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Development of Daily Meal Ordering System for Patient in Hospital using Web-Based Technology

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Abstract: Food services carried out at most hospitals still use a paper menu than an electronic menu. Staff from the Department of Dietetics and Food Service need face-to-face interaction with the patient to take the order based on the doctor's recommendation. The face-to-face interaction between hospital staff and patients could potentially spread the virus (COVID-19). To minimize the spread, a web-based meal ordering system was developed for patients and the Department of Dietetics and Food Service which also improves the hospital food service system. The users of this system are classified into two types, which are the patients and the administrator from the Department of Dietetics and Food Service. The system's design was divided into two categories, namely the interface design (front-end) and database design (back-end). The design of t interface used the sublime text 3 as programmed, and XAMPP software which served as a web server. The Hypertext Markup Language (HTML) and PHP are the programming languages. For web development, MYSQL software was used in the database design. In terms of functionality, each interface has its requirements. The tests revealed that the interface and database were both successfully developed and functional. Patients can place their meals more efficiently with this approach. This approach also can be used to overcome the challenges and disadvantages that the Department of Dietetics and Food Service faces when using manual (paper) methods.

Keywords: Meal Ordering System, Web-Based Technology, COVID-19

1. Introduction

As part of the medical therapy, the food service provided in hospitals is extremely essential [1]. Also, the hospital food service aims to serve the inpatients with nutritional meals that will assist in their

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recovery and health, as well as set an example of healthy eating with menus customized to each patient's individual healthcare needs [2]. The emergence of COVID-19 in December 2019 creates chaos to the healthcare system, given the increase in critically ill pneumonia patients and the lack of definitive treatment [3]. The disease symptoms are similar to those of viral pneumonia, including fever, tiredness, dry cough, and lymphopenia [4] and could spread easily when one is exposed to the virus.

Hence, there is a concern for the hospital's food service management. Currently, the food services at most hospitals are still using the paper menu than the electronic menu. The Department of Dietetics and Food Service requires staff to physically take the meal preferences from the ward. The face-to-face interaction between the hospital's food service staff and patients could potentially spread the virus. The objectives of this project are (i) to develop a web-based meal ordering system for patients and the Department of Dietetics and Food Service, (ii) to reduce the face-to-face interaction between staff and patients in the hospital, (iii) to provide a real-time food service system in the hospital. This system was developed specifically for patients staying in the hospital ward using a web-based system.

2. Related works

There are numerous researches in electronic menu systems as listed in Table 2 including the bedside spoken meal ordering system (BMOS) [5] and the software application system developed by CBORD [6 – 8]. There are extensive advantages of electronic menu systems including satisfaction, easy to track, variation of menu. In terms of satisfaction, 54 patients at an Australian private hospital expressed similar levels of satisfaction with food services under both the printed and 65 patients of the electronic menu, which are 84 % and 82 %, respectively [5]. Moreover, patients' satisfaction with meal temperature, quality, flavour, delivery timeliness, staff courtesy, and clarification of special/restricted diets were improved with an electronic menu from 68 % to 86% one year after implementation [6]. Furthermore, electronic menu patients were satisfied with the quality, temperature, and a great variety of meals substantially higher than the menu on paper in a trial at a Canadian paediatric hospital [8]. A similar trend was also reported in a Dutch hospital whereby the patients' satisfaction with food services was significantly higher with an electronic menu which was 8.1 compared to 7.5 on a scale of 1–10 [9].

Food intake was shown to be greater in the electronic menu, with 98 % of patients taking at least half of their main meals compared to 76 % in the printed menu in two 48-hour audits at an Australian private hospital [5]. Also, another audit performed at the hospital discovered significant mean energy (1588 compared to 1306 kcal) and protein intake (65.9 against 52.3 g) by using the electronic menu system [6]. Interestingly, 38 patients who used the electronic menu had a lower level of energy consumption (1461/1378 kcal) and higher protein intake (0.91/0.84 g per kg) of body weight than 34 patients printed menu at a Dutch hospital [9]. The study in [7] also evaluated the plating errors in five Australian hospitals implementing the electronic menu system. The rate was 15% after 4 months implemented and subsequently, it decreased further to 9% after the system had been in place for a year [7]. Comparatively, plate waste which meals not eaten by the patient decreased from 29 % with paper menus to 12 % with electronic menus in a private Australian hospital [6]. Meat/protein was replaced by milk/tea/coffee as the most wasteful item. Plate waste in the electronic menu was no longer attributed to default dishes, an insufficient menu, or ordering issues. With an electronic menu, the total cost of patient meals was found to be decreased by 15%.

With many advantages of the electronic menu systems and the COVID-19 situation, it makes the system is more in urgent need to be implemented in hospitals as it could minimise the unnecessary interaction.

3. Materials and Methods

This section provides the materials (in terms of system's requirement including the software) and methods. Suitable materials allow the system to be developed more effectively and efficiently. The data was obtained from the websites and another online source of the hospitals implicated due to the

restriction pertaining to the COVID-19 situation when the research was being conducted. Table 1 shows the related electronic menu systems.

Table 1: Related electronic menu systems

System	Advantage	Disadvantage	Reference
Bedside spoken meal ordering systems (BMOS)	• Increase dietary intake • Increase nutrition assistance and patient interaction • Increase staff satisfaction	• Error menu items (main meal does not correlate with the dietary intake) • Does not have personalized services. • Error intake data	[5]
(The CBORD Group Inc.) software application system	• Single centralized cook-chill production for 5 hospitals • Improve meal ordering • Improve patients' meal and menu variety • Improve timing of food ordering and delivery • Increase the energy, protein, and protein-to-energy ratios, as well as % of predicted energy and protein needs. • fewer plate wastes • Decrease patient meal costs	• Error in diet order • Error in interface • Error in menu compilation • Plate error • Small sample size • Error before-after design • No set meal times • Error in the number of auditors collecting data • In a live hospital setting, there was an error in collecting meal intake data.	[6 – 8]
Menu Management System (MMS)	• Improve patient satisfaction • Decrease patient body weight • Great detailed food lists	• Error at food choice • Error at food intake	[9]
Web-based system	• Store patient's health information • Pre-schedule meal plans • Suggest food menus • Food portion control • Meal tracking • Tablet required • Controlled food menu • May collaborate with the existing system • Meal nutrition control	• Not provide a platform for the user to interact with each other. • Error in food portion estimation	[10]
Bedside TV screen system	• The origins of the meal caught the interest of the patients.	• Male patients are less satisfied with the food quantity. • Older individuals may face difficulties in adapting to the electronic systems	[11]

3.1 Materials

The materials used in the development of this system are divided into two main types: interface materials and database materials. This system's materials are shown in Table 2. There are three materials utilized in the development of this system. Sublime Text 3, MYSQL, and XAMPP are the tools used. The sublime text is a comprehensive text editor for working with local files and code databases. The

sublime text editor in version 3.0 is compatible with Windows, Linux, andmacOS [12]. Also, XAMPP is a lightweight Apache distribution that includes all the most important web development technologies in one package [13]. Its content, modest size, and flexibility make it an excellent tool for students who are designing and testing PHP and MySQL applications. Furthermore, [14] uses MYSQL for storing the data onto the database. Next, MySQL is used to establish the database and table that will store the program's data [13].

There are two web programming languages utilized in the development of this system, which are HTML and PHP. HTML is a markup language, whereas PHP is a programming language. HTML defines a web page's basic structure and content, whereas scripts in PHP provide dynamic content. PHP is a server-side language, whereas HTML is a client-side language. PHP is a server-side language, whereas HTML is a client-side language. [14] use PHP for database connectivity purposes which is generally storing the data onto the server.

Table 2: Material of the system

Specification	Detail
Sublime text 3	Web development IDE
XAMPP software	Webserver
HTML and PHP	Web programming language
MYSQL	Database

3.2 Methods

From Figure 1, the users of this system are divided into two groups, namely the patients and the administrator from the Department of Dietetics and Food Service. Patients need to log in to the system using their name and password, this is to protect patient data. After that, they make meals selection based on what has been updated in the system. In addition, patients need to place the order for the next day's meal so that the Department of Dietetics and Food Service staff have ample time in preparing the food. The administrators update the meals and monitor the orders. They can review and monitor the orders made by patients to this system systematically. The suggested meal is from dietician and nutritionist.

Figures 2 and 3 show the flowchart of the system for the patients and the admin, respectively. The patient needs to enter his/her name and password to access the system. He/she will be directed to the system's home interface. After that, the patient clicks the category interface and chooses the three meals for three categories i.e., breakfast, lunch, and dinner. For each category, the patient must choose one meal set. Then, the patient will place and confirm the order. The patient can check the order status in the profile interface.

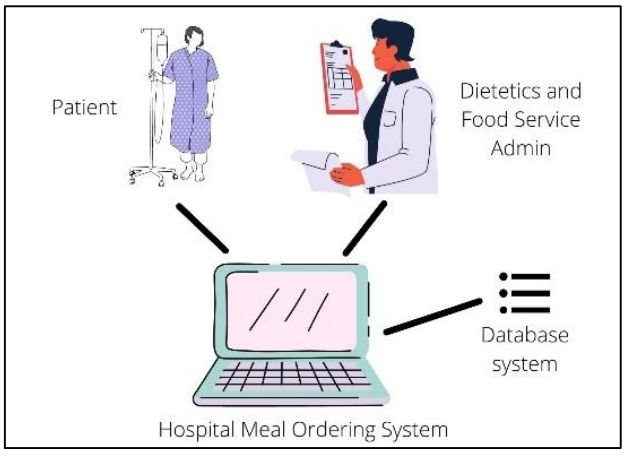

Figure 1: Scope of the project

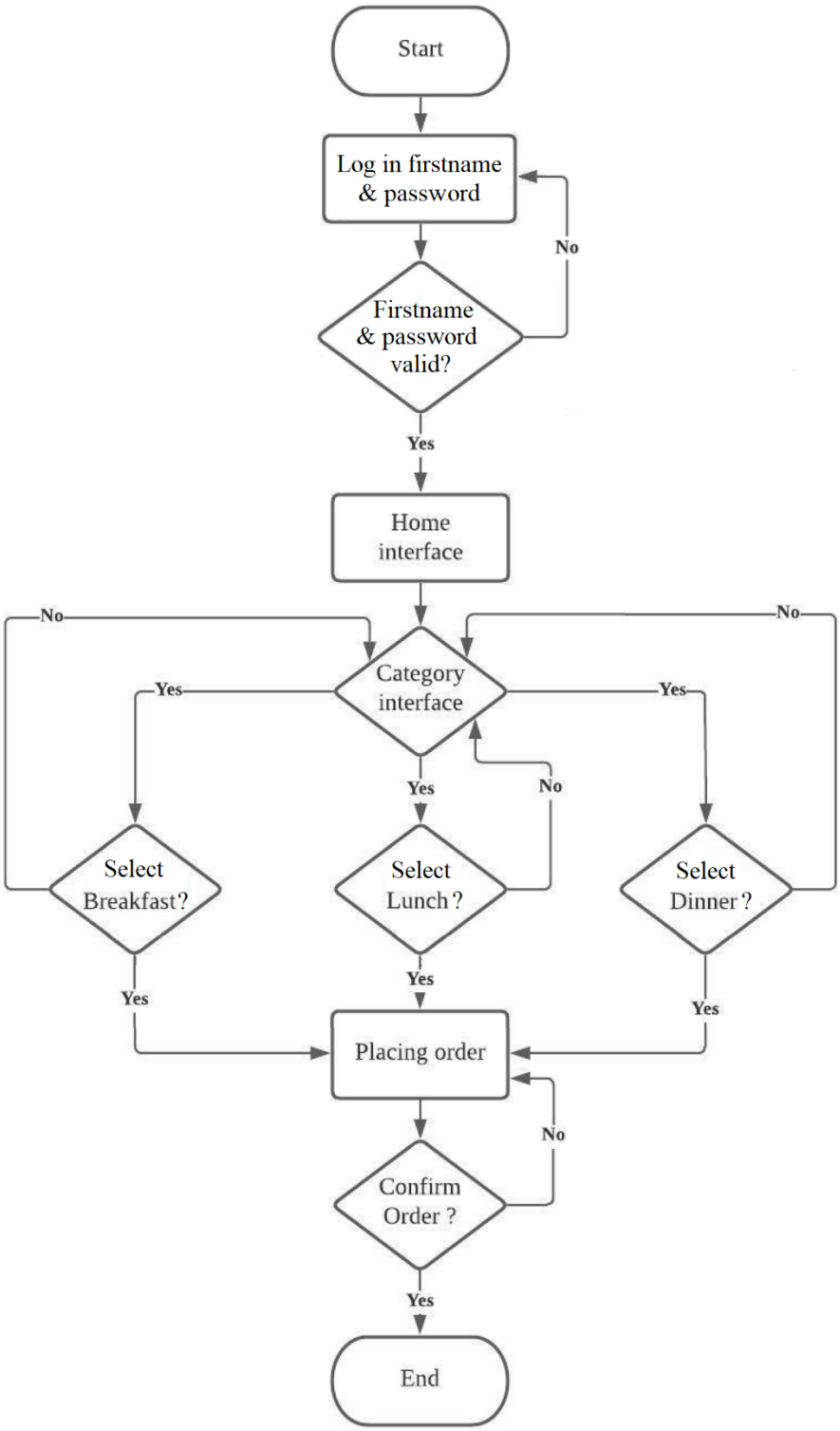

Figure 2: System flowchart (Patient)

For the Department of Dietetics and Food Service administrators, they need to log in to the system using the username and password that have been assigned to them (see Figure 3). Then, the admin will be directed to the admin home interface, which contains the information about the patients, meals, and a list of orders. Following that, the admin will update the meal list according to the hospital's dieticians' and nutritionists' recommendations. The administrator will then keep records of the orders that have been received and update the status of each one.

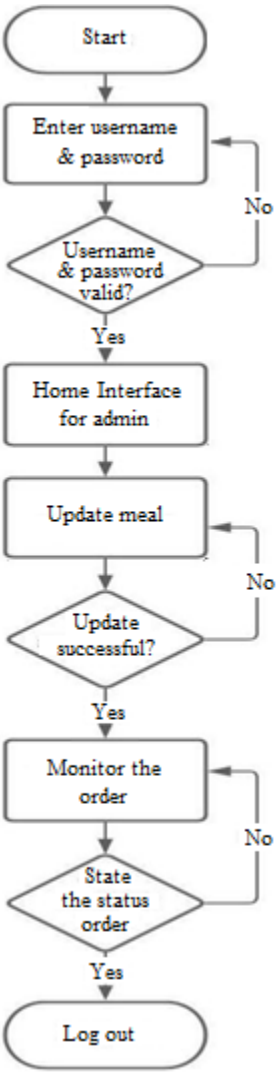

Figure 3: System flowchart (administrator from the Department of Dietetics and Food Service)

3.3 Implementation

Figure 4 shows the patient login interface, the written code for the patient's login interface integrates with the database and the development of a suitable website for the login interface. Users need to enter their first names and password. Dietetics and Food Service administrators provide passwords to secure patients' confidential information from unwanted access.

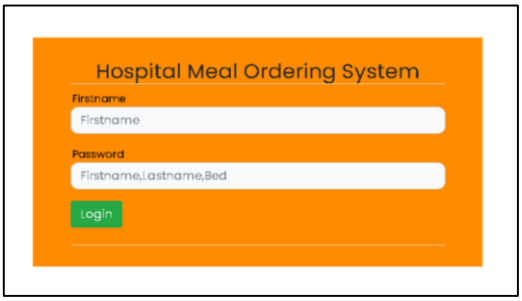

Figure 4: Patients Login interface

After successfully entering the system, the patient will be directed to the home interface, which is visualized in Figure 5. It illustrates an overview of the system, as well as guidelines on how to use it to

place meals. The patient's home interface is designed to provide information about the system and the meals to the patient. For the home interface, there is no database integration.

Figure 6 shows the category interface. This page shows the food categories and their connections with the database categories, allowing the Dietetics and Food Service's administrators to update the categories. Breakfast, lunch, and dinner are included in the interface. Patients must choose their food from these three categories.

Figure 5: Home interface

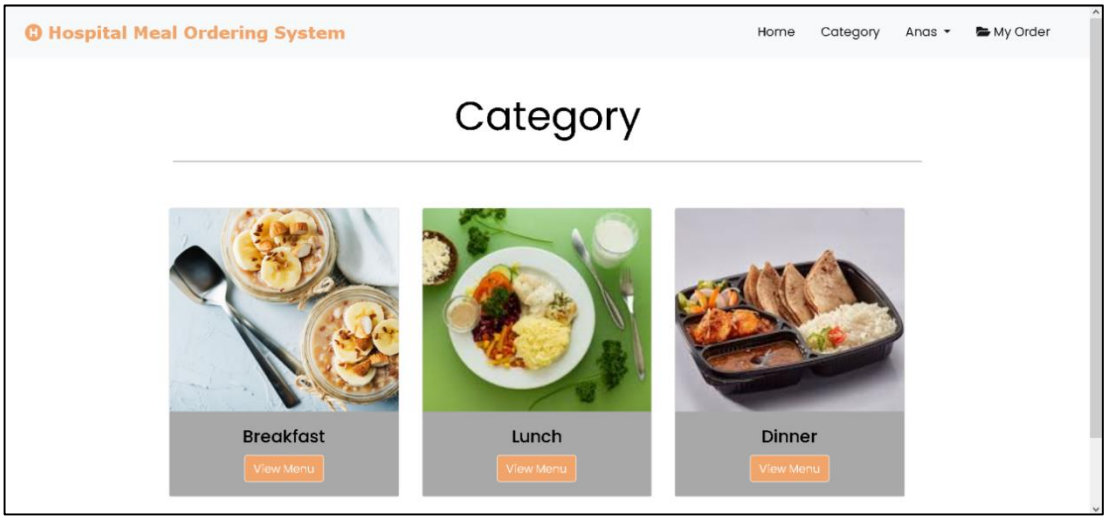

Figure 6: Category interface

Meanwhile, the order list interface is demonstrated in Figure 7. There is a database connection in this interface. A list of selected meals will be displayed before the user checks out, and the patient can still make changes or delete them.

Figure 8 shows the checkout order interface, which shows a list of confirmed food orders. This interface connects to the order database, allowing the Dietetics and Food Service's administrators to track the status of the orders. When the patient has accepted the confirmation of the meals, the administrators of Dietetics and Food Service will be updated of the orders' status.

Subsequently, Figure 9 shows the profile interface of the foods that have been ordered. A list of foods that the patient has confirmed and recorded in the database is shown in this page. The interface will display the approved meals, which will be monitored by the administrator of the Department of Dietetics and Food Services before being prepared.

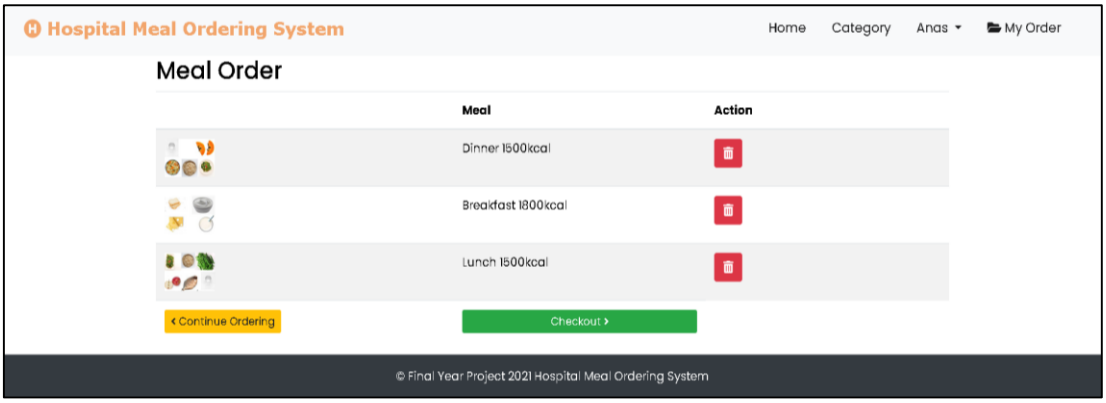

Figure 7: Order list interface

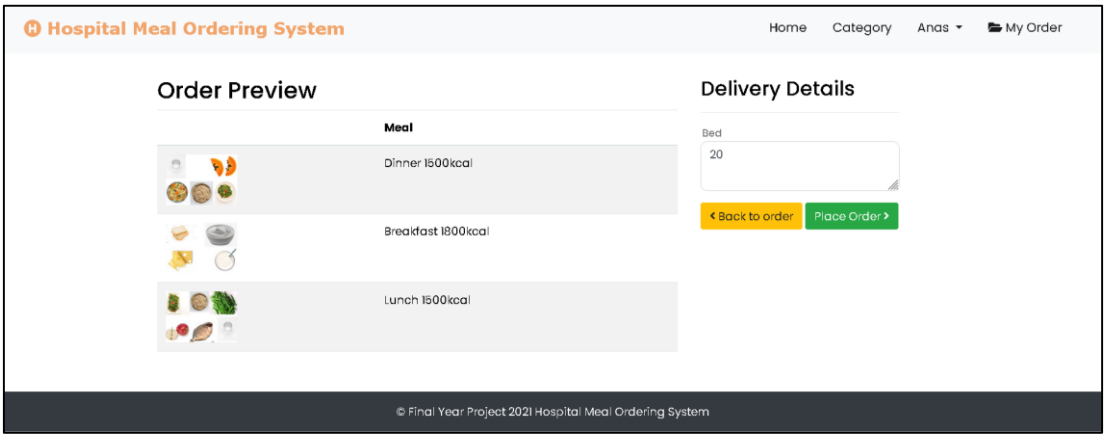

Figure 8: Checkout interface

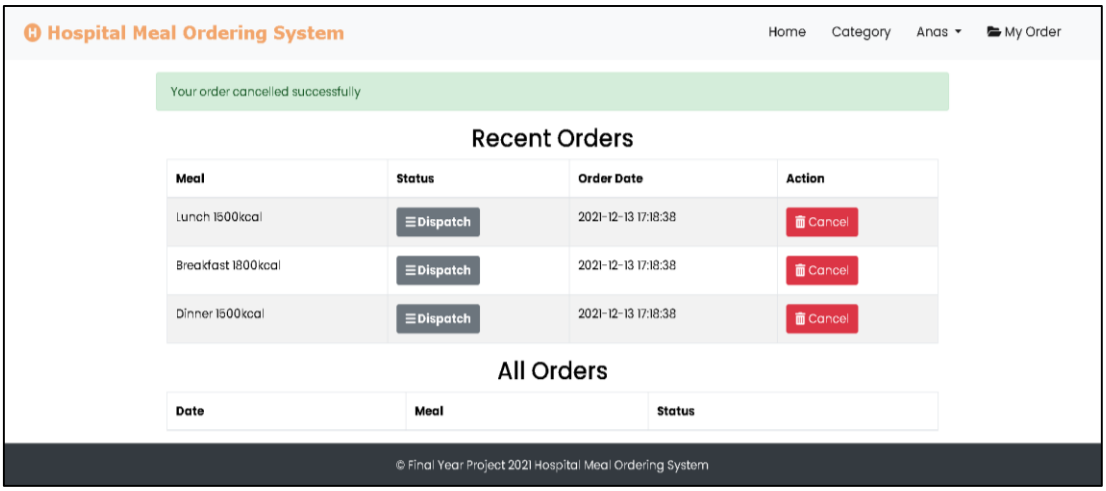

Figure 9: Profile interface

4. Results and Discussion

System testing is a process that is carried out after the system is developed. The testing phase is used to ensure that the Hospital Meal Ordering System development plans are fulfilling the needs of the patients. This test is named the functionality test.

4.1 Results

The purpose of the functionality test is to ensure that the interface developed fulfills the needs of the user and can perform in accordance with the requirements. This test is also performed on each interface to find any system flaws or errors. The functionality of the system can be verified using the test schedule by performing tests on the system's interface. Tables 3 and 4 show the test results of the interface for patient and admin, respectively. In both cases, the system functionality achieved its objectives successfully.

Table 3: System functionality testing for a patient interface

No	Interface	Functional Requirements	Expected results	Test results
1.	Log in	Enter the patient's first name and password	The patient will be logged into the system and directed to the home page.	Successful
2.	Home interface	Display information about the system and how to order food after successful login	After the patient make a login, the home page showed the information system and meal.	Successful
3.	Category interface	Display breakfast, lunch, and dinner for the patients to select.	Patients choose one meal for each category.	Successful
4.	Meal interface	Display three option meals.	Patient selects a meal from each category and enters it into the order list.	Successful
5.	Order interface	Display a list of food orders that made by the patient.	The food list contains foods that have been selected by the patient.	Successful
6.	Checkout interface	Display the detail of meals before checking out.	Display details about the selected meals and order them.	Successful
7.	Profile interface	Display the order that the patient has confirmed.	Contains a list display of meals that have been confirmed and waiting to be sent to the ward.	Successful

Table 4: System functionality testing for admin dietetics and food service interface

No	Interface	Functional Requirements	Expected results	Test results
1.	Log in	Enter admin username name and password	Admin will login to the system and directed to the home page	Successful
2.	Dashboard	Display information about the patient, meal, category, and order	After the admin make a login, the home page showed the information patient, meal, category, and order	Successful
3.	Patient list	Display a list of patients in the system	Admin updates and deletes patient data based on the number of days a patient is on the ward	Successful
4.	Category list	Display a list of categories in the system	Admin updates and deletes category data based on the type of ward.	Successful
5.	Meal list	Display a list of meals in the system	Admin updates and deletes meal data follow the dietitians' advice	Successful
6.	Order list	Display a list of orders and their status of the orders	Admin updates status and deletes order data based on the number of days a patient is on the ward	Successful

4.2 Discussion

This computerized menu ordering system provides a non-face-to-face interaction between the patients and the staff from the Department of Dietetic and Food Service. Thus, it could minimize the spread of COVID-19, which is the main objective of the project. Interestingly, the system also can generate cost savings in the hospital as reported by [15]. The use of a paperless system not only saves the paper cost but also the printing cost. In this case, the computerized systems outperform the printed menus.

Although no survey was done on the users' satisfaction of the system, studies have shown that the visuals presented in the visual menu system (paperless) helped the patient to build realistic meal expectations [2, 16]. The findings revealed that the written menu system does not provide a complete picture of the patient's nutritional requirements and desires. As such, the spoken and visual menu systems can help patients have better meal experiences by supporting them in making correct menu selections and delivering a more individualized meal-ordering service [16].

Another advantage of the system is that menu can be updated easily from any terminal with no restriction of the computer console. This makes the management and accessibility of data becomes easier for the staff [2]. Consequently, the meal preparation process becomes more efficient. In this way, there would be a substantial increase in patients desiring to have the food they ordered because of the decreased time delay between placing an order a meal as observed in [17-18].

As a result, the system developed based on the research can assist patients in ordering food in the hospital. Furthermore, the designed system can reduce ordering and delivery times. It can also minimize on paper usage, reducing the spread of the COVID-19 virus among workers and patients. Also, this approach can be used to overcome the difficulties and drawbacks that the Dietetics and Food Service staff have while using manual (paper) methods.

5. Conclusion

It can be concluded that with the development of the hospital meal ordering system, it provides a new insight into reducing the spread of the COVID-19 among the patients and Dietetics and Food Service Department staff. Apart from that, the paperless system also can assist the staff in managing and monitoring the meal ordering activities more efficiently. Patients place their meals more efficiently with this approach. Furthermore, the system enables hospital administrators to upload meals that the dietician and nutrition assistant have recommended for food selection from a single point. Further improvements in terms of the system interface including the nutrition info should be considered for future works.

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