Smart Restaurant Ordering System

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***Abstract*— The restaurant's system is not entirely faultless. There is a great deal of hassles for both customers and staffs. Users frequently have to wait in queue for food and payments, which is highly annoying given that we typically only have a short amount of downtime each day for lunch. Some locations already have advanced IOT systems. Traditional structures are still in existence, though, in areas like my previous workplace, the university, and many other locations. We must really pinpoint the issue and advance the eating industry's progress. According to study, waiters have a stressful job because there are little social chances available to them. Meanwhile, the waiters substantially influence the experiences of the consumers. Everything in this sector demonstrated a need to be advanced, which would greatly benefit customers and actually save waiters' lives. The goal of this thesis is to identify issues facing the restaurant industry, create an IOT solution to lighten waiters' and customers' workloads, and carefully assess whether the solution meets their needs through prototype testing, experimentation and reviewing previous relevant works. The approach also aimed to employ an effective mechanism to reduce waiting times and draw in more consumers. Everything is covered under the system's scope: a one-stop shop for everything from client seat reservations to paying. Both software and hardware are covered by the system. An arrange-queue device for taking food, a seat reservation device, a food-ready-to-serve alert device, and a Toyippay payment device are all included. The literature reviews are mostly concerned with the pioneering work on smart restaurant systems by other authors. The literature research also demonstrates the requirements for digital transformation and the difficulties involved. This report also includes benchmarking, which demonstrates the worth of the prototype and the design idea for further investigation.**

***Index Terms*—Smart Restaurant, IOT**

I. INTRODUCTION

Since the emergence of 5G technology, which offers rapid data transfer rates and opens up many IOT applications that were previously impractical, IR 4.0 has become a hot issue. However, our way of life hasn't really changed all that much. We still carry out all of our daily tasks manually, which costs us a lot of time and chances. One of them is processes gone through in dining in a restaurant.

The system must be intelligent. Numerous definitions of intelligence exist. From an industrial standpoint, a "smart restaurant" is just a restaurant that makes use of robots and other smart technology. Here, the introduction of a smart restaurant ordering system denotes the introduction of a system that establish connectivity between devices in order to improve the convenience of the customers' lives.

These are the restaurant flow patterns that are most prevalent nowadays. Customers who self-collect must stand in wait from the moment they order food until they take it and pay for it. Customers that visit a restaurant with waiter service can sit down, order food, wait, and then pay for it. However, at peak hours, the waitstaff is very busy. With the use of IOT technology, every stage of the ordering process, including restaurant reservations, meal orders, taking foods and payment may be greatly improved.

First off, there is a good likelihood that we will have to adjust our plans after entering the restaurant since there are no seats available. Many restaurants don't provide a function that lets us reserve a spot for daily eating. Additionally, we must wait in queue for a very long time to order and pick up meals at self-collect restaurants like Mc Donald's. Additionally, improving the calibre of restaurant service has always been a crucial concern. Five key factors—tangibles, reliability, responsiveness, assurance, and empathy—can be used to evaluate the quality of a service [1]. The waiters must be dependable, which entails that they can provide perfect services. The servers must also be attentive to their consumers, which implies that they must be ready to assist them anytime necessary. The servers must also be kind towards the clients and demonstrate concern for them. The technology can assist waitstaff perform better so that they don't lose customers due to stress.

This initiative can lessen the workload of the wait staff in restaurants. According to study, waiters have a greater risk of developing depression [2]. The waiters' lack of social opportunities is the root of this. Utilising the technology, it lessens the workload of the wait staff. A sophisticated restaurant also enhances its branding [3].

We must enhance every step of the restaurant ordering process if we want to make the jobs of consumers and wait staff simpler.

II. LITERATURE REVIEW

Change is very crucial in the restaurant industry. Traditional mode is no longer appropriate as it is highly potential to stress the workers. The longer working time in a restaurant cause a higher probability of depression than in other industries as the waiter has less chance to interact with the others. It reduces the quality of the worker [2]. Besides, the poor quality of work can in turn cause implications to dining experiences.

The change in the restaurant industry can give positive outcomes to restaurants. First, it gives a positive impression to the customers. According to the survey done, a restaurant with

advanced technology can attract people and their friends to dine in [3]. Besides, it reduces waiters' dependencies, which reduces the human errors potentially brought by human inefficiency. According to the research done by various researchers over the years [4][5], service quality highly influenced the brand of a restaurant. To reduce the waiters' service quality, we have to reduce the waiter's workload. This is because the aforementioned research showed that the traditional environment gives a high-stress level to the waiters.

Moreover, an intelligent dining experience can give high satisfaction to customers. According to Kim Et al. [6], the graph below shows the relationship between perceived innovativeness of a fine dining restaurant to customer satisfaction.

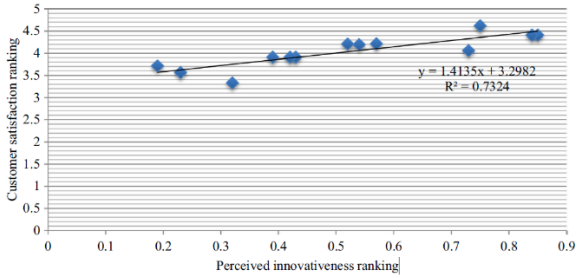

Figure 1 A Graph Showing Relationship of Customer Satisfaction Against Perceived Innovativeness

31% of respondents had given positive comments about menu innovation, while 23% of respondents appreciated customer experience-related innovations.

i. Related Efforts

To improve the waiters' and customers' experiences, several efforts are done.

First, the researchers created a one-stop system for ordering food that includes finding the closest restaurants, making reservations, using a smart menu, ordering food, and paying. An integrated system named Foody and an IOT restaurant system developed by researchers in China will be mentioned in this study of the literature. The block diagram for Foody can be found in the figure below. 'Foody' is a system made up of four components. The cloud database, cloud server, IOT sensor, and mobile app. Customers can download a smartphone app to find the closest restaurant, book a table, and place orders. To display the status of a table reservation, an IOT sensor is coupled to an LED display. The client record will be displayed by the cloud database. The cloud server is then used for data processing.

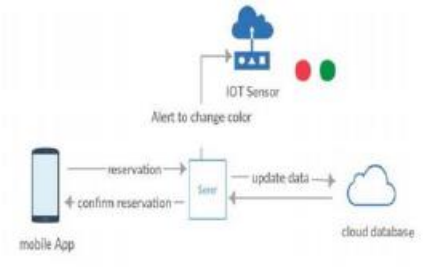

Figure 2: Block Diagram of the Smart Restaurant System (Foody) [1]

Besides, the developers have also built an online food ordering menu that could be customized for shopkeepers to use. Some trials build the app by using near-field communication [7]. The system allows the customer to access menus and other functions by using NFC technology. The figure below shows one of the examples.

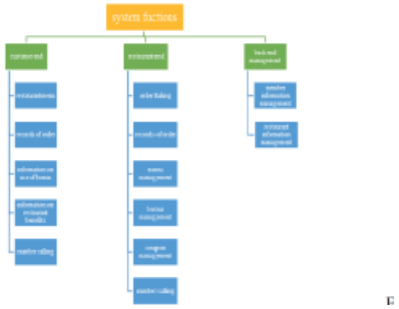

Figure 3 NFC-Based Restaurant Ordering System

However, since the QR code is more convenient, the method has become obsolete. One of these apps is from an online website called Menu Savvy, which allows shopkeepers to customize menus online. There was also some research on using a touch screen to order and RFID to pay [8], which has a concept similar to McDonald's today. Furthermore, some research uses AI to customize dining experiences. One of the applications is using an AI chatbot to customize menus.

The figure below shows one of the examples.

ii. Finding the Closest Restaurant

The program has a map system that can monitor the user's location and display the closest store that is open to them. Foody is the source of one of the current experiments. Foody connects a smartphone application that users download to Google Maps, which tracks their position and displays the closest store for them.

iii. Food Line Up

Chinese scholars had developed a novel concept [2]. Customers must wait in queue for meals after placing their order. The clients might have made greater use of the time. Therefore, the researchers suggested that a mini-WeChat

application might be used to place a meal order before a customer arrived at the business. Using the program, clients may see the line. Consumers might initially shop on the store floor or do other things while they waited for it. For certain well-known and crowded restaurants, it is helpful.

iv. Book a table

The status of the booking is shown on a table gadget [9]. A NodeMCU hardware device with two LED lights and a push button will be present. You may reserve a table either online or in person with a push button. The color of the led light will change once the table is reserved. Say that the first color is green. The device's color will thereafter be changed to red if it is booked. However, because each table requires a separate gadget, the price is rather significant. To offer this gadget extra features, several enhancements are required.

Menu

The menu is used to improve both intelligence and convenience. Many individuals decide to include the menu in an application. By just touching the phone on the object, an NFC-based software was developed to decrease bother [10]. The Chinese researcher decided to use a little program on the WeChat platform, which is a social media site [2]. Users are permitted to scan a QR code to open an app that is comparable to the scannable applications that are currently often used in some eateries. Foody also employs a smart menu to present clients with customized menus [9]. The smart menu may connect to a customer's Facebook or other social media account to learn what foods they now prefer and forecast their future favorites. If we wish to use it, there are certain privacy concerns.

Payment

Even the usage of the QR code has been made possible by an NFC-based program [9]. The software was created to address the issue that some QR codes are difficult to read in a dark restaurant atmosphere. In addition to these payment functions, the app also provides coupon and discount tools, which eliminate the need to manually maintain coupons and discounts.

III. PROJECT METHODOLOGY

To address the issues, a system will be created. Below is a block diagram of the system.

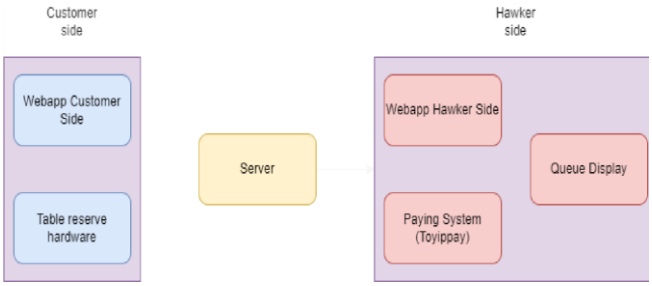

Figure 4: Block Diagram of the System

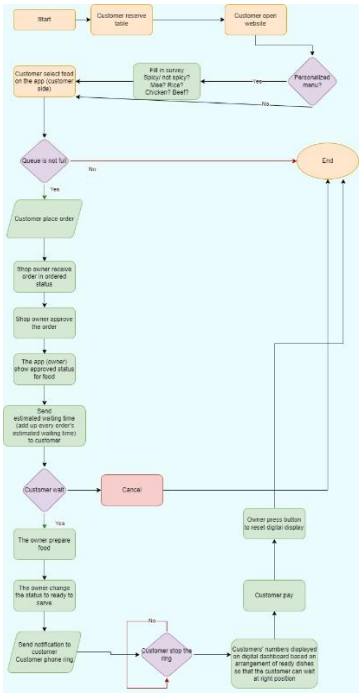

Figure 5: Flowchart of The System

The Smart Restaurant System is composed of three distinct elements: the customer side, the server side, and the hawker side.

i. Customer side

On the customer side, there are two parts, a web app and reservation hardware, which use an ESP2866, an LED light, and a button to communicate with the server. A suitable web app template, such as AdminLTE.io, should be selected to simplify the development process, and a script editor software like Visual Studio, Notepad, or Sublime should be used to develop the JavaScript app. While Sublime is suitable for

displaying JavaScript in color, Xampp must also be used to execute the code.

Figure 6: Block Diagram of Hardware Reservation System

i. Server Side

The server side receives information from both the customer and server sides and performs computations. The server used is developed by using XAMPP and it is located locally at the computer.

ii. Hawker Side

The hawker side includes three components: a web app, queue display, and paying system, which serve as tools for receiving orders, organizing food collection, and processing payments. The web app is written in JavaScript, while the queue display comprises a digital display and a NodeMCU to ensure food collection is more organized. Toyyipay system is the chosen payment system.

ii. Project Schedule

The project schedule for FYP1 and FYP2 includes research and literature reviews on current restaurant systems, the potential of NFC, and ongoing smart restaurant system research, as well as the selection of appropriate platforms and tools for development.

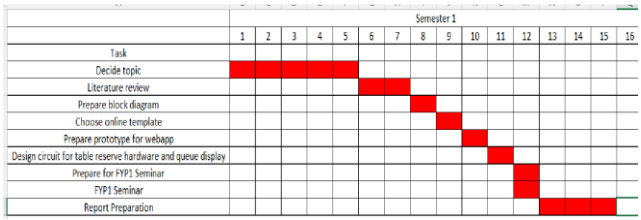

Figure 7: Gantt Chart FYP 1

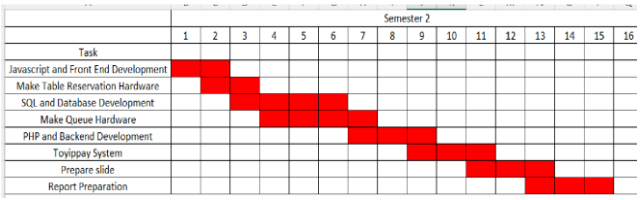

Figure 8: Gantt Chart FYP 2

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IV. RESULT AND ANALYSIS

i. Introduction

Currently, the looking prototype of the website has been designed the hardware of the table reserve device also has been simulated by using Arduino Uno . The preliminary results are shown below.

ii. Results

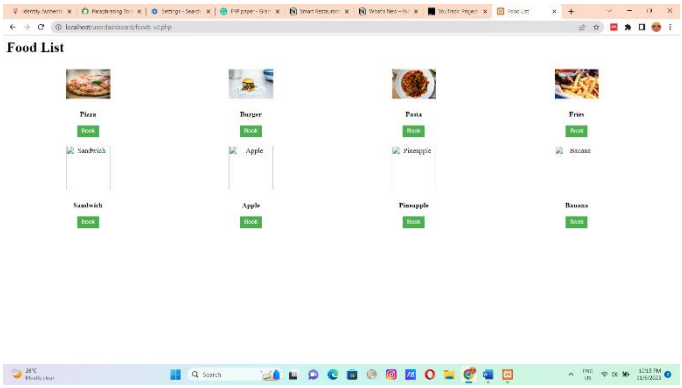

Figure 9: The Food List on Customer Side

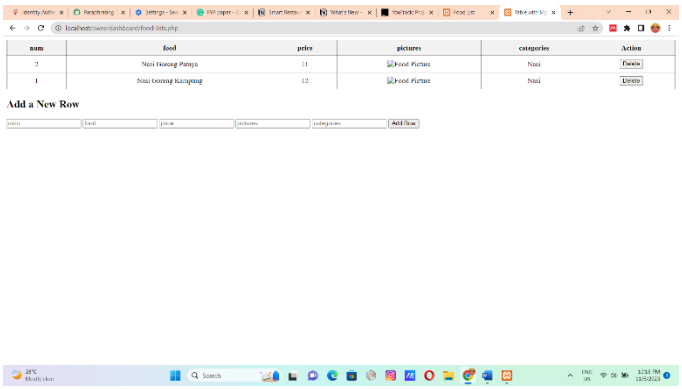

Figure 10: The Food List on The Hawker Side

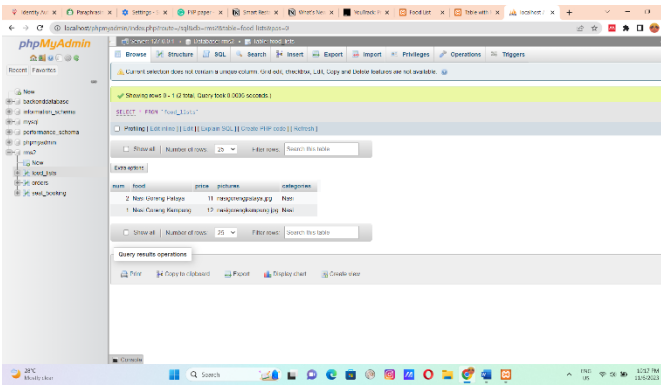

Figure 11: Database That Save Food List for Hawker

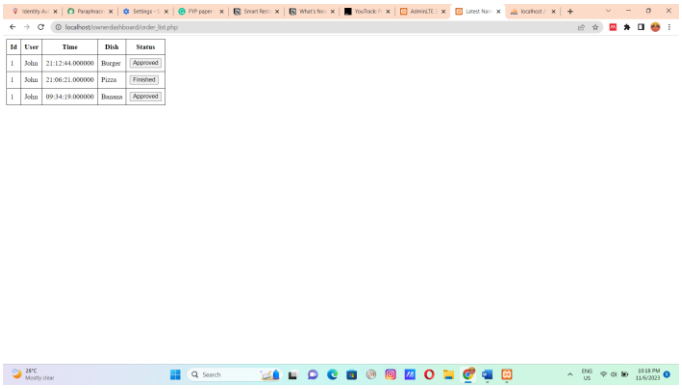

Figure 12: The Customer List

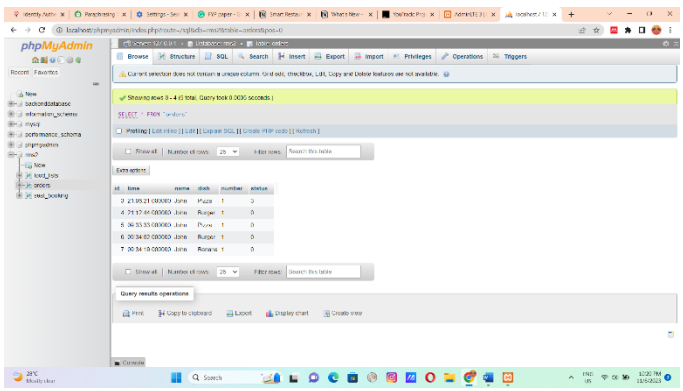

Figure 13: The Tables Booked

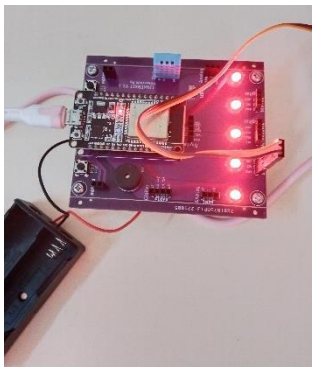

Figure 14: The Led of Table Hardware Before Any Seat Booked

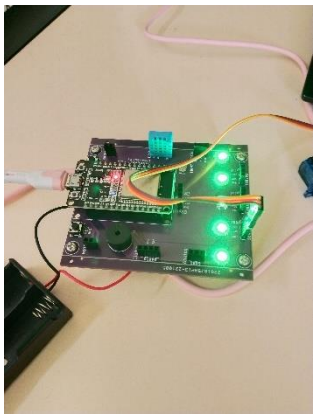

Figure 15: The Led of Table Hardware After This Seat Booked

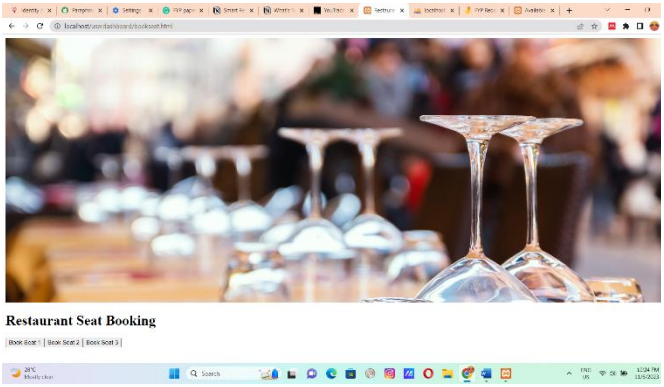

Figure 16: The Seat Booking Webpage

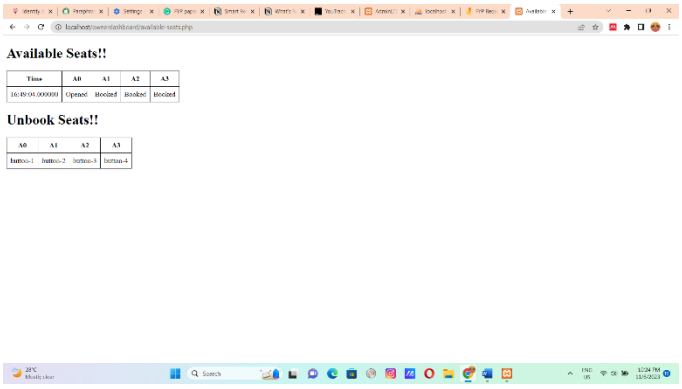

Figure 17: The Page That Shows Available and Non-available Seats

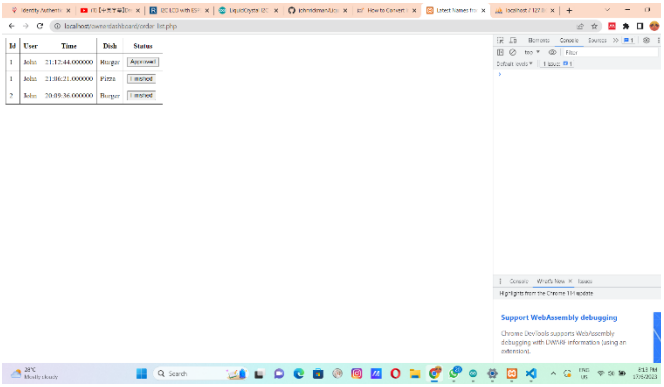

Figure 18: The Status Of Food Preparations at Shop Owner Site

Figure 19: The Queue Display in Initial State

Figure 20: The Queue Display Show That The Food is For Table 1

Figure 21: The Queue Display Show That the Food is For Table 2

Figure 22: ToyyibPay Payment Screen from the User

Figure 9 shows the food list that is displayed on website for customers to choose their food order. The orders will be shown on hawker's panel (Figure 10). These data are saved inside sql database (Figure 11).

Then, the hawkers can look at the order list, and set the customers' status to approved, preparing and finished as shown in Figure 13.

The ESP32 hardware represent a table (Figure 14). When a seat is not booked, red lights are shown. When the book seat button is clicked (Figure 16), the LED of relevant device is turned green as shown in Figure 15.

An LCD used to show the seat number at the queue for customers to take the foods (Figure 19, Figure 20, Figure 21). When the shop owner clicked finish to the following customers, the seats will be displayed at 1st, 2nd, and 3rd positions.

A payment gateway also designed to facilitate the users and the workers (Figure 22).

VI. BENCHMARKING

A development in the project is a great start. However, the potential of the project should be proven by research.

In the first research, a survey is conducted to examines the variables that have an impact on experience extension and satisfaction [11]. One hypothesis stated in the study are related to our project. The hypothesis is that the perceived ease of use has a positive effect on perceived
enjoyment. Perceived Ease Of Use means feeling that particular technology require less work to use [12]. Perceived enjoyment means their subjective experiences of the playfulness and delight that are connected to their senses, pleasure, and emotions [13]. That means, if the work done by the customers are less, they are found enjoy the experience in the restaurant more.

Potentially, the enjoyment could be converted to the power of branding and boost sales. The perceived enjoyment is strongly correlated with the customer intention to reuse the service provided, and this point is supported by research [14]. If the perceived ease of use is proven to be having strong effect on perceived enjoyment, the innovation should be implemented.

The research piece looked into whether clients in restaurants with robot service during the pandemic are satisfied. Customers who visited one of the two robot-service restaurants after the COVID-19 began and were still able to recall their visit provided data for the study. Data was gathered through a survey that was posted online and on several social networking sites. The study identified variables influencing experience satisfaction and experience extension and examined the theoretical underpinnings of the technology acceptance model. For data analysis, the study employed PROCESS Macro for SPSS version 3.2, AMOS version 24, and SPSS version 25. Confirmatory factor analysis was used in the study to examine the constructs' convergent validity, discriminant validity, and reliability. Normality, multicollinearity, and common method bias were all examined in the study.

The research has found that the perceived ease of use has strong effect to the enjoyment. However, the study was constrained by COVID-19 restriction in Oman, which required online data gathering. Future scholars should therefore replicate the current work by gathering data physically instead. The second research examine the core motivations for customers in developing countries such as Malaysia to accept smart transition in restaurant. There are 3 criteria to be investigated, the perceived cost, perceived enjoyment, and novelty.

To define perceived cost, it simply means the estimated price of a goods by the customer, which can be conscious or subcouscious. [15]. The novelty means something is not exist before and different [16][17].

In short, if we make the customers' life easier by reducing their works and make innovation to boost their enjoyment to our services, potentially higher income could be made.

vii. CONCLUSION

The ultimate goal of this project is to create a comprehensive, end-to-end smart system that encompasses the entire dining experience, from making reservations to ordering food, to payment. The reservation system will utilize a NodeMCU and an LED, while the order process will be facilitated through the use of a web application. Payment will be handled by the Toyyipay system, and a cloud-based server will be necessary to process all of the relevant data. Future enhancements will be needed to optimize the reservation hardware, taking customers' behaviors into consideration.

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