

DEVELOPMENT OF QR CODE TECHNOLOGY FOOD ORDERING APP FOR LIMESTONES BALI RESTAURANT WITH USER CENTERED DESIGN AND USABILITY TESTING

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ABSTRACT

While digital adoption is essential for operational efficiency in the culinary sector, many local restaurants still struggle with the inefficiencies of manual ordering and paper menus, which require longer service times and complicate menu updates. Currently, there is a gap in applying structured, user-focused methodologies to effectively bridge these traditional practices with modern digital solutions. To address this gap, this research aims to design a highly usable UI/UX for a web-based QR Code food ordering system tailored specifically for Limestones Restaurant Bali. The study utilizes the User-Centered Design (UCD) method to ensure the system strictly aligns with user needs, progressing through four stages: specifying the context of use, specifying user and organizational requirements, producing design solutions, and evaluating the design against user requirements. The resulting prototype features an interactive digital menu, shopping cart, and two payment options including QRIS and cash. Design evaluation was conducted through user testing with ten respondents using the System Usability Scale (SUS), achieving a score of 71.25. This score places the system in the "Good" category, demonstrating that its usability exceeds standard acceptability thresholds. Ultimately, the main scientific contribution of this study is a UCD-driven design framework and a validated prototype that systematically resolves the physical limitations of manual menus while significantly enhancing the modern customer ordering experience.

Keywords: QR, Apps, Restaurant, Food, Interface

1. INTRODUCTION

The development of digital technology in recent years has had a significant impact on various aspects of human life. Almost all sectors are now starting to adapt to technological advancements, including the culinary sector which is increasingly required to provide fast, efficient, and modern services. The application of digitalization is now an important factor in improving business performance, along with the rapid advancement of technology in various sectors [1]. This also encourages the culinary industry to adapt through a service system based on digital technology. Currently, many restaurants are switching from conventional systems to web-based technologies and applications to support better operations and service. The rapid development of information technology has encouraged the culinary sector to adopt digital technologies such as websites and QR Codes to improve service efficiency and customer experience [2]. One of the applications is the use of QR Code-based digital menus in restaurants. Limestones restaurant currently uses a paper-based menu to serve customers. The use of manual menu often creates some problems, such as physical damage due to frequent use, expensive printing costs when there are price or menu changes, and have limited ability to display food images and descriptions. In addition, the conventional ordering system also causes delays and inefficient services as customers have to wait for confirmation from the admin, while

the admin needs to verify and transfer orders manually [3]. The conventional ordering process is considered less efficient because it requires a longer service time and is not in line with the needs of the digital era which demands speed and ease of access [4].

Various research results show that the implementation of a QR Code in the web-based menu ordering system has a positive impact on service efficiency and reduces customer waiting time. The average booking time before using the system reached 7.42 minutes, while after the implementation of the web-based system and QR Code was reduced to 4 minutes, which indicates a significant increase in the speed of service [5]. The application of QR Code technology plays an important role in improving the quality of service to customers by speeding up the ordering process and reducing waiting times [6]. Therefore, the development of a QR Code-based menu for Limestones Restaurant will be a relevant and strategic step in supporting service efficiency and providing a modern experience for customers. The QR Codes implementation in this system is considered to be able to simplify the ordering flow and minimize dependence on physical menus [7]. The QR menus implementation has been proven to improve operational efficiency and customer satisfaction by providing quick access to easy-to-update menu information [8]. In addition, visual elements such as food photos greatly influence

consumers' perception of quality and purchasing decisions [9]. The presence of food images on menus has been proven to increase consumer purchase intent by more than 30% compared to menus without images [10]. The improvement occurred because images were able to grab customers' attention faster, trigger sensory imagination of the taste and texture of the dish, and reduce uncertainty about the appearance and portion of the food. The combination of attractive visuals and clear descriptions makes customers feel more confident in their choices, thus driving higher purchasing decisions.

Despite these extensive studies on operational efficiency, a significant research gap remains: previous research rarely explores the seamless transition of manual ordering to digital platforms through a truly user-centric design tailored to the specific context of local restaurants. Therefore, the novelty of this study lies in the formulation of a localized digital transition strategy by applying the User-Centered Design (UCD) methodology, creating a UI/UX that not only functionally replaces physical menus but strategically optimizes visual interactions to boost user confidence and purchase intent. To address this gap, the objectives of this study are outlined through the following research questions: (1) 'How can a UI/UX for a web-based QR Code food ordering system be designed using the UCD method to meet the specific needs of Limestones Restaurant?' and (2) 'How does the developed system perform in terms of usability when evaluated with the System Usability Scale (SUS)?' This system will also make the process of updating menus and order management easier for restaurants, making it more efficient and cost-effective. Therefore, this QR Code-based digital menu website is focused on improving the customer experience in the ordering process. This system not only serves as a medium to display menus digitally, but also presents more practical and interesting interactions through the presentation of images and informative food descriptions. With a simple and responsive interface design, customers can place orders faster, while restaurants can update data and manage orders more easily. This website was developed with User-Centered Design (UCD) based on User Testing so that the system design is in accordance with user needs and provides ease of operation. This website is expected to improve restaurant service effectiveness, maintain customer satisfaction, and create a more modern and efficient dining experience.

2. LITERATURE REVIEW

This Literature Review discusses theories and research related to the development of a web-based food ordering system using QR Code as an effort to improve service efficiency and customer experience in the culinary sector. This study covers several

important aspects, namely the concept of food ordering websites, the application of User-Centered Design (UCD) in interface design, usability testing methods to measure the ease of use of the system, and design principles that support the appearance of the interface so that it is easy to operate and attractive to users. To provide a cohesive academic foundation, this review builds a conceptual framework demonstrating that the application of UCD methodology directly influences the usability of the interface, which in turn determines the success of the QR Code-based system implementation.

2.1. Food ordering website

The development of information technology has had a great influence on the culinary sector, especially in the process of serving and ordering food, which is now an effective solution to improve service efficiency and provide a more practical experience for customers. Web-based food ordering systems enable customers to place orders independently, reduce wait times, and minimize transaction errors common in conventional systems [11]. Various studies show that usability is one of the important factors in the success of food ordering websites, where evaluation using the Fuzzy kano method can help understand user preferences and satisfaction [12]. In addition, previous research confirm that the online food ordering system is able to improve the efficiency of restaurant services and strengthen the relationship between customers and managers with the transparency of order data [13]. On the other hand, the emergence of the application of web-based technology in food ordering also makes it easier for managers to update menus, display visual information, and adjust prices without the need to print physical media [14]. Thus, it can be seen as an important innovation in supporting the digital transformation of the culinary sector towards increasingly efficient and modern services in this era. However, a critical analysis of these studies reveals that while operational benefits are well-documented, the transitional design process from conventional to digital is frequently treated as a secondary concern. For instance, studies like [11] and [13] emphasize the end results, efficiency, and data transparency, but do not detail how the interfaces were optimized for varying user demographics. Even when usability is evaluated post-development [12], the foundational design strategy is often missing. This highlights a gap where a structured design methodology is required before implementation, establishing the necessity for a UCD approach.

2.2. User-Centered Design (UCD)

The User-Centered Design (UCD) method is a design approach that focuses on users' needs, behaviors, and goals during the system development process. In the context of food ordering applications,

the implementation of UCD ensures that the interface and user experience are in line with customer expectations. Involving users from the early stages of design helps developers better understand user needs, resulting in designs that are more effective and user friendly [15]. Based on previous research, the application of UCD with a Human-Computer Interaction (HCI) approach can increase efficiency and user satisfaction during interaction with applications [16]. Not only that, other studies also confirm that the integration of UCD principles with Lean UX methods can speed up the design iteration process without neglecting the usability aspect, which has been shown to significantly improve the user experience [17]. This approach is also supported by similar research showing that the Design Thinking method, as part of UCD, helps design interfaces responsive to user needs through the stages of empathy, ideation, prototyping, and testing. Thus, the UCD implementation plays an important role in ensuring that the system is not only technically functional, but also relevant, intuitive, and convenient for customers to use [18]. Conceptually, UCD serves as the engine that translates user requirements into a tangible interface, establishing the prerequisite conditions for high usability. Rather than relying on assumptions, UCD systematically bridges the gap between technical system capabilities and human psychological expectations.

2.3. Usability testing and design principles

The usability testing stage is a step taken to evaluate how easy and efficient the application or website is used as well as how satisfied some of its users are. This process is critical to ensuring that the interface design meets the needs of users and helps identify parts that need to be improved before the launch of the system [19]. Empirical studies show that implementing usability testing on food ordering apps can speed up transactions and reduce mistakes that users make when interacting [16]. In addition, usability testing serves not only as an evaluation tool, but also as a guideline in the design decision-making process to improve digital accessibility for uniform user groups [20]. By carrying out usability testing, developers can receive direct feedback from users, so that the system created becomes more optimal, efficient, and meets market expectations.

To achieve this high usability score, it is important to apply UI/UX design principles to make the digital system look attractive and easy to use. Visual communication within interface design affects the way users perceive a system and can significantly increase user satisfaction [21]. Basic principles such as consistency, simplicity, clear navigation, readability, and proper visual feedback are key factors in creating users' positive experiences. A responsive design that can adapt to various devices is also an important aspect, so that

users get a uniform experience across all digital platforms [19]. In addition, the balance between aesthetic elements and functionality is an important component in interface design, as it can affect how users assess professionalism and trust in the app [18]. The application of design principles should also pay attention to accessibility so that the system can be used by users with various digital capabilities [20]. By paying attention to appropriate design principles, an online food ordering system can provide a convenient, easy-to-understand user experience, and improve the overall restaurant service efficiency. Therefore, the conceptual framework of this study posits that implementing strict design principles within a UCD methodology directly produces a highly usable interface, which ultimately ensures the successful adoption and functionality of the QR Code food ordering system.

3. METHODOLOGY

This study uses the User-Centered Design (UCD) method as the primary approach for designing the interface and user experience of a web-based food-ordering system with QR Code at Limestones Restaurant Bali. The User Centered Design approach utilizes a wide range of methods, techniques, tools, and procedures designed to support the development process of interactive systems that focus on user needs [22]. The User Centered Design method includes four main stages: Specify the Context of Use, Specify User and Organizational Requirements, Produce Design Solutions, and Evaluate Design [23]. Figure 1 shows the stages contained in the User Centered Design method.

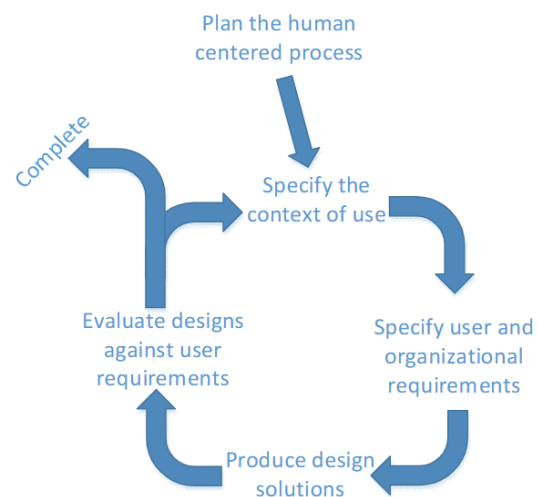


Figure 1. User Centered Design Method

The first stage aims to understand the context of the use of the system by identifying who the users are involved, their needs, and the conditions of the environment where the system will be used. In this study, there are two user groups, restaurant customers who order food using QR Codes through

smartphone devices and admin users who are in charge of updating menus, processing orders, and managing the system. To understand the context of use in more depth, initial observation activities will be planned such as observing the flow of conventional ordering in restaurants, recording customer interactions with paper menus and identifying the work process of the admin in recording orders. The observation instrument used in this study focuses on customer wait times, the frequency of physical menu damage, and the administrative workload required to transfer orders. The information obtained at this stage is planned to be the basis for the preparation of system needs in the next stage.

The second stage is the Specify User and Organizational Requirement. This stage aims to identify the needs of users and organizations based on problems found in the user context through user responses through questionnaires. The collection of these needs is carried out in two ways, namely observation and the distribution of questionnaires. Initial information about the conditions of the order is obtained through direct observation which is carried out in a simple way to understand the general picture of the process in progress. Then, the questionnaire was distributed to ten respondents. The participants were selected using a purposive sampling technique based on specific criteria: active smartphone users, aged between 18 to 35 years old (representing the primary demographic of digital-savvy cafe patrons), and individuals familiar with digital payment methods such as QRIS. Regarding the sample size, while 10 respondents might appear limited for general quantitative surveys, it is academically justified and highly effective within usability engineering; evaluating 5 to 10 representative users is scientifically proven to be sufficient to uncover over 80% of usability problems in a prototype interface. The requirement questionnaire instrument focused on assessing their difficulties with current physical menus and their functional expectations for the digital version.

The third stage is Produce Design Solutions, focusing on developing solution designs based on identified needs. At this stage, the researcher will design the user flow to map the ideal ordering process, followed by the creation of a wireframe as the initial appearance structure of the system. Furthermore, the design will be developed into a high-fidelity prototype using Canva to display a more realistic interface, complete with visual elements, colors, typography, and food images. This prototype will later become the main reference in the user evaluation process.

The last stage is Evaluate Design Against User Requirements. This stage aims to evaluate whether the developed design is in accordance with user needs and expectations. This evaluation is planned to be carried out through User Testing utilizing a

specific task-based research scenario to simulate real-world usage. During the test, respondents were given the following scenario: "Imagine you are a customer at Limestones Restaurant. Use this application prototype to browse the 'Foods' category, select two items, review your shopping cart, and successfully complete the checkout process using the QRIS payment option." Then, the usability evaluation will be carried out using the Usability Scale (SUS) system method, which consists of 10 statements with a Likert scale of 1-5. Evaluations involve 10 respondents. The results of the SUS are used to measure the prototype's usability level and determine if design improvements need to be made. The questionnaires can be seen in Table 1.

Table 1. Questionnaire Questions

No	Questionnaire Questions
1	I think I'll use this QR Code-based ordering system again
2	I find this QR Code ordering system complicated to use
3	I find this QR Code ordering system easy to use
4	I need help from other people or employees in using this system
5	I feel that the features of this system work properly
6	I feel like there are a lot of things that are inconsistent (incompatible with this system)
7	I feel like others will understand how to use this system quickly
8	I find this system confusing
9	I feel that there are no obstacles in using this system
10	I need to get used to it first before using this system

By applying the four stages of UCD, this study developed an interface design that focuses on user needs and improves the efficiency of the food ordering process at Limestones Bali Restaurant.

4. RESULTS AND DISCUSSION

Based on the application of the User-Centered Design (UCD) method, the process of designing a web-based food ordering system with QR Code at Limestones Restaurant is carried out through four stages: Specify the Context of Use, Specify User and Organizational Requirements, Produce Design Solutions, and Evaluate Design. These stages will be described in order according to the case studies in this study.

4.1. Specify the Context of Use

At this stage, a case study is carried out to identify and determine who the potential users of the system are. Users consist of two main groups, namely Limestones Restaurant customers who order food through QR Codes and admins who are in charge of managing menus and processing orders. Initial observations on the manual ordering process show that there are obstacles such as waiting times,

inefficient order recording, and frequent damaged to physical menus. Thus, these findings are the basis for the development of a system to provide a faster, practical, and structured ordering experience.

4.2. Specify User and Organizational Requirements

The second stage is carried out to identify user needs based on the observation and analysis results of the current ordering process. Today's user needs

include easy-to-understand digital menu access, clear visual display, the ability to place direct orders, and clearly presented order information. Meanwhile, the needs of restaurant admins include the convenience of updating menus, seeing incoming orders in real-time, and ensuring that the order flow runs smoothly. The identified functional and non-functional requirements serve as the basis for the system design. Functional, non-functional needs and features can be seen in Table 2.

Table 2. Features List

No	Functional	Non-Functional	Features
1	Displays menu categories (Foods / Drinks / Dessert / Snack) and allows users to switch categories.	Category navigation should be fast, clear, and responsive on mobile/tablet.	Category Navigation
2	Displays product cards: image, name, brief description, and price (tile/grid). Users can view item details	Images and text should be legible, layout consistent, image size proportional.	Product Cards (Image + Title + Desc + Price)
3	Users can increase/decrease qty and add items to Cart; The cart displays a list of products, qty, subtotals, VAT, services, and totals.	Price calculations must be accurate and instant updates as qty changes.	Cart / Price Calculation
4	Provides payment options (QRIS/CASH) and service options (Dine-in/Takeaway). If you select QRIS, display the QR for scanning.	The payment process should be secure, the QR display is clear, the step instructions are visible.	Payment Options (QRIS + Cash), Dine-in/Takeaway
5	After checkout the system generates an Order # (order number) and a payment QR; Display status: Payment Success / Canceled / Go to cashier.	Order status should be real-time reflected in the UI (user & admin) and clear messages.	Order Number & QR Payment, Payment Status
6	Admins can view incoming orders, update status (process/completed), and manage menus (add/edit/delete items & prices).	The admin dashboard should be stable, show real-time order updates and be easy to manage.	Admin Dashboard (Order Management, Menu Management)
7	Provide a prototype UI according to UCD (simple user flow: select a category → select items → cart → select payment → confirmation). Including the notification screen (payment result).	The interface follows the UCD principles: consistent, easy to learn, and testable (SUS/usability test ready)	User Flow / UCD-Based Screens & Notifications

4.3. Produce Design Solutions



At this stage, a web-based user interface design is made according to the user requirements. The design provides an overview of how the system works through the compilation of user personas, wireframes, and prototypes. The design results in the form of user personas, wireframes and prototypes are shown in Figure 2 to Figure 13 according to the report.

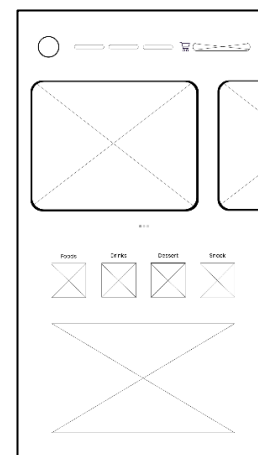


Figure 4 shows a menu category display that helps users choose food types such as Foods, Drinks, Desserts, and Snacks.



Figure 5. Product Cards Wireframe

Figure 5 shows a product card containing an image, name, and price that helps users select a dish.

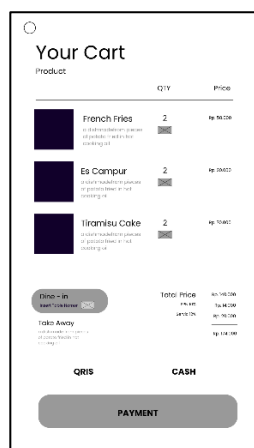


Figure 6. Cart View Wireframe

Figure 6 shows a cart view with a complete order list: item names, quantities, and total prices = that can be reviewed before proceeding to payment.

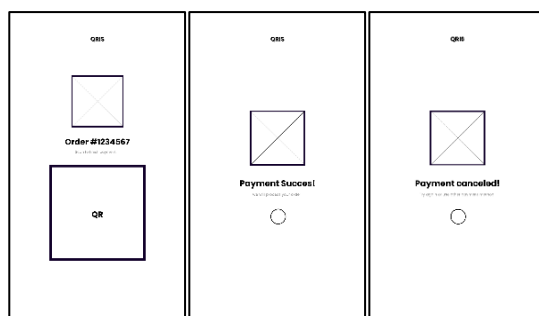


Figure 7. QRIS Payment Wireframe

Figure 7 shows the QRIS payment page, which displays the QR code, order number, and payment status notifications such as successful or failure.

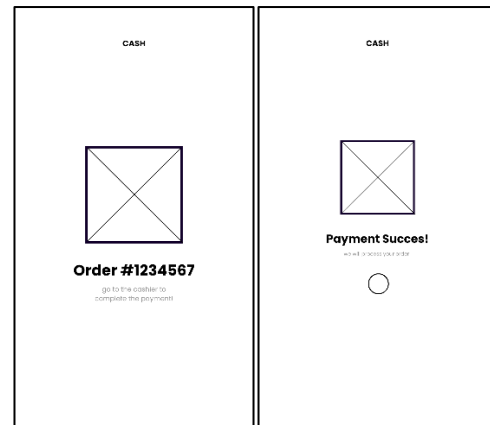


Figure 8. Cash Payment Wireframe

Figure 8 shows the cash payment process, from the notification of the order number to confirmation that the payment has been made successfully.

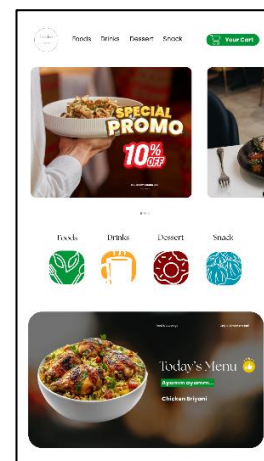


Figure 9. Category Navigation

Figure 9 shows a menu category display, which helps users select food types such as Foods, Drinks, Desserts, and Snacks.

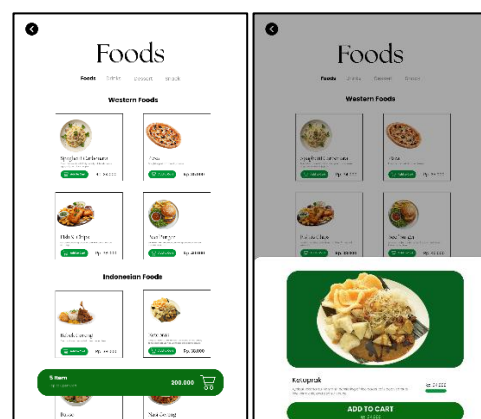


Figure 10. Product Cards

Figure 10 shows a product card containing images, names, and prices to make it easier for users to select the menu.

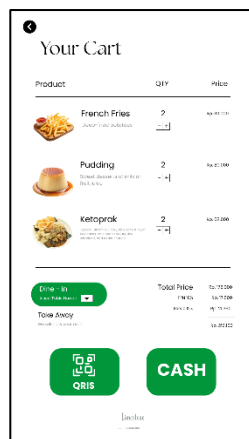


Figure 11. Cart View

Figure 11 shows a cart view showing a complete order list with item names, quantities, and total prices that can be reviewed before proceeding to payment.

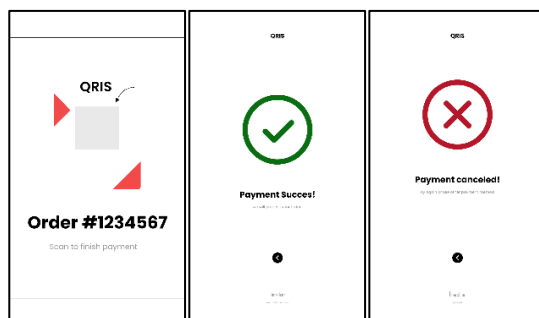


Figure 12. QRIS Payment

Figure 12 shows the QRIS payment page, which displays QR codes, order numbers, and payment status notifications, such as successful or failed.

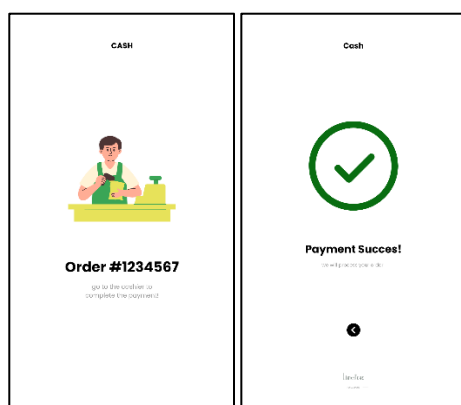


Figure 13. Cash Payment

Figure 13 shows the cash payment process, from the notification of the order number to confirmation that the payment has been successfully made. The interface design is developed using Canva and is focused on a simple and easy-to-understand interface. Menu information is presented

visually so that users can see pictures, descriptions, and food prices clearly. In addition, the booking flow is designed to be as short as possible so that customers can place bookings without any hindrances.

4.4. Evaluate Design

After the design design solution stage, the wireframe and prototype design results will be given to potential users for assessment. The purpose of this evaluation is to assess whether the design is in accordance with the needs of the user. At this stage, evaluation is carried out by an iteration process, so that designs that still do not meet the needs of users, improvements will be made based on input from users. The test uses the System Usability Scale (SUS) method through a questionnaire, then the results are calculated with the formula shown in the image.

$$\bar{X} = \frac{\sum X}{n}$$

$\bar{X}$ = Skor rata-rata

$\sum X$ = Jumlah skor SUS

N = Jumlah responden

In the calculation of the System Usability Scale (SUS), there are rules used for it. For odd-numbered questions, the score obtained from the respondents is subtracted by a value of 1. Meanwhile, for darkly numbered questions, the score is calculated by subtracting the value given by the respondent from the number 5. After the total score of each question is summed up, the results are multiplied by a factor of 2.5. The calculation process was carried out separately for each respondent. Once each respondent's score is obtained, the next step is to calculate the average score of all respondents' scores. After testing with a questionnaire to get the final score, then a calculation is carried out with the formula:

$$\bar{X} = \frac{\sum X}{n}$$

$$\bar{X} = \frac{712,5}{10}$$

$$X = 71,25$$

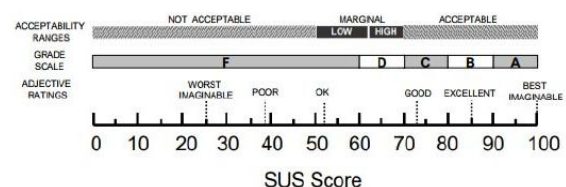


Figure 14. SUS Final Score

Based on the SUS final score diagram that has been displayed, it can be concluded that the final score is 71.25 which is in position C and belongs to the GOOD category. In general, this means that this website can be said to be suitable for using to order food online. While the visual presentation of the

prototype is informative and the SUS score indicates a generally positive user reception, an in-depth analytical review of the user testing process revealed several problematic findings that require further attention. During the implementation of the task-based scenarios, observations indicated that some users experienced friction at specific interaction points. First, two respondents reported slight confusion when navigating between the 'Dessert' and 'Snack' sub-categories, suggesting that the categorization terminology was not entirely intuitive for first-time users. Second, while the inclusion of high-quality food images successfully engaged users, aligning with the findings of Cetlan et al. [10] which state that visuals significantly trigger sensory imagination and purchase decisions, it was observed that these visual elements caused minor interface clutter on smaller smartphone screens, slightly violating the simplicity design principle proposed by Vergara Zurita et al [19].

Furthermore, a critical issue was discovered during the checkout and payment flow. Although the digital system was designed to reduce the 7.42-minute manual waiting time as highlighted in previous studies [5], a few older respondents within the demographic group needed extra time and assistance to confirm their QRIS payment status. They failed to immediately notice the "Payment Success" visual feedback. This specific problematic finding highlights a gap in the visual communication of the interface, reiterating Putra et al [21] argument that proper and prominent visual feedback is crucial in building user trust and preventing transaction anxiety. By connecting these problematic findings with the existing literature, it becomes evident that replacing a physical menu with a digital QR system is not merely a technical transfer of information, but a complex psychological transition for the user. Although the UCD method successfully established a functional and aesthetically pleasing baseline (scoring 71.25), addressing these specific navigational and visual feedback issues in future iterations is imperative. Resolving these minor usability bottlenecks will elevate the system from a "Good" operational tool to an "Excellent" user-centric experience, fully maximizing the efficiency and customer satisfaction potentials theoretically promised by digital ordering systems.

5. CONCLUSION AND RECOMMENDATIONS

Based on the research objectives, two main conclusions can be drawn. First, the UI/UX design for the QR Code-based food ordering system at Limestones Restaurant was successfully developed through the four stages of the User-Centered Design (UCD) method. This approach proved effective in solving the operational constraints of physical paper menus by providing an interactive digital interface focused on easy navigation and optimal use of food

visuals. Second, the design evaluation using the System Usability Scale (SUS) instrument yielded an average score of 71.25, placing it in the "Good" or Grade C category. This demonstrates that the prototype meets acceptable usability standards, is easy for customers to operate, and simplifies the manual ordering process. This study contributes to the human-computer interaction (HCI) literature by showing that integration of the UCD method with visual design principles can effectively bridge the psychological transition of users from conventional systems to digital ordering platforms in local restaurants. Practically, this research contributes a validated framework and system prototype that help restaurants cut operational costs, such as the repeated printing of physical menus, and accelerating administrative workflows.

Despite the positive evaluation results, this study has several limitations that should be acknowledged. The usability testing involved only 10 respondents. While this sample size is sufficient for identifying major UI/UX interface issues, the small sample size limits the statistical generalizability of the findings to a broader user population. Furthermore, the output of this study remains a high-fidelity prototype and has not been fully implemented into an integrated back-end database ecosystem in a real restaurant environment. Based on these limitations, future research should develop this prototype into a fully operational system and evaluate its performance over a longer period. Subsequent testing should involve a larger and more diverse respondents for a more comprehensive quantitative evaluation. Future system development should also add advanced features such as real-time transaction analytics dashboards, automated kitchen notifications, and customer loyalty tracking to give a more holistic evaluation of business efficiency.

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