Improving Fast-Food Restaurants' Method of Operation: Automated Drive-Through Ordering System

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Abstract

As digitalization is on the rise, customers are rapidly changing the way they engage with accessibility and convenience yet the typical drive-through remains unchanged from when it was first introduced in 1947. The researchers conducted a time study in different fast-food restaurants that offer a drive-through service in Metro Manila, Philippines. Data showed an average of 6.27 minutes for the whole transaction in the current layout. Through the use of ProModel Software, the researchers have identified that out of 100 customers, 57 of them experience long queues and delays while 43 of them does not. This paper aims to provide an improved method of operation by revamping the traditional layout of a fast-food drive-through. At the end of the study, the researchers designed a system to balance speed and order accuracy in a drive-through restaurant, reducing the processing time in the proposed layout by 52%, equivalent to 3.27 minutes. The simulation results show that 57 customers who experience long queues and delays in the current system have been reduced to 8 customers in the proposed system which has an 86% improvement in the operation.

Keywords
Digitalization, Accessibility, Convenience, Staging Station, Drive-Through

1. Introduction

1.1 Background of the Study

With people's hectic lifestyles today, time-efficiency in services becomes ever more important. One common example of a service where people could use better methods for time efficiency is a fast-food restaurant's optional drive-through service (Jekanowski, 1999). Quick Service Restaurant (QSR) and Insula Research estimated that about 50 to 70 percent of fast-food sales come from drive-through service.

Most fast-food restaurants offer an optional drive-through service that has been around in many commercial establishments since it was first introduced across America in the late 1950s. In a traditional drive-through setup, for a customer to make an order, several steps are to be followed in a sequential manner. As the customer enters the drive-through lane, the first station a customer passes is the order selection. From there, a customer temporarily stops the vehicle to view the menu board, which displays the food items offered by the restaurant. After, the customer proceeds to the next station to place order. After order placement, the customer advances to order payment to settle the transaction. By the same time, the restaurant prepares the food and arranges it for pickup, which leaves the customer to move forward at the pickup window and put on hold while waiting for their order. Some fast-food restaurants, to accommodate drive-through customers, perform order payment and order preparation simultaneously to optimize time choosing to rely on the accuracy of the order placement (Johnson, 2015). Order preparation immediately commences as the customer places order.

1.2 Problem Statement

From the historical research studies of a quick-service, most fast-food restaurants with drive-through services concentrate on speed of transaction and order accuracy based on the most pressing needs of drive-through customers. However, consumers' attitudes and behaviors have shifted tremendously in recent years and continue to do so. Yet, the typical drive-through remains unchanged from when it was first introduced in 1947.

There is a need for a fast-food restaurant to pay attention to delays for a business to satisfy its customers as longer waiting time has a negative impact on customer service satisfaction (Dube-Rioux, Schmitt, & Leclerc, 1989). For example, some fast-food restaurants deal with potential delays by having a customer who has paid but has not yet received his order, moves forward to the next window putting them into a waiting position resulting in a long queue at the order selection. Often, order selection and order placement cause a bottleneck in a drive-through lane. Some fast-food restaurants deal with this type of delay by sending an employee out from his designated station to accommodate all customers in the waiting position.

As the food service industry continues to grow at an exponential rate, there is a need for fast-food restaurants to adapt the digitalization of a standard drive-through to fit customer's contemporary food service needs. This study aims to provide an improved method of operation for drive-through services by introducing a staging station to serve more customers in shorter time.

1.3 Objectives

- To design a system that increases order accuracy and create a balance between speed and satisfaction to the customers.
- To provide an improved method of operation in a drive-through system to reduce long queues in a customer vehicle stream
- To provide an automated ordering system in a drive-through to allow continual building of brand identity while offering customers a fast and user-friendly experience.
- To allow greater flexibility in the amount of time taken by the customer in the ordering station and allowing rapid selection without having to delay customers upstream.

1.4 Related Literature

Efficiency has always been important among fast-food restaurants and drive-through service is an effort towards this. Red's Giant Hamburg is said to be the first drive-through restaurant in the world, opening the service in 1947. In 1975, the first McDonald's drive-through opened in Arizona to serve members of a local military base who were not allowed to get out of their cars wearing their uniforms. A drive-through seemed perfect at that time in line with the idea of efficiency and convenience (Saxena, 2019).

In recent years, drive-through services has been declining. According to a performance study from Restaurant Trade Publication QSR Magazine, customers spent 20 seconds more time on average waiting for food in a drive-through line in 2019. The study found customers this year to spend an average of 255 seconds going from the speaker to place their order to the window to pick-up their order. Menus are becoming complex as restaurants try to stand out from competitors in an oversaturated market. When Kroc visited McDonald's in 1954, there were nine things on the menu – hamburger, cheeseburger, fries, shakes, and a couple of other drinks. Now, there is an all-day breakfast, combo meals, kiddie meals, and at least nine types of burgers (Oches, 2018).

Innovative drive-through technology appears to be one solution to the speed problems of quick-service restaurants. As the customers are gravitating towards convenience, efficiency, and small lines, there is a need for self-ordering system that allows customers control the order process and reduces the customer's perceived waiting time (Whiting & Weckman, 2004).

KFC Australia opened its first high-tech drive-through operation but is only limited for drive-through operation. KFC also introduced an application in which a customer can order online before arriving in the restaurant. The challenge for the customer in using the app is to operate the phone while driving but lessening the long queues on a drive-through lane. According to Ms. Kristi Woolyrch, the chief marketing director for KFC across the South Pacific region, people nowadays are much more comfortable purchasing their orders using a mobile phone. People are looking for faster, easier, and more convenient options for drive-through services (Perrie, 2019). Howevere, in this study, the proposed system is much efficient because it can accommodate customers for drive-through and dine-in services. There are specific parking lots allotted for drive-through and dine-in customers. The parking lots for drive-through customers are called staging station. Each staging stations has an order panel where a customer can order, pay, and verify their order is complete in the pick-up station.

Self-service digital kiosks change the way consumers think and take actions, thereby having a huge impact on their behavior. Due to societal pressure and fear of judgement, customers often feel disinclined to initiate their own up-sell like higher calorie ingredients or adding a dessert. Self-service kiosks eliminate any potential for societal judgement by a human server or cashier while producing an automated order, which helps the customers feel more comfortable by allowing them to pick whatever they like (Gavett, 2015).

The resulting improvement in the speed of service as well as order accuracy would increase customer satisfaction. Also, an ordering system that would lower the labor costs as well as generate increased sales and profit in the fast-food restaurant is pivotal in today's competitive fast-food service market (Liebman, 2003). The fast-food drive-through should be unique and make its own brand; and the location must be conducive as it was found that customers tended to favor easily accessible and national fast-food restaurant franchises than less accessible, relatively new, and regional counterparts (Min & Min, 2011).

2. Methodology

2.1 Data Collection

The process in a drive-through system was broken down into elements for convenience of observation and timing. A time study was conducted using a stopwatch that was run continuously throughout the observation with a sample size of 100 trials for the current drive-through system while a sample size of 10 trials for the current self-service kiosk of a fast-food restaurant. The data collected for the self-service kiosk was used as the basis for the time of ordering and payment activity in the proposed system. Using the ProModel Software, the researchers validate the data gathered in the time study of a drive-through system of the fast-food restaurants. Table 1 shows the summary report of the simulation and the percentage difference of the current and the proposed system of the drive-through.

In the simulation of the current drive-through system, the researchers assumed that the interarrival time of the customer are in peak hours. The results in the simulation shows that out of 100 customers, 57 of them experienced long queues and delays while the rest have not experienced long queues and delays. The average time of total transaction is said to be 8.2695 minutes.

In the simulation of the proposed drive-through layout system, the researchers also assume that the interarrival time of customers are in peak hours. The staging station has a designated space for customers who wish to order at the drive-through. As shown in figure 1, only two ordering spaces are in operation. Researchers added another station if ever customers arrive more than expected to avoid bottleneck in staging station. The result of the simulation for the proposed system shows that out of 100 customers, 92 of them experienced long queues and delays while 8 of them have not experienced long queues and delays. The average time of total transaction is said to be 3.755 minutes.

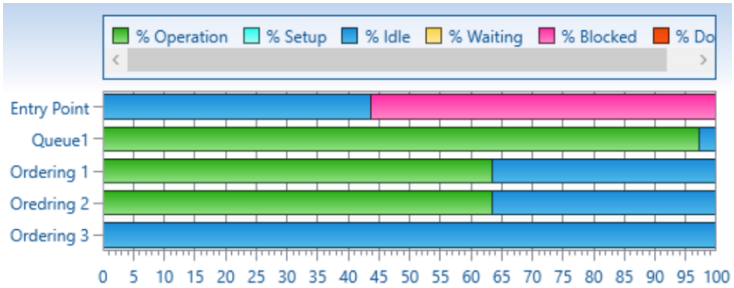


Figure 1. Simulation Result of the Proposed System

Table 1. Comparison Between Current and Proposed System

ACTIVITY	CURRENT	PROPOSED	PERCENT DIFFERENCE
Number of customers with long queues/delays	57	8	86%
Number of customers without long queues/delays	43	92	53%
Average time of transaction (in minutes)	8.2695	3.755	55%

2.2 Discussion of Results

Table 2 shows the comparison of each process for the current and proposed system of drive-through. The ordering and waiting time are both huge contributing factors that cause a bottleneck in a drive-through system. The data collection was from a time study conducted by the researchers on the current drive-through system of fast-food restaurants. These observations were done with 100 trials on the same process which was divided into different parts of the drive-through system.

In the current system, the average time for waiting time of order is 3.06 minutes due to delay experienced in the customer vehicle stream, since generally it is a single line of vehicles which starts from the order selection down to the order pickup. For example, a customer has a minimal order therefore it is faster to prepare but the other customer before them has a lot of complicated food to prepare which makes the customer vehicle upstream to wait. Overall, the whole transaction process of ordering in a drive-through restaurant, excluding the waiting time for the next customer to arrive, has an average total of 6.27 minutes.

The data collection for the proposed system was based on the current self-service kiosk of a fast-food restaurant. The researchers proposed order panel has the same concept method where the customer orders and pays, the difference is that the kiosk is placed on each space of the staging station in a drive-through. The researchers also conducted 10 trials for the time study on the ordering and payment of the self-service kiosk. The whole transaction for the self-service kiosk has an average time of 1.13 minutes for ordering and 0.31 minutes for payment. After the payment, the kitchen staff automatically receive the job order. Given this information, the researchers recorded an estimate average of 1.50 minutes for the waiting time of orders, since the job order is directed in the order preparation stage.

Table 2. Comparison of the current and proposed system

CURRENT SYSTEM	ACTIVITY	PROPOSED SYSTEM
2.42 minutes	ORDERING	1.13 minutes
0.46 minutes	PAYMENT	0.31 minutes
3.06 minutes	WAITING TIME	1.50 minutes
0.33 minutes	PICK-UP	0.33 minutes
6.27 minutes	TOTAL TRANSACTION TIME	3.27 minutes

2.3 Service Blueprint

Figure 2 is used to illustrate and analyze the current system of the order process in a drive-through service. Swim Lane Diagram differentiates the customer experience in staff and cashier and support process in the kitchen. The visual representation shows the interactions between customers and employees, and how backstage activities and systems support these interactions. It gives managers the opportunity to identify potential failure points in the process, where there is a significant risk that things can go wrong and affect the quality of service. In the service blueprint presented, from the customer's perspective, one failure point is recognized. The order-taking is done face to face. The management has to assign one more window instead of having a single-window only. This might add to their cost and cycle time which makes the line queues long.

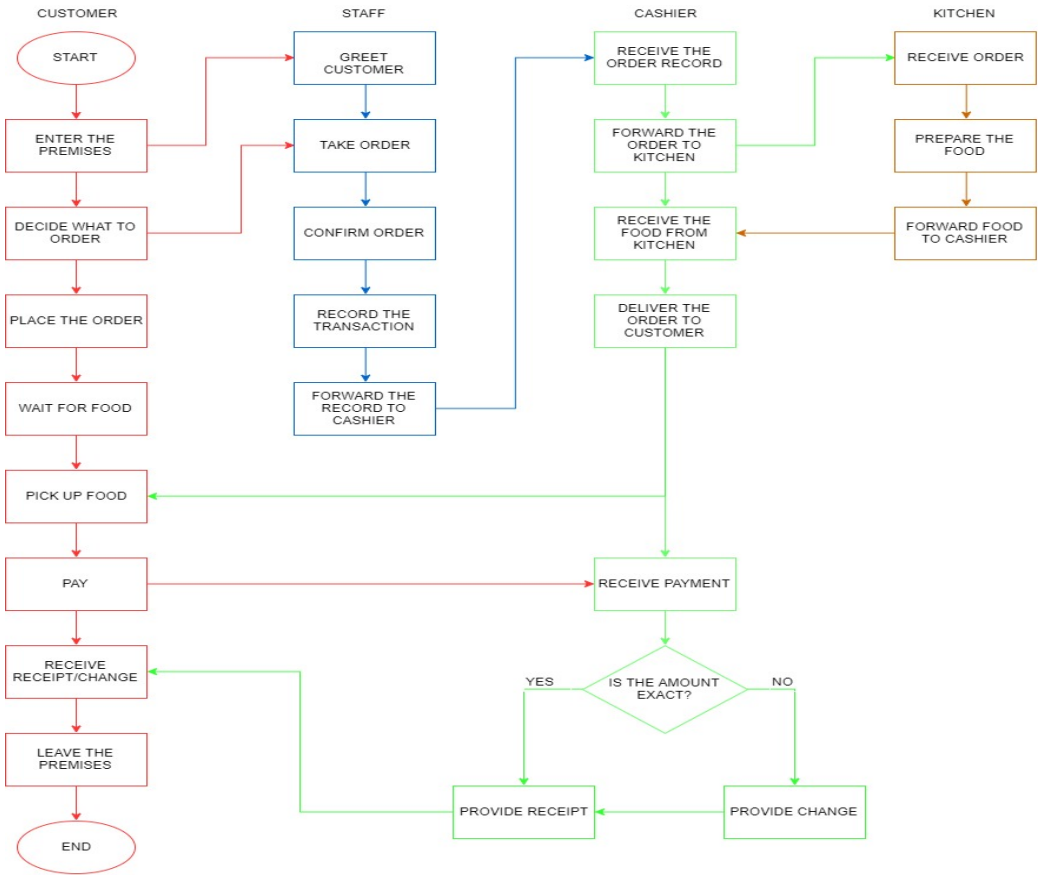


Figure 2. Swim lane diagram for the current system of a drive-through restaurant

3. Proposed System

3.1 Floor Plan Layout for Drive Through

A preferred layout of an improved fast-food drive-through restaurant in figure 3 has an order panel and staging station where incoming vehicle customers are parked in a designated area to accommodate customers all at once without having to delay any process in ordering in a fast-food restaurant. The staging station will have a touchscreen self-service digital kiosk with a built-in payment acceptor for the convenience.

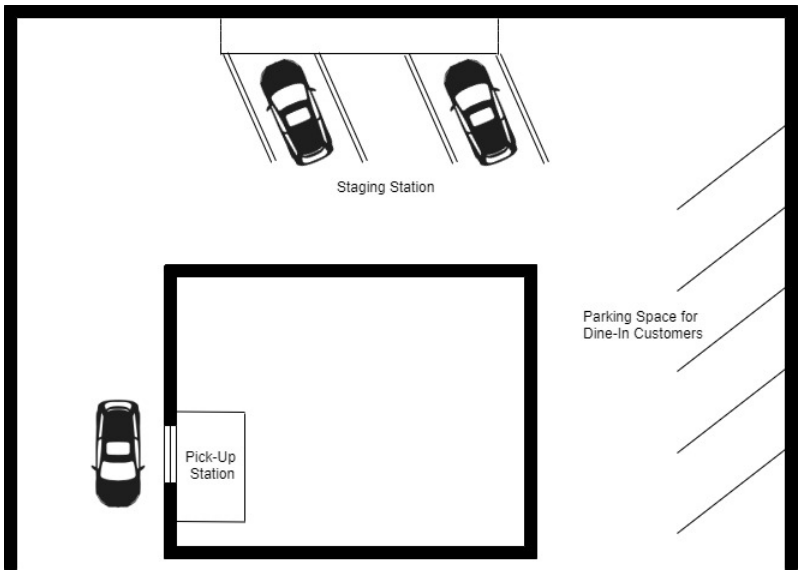


Figure 3. Proposed Layout

3.2 Order Panel

The order panel is a second-generation self-service kiosk, which enables the customers to thoroughly view the menu and place their order right at their fingertips. The kiosk is interconnected with the restaurant's food preparation station and pickup station. The kiosk also has a payment acceptor which offers an option to the customers whether to pay in cash or through debit/credit card. Upon payment, the kiosk prints a receipt which has a unique identification number for each transaction that is scanned at the pickup station for verification of the customer's identity and their order. After completing the order process, the order panel displays a visual order status in the interface.

4. Automated Ordering System

4.1 Ordering System

Ordering System is subdivided into four steps. First, display order menu interface step shows the system interface in the order menu panel. Second, display customer information step shows the summary of the order made by the customer along with their unique identification number. Then, display method step allows the customer to choose whether to pay in cash or to pay using a credit/debit card. Lastly, in generate a receipt step, a kiosk generates a summarized transaction of a customer into a receipt.

4.2 Process Mapping

The use case diagram in Figure 4 demonstrates the different ways the users might interact with the system. Upon using the use case diagram, functional requirements for a self-automated system for drive through restaurant is determined. Functional requirements can be translated into design choices and development priorities. Inside the box indicates the scope of the system which is a sequence of actions that are measurable value to the customer, cash collector, food preparation staff, and store manager.

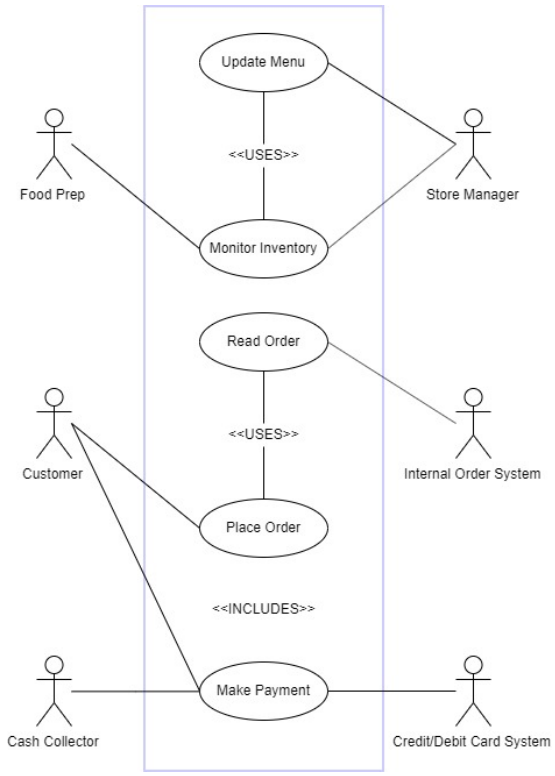


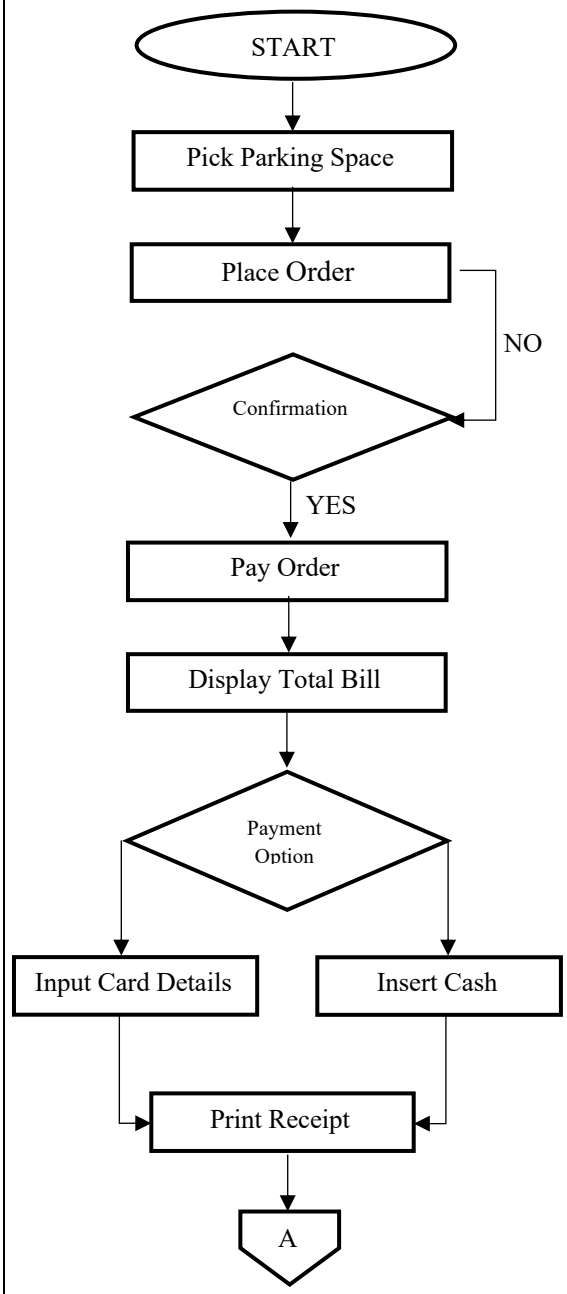
Figure 4. Use Case Diagram

4.3 System Flowchart

A system flowchart in Figure 5 shows that the process starts when the customer goes to the staging station and selects a kiosk for drive through customers to place their order in the panel screen. The system confirms the

customer's order before displaying the total bill of the transaction and payment options. If the customer chooses to pay in cash, the machine activates the payment machine and the customer inserts payment. If the customer chooses to pay via debit/credit card, customer inputs his card details to complete payment. When payment is done, the machine generates a receipt and displays the order status report. The order is then logged into the system database and then forwards it to the food preparation department. After receiving the job order, the kitchen staff prepares the food immediately. A service crew gets the packed food from the food preparation department. When the order is ready for pickup, the customer is notified in their respective order panel that order is complete and may now proceed to the pickup station.

Responsible	Activities	Remarks
Customer	Pick Parking Space	Selecting a parking space designated for drive thru customers
Customer	Place Order	Order food using the automated ordering system
Customer	Confirmation	Confirm whether to change the order or proceed with the payment
	Pay Order	
	Display Total Bill	Shows the total bill of the transaction
Customer	Payment Option	Customer will choice options for the payment
	Input Card Details / Insert Cash	
Machine	Print Receipt	The machine will automatically print the receipt



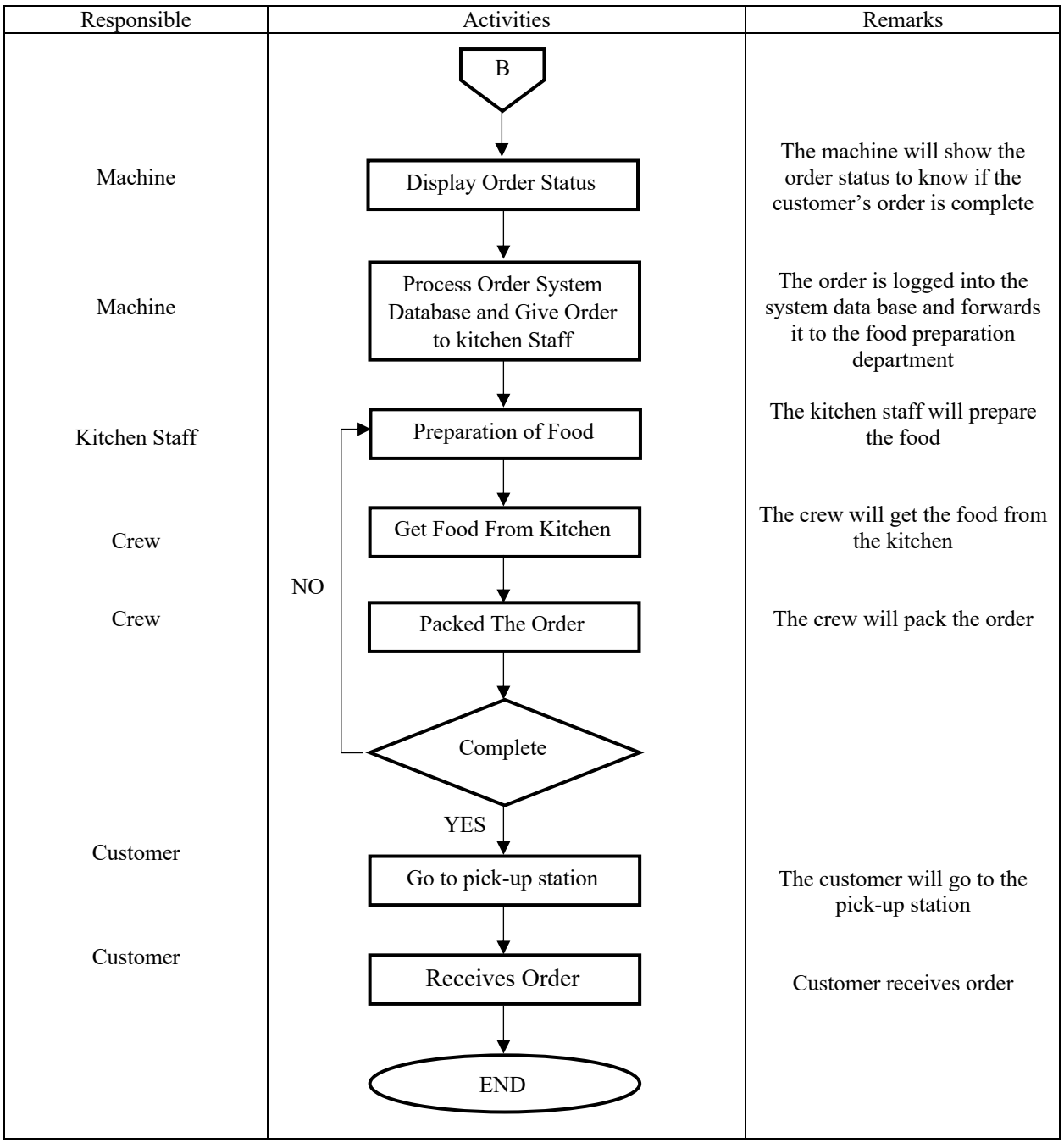


Figure 5. Proposed System Flow Chart (Ordering)

4.4 Data Flow Diagram

The interaction between the system and the outside entities is shown in Figure 6. It shows what the three systems do when a customer orders food. The four systems are from database of the staging station, food ordering system, food preparation, and payment system. As the customer places order, the order details are stored in the food ordering database. The order form is received by the food preparation department. Finished transactions are stored in the payment system database which helps the restaurant to progress within the month.

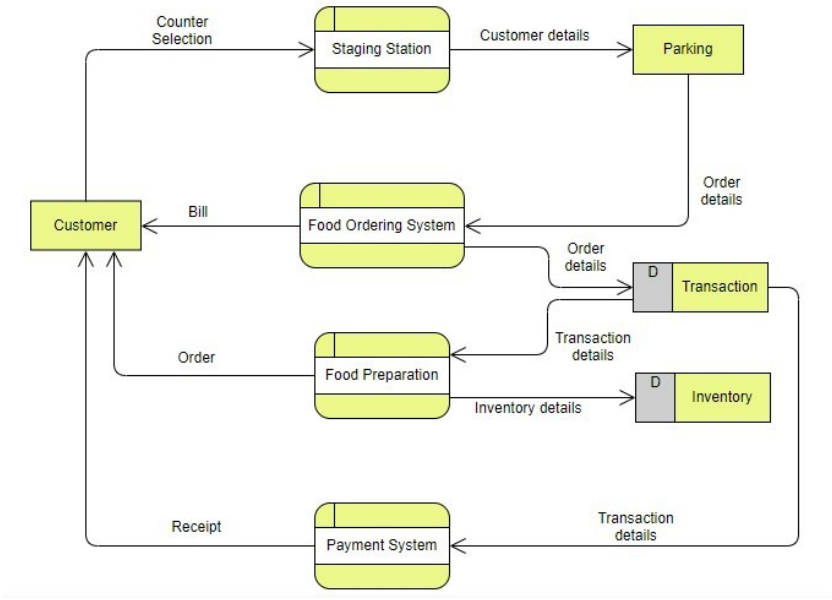


Figure 6. Data Flow Diagram

5. System Interface

An order form in Figure 7 allows the customer to choose the information depending on their choice of order. The information includes a category for easier browsing of their choice of food and displays the items on the menu. It also has a mode of payment in which a customer can choose to pay in cash or via debit/credit card.

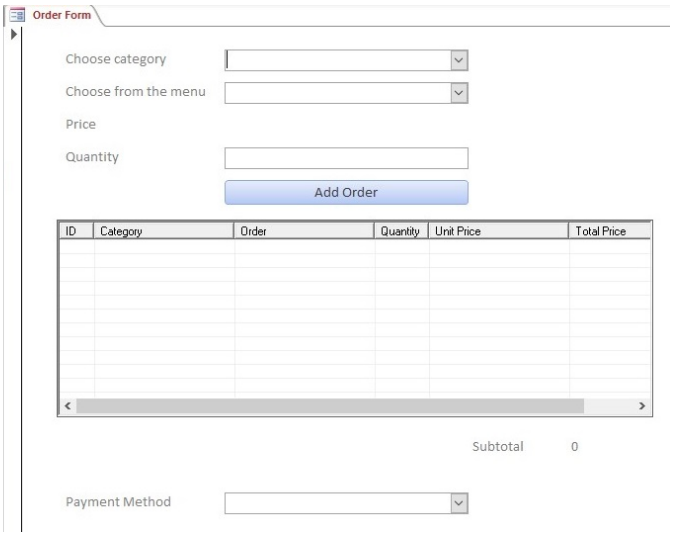
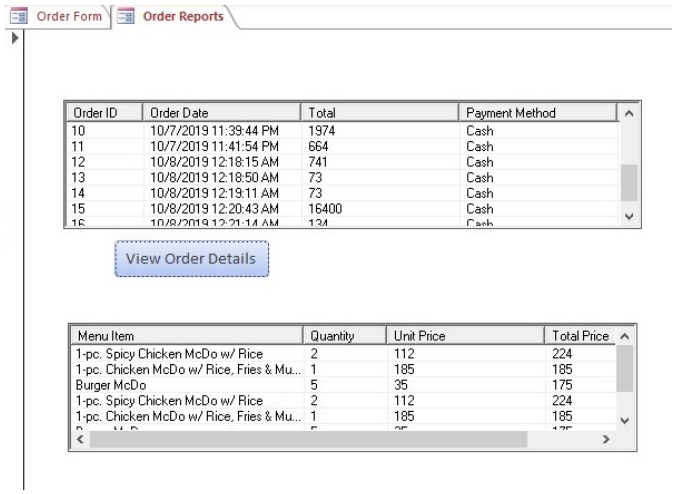


Figure 7. System Interface

5.1 Input Document

After the customer completes the order, an order report as shown in Figure 8 is produced together with a receipt. Included in the order reports are the summary of the transaction per customer. It is made easier for the management to analyze the drive through's daily and monthly sales since the inputs are automatically saved in the database.



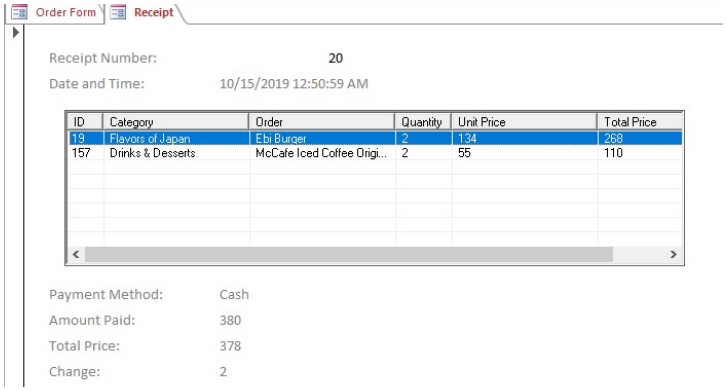
Order ID	Order Date	Total	Payment Method
10	10/7/2019 11:39:44 PM	1974	Cash
11	10/7/2019 11:41:54 PM	664	Cash
12	10/8/2019 12:18:15 AM	741	Cash
13	10/8/2019 12:18:50 AM	73	Cash
14	10/8/2019 12:19:11 AM	73	Cash
15	10/8/2019 12:20:43 AM	16400	Cash

Menu Item	Quantity	Unit Price	Total Price
1-pc. Spicy Chicken McDo w/ Rice	2	112	224
1-pc. Chicken McDo w/ Rice, Fries & Mu...	1	185	185
Burger McDo	5	35	175
1-pc. Spicy Chicken McDo w/ Rice	2	112	224
1-pc. Chicken McDo w/ Rice, Fries & Mu...	1	185	185

Figure 8. Order Report

5.2 External Outputs

The order receipt in Figure 9 will determine the customer details and their orders. The order receipt includes the date and time the order has been made, the category of their choice and their choice of food from the menu, the unit price per item, and its total price.



ID	Category	Order	Quantity	Unit Price	Total Price
19	Flavors of Japan	Ebi Burger	2	134	268
157	Drinks & Desserts	McCafe Iced Coffee Origi...	2	55	110

Figure 9. Order Receipt

6. System Implementation

The researchers conducted a cost benefit analysis on the use of a modernized system database for automated drive-through system. The results are shown in Table 3.

Table 3. Cost benefit analysis of system implementation

COST	BENEFIT
• The cost of buying a self-automated machine for the customer to order • The cost of layout improvements • Training staff to use these programs • Creating new grounds and capacity to fully conduce the new database	• Producing better ordering system without the hassle of using manual forms • Maximizing production capacity of the restaurant • Reduce bottlenecks in drive through • Increased profit as time will be mostly minimized • Long term investment for the restaurant that will boost their services

7. Conclusion

Fast-food restaurants have upgraded their services through drive-through that can be used by customers who have their cars with them and do not want to leave it in the parking or wants to have their food but are in a rush. As drive-through became popular for the customers, the management began to encounter problems in their drive-through service. The researchers conducted a time study to measure the elapsed time by every process in ordering in a drive-through restaurant. Long queues of cars, long time waiting for the orders, small spaces for cars, and fewer items are present at the order station are just some of the problems being encountered by the customers. These are also the reasons why the researchers came up with the idea of improving the ordering system of a drive-through and the goal is to reduce problems so that fast-food restaurants would be able to satisfy the customers and to allocate their services to more customers. In the comparison of the proposed system versus the current system in drive-throughs, the proposed system has an ordering menu display and a built-in payment collection process where the customer will have a choice between cash or card payment. If the customer chooses to pay in cash, the customers can conveniently insert their cash in the kiosk. This method reduces the time and costs for fast-food drive-through as the company does not need to put different windows for the ordering process and payment process. The proposed system also shows on screen the status of the orders and notifies the customer whenever their orders are done and that will be the only time, customers can leave the staging station to pick their food up unlike in the current system, customers have to wait in queue for their orders. This system also reduces the bottlenecks in the drive-through which currently the main problem being encountered by fast-food restaurants, especially during rush hours. The researcher also provided a floor plan layout of the drive-through for implementation. With this proposed system, the researchers are expecting that the management will increase the number of customers that they will be served, and the customer's specifications will be met.

Using the current self-service kiosk as a basis for the proposed system, the researchers were able to reduce the average time of transactions the customers have to spend while ordering. From the current system having an average time of 6.27 minutes per customer, it went down to just 3.27 minutes. Through the use of ProModel Software, the researchers discovered that in the current system, 57 customers out of 100 are experiencing delays and long queues. By creating a simulation for the proposed system, the researchers were able to improve the customer service of the fast-food by reducing the number of customers who are experiencing delays and long queues from 57 customers to just 8 out of 100 which provides an 86% improvement.

The researchers recommend adding the function of a reloadable smart card for payment. The customers will have an additional option on how they want to pay for their orders. It will be a small card that can be tapped onto the system after ordering and it will process the payment afterward. The researchers also recommend adding a mobile application or online website for the customers to order in advance and pick up their orders at the fast-food drive-through. Order customization; discounts for persons with disabilities (PWD) and senior citizens; and discounts for coupons/vouchers can also be added to the system.

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