Analysis and Development of Cafe Menu Ordering Application System using Mobile-based Simple Additive Weighting (SAW)

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ABSTRACT
Cafe is a place that is still visited by many people. The large number of visitors makes it inefficient to order the cafe menu. The current system often forces customers to come directly to the cafe and queue and place orders which can be time-consuming and inconvenient. In addition, many customers may find it difficult to choose a menu that suits their preferences amidst the variety of options available. To overcome these problems, this research aims to present a solution by analyzing and developing a mobile-based application system that uses the Simple Additive Weighting (SAW) method to provide menu recommendations that match user preferences. The SAW method is given a weight on each criterion to calculate the optimal menu recommendation. There are 4 criteria used in this study namely weather, conditions, budget and taste. This mobile-based menu ordering service system is implemented using the Kotlin programming language and database storage media using the MySQL database. The results of the development of this application are expected to increase efficiency, better customer experience, convenience in the menu ordering process and the system can assist in processing cafe data to be more accurate and precise.

General Terms
Android, Kotlin, MYSQL, Menu.

Keywords
Cafe, Menu Ordering, Mobile, Simple Additive Weighting (SAW).

1. INTRODUCTION
The degree to which a city can foster the circumstances necessary for urban operators to actively participate in spatial innovation dynamics and to create novel public logistics networks is another way to measure how smart a city is [1]. Every business group, must have a strategy to advance their business. It is detailed how each stakeholder group's choice of strategy is influenced by certain elements, and how each ultimately adopts evolutionary stable tactics [2]. Numerous aspects, including the state of the environment, society, rate of economic development, industrial structure, degree of policy development, and technical advancement, influence how the energy industry structure is adjusted [3].

Cafe can be interpreted as a place used for fun, but not only that, it is also a place to conduct business such as meetings and discussions or other social events [4]. Cafe are usually designed to be as attractive and comfortable as possible. So that customers who enjoy the cafe can relax and enjoy the atmosphere. The various menus that each cafe offers to customers such as drinks and food. The various menus available at the cafe will make customers have to choose what menu to order. This variety is appealing to customers, but is often a consideration in making choices when customers are about to order a menu. In addition, there are still many cafes that lack in the menu ordering service process, requiring customers to come directly to the cafe and place orders and queue first. Quite often, these queues cause frustration to customers due to long waiting times. Good service in a cafe is needed to improve and facilitate customers in placing orders.

The menu ordering process using the Simple Additive Weighting (SAW) method is a solution to the problems that occur in the cafe industry. This method is based on a very simple working theory that is easily understood by decision makers [5]. There are several values that can be used as criteria in menu selection, namely based on weather, conditions, budget and taste. With these criteria, customers will be given questions so as to produce a menu recommendation output according to the answers that have been filled in by the customer. With this system, it is expected to provide better service than before. The use of sensitivity analysis techniques and quantitative multiple criteria decision making approaches in decision support systems are examined in this research [6]. There are many aspects that must be analyzed, so it uses Simple Additive Weighting to determine [7] the best alternative. There are several values that can be used as criteria in ordering menus that will be recommended, namely based on weather, conditions, budget and taste. With these criteria, customers will be asked questions so as to produce a menu recommendation output according to the answers that have been filled in by the customer. These data are utilized to get insightful knowledge that aids in decision-making [8].

There are several previous studies that use the same method, namely the Simple Additive Weighting (SAW) method in various different cases. Research from [9] is used to determine employee bonuses at PT Mayatama Solusindo by using 4 criteria in the process, namely supervisor assessment, length of service, attendance and warning letters. The results of this study design a website system that can facilitate companies in determining bonuses for each employee according to predetermined criteria. Research conducted by [10] is used for the property insurance selection process with 4 criteria used, namely Risk-Based Capital, Premium, Coverage, and Premium Period. The final result obtained in this research is a website system that can help property owners to choose which insurance company is in accordance with predetermined criteria. The performance of the website system that has been created with 30 sample data for application experiments produces a speed of 1264 ms or 1.264 seconds. Based on the analysis in research [11] to create an Android-based M-Voting Application, this application is used to select prospective student governors majoring in Informatics Engineering. The

criteria used include Vision and mission, Leadership, Experience, and Behavior with 4 alternative candidates for governor. The final result of this application shows the results that have been processed by the SAW method so as to issue voting results for the selection of elected student governor candidates.

Based on the problems and previous research on the Simple Additive Weighting method, this research aims to evaluate the quality, effectiveness, and usability [12] of cafe services and present a better solution in terms of ordering cafe menus, providing menu recommendations that match user preferences through a mobile application system. The way digital platforms function makes it possible to automate the process of collecting, processing, and storing the necessary information [13] about the café's services. This is done as a response to the problems that occur today. With the mobile application system, it is expected to provide better service than before.

2. LITERATURE REVIEW

2.1 Simple Additive Weighting (SAW)

One of the most popular and straightforward multi-attribute decision-making techniques is Simple Additive Weighting (SAW) also known as weighted linear combination, scoring methods, or weighted sum method. Weighted averages form the basis of the methodology. The decision maker assigns weights of relative relevance to each option, multiplying that value by the scaled value, and then adding up all of the products for all criteria to determine the evaluation score for each alternative [14]. The steps of the SAW method calculation are as follows[15]:

1. Determine the criteria and weight values that will be used as a reference in decision making, namely C_i.
2. Determine alternative, namely A_i.
3. Determine the suitability rating value of each alternative on each criterion.
4. Create a match rating table of each alternative on each criterion.
5. Create a decision matrix (X) formed from the suitability table of each alternative on each criterion. The X value of each alternative (A_i) on each criterion (C_i) has been determined.

$$X = \begin{bmatrix} X_{11} & X_{12} & \dots & X_j \\ \vdots & \vdots & \vdots & \vdots \\ X_{i1} & X_{i2} & \dots & X_{ij} \end{bmatrix} \quad (1)$$

6. Normalize the decision matrix by calculating the normalized performance rating (r_{ij}) of alternatives (A_i) on criteria (C_i). there are 2 attributes, namely benefit and cost in the matrix equation.

$$R_{ij} = \frac{X_{ij}}{Max_i\, X_{ij}} \quad \text{Benefit} \quad (2)$$

$$R_{ij} = \frac{Min_i\, X_{ij}}{X_{ij}} \quad \text{Cost} \quad (3)$$

Explanation:

R_{ij}	:	Normalized performance rating of alternative Ai
X_{ij}	:	Rows and columns of the matrix
Max X_{ij}	:	The largest value of each criterion
Min X_{ij}	:	The smallest value of each criterion
Benefit	:	If the largest value is the best
Cost	:	If the smallest value is the best

7. The result of the normalized performance rating (r_{ij}) forms a normalized matrix (R).
8. The final preference value (V_i) is obtained from the sum and multiplication of the normalized matrix row elements (R) with the preference weights (W) that correspond to the matrix column elements.

$$V_i = \sum_{j=1}^{n} W_j R_{ij} \quad (4)$$

Explanation:

V_i	:	Ranking for each alternative
W_j	:	The weight value of each criterion
R_{ij}	:	Normalized performance rating value

3. RESEARCH METHOD

An efficient and structured system is the key to success in application development. A good system architecture is a difficult foundation to ensure that a system can run smoothly, has optimal performance, and meets user needs. In this context, the development of system architecture plays an important role. System architecture refers to the overall design and structure of the system, including the major components as well as the underlying design rules and decisions.

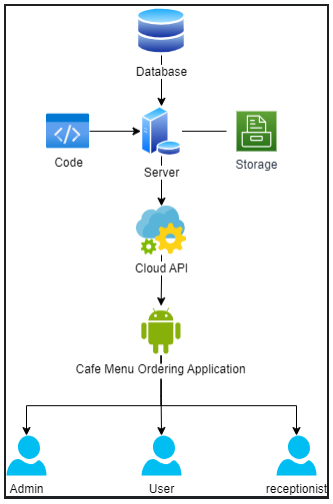

Figure 1. Architecture Diagram

The system architecture design in this cafe menu ordering application system is implemented based on android. The system involves 3 entities, namely the user, admin and receptionist. The three entities utilize an android-based application as an intermediary connected through the Application Programming Interface (API) between the user and the server which functions as a storage area for program code, storage space, and database systems. The introduction of mobile application programming interfaces, or APIs for short, outlines a new approach to simplifying the development of apps and promoting the advancement of new technologies with constrained resources [16].

3.1 Data Collection Procedure

The data sources used in this study used secondary data. Secondary data are information being used for purposes other than those intended when they were collected [17].

3.1.1 Observation

Observation is done by making direct observations at Cafe Lentera. Collect data and information related to the needs of researchers by observing the menu selection process that is being carried out at the place.

3.1.2 Literature Study

Literature studies are carried out by observing, reading and also reviewing sources related to the research title taken. Through literature studies it can be a reference for researchers to develop new systems, and the sources can be obtained from the contents of journals, theses, e-books, and others.

3.2 System Design Logic

The design of a cafe menu ordering will be designed with a mobile-based implementation. The system has characteristics that can support the menu ordering process easily and efficiently. In addition, the system can perform data input and produce output according to user needs. Therefore, the new system design will be further developed as a mobile-based system, especially in the menu ordering services performed. Especially on menu ordering services that are carried out online.

3.2.1 Context Diagram

Context diagram is defined as a visual representation that describes in general the overall process of the Mobile-based cafe menu ordering application system. There are 3 entities in this system including users, admins and receptionists.

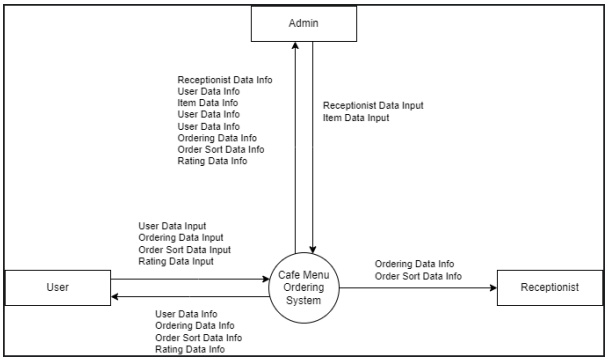

Figure 2. Context Diagram

Fig. 2 shows the flow of important information from each entity. The cafe's menu ordering system is located right in the middle, connected to each other. The system will display information and input data that will be stored in the system database.

3.2.2 Level Diagram

Level diagram is a diagram structure to describe the functions of each application system created. There are 3 processes in the level diagram of this system, namely Master Data, Transactions, and Reports. Fig. 3 shows the level diagram of the cafe menu ordering application system.

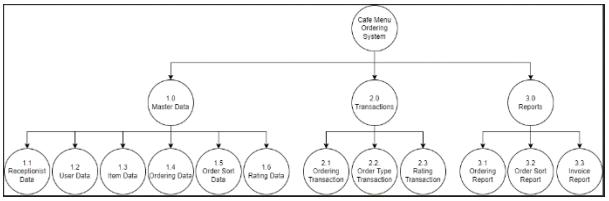

Figure 3. Level Diagram

3.2.3 Entity Relationship Diagram (ERD)

These new data sources can become relevant to planners when the information is integrated with social and built environment datasets [18]. Entity Relationship Diagram (ERD) on cafe menu ordering applications that connect between data in the form of diagrams based on basic data objects. In this diagram there are several tables, namely the user table, order table, order_item table, item table and rating table. Fig. 4 shows the Entity Relationship Diagram (ERD) on the cafe menu ordering application system.

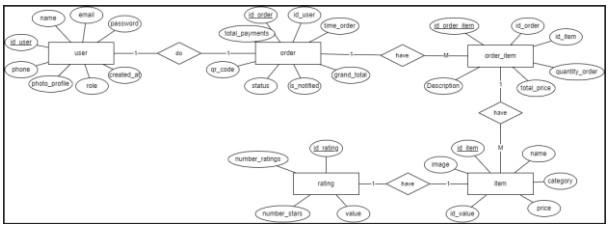

Figure 4. Entity Relationship Diagram

4. RESULT AND DISCUSSION

4.1 Assumption

Based on the results of the previously described analysis, a mobile-based cafe menu ordering application system is designed using the Simple Additive Weighting (SAW) method. It is hoped that the implementation of this application can provide convenience to users to order menus. Services performed can also be more efficient and effective in serving customers.

4.2 Hyphotesis

This hypothesis is based on assumptions obtained and proven in the research stage. The hypothesis of this research is "Application of SAW Method on the System can Facilitate Customers".

4.3 Run an Experiment

This system was created using the Kotlin programming language. Kotlin is one of the modern programming languages currently used to develop mobile-based applications and is open source that can be used on various platforms [19].

4.4 Implementation Simple Additive Weighting (SAW) Method

In this study using a Decision Support System with the Simple Additive Weighting (SAW) Method on the available menu. This method is used to determine the ranking of the menu that is most attractive to customers.

4.4.1 Manual Calculation of SAW

1. Criteria (C_i)
   There are 4 criteria and their weights, namely weather, condition, budget, and taste which can be seen in table 1.

Table 1. Criteria

Criteria	Description	Attribut	Bobot
C1	Weather	Benefit	0,2
C2	Condition	Benefit	0,3
C3	Budget	Cost	0,15
C4	Taste	Benefit	0,35

2. Alternative (A_i)
There are 8 alternative menus used in this research as show in table 2.

Table 2. Alternatif Data

Alternative	Menu
A_1	Beef Crispy Steak
A_2	Spaghetti Aglio E Olio
A_3	Chicken Crispy Steak
A_4	Lentera Platter
A_5	Caramel Macciato
A_6	Merra Berry
A_7	Lemonade Float
A_8	Green Smothies

3. Determine the value of sub-criteria
The assignment of values to each sub-criteria can be seen in table 3 for weather criteria, table 4 for condition criteria, table 5 for budget criteria and table 6 for taste criteria.

Table 3. C1 (Weather)

C1 = Weather	
Weather	**Wight**
Cold	3
Cool	2
Hot	1

Table 4. C2 (Condition)

C2 = Condition	
Weather	**Wight**
with friends / companions	4
With family	3
with girlfriend / boyfriend	2
alone	1

Table 5. C3 (Budget)

C3 = Budget	
Budget	**Wight**
30.000 - 35.000	4
25.000 - 30.000	3
20.000 - 25.000	2
15.000 - 20.000	1

Table 6. C4 (Taste)

C4 = Taste	
Taset	**Wight**
Sweet	5
Salted	4
Spicy	3
Acid	2
Bitter	1

4. Alternative Suitability Level
Table 7 shows the suitability rating of each alternative on each criterion.

Table 7. Table of suitability level of each option against each criterion

Alternatif	C1	C2	C3	C4
A1	2	2	4	4
A2	3	4	2	4
A3	1	1	4	4
A4	3	3	4	5
A5	1	4	2	1
A6	2	2	1	5
A7	1	1	2	5
A8	1	4	1	5

5. Decision Matrix Normalization Process

$$R_{1,1} = \frac{2}{\max\{2;3;1;3;1;2;1;1\}} = \frac{2}{3} = 0{,}67 \text{ (Benefit)}$$

$$R_{2,1} = \frac{2}{\max\{2;4;1;3;4;2;1;4\}} = \frac{2}{4} = 0{,}5 \text{ (Benefit)}$$

$$R_{3,1} = \frac{\min\{4;2;4;4;2;1;2;1\}}{4} = \frac{1}{4} = 0{,}25 \text{ (Cost)}$$

$$R_{4,1} = \frac{4}{\max\{4;4;4;5;1;5;5;5\}} = \frac{4}{5} = 0{,}8 \text{ (Benefit)}$$

6. Normalized matrix (R)
The result of the normalized performance ranking value (r_{ij}) forms a normalized matrix (R).

$$R = \begin{bmatrix} 0{,}67 & 0{,}5 & 0{,}25 & 0{,}8 \\ 1 & 1 & 0{,}5 & 0{,}8 \\ 0{,}33 & 0{,}25 & 0{,}25 & 0{,}8 \\ 1 & 0{,}75 & 0{,}25 & 1 \\ 0{,}33 & 1 & 0{,}5 & 0{,}2 \\ 0{,}67 & 0{,}5 & 1 & 1 \\ 0{,}33 & 0{,}25 & 0{,}5 & 1 \\ 0{,}33 & 1 & 1 & 1 \end{bmatrix}$$

7. Preference value (V_i)

$$V_1 = \{(0{,}67 * 0{,}2) + (0{,}5 * 0{,}3) + (0{,}25 * 0{,}15) + (0{,}8 * 0{,}35)\} = 0{,}60$$

$$V_2 = \{(1 * 0{,}2) + (1 * 0{,}3) + (0{,}5 * 0{,}15) + (0{,}8 * 0{,}35)\} = 0{,}85$$

$$V_3 = \{(0{,}33 * 0{,}2) + (0{,}25 * 0{,}3) + (0{,}25 * 0{,}15) + (0{,}8 * 0{,}35)\} = 0{,}45$$

$$V_4 = \{(1 * 0{,}2) + (0{,}75 * 0{,}3) + (0{,}25 * 0{,}15) + (1 * 0{,}35)\} = 0{,}81$$

$$V_5 = \{(0{,}33 * 0{,}2) + (1 * 0{,}3) + (0{,}5 * 0{,}15) + (0{,}2 * 0{,}35)\} = 0{,}51$$

$$V_6 = \{(0{,}67 * 0{,}2) + (0{,}5 * 0{,}3) + (1 * 0{,}15) + (1 * 0{,}35)\} = 0{,}78$$

$$V_7 = \{(0{,}33 * 0{,}2) + (0{,}25 * 0{,}3) + (0{,}5 * 0{,}15) + (1 * 0{,}35)\} = 0{,}56$$

$$V_8 = \{(0{,}33 * 0{,}2) + (1 * 0{,}3) + (1 * 0{,}15) + (1 * 0{,}35)\} = 0{,}86$$

8. Ranking Result
   After calculating the final value (Vi), the value is obtained from the highest to the smallest and the value is sorted to produce a ranking of 1-8 as in table 8.

Table 8. Ranking Result

Alternative	Menu	Ranking
V8	Green Smothies	1
V2	Spaghetti Aglio E Olio	2
V4	Lentera Platter	3
V6	Merra Berry	4
V1	Beef Crispy Steak	5
V7	Lemonade Float	6
V5	Caramel Macciato	7
V3	Chicken Crispy Steak	8

4.5 Interface Design

4.5.1 Login & Register Page

There are login and register pages before entering the main page of the application. Users are asked to fill in email and password if they already have an account, but if the user does not have an account, the user is asked to register first by filling in or entering the name, email, password and telephone number which will then be verified through the system database. If the data entered is correct, the system will directly redirect to the main page of the application. The user interface can be seen in Figure 5.

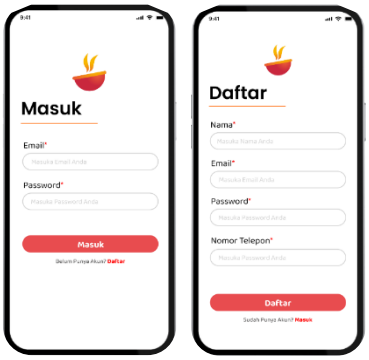

Figure 5. Login & Register Page

4.5.2 Home Page & Menu Detail Page

There is a main page in an application that contains a menu list containing food, drink, and snack options. Users can add menus to the cart by clicking the "add to cart" button. The user interface can be seen in Figure 6.

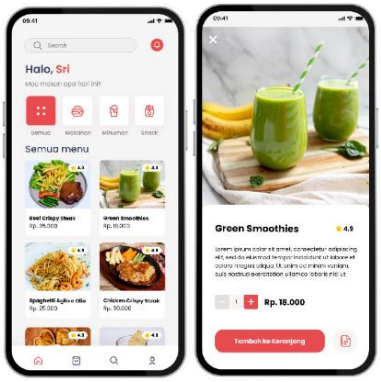

Figure 6. Home Page & Menu Detail Page

4.5.3 Cart & Checkout Page

The user can view and organize the menu items that have been put into the cart. After that, the user can check out by viewing the order total. The user interface can be seen in Figure 7.

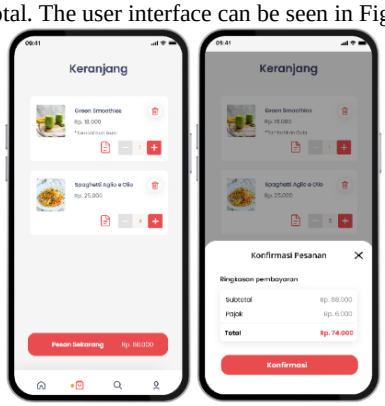

Figure 7. Cart & Checkout Page

4.5.4 Order Confirmation Page and Order Details (QR-Code)

the page displayed to the user after successfully checking out. This page serves to provide confirmation to the user regarding the order that has been ordered. Furthermore, the payment process will provide information related to order details and the QR-Code display is used for order verification and users make payments directly to the receptionist. The user interface can be seen in Figure 8.

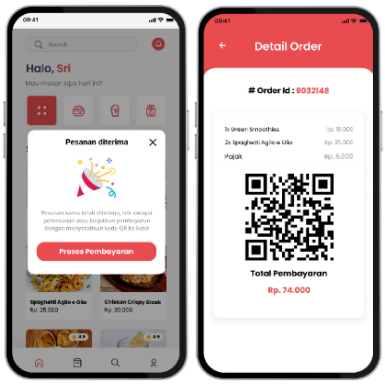

Figure 8. Order Confirmation Page and Order Details (QR-Code)

4.5.5 History Order (Wait and Finish)

There is a user page to view the history of orders that have been ordered, including orders that are still being processed

(waiting) and completed orders. The user interface can be seen in Figure 9.

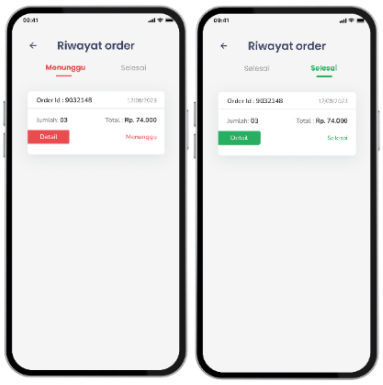

Figure 9. History Order (Wait and Finish)

4.5.6 Order Detail (Success)

the page displayed to the user after successfully completing the payment process. This page is usually used as proof of confirmation of orders that have been paid by the user. The user interface can be seen in Figure 10.

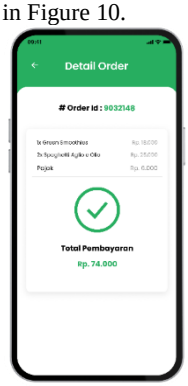

Figure 10. Order Detail (Success)

4.5.7 Recommendation Feature

Recommendation feature page with the Simple Additive Weighting (SAW) method to help users find a menu that suits their preferences and needs. The user interface can be seen in Figure 11.

Figure 11. Recommendation Feature

4.5.8 Question Form

Page containing questions about the criteria that have been determined. Users are required to fill in the question form and the answers that have been inputted will become the weight value for each criterion.

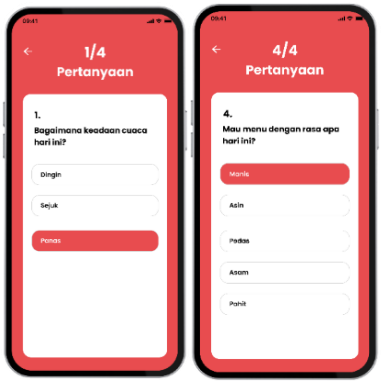

Figure 12. Question Form

4.5.9 Menu Recommendation

There is a menu recommendation results page based on the answers that have been inputted by the user. This page helps users in the process of selecting menus according to their needs.

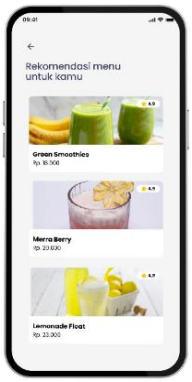

Figure 13. Menu Recommendation

4.5.10 Profile & Edit Profile

Users can view personal information, view order history and edit personal information such as name, email and phone number.

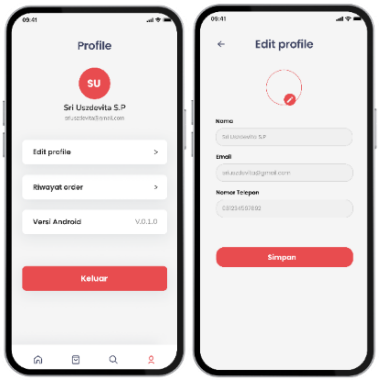

Figure 14. Profile & Edit Profile

4.6 Discussion of Result

Testing is very important in building a system. This test is carried out to ascertain whether the system built is in accordance with a predetermined plan. Testing the Menu Ordering Application system using the Simple Additive Weighting (SAW) method is done using the Black Box testing method. Another name for black box testing is functional testing. This type of functional testing creates test cases using

the data from the specification [20]. The test results on the system can be seen in table 9.

Table 9. Black Box Testing

Scenario	Expected results	Testing Results	Conclusion
User input the username and password correctly and click the login or register button.	The system will accept access and user login	As expected	Succesful
Users can add and delete menus in the cart	The system can add and delete menus as selected.	As expected	Succesful
The user sees the total order to be paid.	The system displays the order details.	As expected	Succesful
User can view the "Order History" page	The system displays a "waiting" status if the payment process has not been carried out, but if it has been carried out the system will automatically display the "success" status.	As expected	Succesful
Users can search the recommend ation menu dengan fitur “Search”	The system displays a question form to be inputted by the user as the weight of each criterion.	As expected	Succesful
The user views the menu recommend ations.	The system displays menu recommendatio ns as inputted by the user.	As expected	Succesful

5. CONCLUSION

The conclusion that can be drawn is that this research aims to analyze and develop an application system that focuses on ordering cafe menus. This system offers a mobile-based solution to improve efficiency and convenience in the process of ordering and selecting cafe menus. With this research, it is hoped that users can easily access the menu ordering application system and contribute to improving service quality in the cafe industry. Further development of this application can be expanded by adding additional features, such as real-time order tracking or integration with third-party food provider platforms. In addition, it can improve the accuracy of menu recommendations by considering additional factors, such as customer reviews, user location, and order time.

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