaurants, waiting line is not consistent due to there is a peak meal time in a day. There are more factors that each customer varies due to how much would the customer order, and every order might be different leads to different service time.

This paper is organized as follows. Section 2 explains about all types of Queue management methods. Section 3 shows the comparison of similar methods, followed by the deployment platform in Section 4. Section 5 illustrates the proposed solution of QMS-OTS. The conclusions and extent of future work are examined in Section 6.

## II QUEUE MANAGEMENT SYSTEM

According to Sheikh (2016) there are few concepts of queue management such as “Shortest Processed First (SPF), First Come First Serve (FCFS), Single Queue (SQ), Multiple Queue (MQ), Diffuse Queue (DQ) and Head of Queue (HQ)”. SPF is an algorithm that chooses to execute a job that requires lesser time. Followed by FCFS, where a customer that comes in first will be served first, which is fairly treated. SQ is used for a small number of the customer as it is limited to a single queue meanwhile MQ is used to handle the issue of a significant amount of customer by providing more counters to treat few customers at the same time. Followed by DQ that doesn't consist of an actual queue where customers place in the queue with the process of a ticket.

According to Zhixia (2016), four main factors which need to be given importance in a restaurant queue management system as follows:

- a. The inevitable choice to improve customer satisfaction.

Restaurant owners have been mistaken that queueing up is kind of recognition for their restaurant because people are willing to wait for something good but a huge scale of restaurants which are available are now improving on their customer experience. So, day by day is queueing up will directly affect the customer satisfaction too.

- b. The effective means to cultivate loyal customers

If you let the customers wait for a long time, longer than the time limit of their enduring psychological capacity, the customer will not be pleased and will give up the waiting or the queue. Certain restaurants provide additional facilities such as the internet, free drinks, snacks or other services for customers who are waiting in the queue.

- c. The important way to establish enterprise competitive advantage

The pace of life of people becomes faster and faster in modern society and time is the precious resource of customers, so the time wasted in queueing up is also a kind of value loss for customers. The customers are more likely to buy quick services with short queueing time.

- d. The important link to improve economic efficiency of restaurant

Effective management of restaurant queueing problem can optimize the configuration of service staff, reduce human resource costs and improve service efficiency of catering enterprises at the same time.

Roy et al. (2016) recommended Semi-Open Queueing Networks (SOQNs) to improve the performance of the restaurant. SOQN matches the customers with the resources on their arrival to the restaurant. The resources are responsible for bringing customers to visit different nodes or activities and process the customer's order. Roy et al. (2016) has proposed the integrated model that uses the two-level queueing network to capture the process in the kitchen and also table allocation for the customers to dine in. This model was analyzed using Continuous-Time Markov Chain (CTMC) model for the performance. In the simulation process, they have used fixed tables number and capacity which does not represent the actual environment. The actual environment will have different tables with different capacity and more than one burners to be used in the kitchen to prepare the meals.

Xu et al. (2016) have considered three different types of queue policies, namely FCFS, flexible customers have a high priority (FCHP) and deterministic customers have a high priority (DCHP). According to Xu et al. (2016), “the queueing policies do not affect the revenue, but they do affect the pricing strategies for the deterministic service.” The cost for the deterministic service should be higher than the cost for the probabilistic service by embracing the FCFS policy or the DCHP policy. However, using FCHP policy the pricing strategy depends on the market size meanwhile the price for the deterministic service could be lower than the price for the probabilistic service in a small or moderate market. This can be further improved by displaying the queue visibility, and customers will be able to choose the shortest queue or dynamically being placed in the shortest queue. This was not considered by Xu et al. (2016), and thus, can be implemented in this proposed solution as we might have different queues for the different capacity of tables.

Referring to Uddin et al. (2016), improper management such as queue will cause tension or stress among customer which can lead to reduced job satisfaction of the employees. Thus, the automated queue management system is developed to help service providers to manage customer efficiently. The aim of this system is to dissect the queue status and take a choice which customer to be served first. He proposed FCFS and SPF. Unlike usual FCFS, the proposed system will test the queueing system using testing algorithm every 15 minutes and make a comparison between waiting time and average waiting time. The aim is to determine the ability of the new queueing system against the ordinary queueing system.

**Table 1: Comparison of Queue Management System**

Q- Application	Mv Queue Status	QueQ	QueueBee
Free to user	Free	Free	Free
Platform	Mobile	Mobile	Mobile
Booking method	Booking by making phone call	Booking through the mobile application itself	Booking by NFC at service providers
Location of user while making booking	User could be at home	User have to get within 2km near to the targeted area	User have to reach the targeted location
Notification	None	Sends notification when its user's turn	Early notification
Extra Features	None	Promotion of merchant could be reviewed	User could send feedback through the application

### III COMPARISON OF SIMILAR SYSTEM

We have identified 3 similar concepts system which is already available in Google App store, but some are not applicable to Malaysian concepts. The similar applications are MVQueue Status, QueQ and QueueBee. Refer to Table 1 above, for the summarized comparison.

MVQueue allows the user to make a booking via phone calls, QueQ requires a radius of 2KM from the service provider to do booking meanwhile QueueBee need users to be in the specific location and scan the QR Code or NFC to complete the booking. QueueBee sends an early notification and allows users to send feedback via the application meanwhile QueQ will only send the notification if only the application is turned's on or active also allows users to view the promotions. MVQueue has a disadvantage, where it does not enable users to send feedback or send any notifications. All the three applications are using First in First Out (FIFO) Concept, which is not actually suitable for casual dining restaurant.

Based on the review of other applications and research literature, we think Queue Management System for a casual dining restaurant should have the following features:

1. Free to download
2. Should be able to order and make payment
3. Should be able to get accurate queuing time and waiting time for the order to be served.

4. Fill the table seating of the restaurant based on the table's capacity
5. Notify the kitchen for preparation of meals based on customer arrival time to reduce waiting time for meals.
6. Orders and payment should be able to make in any location.

The application should be able to display a list of restaurants which allow virtual queue in the current location.

### IV CLOUD-BASED APPLICATION

Mobile Cloud Computing is an interconnection between cloud computing, mobile computing and wireless network which provides a better resource to mobile user and service providers (Yadav et al., 2016). According to Yadav et al. (2016), "cloud computing viewed as a substitutional for traditional or outdated mainframe client-server model because the resources are ubiquitous, scalable, highly and virtualized". In this implementation, we are proposing to implement this system in cloud-based mobile application to reduce the resource usage in the mobile device (Kanesaraj et al., 2015).

### V PROPOSED SOLUTION

There are few parameters which have to be taken into consideration in this queue management system, which are:

1. Number of people waiting
2. Food ordered by people waiting
3. Availability of tables (varies by number of seating)
4. A number of stove and chef available (this will be taken into consideration in our future work).

A usual or traditional method uses the following method.

Q = Queue number  
 To determine the waiting time,  
 Qt = Queue Time  
 t= average time used for per transaction.

$$Qt = Current\_Qt + t \tag{1}$$

As for the table optimization, we propose to have multiple Queue in a single QMS. Assuming that we have three types of the table which come with the table capacity of two (Q(a)), four (Q(b)) and six (Q(c)).

$$Q(a)t = Current\_Qt (a) + t \tag{2}$$

Referring to Equation (2), waiting time will be split based on table seating. So, customers who come alone or with another one person will be given a Queue Number (Q(a)) and the total waiting time. If a family comes with 6 people, they do not have to wait for these 1 or 2 persons, but can get the same waiting time. As the queue is split.

As for the waiting time for the food to be served will be calculated based on order type and cooked in which stove. In this case, we assume there is only two stoves(S) and two chefs(Ch). We also assume that each chef is assigned to each stove. The total waiting time for food to be served will be calculated as shown in Equation (3).

ft = food waiting time

$$Q(a)ft = \text{total number of order } (t) + \text{previous yet to ready food } (t)$$

(3)

**Algorithm 1: The Process of Waiting Time.**

```

Begin
Double CNumber = Get_Current_Number();
Double TimeTaken =
Get_total_time_to_Complete_cooking(Stove_ID)
Double FoodPreTime =
timeTakenForCooking(Food_ID)
Double AvgTimeBasedTable =
timeTakenBasedOnSeat(Table_ID)
Double TimeToBeSeated = CurrentTime() +
                        AvgTimeBasedTable
Double TotalWaitingTimeForFood = TimeTaken +
                        FoodPreTime
IF (AvgTimeBasedTable < TotalWaitingTimeForFood)
Then
TotalWaitingTimeForFood = TimeToBeSeated +
                        TimeTaken +
                        FoodPreTime
ELSE
TotalWaitingTimeForFood = TimeToBeSeated + 5
Minutes
END IF
END

```

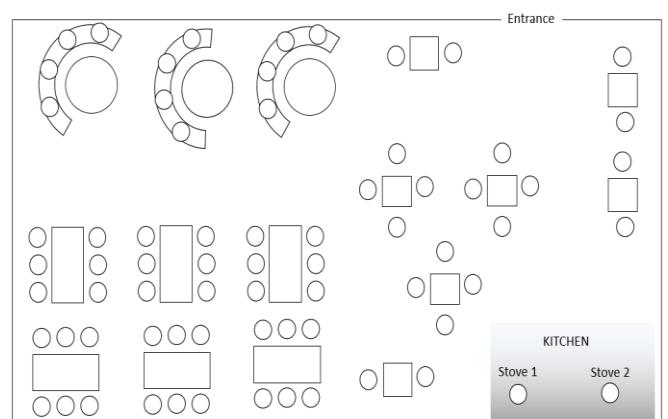
Algorithm 1, shows the how the total time to be seated and also total waiting time for food will be calculated. The total waiting time for food is dependable on the time where the customer will be allowed to be seated. By synchronizing the kitchen staff and the queue number, we will be able to serve the customer with their food immediately when they are seated. This improves the customers rating towards a restaurant as mention by Zhixia (2016). To ensure we are able to synchronize with kitchen staff or crew, we will need to have the average preparation time for each food and the time

availability for each stove. This allows us to calculate the time taken for the order to be cooked and also the queue time for the order to be cooked. This helps the customer to plan their meals, as they will walk be able to walk in 5 – 10 minutes before the meal is prepared rather than sitting down and waiting for the food. The average time taken based on table seating is also important, as the different number of visitors will be taking a range of time. A couple may take lesser time than a bunch of friends of 6, who will have more stories to discuss and complete their meals.

Figure 1 shows the proposed layout for the study of QMS-OTS. The tables seating is arranged as two, four and six. The design of tables does not affect our algorithm as our scope covers the number of seating only. We have also included the stoves in our layout as the number of stove influence the waiting time for the food.

## VI CONCLUSION

Queuing is common phenomena in any casual dining restaurant in Malaysia. This issue will result in frustration and unhappiness of the customer, or even the loss of business. Since this is an era of smart device, we propose a mobile-based queue management system to enable a user to view, book and manage his queue before prior arrival to the restaurant. In our system, the queue time is taken into consideration based on the several factors such as waiting time, food serving time, availability of tables and so on. As for future work, we would like to improve further on number of seating and also stoves used in the restaurant. The stoves can also be customized to be used for a specific order.



**Figure 1. Proposed Layout for Dining Restaurant to Implement QMS-OTS.**

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