International Journal of Informatics and Computation (IJICOM)
Vol.7, No.2, 2025
ISSN: 2685-8711, E-ISSN: 2714-5263 DOI: 10.35842/ijicom

GuardCare: Child's Nutritional Status Diagnostics Using Rule-Based Reasoning

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Abstract

Nutritional status is a critical factor in ensuring the proper growth and development of children under five years old. It encompasses both undernutrition (stunting, wasting, and underweight) and overnutrition (obesity). However, existing diagnostic tools are often limited to healthcare facilities, restricting parents' ability to monitor their children's nutritional health independently. To address this gap, the system was developed using the Mobile Application Development Life Cycle (MADLC) and implements a Rule-Based Reasoning (RBR) engine with forward chaining to diagnose conditions. The results demonstrated high functional stability, with all black box test cases passing successfully. Furthermore, expert validation yielded a feasibility score of 89.09%, categorizing the application as "Very Feasible" and confirming its diagnostic accuracy. This study concludes that the development of the GuardCare application was successful, resulting in a valid and reliable tool for its intended purpose of nutritional status diagnosis.

Keywords:
Nutritional Status, Rule-Based Reasoning, Diagnostics, MADLC

1. Introduction

Every child under five years old should have access to timely and accurate diagnostics for their nutritional status to ensure they receive appropriate interventions to prevent malnutrition, including stunting, wasting, underweight, or obesity [1]. Wasting, stunting, and underweight are some of the indicators commonly used to measure undernutrition, whereas obesity and overweight are categorized as overnutrition. According to the WHO, in 2015, approximately 42 million children under the age of five were overweight or obese, while 156 million children experienced stunting. Several studies show that the link between early-life nutritional inadequacies and the development of obesity or chronic diseases later in life is not merely coincidental. Nutritional inadequacies in childhood, even during pregnancy, predispose people to obesity and chronic diseases like diabetes and heart disease later in life [2].

In Indonesia, malnutrition remains a significant concern. UNICEF reported in 2019 that malnutrition in Indonesia remains a significant concern, with stunting affecting 20% of children, wasting impacting around 8%, and around 1 million children were obese [3]. The dual burden of malnutrition, which includes undernutrition (wasting, stunting, and underweight) and overnutrition, illustrates a significant nutritional imbalance among Indonesian children [4]. Inadequate nutrition intake during early childhood can result in lasting issues, including stunted physical growth, delayed cognitive development, and irreversible damage to brain function [5]. The three primary categories of undernutrition are

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wasting, stunting, and underweight. Wasting refers to low weight-for-height, typically indicating recent and severe weight loss due to inadequate food intake or infectious diseases like diarrhea. Moderately or severely wasted young children face an increased risk of mortality, but treatment options exist [6]. Stunting is defined by low height relative to age. It arises due to long-term chronic or recurrent undernutrition, often linked to poor socioeconomic circumstances, inadequate maternal health and nutrition, frequent illnesses, and inappropriate infant and young child feeding and care during early life. Stunting obstructs children from reaching their full physical and cognitive potential. Underweight children exhibit low weight-for-age and may experience stunting, wasting, or both. Underweight refers to a condition where a child’s weight is below the standard or usual range. The condition of being underweight can affect various aspects of a child’s growth, including bones, hair, and skin [7]. In contrast, overnutrition is exemplified by obesity, a pathological condition that occurs when energy intake exceeds expenditure over a prolonged period. Obesity results in excessive fat accumulation that can harm bodily functions and overall health. This imbalance, often due to overconsumption and inadequate physical activity, poses significant health risks [8].

Diagnostic tools for assessing children's nutritional status are typically available only in healthcare facilities, such as integrated health posts (Posyandu) and community health centers (Puskesmas), where professional evaluations are conducted by trained health workers [9]. However, the absence of accessible diagnostic resources significantly limits parents’ ability to independently monitor their child’s nutritional status [10]. This limitation increases the risk of unrecognized nutritional issues, which can lead to serious long-term health consequences, including stunted growth, developmental delays, or the onset of chronic diseases. Therefore, there is a critical need for a solution that enables parents to effectively assess their child's nutritional status conveniently and accurately, supporting early intervention and improved health outcomes.

In this technological era, a system can be developed to gain parents' awareness regarding their child’s nutritional status, as well as help parents to take proper care of their children. With the existence of easily accessible mobile applications, a diagnostic can be conducted to determine their child's nutritional status. This allows for timely interventions and encourages parents to pay closer attention to their child's nutritional intake and growth patterns [11]. A method called Rule-Based Reasoning can be used to develop a simple diagnostic that has been mentioned before. Rule-Based Reasoning is a system under Artificial Intelligence that applies knowledge acquisition to accumulate and reason to conclude. The knowledge is utilized to create rules that enable it to make a diagnosis through logical computation [12].

This research proposes the creation of GuardCare, a mobile application that provides diagnostic assessments of a child’s nutritional status using Rule-Based Reasoning. Parents can input the child’s weight, height, and age into the application; therefore, the system calculates Z-scores for weight-for-age (WFA), height-for-age (HFA), and weight-for-height (WFH) to classify the child’s nutritional status into one of five categories: normal, stunting, wasting, underweight, or obesity. These classifications will be made using calculated Z-scores for weight-for-age, height-for-age, and weight-for-height. GuardCare will also offer personalized recommendations based on the diagnostic results. These recommendations will guide parents in adjusting their child’s diet and ensuring healthier growth.

2. Related Works

Previous studies on nutritional information systems have explored both mobile and web-based platforms to assist in monitoring and assessing children's nutritional status. One Android-based application, developed using the Waterfall model and R&D approach, employed algorithms based on the WHO LMS method and age calculations to determine nutritional status [13]. Similarly, another study applied the Waterfall model to develop a web-based system hosted locally at a community health center. This system utilized the CHAID decision tree method to classify nutritional status based on key variables such as age, gender, weight, height, and health post location [14].

Another web-based system focused on decision support for nutritional classification employed the Simple Additive Weighting (SAW) method to address parental confusion regarding multiple nutrition categories available in health centers. While these systems successfully translated clinical logic into digital interfaces, they mostly relied on conventional decision-making algorithms, offering limited adaptability in dynamic diagnostic scenarios [15]. In contrast, Rule-Based Reasoning (RBR) has been introduced in several studies as a more flexible approach for handling classification and diagnosis. Although it has been applied to nutrition-focused systems, such as one developed for monitoring stunting using expert-derived rules [11]. These differences underline RBR's adaptability across use cases, even within the same domain.

Beyond nutrition, RBR has seen broader application in fields such as cybersecurity, retail, and agriculture. In the context of robotic network safety systems, RBR has been used to enhance data classification through intelligent rule-based analysis, improving system responsiveness and security [16]. In the retail sector, RBR has supported store owners in classifying mobile phone purchases by analyzing historical transaction data, aiding in inventory planning and order placement. This system was developed using the Rapid Application Development (RAD) method to ensure iterative and user-focused deployment [17]. In agriculture, RBR has been utilized to build web-based diagnostic tools for identifying plant diseases based on observable symptoms. These systems are designed to deliver accurate and timely diagnoses along with appropriate treatment recommendations, all through user-friendly interfaces tailored to farmers' needs [18]. These diverse applications highlight the flexibility and problem-solving capabilities of RBR in developing expert systems that require structured, rule-driven decision-making.

In parallel, the Mobile Application Development Life Cycle (MADLC) has been increasingly adopted in various domains to guide the systematic development of mobile solutions. One study utilized MADLC to create an AR-based app that educates children about body boundaries and raises awareness of child sexual abuse [19]. Another research created an Android-based learning medium (m-learning) to provide parents with easy access to the latest reference information on child development [20]. In another study, MADLC was applied to develop a mobile application for detecting corn leaf diseases. This app aims to collect detailed information on different types of leaf diseases typically affecting corn crops. Moreover, the disease detection feature was developed using image processing techniques and artificial intelligence [21]. These implementations demonstrate MADLC's flexibility in supporting diverse application needs.

Previous studies have introduced solutions such as web-based platforms and mobile applications, but limitations persist in terms of accessibility and personalized nutritional recommendations. Rule-Based Reasoning (RBR) has demonstrated its effectiveness in terms of problem-solving across domains, making it a suitable approach for nutritional diagnostics. This research aims to address existing gaps by developing a comprehensive mobile application that enhances accessibility, accuracy, and real-time guidance for managing nutritional status effectively by integrating RBR with the MADLC.

3. Proposed Method

The Mobile Application Development Life Cycle (MADLC) will be used as a methodology for mobile application development of this proposed project. MADLC development process progresses through a series of stages, including identification, design, development, prototype, testing, deployment, and maintenance, sequentially [22]. This method is highly appropriate for utilization due to its enhanced accuracy, systematic nature, and easily comprehensible phases for developing applications. Fig. 1. depicts the stages of the MADLC methodology.

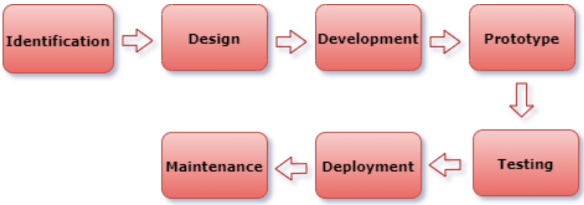

Fig. 1. Mobile Application Development Life Cycle

3.1 Identification Phase

Identification involves identifying ideas to discover a resolution through a mobile application. These ideas require detailed analysis to determine the application's scope before advancing to the next phase [23]. The identification phase begins with defining the research area and articulating the problem statement by establishing the domain concerning the nutritional status of children under five years old, and the research area focuses on rule-based reasoning.

3.2 Design Phase

In this phase, the mobile application developer transforms ideas into the initial design of the application. A critical aspect of the design phase is creating a storyboard for user interface interactions [24]. The first stage involves users or parents being required to log in, or if they don't have an account, they will sign up by providing some information. After logging in, the user will be directed to the homepage and then guided to create a child profile if one does not already exist. This child's profile page required essential data such as the name, date of birth, sex, and blood type. The user can access the diagnostic feature if the profile of the child is completed, the main function of this mobile application.

Within the diagnostic process, parents will be asked to input their child's data, such as height, weight, and age. This information will be used to calculate the child's nutritional status, categorizing it into one of the following: stunting, wasting, underweight, obesity, or normal condition. Following the child's nutritional status result, the system directed to the recommendation page. This page offers personalized guidance tailored to the specific nutritional issue, such as advice on managing the child's nutritional intake. After reviewing the recommendations, the user will be directed to the history page, where they can view and track the child's growth history, including height, weight, and nutritional status over time.

3.3 Development Phase

The development phase involved the implementation of the application based on the outcomes from the design phase [25]. The coding process was executed using the Android Studio IDE with the Kotlin programming language to develop the front-end, focusing on creating an intuitive user interface and a positive user experience. A primary focus of the backend development was the integration of a local database using SQLite. SQLite was chosen as it is a lightweight, serverless, and self-contained SQL database engine ideal for mobile applications, storing all data in a single text file on the device. The final stage of development was the implementation of the expert system. The Rule-Based Reasoning method was integrated into the application, employing a forward chaining technique to power the diagnostic process. This involved translating the WHO growth standard tables and diagnostic rules into functional code within the `ZScoreCalculation` class.

3.4 Prototyping Phase

During this stage, functional aspects of every prototype undergo assessment. Prototypes are tested and delivered to the stakeholders or users as well for feedback. This iterative process persists until the application reaches its final form [25]. This study adopted an iterative prototyping approach, where the prototyping phase was integrated directly into the development cycle. Instead of creating separate, non-functional mockups, each developed module served as a functional prototype that was immediately available for internal testing. This iterative process began with a core prototype that included user registration and the basic diagnosis function. Subsequent iterations incrementally added features such as the history view, growth charts, and recommendation pages. Each iteration produced a more complete, high-fidelity prototype. The final version submitted for the testing phase was a feature-complete application, allowing for a comprehensive evaluation of its functionality.

3.5 Testing Phase

The testing phase was conducted on both emulators and physical Android devices to ensure stability and compatibility. The evaluation employed two distinct methods:

1. Functional Black Box Testing: This testing was performed by the researcher to assess the application's functionality from an end-user perspective. It ensured that all features operated as designed, the user interface displayed correctly, and the application was usable across different scenarios [25].
2. Expert Validation: Following the functional testing, the application was submitted to a subject matter expert (a Nutritional Science Lecturer) for content and logic validation. This crucial step assessed the accuracy of the diagnostic rules and the appropriateness of the health information provided.

4. Experimental Setup

4.1 Rule-Based Reasoning

In this study, we construct rule-based reasoning as a method of reasoning that employs rules within a knowledge base, typically represented using IF-THEN statements. The IF-THEN structure is utilized when there is previously known information from experts, specialists, or collectively agreed guidelines [12]. To manage the rules in rule-based reasoning, there are two techniques: forward chaining and backward chaining [26]. The technique suitable for this research, which requires diagnosing a child's nutritional status. Table 1 shows the categories and thresholds of children's nutritional status.

Table 1. Thresholds of Children's Nutritional Status based on Z-Scores

Index	Standard Deviation (Z-Score)	Nutritional Status
Weight for Height (WFH) for a child aged 0 – 60 months	Z−Score > +3	Obese
	+2 < Z−Score ≤ +3	Overweight
	−2 ≤ Z−Score ≤ +2	Normal
	−3 ≤ Z−Score <−2	Wasted
	Z−Score < −3	Severely Wasted
Length or Height for Age (LHFA) for a child aged 0 – 60 months	Z−Score ≥ − 2	Normal
	−3 ≤ Z−Score <− 2	Stunted
	Z−Score <−3	Severely Stunted
Weight for Age (WFA) for a child aged 0 – 60 months	Z−Score ≥ −2	Normal
	−3 ≤ Z−Score < −2	Underweight
	Z−Score < −3	Severely Underweight

The system's knowledge base is derived from the WHO databases. It consists of a fact base, containing the WHO Child Growth Standards, and a rule base, containing a set of "IF-THEN" production rules. The primary diagnostic indices are Weight-for-Age (WFA), Height-for-Age (HFA), and Weight-for-Height (WFH). The Z-score for the Weight-for-Age (WFA) and Weight-for-Height (WFH) indices is calculated using the LMS formula as shown in Equation (1).

$$Z - Score = \frac{((ISV/M)^L)-1}{L \times S} \quad (1)$$

Where *ISV* is the Individual Subject Value, and *L* (Lambda), *M* (Median), and *S* (Coefficient of Variation) are the reference values retrieved from the WHO data. For the Length/Height-for-Age (LHFA) index, a simplified Z-score formula is used in Equation (2) where *MSV* is the Median Standard Value and *SDV* is the Standard Deviation Value. The specific Z-score thresholds and the prioritized rule set implemented in the inference engine are detailed in the Results section.

$$Z\text{ - }Score = \frac{ISV - MSV}{SDV} \quad (2)$$

Table 1. The Notation of Z-Score

Notation	Description
ISV	*Individual Subject Value (height/length or weight)*
L	*Lambda*
M	*Median*
S	*Coefficient of Variation*
MSV	*Median Standard Value*
SDV	*Standard Deviation Value*

5. Result and Analysis

5.1 Implemented Rules

This research used rule-based reasoning with the forward chaining technique. Rule-based reasoning is also identified as a method of reasoning that employs rules within a knowledge base, typically represented using IF-THEN statements [30]. It's aligned with the forward chaining technique; a basic forward chaining algorithm begins with specific facts in the knowledge base, executes all of the rules that form the foundation of those facts, and then adds the outcomes to the knowledge base [31]. The calculated Z-Scores are passed as facts to the rule-based reasoning inference engine, which is systematically detailed in Table 2 to derive a single, definitive nutritional status.

Table 2. Implemented Diagnostic Rule Set in IF-THEN Format

Rule Group	IF Condition (Fact)	THEN Diagnosis (Conclusion)
Acute Malnutrition / Overnutrition		
R1	The child's (Male/Female) WFH Z-Score is less than -3.0	Severely Wasted
R2	The child's (Male/Female) WFH Z-Score is less than -2.0	Wasted
R3	The child's (Male/Female) WFH Z-Score is greater than +3.0	Obese
R4	The child's (Male/Female) WFH Z-Score is greater than +2.0	Overweight
Chronic Malnutrition		
R5	The child's (Male/Female) LFHA Z-Score is less than -3.0	Severely Stunted
R6	The child's (Male/Female) LFHA Z-Score is less than -2.0	Stunted
Underweight Status		
R7	The child's (Male/Female) WFA Z-Score is less than -3.0	Severely Underweight
R8	The child's (Male/Female) WFA Z-Score is less than -2.0	Underweight
Default		
R9	None of the above conditions for the child (Male/Female) are met	Normal

5.3 System Testing and Evaluation

1) Functional Black Box Testing
Functional testing using the Black Box method was conducted to verify all core features of the GuardCare application. The purpose of this testing is to ensure that each function operates according to the design specifications, as well as to identify and fix the bugs, user interface issues, and user flow problems [32]. The testing involved five primary test scenarios covering the main user flows, from diagnosis to data synchronization and navigation, as documented in Table 3. Each test case was executed to compare the application's actual results against the expected outcomes.

Table 3. Result of Black Box Testing

Test ID	Feature	Testing Scenario	Testing steps	Expected Result	Actual Result	Status
BB-001	Diagnosis	Perform a diagnosis with valid data for a “Normal” nutrition child	1. Select child profile 2. Navigate to “Diagnosis” page. 3. Enter Weight: 11 kg, Height: 85.0 cm for a 24-month-old girl 4. Press “Save”	App displays “Normal” nutritional status and valid Z-Scores	App successfully displays “Normal” nutrition and correctly calculates Z-Score	Pass
BB-002	Diagnosis	Test input validation with an empty field	1. Go to the Diagnosis page 2. Leave the “Weight” field empty 3. Press “Save”	The error message “Weight is required” appears.	Expected error message appears.	Pass
BB-003	Data Synchronization	Test whether the Homepage updates after a new diagnosis	1. Note current status on Home Page (e.g., “Normal”) 2. Perform a new diagnosis with a different result (e.g., “Severely Wasted”) 3. Save the result and return to the Home Page	The “Current Status” badge and indicators update to show “Severely Wasted”	Homepage successfully updates to reflect the latest diagnosis result	Pass
BB-004	History	Test if the History page shows the correct Z-Score	1. Perform a new diagnosis 2. Note the Z-Score 3. Open the History page	New entry in the history list displays the new entry Z-Score	The history list accurately shows the new entry with the correct Z-Score	Pass
BB-005	Navigation	Test Bottom Navigation functionality from the Profile page	1. Go to the “Recommendation” page. 2. Tap the “Home” icon on the Bottom Navigation Bar	App returns to MainActivity and “Home” icon is highlighted	Navigation succeeds and the correct item is highlighted	Pass

The functional accuracy achieved in this testing phase was 100%, as all five test cases passed. This result indicates that the application is functionally stable, responsive, and free of critical bugs in its primary user workflows. The successful completion of this phase confirmed the application's readiness for the subsequent expert validation stage.

2) Expert Validation

To measure the accuracy and content feasibility of the GuardCare application, a validation phase was conducted with a subject matter expert. This validation is crucial as it assesses the correctness of the application’s rule-based logic against professional scientific standards [33].

- Validator: A Nutritional Science Lecturer from Universitas Aisyiyah Yogyakarta

- Methodology: The validator was presented with the application and a structured validation form. They were asked to assess three primary aspects: Diagnostic Accuracy, Clarity of Information, and Recommendation Appropriateness, based on predefined case studies and a direct review of the application's features.

Quantitative Assessment Results

The quantitative data were collected using a 5-point Likert scale, a widely used psychometric scale in research to measure attitudes or opinions. The scale was defined as follows:

- 5 – Very Appropriate / Very Clear
- 4 – Appropriate / Clear
- 3 – Fairly Appropriate / Fairly Clear
- 2 – Less Appropriate / Less Clear
- 1 – Not Appropriate / Not Clear

The scores from the expert are summarized in Table 4.

Table 4. Result of the Expert Assessment

Aspect	Item No.	Statement	Score
Diagnostic Accuracy	A1	The final nutritional status displayed (e.g., Severe Wasting, Stunted) is appropriate for the given input data.	4
	A2	The calculated Z-Score values (WAZ, HAZ, WHZ) appear accurate based on WHO standards.	4
	A3	The calculation of the child's age in months based on the date of birth is accurate.	5
	A4	The application's logic for differentiating between length-for-age (<24 months) and height-for-age (≥24 months) is correct.	4
Clarity of Information	B1	The nutritional status terms used (e.g., 'Severely Wasted', 'Stunted') are easily understandable for lay parents.	5
	B2	The visual presentation (e.g., use of red, yellow, and green colors) is effective in conveying the urgency level of the nutritional status.	5
	B3	The information displayed on the Status Detail page and the main Dashboard is consistent.	5
	B4	The descriptive text for each nutritional status is sufficiently informative and not misleading.	4
Recommendation Appropriateness	C1	The suggested 'Meal Plan' content is generally appropriate for each nutritional status category.	4
	C2	The 'Physical Activity' and 'Health Tips' recommendations are safe, relevant, and applicable for parents.	4

	C3	Overall, the recommendations provide useful initial guidance and encourage users to seek further professional consultation.	5
Total Score	11 items		49

The feasibility level is determined by comparing the total score obtained against the maximum ideal score.

1. Total Score Obtained (∑X): 49
2. Maximum Ideal Score: (Number of Items) x (Highest Score) = 11 x 5 = 55
3. Feasibility Percentage:

$$\frac{Total\ Score\ Obtained}{Maximum\ Ideal\ Score} \times 100\% = \frac{49}{55} \times 100\% = 89.09\%$$

The resulting percentage is interpreted using a feasibility criteria scale [34], as shown in Table 5.

Table 5. Feasibility Percentage Criteria

Percentage Range	Qualitative Criteria
81% - 100%	Very Feasible
61% - 80%	Feasible
41% - 60%	Fairly Feasible
21% - 40%	Less Feasible
0% - 20%	Not Feasible

The feasibility score of GuardCare is 89.09%, and the application is specified to the “Very Feasible” category. This high score indicates that the expert considers the application’s rule-based inference for diagnosing nutritional status to be valid and accurate.

5.4 Diagnostic Accuracy

This section presents a detailed diagnostic case study to demonstrate the practical application and verify the accuracy of the implemented system.

- Case Study: A case is defined for a female child who is 48 months old, with a weight of 12 kg and a height of 90 cm.
- Reference Data Retrieval: Upon receiving the input, the system queries its internal database, which contains the WHO Child Growth Standards. For this specific case, the reference values shown in Table 6 are retrieved.

Table 6. WHO Reference Values for Case Study

Index	Reference Values		
Weight-for-Age (WFA)	**L**: -0.3359	**M**: 16.0533	**S**: 0.13886
Height-for-Age (LHFA)	**MSV**: 102.7312	**SDV**: 4.3075	
Weight-for-Height (WFH)	**L**: -0.3833	**M**: 12.6461	**S**: 0.08911

In this study, we also calculate the Z-score using the input data and the reference values from the. Table 5 depicts how the system applies the LMS formula to calculate the Z-score for each index:

1. Weight-for-Age (WFA) Z-Score:

$$Z - Score = \frac{(\left(\frac{12.0}{16.0533}\right)^{-0.3359}) - 1}{(-0.3359\ x\ 0.13886)} = -2.21$$

2. Height-for-Age (HFA) Z-Score:

$$Z - Score = \frac{90 - 102.7312}{4.3075} = -2.96$$

3. Weight-for-Height (WFH) Z-Score:

$$Z - Score = \frac{(\left(\frac{90}{12.6461}\right)^{-0.3833}) - 1}{(-0.3833\ x\ 0.08911)} = -0.59$$

As the inference process and final diagnosis, the calculated Z-Score (WFA = -2.21, HFA = -2.96, WFH = -0.59) becomes the new facts for the RBR inference engine. The engine iterates through the prioritized rule set (as defined in Table 2) to derive a conclusion:

1. WFH Evaluation (Priority 1): The engine first evaluates the WFH Z-Score of -0.59. This value is within the normal range (-2 to +2), so it does not trigger any rules for Wasting or Obesity. No conclusion is made.
2. HFA Evaluation (Priority 2): The engine proceeds to the next priority group, evaluating the HFA Z-Score of -2.96. This value matches the condition for Rule R6 (Z-Score < -2.0). Rule R6 is IF the HFA Z-Score is less than -2.0, THEN the conclusion is Stunted.
3. Final Diagnosis: The inference process stops as a conclusion has been reached. The final diagnosis determined by the system is Stunted.

Based on the outcomes of functional testing, expert validation, and diagnostic case analysis, the GuardCare application has been comprehensively verified for accuracy and reliability. Black-box testing indicates that the application demonstrates high functional stability and robustness, with all primary features performing in accordance with design specifications. Expert validation resulted in a feasibility score of 89.09%, categorized as "Very Feasible," thereby substantiating the accuracy of the diagnostic logic and its alignment with established professional standards.

6. Conclusion

According to the experimental results, the GuardCare application has successfully implements the RBR method using Forward Chaining techniques to perform diagnostic assessments of a child’s nutritional status. Functional Black Box Testing demonstrated a 100% success rate, indicating that all application features operate reliably and in accordance with the design specifications. Furthermore, expert validation by a subject-matter specialist (nutritionist) yielded a feasibility score of 89.09%, classified as "Very Feasible." This confirms that the diagnostic logic used to classify nutritional status (stunting, wasting, underweight, obesity, or normal) is accurate and aligns with established professional standards. Overall, this study successfully addresses the research problem by delivering an accessible tool for parents to independently monitor their child’s nutrition.

References

[1] L. Yuliarsih, “Gambaran Status Gizi Dan Pola Makan Balita di Wilayah Kerja Puskesmas Astanajapura Kabupaten Cirebon Tahun 2019,” *Cerdikia Jurnal Ilmiah Indonesia*, vol. 2, no. 1, pp. 130–140, Feb. 2020.

[2] Agustina, B. S. Prahastuti, and D. Khoirunnisa, “Double Burden of Malnutrition,” *Cegah Stunting*. [Online]. Available: https://www.cegahstunting.com/post/double-burden-of-malnutrition. Accessed: Nov. 25, 2023.

[3] UNICEF, “Nutrition - Tackling the ‘triple burden’ of malnutrition in Indonesia,” *UNICEF*. [Online]. Available: https://www.unicef.org/indonesia/nutrition. Accessed: Jul. 03, 2025.

[4] D. Ayuningtyas, D. Hapsari, R. Rachmalina, V. Amir, R. Rachmawati, and D. Kusuma, “Geographic and Socioeconomic Disparity in Child Undernutrition across 514 Districts in Indonesia,” *Nutrients*, vol. 14, no. 4, Feb. 2022, doi: 10.3390/nu14040843.

[5] N. K. S. Julyantari et al., “Implementasi K-Means Untuk Pengelompokan Status Gizi Balita (Studi Kasus Banjar Titih) Implementation of K-Means for Clustering the Nutritional Status of Toddlers (Banjar Titih Case Study),” *Jurnal Janitra Informatika dan Sistem Informasi*, vol. 1, no. 2, pp. 92–101, 2021, doi: 10.25008/janitra.

[6] World Health Organization, “Malnutrition,” *World Health Organization*. [Online]. Available: https://www.who.int/news-room/fact-sheets/detail/malnutrition. Accessed: Nov. 29, 2023.

[7] Marcinda and D. A. Mirasanti, “Kenali Perbedaan Underweight, Stunting, dan Wasting beserta Cirinya!,” *PrimaKu*. [Online]. Available: https://primaku.com/tumbuh-kembang/kenali-perbedaan-underweight--stunting--dan-wasting-beserta-cirinya-. Accessed: Nov. 29, 2023.

[8] Indanah, Sukesih, Fairuzza, and Khoiriyah, “Obesitas pada Balita,” *Jurnal Ilmu Keperawatan dan Kebidanan*, vol. 12, no. 2, pp. 242–248, 2021.

[9] D. P. Fadiyah, Y. Iswari, D. Ramdhania, D. Damayanti, D. N. Wasliyah, and I. Indriani, “Penerapan Teknologi Untuk Menilai Status Gizi Pada Balita,” *Journal of Health Educational Science And Technology*, vol. 5, no. 2, pp. 127–134, Aug. 2022, doi: 10.25139/htc.v5i2.4641.

[10] Rosari et al., “Developing a Nutritional Assessment Tool for Toddlers Using Anthropometry and IoT Technology,” *International Journal of Advanced Health Science and Technology*, vol. 4, no. 2, pp. 67–71, Apr. 2024, doi: 10.35882/ijahst.v4i2.319.

[11] H. R. Jannah, S. Kusumadewi, and R. E. Fitriyanto, “Stunting Management Monitoring System,” *Sinkron*, vol. 7, no. 1, pp. 185–195, Jan. 2022, doi: 10.33395/sinkron.v7i1.11267.

[12] N. Masri et al., “Survey of Rule-Based Systems,” 2019. [Online]. Available: www.ijeais.org/ijaisr.

[13] H. Al Rahmad et al., “Effectiveness of Using Android-Based Applications for Nutrition Monitoring of Toddlers in Banda Aceh,” *Open Access Maced. J. Med. Sci.*, vol. 10, no. E, pp. 444–451, Jan. 2022, doi: 10.3889/oamjms.2022.7599.

[14] S. Larissa, Z. Lewoema, and P. T. Prasetyaningrum, “Implementasi Data Mining Pada Klasifikasi Status Gizi Bayi Dengan Metode Decision Tree CHAID (Studi Kasus: Puskesmas Godean 1 Yogyakarta),” *Journal of Information Technology Ampera*, vol. 5, no. 1, pp. 2774–2121, 2024, doi: 10.51519/journalita.v5i1.538.

[15] S. Shofia, M. Jhulianawati, F. Nurapriani, and P. D. Atika, "Sistem Pendukung Keputusan Penentuan Status Gizi Balita dengan Menggunakan Metode Simple Additive Weighting (SAW)," *Jurnal Informatika Utama*, vol. 1, no. 1, pp. 11–14, Jun. 2023, doi: 10.55903/jitu.v1i1.71.
[16] Y. Jiang, "Data Security Analysis Based on ReXNet Network With Rule-based Reasoning for Intelligent Cooperative Robot Design," *International Journal of Network Security*, vol. 25, no. 3, pp. 545–551, 2023, doi: 10.6633/IJNS.202305.
[17] S. Handayani, R. Toyib, and S. Wibowo, "Classification of Mobile Phone Purchases Based on Sales Transaction Data Using the Rule Based Reasoning," *Article History*, 2024.
[18] M. Husna et al., "Aplikasi Diagnosa Penyakit Tanaman Buah Menggunakan Metode Rule Based Reasoning," 2024. [Online]. Available: http://jurnal.goretanpena.com/index.php/JSSR.
[19] Z. A. Nasrudin, N. H. M. Ariffin, N. S. A. Rashid, and I. Mazlin, "MYbody: Augmented Reality Mobile App for Understanding Body Boundaries Using MADLC," in *Proc. 2023 10th Int. Conf. Electrical and Electronics Engineering (ICEEE)*, pp. 200–206, 2023.
[20] S. Atmojo, S. Dewi, N. Widhiyanta, and R. Utami, "Aplikasi Android Halo Balita Dengan Metode MADLC," *Jurnal TEKNOINFO*, vol. 16, no. 1, pp. 119–123, 2022.
[21] T. S. Jaya et al., "Pengembangan Aplikasi Mobile Pendeteksi Penyakit Daun Tanaman Jagung dengan Metode Mobile Application Development Life Cycle (MADLC)," *JSI: Jurnal Sistem Informasi (E-Journal)*, vol. 16, no. 1, 2024.
[22] M. A. Jaffar, P. Purwantoro, and A. A. Ridha, "Aplikasi Kehadiran Mahasiswa Menggunakan NFC Card Berbasis Mobile Android," *Jurnal Informatika Universitas Pamulang*, vol. 6, no. 1, p. 7, Mar. 2021, doi: 10.32493/informatika.v6i1.7368.
[23] L. Shanmugam, S. F. Yassin, and F. Khalid, "Incorporating the Elements of Computational Thinking into the Mobile Application Development Life Cycle (MADLC) Model," Jun. 2019.
[24] U. Ependi, "Solusi Mudah Belajar Matematika Tingkat Sekolah Dasar Menggunakan Perangkat Lunak Model MADLC," *JATISI (Jurnal Teknik Informatika dan Sistem Informasi)*, vol. 2, no. 2, Mar. 2016.
[25] Sutra, I. Effendy, and M. Ariandi, "Sistem Informasi Jasa Ekspedisi Pengiriman Barang Berbasis Mobile Menggunakan Metode MADLC," *Bina Darma Conference on Computer Science*, 2020.
[26] R. Turgunbaev, "Application of Rule-Based Reasoning in the Automatic Extraction of Metadata from Academic Articles," *European Journal of Innovation in Nonformal Education (EJINE)*, 2022. [Online]. Available: www.innovatus.es.
[27] D. Wira, T. Putra, and R. Andriani, "Unified Modelling Language (UML) dalam Perancangan Sistem Informasi Permohonan Pembayaran Restitusi SPPD," vol. 7, no. 1, 2019.
[28] R. Pakaya, A. R. Tapate, and S. Suleman, "Perancangan Aplikasi Penjualan Hewan Ternak Untuk Qurban Dan Aqiqah Dengan Metode Unified Modeling Language (UML)," *Jurnal Technopreneur (JTech)*, vol. 8, no. 1, pp. 31–40, May 2020, doi: 10.30869/jtech.v8i1.531.
[29] J. Margaretha and A. Voutama, "Perancangan Sistem Informasi Pemesanan Tiket Konser Musik Berbasis Web Menggunakan Unified Modeling Language (UML)," *JOINS (Journal of Information System)*, vol. 8, no. 1, pp. 20–31, Jun. 2023, doi: 10.33633/joins.v8i1.7107.
[30] O. Muraina and I. A. Adeleke, "Researchers' Artificial Intelligence Expert System Rule-Based Decision Making Using Visirule," *International Journal of Progressive Sciences and Technologies (IJPSAT)*, vol. 28, no. 1, pp. 351–358, 2021, doi: 10.52155/ijpsat.v28.1.3454.
[31] L. P. Wanti, N. W. A. Prasetya, and O. Somantri, "Expert System for Diagnosing Inflammatory Bowel Disease Using Certainty Factor and Forward Chaining Methods," *Journal of Innovation Information Technology and Application (JINITA)*, vol. 5, no. 2, pp. 166–175, Dec. 2023, doi: 10.35970/jinita.v5i2.2096.
[32] F. Ummawati and A. Mulyani, "Aplikasi Pengenalan Pariwisata Pulau Bawean Berbasis Android," *Jurnal PROSISKO*, vol. 7, no. 1, Mar. 2020.
[33] Irawan and P. Rosyani, "Perancangan Aplikasi Pengenalan Kebudayaan dan Pariwisata Kabupaten Cianjur Berbasis Android," *TIN: Terapan Informatika Nusantara*, vol. 2, no. 8, pp. 521–526, Jan. 2022, doi: 10.47065/tin.v2i8.1187.
[34] Rachman, Yochanan, A. I. Samanlangi, and H. Purnoomo, *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. CV Saba Jaya Publisher, 2024.