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Customer Queue Simulation in a Restaurant Using Web-Based Monte Carlo Method

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ABSTRACT

Modeling and simulation have become important tools in various fields for understanding and optimizing complex systems. In the modern era, advances in information technology and computing offer significant opportunities to apply modeling and simulation more effectively. One area where modeling and simulation can be applied is in the food industry, particularly in addressing queuing issues. Long queues in the context of buying and selling often result in losses for business owners. Restaurants, in particular, often face significant queueing challenges. To address this, simulations are needed to help improve the efficiency and effectiveness of customer service in restaurants. This research aims to design and develop a Food and Beverage Ordering Information System that can help manage transactions and sales reports digitally in a restaurant or cafeteria environment. This simulation uses the Monte Carlo method. Analysis shows that the application of Monte Carlo simulation to restaurant queuing systems can improve service efficiency, particularly in reducing customer waiting times and optimizing the use of service resources. Through testing several queue structure models namely single channel-single phase, single channel-multi phase, and multi-channel-multi phase with a software engineering approach, starting from system requirements analysis, design modification, to queue structure design. The application was tested using the blackbox testing method. The test results showed that all main features, such as login, add menu, transaction, and print report, functioned properly as expected and could handle both valid and invalid inputs correctly.

Keywords : *Monte Carlo, Restaurant, Simulation, Queue;*

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1. INTRODUCTION

Modeling and simulation have become crucial tools across various fields for understanding and optimizing complex systems. In the modern era, advancements in information and computational technology provide significant opportunities to apply modeling and simulation more effectively. Modeling involves creating an abstract representation of a real-world system to simplify analysis and prediction. Meanwhile, simulation is a model-based experiment used to evaluate specific scenarios without interfering with the actual system (Santoso et al., 2024). In the context of Indonesia, modeling and simulation have been applied across various sectors, including transportation, healthcare, and disaster mitigation. For example, traffic simulation is used to reduce congestion in major cities like Jakarta (Aqidawati et al., 2023). In the context of Indonesia, modeling and simulation have been applied across various sectors, including transportation, healthcare, and disaster mitigation. For instance, traffic simulation is utilized to alleviate congestion in major cities like Jakarta, and the spread of COVID-19 has been modeled using the SEIR epidemiological framework.

The aim of this study is to explore a service system in a restaurant using the Monte Carlo simulation approach. Monte Carlo is characterized by its intuitive nature and ease of understanding. The Monte Carlo method has the capability to handle parameters with randomly varying characteristics, allowing the exploration of factors whose changes cannot be predicted accurately (Warjaya et al., 2024). The scope of this study is limited to the restaurant website, starting from

entering the system, placing an order, making a payment, waiting for the order, receiving the order, and exiting the system.

2. LITERATURE REVIEW

Modeling and simulation enable governments and institutions to make data-driven decisions more effectively. However, there are still challenges in implementing modeling and simulation in Indonesia. Key obstacles include limited data availability, inadequate technological infrastructure, and the low adoption of simulation technology on a large scale. This study aims to explore the fundamental concepts, implementation, and applications of modeling and simulation across various sectors in Indonesia. By doing so, it is expected to provide a more comprehensive understanding of the benefits and challenges associated with modeling and simulation in the country. Modeling is an abstraction process designed to represent a real-world system in a simplified form, whether mathematically, visually, or computationally. Such models can be used to analyze system behavior and predict outcomes resulting from specific changes (Hakim et al., 2024). For instance, mathematical models are often used to describe relationships between variables in transportation or healthcare systems. Simulation, on the other hand, is a model-based experiment that allows the testing of various scenarios without interfering with the original system. Simulations are employed to study system behavior under conditions that are challenging or impossible to observe directly. One example is the use of simulation in supply chain distribution to optimize logistics efficiency (E. Kurniawan et al., 2024).

In the context of Indonesia's highly popular food business sector, restaurant managers constantly compete and strive to be the best in the eyes of customers. They are always working to provide the best service to ensure customer loyalty and prevent them from switching to other brands. Queuing is a situation where the number of service resources is insufficient to meet the demand from customers, or in other words, it occurs when there is an imbalance between the arrival patterns and the capacity to serve customers efficiently (Putri et al., 2025). Queues create several problems in buying and selling contexts, leading to losses for business owners. Therefore, a simulation is needed to improve restaurant customer service, making it more effective and efficient. In the food business industry, providing fast and efficient service is more likely to attract customers.

Many studies have discussed service system simulations. One such study examined the Service System Simulation of Order Processing at XYZ Coffee Shop Sidewalk Branch in Jimbaran using ProModel software. ProModel is a simulation application commonly used for planning, designing, and improving both existing and new manufacturing and logistics systems. It focuses on issues such as resource utilization, production capacity, productivity, and inventory. The aim of this research was to provide an overview of how the service system operates at XYZ Coffee Shop Sidewalk Jimbaran, which could then be used to identify and eliminate existing problems, with the output being proposed solutions based on the simulation. The results indicated that the simulation model was valid, and the proposed improvements included enhancing capacity at locations within the system (Utami et al., 2024). also shows that queuing systems in restaurants can be effectively analyzed through queue structure modeling such as single channel-single phase, single channel-multi phase, and multi-channel-multi phase. Another study is a simulation analysis of the food ordering queue system at Rahmawati Rahmawati Gresik floating shop, this research uses ARENA software. ARENA is a flexible tool in the analysis of creating simulation models that accurately use internal processes. The purpose of this research is to assess the ability of the service queue system at Warung Apung Rahmawati so as to obtain a shrinkage in the number of customer queues and an increase in effectiveness at work. This restaurant applies the flow of activities applied to the Warung Apung Rahmawati restaurant using queuing discipline with the First Come First Served (FCFS) or First In First out (FIFO) system, meaning that customers who arrives early will be served first. But in reality Warung Apung Rahmawati still faces obstacles, namely the number of queues at the cashier which is sometimes not balanced with the number of cashiers working. (K. Kurniawan et al., 2022). A simulation approach can also use Monte Carlo, as seen in the study titled "Simulation in Optimizing Sales Improvement of Kareh- Kareh Cakes Using the Monte Carlo Method." The goal of this research was to predict sales improvement and the accuracy of sales forecasts. The results showed that applying the Monte Carlo method to predict future cake sales based on past sales data was successful, with

predictions indicating that 93% of the daily average sales reached 190 during the first 12 days and 92% during the second 12 days, with a daily average of 182 sales (Hendra et al., 2023).

From the reviewed literature, it can be concluded that simulation studies on service systems using software such as ARENA or ProModel, as well as the Monte Carlo simulation approach, provide insights into how a service system operates. These simulations help identify and eliminate existing problems, with the output being proposed solutions that can lead to improved service quality in terms of efficiency and effectiveness.

3. METHOD

In everyday life in today's era of technology and computerization, we often hear the term "system." For example, computer systems, operating systems, information systems, geographic systems, academic systems, and so on. Whether we realize it or not, we frequently use services provided by these systems and are greatly assisted by their existence. A system is defined as a collection of interconnected objects that are interdependent in order to achieve a common goal within a complex environment. Many systems are studied or encountered in everyday life, such as the solar system, information systems, communication systems, queuing systems, and so on. Within each of these systems, there are entities that interact with each other (Subroto et al., 2023).

The Monte Carlo Simulation Method is a technique that typically involves the use of random numbers and computer-generated probability theory to solve problems of forecasting, estimation and risk analysis. The term Monte Carlo method was coined by S. Ulam and Nicholas Metropolisin reference to the game of roulette, a popular attraction in Monte Carlo, Monaco. The Monte Carlo method has a number of key characteristics that make it highly effective in simulating random and complex systems (Karomah, 2023).

A queue is a waiting line of customers (units) that require service from one or more servers (service facilities). In other words, a queue is an event that describes a situation where a group of people gather to take turns in receiving a product or service. In daily life, long queues are often encountered where people wait to be served by a service provider. One place where queuing problems are commonly found is in restaurants, which can have long lines of customers (Wahidah Alwi et al., 2023).

Queueing systems are the result of the development of queueing theory, which regulates service according to arrival times to achieve effective and efficient performance, offering a solution to queue-related issues. A queueing system can be described as a system with service facilities where specific units (usually called "customers") arrive to be served. Whenever the number of customers in the system exceeds the capacity of the service facilities to handle them simultaneously, the waiting line (queue) will grow longer. Customers waiting in line take their turns for service according to established rules, and after being served, they leave the system (Madhavi et al., 2024). So, the input to the system consists of customers requesting service, and the output is the customers being served. A queueing system is typically characterized by the following terms:Unifed Modelling language:

1. Input Process, in a queueing system, if customers arrive at times t0,t1,t2,…t_0, t_1, t_2, \dots, the inter-arrival time is defined as ur=tr−tr−1u_r = t_r - t_{r-1}, where r=1,2,3,…r = 1, 2, 3, \dots. The random variable uru_r, which represents the time between arrivals, is typically assumed to be independent statistically. The probability distribution of uru_r is denoted by A(u)A(u), which is called the inter-arrival time distribution or more simply, the arrival distribution or input distribution.
2. Queue Discipline, queue discipline refers to the rules governing the service of customers from the moment they arrive until they leave the service area. The arrival-based rule is typically based on FIFO (First In, First Out), which means that customers are served in the order they arrive, with the first customer to arrive being the first to be served.The most common queue discipline is **"first come, first served" (FCFS)**, where customers are served in the exact order of their arrival. This means that the customer who arrives first will be the first to receive service, and subsequent customers are served in that same sequence. This rule ensures fairness by prioritizing the order of arrival (Restiana, 2022).

The queuing process is generally grouped into four basic structures of queuing models, in

the simulation of customer queues in a restaurant from an existing service facility, namely:

a. *Single Channel-Single Phase,* the Single Channel-Single Phase model, which is often associated with the M/M/1 model in queuing theory, describes a service system with one waiting line (queue) and one service facility (service facility). The function of the M/M/1 system is to analyze and measure the performance of service operations, such as average waiting time in queue, average queue length, server utilization, and probability of empty or full conditions. *Single Channel – Single Phase* It is a type of queue that has only one line and one service. An example in this case is a single cashier (Nisa et al., 2024).

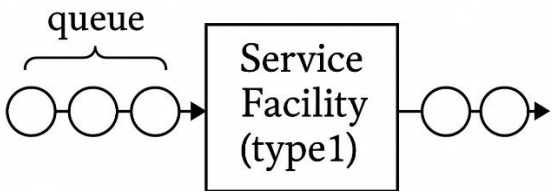

Figure 1. *Single Channel-Single Phase*

b. *Single Channel-Multi Phase,* it is a type of queue that has only one line and two or more services. An example in this case is the seating queue (waiting list), where customers who arrive must wait in a single queue for service and then be directed to a table based on the number of people they wish to seat (Luthfi et al., 2023).

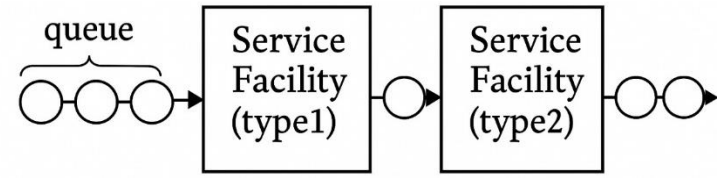

Figure 2. *Single Channel-Multi Phase*

c. *Multi Channel–Multi Phase*, phase model represents a queuing system where a single waiting line flows through various phased service stages, and at each stage there are several servers (multi-channel) serving in parallel. Each customer entity will pass through all phases sequentially but can be served by different servers at each stage. For each phase in a Multi Channel system, we use the M/M/c model approach. Here is the basic formula:

1. Server utilization ratio (ρ):

a measure that indicates how efficiently servers are utilized in a system. In general, it can be defined as the ratio between the request arrival rate and the server service rate. This ratio helps in measuring the efficiency of server usage, the higher the ρ value, the more congested the server usage is. In the context of queue or service system simulation, understanding and monitoring ρ is key to optimizing system performance and preventing overloading. ρ is the key to optimizing system performance and preventing overloading (Akbar et al., 2021). Here's the formula:

$$\rho = \frac{\lambda}{c \cdot \mu} , \quad (1)$$

2. The probability of an empty system (P_0)

empty system probability is a measure of the probability that there are no customers or entities in the queuing system at a given time. The function of is very important in analyzing the performance of a queuing system. First, this value indicates the chance that the server is not in use, aka in an empty state. This is an important indicator to determine whether the system capacity is too large so that the server is often idle, or vice versa is too small so that the queue builds up. Thus, it is not just a statistical figure, but also a vital measurement tool in modeling and simulating service systems, because it is able to reflect the balance between the capacity and workload received by the system.

$$P_0 = \left[\sum_{n=0}^{c-1} \frac{(\lambda/\mu)^n}{n!} + \frac{(\lambda/\mu)^c}{c!} \cdot \frac{1}{1-\rho}\right]^{-1}, \quad (2)$$

3. Average number of customers in queue (Lq):

One of the important parameters in queueing theory used to measure the average number of customers waiting in line before receiving service. Monitoring and analyzing Lq helps operational managers in designing strategies for adding service facilities or rearranging service schedules to make the system more efficient. In Monte Carlo-based simulations, such as those used in this study, the Lq value is calculated based on the probabilistic distribution of arrivals and service times, enabling more precise decision-making in customer queue management.

$$L_q = \frac{P_0 \cdot (\lambda/\mu)^c \cdot \rho}{c! \cdot (1-\rho)^2}, \quad (3)$$

4. Average waiting time in queue (Wq):

The average time spent by customers in queues before receiving service. According to various recent studies, including a journal by Kumar & Sharma (2021), Wq is used to evaluate the efficiency of service systems and customer experience. Understanding Wq is very important for operational managers in identifying bottlenecks in the service process and determining improvement measures, such as adding service resources or rescheduling operational processes. In the context of Monte Carlo simulation, Wq is calculated through a process of repeated testing by introducing random variations in arrival and service times, thereby producing a realistic estimate of customer waiting times in the queueing system.

$$W_q = \frac{L_q}{\lambda}, \quad (4)$$

5. Average number of customers in the system (L):

One of the important parameters in queueing theory that measures the average number of customers in the system, both those waiting in line and those being served. In the context of simulation, L is also a reference in the overall evaluation of service models, because this value reflects the impact of arrival and service variability on the system. Thus, L is not only descriptive, but also predictive and strategic.

$$L_q = \frac{P_0 \cdot (\lambda/\mu)^c \cdot \rho}{c! \cdot (1-\rho)^2}, \quad (5)$$

6. Average customer time in the system (W):

A parameter in queueing theory that indicates the average time spent by customers in the system, from arrival until the customer is served and leaves the system. The main function of the W value is as an indicator of the total waiting time experienced by customers, making it very useful for evaluating customer satisfaction. The W value includes waiting time in the queue and service time, which together provide a comprehensive overview of system performance. In practice, if the W value is too high, this indicates the need for improvements in service capacity, process flow, or workforce numbers. Therefore, W is a key parameter in data-driven strategic decision-making to continuously improve service quality.

$$W_q = \frac{L_q}{\lambda}, \quad (6)$$

4. RESULTS AND DISCUSSION

1. Design UML

a. Use case diagram, a diagram use model interactions between users with the information system to be created. Diagram use case helps thr software development team to understand the interaction between the user and system

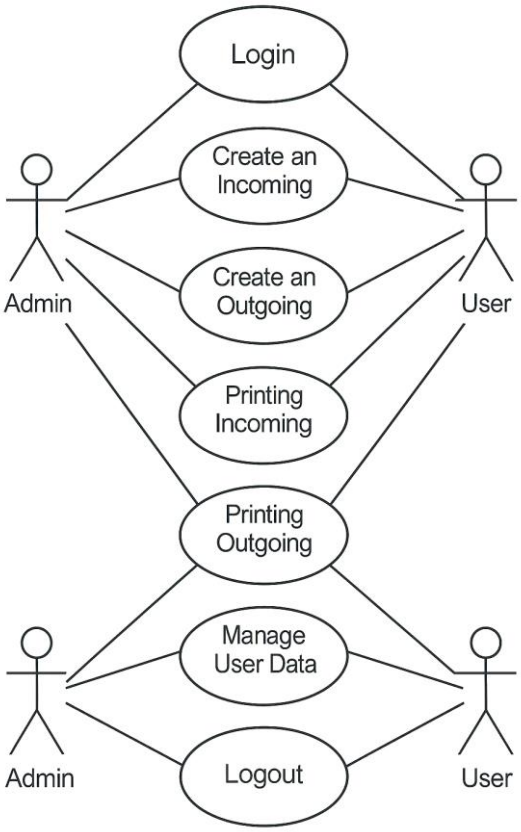

Figure 3. Use Case Diagram

This system begins with a login process carried out by two types of actors, namely Admin and User. After successfully logging in, users can access various features as needed. One of the available features is the creation of incoming letters (Create an Incoming), where users can record and save received letters into the system. In addition, users can also create an outgoing letter (Create an Outgoing) for the purpose of sending official documents. Incoming and outgoing letters that have been created can be printed through the Printing Incoming and Printing Outgoing features. The system also provides a user data management feature (Manage User Data) that allows admins and users to update their respective account information. After completing all activities in the system, users can exit through the Logout process to end the usage session. All these processes are designed to be accessed by both admins and users with an efficient and structured flow (Santoso et al., 2024).

b. Activity diagram, a diagram used to model the workflow or activity of a system or business process or a menu software. This diagram illustrates the squace of activities, actions, and decisions that occur in a process.

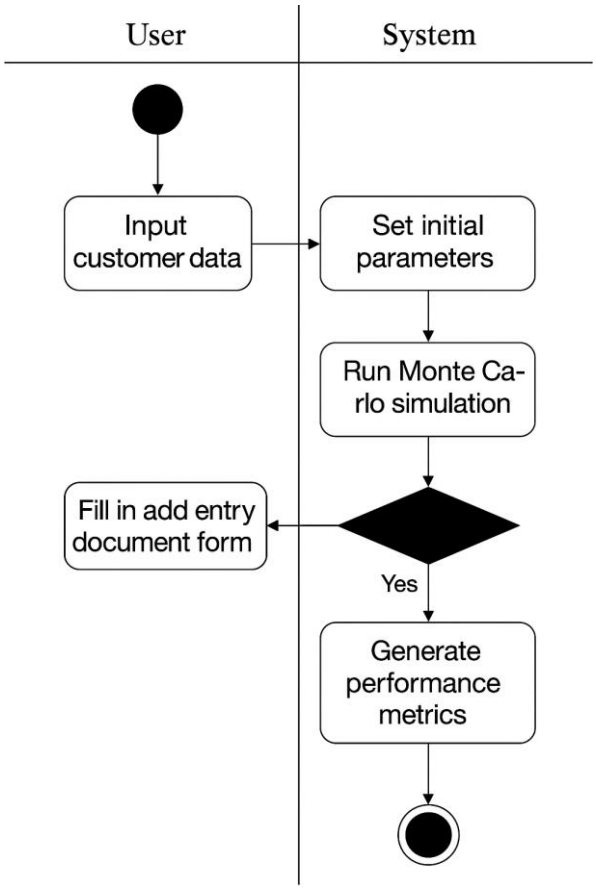

Figure 4. Activity Diagram

The process starts when the user inputs customer data into the system. After the data is entered, the system automatically sets the initial parameters required for the next process. Then, the system runs a Monte Carlo simulation to analyze the data and predict possible outcomes based on the preset parameters. After the simulation is run, the system checks whether additional entry form filling is required. If yes, the user is prompted to fill in the additional document entry form to complete the required information. Once the additional data is entered, the system continues the process by generating performance metrics as the final result of the analysis. The process is completed once the performance metrics have been generated, providing a snapshot of performance that can be used for further decision-making (Yolanda et al., 2023).

c. Class Diagram is a diagram used to illustrate the structure of the sytem in terms of defining the classes that will be created to build system. These diagrams are commonly use in software engineering to visualize the desigssn of a sytem, particularly in object-oriented programming (Fu'adi et al., 2022).

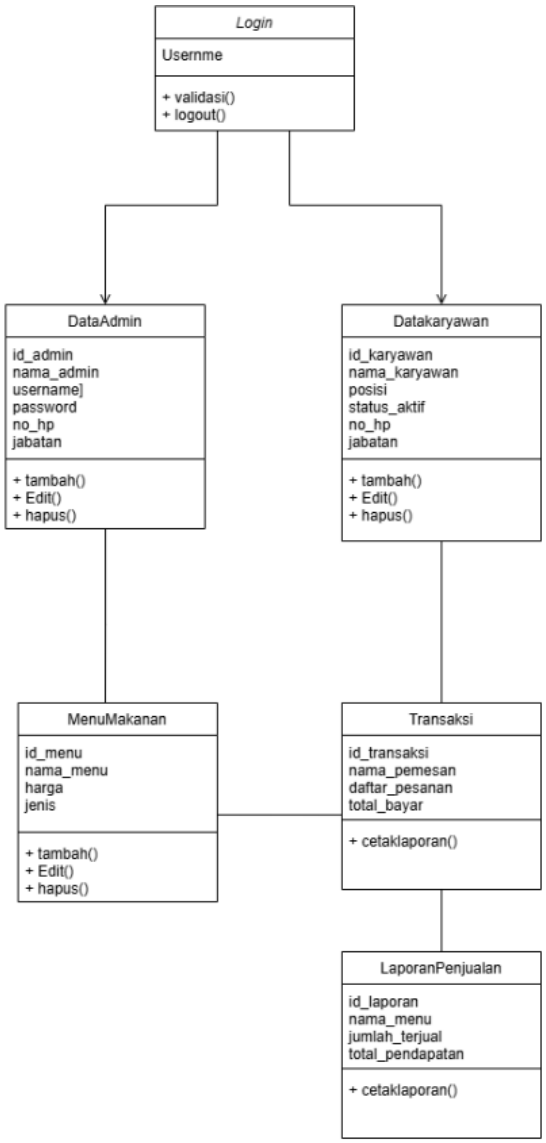

Figure 5. Class Diagram

2. Implemantation

a. Login page

The login page is initial page that must be passed by the user to be able to accsess the restaurant sytem. This page serves as the main security so that only users who are registered and have authorized access rights, such as admin or cashier, can enter and manage data in system.

On this page, users are asked to enter their username and password as credentials to authenticate. Once the data entered is correct and verified, the user will be directed to the main page of suyem, such as the transaction data page or sales summary.

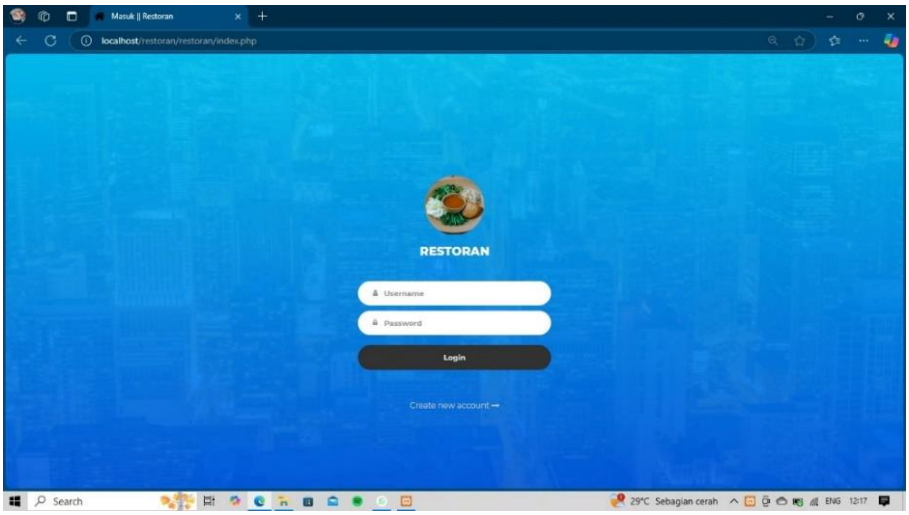

Figure 6. Restaurant Website Login Page

b. Dashboard

This website is a restaurant management system that is used to organixe and display employee data or restaurant employess. Employee data table: displays important information such as:

1. Employee name
2. Posisition/title (cashier, waiter,owner, etc)
3. Activeness

Navigation buttons and quick functions:

1. Add employee
2. Add posisition
3. Add other data related to restaurant operations

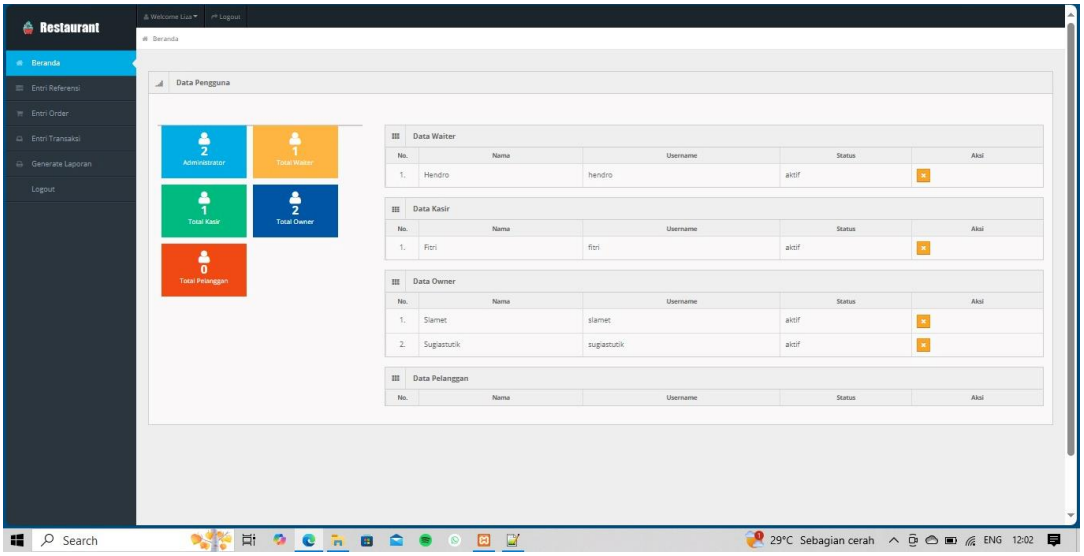

Figure 7. User Data Display

c. Menu page

This page is the main menu page of the web-based restaurant system. On this page, various menu cards are displayed that contain pictures of food or drinks, such as tea, juice, rice, or fried chicken. Each menu card displays the menu name, price, and action buttons such as edit and delete. The edit button is used to change menu information such as name, image, or price, while the delete button is used to remove the menu from the list. The main function of this page is to display all available menus in a complete and organized manner, as well as allowing the admin to manage food and beverage data. This management includes adding new menus, editing existing menus, and deleting menus that are no longer offered. Thus, this page makes it easy for admins to update menu information and ensure the digital menu display remains relevant to customers.

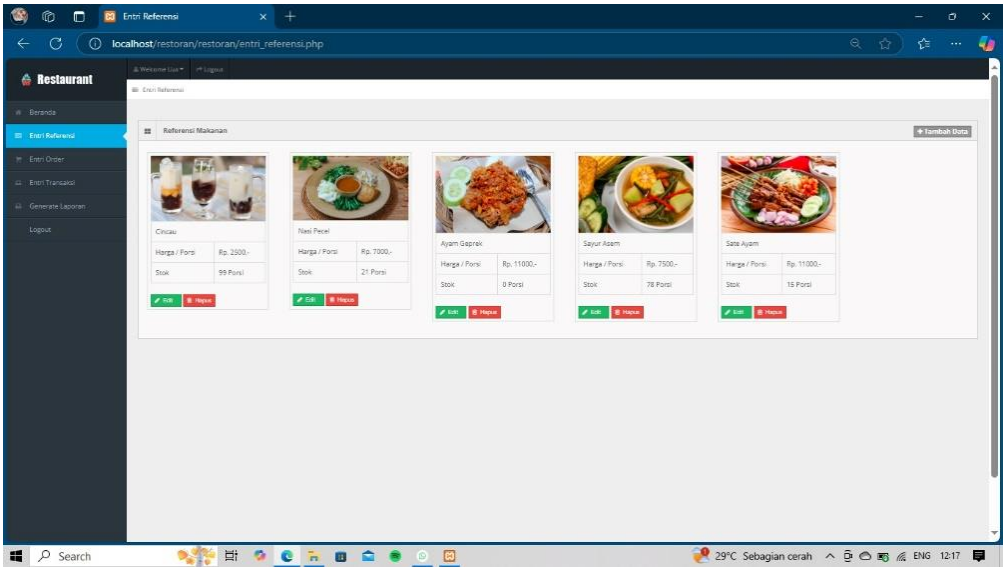

Figure 8. Restaurant Menu Display

d. Order entry page

The image shows the order entry page of the web-based restaurant system. In the main part of this page, there is a display of food and beverage menus in card form, which includes menu images, food or beverage names, prices per serving, the amount of stock available, and a green button that says “Order” for each item. Some examples of menus displayed include Cincau drinks, Nasi Pecel, Sayur Asem, and Chicken Satay. Each menu displays price information and remaining stock clearly, making it easier for users to choose the available menu before placing an order.

On the right side of the page, there is an order cart feature that is used to record the menu that has been selected. Users can fill in the table number, select the menu, determine the order quantity, and the total price will automatically appear based on the order entered. After the data is filled in completely, the user can press the “Save Order” button to complete the transaction

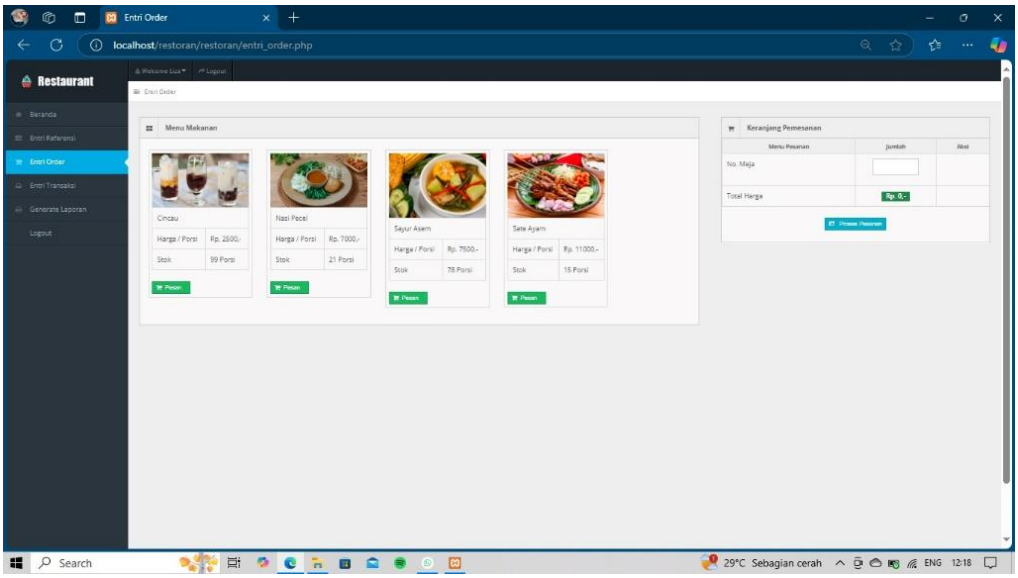

Figure 9. Incoming Order Display

e. Transaction list

The page displayed is a transaction data page or order history on the restaurant system. This page serves to display all the list of orders that have been made by customers. Each transaction is displayed in from af a table that contains important information such as date of the transaction, the name of or orderer, menu ordere, the order amount and total payment. In addition, in the action column there are two buttons, namely the green edit button which is used to change transaction data, and the red delete button based on certain date ranges and keyword, making it easier for admins to find certain transaction quickly. This page is very useful for admins or restaurant cashier in managing order data and ensuring all transaction are recorded properly.

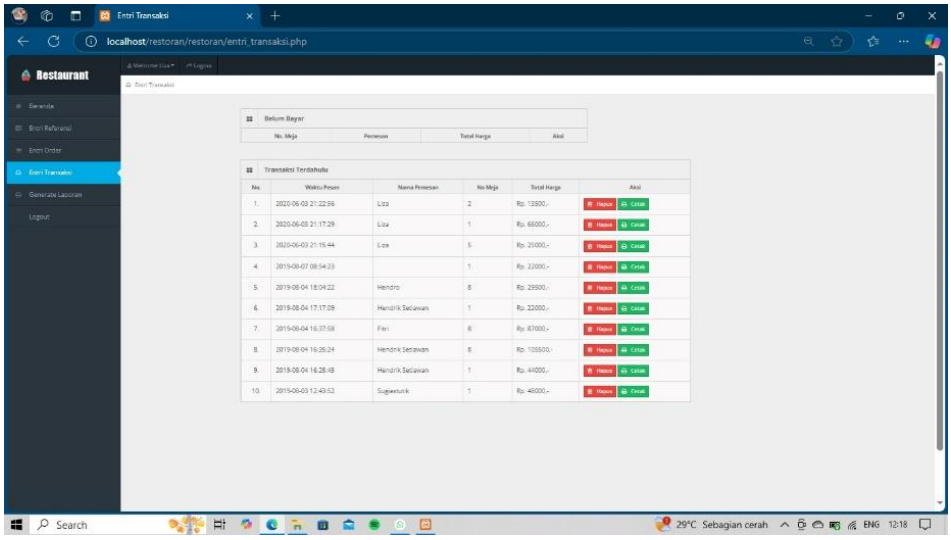

Figure 10. Display of Purchase Transaction Results List

f. Sales report

This page displays a summary of restaurant sales data that focuses on the number of orders and overall revenue from food and beverages that have been ordered by customers. In information is presented in the from of a table that contains details of the number of orders of each type of menu, both food and beverages, along with the total price generated from these

sales. This table helps the admin or restaurant management to monitor sales performance quicky and accrutaley. The data displayed includes:

1. Menu name
2. Order quantity
3. Total revenue, calculation of the total money earned from the sale of each menu (number of orders x unit price)

g. Program for calculating customer data

```
import pandas as pd
 # Baca file Excel menggunakan pd.read_excel
df = pd.read_excel('data restaurant.xlsx') # Tampilkan data print(df.head())
 # Menampilkan 5 baris pertama
```

	No	Nama Pelanggan	Menu	Jumlah	Harga	Total
0	1.0	Hendro	Sate Ayam	2.0	11000.0	22000
1	NaN	NaN	Sayur Asem	1.0	7500.0	7500
2	NaN	Total	NaN	NaN	NaN	29500
3	2.0	Hendri Setiawan	Nasi Pecel	1.0	7000.0	7000
4	NaN	NaN	Sayur Asem	2.0	7500.0	15000

Figure 11. Program Output Display

3. Application testing

Based on testing using the blackbox method, all main features run according to expectations, the system can handle valid input and also display an error message for invalid input, the login security function has been tested and can verify data appropriately, the transaction function processes data and generates total payments correctly, the report feature can produce output files as it should.

Tested Features	Input Provided	Expected Results	Status
Login	Username and Password valid	Log in to the user dashboard	Successful
Login	Incorrect username/password	Display the message 'login failed'	Successful
Ordering Menu	Select menu + amount	Order data is saved and displayed	Successful
Payment Transaction	Order completed > click pay	Total price appears and transaction is successful	Successful
Sales Report	Access the report menu	Display daily/monthly sales data	Successful
Order Quantity Input Validation	Enter letters instead of numbers	Invalid input error message displayed	Successful
Logout	Click the logout button	The system returns to the login page	Successful

5. CONCLUSION

This research highlights the importance of modeling and simulation as strategic tools in improving the efficiency of service systems, especially in the food industry such as restaurants. The research was conducted at a restaurant that experienced the problem of long customer queues, especially during peak hours, which resulted in decreased service quality and potential loss of customers. To overcome these problems, this research aims to design and build a web-based food and beverage ordering information system using the Monte Carlo simulation approach.

This approach allows modeling the customer queue process as a whole, starting from the customer entering the system, placing an order, making a payment, waiting for an order, to receiving and exiting the system. The system is designed to simulate various service scenarios using queue structure models such as single channel-single phase, single channel-multi phase, and multi channel-multi phase to effectively analyze service performance.

The result of this research is a web-based restaurant application equipped with login features, menu data management, food and beverage ordering, payment transactions, and sales reports. This application is tested using the blackbox method to ensure all features run according to their functions. The test results show that all the main features, such as login, ordering, payment transactions, and report generation, function properly.

REFRENCES

Akbar, H. P., Basuki, A., & Setiawan, E. (2021). Peningkatan Utilisasi Jaringan Distributed Storage System Menggunakan Kombinasi Server dan Link Load Balancing. *Jurnal Teknologi Informasi Dan Ilmu Komputer*, *8*(3), 525–532. https://doi.org/10.25126/jtiik.2021834294

Aqidawati, E. F., & Nugraha, I. (2023). Simulasi Usulan Perbaikan Sistem Antrian di Bank XYZ. *Waluyo Jatmiko Proceeding*, *16*(1), 591–600. https://doi.org/10.33005/wj.v16i1.53

Fu'adi, A., & Prianggono, A. (2022). Analisa dan Perancangan Sistem Informasi Akademik Akademi Komunitas Negeri Pacitan Menggunakan Diagram UML dan EER. *Jurnal Ilmiah Teknologi Informasi Asia*, *16*(1), 45–54.

Hakim, C. B., Arifiya, P. T. N., Nugroho, N. M., & Iman, N. (2024). USULAN MODEL SISTEM ANTRIAN PADA INSTANLASI FARMASI BPJS RUMAH SAKIT ABC DI KUDUS. *JURNAL TEKNOLOGI DAN MANAJEMEN INDUSTRI*, *5*(1), 1–9.

Hendra, Y., Syahputra, E. A., & Juledi, A. P. (2023). SIMULASI DALAM PENGOPTIMALAN PENINGKATAN PENJUALAN KUE KAREH-. *Journal Computer Science and Information Technology(JCoInT)*, *1*, 107–118.

Karomah, B. (2023). *Simulasi Monte Carlo Dalam Menentukan Nilai Opsi Saham*.

Kurniawan, E., Fahlovi, O., Avista, Z., Witanto, Y., & Ilyasa, R. (2024). Peran Digital Twin dalam Otomatisasi Manufaktur yang Berkelanjutan. *Prosiding Sains Dan Teknologi*, *3*(1), 51–61.

Kurniawan, K., & Andesta, D. (2022). Analisis Simulasi Sistem Antrian Pemesanan Makanan Pada Warung Apung Rahmawati Gresik. *JUSTI (Jurnal Sistem Dan Teknik Industri)*, *3*(3), 368–376.

Luthfi, M., Ilhamsyah, & Rusi, I. (2023). Rancang Bangun Sistem Antrian OnlineMenggunakan Metode Single Channel-Multi Phase. *JSI : Jurnal Sistem Informasi*, *15*(1), 3033–3043.

Madhavi, C., Dasanayaka, D., & Senevirathne, V. (2024). *ANALYZING TICKETING PERFORMANCE OF THE KANDY RAILWAY STATION ANALYZING TICKETING PERFORMANCE OF THE KANDY*. *March*.

Nisa, N. C., Wahyu, A., Samudra, A., & Fatoni, R. (2024). MODEL SISTEM ANTRIAN UINSA MART MENGGUNAKAN POLA SINGLE CHANNEL SINGLE PHASE. *Infotronik: Jurnal Teknologi Informasi Dan Elektronika*, *9*(1), 12–18.

Putri, A. A., Utomo, P. E. P., & Iftita, H. (2025). Analisis Teori Antrean untuk Menilai Kualitas Pelayanan pada Usaha Pangsit Chili Oil Menggunakan Model Saluran Tunggal-Fase Tunggal. *Jurnal Indonesia: Manajemen Informatika Dan Komunikasi*, *6*(2), 1115–1125.

Restiana, R. (2022). *Pemodelan Dan Simulasi Sistem Antrian Pelayanan Poliklinik Serta Usulan Perbaikan Dengan Menggunakan Flexsim (Studi Kasus: Puskesmas Gunung Samarinda, Balikpapan)*.

Santoso, T., & Basuki, A. (2024). *Metode Simulasi Monte Carlo*. *7*(x), 1–16.

Subroto, D. E., Supriandi, Wirawan, R., & Rukmana, A. Y. (2023). Implementasi Teknologi dalam Pembelajaran di Era Digital: Tantangan dan Peluang bagi Dunia Pendidikan di Indonesia. *Jurnal Pendidikan West Science*, *1*(07), 473–480. https://doi.org/10.58812/jpdws.v1i07.542

Utami, N. M. C., Sitanggang, B. E. I., Widhiatmika, I. W. A., Wahyuni, N. N. T., & Aryani, N. K. I. (2024). Simulasi Sistem Pelayanan Pemesanan Kedai Kopi XYZ Cabang Sidewalk - Jimbaran. *Go-Integratif : Jurnal Teknik Sistem Dan Industri*, *5*(01), 36–51. https://doi.org/10.35261/gijtsi.v5i01.11321

Wahidah Alwi, Adiatma, & Andi Nurfadhilah. (2023). Analisis Sistem Antrian Pembuatan Kartu

Tanda Penduduk (KTP) di Kantor Dinas Kependudukan dan Catatan Sipil Kabupaten Barru. *Jurnal MSA (Matematika Dan Statistika Serta Aplikasinya)*, *11*(1), 133–140. https://doi.org/10.24252/msa.v11i1.40892

Warjaya, A., & Karo, I. M. K. (2024). SIMULASI MONTE CARLO DALAM MEMPREDIKSI PENDAPATAN. *JATI(Jurnal Mahasiswa Teknik Informatika)*, *8*(4), 5799–5806.

Yolanda, A. E., Wanandi, B. S., Yahya, H., Fiddarain, S., & Ikhwan, A. (2023). Perancangan Aplikasi Multimedia Berbasis Android Dalam Pembelajaran Membaca Tingkat Taman Kanak-Kanak. *Jurnal Penelitian Dan Pengkajian Ilmiah Eksakta*, *2*(1), 61–66.