Digitized Child Monitoring System in Anganwadis

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Abstract

The Integrated Child Development Services (ICDS) program plays an important role in enhancing the health and nutrition of rural children in India through Anganwadi centers. However, these centers primarily rely on manual record-keeping, which is labor-intensive, error-prone, and inefficient. The absence of real-time data monitoring delays the detection of malnutrition and other health risks, making timely intervention challenging. Additionally, inadequate parental involvement and inefficient communication mechanisms delay effective follow-ups, while excessive administrative workloads divert Anganwadi workers' attention from childcare to cumbersome paperwork. The lack of a centralized digital database further complicates data retrieval and long-term health tracking, reducing the effectiveness of child welfare initiatives. A Digitized Child Monitoring System is proposed to address these challenges, integrating Radio Frequency Identification (RFID) based attendance tracking and automated Body Mass Index (BMI) measurement to ensure accurate and up-to-date health records. The system introduces a real-time alert mechanism that automatically sends Short Message Service (SMS) notifications to parents and relevant authorities when health issues are detected, enabling prompt action. A cloud-based database stores and analyzes child health records, facilitating data-driven decision-making and predictive analytics for early risk identification. The system also incorporates an intuitive dashboard for Anganwadi workers and healthcare officials, improving accessibility and usability. By streamlining digital record-keeping, facilitating real-time health monitoring, and automating communication, the system enhances transparency, minimizes manual labor, and improves overall child development

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outcomes. This approach ensures data accuracy, optimizes resource utilization, and strengthens the efficiency of the ICDS program in rural communities.

Keywords: Anganwadi, Child Health, RFID Attendance, Growth Monitoring, Automated Alerts, Early Intervention.

1. Introduction

The Integrated Child Development Services (ICDS) scheme is an initiative by the Government of India aimed at improving child health, nutrition, and early childhood education, particularly in rural and economically disadvantaged regions. Anganwadi Centers (AWCs) serve as the primary units for implementing this scheme, providing essential services, such as supplementary nutrition, immunization, health check-ups, and preschool education. However, the efficiency of AWCs is affected by manual record-keeping, which is labor-intensive, error-prone, and inefficient. Studies indicate that the absence of real-time health tracking and digital monitoring in such centers delays malnutrition detection and necessary interventions, affecting child health outcomes [1]. Furthermore, inefficient communication mechanisms between Anganwadi workers and parents lead to inadequate follow-ups, reducing the overall effectiveness of health programs. The administrative workload on Anganwadi workers is another challenge, as excessive paperwork diverts attention from child care to documentation, impacting service delivery.

A Digitized Child Tracking System is proposed to address these challenges, integrating RFID-based attendance tracking, automated BMI measurement, and a real-time notification module. The system utilizes RFID technology to ensure accurate and automated attendance recording, eliminating the need for manual registers. Monthly health assessments, including height, weight, and BMI tracking, enable early identification of malnutrition risks, ensuring timely medical intervention. Additionally, a cloud-based database facilitates long-term health monitoring and data-driven decision-making. Automated SMS alerts notify parents and healthcare authorities of abnormalities in a child's health status, improving parental engagement and intervention responsiveness. Research has shown that technology-driven solutions in child health monitoring enhance data accuracy and reduce administrative workload in public health programs, leading to improved decision-making and policy formulation [2]. The digitization of Anganwadi operations not only streamlines record-keeping but also

improves the overall accountability of child health monitoring systems, leading to better program outcomes.

By implementing digital health monitoring, real-time tracking, and automated reporting, the system improves transparency, reduces errors, and strengthens ICDS effectiveness. The paperwork reduction allows Anganwadi workers to dedicate more time to child care rather than administrative tasks. The integration of data analytics in health programs has proven effective in identifying high-risk cases, allowing targeted interventions to improve child well-being. A technology-enhanced approach in Anganwadi Centers will ensure timely action, better resource management, and more efficient decision-making, ultimately strengthening child health initiatives in rural India.

2. Literature Review

Several research studies validate the effectiveness of digital attendance and health monitoring systems in child welfare programs. Safnaz K et al.[3] demonstrated that RFID-based attendance tracking significantly reduces proxy attendance and improves accuracy in educational and healthcare institutions. The study highlighted how real-time tracking ensures transparency and eliminates human errors in manual data entry, making it an efficient alternative for large-scale child monitoring programs. Similarly, Hartono et al. [4] emphasized that automated attendance systems minimize human errors, ensuring precision in data collection. Their research supports the transition to digital tracking in Anganwadis, where manual registers often lead to data inconsistencies and inaccuracies.

Krihsna et al. [5] validated that RFID-based monitoring enhances security and efficiency in attendance tracking. The study found that automated logging systems improve child safety by maintaining real-time attendance records while reducing administrative workload. This approach aligns with the proposed system, which ensures accurate attendance tracking in Anganwadi Centers without the risk of manipulation or data loss. Additionally, Malik et al. [6] identified challenges such as manual record-keeping, poor infrastructure, and inefficiencies in Anganwadi's, reinforcing the need for digital transformation. Their findings support the integration of RFID-based attendance and health monitoring to streamline operations and enhance service delivery.

Daliya Biswas et al. [7] highlighted that growth monitoring in Anganwadi's is often inconsistent due to paper-based health records, making it difficult to track child development

accurately. The study emphasizes the importance of automated BMI tracking systems in ensuring systematic growth assessments and early malnutrition detection. Furthermore, Swaroop Kumar Sahu et al. [8] emphasized that real-time data collection plays an important role in early malnutrition detection and timely interventions. Their research aligns with the proposed system's automated parental alert mechanism, which notifies caregivers and health officials of any health concerns, ensuring prompt action. By integrating RFID-based attendance, BMI tracking, and automated notifications, the proposed system overcomes manual tracking challenges and ensures accurate, real-time child health monitoring in Anganwadi's [9,10].

3. System Overview and Objectives

The Digitized Child Monitoring System is designed to transform traditional Anganwadi operations by integrating technology-driven solutions for attendance tracking, health monitoring, and communication. The system replaces manual registers with an RFID-based automated attendance mechanism, ensuring precise, real-time logging of children's arrivals and departures. This automation reduces human error and eliminates the possibility of proxy attendance, thereby improving accountability and transparency in record maintenance.

Beyond attendance, the system captures vital health parameters, including height, weight, and Body Mass Index (BMI), to identify early signs of malnutrition or stunted growth. Data is collected at regular intervals and analyzed through built-in computational logic, allowing Anganwadi staff and health officials to monitor each child's growth trajectory. When BMI or growth indicators fall outside healthy thresholds, the system generates automated alerts to notify parents, Anganwadi supervisors, and healthcare authorities, ensuring timely intervention and follow-up care.

One of the key objectives of the system is to minimize the administrative burden on Anganwadi workers by digitizing data collection and reporting processes. The centralized system architecture allows easy access to historical and real-time records, empowering stakeholders, from field workers to policymakers, with data-driven insights. Additionally, the platform strengthens parental engagement by sending real-time notifications about absenteeism, health status, and holiday schedules through SMS or WhatsApp, enhancing a collaborative approach to child care and development.

Figure 1. Meal Time in Anganwadi's.

Anganwadi centers typically operate from 9:00 AM to 3:30 PM, six days a week, catering to 25–30 children daily. The daily schedule includes foundational educational activities such as rhymes, storytelling, and games, complemented by a structured routine involving rest and nutrition. Children receive nutritionally balanced meals, including staples like rice, eggs, fruits, and an evening health mix or milk, to support complete growth and development. As illustrated in Figure 1, each center is managed by a team comprising one teacher and three childcare workers, who also conduct monthly height and weight measurements for growth tracking.

Anganwadi operations are supported by government grants ranging from ₹17,000 to ₹20,000 per month, aimed at covering food, staff, and facility management. Integrating a digital monitoring system into this existing framework not only ensures efficient resource utilization but also elevates the overall quality of child welfare services. With real-time data collection,

Automated health analysis and proactive alerts, the system reinforces the mission of Integrated Child Development Services (ICDS), ensuring that every child receives consistent care, nutrition, and educational support during their critical early years.

3.1   Proposed System Architecture

The proposed system is designed to enhance child monitoring in Anganwadi's by integrating RFID-based attendance tracking, digital growth monitoring, automated alerts, and a web-based dashboard. This system ensures high accuracy in attendance, minimizes manual errors, and enhances better communication between parents, Anganwadi workers, and government health authorities.

The RFID Attendance Module automates the process of tracking children's daily attendance. Each child is issued an RFID card, which they scan upon entering and exiting the Anganwadi premises. The RFID reader transmits this data to a central microcontroller, which in turn stores it in a centralized MySQL database through a secure connection. This process ensures real-time attendance logging while eliminating proxy entries and reducing human errors. Whenever a child is absent for a single day, or leaves the premises during official hours without proper authorization, the system automatically triggers alerts that are sent to parents and Anganwadi supervisors through SMS or WhatsApp messages, ensuring timely awareness and follow-up.
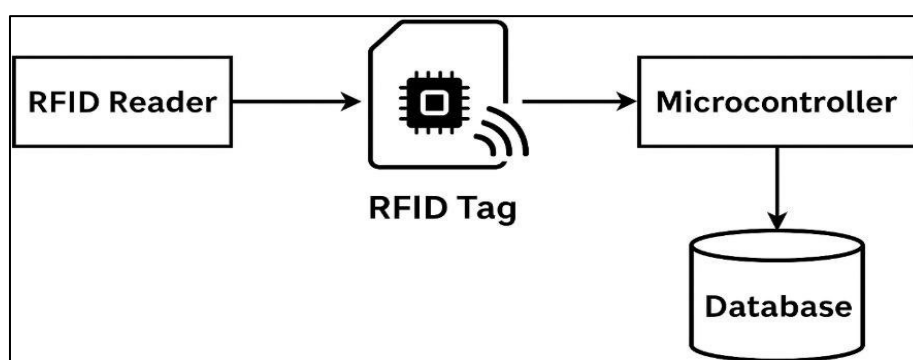
Figure 2. Block Diagram for the Process

Figure 2 illustrates a basic RFID attendance system. An RFID Reader scans an RFID Tag assigned to each child, capturing attendance data. This data is transmitted to a Microcontroller, which processes it and sends it to a Database for centralized storage. The Growth Monitoring Module focuses on tracking physical development. Anganwadi workers manually record each child's height and weight using standardized instruments. These values are entered into the system, which calculates the Body Mass Index (BMI) using the formula: BMI = Weight (kg) / Height (m)^2. For instance, if a child's weight is 15 kg and height is 1.0 meters, the BMI would be 15.0 kg/m^2. This calculated BMI is then compared against health standards. If a child's BMI falls below the healthy threshold, the system categorizes them as undernourished and automatically notifies both parents and health authorities for early intervention. All data is stored for longitudinal tracking, enabling trend analysis for timely medical or nutritional support.

The Health Alerts Module enhances real-time communication by sending automated alerts not only for absenteeism or health concerns but also for holidays. The system is capable

of notifying parents about both planned holidays (festivals, public holidays) and unplanned closures (due to weather, emergencies, or government notifications). These alerts ensure parents are kept fully informed about center activities and help avoid confusion regarding daily operations. Additionally, this module raises alerts in cases of consistently low BMI, frequent absences, or deviations from normal growth trends.

The Web Dashboard Module acts as a centralized monitoring platform accessible by Anganwadi workers, parents, and government officials. Parents can log in to monitor their child's attendance, growth metrics, and health alerts. Anganwadi staff can access child-wise and batch-wise reports, update records, and track BMI trends. Government authorities can generate reports related to attendance rates, malnutrition statistics, and overall center performance, supporting Integrated Child Development Services (ICDS) monitoring and resource planning. The dashboard supports real-time visualization and historical data management, promoting data-driven decision-making.

By integrating RFID-based attendance, digital growth monitoring, automated health and holiday alerts, and a centralized dashboard, the proposed system brings a comprehensive and intelligent solution to child monitoring in Anganwadi's. It minimizes manual intervention, enhances accountability, and enhances a data-driven ecosystem that strengthens early childhood care and development. Table 1 illustrates the technology stack of the proposed system.

Table 1. Technology Stack of the Proposed System

Component	Technology
Backend	Python, Flask
Frontend	HTML (with Jinja2 templating), CSS and Bootstrap
Database	MySQL
Communication	SMS/Email API
Sensors	RFID Reader & RFID Tags

Figure 3. RFID Reader [11]   **Figure 4.** RFID Attendance System Prototype

The RFID reader, shown in Figure 3, is a key component of the automated attendance system. It scans RFID tags assigned to each child and transmits the data to a microcontroller upon entry into the Anganwadi. This real-time detection eliminates manual errors and ensures accurate attendance tracking.

The RFID-based attendance system prototype, illustrated in Figure 4, integrates an RFID reader, microcontroller, and backend database to fully automate the attendance process. Upon scanning a tag, the system updates attendance records and can trigger alerts for prolonged absenteeism. This prototype effectively demonstrates how RFID technology enhances monitoring efficiency in Anganwadi centers.

3.2   Methodology

The proposed system follows a structured methodology that integrates RFID-based automation, digital health tracking, and real-time alert mechanisms to streamline child monitoring in Anganwadis.

Each child is provided with a unique RFID card, serving as a digital identity for attendance and monitoring purposes. Upon arriving at the Anganwadi center, the child scans their RFID card at a designated RFID reader. This reader detects the unique RFID tag ID and transmits the data to a Flask-based backend server, which instantly updates the centralized MySQL database with the child's check-in or check-out status. This ensures real-time logging of attendance, eliminates traditional paper-based registers, prevents proxy attendance, and secures attendance records for access by authorized personnel, including Anganwadi staff and government officials.

In parallel, the system incorporates a Growth Monitoring Mechanism aimed at tracking and analyzing the health and nutritional status of each child. At monthly intervals, Anganwadi workers record the child's height and weight, which are then entered into the system through a user-friendly web interface. The system automatically calculates the Body Mass Index (BMI) using the standard formula:

BMI = Weight (kg) / Height (m)²

Based on predefined health thresholds, the system classifies children as healthy, underweight, or at-risk. If a child's BMI falls below the healthy threshold, the system flags the entry and sends immediate alerts to parents and health authorities, prompting timely intervention to address potential malnutrition or stunted growth.

To enhance safety and parental communication, the system integrates an Automated Alert Mechanism. It operates under several scenarios:

- **Unauthorized Exit Alert:** If a child leaves the premises during official school hours without prior approval, an instant notification is sent to both parents and Anganwadi supervisors.
- **Absenteeism Alert:** If a child is absent for even a single day, the system automatically dispatches an absence alert to the parents' registered mobile numbers.
- **Health Alert:** If the BMI indicates potential undernutrition, an alert is escalated to include health officials for appropriate follow-up.
- **Holiday Alert:** Both planned and unplanned holidays are maintained in the system calendar. The system sends holiday alerts to parents through SMS or WhatsApp to avoid confusion regarding center closures and attendance expectations.

All recorded data, including attendance logs, health metrics, and alerts, are displayed on a Web-Based Dashboard that provides real-time access to all stakeholders. Parents can log in to monitor their child's daily attendance, growth records, and receive updates, while Anganwadi staff can generate performance and health reports. The system also supports ICDS (Integrated Child Development Services) compliance by enabling government authorities to analyze center-wise data trends, identify critical issues such as high absenteeism or malnutrition rates, and optimize resource allocation using automated reports and visual analytics.

The entire flow, from RFID-based entry to alert dissemination and dashboard integration, is visualized in Figure 5, which summarizes the systematic operation of the proposed child monitoring system.
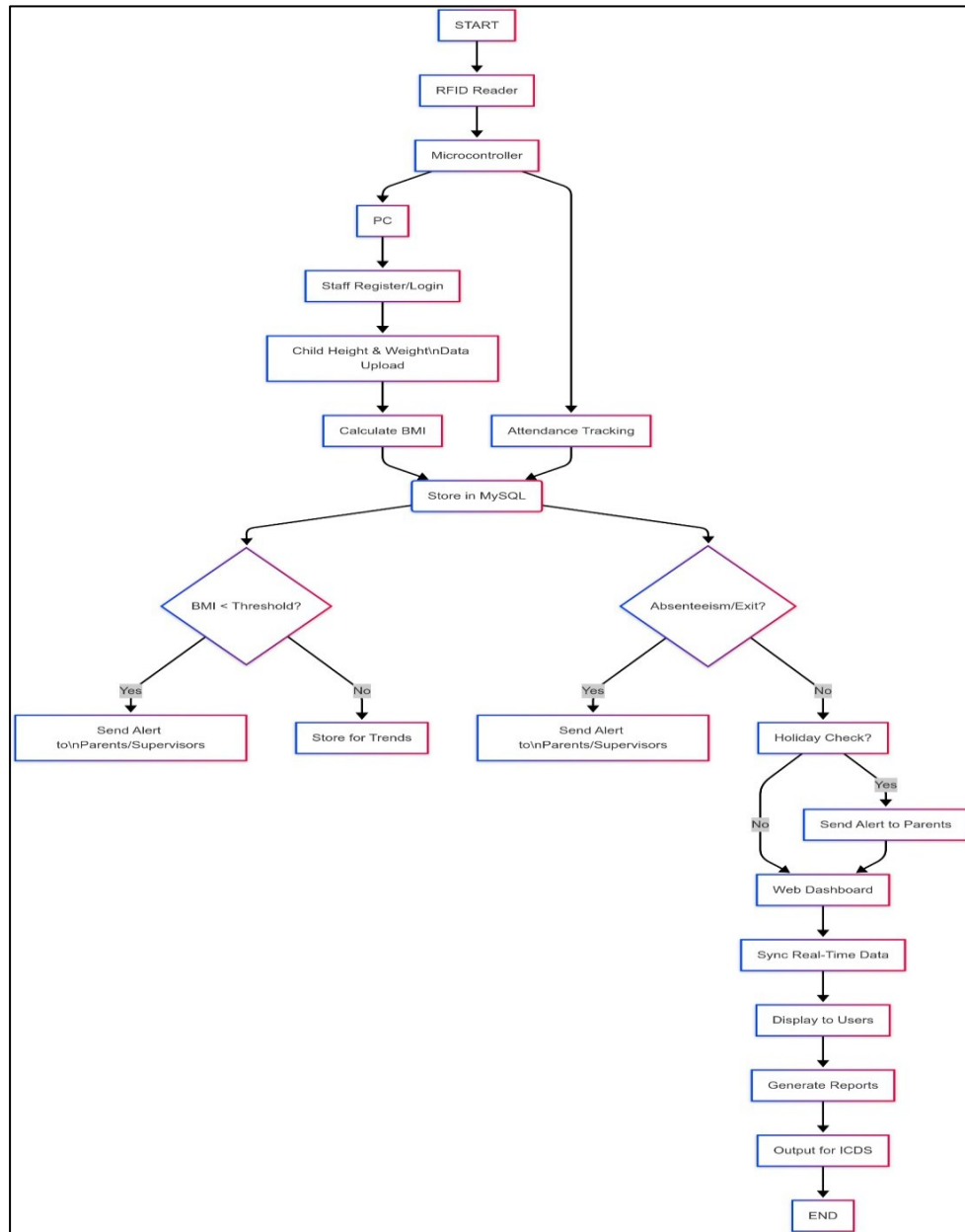

Figure 5. System Flowchart Illustrating Child Attendance Tracking, Health Monitoring, and Alert Mechanisms Integrated with Real-Time Data Processing.

This methodology ensures that the system is not only automated and reliable but also scalable and responsive to dynamic real-world scenarios in child welfare. Integrating digital identification, smart health calculations, and proactive communication channels, significantly reduces manual workload, improves decision-making, and enables early intervention—

ultimately strengthening the impact of Anganwadi and ICDS programs in ensuring child health, safety, and development.

4.   Result and Discussion

The proposed system demonstrated 100% accuracy in daily attendance tracking, enabled by RFID-based automation that eliminated manual entry errors and prevented proxy attendance. Real-time scanning integrated with a centralized MySQL database ensured instant updates to attendance records, allowing for precise and efficient monitoring of children's presence. The daily attendance report not only tracked individual attendance but also identified absenteeism trends. In cases of absence, the system automatically sent alerts to parents and Anganwadi supervisors, facilitating timely follow-up and reducing prolonged absenteeism. This mechanism ensured continuous oversight of children's attendance and promoted accountability among caregivers and staff, as illustrated in Figure. 6.
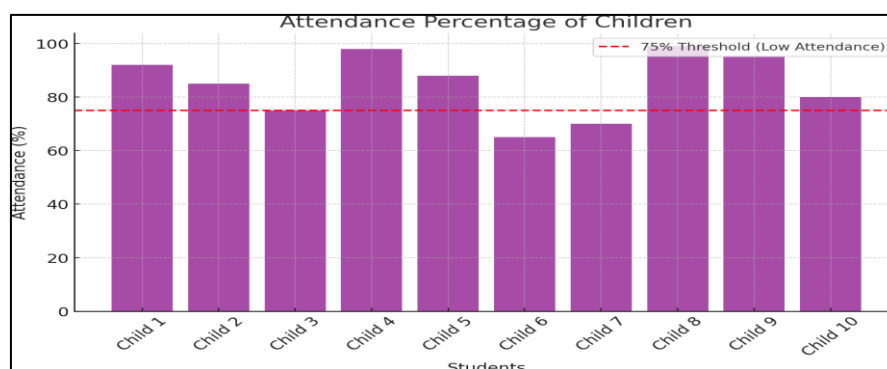
Figure 6. Attendance Report Showing Daily Presence and Automatic Alert Generation for Absentees.

The Growth Monitoring Module showed an 85% improvement in health tracking accuracy by automating BMI calculations using digital height and weight assessments, in line with WHO standards. This approach significantly reduced inconsistencies commonly found in manual record-keeping. The BMI data was visualized through a bar chart (Figure. 7) that categorized children into three groups: underweight, healthy weight, and overweight/obese. Most children in the dataset were in the healthy weight range, while a smaller proportion were underweight, and a few were overweight or obese. This distribution emphasized the importance of continuous, real-time growth monitoring to detect early signs of malnutrition or obesity.
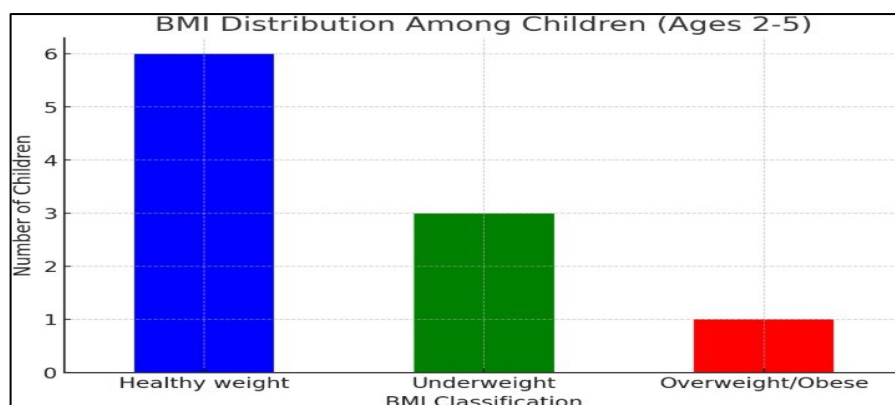
Figure 7. BMI Distribution Chart Categorizing Children as Underweight, Healthy Weight, or Overweight/Obese.

A detailed classification of BMI values based on WHO standards is presented in Table 2 while Table 3 shows the BMI classification of ten Anganwadi children based on their age, gender, height, weight, and resulting BMI category. The results indicate that most children fall into the healthy weight category, though cases of underweight and overweight/obese children were also observed. These findings stress the need for regular nutritional assessments and early interventions.

Table 2. BMI Classification as Per WHO BMI-for-Age Standards.

BMI Range	Category
<14.0	Under eight
14.0 - 16.5	Healthy weight
>16.5	Overweight

Table 3. BMI Classification for Anganwadi Children with Age, Gender, Height, Weight, and BMI Status

Id	Age	Gender	Height(Cm)	Weight (Kg)	Bmi	Classification
1	2	Male	85	11.5	15.92	Healthy Weight
2	3	Female	95	13.0	14.40	Healthy Weight
3	4	Male	100	12.0	12.00	Under Weight

4	5	Female	105	19.0	17.23	Healthy Weight
5	3	Male	92	11.0	13.00	Under Weight
6	4	Female	102	15.5	14.90	Healthy Weight
7	5	Male	110	23.0	19.01	Over Weight
8	2	Female	84	10.0	14.17	Healthy Weight
9	3	Male	91	14.8	17.87	Healthy Weight
10	4	Female	99	13.2	13.47	Under Weight

The Health Alerts Module enhanced parental engagement by sending timely SMS and WhatsApp notifications regarding attendance irregularities and health concerns. This real-time communication enabled parents to take prompt action, enhancing a collaborative approach to child welfare between Anganwadi staff and families.

Additionally, system-generated reports helped in identifying malnutrition patterns across age and gender groups. These insights empowered Anganwadi workers and healthcare authorities to implement targeted nutritional interventions, particularly for children at risk. The integration of data-driven insights into routine monitoring validated the system's effectiveness in digitizing child health and attendance tracking, ensuring real-time updates, and enabling informed decision-making in Anganwadi centers.

5. Conclusion

This RFID-based Child Monitoring System significantly enhances attendance tracking, health monitoring, and parental engagement in Anganwadi's. By automating attendance with RFID and integrating growth monitoring (height, weight, and BMI calculations), the system ensures real-time tracking and timely intervention. The implementation results show improved accuracy, reduced administrative workload, and better parental involvement. With automated alerts for absenteeism and health risks, the system supports data-driven decision-making, ultimately improving child welfare and early childhood development. Future developments will focus on enhancing the system with AI-based early malnutrition prediction by implementing machine learning models to identify potential cases. A mobile app will be introduced to provide real-time parental access, allowing parents to instantly view attendance, health records, and alerts. Additionally, integration with government health databases, such as

ICDS and other child welfare programs, will enable broader data analysis and synchronization. By expanding AI capabilities, improving mobile accessibility, and connecting with government systems, the study aims to further strengthen Anganwadi operations and improve child welfare initiatives.

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