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Full Length Research Article

DEVELOPMENT AND IMPLEMENTATION OF AN INTEGRATED FOOD COMMODITIES RESERVATION AND MANAGEMENT SYSTEM FOR THE KASU MAJLIS COOPERATIVE SOCIETY USING STRUCTURED APPROACH

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ABSTRACT
This paper presents the development and implementation of an integrated food commodities reservation and management system for the KASU Majlis Cooperative Society. Developed using PHP and MySQL within the XAMPP environment, this web-based system addresses inefficiencies in the existing manual process, thereby enhancing operational efficiency and member satisfaction within the cooperative society. This research identifies key challenges, such as delays and inaccuracies in processing requests and inventory management. In response, an automated system has been developed to modernize these processes. The key features include user registration, reservation tracking, and inventory management. The system allows users to confirm their details, view available commodities, reserve items online, check costs, and print reservation forms with email notifications sent upon request submission. These features ensure convenience, transparency, and efficiency. The system was designed using the waterfall model because of its simplicity and ease of implementation. Comprehensive testing was conducted to validate the reliability and performance of the system. The results from the implementation show significant improvements in request-handling accuracy and operational efficiency. Feedback from users indicates increased satisfaction owing to the user-friendly interface and timely updates of the system. The successful deployment of this system demonstrates its potential to enhance operational workflow, reduce waiting times, and improve communication between members and executive officers. This study offers a practical and scalable solution to common challenges in cooperative management, providing a foundation for future advancements in automated systems for similar cooperatives or organizations.

Keywords: Food commodities, management system, reservation system, cooperative society, automated system.

INTRODUCTION

Organizations worldwide increasingly rely on information systems to research, develop new revenue streams, engage customers, and streamline time-consuming tasks (Amparo et al., 2020). An information system is an organized approach to the collection, organization, and communication of information, providing the necessary adjustments to transition from manual to automated processes. The transitioning from an industrial to an information society has profoundly impacted the social, economic, and cultural facets of human life (Oghenekaro & Okafor, 2023). Information systems technology is crucial, dramatically transforming the economy and business operations. Automated systems offer numerous advantages, including faster and more accurate reporting, better business decisions, and efficient resource allocation (Amparo et al., 2020). They facilitate smoother interactions within organizations by enabling better data transfer capabilities and streamlining transaction processing.

Cooperative societies, like the KASU Majlis Cooperative Society, are essential for pooling resources to achieve collective goals that are challenging individually (Rilwan et al., 2021). These democratically grounded organizations enhance individuals' living standards through collective economic efforts (Ajayi et al., 2021). By uniting members around shared objectives, cooperatives demonstrate that collective action accomplishes what individuals alone cannot (Ajayi et al., 2021).

Information technology is revolutionizing the traditional manual operations of cooperative societies. Faced with modern economic challenges and rapid technological advancements, cooperatives must innovate and adapt to remain effective and relevant. Technology automates various processes, enhancing efficiency and accuracy in managing member records, financial transactions, loan and savings activities, inventory, and communication.

An automated food commodities reservation and management system leverages information systems to improve inventory and food supply management within the cooperative. Food commodities include staple foods, packaged goods, and processed items managed and distributed to members.

In Nigeria, cooperative societies have traditionally managed operations manually, often with spreadsheets. As cooperatives grow, this manual approach becomes inefficient. Paper records and documents pose challenges exacerbated by rapid technology advancements and evolving operational needs. An integrated food commodities reservation and management system is proposed to reduce operational costs and improve efficiency. The KASU Majlis Cooperative Society, currently relying on a semi-automated approach using Excel spreadsheets, faces delays in processing requests, inaccuracies in inventory management, and inefficient communication. Addressing these challenges is crucial for improving operational efficiency and member satisfaction.

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Amparo et al. (2020) emphasize the critical role of information systems in enhancing the operational efficiency of cooperatives, mainly through the development of a Web-based Cooperative Management System. Their study highlights the transition from manual to automated processes, reducing errors and streamlining sales, loans, and inventory management. Implementing a user-friendly interface and robust security measures, the proposed system aims to improve communication among members and staff while protecting sensitive data. Improved data accuracy and accessibility ultimately contribute to more effective management practices and member engagement.

Rilwan et al. (2021) studied the design and implementation of a custom, web-based cooperative loan application management system to address inefficiencies in manual record-keeping. They highlighted labor-intensive processes and errors in loan management, advocating for an ICT-based solution to improve efficiency. Oluyombo (2013) explored the impact of cooperative loans on rural finance, emphasizing the importance of financial institutions in meeting members' needs but did not focus on technological advancements. Similarly, Mbam et al. (2014) developed a cooperative management system that improved loan tracking but lacked practical case validation. These studies underscore the critical need for innovative technological solutions in cooperative management to streamline processes and improve member services. In present-day Nigeria, widespread dissatisfaction and industrial conflicts in public universities highlight the need for better management and service conditions to improve living standards (Okechukwu et al., 2021).

The growing membership base of the KASU Majlis Cooperative Society underscores the need for a more efficient system. The inefficiencies and errors in manual processes necessitate a streamlined, automated solution. Transitioning to automated systems promises enhanced efficiency and accuracy in operations.

This presents an integrated food commodities reservation and management system using a structured approach for the KASU Majlis Cooperative Society. Leveraging technologies such as PHP and MySQL within the XAMPP environment, this web-based system seeks to automate and improve reservation and management processes. Employing the waterfall model for system development, the research used a systematic approach to design, implementation, and evaluation. The effectiveness of the new system was compared to the existing manual process, focusing on user perceptions, satisfaction, and scalability potential for other cooperative organizations.

METHODOLOGY

System development methodology is important because it reduces risk and increases the likelihood of project success. By adopting a structured development approach, an organization can effectively manage a project from the selection stage through to the operation stage. In this study, the methodology adopted involves system analysis, design and implementation. The existing system was thoroughly analyzed and based on the findings, the proposed system was designed and implemented. The Waterfall Model is the ideal methodology to meet the requirements of the proposed system. This methodology which is known for its linear and sequential process, ensures that each phase is meticulously executed before progressing to the next, thereby delivering optimal results for the end users and allowing developers to adhere to schedules and meet deadlines effectively. The Waterfall Model comprises several phases: requirements, analysis, design, implementation, testing, deployment and maintenance. Table 1 shows the system development tasks and deliverables for the proposed system.

Table 1: System Development Task and Deliverables

Phase	Activity	Deliverable
Requirement	Gather and analyse user requirements to identify system needs and challenges.	• Proposal outlining scope and objectives • Gantt Chart • Functional and Non-Functional requirements documentation • Conceptual Data Model (CD) or Data Flow Diagram (DFD) to depict system processes. • Entity-Relationship Diagram (ERD) representing the database relationships and entities.
Design	Develop flowcharts to visualise system processes and discuss system functionality.	• Flowchart illustrating system logic and process flow • Database schema and data dictionary • User interface showcasing system layout and interaction
Implementation	Translate design specifications into functioning system components by programming and development.	• Program code files containing implemented system functionalities
Testing	Conduct comprehensive testing to ensure the system is error-free and meets user requirements.	• Test cases covering all system functionalities and scenarios.

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Maintenance	Collecting user feedback and iteratively improving the system based on real-world usage.	• Improve the system based on user feedback

System requirement analysis involves assessing functional and non-functional aspects for the success of any project. Table 2(a) shows the proposed system's functional requirements for the staff members, who are the users, while Table 2(b) shows the functional requirements for the administrators. Meanwhile, Table 3 shows the non-functional requirements.

System Requirement

Table 2(a): Functional Requirements for Users

No.	Modules	Deliverable
1	Login	• The system should allow users to log in using their staff personnel number • The system should verify the correctness of user details. • Upon successful login, the system should display the homepage.
2	Food Item selection	• The system should enable users to view all available food items. • Users should be able to view their selected food items.
3	Reservation	• Users should be able to select and reserve food items. • The system should allow users to remove or cancel selected reservations.
4	Report	• Users should be able to print a copy of the completed request form. • The system should send an email to users containing an itinerary of selected and reserved items.

Table 2(b): Functional Requirements for Administrator

No.	Modules	Deliverable
1	Login	• The system should allow the administrator to log in using their email and password. • The system should notify the administrator of any incorrect login credentials. • Upon successful login, the system should display the administrator homepage.
2	Manage Food Item Requests	• The system should enable the administrator to view all requests from staff members. • Administrators should be able to check for staff members' outstanding balances. • Administrators should be able to approve or reject requests, and staff members should receive automatic email notifications regarding the decision on their request. • Administrators should be able to view all approved requests. • The system should allow administrators to modify any requests made by staff members.
3	Manage food items	• The system should allow administrators to add new food items. • Administrators should be able to modify the quantities and prices of available food items. • Administrators should be able to delete food items from the system.
4	Manage Report	• Administrators should be able to view and print deduction schedules to send to the bursary department of the university. • Administrators should be able to view and print the monthly purchases to determine gross profit. • The system should allow administrators to change the status of reports after taking action.

Table 3: Non-Functional Requirements for Administrator & Staff Members

No.	Requirements	Descriptions
1	Performance	• The system should load the home page within 10 seconds after successful login. • The system should be accessible anytime, anywhere. • The system should maintain functionality even during periods of high workload.
2	Operational	• The system should have a user-friendly interface for ease of use. • The system should be compatible with various web browsers.
3	Security	• Users must log in with their unique ID and password. • All staff member details should be securely stored in the database.

System Analysis

Figure 1 illustrates the context diagram for the KASU Majlis Cooperative Integrated Food Commodities Reservation and Management System, which will have two categories of users: staff members and administrators. Users will access various modules, such as logging in, viewing and selecting available food items, and printing reports.

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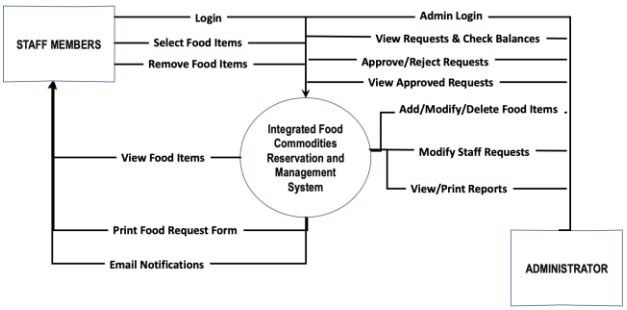

Figure 1: Context Diagram for the proposed system

Figure 2 illustrates the Data Flow Diagram (DFD) for the KASU Majlis Cooperative Integrated Food Commodities Reservation and Management System. This DFD provides a graphical representation of the flow of information and the transformations applied to data as it flows from input to output. In the DFD, data flow is depicted by arrows, which indicate the movement of data between processes, data stores and external entities. The DFD represents a system at several levels of abstraction, with the administrator and staff members as the external entities. The figure features five (5) processes and five (5) data stores, each designed to collect user information and store it in a specific database based on users' data.

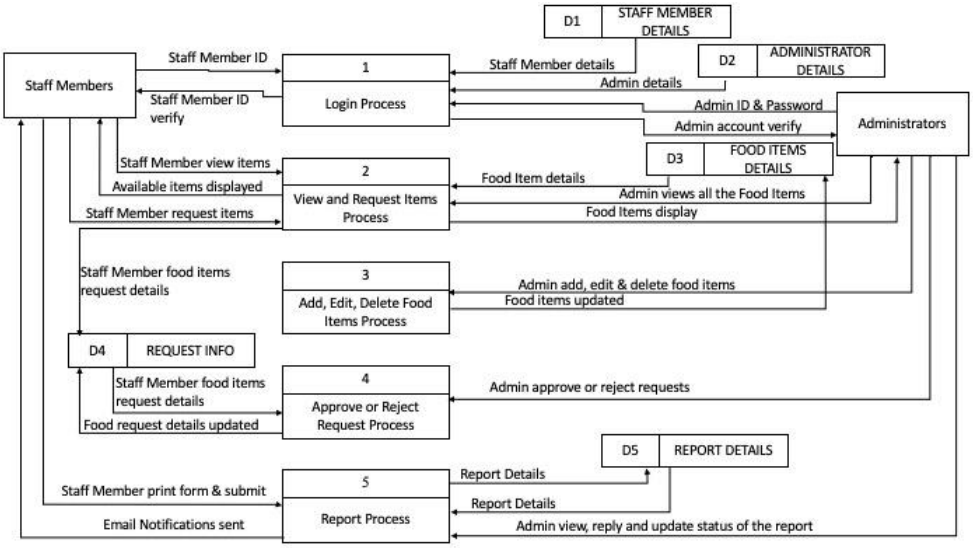

Figure 2: Data Flow Diagram for the proposed system

Figure 3 presents the Entity Relationship Diagram (ERD) derived from the 5 data stores in the DFD. The ERD models the data structure of the system by defining 5 entities, each corresponding to a data store from the DFD. These entities are characterized by their attributes including primary keys uniquely identifying each record and foreign keys establishing relationships between entities. The ERD serves as a blueprint for organizing and structuring the data, ensuring that the database is well-defined and supports efficient data retrieval and management.

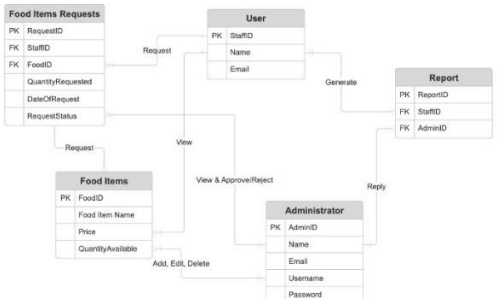

Figure 3: Entity Relationship Diagram for the proposed system

System Design and Development

The system design is essential for translating system requirements into a structured architecture, guiding the implementation of the Integrated Food Commodities Reservation and Management System for the KASU Majlis Cooperative. This phase involved creating detailed models that defined the structure of the system, data flow, and interactions. Flowcharts were created to visually represent the logical flow of processes and decisions within the system, providing a clear roadmap for development. Figures 4 and 5 illustrate the user flowchart for staff members and the administrator flowchart, respectively, showcasing how information moves through the system and how various decisions are made.

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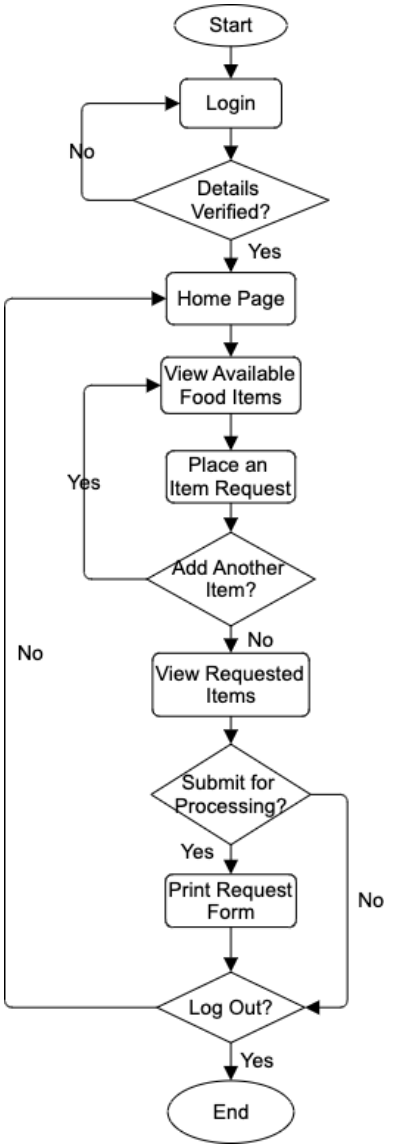

Figure 4: User flowchart for the proposed system

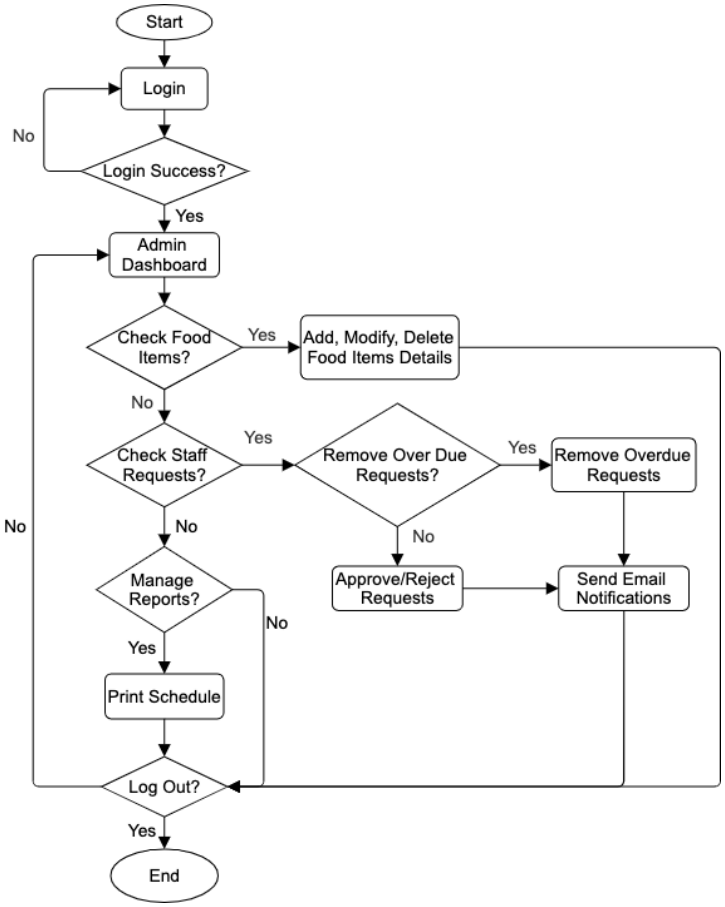

Figure 5: Administrator flowchart for the proposed system

Following the flowchart development, the user interface design was a critical focus, ensuring the system is both intuitive and user-friendly. Sridevi (2014) emphasized the importance of user interface design in computer-based systems, noting that a poor interface can significantly hinder the user's ability to effectively use an application's computational power. To address this, the proposed system's interface is designed to be simple, consistent, and easy to navigate, as demonstrated in Figures 6 and 7.

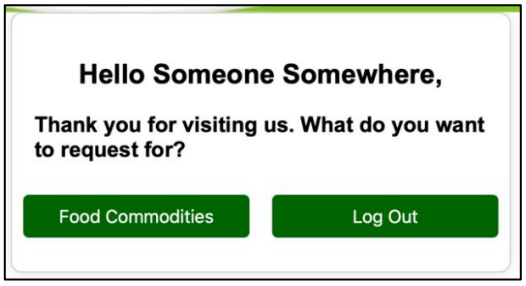

Figure 6: Staff Member's Dashboard

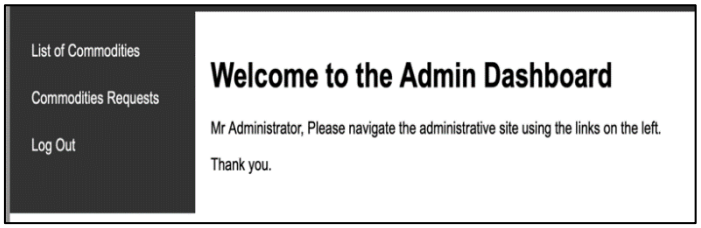

Figure 7: Interface for Administrator Dashboard

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Figure 6 presents the dashboard for staff members, featuring a straightforward login process, a 'Food Commodities' button for requesting food items, and a secure 'Log Out' button to ensure privacy. Figure 7 illustrates the dashboard for administrators, which includes features like a 'List of Commodities' link to view available items and a 'Commodities Requests' link to manage staff requests. The design allows for future expansion, such as adding features for housing and savings contributions, depending on the cooperative's needs.

Module design outlined the specific tasks for each user role, while security design incorporated measures such as authentication and data encryption to safeguard sensitive information. Together, these design elements formed a comprehensive blueprint, ensuring that the system's development aligned with the project's goals and provided a smooth transition from design to implementation.

IMPLEMENTATION AND TESTING

This section discusses the implementation of the system design phase according to the system specification and design. While the testing phase can be divided into two, namely alpha testing by the system developed and alpha testing by the system users. The testing phase is an important phase to ensure system users are able to evaluate system flow and system functionality according to the system requirements set by user.

Implementation

The design implementation phase has been developed for Integrated Food Commodities Reservation and Management System for the KASU Majlis Cooperative based on the design identified. The system was developed and hosted on a local server using XAMPP and accessed via a web browser such as Google Chrome. The programming languages used to develop the system include PHP, CSS, and HTML, with MySQL as the database. The implementation focused on creating user-friendly modules for both staff members and administrators. For staff members, the system offers a simple login process, easy confirmation of personal details, and the ability to select food items efficiently. For administrators, the system includes modules for secure login, clear viewing and management of staff requests, and the ability to approve or reject requests. Additionally, administrators can add, edit, or delete food items on behalf of members and seamlessly view or download the deduction schedule which is sent to the bursary for deductions from salary. These modules are shown in Figures 8 to 19.

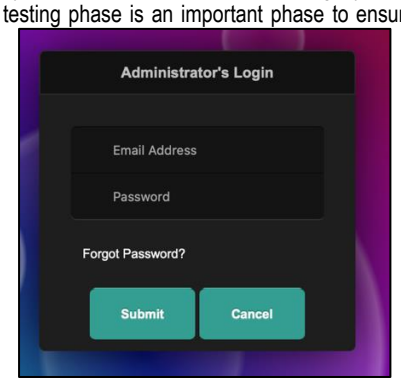

Figure 9: Login interface for administrator

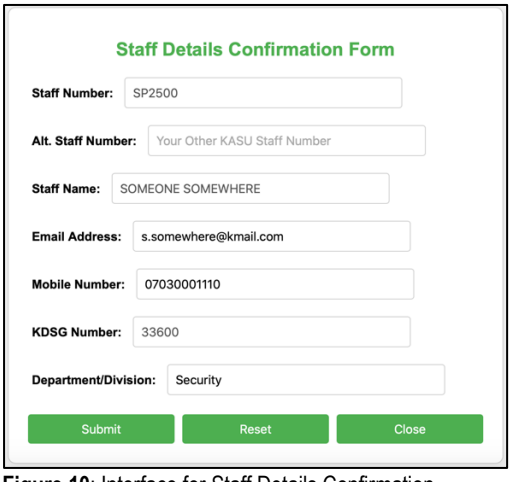

Figure 10: Interface for Staff Details Confirmation

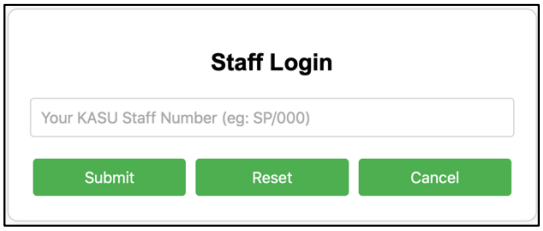

Figure 8: Login interface for Staff Members

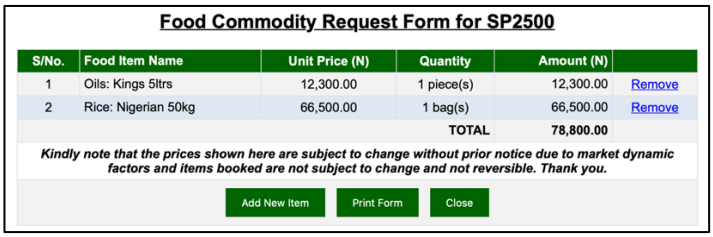

Figure 11: Interface for Food Commodity Request by Staff Members

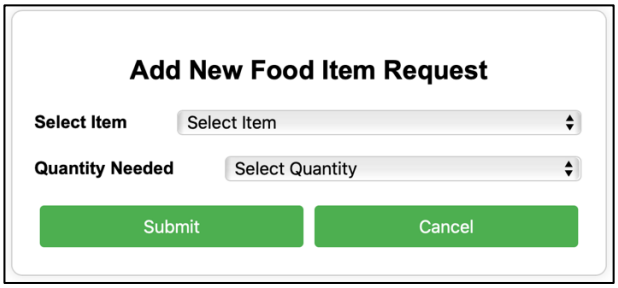

Figure 12: Interface for Food Commodity Request

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Figure 13: Interface for List of Commodities

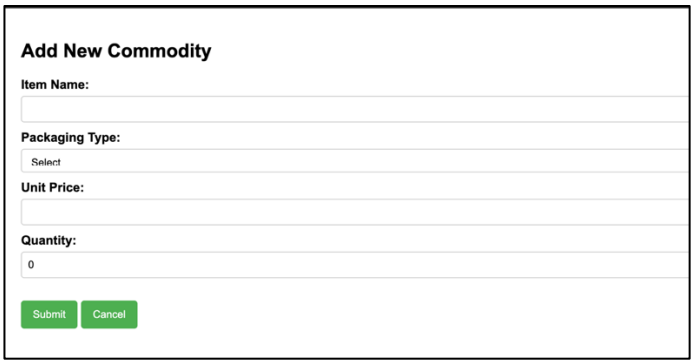

Figure 14: Add New Food Commodity page

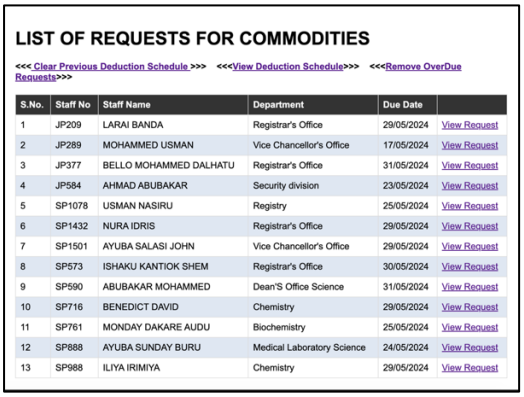

Figure 16: List of Requests for Commodities page

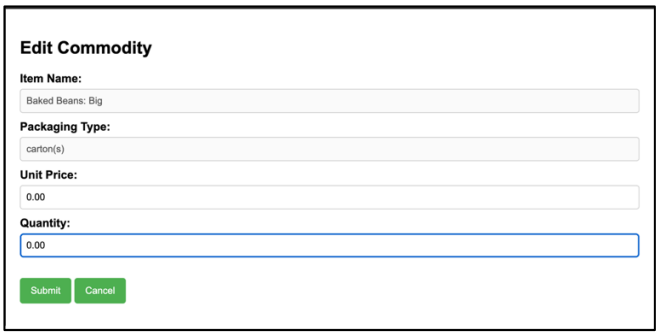

Figure 15: Edit Commodity page

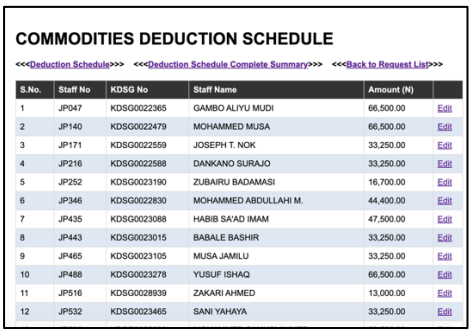

Figure 18: Commodities Deduction Schedule Page

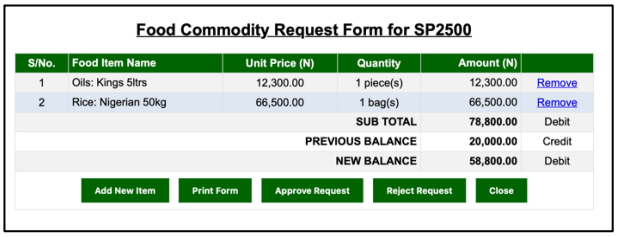

Figure 17: Individual Request Page

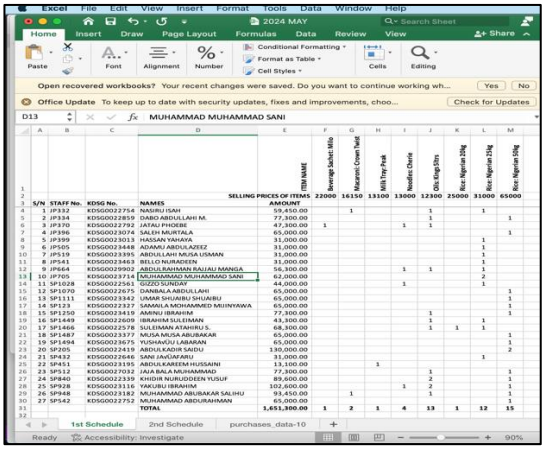

Figure 19: Deduction Schedule in Spreadsheet Format

Testing

The testing phase, a meticulously thorough step in software development, serves as a litmus test for the readiness of the system for implementation (Spacey, 2018). This phase involves a comprehensive assessment of the functionality of the system, leaving no stone unturned in identifying potential operational errors. A comprehensive testing plan, including detailed test cases,

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expected outcomes, and actual outputs, is essential for verifying that individual modules and the entire system operate correctly.

System testing, as highlighted by Ransom (2020), is designed to ensure that the developed code and programming align with customer requirements, thereby enhancing customer satisfaction. This phase includes module testing and overall system testing. Module testing examines each developed module independently, ensuring it performs its designated functions correctly. The system testing extends this examination to the entire system, verifying that all components work together seamlessly.

Specific tests were conducted on various interfaces, such as the login function, as shown in Tables 4a and 4b to ensure user interface responsiveness, data accuracy and system stability. Additional tests for the staff members include the confirmation of staff member details (Table 5), staff member homepage (Table 6), display of requested food items (Table 7), adding new food item requests (Table 8), and printing out request forms (Table 9). For administrators, the test plan includes the following modules such as displaying a list of all staff requests for food commodities (Table 10), viewing individual staff requests (Table 11), viewing deduction schedule for staff requests (Table 12), displaying a list of all food commodities (Table 13) and lastly adding, modifying or removing food commodity items (Table 14). These tests also involved checking for user interface responsiveness, data accuracy and system stability.

Moreover, User Acceptance Testing (UAT) was conducted as a collaborative effort to measure user satisfaction, gather feedback, and provide insights for future system enhancements, highlighting the essential role of the development team in ensuring the system meets user expectations.

Table 4(a): Test Plan for Staff Login Function

No.	Test Case	Expected Outcome	Actual Output
1	Fill in a valid Staff ID Number	Once the staff inserts their Staff ID, the system will direct them to either the confirmation of details page or their homepage/dashboard.	Same as the expected outcome.
2	Fill in an invalid Staff ID Number	If the user inserts a Staff ID number that is not in the system, the system will display a message and direct the user to the registration page.	Same as the expected outcome.

Table 4(b): Test Plan for Administrator Login Function

No.	Test Case	Expected Outcome	Actual Output
1	Fill in a valid email address and password	Once the administrator inserts their email address and password, the system will direct them to their homepage/dashboard.	Same as the expected outcome.
2	Fill in an invalid email address and password.	If the administrator inserts a wrong email address or password, the system will display an error message and redirect the administrator to the login page.	Same as the expected outcome.

Table 5: Test Plan for Confirmation of Staff Member Details

No.	Test Case	Expected Outcome	Actual Output
1	Staff view the details displayed on their screen	Once the staff details are displayed, the staff member can view and correct any mistakes before being directed to their homepage.	Same as the expected outcome.

Table 6: Test Plan for Staff Member's Dashboard/Homepage

No.	Test Case	Expected Outcome	Actual Output
1	Staff clicks the "Food Commodities" button to view and request food commodities.	Users can view the food items selected and add more, remove items, or print their forms.	Same as the expected outcome.

Table 7: Test Plan for Display of Requested Food Commodities

No.	Test Case	Expected Outcome	Actual Output
1	Staff member views on all food items already selected and reserved	Users can view the selected food items, add more, remove, or print their form.	Same as the expected outcome.

Table 8: Test Plan for Add New Food Item Request

No.	Test Case	Expected Outcome	Actual Output
1	Staff selects an item from the available items using the drop-down box and also selects the number of quantities needed.	Users can select and add an item to the already selected and reserved items.	Same as the expected outcome.

Table 9: Test Plan for Print Food Commodities Request Form

No.	Test Case	Expected Outcome	Actual Output
1	Staff prints their food commodity request form, displaying all necessary details of their request.	Users can print the form displaying all selected items and staff details.	Same as the expected outcome.

Table 10: Test Plan for List of Requests of Commodities

No.	Test Case	Expected Outcome	Actual Output
1	The administrator views a list of all staff requests	The administrator can view a comprehensive list of staff requests for commodities	Same as the expected outcome.

Table 11: Test Plan for Viewing Individual Staff Requests for Food Commodities

No.	Test Case	Expected Outcome	Actual Output
1	Administrator views individual staff requests	The administrator can view a comprehensive list of requests for food items made by an individual staff member, including the current total and any previous outstanding balance.	Same as the expected outcome.
2	Administrator modifies staff member's food items.	The administrator can add new, modify or remove food items for the individual staff member's request	Same as the expected outcome
3	Administrator approves or rejects staff member request	The administrator can approve or reject the staff member's request for food items. The system will automatically send an email notification on the request status.	Same as the expected outcome

Table 12: Test Plan for Viewing Deduction Schedule for Staff Requests

No.	Test Case	Expected Outcome	Actual Output
1	Administrator views staff members list for deduction	The administrator can view a summarised list of staff members and their details, including the amount to be deducted from their monthly salary.	Same as the expected outcome.
2	Administrator downloads schedule	The administrator can download the schedule in Excel format, which will be sent to the bursary department for deductions from the staff's monthly salary. Another copy of the schedule, which consists of a comprehensive list of food items collected by staff members and the staff details, is downloaded.	Same as the expected outcome.

Table 13: Test Plan for Viewing List of all Food Commodities

No.	Test Case	Expected Outcome	Actual Output
1	Administrator views the list of all food commodities	The administrator can view a summary of all food commodities and the available quantities.	Same as the expected outcome.

Table 14: Test Plan for Add/Edit/Remove of Food Commodity Item

No.	Test Case	Expected Outcome	Actual Output
1	Administrator adds new food commodity item	The administrator can add a new food commodity item with its respective details that are not on the system.	Same as the expected outcome.
2	Administrator edits food commodity items.	The administrator can edit the price and quantities available for any food commodity item in the system.	Same as the expected outcome.
3	Administrator removes food commodity item	The administrator can remove any food commodity item from the system.	Same as the expected outcome.

RESULTS AND DISCUSSION

This section discusses the results of the user acceptance test (UAT) conducted after system deployment. Online Questionnaires using Google Forms were distributed to stakeholders, including 8 staff members and 2 administrators, to provide feedback on user experience. The information gathered was used to emphasize the importance of UAT in evaluating the effectiveness of the system. UAT is designed to ensure that the new system is not just a technological advancement but a tool that meets end users' needs, business requirements, and expectations. The testing focused on two main areas: application design and functionality. The results, particularly regarding the graphical user interface (GUI) design, are shown in Figure 20, where most participants gave the GUI an average rating.

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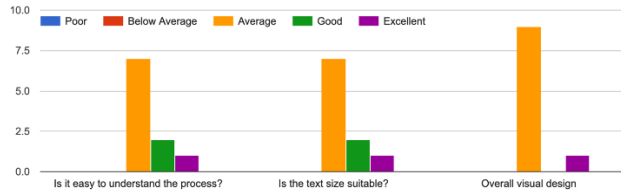

Figure 20: User Acceptance Test on Graphical User Interface

Figure 21 presents the results of the system functionality test. Most participants rated nearly all functions of the new system with an average rating.

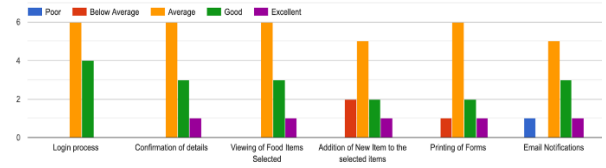

Figure 21: User Acceptance Test on System Functionalities

Figure 22 shows the results of the overall system performance evaluation. Sixty percent (60%) of the participants rated it as excellent, while the remaining 40% rated it as good. This result indicates the strong performance of the system.

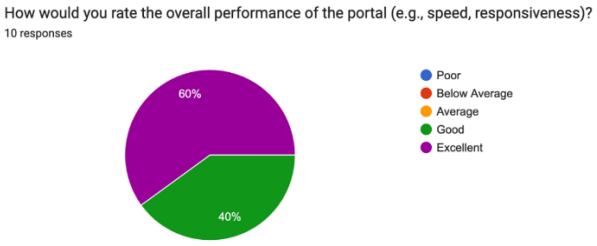

Figure 22: Overall System Performance Evaluation

Figure 23 shows the results of user satisfaction with the system, particularly with the secure login and data privacy features. Fifty percent (50%) of participants rated this aspect as excellent, 30% as good, and the remainder as average or below average. This result underscores the reliability of the system and the importance of user experience.

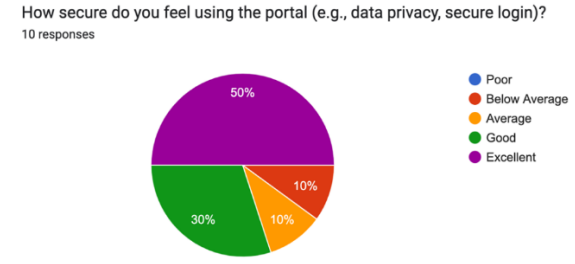

Figure 23: User Satisfaction Evaluation

Figure 24 shows the overall user experience of participants. Sixty percent (60%) rated it as excellent, 30% as good, and 10% as average. This outcome strongly emphasizes the need to maintain a positive user experience, reassuring technical experts about the usability of the system.

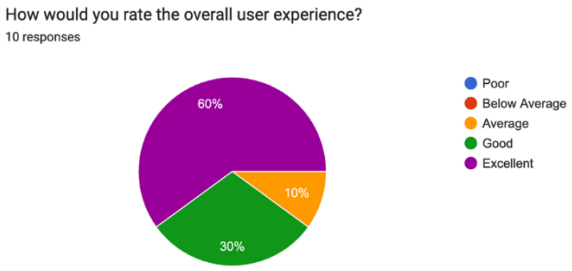

Figure 24: Overall User Experience Evaluation

Conclusion

The Integrated Food Commodities Reservation and Management System was designed to address the inefficiencies and challenges of manually managing food commodity requests at the KASU Majlis Cooperative Society. Through systematic design, implementation, and testing, the system successfully met the needs of university staff and the executive members of the cooperative, particularly the food commodities officer. The testing, encompassing module, functional, and user acceptance tests, confirmed that the system significantly improved operational workflows, reduced waiting times, and enhanced communication, leading to increased user satisfaction. The system provides several key advantages, allowing staff to easily view and request food items via browsers like Chrome, Firefox, and Safari, and also streamlines administrative tasks, enhancing efficiency by reducing the time required to compile and manage requests.

However, the system currently lacks features for viewing request history and determining staff eligibility to request a new batch of food commodities based on whether they have partially or fully paid outstanding balances from previous items, which would improve tracking and financial accountability. Future enhancements like real-time notifications and advanced inventory management features like accounting capabilities could further optimize functionality and user experience.

Overall, the system has successfully addressed significant issues of the previous manual approach and offers a scalable solution for cooperative management. With the implementation of the recommended improvements, the system will continue to evolve, meet the growing needs of the cooperative and further enhance food commodity management.

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