G-Tech : Jurnal Teknologi Terapan
Vol. 9, No. 3, July 2025, p. 1387-1397
E-ISSN: 2623-064X | P-ISSN: 2580-8737

NutriMatrix: A Nutrition Management Application Using Mobile Application Development Life Cycle (MADLC) Method

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Article Information

Article History

Received : June 06, 2025
Revised : June 17, 2025
Published : July 10, 2025

***Keywords*:**
Android;
Database;
MADLC;
Mobile Application;
Nutrition.

ABSTRACT

Nutrition is essential to maintaining a healthy lifestyle, yet many individuals lack awareness and control over their daily intake, increasing the risk of chronic diseases. This article introduces NutriMatrix, an Android-based application designed to help users independently manage their nutrition. The app enables users to log their daily food consumption, automatically calculate nutrient values, and receive AI-generated dietary suggestions. It also offers personalized progress reports over selectable timeframes (daily, weekly, or monthly). Developed using the Mobile Application Development Life Cycle (MADLC) method, NutriMatrix follows seven structured phases: identification, design, development, prototyping, testing, deployment, and maintenance. Key features include CRUD-based food logging, a nutrition calculator, an AI assistant called NutriBot for feedback and suggestions, and a progress report for tracking nutrient trends. The app also includes educational articles to promote healthy lifestyle. The backend was developed using Express.js and MySQL, while the frontend used React Native for cross-platform compatibility. Integration testing confirmed that all modules functioned smoothly and cohesively. The application was tested by 158 respondents using usability and user acceptance testing methods, resulting in an average usability score of 3.4 (85%) and a user acceptance score of 3.32 (83%), indicating a high level of user satisfaction and successful feature performance.

INTRODUCTION

One of the key components in maintaining human health is nutrition. Nutrition refers to a collection of substances contained in food that function to sustain life, support growth, and ensure the body functions optimally through the processes of digestion, absorption, storage, metabolism, and the elimination of unnecessary nutrients (Nomira, 2024). The human body requires a balanced intake of nutrients because each type of nutrient, whether macronutrients such as carbohydrates, fats, and proteins or micronutrients such as vitamins and minerals, plays an essential role in supporting the immune system, repairing body tissues, and regulating various biological processes (Hidayah et al., 2023).

Technology plays a crucial role in modern life as it transforms how people work, communicate, learn, and access information. In this digital era, technologies are not merely supporting tools but also major drivers of innovation across various sectors. Their presence enables the creation of efficient and effective systems that accelerate decision-making, broaden access to information, and boost productivity (Ria & Budiman, 2021). One of the most common forms of technology in daily life is Android smartphones, which have been widely used since 2008. These devices not only facilitate communication but also provide vast access to information and online learning opportunities (Aprilia & Anshor, 2021). In other words, technology has become an integral part of modern human life, offering positive impacts when used wisely and appropriately.

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Related studies in this field include one by Yuliati in 2021, who developed MoGiz, an android-based mobile application designed to monitor nutritional status across various age groups. The application features anthropometric measurements, nutritional consultations, articles, and gamification elements such as quizzes and points redeemable for rewards (Yuliati et al., 2021). Another study by Bunyamin in 2022 developed Foodivore, an Android-based daily calorie management application that utilizes Artificial Intelligence (AI) technology (TensorFlow) to scan foods and automatically calculate calories based on users' activity levels. The app also includes meal planning features, meal reminders, and nutritional articles (Bunyamin et al., 2022). Meanwhile, Setyawan in 2020 developed the Diet Planner (DINNER) application aimed at individuals with obesity, implementing the DEBM (Delicious, Happy, Enjoyable Diet) method. This android-based app serves as a meal and water intake reminder, provides dietary guidance, and presents statistics tracking users' weight loss progress throughout the program (Setyawan et al., 2020).

Unlike previous applications such as MoGiz, Foodivore, and DINNER, which tend to focus on isolated functions like anthropometric monitoring, AI-based calorie tracking, or fixed diet planning, NutriMatrix aims to offer an integrated and adaptive solution that covers all essential aspects of independent nutritional management. NutriMatrix combines food intake logging, automated calculation of macro and micronutrients, along with personalized dietary suggestions generated by artificial intelligence based on the user's weight, height, and goals.

Furthermore, NutriMatrix introduces a smart progress report system that presents visual insights through charts, allowing users to monitor and evaluate their dietary patterns over a specific period. This combination of features positions NutriMatrix as a holistic platform that not only enables users to manage their nutrition independently but also delivers meaningful insights and adaptive recommendations, offering a unique contribution beyond the capabilities of previous applications.

This research aims to develop an Android-based application that can record users' daily food intake, calculate and display nutritional values based on the foods consumed, and generate automatic assessments and suggestions through Artificial Intelligence (AI) based on the consumption patterns. The benefits of this research include enabling users to monitor and manage their nutritional intake independently, supporting the development of healthy eating patterns, and providing useful data for healthcare professionals and researchers for evaluation and future development of nutritional information systems.

RESEARCH METHODS

Mobile Application Development Lifecycle (MADLC) is a structured development model consisting of seven stages: identification, design, development, prototyping, testing, deployment, and maintenance, specifically tailored to ensure the successful creation of mobile applications from concept to product (Agustin et al., 2024). The adoption of MADLC is crucial because it systematically guides developers through iterative and user-centered stages, allowing for clear planning, risk reduction, and enhanced design decisions in mobile app projects (Mustapa & Mustapa, 2020).

The application was developed following the seven phases of MADLC. The identification stage is aimed at exploring new ideas through brainstorming, which are then structured into functional requirement diagrams to visualize what the system should accomplish (Syakti, 2019). In the design phase, the developer translates conceptual ideas into preliminary application designs, establishes the software architecture, identifies essential prototypes and modules, and constructs an interactive User Interface (UI) storyboard as a key element of the design workflow (Jaya et al., 2024).

The development phase is the implementation stage, where a suitable programming language is used to code the application's functional requirements and user interface (Wambua & Kamau, 2023). This phase is the core of the MADLC process, where all designs from the previous stages are translated into executable program code. The following stage is the prototyping phase, a

phase that involves testing functional features, gathering user feedback, and iteratively refining the prototype until it is finalized and ready for the next testing stage (Raus et al., 2016).

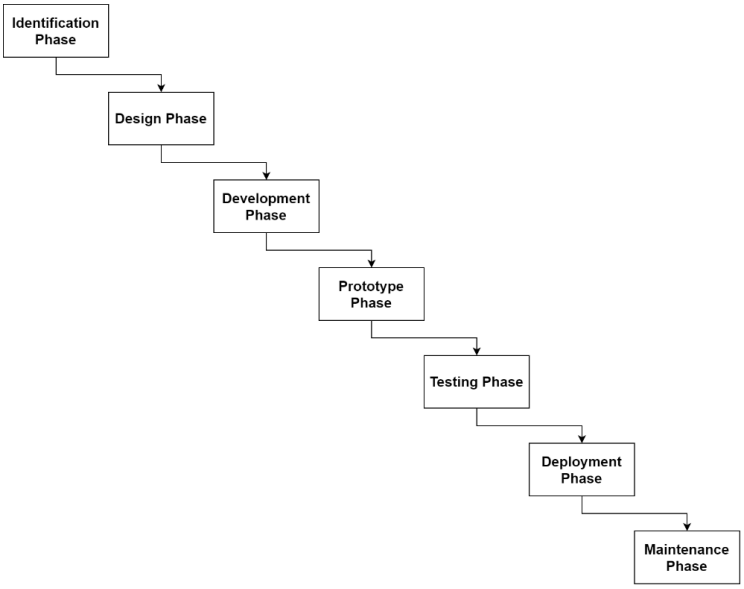

Figure 1. Mobile Application Development Life Cycle (Sesilia, 2023)

Once the prototype is deemed sufficient, the application moves into the testing phase, a process of executing a program to uncover hidden errors to ensure that the software or application is behaving as intended. For this application, the application was tested by the developer through a series of integration test cases to ensure that each module functions correctly and returns a successful status. Furthermore, usability testing was conducted through a questionnaire from 158 respondents, evaluating 5 different features, each with its own 3 components, to measure how effectively and intuitively users interacted with the application. Using the same respondents, User Acceptance Testing (UAT) was also done through a questionnaire to determine the overall acceptance level of the application from a user satisfaction perspective.

The next phase after passing the test, the application would undergo a deployment phase, where it would be packaged as an APK file and distributed via limited channels like Google Drive for beta testing. Lastly, the final phase is the maintenance phase, a continuous stage that aims to preserve high quality and stable performance of the mobile application by identifying and correcting defects in design, coding, and logic during regular operation (Kajanath & Sakthymayuran, 2023).

RESULTS AND DISCUSSION

The development and evaluation of the system begins by presenting the Proposed Business Process to illustrate how the system aligns with operational workflows, followed by the use case diagram and Entity Relationship Diagram (ERD) that define its functional and data structures. The application User Interface (UI) showcases the visual layout and user navigation flow. To ensure the system components work cohesively, Integration Testing is conducted. Further evaluation includes usability testing to measure user interaction and ease of use, as well as User Acceptance Testing (UAT) to validate whether the system meets user needs and expectations based on their feedback.

In addition to functional evaluation, the NutriMatrix prototype is also compared to existing nutrition applications such as MoGiz, Foodivore, and DINNER in terms of features, interface design, accuracy, and flexibility. With its modern and intuitive interface, NutriMatrix demonstrates a more accurate, adaptive, and user-centered approach to nutrition management. NutriMatrix stands out as the most comprehensive solution, combining daily food intake tracking, automatic nutrient analysis, AI-driven personalized suggestions, and progress visualization.

Proposed Business Process

Business Process Modeling Notation (BPMN) is a standard for modeling business processes that provides a graphical notation for describing a business process (Mastan, 2023). Business Process Model and Notation (BPMN) is a standardized graphical notation used to model business processes in the form of systematic flow diagrams, making it easier for all stakeholders, including technical and nontechnical parties, to understand, design, and document business processes (Wirya, 2022). The use of BPMN is essential because it enables organizations to represent complex workflows in a structured manner, supporting validation, analysis, and the identification of problems and inefficiencies within ongoing processes (Koniyo et al., 2024).

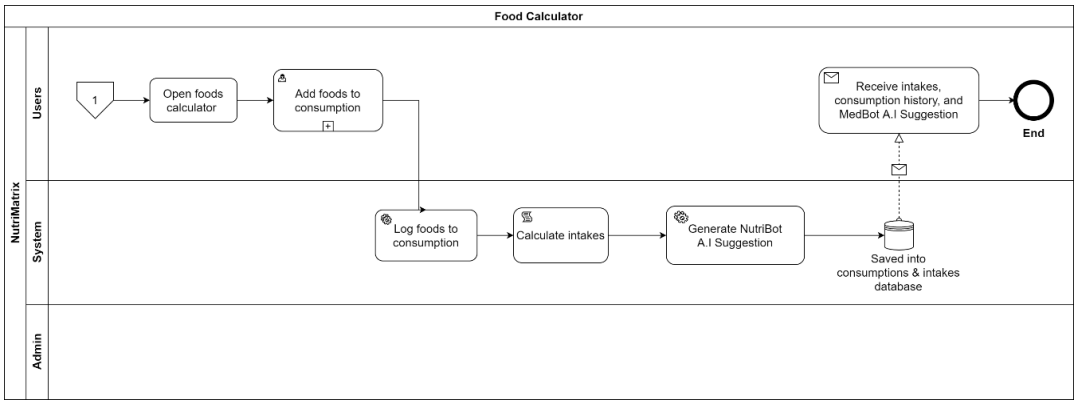

Figure 2. Proposed BPMN of Food Calculator

The use of the NutriMatrix application begins with an authentication process, where users can register if they do not have an account, then log in and complete their personal information and nutritional goals. Once logged into the system, users can access various main features such as the food calculator to record consumed foods, calculate nutritional intake, and receive suggestions from NutriBot Artificial Intelligence (AI), with all data stored in the database. Additionally, users can search for nutritional information about various foods through a search feature supported by data updated by the admin. The application also provides a progress report feature that allows users to input a specific time range to view consumption charts, total intake, and follow-up suggestions from MedBot Artificial Intelligence (AI), enabling users to monitor their nutritional development regularly.

Use Case Diagram

Figure 3. Use Case Diagram of NutriMatrix

Use case diagram is a functional description of a system from the perspective of its users (Setiyani, 2021). A use case is executed by illustrating the type of interaction between a user of a

program (system) and the system itself (Ihramsyah et al., 2023). The use case diagram in NutriMatrix application shows how users interact with the system to record food consumption, calculate nutritional intake, view AI suggestions, monitor progress, and read articles. Users can also manage their personal data, save foods to a preference list, and view consumption history. Meanwhile, administrators have full access to manage categories, food items, users, and articles through CRUD features to ensure smooth system operation.

Entity Relationship Diagram

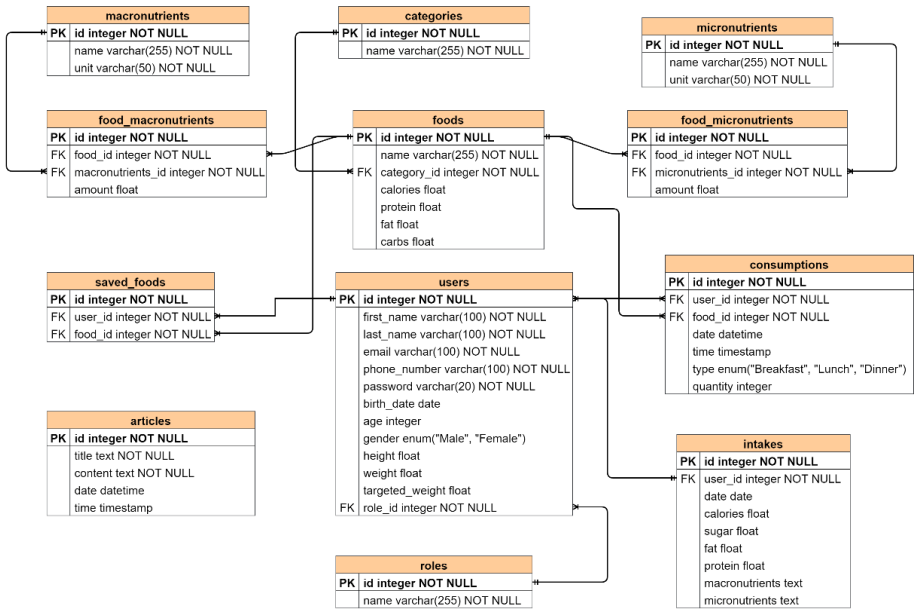

Figure 4. Entity Relationship Diagram of NutriMatrix

The Entity Relationship Diagram (ERD) is a high-level conceptual data model used to describe a system and its boundaries (Togatorop et al., 2021). ERD is used to design a database by showing in detail the relationships between entities and their attributes, forming a structured and clear model using specific notations and symbols (Mukhlis & Santoso, 2023). There are a total of 12 database tables in the NutriMatrix ERD, with each table having relationships based on its respective function. The ERD illustrates a database structure consisting of entities such as users, foods, consumptions, articles, as well as nutritional composition tables like macronutrients and micronutrients. Users can record their daily food intake, save favorite foods, and view a summary of nutritional intake calculated based on food data and its nutritional content. The relationships between tables such as users, foods, consumptions, intakes, macronutrients, and micronutrients form an integrated system that supports comprehensive nutritional tracking and evaluation for users.

Application User Interface

User Interface (UI) is a term that refers to the service display when users interact with a product or service (Wiwesa, 2021). User Interface emphasizes the visual and aesthetic aspects of a website or application's appearance aplikasi (Jamilah & Padmasari, 2022). The following are the UI displays of the NutriMatrix application (see Figure 7). This interface functions to display a summary of daily nutritional intake, including calories, sugar, fat, and protein. Users can add foods they have consumed and view daily progress in the form of circular charts. An informative article list is also available to expand knowledge about healthy eating habits. This page serves as the main control center for the user's daily activities within the application.

Figure 5. Home User Interface

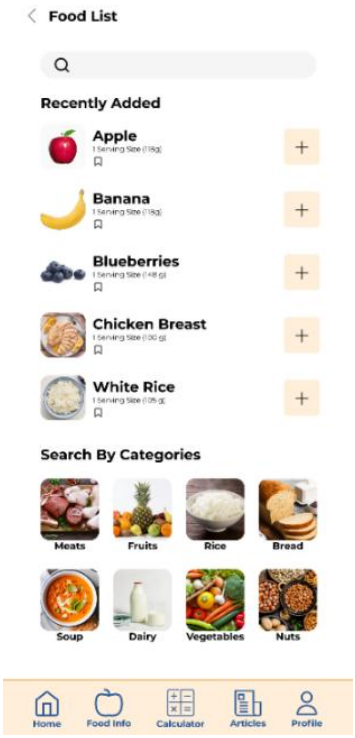

Figure 6. Food List User Interface

This interface provides a list of newly added foods as well as a search feature based on categories such as fruits, meats, vegetables, and grains. Each food item is accompanied by serving size and an icon to add it to consumption. This interface is designed to allow users to search and select foods quickly and conveniently. Food information is presented visually to support easy identification.

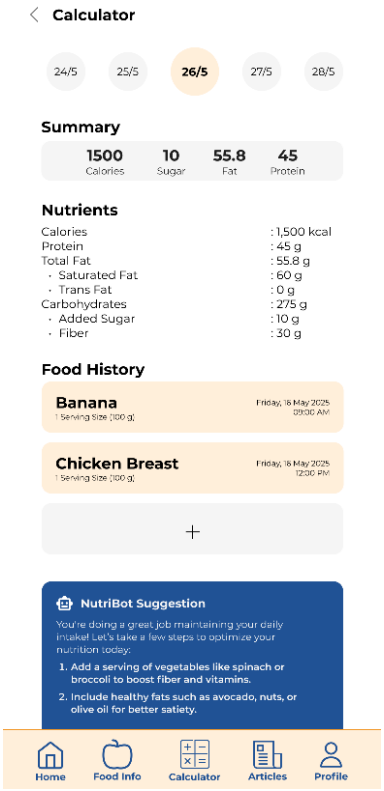

Figure 7. Food Calculator User Interface

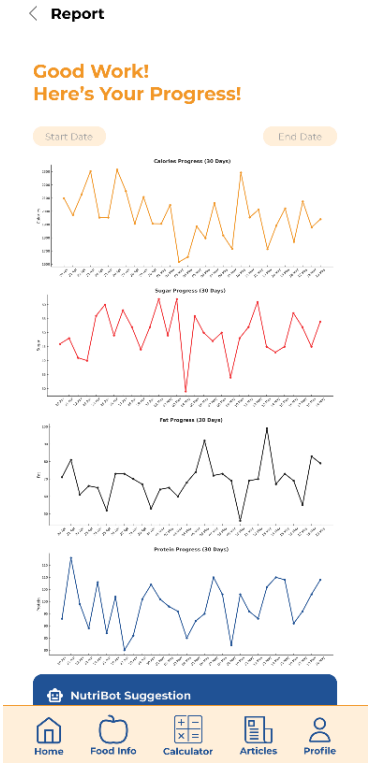

Figure 8. Progress Report User Interface

This interface features the application's core functionality, which calculates the total nutrition consumed on a specific day and displays it in a numerical summary and detailed breakdown per nutrient. The list of foods consumed on that day is shown below the summary. NutriBot provides AI-based suggestions to help users maintain or improve their nutritional intake. This page plays a vital role in evaluating the user's daily nutritional balance. This interface displays graphical progress of calorie, sugar, fat, and protein intake over a specific time period. The charts help users track trends and progress toward their nutritional goals. A date selection option is available to compare progress across different periods. NutriBot also provides additional suggestions based on consumption patterns.

Integration Testing

Integration testing is a type of software testing aimed at ensuring that the interfaces between components function according to the software design (Fahrozi et al., 2023). The following are the results of the system and features that have been tested using integration testing:

Table 1. Integration Testing of NutriMatrix

No	Test Case	Description	Expected Result	Actual Result	Status
1	Sign Up	User creates an account	User successfully creates an account	User successfully creates an account	Successful
2	Login	User enters email & password	User successfully enters the application	User successfully enters the application	Successful
3	Profile	User fills personal data	User successfully fills personal data	User successfully fills personal data	Successful
4	Current Intake	Application displays current intake from the database	Application succesfully displays current intake from the database	Application succesfully displays current intake from the database	Successful
5	Current Consumptions	Application displays current consumptions from the database	Application successfully displays current consumptions from the database	Application successfully displays current consumptions from the database	Successful
6	Food List	Application displays food lists from the database	Application successfully displays food lists from the database	Application succesfully displays food lists from the database	Successful
7	Search Foods By Categories	User searches food lists by their categories from the database	User successfully searches food lists by their categories from the database	User successfully searches food lists by their categories from the database	Successful
8	Food Info	Application displays food's information from the database	Application successfully displays food's information from the database	Application successfully displays food's information from the database	Successful
9	Manage Consumptions	User manage (CRUD) consumptions	User successfully manage (CRUD) consumptions	User successfully manage (CRUD) consumptions	Successful
10	Calculate Intake	Application calculates intakes from consumptions taken and dates chosen.	Application successfully calculates intakes from consumptions taken and dates chosen.	Application successfully calculates intakes from consumptions taken and dates chosen.	Successful
11	Progress Report	Application displays 4 graphs (calories, sugar, fat, protein) taken by the start date until end date chosen.	Application succesfully displays 4 graphs (calories, sugar, fat, protein) taken by the start date until end date chosen.	Application succesfully displays 4 graphs (calories, sugar, fat, protein) taken by the start date until end date chosen.	Successful
12	NutriBot Suggestions	Application generates A.I suggestions specifically for users	Application succesfully generates A.I suggestions specifically for users based on their	Application successfully generates A.I suggestions specifically for users based on their	Successful

No	Test Case	Description	Expected Result	Actual Result	Status
		based on their target and consumptions.	target and consumptions.	target and consumptions.	
13	Manage Foods Database	Admin manage (CRUD) foods database	Admin successfully manage (CRUD) foods database	Admin successfully manage (CRUD) foods database	Successful
14	View Articles	Application displays articles	Application successfully displays articles	Application successfully displays articles	Successful
15	Manage Articles	Admin manage (CRUD) articles	Admin successfully manage (CRUD) articles	Admin successfully manage (CRUD) articles	Successful

Usability Testing

Usability testing is the process of understanding users by observing how they use a product or application feature to achieve specific goals of interest (Barnum, 2020). For this application, usability testing was conducted through a questionnaire distributed to 158 respondents. The evaluation focused on five main feature categories of the application, which would later be assessed using three different components. Respondents rated each component using a 4-point Likert scale ranging from very poor to very good. The scores were then averaged per component and per category to obtain a comprehensive view of user experience within each feature set. After calculating individual components and category averages, a total accumulated average was computed by averaging the scores of all categories. To convert the final average into a percentage that reflects the overall usability level, the result was divided by the highest Likert scale score (4) and multiplied by 100. This method provides a quantitative benchmark to evaluate the usability of the application from the users' perspective and helps identify which features offer the most seamless and efficient user experience.

Table 2. Usability Testing

No	Category	Component	Average	
1	Food Database	Usage Rate	3,32	3,38
		Goal Completion Rate	3,44	
		Usability	3,37	
2	Consumptions & Intakes	Usage Rate	3,35	3,4
		Goal Completion Rate	3,4	
		Usability	3,46	
3	NutriBot A.I Suggestion	Usage Rate	3,46	3,41
		Goal Completion Rate	3,41	
		Usability	3,37	
4	Progress Report	Usage Rate	3,41	3,41
		Goal Completion Rate	3,35	
		Usability	3,47	
5	Article	Usage Rate	3,41	3,41
		Goal Completion Rate	3,45	
		Usability	3,36	
Total Accumulated Average			**3,4**	
Persentase (%)			**85%**	

User Acceptance Testing

User Acceptance Testing (UAT) is done primarily by the users with support from the project team, aiming to confirm that the system is complete, meets the business needs that prompted its development, and is acceptable to the users (Dennis et al., 2022). The User Acceptance Testing (UAT) was conducted using the same 158 respondents from the previous usability testing, through a questionnaire based on eight acceptance-related components.

Each respondent provided scores for the eight components using a 4-point Likert scale ranging from very poor to very good. The individual component scores were then averaged across all respondents to obtain a mean score for each component. To determine the overall level of system acceptance, a total accumulated average was calculated by averaging the scores of all eight components, which would later be converted into a percentage to provide a more interpretable metric. The conversion was done by dividing the average score by the maximum scale value of 4, then multiplying by 100.

This approach provides a quantitative representation of how well the system is accepted by its users and how effectively it fulfills the expectations set forth during its development.

Table 3. User Acceptance Testing (UAT)

Component	Average
Usability	3,35
Functionality	3,36
Perceived Usefulness	3,34
Information Quality	3,3
Performance	3,28
Security	3,34
Personalization	3,29
Satisfaction	3,29
Total Accumulated Average	**3,32**
Percentage (%)	**83%**

CONCLUSION

Based on the implementation and testing that have been carried out, it can be concluded that the Android application NutriMatrix has successfully fulfilled its purpose as a personal nutrition monitoring tool by providing various features that help users manage and evaluate their daily nutritional intake. This application is specifically designed to assist users in recording consumed foods, calculating nutrient intake, receiving AI-based suggestions for improvement, and monitoring progress through detailed visual reports.

During its development process, the application applied the Mobile Application Development Life Cycle (MADLC) method. This resulted in a mobile application that is functional, stable, user-friendly, and aligned with user needs. NutriMatrix consists of several core modules. The food logging module allows users to perform CRUD operations on their daily consumption, enabling them to add, edit, or delete foods they have consumed.

The food database is equipped with macronutrient and micronutrient information used to calculate total calories, protein, fat, carbohydrates, sugar, and other essential nutrients. Users can also save favorite foods to facilitate faster logging in the future. The nutrition calculator feature summarizes the user's daily nutrient intake and presents it in a clear numerical and graphical format. Integrated with an Artificial Intelligence (AI) assistant called NutriBot, this feature provides personalized recommendations based on the user's nutritional balance. It helps users identify deficiencies or excesses in their diet and offers suggestions for foods or habits to improve it.

To support long-term health goals, the progress report module displays the user's nutrient intake history in the form of time-based graphs. This module allows users to track how consistently they are meeting their nutritional targets. Combined with the profile and goal-setting feature, users can enter and update personal data such as weight, height, age, and target weight to receive a more tailored nutrition plan. In addition, the application includes an article section, which provides educational content about nutrition, healthy eating, and lifestyle. Administrators also have special access to manage core data such as food categories, food items, users, and articles.

This ensures that the information displayed in the application remains accurate, up-to-date, and relevant to users' needs. Testing using the integration testing method shows that the application performs well, with all modules working seamlessly together. Its intuitive interface makes it easy to use without the need for special training, and user feedback confirms that the application is informative and effective in supporting their nutritional goals. Thus, NutriMatrix proves to be a helpful, flexible, and user-centered solution for modern nutrition management.

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