



## E-Nutrition: Development of a Mobile and Web Health and Nutrition Management System for the City Nutrition of Tayabas

**Abstract:** The growing demand for effective health and nutrition services in Tayabas City exposed challenges in managing and monitoring nutrition programs, particularly in organizing data, ensuring accessibility, and generating reports. Traditional approaches, which relied heavily on manual documentation, often led to inefficiencies, errors, and delays in service delivery. To address these issues, this study introduced E-Nutrition, a mobile and web-based health and nutrition management system designed to enhance the operations of the City Nutrition Office. The main goal of E-Nutrition was to simplify the administration of nutrition programs by providing a centralized digital platform for real-time data entry, tracking, and reporting. Built using agile development methodologies, the system incorporated essential features such as automated data processing, graphical reporting tools, and intuitive interfaces tailored for administrators and beneficiaries. Preliminary evaluations revealed notable improvements in data accuracy, faster report generation, and higher satisfaction among users. The integration of mobile and web platforms ensured the system was accessible and easy to use for various stakeholders, improving the delivery of nutrition services. These findings positioned E-Nutrition as an innovative solution to existing challenges in nutrition management and suggested its potential for broader adoption in similar settings.

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### 1. Introduction

Following a healthy diet had become a challenge, either due to the wide variety of food and ingredient combination possibilities or the lack of knowledge necessary to make healthy choices (Ribeiro et al., 2017). Nutrition played a critical role in health and development. Improved nutrition was associated with better infant, child, and maternal health, stronger immune systems, safer pregnancies and childbirth, a reduced risk of non-communicable diseases (such as diabetes and cardiovascular disease), and greater longevity. Healthy children learned better, while individuals with adequate nutrition were more productive and had the potential to break cycles of poverty and hunger gradually.

Malnutrition, in all its forms, posed significant threats to human health. The world faced a double burden of malnutrition, encompassing both undernutrition and overweight, particularly in low- and middle-income countries. Malnutrition presented itself in multiple forms, including undernutrition



(wasting or stunting), vitamin or mineral deficiencies, overweight, obesity, and diet-related non-communicable diseases (WHO, 2019). Nutrition apps were shown to effectively change eating behaviors and diet-related health risks. However, while they contributed to addressing overweight and obesity rates, widespread adoption remained limited. Understanding factors that motivated or hindered long-term nutrition app use was critical for developing design guidelines to encourage uptake and sustained use (König et al., 2021). Although mobile phones increasingly delivered health interventions, the evidence supporting the effectiveness of health apps was incomplete. Research primarily focused on medical and nutritionist perspectives, often overlooking consumer behavior (Elbert et al., 2016).

Tayabas City, recognized as one of the Smart Cities in the Philippines and led by Mayor Lovely Reynoso-Pontioso, received the Consistent Regional Outstanding Winner in Nutrition (CROWN) Award during the National Nutrition Awarding Ceremony on January 12, 2024, at the Manila Hotel. This prestigious recognition highlighted the city's consistent implementation of effective nutrition programs over the past three years (Tayabas City Receives CROWN Award for Exemplary Nutrition Programs).

However, based on interviews conducted by the proponents with the City Nutrition Action Officer, the City Nutrition Office still relied on traditional systems like spreadsheets for day-to-day operations. Sensitive records and personal information remained vulnerable to data leaks and unauthorized access. Additionally, the office aimed to maintain nutritional records and statuses for all Tayabasin, particularly children aged 0–59 months or under five years.

To enhance the current processes in the City Nutrition Office, the proponents proposed a Web and Mobile Health and Nutrition Management System to assist staff with daily tasks and secure nutritional records. This system was designed to create personalized meal plans based on user-provided information, including body mass index, personal preferences, and activity levels. The system's nutritional recommendations and application were designed for adult residents of Tayabas, featuring user-friendly interfaces and adhering to nutritionist guidelines. The proponents believed that implementing a Health and Nutrition Management System for Tayabas City would not only be an achievement but also serve as further proof of the city's commitment to embracing innovation.

## 2. Objectives

The primary aim of this project was to develop a mobile and web health and nutrition management system for the City Nutrition Office of Tayabas that could generate personalized healthy meal plans based on the health information provided by the user, body mass index, and nutritional status.

Specifically, the study aimed to:

1. To identify needed requirements for the development of the proposed system;
2. To design the proposed system based on the identified requirements using UML diagrams.
3. To develop a system using different software tools (Directus CMS for backend, MySQL for Database Management, Vue.js and Flutter frameworks for frontend).
4. To test the functionalities of the proposed system using Black-box testing techniques.

5. To evaluate the proposed system using ISO 25010.

### 3. System Methodology

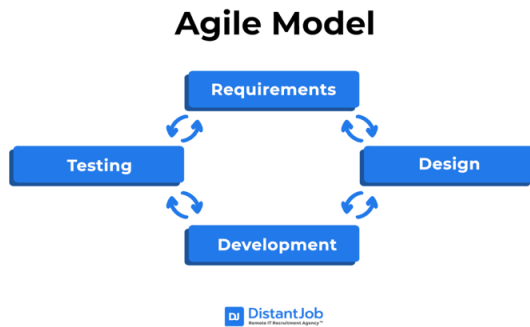


**Figure 1. Software/system development methodology**

Figure 1, (Almeida, 2024) depicted the software development methodology used by the researchers. The Agile Software Development methodology was used to develop the e-Nutrition system, focusing on flexibility, client feedback, and collaboration to ensure the product met user needs. Its iterative and incremental approach improved efficiency, encouraged innovation, and allowed teams to adapt and learn from mistakes while delivering quick and effective results.

The Agile model divided the project into small, incremental steps. During the requirements phase, information was gathered from the City Nutrition Office in Tayabas City regarding procedures, problems, and issues with the current system. Interviews were conducted with system users to gather essential details, such as user roles and use cases, ensuring a clear understanding of system requirements. Use cases were created to visually represent system functionality. In the design and development phase, a combination of programming languages and tools was used. To test the system's effectiveness, staff from the City Nutrition Office and nutrition experts participated in the evaluation process.

Feedback was collected to identify areas for improvement and enhance the system's functionality and usability.

### 4. Results and Discussion

The proposed project involved conducting interviews with the City Nutrition Officer to gather the system's functional requirements and user needs. These interviews took place during a meeting between the proponents and the City Nutrition Officer. The proponents prepared questions designed to clarify and expand their understanding of the project requirements. As a result, they were able to identify the application's needs and the measures necessary to secure user data. The advice and suggestions provided by the City Nutrition Officer were carefully considered and incorporated into the proposed project to enhance its effectiveness.

#### 4.1 Design of the System

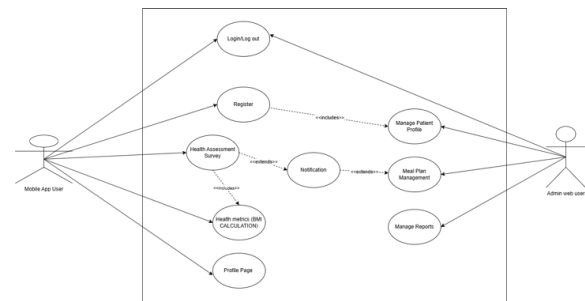


**Figure 2. Use case diagram of the system**

Figure 2 presented the use-case diagram for the proposed system, illustrating the relationships and interactions between the use cases and actors. This section detailed the functionalities offered by the e-Nutrition system. The system's users were categorized into mobile app users (patients) and administrators (dietitians). Once users submitted their health data, administrators provided recommended meal plans based on the users' health assessments and BMI results.

## 4.2 System Development

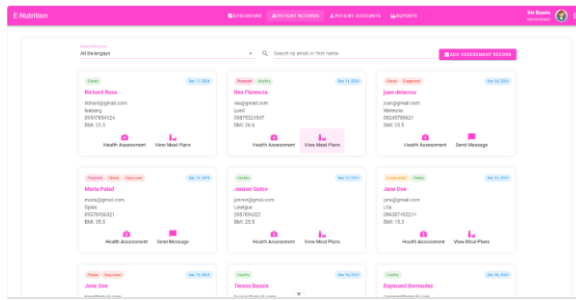


Figure 3. Patient profile of the system

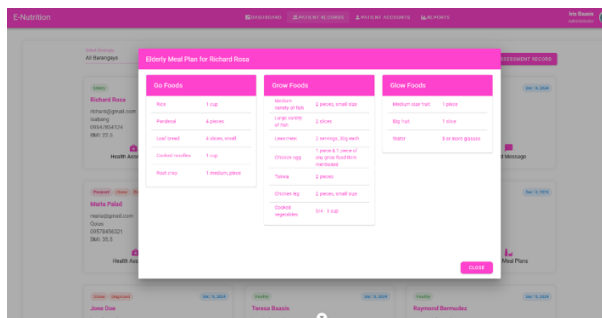


Figure 4. Automated Meal Plan

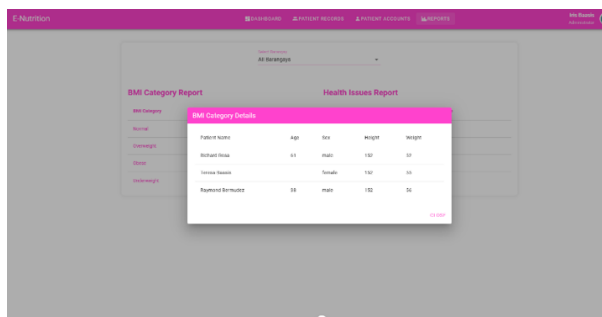


Figure 5. Reports

Figures 3, 4, and 5 show the dashboard admin interface of the pro The overall interaction between the users and the system was depicted in Figure 2.

The development phase of the e-Nutrition system involved building the core functionalities for both the mobile and web platforms. The mobile app allowed patients to submit health data, while the web platform enabled administrators to manage data and provide personalized meal plans. The proponents used various programming tools

and conducted regular testing and debugging to ensure system functionality. Collaboration with stakeholders ensured issues were addressed, resulting in a stable and user-friendly system

## 4.3 Respondents of the Study

The respondents of the study were the City Nutrition officer and staff.

## 4.4 Evaluation Results

Table 1. Functionality Suitability Result

| Criteria                                                                                                                     | Weighted Mean | Verbal Interpretation |
|------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------|
| 1. Functional Appropriateness. The system meets the functional requirements.                                                 | 4.00          | Agree                 |
| 2. Functional Correctness. The system performs the required tasks and functions.                                             | 3.89          | Agree                 |
| 3. Functional Completeness. The system does not have any missing or incomplete functions that are necessary for the process. | 3.78          | Agree                 |
| Overall Mean                                                                                                                 | 3.89          | Agree                 |



Table 1 presented the data on the system's functional suitability, which was evaluated based on functional appropriateness, functional correctness, and functional completeness. The results indicated that the system effectively met its functional requirements, receiving a mean score of 4.00, reflecting agreement that it was suitable for its intended purpose. Additionally, the system demonstrated its ability to perform the required tasks and functions accurately, with a mean score of 3.89, signifying agreement among the evaluators. In terms of functional completeness, the system showed no missing or incomplete features, achieving a mean score of 3.78, highlighting that all essential functionalities were included. Overall, the evaluation of the system's functional suitability resulted in a mean score of 3.89, emphasizing its effectiveness and reliability in fulfilling its intended purpose.

**Table 2. Interaction Capability Result**

| Criteria                                                                                                      | Weighted Mean | Verbal Interpretation |
|---------------------------------------------------------------------------------------------------------------|---------------|-----------------------|
| 1. Appropriate Recognizability<br>. The user can recognize whether the system is appropriate for their needs. | 4.22          | Strongly Agree        |
| 2. Operability.<br>The system has attributes that make it easy to operate and control.                        | 4.33          | Strongly Agree        |

|                                                                                                                                                        |      |                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------------|
| 3. User Engagement.<br>The interface design presents functions and information in an inviting and motivating manner encouraging continued interaction. | 3.11 | Moderately Agree |
| Overall Mean                                                                                                                                           | 3.89 | Agree            |

Table 2 presented the data on the system's interaction capability, evaluated based on appropriate recognizability, operability, and user engagement. The results showed that users strongly agreed that the system was suitable for their needs, as reflected by a mean score of 4.22. The system was also considered easy to operate and control, receiving a mean score of 4.33, which indicated strong agreement among the evaluators. However, in terms of user engagement, the system's interface design earned a mean score of 3.11, suggesting moderate agreement that it effectively presented functions and information in an inviting and motivating manner. Overall, the system's interaction capability was rated with a mean score of 3.89, indicating general agreement among the evaluators regarding its effectiveness.



**Table 3. Reliability Result**

| Criteria                                                                                                                                                             | Weighted Mean | Verbal Interpretation |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------|
| 1. Faultlessness. The system performs specified functions without fault under normal operation.                                                                      | 3.78          | Agree                 |
| 2. Availability. The system is operational and accessible when required for use.                                                                                     | 4.33          | Strongly Agree        |
| 3. Recoverability. The system can recover the data directly affected and re-establish the desired state of the system Navigations on the different modules are easy. | 3.56          | Agree                 |
| Overall Mean                                                                                                                                                         | 3.89          | Agree                 |

Table 3, showed the data on the system's reliability, evaluated based on faultlessness, availability, and recoverability. The results indicated that the system generally performed

its functions without errors during normal operation, earning a mean score of 3.78, which signified agreement. It was also highly rated for its availability, with a mean score of 4.33, suggesting strong agreement that the system was operational and accessible when needed. Regarding recoverability, the system demonstrated the ability to recover data and restore its desired state, receiving a mean score of 3.56, reflecting agreement on its effectiveness. Overall, the system's reliability was rated with a mean score of 3.89, indicating general agreement among the evaluators regarding its dependability.

**Table 4. Security Result**

| Criteria                                                                                                                         | Weighted Mean | Verbal Interpretation |
|----------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------|
| 1. Confidentiality. The system ensures that the data are accessible only to those authorized to have access.                     | 4.11          | Agree                 |
| 2. Integrity. The system ensures that the state of its system and data are protected from unauthorized modification or deletion. | 4.11          | Agree                 |
| Overall Mean                                                                                                                     | 4.11          | Agree                 |



Table 4, presented the data on the system's security, assessed based on confidentiality and integrity. The evaluation revealed that the system effectively protected data confidentiality, achieving a mean score of 4.11, which indicated agreement that only authorized individuals had access to the data. Additionally, the system ensured data integrity by safeguarding its data and state from unauthorized modifications or deletions, also receiving a mean score of 4.11, reflecting agreement. Overall, the system's security was rated with a mean score of 4.11, demonstrating consensus among the evaluators regarding the effectiveness of its security measure.

**Table 5. Maintainability Result**

| Criteria                                                                                                                                 | Weighted Mean | Verbal Interpretation |
|------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------|
| 1. Modularity. The system is composed of discrete components such that a change to one component has minimal impact on other components. | 4.00          | Agree                 |
| 2. Modifiability. The system can be effectively and efficiently modified without introducing                                             | 4.33          | Strongly Agree        |

|                                                                                                                                                  |      |                |
|--------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------|
| defects or degrading existing product quality.                                                                                                   |      |                |
| 3. Testability. The test criteria can be established for a system, and tests can be performed to determine whether those criteria have been met. | 4.33 | Strongly Agree |
| Overall Mean                                                                                                                                     | 4.22 | Strongly Agree |

Table 5, showed the data on the system's maintainability, evaluated based on modularity, modifiability, and testability. The results indicated that the system received a mean score of 4.00 for modularity, suggesting agreement that the system's components were discrete and that changes to one component had minimal impact on others. In terms of modifiability, the system was highly rated with a mean score of 4.33, strongly agreeing that it could be modified efficiently without introducing defects or compromising its quality. Similarly, the system's testability was rated highly, with a mean score of 4.33, reflecting strong agreement that test criteria could be established and tests could be performed to ensure these criteria were met. The overall mean score for the system's maintainability was 4.22, indicating strong agreement regarding its ease of maintenance.

## 5. Conclusion and Recommendation



The developed 'e-Nutrition: Development of a Mobile and Web Health and Nutrition Management System for the City Nutrition of Tayabas' highlighted major improvements achieved by transitioning from a manual process and spreadsheet-based system to a digital solution. This system significantly improved the accuracy of nutritional data, minimized human errors, and ensured strong data security for patient records. It also provided personalized meal plans tailored to individual needs, efficiently managed records, and generated detailed reports based on BMI categories. Overall, the e-Nutrition system streamlined operations for the city nutrition office and empowered residents to better manage their health and nutrition, leading to improved health outcomes for all age groups in Tayabas. The results offered valuable insights into the effectiveness of the e-Nutrition system in meeting the nutritional and health needs of the community, contributing to the overall goal of promoting healthier lifestyles.

Based on the findings and conclusions of the study, the researchers made several recommendations that aimed to improve the design of the bridge or offer additional insights for future research, such as: a) Automated Meal Plan if the User is healthy and no medical condition and Meal History, and b) Automated Generated Reports based on BMI Category and Health Condition.

**Conflict of Interest.** There is none among the authors

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