CNHMS: Children Nutrition and Health Monitoring System

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Abstract
Malnutrition is a global issue affecting nations everywhere, with children's health being a top priority in combating this problem. This study focuses on developing and evaluating a health monitoring system for Butigue, a barangay in Paracelis, Mountain Province, comprising eight sitios. The system assists health workers in tracking and assessing children's health status by inputting details and receiving immediate assessments. It supports barangay decision-making processes related to health improvement initiatives. Additionally, the user-friendly system allows parents to keep track of their children's health, receive updates, and access health worker recommendations. The study utilizes descriptive and statistical methods to analyze data and evaluate the system's features using the ISO 20510 Software Quality Characteristics Tool. This evaluation framework assesses the system's functionality, reliability, usability, efficiency, maintainability, and portability. Through ongoing monitoring and assessment, the system aims to play a significant role in the broader effort to reduce malnutrition and improve children's health on a larger scale.

Keywords: Children, Malnutrition, ISO 20510

I. INTRODUCTION

Malnutrition become a common problem faced in every country. According to the World Health Organization (2018), every country is affected by malnutrition. Malnutrition results from insufficient or overconsumption of nutrients (Streit, 2018). The Global Goals for Sustainable Development (2020) stated hunger is the prime cause of death worldwide. Correspondingly, the latest report of Sustainable Development 2023 under SDG 2 reported that more than 600 million people worldwide will face hunger by 2030. Moreover, malnutrition continues to be a problem worldwide, threatening the well-being and future development of children. Health monitoring becomes significant in determining the status of the people. However, paper-based methods are still implemented, complicating the process in small clinics, particularly in monitoring children's nutrition. As stated by Irache et al. (2019), monitoring is delayed by the lack or weakness of paper-based child nutrition surveillance systems. Correspondingly, Kerr et al. (2016) stated that using extensive procedures such as paper-based documentation may be too demanding for participants, perhaps resulting in lower acceptability. In short, paper-based methods are ineffective and burdensome for monitoring nutrition and health, particularly for children.

The most urgent goals of Sustainable Development Goals 2 and 3 are related to the proposed system. The Sustainable Development Goals address all the key health topics and aim to end hunger and achieve good health and well-being while addressing the growing problem of malnutrition. Children's Nutrition and Health Monitoring System are designed to monitor children's progress/growth and provide a basis for future decision-making. SDG 2 targets to eliminate hunger, supply sufficient food, increase health standards, and support sustainable agricultural practices. The targets of Sustainable Development Goal 3 cover a wide range of health issues, including reproductive health, maternal and child health, and other health-related themes. Monitoring health should include the health-related aims listed in the SDGs. The development of CHNMS aligns with these two SDGs as it focuses on child health and nutrition. In 2017, the National Nutrition Council reported approximately 3.8 million Filipino children, or 33.4% of the total, have stunted growth,

which means they are shorter than their age group. Furthermore, monitoring should focus on multisectoral efforts to find appropriate solutions to children's health.

However, monitoring health at the barangay level still involves manual processing of records, which are sorted in envelopes and kept in one place. According to the registered Barangay Nutrition Action Officer at the Barangay Center of Butigue, residents, specifically children, go to the barangay for weighing. Nurses monitor children's health and nutrition through pen and paper. Children from 0 months to 5 years old are covered by centers and given food supplements from CHO after checking their previous records before rendering final data. Also, acquiring children's data is divided per sector, with a health worker assigned per sector/purok. The hard copy is then submitted to the BNOA to input the data gathered by the assigned health worker. However, this process is time-consuming for recording and retrieving children's data. Moreover, the manual taking and monitoring of the weight and height of children use an OPT tool as an assistant for easy computing BMI, as it auto-computes and determines children's status and provides a summary report. But still, there are limitations regarding using this tool.

Many systems have been built to monitor and record the condition of children's health and nutrition, serving as a foundation and offering sufficient support for the development of the proposed system. The Children's Nutrition and Health Monitoring System records and monitors children's nutrition and health within the barangay. Children's information, including their previous health data, must be recorded. The simple calculation of the BMI tracker will be linked to Children Nutrition Tracking, determining the children's health status, including their weight and height. Additionally, the system includes a map that provides barangay health workers with a comprehensive visual representation of the prevalence of malnutrition across different 'Purok.' Using an easy-to-use interface, barangay health workers can zoom in to examine specific details regarding the number of malnourished children in each 'Purok'. Children's parents' contact numbers will also be recorded to notify them through SMS notification. The data generated will be displayed using a bar graph chart for monitoring the quarterly status and individual status, and will be used for providing recommendations as a basis for the barangay to make decisions. This system is not used to monitor illness but for children's health and nutrition only.

The proposed system presents a developed solution in Barangay Butigue, located in Paracelis, Mountain Province, for manual processing into the direct recording of all the information gathered. Instead of writing down the children's information, using this system allows for quick and effective attachment of that information. This system also monitors a child's status as it will report to their parents via SMS notification when there's a problem regarding their child's condition and for the next follow-up check-up. Aside from monitoring children's health and nutrition, the system also has its database backup, which guarantees the safety and accessibility of data. The Children's Nutrition and Health Monitoring System aims to help identify children's physical growth and take an easy time for the assigned health worker to input data for children's healthcare. This system also aims to make the works of the center trouble-free, providing easy access to children's information, preventing severe malnutrition, and prioritizing children's health improvement.

Statement of the Problem

1. What are the problems and issues in managing and monitoring of children health and nutrition?
2. What computerized system can be developed to address the identified problems and issue?
3. What is the extent of compliance of the develop system to ISO 25010 Software Quality Standards as assessed by IT experts in terms of?
    3.1. Functional Sustainability;
    3.2. Performance Efficiency;
    3.3. Compatibility;
    3.4. Usability;
    3.5. Reliability;
    3.6. Security
    3.7. Portability
4. What enhancements can be made to improve the developed system?

II. MATERIALS AND METHODS

This study employed a descriptive research design and system development methods. Descriptive research describes data and characteristics of the system being evaluated and collected for evaluation.

For the development of the system, the Software Development Life Cycle (SDLC) was utilized to identify the series of phases that provide a common understanding of the software-building process.

Figure 1. Agile Model

Figure 1 presents the Agile Development Methodology that will be used in developing the computerized system. This model prioritizes breaking tasks into smaller iterations, and requirements are provided at the beginning of the development process because these components do not directly involve long-term planning. Each iteration involves a team working through a full software development life cycle, and frequent changes are required.

Requirements: The researchers develop the system by identifying and defining all the requirements needed for data gathering. This includes interviewing involved individuals, taking notes, reviewing sources, and proofreading to fulfill the requirements for the system.

Design: The researchers focus on designing the system and defining the model and interface for Barangay Butigue, Paracelis, Mountain Province.

Development: After defining the requirements, development will commence, and the developer will construct the system within the given time frame. Bug fixing will also occur in this stage to prepare for final system testing. System design utilizes diagrams such as HIPO, ERD, and DFD for System Development. The software used for system development includes PHP, XAMPP, and MySQL for the back-end, while CSS, HTML, and JavaScript are used for the front-end.

Testing: The entire system will undergo testing once completed, involving both IT experts and users to evaluate the system's performance and fix any bugs. Testing will occur on the computer intended for implementation.

Deployment: Once the system is checked and passes the functionality test, it will be installed and implemented at Barangay Butigue, Paracelis, Mountain Province.

Review: Reviewing will serve as the basis for monitoring and maintaining the system as problems arise during user-end use.

III. RESULTS AND DISCUSSION

The extent of acceptance of the developed system to ISO 25010 Software Quality Standards as assessed by the IT experts in terms of:

Table 1. IT Experts' acceptance level of the developed system in terms of Functional Sustainability

FUNCTIONAL SUSTAINABILITY	Users	Over-All Mean
1. Functional Completeness - degree to which the set of functions covers all the specified tasks and user objectives.	4.33	4.33
2. Functional Correctness - degree to which the functions provide the correct results with the needed degree of precision	4.33	4.33
3. Functional Appropriateness - degree to which the functions facilitate the accomplishment of specified tasks and objectives.	4.00	4.00
Category Mean	4.22	4.22

Table 1 shows users' assessments of the developed system's compliance with ISO 25010 Software Quality Standards for Functional Sustainability. With a category mean of 4.22, the system is considered a high extent. This implies that the system's functionalities fulfilled the specified duties, requirements, and objectives set by IT experts.

Table 2. IT Experts' Acceptance Level of the Developed System in Terms of Performance Efficiency

PERFORMANCE EFFECIENCY	Users	Over-All Mean
1. Time-behavior - degree to which the response and processing times and throughput rates of a product or system, when performing its functions, meet requirements.	4.33	4.33
2. Resource Utilization - degree to which the amounts and types of resources used by a product or system, when performing its functions, meet requirements.	4.00	4.00
3. Capacity - degree to which the maximum limits of the product or system, parameter meet requirements.	4.33	4.33
Category Mean	4.22	4.22

Table 2 shows users' assessments of the developed system's compliance with ISO 25010 Software Quality Standards for performance efficiency. With a category mean of 4.22, the system is considered a high extent. The result indicates that the system meets the requirements in terms of response times and throughput rates, efficiently utilizes resources and satisfaction with the system's capacity to meet the requirement.

Table 2. IT Experts' Acceptance Level of the Developed System in Terms of Compatibility

COMPATIBILITY	Users	Over-All Mean
1. Co-existence- Degree to which a product can perform its required functions efficiently while sharing a common environment and resources with other products, without detrimental impact on any other product.	4.33	4.33
2. Interoperability - Degree to which two or more systems, products or components can exchange information and use the information that has been exchanged.	4.00	4.00
Category Mean	4.17	4.17

Table 2 shows users' assessments of the developed system's compliance with ISO 25010 Software Quality Standards for compatibility. With a category mean of 4.17, the system is considered a high extent. The system suggests that the system is compatible with different system configurations, specifications and operating system. System Integrating with different environments and exchanging information with other systems or components.

Table 3. IT Experts' Acceptance Level of the Developed System in Terms of Usability

USABILITY	Users	Over-All Mean
1. Appropriateness Recognizability- Degree to which users can recognize whether a product or system is appropriate for their needs.	4.67	4.67
2. Learnability - degree to which a product or system can be used by specified users to achieve specified goals of learning to use the product or system with effectiveness, efficiency, freedom from risk and satisfaction in a specified context of use.	4.67	4.67
3. Operability - Degree to which a product or system has attributes that make it easy to operate and control.	4..00	4.00
4. User error protection - Degree to which a system protects users against making errors.	3.67	3.67
5. User interface aesthetics - Degree to which a user interface enables pleasing and satisfying interaction for the user.	3.67	3.67
6. Accessibility - Degree to which a product or system can be used by people with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use.	3.33	3.33
Category Mean	4.00	4.00

Table 3 shows users' assessments of the developed system's compliance with ISO 25010 Software Quality Standards for usability. With a category mean of 4.00, the system is considered a high extent. The result implies that the system offers an intuitive and user-friendly experience, facilitating effective interaction and achieving high user satisfaction

Table 4. IT Experts' Acceptance Level of the Developed System in Terms of Reliability

RELIABILITY	Users	Over-All Mean
1. Maturity - Degree to which a system, product or component meets needs for reliability under normal operation.	4.00	4.00
2. Availability -Degree to which a system, product or component is operational and accessible when required for use.	4.00	4.00
3. Fault tolerance - Degree to which a system, product or component operates as intended despite the presence of hardware or software faults.	3.67	3.67
4. Recoverability - Degree to which, in the event of an interruption or a failure, a product or system can recover the data directly affected and re-establish the desired state of the system.	5.00	5.00
Category Mean	4.17	4.17

Table 4 shows users' assessments of the developed system's compliance with ISO 25010 Software Quality Standards for reliability. With a category mean of 4.17, the system is considered to a very extent. The result implies that the system demonstrates consistency and dependable performance, ensuring users can rely on it for their monitoring and management needs.

Table 5. IT Experts' Acceptance Level of the Developed System in Terms of Security

SECURITY	Users	Over-All Mean
1. Confidentiality - Degree to which a product or system ensures that data are accessible only to those authorized to have access.	3.67	3.67
2. Integrity - Degree to which a system, product or component prevents unauthorized access to, or modification of, computer programs or data.	4.00	4.00

3. Non-repudiation - Degree to which actions or events can be proven to have taken place, so that the events or actions cannot be repudiated later.	3.33	3.33
4. Accountability - Degree to which the actions of an entity can be traced uniquely to the entity.	3.67	3.67
5. Authenticity - Degree to which the identity of a subject or resource can be proved to be the one claimed.	4.00	4.00
Category Mean	3.73	3.73

Table 5 shows users' assessments of the developed system's compliance with ISO 25010 Software Quality Standards for security. With a category mean of 3.73, the system is considered to a moderate extent. The result implies that the system protects the records/data confidentiality from any unauthorized access.

Table 6. IT Experts' Acceptance Level of the Developed System in Terms of Maintainability

MAINTAINABILITY	Users	Over-All Mean
1. Modularity - Degree to which a system or computer program is composed of discrete components such that a change to one component has minimal impact on other components.	4.33	4.33
2. Reusability - Degree to which an asset can be used in more than one system, or in building other assets.	4.33	4.33
3. Analysability - Degree of effectiveness and efficiency with which it is possible to assess the impact on a product or system of an intended change to one or more of its parts, or to diagnose a product for deficiencies or causes of failures, or to identify parts to be modified.	4.33	4.33
4. Modifiability - Degree to which a product or system can be effectively and efficiently modified without introducing defects or degrading existing product quality.	4.00	4.00
5. Testability - Degree of effectiveness and efficiency with which test criteria can be established for a system, product or component and tests can be performed to determine whether those criteria have been met.	4.00	4.00
Category Mean	4.20	4.20

Table 6 shows users' assessments of the developed system's compliance with ISO 25010 Software Quality Standards for maintainability. With a category mean of 4.20, the system is considered to a high extent. The result implies that the system is well-designed and structured, with continued functioning even if modifications are made, and testing, ensuring its sustainability.

Table 7. IT Experts' Acceptance Level of the Developed System in Terms of Portability

PORTABILITY	Users	Over-All Mean
1. Adaptability - Degree to which a product or system can effectively and efficiently be adapted for different or evolving hardware, software or other operational or usage environments.	4.67	4.67
2. Installability - Degree of effectiveness and efficiency with which a product or system can be successfully installed and/or uninstalled in a specified environment.	4.33	4.33
3. Replaceability - Degree to which a product can replace another specified software product for the same purpose in the same environment.	4.67	4.67
Category Mean	4.56	4.56

Table 7 shows users' assessments of the developed system's compliance with ISO 25010 Software Quality Standards for portability. With a category mean of 4.56, the system is considered to a high extent. The result implies that the system is highly adaptable, installable, and replaceable, making it well-suited for deployment in various operational environments and settings.

Table 8. Summary of IT Experts' Acceptance Level of the Developed System in Compliance with ISO 25010 Software Quality Standards.

ISO 25010 Software Quality Standards.	User (Category Mean)	Descriptive Rating
Functional Sustainability	4.22	Compliant to a high extent
Performance Efficiency	4.22	Compliant to the high extent
Compatibility	4.17	Compliant to the high extent
Usability	4.00	Compliant to the high extent
Reliability	4.17	Compliant to the high extent
Security	3.73	Compliant to a moderate extent
Maintainability	4.20	Compliant to the high extent
Portability	4.56	Compliant to the very high extent
GRAND MEAN	4.16	Compliant to a high extent

Table 8 represents the summary assessment by users on the developed system's compliance with ISO 25010 Software Quality Standards. It assesses functionality longevity, performance efficiency, compatibility, usability, dependability, system security, system maintainability, and system portability. The system got a grand mean of 4.16, descriptively interpreted as compliant to a high extent. This implies that the system fulfills the ISO 25010 Software Quality Standards across all metrics and is very satisfactory to experts.

Practices, Problems, and Issues Encountered in Manual Attendance Taking and Summary Report Preparation

Barangay Butigue, located in Paracelis, Mt. Province, administered health monitoring at the barangay through manual processing of records, wherein workers wrote and sorted them into envelopes kept in one place. Problems encountered during the actual gathering of the manual processes included time-consuming recording of information, especially for follow-ups on newborn babies and those who hadn't yet registered. Furthermore, keeping files in the barangay center posed security risks, as unexpected losses could occur due to calamities.

Monitoring the health status of children in the barangay involved acquiring their height and weight using a tool provided by the Department of Health (DOH) known as the OPT tool. This tool, an Excel file, was used to input data gathered from the children, making a significant contribution to monitoring their condition. However, it had limitations, such as recording only BMI (height and weight) and difficulty in updating previous information to reflect current data (using the same format). Additionally, file recovery proved challenging.

Problems in obtaining children's information were divided into sectors, with assigned health workers responsible for acquiring and submitting the data to the Barangay Nutrition Action Officer (BNOA), who inputted the data into the OPT tool. Furthermore, there was an issue with parents being reluctant to send their children to the barangay. As a result, health workers needed to personally inform and visit the parents to attend to their children's health needs.

Developed Computerized System to Address Identified Problems and Issues in Manual Attendance Taking

The Children Nutrition and Health Monitoring System was developed to address identified issues and problems in administering barangay health at the computerization level only. Aside from faster and more efficient record-keeping and access to real-time data, the system was developed using HTML 5, CSS, PHP 5, and JavaScript as web tools, with MYSQL serving as the database.

Web-based: The system is a web-based platform capable of supporting a large number of users while remaining stable. This enables faster data entry from the completed forms provided.

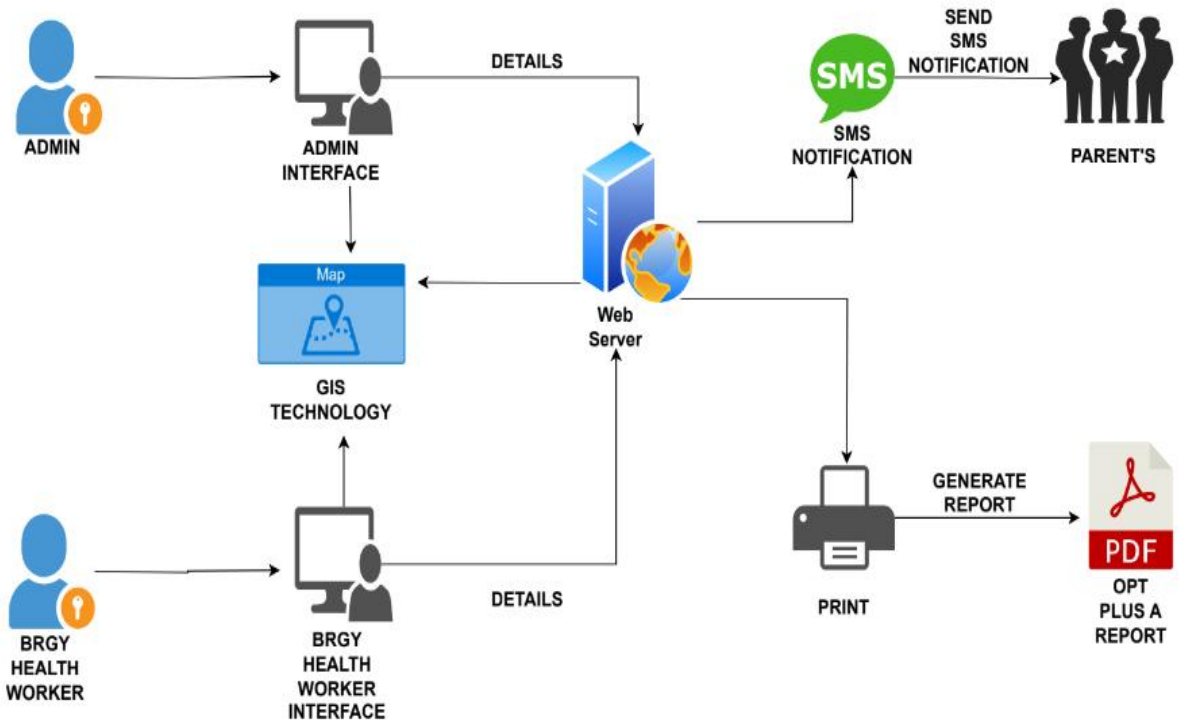

Figure 2. Client/Server Architecture of the Children's Nutrition and Health Monitoring System

IV. CONCLUSION AND RECOMMENDATION

Based on the comprehensive evaluation conducted by IT experts, the Children's Nutrition and Health Monitoring System demonstrates significant efficacy, prompting a recommendation for adoption by Barangay Butigue. The study highlights the prevalent reliance on manual processing of health records within the barangay, leading to inefficiencies and inaccuracies, particularly due to data division across various sectors. In response, the developed system offers a comprehensive solution, providing a fast and user-friendly recording system while addressing identified issues. Notably, the system's compliance with ISO 25010 standards reflects its high performance across key categories, indicative of its robustness and reliability. Furthermore, the system aligns with Sustainable Development Goals, particularly SDG #2 (Zero Hunger) and #3 (Good Health and Well-being), by facilitating easy access to vital health information and promoting community health initiatives. Moving forward, suggestions for enhancements include improvements in data handling, graphical representation for progress tracking, and reinforced security measures to ensure data integrity and confidentiality.

Recommendation

Based on the findings of this study, several recommendations emerge to enhance the effectiveness and sustainability of the developed system. Firstly, further development and enhancement of the system are highly recommended to improve its functionality and add new features that address emerging needs.

Additionally, it is important to consider implementing the system beyond its initial scope to test its performance and functionality in different contexts. Moreover, promoting user adoption of digitalization is crucial to facilitate easy and fast access to records and monitor the health progress of the community. These recommendations aim to ensure the continuous improvement and relevance of the system in addressing evolving challenges in health monitoring and management.

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