PROGRESS REPORT ON PROJECT OF MODELLING AND STIMULATING

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MODELLING AND STIMULATION

TITLE OF THE PROJECT:

MODELLING AND SIMULATING FOR FOOD ORDERING SYSTEM OF A DIGITAL CAFETERIA OR RESTAURANT”

***ACKNOWLEDGEMENT*:**

I would like to express my deepest appreciation towards all the resources that has provided me the possibility to make progress in our report. A special gratitude I give to our Modelling and Stimulation subject teacher Pratibha Kamal, whose stimulating suggestions and encouragement helped to coordinate in writing this

report. Since the cafeteria or restaurant business is the most common among all of us, constructing a digital cafeteria upon stimulation inspired us the most to process the whole report. As it takes a very long time standing on queues of famous cafeterias to get our order, we planned out the most efficient way to serve the food in the restaurant business.

***ABSTRACT*:**

Cafeteria or Restaurant is a business that prepares and serves food and drinks to customers. Meals are generally served and eaten on the premises. During ordering the food sometimes customer face some problems like the communication, line for ordering food and getting table. Thus, we get the idea of making the project and in order to simulate the situation before the implementation. It comes the reason of executing this project. This is a system which will make the food ordering and serving easier in a cafe or restaurant for customers and distributors respectively. System was simulated at peak hours. Customer arrival was generated as soon as the customer joins the system and the inter-arrival time was noted down. Once the customer reaches the cash window, its service time and request time was noted and to also find out the proportion of people ordering Food (and not Beverage, etc.). Then service time of customer at Food queue were noted down. The average waiting time in Food queue was noted down manually for model validation and testing. Once the simulation model was constructed and simulation was run at peak hours, for a no. of replications, the model is validated. Results were coming out to be positive and further suggestions were made to reduce that average waiting time.

***INTRODUCTION*:**

It's often common that we can see a huge crowd in the restaurants, so when we approach a cafeteria or restaurant, we have to stay in a queue for longer period time since they are based on manpower which is generally very limited in a sense. But in this new modeling of the system of food ordering, no customer has to stay in line, they are available with the overview of the whole menu card with which foods are available in the restaurant at that specific time. It is simulated like that they don’t have to wait for the waiter to eventually order food which saves a lot of time whatsoever. They are also being able to see the time of preparing food and how much time it is needed to serve the food which is beneficial from a customer point of view.

Our main objective of the project is to reduce the average waiting time of customer in the cafeteria. Now here comes a point of "Critical time". If we define critical time, we can say that it is the time customers are willing to wait in the queue without having exhaustion. Although it purely depends upon the customer but we did an online stimulation to calculate the time likewise. The purpose of the project is to represent a whole internal food ordering system in a cafe or restaurant from describing food menus to what to order with their arrival time, waiting time, delay and furthermore. Through the modeling and simulating of this project, it will be an easier for customer to order food through a device with approximate time information.

The modeling and simulating of the digital food ordering system is based on the concept of ordering food in a general restaurant; in this case a digital platform from a customer point of view.

***OVERVIEW OF THE PROBLEM*:**

A digital cafeteria schedule defines a schedule from ordering food to serving the food on the table without any extra delay and as well as human interaction. The model is aimed to simulate utilization of time for the customers and the maximum profit of the cafeteria. The customers may come alone or in a group and can order the preferable quantity of food. The number of counters and the menu from which they choose the food is always fixed. For each counter service, the following parameters are defined: a sequence of customers, average time intervals for the customers ordering their food, food preparation average time and even the types of extra facilities given by the cafeteria. Here, firstly the customer will come and order food as per their liking and pay the registered bill for the food from then the service time will start and when the system will be able to serve the food on the table, the customer will confirm the delivery on the system; by which we will be getting the waiting time of the customer and the service time of the system. Furthermore, foods could only be served to the customer in predefined time windows. Food serving capacities are limited and known. Again, an approximate time will be determined per serving by the system and we will be able say we will be serving the food in a certain amount of time. As for example, if someone orders one burger which will take 10 minutes to be served and one drink that will take 5 minutes to be served; so in total we can say that the system will take 15 minutes to serve the whole meal which by far defined by the system controller and later reduce the delay time if any. A planner modifies the schedule generated if the problem specific constraints or new information become available. The main task of the simulation model is to evaluate the efficiency of initial or modified cafeteria schedule taking into account stochastic conditions by estimating the

average total idle time of all service for the combination of assigned counters to serve the food. Here, the service idle time is defined as a sum of time periods when the counter service waits for the next customer to come. As control variables, the parameters of the cafeteria schedule are introduced, i.e., an order token number and the number of people working to make the food.

APPROACH: Here we are stimulating a digital cafeteria where there will be counters on which the customers will proceed and place there order accordingly. We can describe the whole circumstances as,

- ***EVENTS:***

❖ Customer Arrival Event → As a customer joins the Queue through the system.

❖ Departure Event → As the Customer leaves the queue at distributor counter.

❖ Ordering and Billing Event – The customers are able to choose their food as their choice and also be able to see see the price and waiting time according to their food

❖ Time Event - Customers will be able to see the time of their arrival, departure, waiting time, service time etc.

Customer arrival was generated as soon as the customer joins the cash counter queue and the inter-arrival time was noted down. Once the customer reaches the cash window, its service time and request time was noted to plot the frequency distribution of inter-arrival and service time of customer and to also find out the proportion of people ordering Food (and not Beverage, etc.).

We can also mention the system characteristics as follows:

• Operating Time of Cafeteria → 7:00 A.M. to 9:00 P.M

• Peak Time for Food → 12:30 P.M. to 2:00 P.M. && 6.00 P.M to 8.00 P.M

• Customer → Single or Group

• Cashier → Single

• Distributor → Single

• Service Window → Single Customer arrives as either group or single but it was observed that only one person out of the group joins the cash counter for placing the order so arrival event occurs once the customer joins the queue and multiple people in group are considered as single arrival event as well.

- ***METHODOLOGY*:** Since the main ideas are mentioned in the introduction and also described in the overview, it is strongly stated that the aim of the whole project is to have a solution about the time delay and queue maintaining in a cafeteria which gradually decreases their efficiently. Thus, the idea of making a program as the satisfied solution for both sides.
  - This process by which we are constructing the food ordering system is coding with computer languages such as C++ or Python. Not only the program will be implemented upon a digital cafeteria to show which order do they need to cook for customer of the respective table, but also the program itself will show how much time will it take on waiting for the desired dish to be served in the table. Because of this, ordering food from the restaurant will be easier for every customer and be able to reduce the work for receptionist to be performed. Also, there will be a table management system which will show us the much time each customer taking per meal. By this when all the tables are full, we can still tell the next customer when he can get a free table.
  - In terms of implementation, if the restaurant invested big amount of money as the budget to implement this system into be a part of restaurant service for real. Restaurant's director and Board of director will discuss about the feasibility of this project. Should it be approved or will it be worthy for big amount of money to develop this thing. After talking about possibility of the project they might not see the picture of the system and how it will satisfy customer in term of using this. The questions will be asked by many executive officers whether it will actually help us to satisfying customer needs or it will be wasted a lot of funds on something that not worthy for.
  - Here comes the term of solution that would help describe the things clearer. And help the executive officers understand the process of the system easier. To satisfied those question, the simulation would be answers for those questions by simulating all of variable and possibility into the simulation model and solve those question or show the bigger picture of the system by simulation the situation before the implementation.

- ***THEORY INCLUDED*:** The implementation of the 2 systems have a main idea of processing as the Single Server Queuing Service. It is Single-server service node consists of a server plus its queue. One Single Server Queue will show you the time spending in order to get in the service and another one will show how much time customer is taking in the restaurant.

Table for food order time: (we assume that it need 5 minutes for cooking each item, but in main program it will be different)

CUSTOMER NUMBER	ORDER TIME	COOKING START	DELIVERY TIME	WAITING TIME
01	0	0	5	5
02	2	5	10	8
03	12	12	17	5
04	20	20	25	5

Table for customer spend time in restaurant:

CUSTOMER NO.	ARRIVAL TIME	LEAVING TIME	TIME SPENT IN THE RESTAURANT
01	**0**	**30**	**30**
02	**2**	**18**	**16**
03	**12**	**30**	**18**
04	**20**	**39**	**19**

Queuing system is mathematical models to describe congestion. It happens every time which customer waiting for the service. Based on the order time customer have to wait for a certain time, as it is a single queue system, at a time it can take only one order. If an order is already in the system, for customer 2 in when he ordered the food for first customer was cooking. That's why he had to wait for the server to be free and then his order has been started preparing.

- ***DATA IN-NEEDED*:** Data which be required in this system will be defined by orders of customers and number of customers in the system. Each order has its time to be cooked such as Burger will be done and ready to be served in 10 minutes after ordering or Tea will be ready to serve after 5 minutes after ordering depend on how hard is procedure of cooking and

not only the menu effect the time of food cooking, but also the number of customers will affect the system too. Because the number of chef and waiters/waitress who will bring the foods to customer's will be limited or constraints. Thus, the greater number of customers order food in system, the more works for service work to take longer and it will affect waiting time of customers too, Other than these things, everything has been defined by itself process such the time the customer spend in order to select their order, etc.

- ***MODEL SAMPLE*:** To form the model with ease, we will make the number of tables as 10 and 3 chefs for cooking in kitchen. It may be increased of any variable for this in further to make the model simulates more precise and accuracy.

CONCLUSION: The visualization of customer and counters utilization combined with statistical data can be used by expert to redefine digital cafeteria. Possible transformations of the schedule are also visible.

This model provides "what if" analysis for further improvement of the schedule generated with heuristic algorithms. It is also useful for cafeteria schedule adjustment for unexpected changes of input data and parameters, when heuristics are excessive for regeneration of a new schedule. As all the customers are simulated separately, simulation model is very flexible in terms of unique parameter definition for each vehicle. Moreover, this model can be applied for simulation-based optimization of scheduling problem with time windows. In this case the model would provide fast estimation of proposed optimal variants of schedule.

A Statistical Report can also be generated which can provide aggregated information about vehicle utilization and idling, which is not shown in model window.

OUR WORK TILL DATE:

There will be the Monte Carlo simulation table of this event in order to initialize you the ideas of what are we doing and we processed till the study of simulation in the Arena simulation or Any logic Simulation so that we can display you the

work principle of this system and also to distinguish 2 of them we will demonstrate this two thing to you for clarifying the question of the work.

And in order to plot the graph which may be included inside the system, we also study simulation programming languages as Python which contain a lot of useful library to deal with numerical part of simulation or porting a graph or formula such as this library.

Matplotlib is an amazing visualization library in Python for 2D plots of arrays. Matplotlib is a multi-platform data visualization library built on NumPy arrays and designed to work with the broader SciPy stack. One of the greatest benefits of visualization is that it allows us visual access to huge amounts of data in easily digestible visuals. Matplotlib consists of several plots like line, bar, scatter, histogram etc.

As we are doing the project based on our knowledge we are gaining in this course, we are able to make the half of the project almost with necessary coding and other simulation parts. We have already made some trial and try to give the system an interface to show it.

***PROPOSED FOR NEXT REVIEW*:**

Implementation of all variable into the simulation model with either arena simulator or Any-Logic Simulator with the proper graph explain and distinguish between the old method or new method of ordering food. Make the survey if people prefer which method to be another variable for decision for feasibility. In the next review this most probably will be done:

1. Simulation of ordering of both methods.
2. Trying to input other variable which might affect the effective of project to see the solution of it.
3. Trying to learn new things to input the data inside the project to get more precises.
4. Well preparing for statistical report which provide the data which supposed to be in this model but still not here.

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