

Smart Anganwadi Hub for Nutrition, Growth, and Attendance Management

Rajeswari K¹, Swathi B², Sathiya Jothi N³, Renuka A⁴

Assistant Professor, Department of Computer Science and Engineering, Vivekanandha College of Engineering for Women, Tamil Nadu, India

Student, Department of Computer Science and Engineering, Vivekanandha College of Engineering for Women, Tamil Nadu, India

Abstract—Anganwadi centers play a crucial role in child development by offering key services related to nutrition, health monitoring, and early education. Conventional data management methods often lead to inefficiencies in tracking children's progress, nutritional health, and attendance. This paper introduces a Smart Anganwadi Hub that integrates digital tools and automated systems to enhance monitoring and management. The proposed system incorporates IoT-enabled devices, AI-driven analytics, and cloud-based data storage for real-time data collection and analysis. Automated attendance tracking through biometric or RFID systems enhances accuracy while reducing human errors. Machine learning algorithms assist in growth and nutrition monitoring to identify developmental patterns and potential malnutrition risks at an early stage. Additionally, mobile applications provide caregivers and Anganwadi workers with real-time reports and alerts for necessary interventions. Initial trials indicate improved data accuracy, efficiency in decision-making, and enhanced service delivery. This Smart Anganwadi Hub represents a significant advancement in child welfare programs by ensuring data-driven, proactive intervention strategies.

I. INTRODUCTION

Anganwadi centers are key components of India's Integrated Child Development Services (ICDS), focusing on maternal and child health, nutrition, and early childhood education. These centers serve as crucial monitoring points for child growth, nutrition intake, and attendance, particularly in rural and semi-urban areas. However, conventional record-keeping methods lead to inefficiencies, inconsistencies, and delayed interventions.

To address these challenges, this paper presents a Smart Anganwadi Hub—a technology-driven solution designed for effective nutrition tracking, growth

assessment, and attendance monitoring. By leveraging Internet of Things (IoT), artificial intelligence (AI), cloud computing, and biometric technologies, this system streamlines operations and enhances service efficiency. Real-time data analytics facilitate early detection of malnutrition risks, irregular attendance patterns, and growth abnormalities, enabling timely intervention by healthcare professionals and policymakers.

Key Objectives of the Smart Anganwadi Hub:

1. Automating attendance management using RFID, biometrics, or mobile applications for precise tracking.
2. Enhancing nutrition monitoring through digital food tracking and AI-powered diet recommendations tailored to individual needs.
3. Utilizing machine learning algorithms to analyze height, weight, and health parameters for early detection of malnutrition.
4. Providing real-time data access via a cloud-based dashboard and mobile application for caregivers, Anganwadi workers, and health officials.
5. Assisting in decision-making with predictive analytics for resource allocation, policy formulation, and targeted interventions.

By integrating digital technologies, the Smart Anganwadi Hub has the potential to revolutionize child welfare initiatives, making them more data-driven, efficient, and responsive to children's needs. This paper explores the system's design, implementation, impact, and potential challenges.

II. DATA ANALYSIS AND FEATURE ENGINEERING

The Smart Anganwadi Hub employs advanced data analytics and feature engineering to extract

meaningful insights from child health, nutrition, and attendance data. Efficient data processing facilitates early detection of anomalies, malnutrition risks, and attendance trends, enabling timely interventions.

1. Data Collection and Preprocessing
 - Sources include biometric attendance systems, growth monitoring devices (height, weight, BMI), digital nutrition logs, and health records.
 - Preprocessing involves handling missing data, outlier detection, normalization, and feature scaling.
2. Exploratory Data Analysis (EDA)
 - Time-series analysis for attendance trends.
 - Growth curve analysis to detect height and weight deviations.
 - Clustering methods to categorize children based on health status.
 - Correlation matrices to identify factors influencing malnutrition.
3. Feature Engineering for Predictive Modeling
 - Growth velocity metrics track height and weight changes over time.
 - Nutritional deficiency indicators highlight dietary gaps.
 - Attendance consistency scores assess irregular patterns.
 - A health risk index combines multiple indicators to detect at-risk children.
4. Machine Learning-Based Analysis
 - Decision Trees & Random Forests classify malnutrition risk levels.
 - Support Vector Machines (SVM) predict stunted growth.
 - K-Means Clustering groups children based on growth and attendance trends.
 - Neural Networks identify complex nutrition and growth deviations.
5. Real-Time Monitoring and Visualization
 - A cloud-based dashboard displays health indicators and alerts.
 - Personalized nutritional plans based on predictive models.
 - Automated notifications for attendance irregularities.

CHILD'S HEIGHT DISTRIBUTION RELATIVE TO PARENTAL HEIGHT

Child growth is influenced by genetic and environmental factors, with parental height serving as a predictor of expected growth. This system evaluates height deviations using statistical models, percentile-based growth assessments, and clustering techniques. By analyzing observed versus expected growth, the system identifies risks such as stunting or excessive growth and provides tailored nutritional and medical interventions.

GROWTH PREDICTION USING LOGISTIC REGRESSION

A logistic regression model predicts growth outcomes based on nutrition, parental height, socioeconomic status, and health parameters. The model classifies children into normal growth, stunted growth, or at-risk categories, enabling early interventions. Model performance is assessed using precision, recall, F1-score, and ROC curves to ensure accuracy.

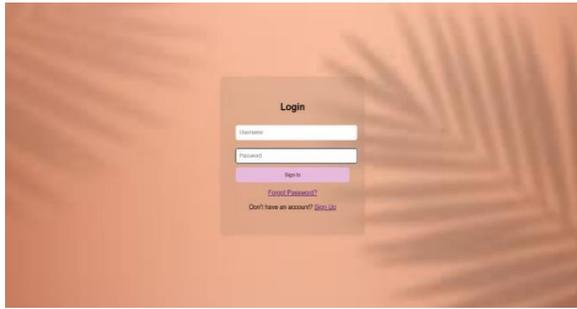
ICDS SCHEME MODULE: CHATBOT & PPT-BASED INFORMATION SYSTEM

The Smart Anganwadi Hub integrates an AI-driven chatbot and a PPT-based information system for real-time assistance and efficient communication. This chatbot provides caregivers and Anganwadi workers with access to growth insights, nutritional guidance, and ICDS service updates. The PPT-based system supports training sessions and visual presentations to enhance awareness and record-keeping efficiency.

IMPACT ON CHILD WELFARE PROGRAMS

- Improved child growth monitoring through AI-driven analytics.
- Empowered parents with real-time nutritional guidance.
- Enhanced training for Anganwadi workers.
- Automated attendance tracking for increased participation.
- Data-driven decision-making for improved policy implementation.

III. RESULTS



(a) Login page



(b) Dash board



(c) Height and weight module



(d) Attendance module



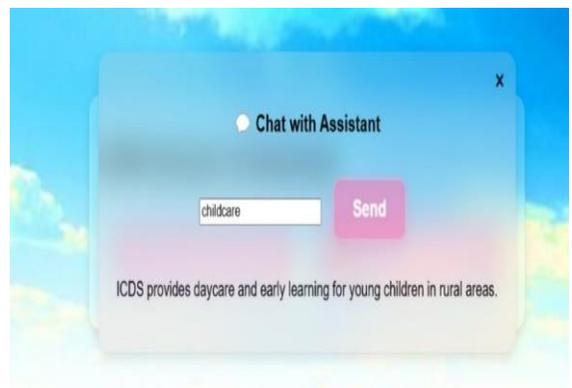
(e) ICDS module



(f) ICDS schemes



(g) Ppt view



(h) Chat bot

Registered Children

Name: Swathi Soppathi
Age: 13
DOB: 2004-05-12T18:30:00.000Z
Gender: Female
Blood Group: A+
Father: soppathi
Mother: sharmuganelli
Phone: 9545733003
Address: ramakul

Name: s1
Age: 2
DOB: 2004-05-29T18:30:00.000Z
Gender: Female
Blood Group: A+

(i) Registered form

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