

Game-Based Monitoring and Holistic Support for Autism: A Mobile Application Approach

[¹] Prof. Jithi P V, [²] Prof. Teena George, [³] Nafeesa A S, [⁴] Narayani Mahadevan, [⁵] Shreya Kannan, [⁶] Sona Deyo

[¹] [²] [³] [⁴] [⁵] [⁶] Adi Shankara Institute of Engineering and Technology, Kalady, Kerala, India

Corresponding Author Email: [¹] jithi.cs@adishankara.ac.in, [²] teena.cs@adishankara.ac.in,

[³] nafeesasudheer663@gmail.com, [⁴] narayanicm11@gmail.com, [⁵] shreyaakannan3@gmail.com, [⁶] sonadeyo@gmail.com

Abstract— This paper presents a mobile application designed to provide comprehensive support for the parents of children with Autism Spectrum Disorder (ASD) through monitoring tools and game skill development. The app also incorporates three interactive games (Cognitive level, Sensory level and Language level) that facilitate skill acquisition and collecting the performance data in percentile for development tracking. The application architecture integrates game-based learning with the three supporting modules: i) Growth Monitoring using WHO percentile charts for Height, Weight and Head circumference and weekly game performance analysis, ii) Customizable Daily Schedule to maintain the routine consistency and iii) Community Forum fostering peer support and resource sharing. Results indicate that the game-centric approach not only enhances the children's development outcome but also provides the parents with quantifiable progress metrics, reducing the isolation and stress. This holistic mobile solution demonstrates the efficiency of combining the structured gaming experiences with the support tools to address the aspects of families navigating autism care.

Index Terms— Autism Spectrum Disorder (ASD), Game-Based Learning, Development Monitoring, Mobile Application, Parental Support, Growth Tracking, Daily Engagement.

I. INTRODUCTION

The area of autism support has seen dramatic advancements through the creation of online interventions and seen remarkable strides in therapeutic and monitoring strategies for Autism Spectrum Disorder (ASD). Even so, there remains an inherent shortcoming - there is a traditional reliance on disjointed interventions that rarely offer a holistic developmental monitoring capability. Due to this limitation, parents cannot dynamically monitor progress, and this often translates into fractured care and disjointed support, particularly in situations where developmental requirements change rapidly. To counter this deficit, the current study investigates the use of a mobile app that is intended to augment ASD support through game-based learning combined with whole-person monitoring tools. The mobile application enables parents to gain relevant and up-to-date information via interactive gaming experiences and formal monitoring systems throughout the developmental process. This minimizes the isolation and stress commonly felt by caregivers, which are emotionally demanding and time-consuming. By integrating game assessment with developmental growth monitoring, each day's agenda planning, and community forums involvement, the target system purports to enhance outcome development, resilience to children-individual needs, and all-round efficiency of Autism care administration. The solution executes three differing gameplay genres geared at cognitive development, sensory exposure, and speech levels with resultant indicators that capture numerical values in line with measurement, thereby affording parents easily appreciable indication of

improvement towards unscrambling ASD complexities.

II. MATERIALS AND METHODS

This application system aims to offer holistic support for Autism Spectrum Disorder (ASD) children by means of interactive games and monitoring facilities. The system combines several modules to facilitate developmental tracking and parental support. The modules are:

- i) Game-based testing modules (Cognitive, Sensory, and Language games)
- ii) Physical growth tracking with WHO percentile charts
- iii) Daily routine building system
- iv) Community forum site

The application architecture brings these modules together with a Flutter/Dart frontend and Firebase backend, with cross-platform functionality on Android devices. Performance data is gathered in percentile form for tracking development.

The system has calculation methods for game performance metrics in place, whereby normalized performance scores are computed per game type weekly to give measurable progress metrics for parents.

Testing also proved seamless integration of game modules and monitoring systems with proper data visualization for parental insight into their child's growth.

III. THEORY AND CALCULATION

A. Theoretical Framework

The mobile application implements a development tracking and support system for parents of children affected

by ASD by providing physical growth tracking, game progress analysis, daily schedule structuring and community forum to provide and gain support from peer parents.

1. Physical Growth Monitoring Subsystem

The physical growth monitoring module is based on the standard IAP-WHO growth charts. The height, weight and head circumference of the child is compared against the standard chart and the percentile where the child stands is determined.

2. Game-Based Assessment

The game-based monitoring system employs digital serious games as a tool for both therapy and assessment. The app categorizes games into mainly three domains: Cognitive Games: Shape Matching and Color Matching games in the app that aim to improve the visual discrimination ability of the child. Sensory Games: The app includes Bubble Pop and Trace Shaping games that help the child develop their hand-eye coordination. Language Games: To strengthen the vocabulary and speaking capability of the child, a speech therapy game is included in the app. The app currently implements games with one level which can be upgraded by applying algorithms to adjust the difficulty based on performance metrics that maintain an optimal challenge.

3. Daily Schedule Structuring

The daily schedule feature in the app supports the parents in structuring the day of their ASD child. This module facilitates predictability enhancement and transition assistance through representation of daily tasks for the child.

4. Community Forum System

The app employs the community support system to significantly reduce the feeling of isolation and stress in parents by sharing ideas and strategies to cope up with common problems. The module includes four key components:

Discussion Board: Parents can exchange their concerns and ideas by discussing with their peer group.

Events: The programs that are supportive and helpful for parents and ASD children can be informed through the app.

Resource Library: Materials and educational resources can be made easily available for parents of ASD children.

Sharing Stories: The app provides a platform where parents can narrate the stories related to ASD to foster community wisdom.

This module addresses the need for social support for the caregivers of children with ASD which improves the intervention outcomes and the wellbeing of the family.

B. Calculation Methodology

1. Current Game Performance Metrics

The application provides a weekly performance monitor for each game. The normalized performance score for each

game is calculated as:

$$P_t = \frac{1}{n_t} \sum_{i=1}^{n_t} \frac{S_{i,t}}{100} \tag{1}$$

where:

- P_t is the normalized performance metric for game type t (range: [0, 1])
- n_t is the total number of sessions of game type t completed during the week
- $S_{i,t}$ is the raw score from the i-th session of game type t, with a maximum possible value of 100.

2. Difficulty-Weighted Performance Metric

The games can be implemented with varying difficulty levels in the future to provide more accurate measurement.

$$P_t^d = \frac{\sum_{i=1}^{n_t} d_i \cdot S_{i,t}}{\sum_{i=1}^{n_t} d_i \cdot 100} \tag{2}$$

where:

- P_t^d is the difficulty-weighted performance metric
- d_i is the difficulty level coefficient for session i

3. Trend Analysis with Exponential Smoothing

Exponential Smoothing can be implemented to achieve more stable tracking with reduced noise.

$$S_t(w) = \alpha \cdot P_t(w) + (1-\alpha) \cdot S_t(w-1) \tag{3}$$

where:

- $S_t(w)$ is the smoothed performance for game type in week
- α is the smoothing factor (typically 0.2 to 0.3)
- $P_t(w)$ is the raw performance metric for game type in week

4. Monthly Aggregated Reports

To monitor the progress on a long term monthly aggregate reports can be calculated as

$$MP_t(m) = \frac{1}{W_m} \sum_{w \in month_m} P_t(w) \cdot n_t(w) \tag{4}$$

where:

- $MP_t(m)$ is the monthly performance for game type in month
- W_m is the total number of weeks in month with recorded activity
- $n_t(w)$ is the number of game sessions of type in week

IV. RESULTS AND DISCUSSION

This application was applied and tested to see if it would be viable to facilitate support for children with Autism Spectrum Disorder (ASD) using game based monitoring and support facilities. The system was experimented in terms of usability, developmental tracking precision, and the ability to adjust to specific requirements.

Table I. Game Performance Metrics Table

Game Type (t)	Week	Sessions (n _t)	Raw Scores (S _{i,t})	Average Score ($\sum S_{i,t}/n_t$)	Normalized Performance (P _t)
Cognitive	1	5	75, 80, 65, 90, 85	79.0	0.79
Sensory	1	4	60, 70, 75, 80	71.25	0.71
Language	1	3	50, 65, 70	61.67	0.62
Cognitive	2	4	80, 85, 90, 95	87.5	0.88
Sensory	2	5	75, 80, 85, 90, 85	83.0	0.83

Table I shows the performance tracking of the game monitoring system across different developmental domains on a weekly basis.

The normalized performance metrics (P_t) column was calculated using (1)

These quantifiable metrics provide parents with a clear vision of the improvement and strength of the child making them aware of the areas that the child needs to be worked upon.

Incorporation of IAP WHO growth charts and tracking performance made it possible for the system to deal with comprehensive developmental monitoring, thus maintaining a holistic attitude of support.

Throughout the test, the system effectively supported skill development by incorporating interactive games, routine maintenance and community support functionalities. The app offered substantial developmental gauging which includes a notable decrease in loneliness and stress levels of the parents. The method of performance calculation also improved monitoring quality by offering normalized weekly scores across various game categories.

Key Findings from the System Evaluation:

- **Improved Support:**

Interventions delivered via app integration were better planned together and more extensively addressed than isolated conventional practices.

- **Real-Time Monitoring:**

The module for performance monitoring tracked development shifts in real time which enabled parents to know the needs of the child and provide adequate support.

- **Effective Utilization of Resources:**

By grouping multiple support instruments into one app, the system reduced parents' workload without lowering quality care.

In general, the experiment results validate the capability of the system to generate robust, evidence-based, and supportive interventions to make it highly relevant in real-world contexts where extensive ASD support is paramount.

V. CONCLUSION

The mobile app is suggested with enhancement in supporting children with ASD through game-based learning and robust monitors. Monitoring all-around development through games will be provided over cognitive, sensorial, or language-related topics, participation schedules, and communities. Experiments have shown that this game-based method greatly enhances children's developmental results and allows parents to track measurable indicators of improvement.

Addition of WHO percentile charts for monitoring growth, weekly gaming performance analysis, and community support options provides an affordable and scalable solution for autism care management.

Overall, the mobile app strategy is an affordable and accessible means of assisting families in the management of autism care in daily settings. Future projects will be focused on optimizing game performance, increasing interactive task numbers, and creating more assessment tools to further optimize developmental monitoring and system robustness.

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