PULSEMIND: AI-DRIVEN BEHAVIORAL ASSESSMENT AND INTERVENTION FOR ADHD

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Dissertation submitted in partial fulfillment of the requirements for the Bachelor of Science (Hons) in Information Technology

Department of Information Technology

Sri Lanka Institute of Information Technology

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DECLARATION

I declare that this is my own work, and this dissertation does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text. Also, I hereby grant to Sri Lanka Institute of Information Technology the non-exclusive right to reproduce and distribute my dissertation in whole or part in print, electronic or other medium. I retain the right to use this content in whole or part in future works (such as articles or books).

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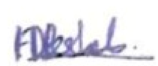
Dilshani H.T.D.P.	IT21379574	
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ABSTRACT

PulseMind is an AI-driven, gamified behavioral assessment and intervention system designed to support early identification and personalized treatment of Attention-Deficit/Hyperactivity Disorder (ADHD) in children aged 5 to 10. Traditional ADHD diagnostic methods are often subjective, time-consuming, and lack interactivity, particularly in low-resource settings. This research presents a novel solution that integrates real-time behavioral monitoring, machine learning classification, emotional adaptation, and gamified learning into a unified, accessible platform. The system includes an interactive reaction-time game to assess attention span, impulsivity, and motor control, combined with an adaptive DSM-5-based parent questionnaire. Data collected from both components are analyzed using machine learning models—including Neural Networks, Support Vector Machines, and Random Forests—to classify the child into ADHD subtypes: inattentive, hyperactive-impulsive, or combined. The system achieved a classification accuracy of 84.3% when using combined data sources. Additionally, emotion-aware intervention games respond dynamically to a child's mood using real-time facial emotion recognition, enabling tailored adjustments to game difficulty and feedback. For children with hyperactivity-impulsivity, a structured mindfulness module with personalized daily routines promotes self-regulation and emotional control. A real-time monitoring dashboard provides caregivers and educators with actionable insights and predictive alerts for future behavioral challenges. The system was evaluated across multiple devices and demonstrated strong usability, engagement, and diagnostic performance. This research highlights the potential of AI, gamification, and affective computing to enhance ADHD care and offers a scalable, culturally adaptive solution suitable for educational and clinical environments, particularly in developing regions.

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LIST OF ABBREVIATIONS

Abbreviation	**Full Form**
ADHD	Attention-Deficit/Hyperactivity Disorder
DSM-5	Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition
AI	Artificial Intelligence
ML	Machine Learning
SVM	Support Vector Machine
CNN	Convolutional Neural Network
API	Application Programming Interface
UI	User Interface
UX	User Experience
SUS	System Usability Scale
JWT	JSON Web Token
VADPRS	Vanderbilt ADHD Diagnostic Parent Rating Scale
CBT	Cognitive Behavioral Therapy
NLP	Natural Language Processing
PC	Personal Computer
CRUD	Create, Read, Update, Delete
HTML	HyperText Markup Language
CSS	Cascading Style Sheets
JS	JavaScript
IT	Information Technology
UML	Unified Modeling Language

1. INTRODUCTION

Attention-Deficit/Hyperactivity Disorder is considered a neurodevelopmental disorder, affecting 5-8% of children of school age worldwide [1]. This neurodevelopmental disorder is characterized by persistent symptoms accompanying inattention, hyperactivity, and impulsivity that appreciably interfere with a child's ability to attain optimum achievement in educational settings, social interactions, and everyday life experiences [2] [3]. Timely recognition and intervention for ADHD are essential means of helping children develop practical coping strategies, thus improving quality of life [4]. Generally, ADHD symptoms are always persistent across various developmental stages, leading to long-term outcomes if not appropriately managed [5] . In most low- and middle-income countries, awareness regarding the assessment and management of ADHD is lacking, as in the case of Sri Lanka. This further underlines the requirement for diagnostic and intervention tools that are accessible and culturally relevant. Meeting these needs during primary school can give much-needed support to young children and help reduce the negative consequences related to undiagnosed ADHD, such as failure in school, social isolation, and low self-esteem [6].

Traditional diagnosis and treatment methods are not customized and dynamic, resulting in broad treatment protocols that do not account for the unique needs of each child. This study proposes a new, AI-powered, gamified behavior assessment and intervention system to revolutionize ADHD treatment through adaptive technology and machine learning techniques. The focus of this research is to develop an Artificial Intelligence-based system that assists in diagnosis as well as intervention for children of different ADHD subtypes—Predominantly Inattentive and Hyperactive-Impulsive. With the integration of behavioral tasks, emotion detection, and adaptive learning procedures, the system not only diagnoses the specific ADHD subtype but also provides personalized, interactive, and optimal interventions.

The envisaged application starts with a gamified diagnostic test measuring the core cognitive characteristics such as attention span, impulsivity, and hyperactivity. The kids interact with audio and visual stimuli in an entertaining environment, and their results are measured according to parameters such as reaction time and sustained attention. This assessment is informed by established diagnostic tools such as the Vanderbilt ADHD Diagnostic Parent Rating Scale and the Conners' Rating Scale, rendering it clinically valid and increasing child engagement through gamification. Following the game, children are given an adaptive questionnaire that automatically adjusts to their responses and to their performance. The approach enables one to achieve a more profound, individualized evaluation of ADHD symptoms. Through the combination of behavioral indicators and machine learning approach, the system can categorize children into ADHD subtypes and offer insights to help teachers, caregivers, and medical professionals create targeted interventions.

For Predominantly Inattentive ADHD children, treatment is focused on enhancing attention, organizational ability, and self-regulation of feelings. Central to this is a series of games for improving attention whose levels adjust in real-time based on performance data and analysis of facial expression so that experience is aligned with mood and mind state of the child at a particular moment. The system also includes emotion-based adaptation of games, dynamically changing tasks or adding motivators in response to feelings such as frustration or sadness. This is complemented by time management concept-based task organization tools such as the Pomodoro Technique, helping children effectively organize and sequence tasks. A reward and tracking system for progress also motivates consistent effort and development, enhancing long-term development in attention and executive function skills. The key innovation here is using real-time emotional adaptation and reinforcement learning to personalize the learning path, as opposed to standard static models. This type of model involves a dynamic system that can accommodate differences between individuals, thus leading to more and deeper change.

Hyperactive-Impulsive ADHD children will experience difficulties with control of emotions and inhibition of behavior. General treatments such as medication and general behavioral therapy will be too broad and will not specifically cater to the specific needs of these children. This study addresses the gap by combining a multi-dimensional intervention process with physical exercise, mindfulness exercises, and tailored schedules. Such an approach allows children to dissipate excess energy in constructive directions while promoting self-regulation, emotional control, and responsivity. Combining best practice with innovative technology, the system provides a flexible and integrated platform for intervention. The use of community detection processes and classification structures also allows identification of performance-based groups within the population of ADHD patients, ensuring that interventions are directed at distinct cognitive and behavioral profiles.

Adjusting for heterogeneity of ADHD symptoms and treatment responses, this project prioritizes individualized participation. The system uses machine learning to analyze patterns of behavior and dynamically adapt intervention strategies, such as changing difficulty of activities or suggesting alternative activities. Children can also suggest activities based on interests, increasing autonomy, self-awareness, and motivation. If the child does not respond well to a suggested activity, the system gives the child options that are more pertinent to the child's interests and previous responses. This keeps the child engaged, avoids demotivation, and turns the child into an active player in their own developmental process.

This research also examines the implementation of Natural Language Processing (NLP) to provide immediate, personalized feedback from children's verbal and written responses. A simple-to-use dashboard shows progress, identifies success points, and alerts caregivers or teachers to any Cause for concern. Predictive analytics also enable early warning indicators of problems occurring and provide initiative-taking recommendations, potentially maximizing long-term outcomes.

For Sri Lanka, where there is limited specialized ADHD assessment and intervention available, this project offers a cheap, interactive, and accessible option. Operating in consultation with medical professionals, including cognitive disorder specialist Dr. Kamalini Wanigasighe, the research ensures that the system is evidence-based and ethical. Using Artificial Intelligence, emotion recognition, and adaptive gamification, this project proposes a fresh paradigm for managing ADHD. Having the potential to develop an adaptive, emotionally smart system that helps children's intellectual, behavioral, and emotional development over the years, this app can empower children, parents, and teachers and bridge the gaps in the current diagnosis and interventions of ADHD, especially in low-resource environments.

1.1.Background Literature

Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder characterized by pervasive inattention and/or hyperactivity-impulsivity patterns that interfere with functioning or development. According to the DSM-5, symptoms must occur in two or more settings (e.g., school and home) and cause significant impairment. Symptoms are divided into two broad domains: inattention and hyperactivity-impulsivity [7].

ADHD Assessment Methods and Tools

Traditional ADHD diagnostic methods rely heavily on clinical interviews, direct observation, and parent, teacher, or caregiver rating scales. The Conners' Rating Scales and the ADHD Rating Scale IV are commonly used; however, they may be less than objective since they are subjective reports [8] [9]. The Vanderbilt ADHD Diagnostic Parent Rating Scale (VADPRS) is also among the most widely used scales specifically designed for use by parents of children ages 6 to 12 and typically is extended to age 15. It is not only measuring primary ADHD symptoms but also concomitant conditions like anxiety, depression, and oppositionality, giving more detailed diagnostic information [10].

Limitations of Traditional Interventions

Behavioral interventions such as Cognitive Behavioral Therapy (CBT), parent training, and classroom strategies have been shown to improve the behavior of children with ADHD however, are rigid and do not respond to real-time improvement on the child's part. Moreover, the lack of instant feedback makes individualized intervention impossible, whereby it becomes difficult to refine approaches based on the immediate behavioral cues [11].

Technology-Based ADHD Management and Its Gaps

Even with technological progress, current systems of ADHD management tend to be narrow focused on monitoring behavior. Most do not have real-time adaptive capabilities, predictive analysis, or actionable insights. This limitation necessitates the development of a more holistic, intelligent system based on real-time data analysis and adaptive models of learning to better fit the varied needs of children with ADHD.

Predominantly Inattentive ADHD and Challenges

ADHD-PI children usually display symptoms of forgetfulness, difficulty sustaining focus, and a deficiency of organizational skills. These behaviors are not as noticeable as frank hyperactivity in other ADHD forms and tend to lead to delayed diagnosis and lost early intervention. Daydreaming, spacing out, or forgetting what they are supposed to do can have a seriously detrimental effect on schoolwork and social functioning [12].

Gamification for Inattention and Focus Enhancement

Gamification is an effective method for improving attention and managing inattention in children with ADHD. By incorporating elements such as levels of advancement, rewards, and challenges, gamified interventions enhance interest and motivation. Difficulty-adjusting games that adapt difficulty dynamically based on the child's performance have been particularly helpful in addressing attention and task completion issues [13].

Emotional Regulation and Real-Time Adaptation

Emotional impulsivity is one of the core features of ADHD that affects task engagement and satisfaction. Children with ADHD-PI experience frustration or boredom, especially for tasks requiring sustained effort. Emotion analysis-based real-time affect detection systems can monitor emotional states and adaptively control task difficulty or introduce motivational aspects based on affective feedback. This approach not only sustains engagement but also supports emotional self-regulation [14].

Proposed AI-Based Intervention System

- The proposed research introduces an AI-driven behavioral intervention system for children with Predominantly Inattentive ADHD. The system includes:
- Focus Enhancement Games: These adjust difficulty levels dynamically based on the child's performance and affective state to prevent boredom and frustration.
- Emotion-Based Game Adaptation: Activities change in real-time to adapt to affective states like sadness or frustration, introducing motivators or alternative activities as required.
- Task Organization Tools: Based on strategies such as the Pomodoro technique, these tools help children with task organization and time management.
- Reward and Progress Tracking: A built-in reward system encourages task completion daily and ongoing refinement of attention and organization.
- Dynamic and Personalized Learning: The most profound innovation is bringing together reinforcement learning with emotion-adaptive feedback to personalize the experience based on the unique behavioral style and personal preferences of the individual child.

1.2.Research Gap

Attention-Deficit/Hyperactivity Disorder (ADHD) is one of the most studied neurodevelopmental disorders, particularly in cognitive psychology and the newly emerging field of artificial intelligence (AI)-based interventions. Traditional measures—Vanderbilt ADHD Diagnostic Parent Rating Scale (VADPRS), Conners' Rating Scale (CRS-3), and clinical observations—continue to be the primary measures used in the diagnosis of ADHD. These approaches are based on individual parental, teacher, and caregiver judgment and are therefore open to bias, inconsistency, and lack of context. This is creating a greater demand for more objective, adaptive, and data-based solutions for improving the reliability and consistency of ADHD diagnosis and intervention [15].

AI and ML technology have already been demonstrated to be well-positioned to meet these demands. Such studies have proven that Support Vector Machines (SVM), Random Forests, and deep learning models can identify ADHD more accurately by analyzing behavioral patterns, cognitive responses, and neurophysiological data. These artificial intelligence models process multimodal data such as response time, attention lapses, motor activity, and executive functioning, thereby giving a more detailed diagnostic picture. However, while appearing with encouraging early indications, such AI-based diagnosis devices remain much experimental and not yet incorporated in everyday clinical or pedagogic use [16].

Computerized interventions, including cognitive training software and serious games (e.g., Plan-It Commander), have also been discovered to be effective in supplementing ADHD treatment by improving attention regulation, impulse control, and executive functioning. One of the main disadvantages of these interventions is that they are static. Most interventions do not modify themselves based on an individual child's individual progress or behavioral feedback, thereby limiting their long-term effectiveness and personalization [17].

To address this, researchers are now studying AI-based adaptive learning systems. These can potentially dynamically adjust task difficulty, provide tailored feedback, and tailor interventions based on real-time performance metrics. Reinforcement learning and predictive analytics are most likely to predict symptom change and suggest best-fit intervention approaches. Adaptive frameworks such as these, however, are still in their initial stages and have not yet been implemented widely clinically or evaluated extensively across heterogeneous ADHD subtypes [18].

Gamification has emerged as an engagement strategy that encourages children to undergo therapeutic or diagnostic processes. Research confirms that game-based interfaces enhance participation and cognitive stimulation among ADHD individuals in most gamified ADHD systems, however, are not real-time adaptable nor deeply integrated with emotional and behavioral analysis [19]. Emotion regulation, the core issue in ADHD, is still overlooked in digital therapeutics [20]. However, emotional frustration or tedium powerfully influences attention and task performance in children with the Predominantly Inattentive (PI) subtype. Tools such as facial emotion recognition could be made more impactful through making interventions more responsive by tailoring tasks to existing real-time emotion state, but there is minimal existing usage within ADHD support.

Furthermore, most existing platforms are specialized in focus—either tracking or static treatment—and lack comprehensive, continuous feedback loops for parents, educators, or therapists. Although wearable devices and mobile-based ADHD aids are becoming popular, they often lack inherent decision-making, adaptive personalization, or multiple-modal data analysis for complete ADHD support.

While considerable progress has been made in both conventional and AI-aided ADHD assessment and treatment, several critical gaps remain,

- Lack of Objectivity and Real-Time Adaptation: The conventional assessment processes are highly subjective and non-adaptive to a child's ever-changing behavior and mood. AI models exist but are unrealistic or unavailable for application at the real-time level in homes or schools.
- Static Nature of Current Interventions: Few, if any, gamification software and digital cognitive training programs dynamically adjust difficulty, feedback, or design based on user improvement or affective state.
- Underuse of Emotion Recognition: Affect regulation is the core of ADHD control, yet most of the current digital interventions fail to utilize real-time emotion recognition to tailor content or provide support in frustration or disengagement.
- Limited Scope of Current Applications: Most existing applications tend to focus on either diagnosis or treatment and barely provide end-to-end support covering assessment, real-time monitoring, adaptive learning, and caregiver feedback.
- Underrepresentation of ADHD Subtypes in Personalized Design: Current systems hardly account for the distinct profiles of ADHD subtypes, especially the inattentive subtype that is harder to identify and is diagnosed later since its symptoms are concealed.

To bridge these gaps, this study proposes the development of an AI-powered, gamified behavior test and intervention system for children with ADHD. The system will integrate:

- Machine Learning Models (e.g., SVM, Random Forests) to deliver accurate subtype classification.
- Gamified Behavior Tasks are specifically crafted to quantify attention span, impulse control, and motor activity.
- Adaptive Learning Systems that dynamically adjust to a child's performance and cognitive load.
- Emotion Recognition to detect disengagement or frustration and tailor task difficulty dynamically.
- Predictive Analytics to track symptom emergence and enhance intervention scheduling.
- Real-time feedback Dashboards for clinicians, teachers, and parents to facilitate individualized treatment.

By connecting AI-based evaluation, affect-conscious learning, and adaptive interventions to a unified framework, this project aims to conceptualize a better-integrated, interactive, and personalized ADHD care system.

1.3.Research Problem

Attention-Deficit/Hyperactivity Disorder (ADHD) is one of the most prevalent childhood neurodevelopmental disorders, characterized by hyperactive, impulsive, and inattentive symptoms that continue into adulthood. Such symptoms result in substantial impairment to a child's academic success, social life, emotional development, and quality of life. Though early detection and treatment are imperative to maximize results, standard diagnostic methods for ADHD, particularly for children aged between 5 and 10 fraught with serious limitations.

The older traditional diagnostic procedures often rely on subjective ratings, such as parent and teacher reports, lengthy pencil-and-paper rating scales, and clinical observations. These methods are often biased, time-consuming, and not structured to engage young children interactively [21]. Most critically, they are incapable of capturing real-time behavioral indices like reaction time variability, sustained attention, and impulse control, which are the defining characteristics of ADHD. Hence, the diagnostic process is not objective and tends to lead to sporadic or delayed diagnosis of the disorder. Moreover, present ADHD assessment tools are also not formed to meet the cognitive and affective needs of young children. They are devoid of gamification, personalization, and dynamic adaptive feedback elements, which are critical to maintaining the attention and interest of children throughout assessment. They are not dynamically adaptive to the performance, learning rate, or affective state of the child, limiting their utilization in symptom-specific assessment and treatment.

A further challenge is that most ADHD diagnostic and intervention measures are not culturally applicable. They are constructed in Western environments and are not highly generalizable to settings such as Sri Lanka, where educational practices, cultural belief systems, language, and available resources are quite different [22]. Therefore, children in such settings are likely to have restricted access to developmentally valid, culturally responsive diagnostic solutions. Moreover, existing ADHD intervention systems rarely have predictive information on future impending problems that a child may face. For instance, such a transition from elementary to secondary school introduces increased academic and social demands, which tend to amplify the symptoms of ADHD. However, most interventions lack the predictive capacity to note this type of change or adjust their intervention style suitably. Failure in such predictive powers and planning erodes the capacity to serve a child proactively [23].

The second major flaw is the absence of actionable data-driven recommendations for caregivers and instructors. Where there are behavioral data in real time, they are often in raw or complicated forms that are difficult to interpret. This deprives caregivers of relevant guidance and results in variable or suboptimal management strategies. Given these limitations, there is certainly a demand for a smart, scalable, and culturally aware ADHD evaluation and intervention system that exploits modern technologies such as artificial intelligence (AI), machine learning (ML), and adaptive gamified environments [24]. Such a solution would need to be capable of tracking a child's current interactions across various environments (home, school, therapy), filtering behavioral trends in real-time, identifying emotional and cognitive triggers, monitor progress, and provide dynamic feedback tailored to the child's individual needs and developmental stage.

The present research sets out to address these gaps by developing an AI-driven, gamified ADHD assessment module with DSM-5 diagnostic criteria. At the core of the system is a reaction-time game that impartially evaluates attention span, response inhibition, and impulse control. A dynamic, subtype-specific questionnaire will then be created and answered by the caregiver or parent according to the child's behavioral profile from the game to increase diagnostic accuracy. The two flows of information—real-time behavior data and contextual parental feedback—will be fused using machine learning algorithms to accurately determine the probable ADHD subtype: inattentive, hyperactive-impulsive, or combined type.

The system is intended to be interactive with children and reduce the reliance on subjective observation and memory. The system will also generate automated, individualized reports of feedback for caregivers in terms of symptom profiles, intervention suggestions, and concrete strategies for both home and school environments. Furthermore, the system will have emotion detection, scale of difficulty adjusting to individuals, and reinforcement-driven feedback to keep interest and relevance high over the long term. The blend of mindfulness-based interventions, structured routines, and adaptive learning pathways will allow children to learn essential life skills such as self-regulation, emotional regulation, and resilience. These individualized interventions will keep adapting based on the child's progress, interests, and emotional status, ensuring their long-term effectiveness.

By integrating AI technologies, real-time behavioral analytics, cultural adaptability, and gamified engagement, this research aims to create a holistic, child-centered system for early assessment and intervention of ADHD. The outcome will be a scientifically grounded, scalable solution that bridges the gap between traditional diagnostic approaches and modern, personalized digital solutions—improving the quality of life for children with ADHD and their families.

1.4.Objectives

1.4.1. Main objective

To develop an AI-assisted, gamified assessment and intervention system for children aged 5–10 that enables accurate, engaging, and culturally relevant identification of ADHD subtypes, while providing personalized, data-driven recommendations and interventions based on real-time behavioral monitoring and DSM-5 diagnostic criteria.

1.4.2. Sub objectives

- To design and implement an interactive, gamified behavioral task.

  that objectively captures core ADHD-related symptoms such as sustained attention, impulsivity, and reaction time variability through child-friendly digital gameplay.
- Develop a dynamic, adaptive questionnaire system.

  that is triggered based on the child's performance in the behavioral task, aligning with DSM-5 criteria for identifying the three ADHD subtypes (inattentive, hyperactive-impulsive, and combined).
- To apply machine learning models for symptom classification

  Integrating data from both the gamified behavioral tasks and parent-reported adaptive questionnaires, enabling accurate and objective ADHD subtype identification.
- To provide personalized, real-time feedback and intervention suggestions

  for parents and caregivers, generated through analysis of the child's behavioral patterns, with actionable strategies for supporting the child at home and school.
- To incorporate adaptive learning mechanisms and reinforcement-based feedback

  into the system, ensuring that the digital activities remain engaging, age-appropriate, and tailored to the individual needs, emotional states, and progress of each child.
- To introduce predictive analytics for future planning

  by identifying potential future challenges—such as transitions between educational stages—and adapting the intervention strategies proactively.
- To enhance caregiver support and decision-making

  through intuitive dashboards and visual reports that translate complex behavioral data into easy-to-understand insights and practical recommendations.

2. METHODOLOGY

2.1. Methodology

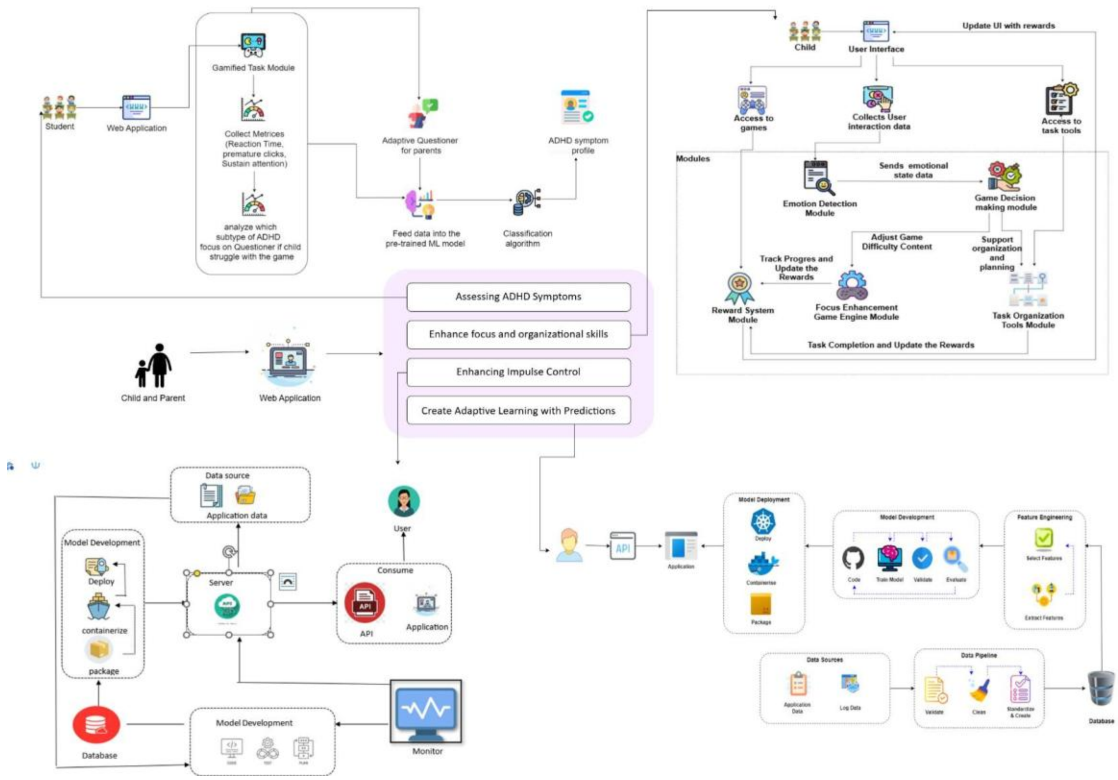

Figure 2.1 System Architecture Diagram

The decision of using the ADHD assessment and intervention application for Sri Lankan primary school students has been done with a robust system architectural focus to enable proper diagnosis as well as assessment and management of the ADHD students in the schools. The design comprises of four main modules with each capable of offering functions based on the best clinical and technological practices. This Gaming inspired application provides Culturally informed, fun, and evidence-based approach to ADHD for children, parents, and teachers through incorporation of gamified modules, adaptive learning, intervention based daily routines, and AI based predictive analytics.

The first part is an AI gamification concept for ADHD symptoms assessment based on DSM-5 criteria to make the actual screening outcome for ADHD symptoms more effective. This module employs a game format like the “falling star” reaction time game to acquire quantitative performance information indicative of key aspects of ADHD, namely response time, duration of focus and impulsiveness manifested in early clicks. This format of delivery makes it extremely easy to engage the child, and in the process their symptoms are self-reported through the games played. In addition to the gamified task, the parents fill in the adaptive DSM-5 questionnaire that can be the Vanderbilt ADHD Diagnostic Parent Rating Scale [40] [32]. This questionnaire changes depending on the answers, focuses on actions that could be signs of ADHD, and gives another aspect to the evaluation based on what the parent sees. The data collected from the game-based task and the survey are further fed for analysis to a pre-trained machine learning model that can distinguish certain types of ADHD, such as Inattentive, Hyperactive-Impulsive, or a combination of both. In this regard, a preliminary diagnosis can also help in development of intervention programs as well as informing parents of assessment results based on clinical norms.

The second one is called Focused on Enhancing Attention and Organizational Skills for children with inattentive ADHD. This module uses adaptive educational strategies to assess, approach, and conduct activities with the child based on his learning style, attitude, and mood. Use of reward systems like stars/trophy, level system, and daily on-goings – like badges are incorporated in the activities to ensure that there is always constant usage. Further, using adaptive technology, behaviors and emotion are recorded in real time to optimize challenges and content to the students' respective moods and attentiveness. Such an approach makes the intervention not only contingent of the child's current cognitive and emotional development needs but also compounding the effect of reward-based practice on sustained attention and organizational skills, thus leading to long term changes in focus and learning behaviors.

In the third component, the system deals with Impulse Control Through Structured Routines for students with hyperactive-impulsive ADHD. This module provides the parent with a variety of structured timetables and schedules that help the child conquer impulse control as well as manage his or her hyperactivity. Everything that takes place in the module is performed with the intention to promote positive energy outlets and to strengthen self-controlling skills. The common ones include exercises, practicing mindfulness, and completing routines that would give some pre-planned structure to one's day. Affordable Five Choose from these suggested five schedules for caregivers and educators that have been configured in a way that these routines may be modified in several bases on the children's needs and preferences. This component assists the children to internalize compliance within the fun activities hence developing discipline to overcome impulsive behavior while implementing a well-planned but elastic structure of behavior.

The last component is an AI-Driven Adaptive Learning and Intervention System which tracks the progress of the child and intervene in response to data acquired in real-time. Such main performance indices as response time, the rate of completion of specific tasks, duration of attention, behavioral data are collected in this module to capture developmental progression of the child. Based on this data, more sophisticated algorithms are applied that permit the foreseen future complications and change intervention measures. The ideas which are obtained are shown from the well-organized interface which are good for both the child and the teacher to comprehend the child's useful abilities or improvement required, and the learning achievements. To help a caregiver or an educator, individual feedback is offered, which is based on analyzed changes in the child's activity patterns and can be used to create individual recommendations on how to approach the child in the next period of development. Programs in this continuous, adaptive learning model ensure that the existing interventions are effective all the time because they complement the development of individual children with ADHD. As a conclusion, this ADHD assessment and intervention system integrates the concept of gamebased assessment, the concept of learning adaptive, the structure of routine, and the applied predictive analytics and artificial intelligence to elaborate a comprehensive and personalized management mode of ADHD. Here layout of each component is consistent with OH clinical standards whereas modification of the components to fit the Sri Lankan context and match the cultural and learning realities of the population of primary school students is a mean of bridging between raising awareness in clinical sense and intervention into the day-to-day problem solved by the members of the target group. Being based on the data, but at the same time being a highly entertaining tool, this approach fosters a highly personalized approach to addressing the wide range of symptoms that may stem from ADHD which will ultimately increase its practicality, use, and efficacy for children, parents, and educators out there

2.2.Software Solution

2.2.1. Development process

Our development process follows the Agile methodology, which emphasizes flexibility, collaboration, and iterative progress. Unlike traditional, linear development models that rely on a fixed, sequential plan, Agile enables us to divide the work into smaller, manageable units known as sprints. This approach allows for continuous feedback, timely adjustments, and ongoing integration of changes throughout the project lifecycle, resulting in products that are more adaptable and aligned with user needs.

To support our Agile workflow, we utilize Microsoft Teams Planner as our task management tool. Planner enables our team to create, assign, and monitor tasks in an organized and visual format. Each sprint is mapped out within Planner using buckets and task cards, where team members can update progress, add comments, set priorities, and attach relevant documents. This promotes transparency, accountability, and collaboration among the team, ensuring that everyone stays aligned and informed throughout the development cycle.

By combining Agile practices with Planner's organizational features, we can maintain a clear structure while remaining adaptable to changes, delivering high-quality solutions in an efficient and user-centered manner.

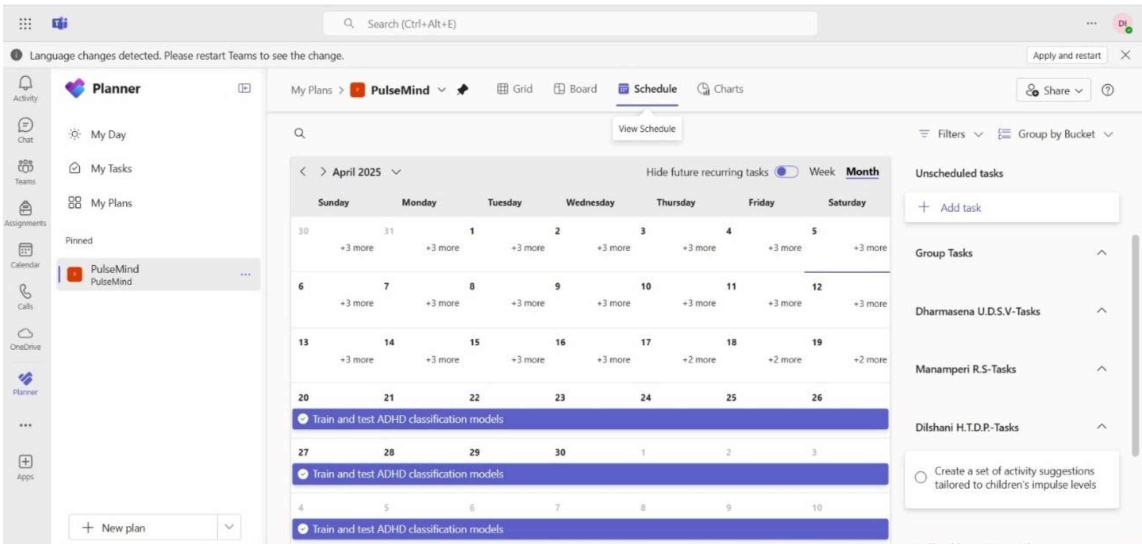

Figure 2.2 MS planner

2.2.2. Requirement gathering

- Interviews

Talk with Child Psychologists to elaborate on the symptom indicators and the diagnostic criteria. Interview the teachers as they can with advice on the in-school behaviors that are relevant to this ADHD problem. The parents will be best placed to inform them regarding their experience with the assessment given to their children and what information would prove valuable.

- Surveys and Questionnaires

Quantitative data collection can be done by distributing surveys to parents and teachers. These would focus on the manifestation of ADHD symptoms in children. Surveys can also include questions to ask parents about types of feedback that are useful and the extent of detailing desired in the assessment results.

- Focus Groups

Conduct focus groups with parents, teachers, and child psychologists to identify the necessities of the assessment tool for ADHD. It can be used to confirm or refute first concepts such as the falling star game idea, as well as which changes to the feature set or adjustments to the numbers would make it even more feasible and of higher diagnostic.

- Observational Studies

Trials were performed with children playing with an early prototype of the game in 1-1 sessions. Pay attention to how they will respond to certain aspects of the game, whether they like it, and how they will respond to graphical or sound rewards. Also, pay attention to such points that could create confusion or instabilities that would be used to help refine the surface of the user interface.

- Document Analysis

An analysis of the DSM-5 criteria in detail to find out the correlation between the features of the assessment and the standardized symptoms. Self-developed questionnaires, academic papers, clinical guidelines, and existing screening tools should be reviewed to have a clear picture of the frequently utilized techniques and indicators and, therefore, find out where this tool can provide a new or improved solution.

- Prototyping

Develop the Falling Star Game and parent feedback form on paper. These prototypes will be shared with a selected group of users, such as teachers and parents, for testing purposes and should solicit responses in terms of engagement, usability, and clarity. Refine the prototype based on suggestions provided by the users to make sure that the prototype meets the needs of the users.

2.3. Project Requirements

2.3.1. Functional requirements

- User Registration and Authentication

  The system must offer secure login and registration options for parents, clinicians, and administrative users to ensure data privacy and user role management.

- Gamified Behavioral Task Module

  The system must offer interactive reaction-time games that measure behavioral markers such as sustained attention, impulsivity, and reaction time variability in real time.

- Adaptive DSM-5-Based Questionnaire

  The system must generate a dynamic, symptom-based caregiver questionnaire based on the child's performance of behavioral tasks and aligned with DSM-5 ADHD subtype criteria.

- Data Collection and Storage

  The system must collect, store, and organize game data, questionnaire responses, timestamps, and interaction metrics for each user session.

- Machine Learning-Based ADHD Subtype Classification

  The system must utilize machine learning algorithms to match grouped behavioral and questionnaire data to classify the child as one of the three subtypes of ADHD.

- Personalized Feedback and Recommendations

  The system must generate personalized caregiver reports with symptom details, education support strategies, and home intervention recommendations.

- Progress Monitoring Dashboard

  There should be a visual dashboard that tracks the child's development process, changes in behavior over time, and effectiveness of intervention.

- Structured Activities and Mindfulness Modules

  Guided activities such as breathing, meditation, and games to develop habits in attention and emotion regulation must be incorporated in the system.

- Predictive Alert and Transition Support

  The system should provide feedback about potential future challenges (e.g., coping with a change in the school environment) and provide recommendations for initiative-taking interventions.

2.3.2. Non-functional requirements

- Usability

  The system should have a fun, intuitive user interface that is engaging and easy for 5–10-year-old children to use, and collapse to information texting for parents and caregivers.

- Performance and Responsiveness

  The system should offer low-latency performance under gaming and questionnaire modules to offer fluid user experience and precise reaction-time data for reaction-time tasks.

- Scalability

  The system should be scalable to manage increasing numbers of users, data entries, and gameplay sessions without compromising performance.

- Security and Privacy

  The system should be able to provide data encryption and user authentication features to protect the confidentiality of child health data and comply with applicable data protection standards.

- Adaptability

  The system should adaptively adjust difficulty levels in tasks and interventions based on the progress and performance patterns of the current child.

- Cultural Relevance and Localization

  The system must be developed so that language support and culturally appropriate content can be employed in Sri Lankan contexts, including indigenous education terminology and parent communication.

- Reliability and Fault Tolerance

  The system must ensure reliable capture of behavior data and uninterrupted execution without loss of data on the occurrence of network or system failure.

- Portability

  The system must be made available on various platforms such as tablets, desktops, and mobiles so that it may be accessible at home, school, or therapy centers.

- Maintainability and Extensibility

  The system architecture should be modular so that in the future, new games, modules, or new diagnostic criteria can be incorporated.

2.3.3. Software requirements

Frontend Technologies

- Implement user interfaces using React.js with functional components and hooks
- Utilize Phaser 3 for game development and interactive assessment activities
- Design responsive interfaces compatible across desktop and mobile devices
- Create interactive visualizations and charts for data presentation and progress tracking
- Implement real-time feedback mechanisms with visual cues and animations

Backend Technologies

- Develop server-side architecture using Node.js with Express.js framework
- Design RESTful API endpoints for client-server communication
- Implement input validation and sanitization for all user-submitted data
- Configure API monitoring for performance metrics including throughput and response times
- Create microservice architecture for modular system components

Database Requirements

- Implement MongoDB for flexible schema design and scalable data storage
- Store structured data including user profiles, assessment results, and performance metrics
- Configure data encryption for all sensitive health information
- Implement efficient data retrieval mechanisms for real-time processing
- Design database schemas optimized for machine learning model inputs and outputs

Machine Learning & AI Requirements

- Develop neural network models using TensorFlow and Keras for ADHD classification
- Implement Convolutional Neural Networks (CNN) for emotion recognition capabilities
- Create reinforcement learning systems based on Q-learning for personalized interventions
- Develop comparative model framework for evaluating multiple algorithms (Random Forest, SVM, Logistic Regression)
- Implement feature engineering processes and model validation using standard metrics
- Design model retraining pipelines for continuous improvement with new data
- Configure Python-based machine learning services with FastAPI for integration

Computer Vision Requirements

- Implement OpenCV for real-time image processing and facial recognition
- Develop emotion detection capabilities trained on multi-emotion datasets
- Configure efficient frame capture and processing for real-time performance
- Implement privacy-focused design ensuring no raw video storage

Security Requirements

- Implement JWT-based authentication system
- Configure role-based access control for different user types
- Apply encryption for data at rest and in transit
- Implement secure API communication between system components
- Design compliance features for healthcare data protection regulations

Deployment & Infrastructure Requirements

- Containerize application components using Docker
- Configure Kubernetes for orchestration and high availability
- Implement continuous integration and deployment pipelines
- Configure version control using GitHub for code and model management
- Design system for scalability to handle increasing user load

2.4. Commercialization Plan

Market Research and Analysis

- Identify the Target Market

  Primary school students in Sri Lanka and in the future other South Asian countries where both awareness of ADHD and access to diagnosis and intervention are very scarce. Add schools, clinics, and parents as target customers especially those in areas where they have little or no access to specialized ADHD products.
- Market Size and Growth Potential

  Investigate how many children in Sri Lanka, and in the wider zone, have ADHD and estimate potential users. Specifically, growth trends in educational and healthcare digital solutions and telehealth services.

Business Model

- Subscription Model

  For parents, schools, and clinics with necessary, monthly, or annual subscriptions. Offer different subscription tiers: There are three packages: Basic, which offers only assessment; Premium package that offers assessment, as well as personalized interventions and Enterprise package designed for schools and clinics where many users will be applying for the program.
- Freemium Model

  Have a basic free version with some of the app's functionalities. Users can pay additionally to get access to more state-of-the-art AI scanned adaptive learning and feedback.
- Licensing to Educational Institutions

  Provide licenses for schools to use this application with many of the students, at cheaper prices.
- Partnerships with Healthcare Providers

  Join pediatricians, therapists, and all other people who can use your app as a part of the complex approach to ADHD treatment.

Pricing Strategy:

- Basic Plan
- Price: Free
- Features:

- ✓ Screening of ADHD symptoms by means of the questionnaires which are filled in interactively.
- ✓ Simple looking and inattention, and hyperactivity monitoring
- ✓ Few of the progress reports are within the app.
- ✓ Simple advice on coping with ADHD behaviors
- ✓ Best for small ones (parent or teacher) who do not require professional test to administer to their child or student.

- Premium Plan
- Price: $10/month
- Features:
  - ✓ Complete ADHD evaluation with the comprehension of symptoms and the ADHD subtypes (Inattentive, Hyperactive Impulsive, and Combined).
  - ✓ Computerized self-directed individualized therapies and cognitive exercises
  - ✓ App notifications and SMS alert for the need to intervene.
  - ✓ Interactive progress tracking with capability of weekly or monthly scheduled reports.
  - ✓ Inattention management and impulse control through using adaptive learning games.
  - ✓ Perfect for both homes and schools that in need of a solution and resource for ADHD issues.

- Group Plan
- Price: $150/month
- Features:
  - ✓ You get to enjoy all the features from the Premium Plan
  - ✓ Multiple usage up to 25 each student
  - ✓ Report on the group-level of analysis on the identified patterns
  - ✓ The professors can give and monitor multiple classes or groups from one console/panel.
  - ✓ Opportunity to request professional individual and group sessions with focus on ADHD approaches for teachers.
  - ✓ Assigned account manager for assistance and individualized getting started.
  - ✓ Recommended for schools, clinics or any institution that requires supporting many children.

2.5. Testing & Implementation

2.5.1. Implementation

AI-Driven Gamified ADHD Symptom Assessment

The implemented component of the Pulse Mind system focused on developing an AI-assisted, gamified assessment platform aimed at the early detection and classification of Attention-Deficit/Hyperactivity Disorder (ADHD) in children aged 5 to 10. The multifaceted implementation strategy incorporated clinical diagnostic criteria with engaging gameplay elements and machine learning capabilities to create a comprehensive assessment tool.

The core of the system was a behavioral assessment game—titled the "Falling Star Game"—designed to evaluate reaction time, sustained attention, and impulsivity. This game was built using Phaser 3 for game mechanics and React.js for user interface management. The implementation required careful calibration of game parameters to ensure they aligned with established neuropsychological measures of attention and impulsivity.

The game presents falling star objects that require timely responses from the child, with each successful interaction recorded and analyzed. The development process involved creating physics-based animations using Phaser's built-in engine, implementing collision detection algorithms, and establishing precise timing mechanisms to measure reaction speeds down to millisecond accuracy. The game dynamically adjusted its difficulty based on the child's performance by increasing the speed of falling stars after every series of correct responses, creating an adaptive challenge curve that prevented both frustration and boredom while continuing to test attentional limits.

To enhance engagement and provide real-time reinforcement, multiple feedback mechanisms were implemented, including: 1) visual cues such as color changes and animations to indicate successful or missed interactions, 2) age-appropriate motivational messages that appeared at strategic intervals to maintain motivation, and 3) audio prompts using carefully selected sound effects that provided immediate auditory feedback without causing distraction. In addition to the behavioral game, an adaptive DSM-5-based parental questionnaire was developed to gather clinical observations of the child's behaviors. This digital questionnaire was implemented using React.js to dynamically adapt the interface in real time based on the user's responses. The implementation required creating a sophisticated branching logic system that could modify follow-up questions based on previous answers, allowing for more detailed exploration of reported symptoms.

The questionnaire covered all 18 DSM-5 symptom criteria across the domains of inattention and hyperactivity-impulsivity. Each question used a Likert scale to measure symptom frequency and severity, with custom-designed interactive sliders to make the rating process intuitive for parents. The implementation included visual aids and examples for each question to ensure parents understood the behaviors being assessed. The system employed advanced form validation techniques to ensure completeness and consistency of responses, with built-in safeguards to prevent submission of contradictory information. Responses were scored numerically using clinically validated algorithms and transformed into weighted features fed into the ADHD subtype classification model. The backend of the system was developed using Node.js, enabling smooth communication between the front-end game, parent questionnaire, and machine learning engine. The implementation utilized RESTful API principles with JSON Web Token (JWT) authentication to ensure secure data transmission between components

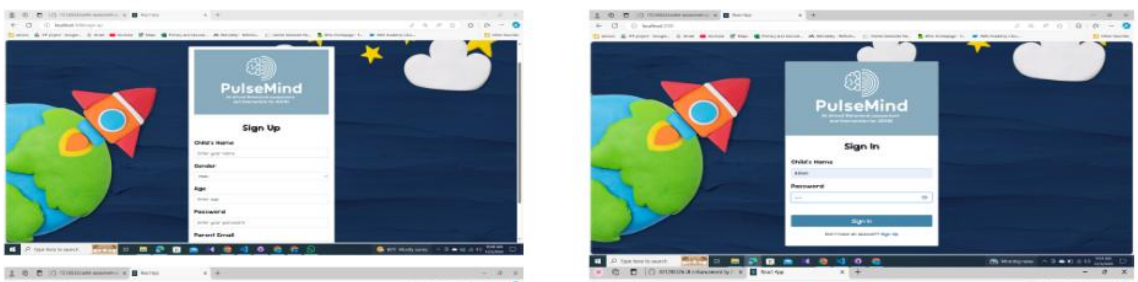

Figure 2.3 Signup & Sign in

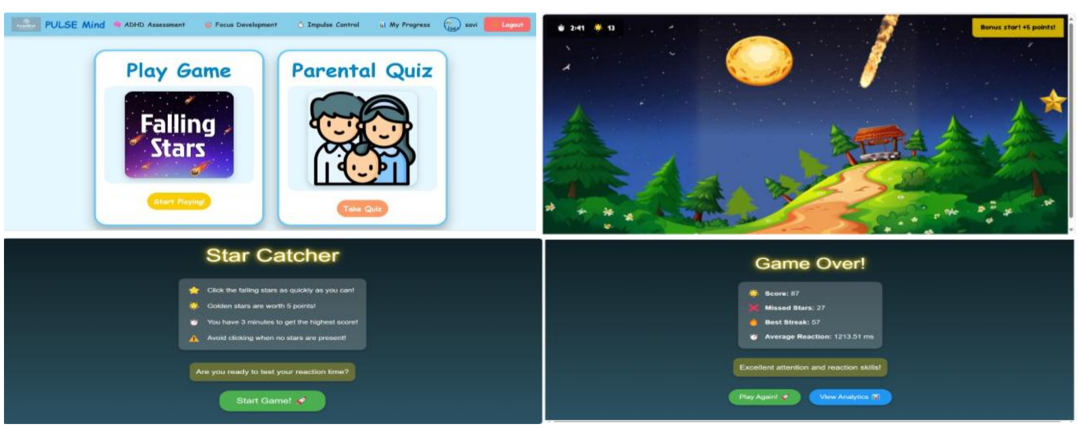

Figure 2.4 ADHD Symptom Assessment UI

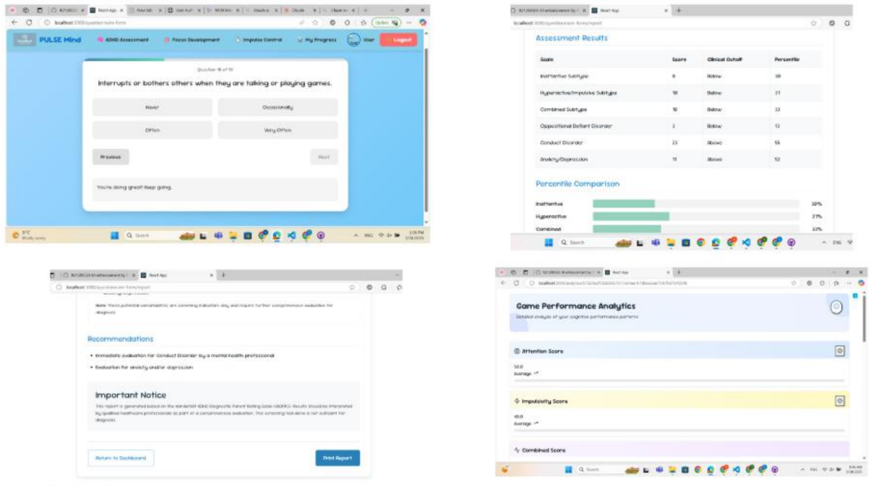

Figure 2.5 ADHD Symptom Assessment UI

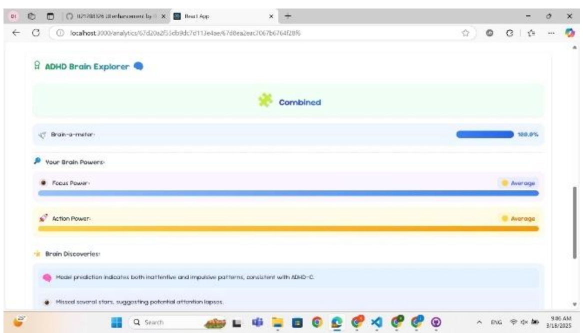

Figure 2.6 ADHD Symptom Assessment UI

Creates specific tools and activities to help children with predominantly inattentive ADHD improve focus and stay organized

The developed system provides an interactive and emotionally adaptive therapeutic experience for children aged 6–12 diagnosed with Predominantly Inattentive ADHD. Its core objective is to improve focus and emotional regulation through personalized, mood-aware gameplay. By using real-time facial emotion recognition, the game responds dynamically to the child’s emotional state, ensuring sustained engagement and minimizing frustration.

The emotion detection module is powered by a Convolutional Neural Network (CNN) trained on a curated dataset to recognize five emotions: happy, sad, angry, surprised, and neutral. Implemented with Python, OpenCV, and FastAPI, the system captures webcam frames and processes emotions locally in real time. Detected emotions are transmitted to the front end, developed in React.js, where they influence gameplay elements such as difficulty, feedback, and reward frequency. The interface is designed to be colorful and child-friendly, featuring mini-games like pattern matching and memory tasks that support attention development.

The backend, built with Node.js and Express.js, handles API communication, session control, and data storage. MongoDB is used to store structured data including emotion labels, performance metrics, and session histories. A key feature is the reinforcement learning engine based on Q-learning, which personalizes future sessions by learning from emotional patterns, gameplay behavior, and reward responses.

To support caregivers, the system includes a parental dashboard that displays emotion trends, attention scores, and long-term progress charts. These reports help parents and clinicians collaborate on treatment decisions. Privacy is a top priority—no raw video is stored, only emotion labels with timestamps, and all data is encrypted and stored securely. Authentication is managed using JWT, with role-based access control.

The architecture is modular, with each component—emotion detection, game engine, user management, reinforcement learning, and database—operating as an independent microservice. This ensures flexibility and scalability, allowing future enhancements like voice emotion recognition or multilingual support without disrupting existing functionality.

In summary, the system blends AI, real-time emotion monitoring, and personalized gameplay into a secure and scalable platform. It offers a promising digital intervention tool that supports children with ADHD in developing focus and emotional resilience while involving caregivers in the therapeutic process.

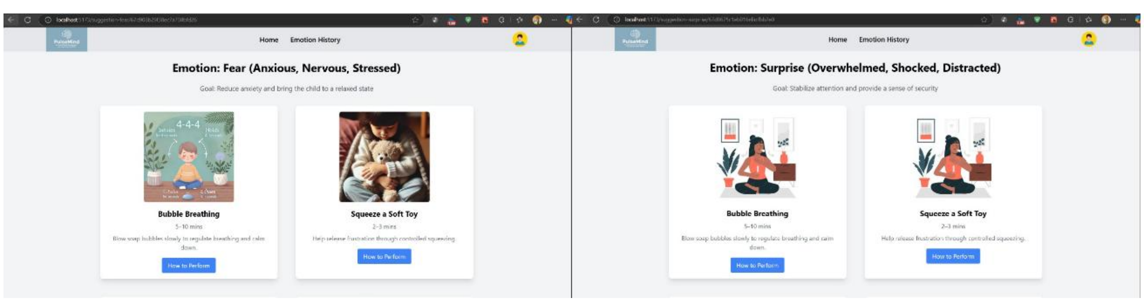

Figure 2.7 User Interfaces

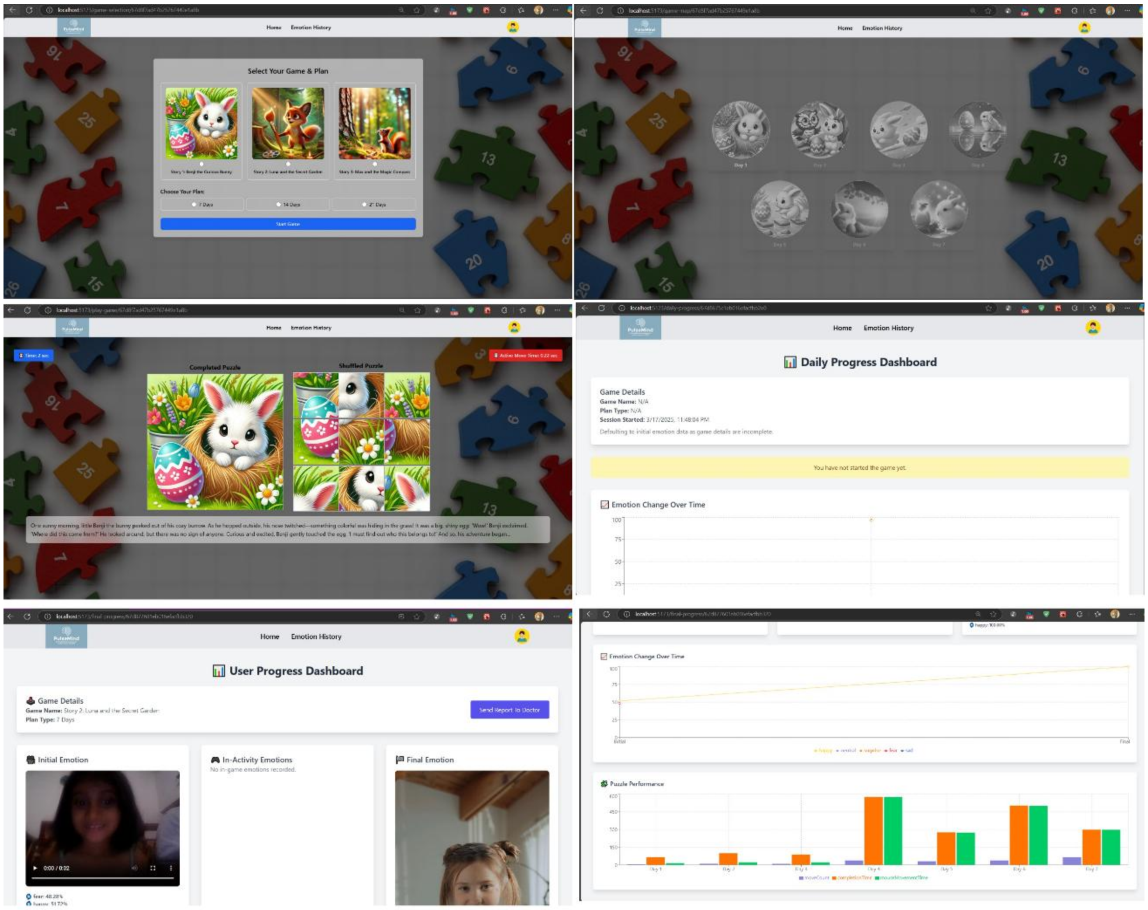

Figure 2.8 User Interfaces

Enhancing Impulse Control in ADHD Students Through Structured Timetables

The implementation of the Mindfulness for ADHD module centers around the integration of mindfulness-based techniques into a user-friendly digital platform designed for children aged 3 to 10 with hyperactive-impulsive ADHD. The system includes a wide range of interactive exercises such as breathing techniques, guided meditation, and music-assisted relaxation activities. These exercises are tailored to suit the short attention spans and behavioral patterns of young children, with engaging visuals, calming sounds, and animations that maintain their interest and encourage participation.

A key component of the system is the profile management module, which allows caregivers and parents to input detailed behavioral data, daily routines, and emotional triggers. Based on this input, the platform generates personalized daily mindfulness schedules, helping children establish structured, low-stress routines. The schedule may include morning breathing exercises, midday music relaxation for focus, and evening art therapy to promote emotional expression.

The back end of the platform is built using Node.js, which securely handles user data and ensures personalization features operate efficiently. All personal and behavioral data is stored under strict privacy protocols. Meanwhile, React is used for frontend development, offering a smooth, graphics-rich, and responsive interface optimized for young users.

To ensure long-term scalability and performance, the entire application is containerized using Docker and orchestrated with Kubernetes. This deployment method supports high availability and adaptability to different usage loads. Continuous testing and updates are carried out based on expert and caregiver feedback, making the module a dynamic and sustainable solution for ADHD management.

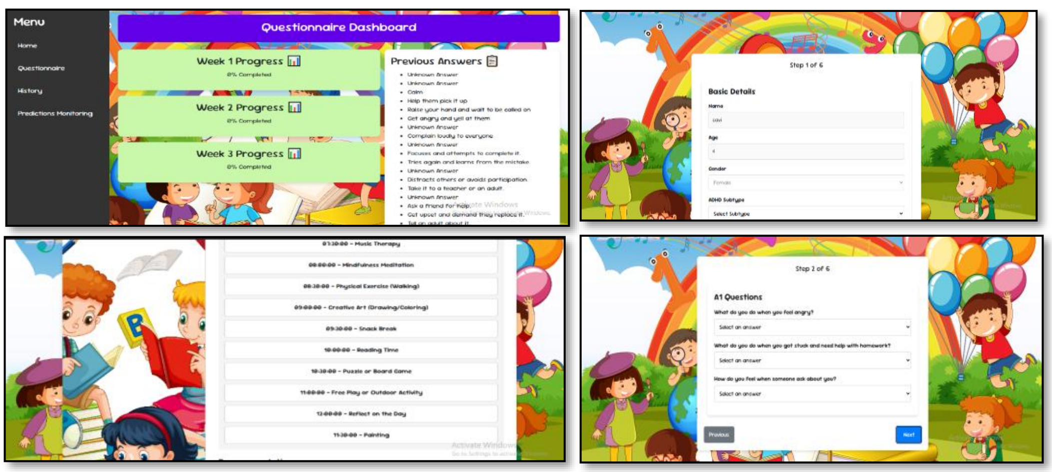

Figure 2.9 Impulsivity control component UI

AI-Driven Adaptive Learning and Intervention System with future predictions for Personalized ADHD Management in Children

The research describes the advanced ADHD management system setup. This begins with data gathering from schools and hospitals and continued with rigorous data preprocessing (cleaning, filtering, standardization), encryption, and secure storage. At the center of the system is the machine learning model (initially Random Forest, SVM, Logistic Regression, and Neural Networks were considered, and the most accurate one was chosen) for predicting challenges children with ADHD will face in the future and offering personalized prevention mechanisms.

An important feature is the integrated monitoring dashboard that allows teachers and caregivers to track the child's progress and effectiveness of the strategies implemented. Before model training, exhaustive feature engineering is going to be done to identify major predictive features. The predictions and recommendations from the selected and trained model will be securely stored and displayed through the dashboard. A feedback loop allows continuous monitoring and adjustment of the predictions and prevention methods. For the long-term maintenance and reproducibility of the model, the system applies version control (GitHub). The model is integrated with a web application that comprises a user-friendly React frontend and a high-performance Node.js/Express.js backend for API requests, data validation, and secure communication with the Python-based ML model. The backend performance (throughput, response time, error rate, etc.) is continually monitored.

The backend then sends validated user input to the ML model and retrieves the corresponding predictions (future challenge type and personalized prevention mechanism) for display on the frontend. The monitoring dashboard provides a detailed view of a child's history, mechanisms employed, engagement, and overall performance. The whole application is containerized with Docker for portability and deployed on Kubernetes for high availability and reliability. The functionalities of the application are exposed via a well-defined API, providing avenues for scalability and strong performance, leveraging technology in machine learning and cloud computing for an efficient and large-scale ADHD intervention management system.

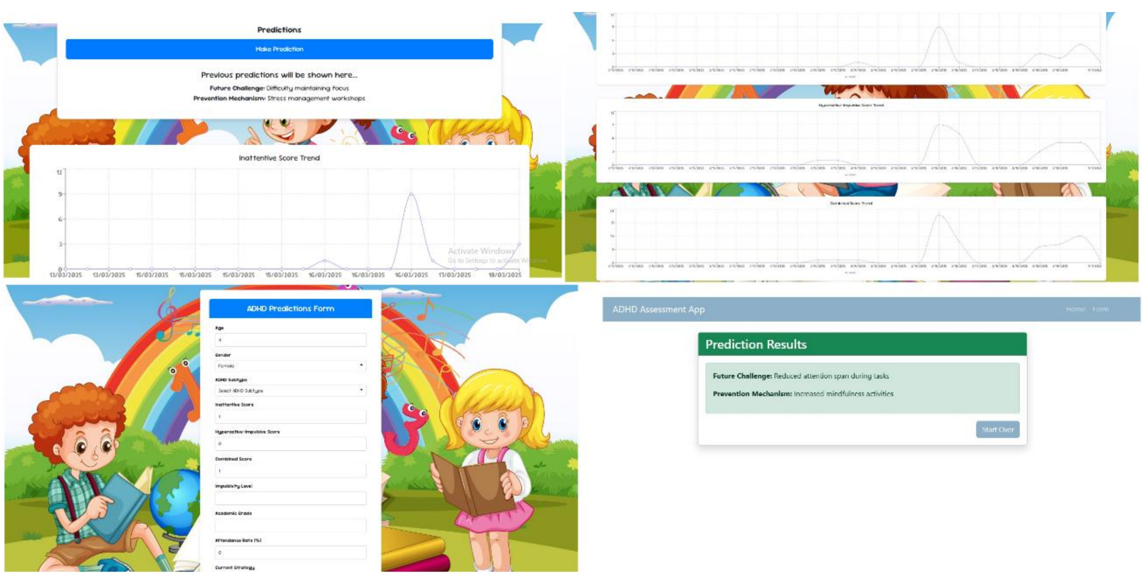

Figure 2.10 User Interfaces

2.5.2. Testing

AI-Driven Gamified ADHD Symptom Assessment

The system backend operated with Node.js technology to link the front-end game with the parent questionnaire and machine learning engine. The TensorFlow and Keras model implements a three-layer neural network to classify ADHD cases among the possible outcomes that include inattentive and hyperactive-impulsive and combined types and no ADHD diagnosis. User data is stored in MongoDB so the system has scalable storage and flexible schema design for game performance data alongside questionnaire results and classification outcomes. The model accessed a retraining module through which it processed new user data to enhance its performance during each data update.

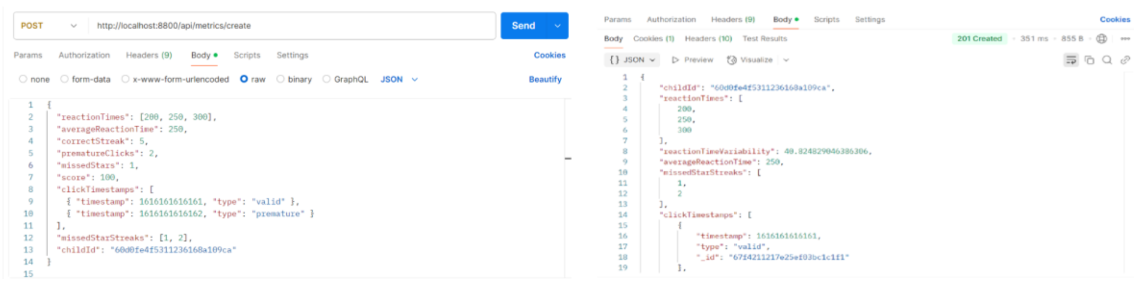

Figure 2.12 API testing Game metrics

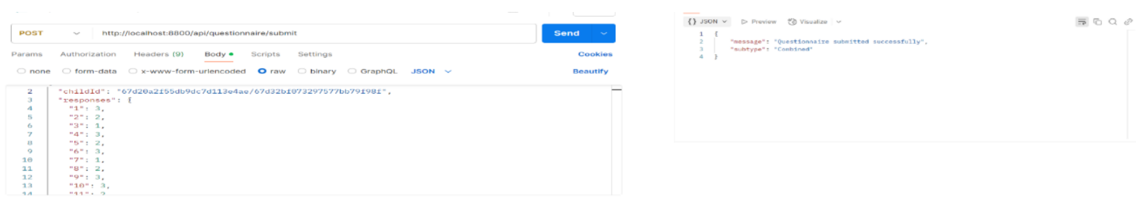

Figure 2.11 API testing parent questionnaire

Creates specific tools and activities to help children with predominantly inattentive ADHD improve focus and stay organized

The Emotion-Aware Game-Based Intervention system was tested through unit and integration testing to ensure stable performance, smooth real-time interactions, and appropriate emotional adaptation during gameplay. The emotion recognition pipeline was validated for proper classification and seamless communication with the game interface using API testing tools like Postman and browser developer tools. The React-based front end was tested for responsiveness and dynamic UI behavior across multiple devices, while the backend was verified for secure session handling, data logging, and API reliability. Emotional state transitions were simulated to confirm that the game mechanics adjusted as expected—changing difficulty, rewards, and visual feedback accordingly. Functional testing also confirmed that the system maintained ethical standards by storing only emotion labels and timestamps without saving webcam footage.

Enhancing Impulse Control in ADHD Students Through Structured Timetables

The mindfulness-based ADHD management system was evaluated with cross-validation techniques, real-time usability testing, and performance tracking. The machine learning models were trained with k-fold cross-validation for the best generalizability. Logistic regression proved to be the most stable model in behavior prediction and intervention time. The usability was tested by experts and caregivers, and individualized schedules were certified. Backend APIs were tested for integrity and reliability of data. Real-time monitoring ensured timely resolution of complaints.

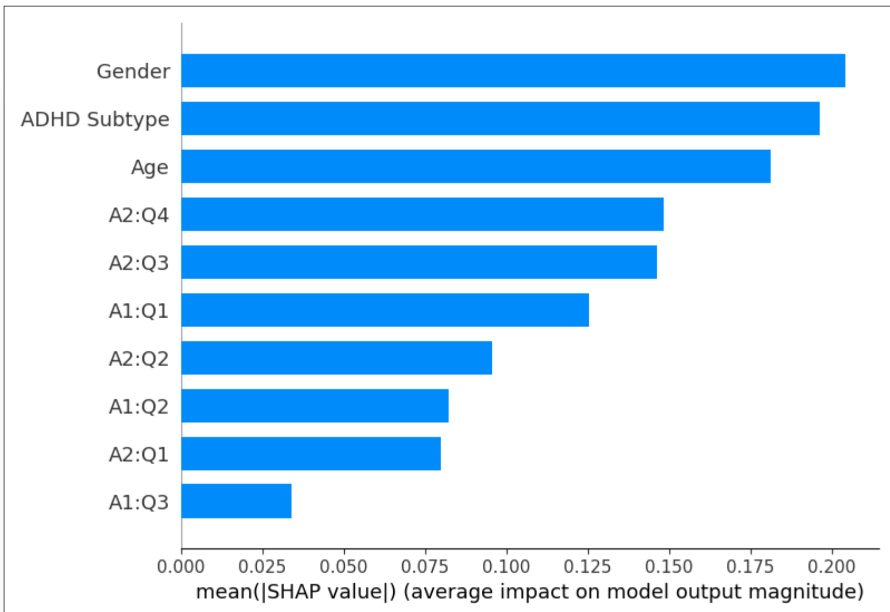

Figure 2.13 Test Enhancing Impulse Control

AI-Driven Adaptive Learning and Intervention System with future predictions for Personalized ADHD Management in Children

This will be subjected to a rigorous multi-dimensional testing of the superior system intended for ADHD management, in the following manner. The unit tests focus on verifying the isolated functionality of individual components, such as data processing within ML models and those for other API endpoints with reference to user interfaces. Subsequently, integration tests examine the interaction between these components - their communication with the frontend and backend, backend and machine learning model, and the system connection to the database.

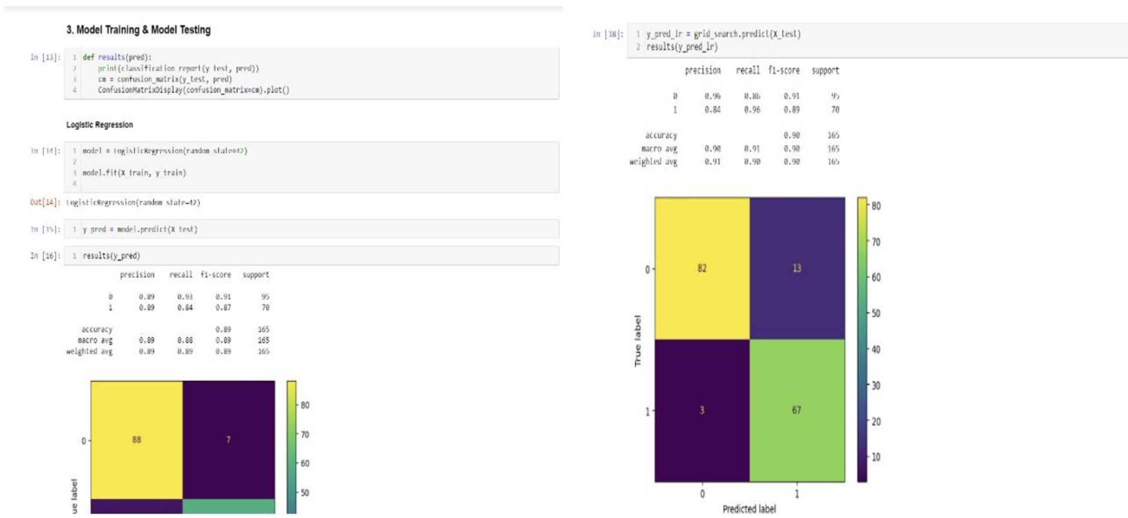

Figure 2.14 Model Training

In performance testing, the study will be on the efficiency, responsiveness, and stability of the system under different user loads, with a close focus on how API calls actuate their duration, throughput, and error rates mainly critical for the ever-updating monitoring dashboard alongside the dashboard performance. Security testing will identify and mitigate risks concerning user authentication and access control, data encryption both in transit and at rest, input sanitization against malicious attacks, and entire penetration testing against real threats.

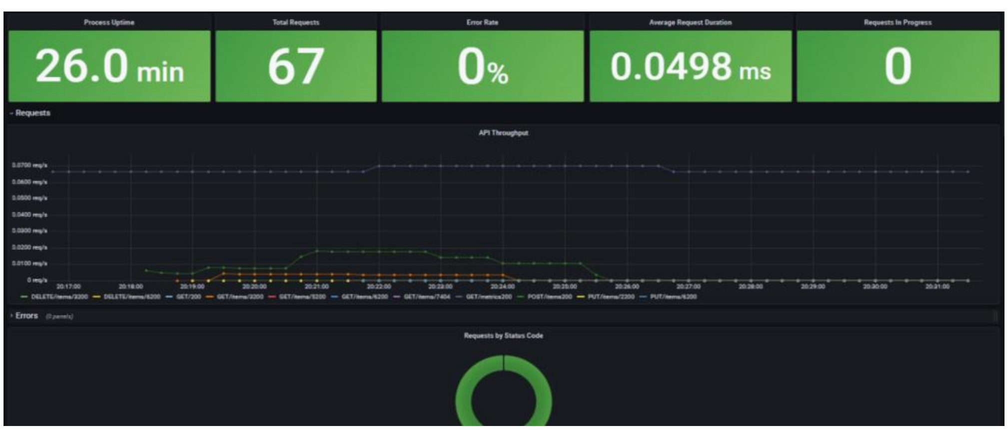

Figure 2.15 Performance testing

To ensure that the application is perceived positively by users, usability testing will evaluate how well the system is designed to work by focusing on ease of use by teachers, parents, and in time, children. The testing will include a wide range of different test data reflecting real-world scenarios, including synthetic data, anonymized real data, and various edge cases, leveraging automated test case execution for efficiency. Most importantly, the involvement of domain experts such as psychologists, educationists, and caregivers throughout the lifecycle of testing would ensure that the system address the real clinical relevance and applicability of these tests comprehensively to guarantee a reliable and accurate, as well as secure and user-friendly system for the management and support of children with ADHD.

2.5.3. Test cases

AI-Driven Gamified ADHD Symptom Assessment – IT21288326 - Dharmasena U D S V

Table 2.1 ADHD assessment component test case summery

Test ID	Title	Module	Expected Output	Result
TC01	Reaction Time Recording	Falling Star Game	Reaction time is accurately measured and stored	Pass
TC02	Sustained Attention Across Rounds	Falling Star Game	Consistent attention data is recorded	Pass
TC03	Premature Click Detection	Falling Star Game	Impulsive clicks are logged and analyzed	Pass
TC04	Parent Feedback Form Submission	Parent Feedback	Feedback saved and linked to child's profile	Pass
TC05	Combined Diagnosis	ADHD Type Analysis	ADHD subtype diagnosis generated	Pass

Creates specific tools and activities to help children with predominantly inattentive ADHD improve focus and stay organized

Table 2.2 Emotion-Aware Game-Based Intervention component test case summery

Test ID	Title	Module	Expected Output	Result
TC01	Emotion Detection Trigger	Emotion Recognition	Real-time facial emotion is detected and label returned	Pass
TC02	Dynamic Game Adjustment	Game Engine	Game difficulty and feedback adapt based on detected emotion	Pass
TC03	Reward Display Update	Game UI	Reward board updates in real-time after game completion	Pass
TC04	Session Report Generation	Backend API	Session summary is stored and retrievable via parental dashboard	Pass

TC05	Camera Permission Handling	Webcam Access	Prompt displayed and emotion capture begins after user consent	Pass

Enhancing Impulse Control in ADHD Students Through Structured Timetables

Table 2.3 Impulsivity control component test case summery

Test ID	Title	Module	Expected Output	Result
TC01	Personalized Routine Generation	Mindfulness System	The system generates a daily routine based on child's profile data	Pass
TC02	Mindfulness Exercise Completion Tracking	Mindfulness System	Completion of each exercise is recorded in the child's progress log	Pass
TC03	Visual Schedule Display	Mindfulness System	A child-friendly visual schedule is shown for the current day	Pass
TC04	Relaxation Activity Engagement	Mindfulness System	Child engages with music-assisted relaxation exercises successfully	Pass
TC05	Impulsivity Control through Routine Engagement	Mindfulness System	Child shows reduced impulsive behavior after completing tailored mindfulness routines	Pass

AI-Driven Adaptive Learning and Intervention System with future predictions for Personalized ADHD Management in Children

Table 2.4 AI-Driven adaptive learning and intervention system test case summary

Test ID	Title	Module	Expected Output	Result
TC01	Future Challenge Prediction	Future Prediction	Predict Academic, Social and Other Challenges children with ADHD might face in future	Pass
TC02	Prevention Mechanism Generation	Prevention Mechanism	Predict suitable prevention mechanisms for future challenges identified in above	Pass
TC03	Monitoring Dashboard - Data Display	Monitoring Dashboard	Properly display accurate results and data in dashboard	Pass
TC04	Performance - API Response Time	Backend API	Send responses from model for user requests with minimum duration and throughput	Pass
TC05	Personalized Data Retrieval (Child Profile)	Monitoring Dashboard	Display personalized charts and details about children in dashboard properly	Pass

3. RESULTS AND DISCUSSION

3.1. Results

AI-Driven Gamified ADHD Symptom Assessment

The PulseMind system demonstrated promising results in terms of diagnostic accuracy, user engagement, and system performance. The gamified behavioral assessment achieved a session completion rate of 94.3%, with an average session time of just under five minutes, reflecting strong engagement among children aged 5 to 10. Compatibility testing showed consistent performance across various devices, including desktops, laptops, tablets, and smartphones, with an average response latency of below 50 milliseconds across platforms.

Table 3.1 Performance Metrics by Device Type

Device Type	Avg. Response Latency (ms)	Session Completion Rate
Desktop PC	34	96.8%
Laptop	42	95.2%
Tablet	46	93.7%
Smartphone	49	91.5%

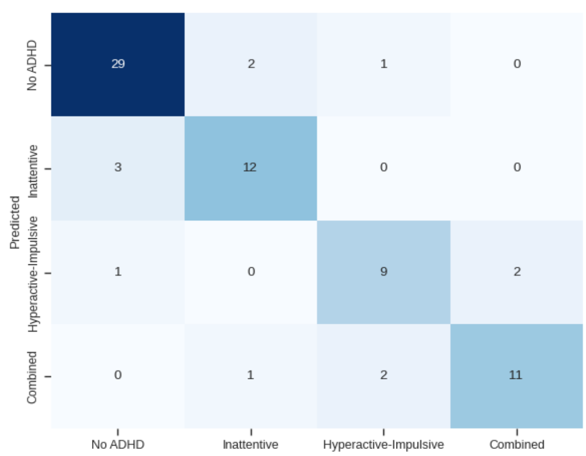

Figure 3.1 Confusion matrix showing classification accuracy

The machine learning model trained on combined behavioral and questionnaire data achieved an overall classification accuracy of 84.3%, with a precision of 82.7%, recall of 81.9%, and an F1-score of 82.3%. The confusion matrix indicated the strongest performance for the "Combined" ADHD subtype. Importantly, the model's predictions matched clinical ADHD diagnoses in 82.1% of cases when validated against real-world data. Parental engagement with the questionnaire was also high, with a 91.2% completion rate. Parents found the form easy to use, and most appreciated the final diagnosis and explanation summary. On the System Usability Scale (SUS), children gave the interface a score of 87.2/100, and parents rated it 82.3/100.

Additionally, the system significantly reduced assessment time. On average, a complete PulseMind evaluation took 14.1 minutes, compared to over 2 hours in traditional clinical methods, resulting in over 70% time and cost efficiency.

Creates specific tools and activities to help children with predominantly inattentive ADHD improve focus and stay organized

The Emotion-Aware Game-Based Intervention for ADHD demonstrated a high level of engagement among children, with an impressive session completion rate of 92.4%. This indicates that most children who started the intervention were able to complete the sessions, showcasing the system's ability to retain user attention. The system performed consistently across different devices, ensuring accessibility and usability for a wide range of users.

In terms of session duration, the average time spent per child was 12.5 minutes, which reflects a sustained interest in the gamified therapy. This indicates that the design of the intervention, particularly with its dynamic difficulty adjustments and emotion-based adaptations, effectively engaged the users and maintained their attention.

The table below summarizes the response latencies by device type, highlighting the performance variations across different devices and the session completion rates,

Table 3.2 Performance Metrics by Device Type

Device Type	Avg. Response Latency (ms)	Session Completion Rate	Avg. Session Duration (min)
Desktop PC	35	94.2%	13.1
Laptop	40	93.5%	12.7
Tablet	45	92.1%	12.3
Smartphone	48	90.7%	11.9

The emotion recognition module performed well by detecting emotional states accurately and quickly. On average, the system identified emotional cues with a response time of around 500 milliseconds per frame.

The system adjusted gameplay difficulty and feedback in real time according to the detected emotions (happy, sad, angry, surprised, and neutral). This feature of emotion-based game adaptation helped keep children engaged and provided a tailored experience based on their emotional state.

The overall response time of the game mechanics to emotional changes, including the adjustments in game difficulty and feedback, averaged around 750 milliseconds. This quick response time helped ensure that emotional changes were immediately addressed, enhancing the overall user experience.

The system was tested across multiple devices, and the results showed that desktop and laptop devices performed slightly better in terms of session completion rates and lower latency compared to tablet and smartphone devices. However, it is important to note that all devices provided an acceptable user experience. The intervention's performance was consistently good across all device types, ensuring that the intervention can be used in a variety of environments, from homes to schools, without any significant compromises in quality. The adaptation to various device types makes the intervention versatile and accessible to a wide user base, increasing the likelihood of positive engagement from children with ADHD.

Enhancing Impulse Control in ADHD Students Through Structured Timetables

The system is designed to address impulsivity and enhance attention in children with hyperactive-impulsive ADHD. The system used specially formatted mindfulness interventions, such as breathing exercise, guided relaxation, and music therapy. With daily attendance tracking and behavioral patterns, the system identified improved following instructions in children, decreased disruptive behavior, and calmness. The baseline predictive model used was Logistic Regression, which yielded accurate predictions and early interventions with noticeable changes in behavior.

AI-Driven Adaptive Learning and Intervention System with future predictions for Personalized ADHD Management in Children

The monitoring dashboard data collected from models of prediction and prevention reveals a strong correlation between some behavioral patterns inferred from the application interaction and the parameters of the output at the system level. There was a noteworthy association found between these behaviors on the dashboard and predictions of future hyperactivity-impulsivity-related difficulties made by the prediction model. In addition, prevention mechanisms recommended by the system and visible on the dashboard correspond to these predicted challenges, suggesting a coherent and data-driven approach to intervention planning. Therefore, trends and correlations displayed on the monitoring dashboard provide useful real-time insight into the patterns of behavior of the child and correlating predictions and suggested preventative strategies generated from the system's underlying models.

3.2. Research Findings

AI-Driven Gamified ADHD Symptom Assessment

The findings from this study emphasize the effectiveness of integrating real-time behavioral data with adaptive parent-report questionnaires in accurately identifying ADHD subtypes in children. The system's design enabled the capture of both in-game behavioral patterns and subjective parent-reported symptoms, providing a holistic view of the child’s attentional and behavioral profile.

One of the most significant outcomes was the observed correlation between specific game metrics and parent-reported symptoms. For example, behavioral indicators of inattention—such as delayed response times and frequently missed target stimuli ("missed stars")—showed a strong correlation with high scores on parent-reported inattention scales. This suggests that the gamified tasks are effective in capturing real-world inattention symptoms in a non-invasive and engaging manner.

Similarly, impulsive behaviors recorded during gameplay, such as frequent premature clicks, aligned closely with parent-reported hyperactivity and impulsivity symptoms. This strong relationship further validates the gamified system's ability to reflect core ADHD behavioral traits through measurable interactions. To quantify the effectiveness of different data sources, three distinct models were evaluated: one using only game-derived metrics, another using only questionnaire data, and a third combining both. The comparative results are summarized in Table 3.2.

Table 3.3 Comparison of Data Modalities

Data Source	Accuracy	Precision	Recall	F1 Score
Game Metrics Only	76.5%	74.3%	73.8%	74.0%
Questionnaire Only	79.8%	78.2%	77.5%	77.8%
Combined Approach	84.3%	82.7%	81.9%	82.3%

The combined approach, which integrates both behavioral metrics and questionnaire responses, outperformed the individual modalities across all evaluation metrics—accuracy, precision, recall, and F1 score. This demonstrates that merging objective gameplay data with subjective parent observations creates a more robust and reliable model for ADHD subtype classification.

These results underscore the value of a hybrid assessment strategy, supporting the idea that multi-modal data fusion can enhance the diagnostic process. The success of this AI-driven, gamified system highlights its potential not only as an engaging screening tool but also as a foundation for more precise, personalized intervention strategies in future ADHD research and clinical practice.

Creates specific tools and activities to help children with predominantly inattentive ADHD improve focus and stay organized

The study further underscores the critical role of adaptive gamification in supporting children with ADHD by recognizing and responding to emotional cues. This approach capitalizes on the child's emotional state to create a more personalized and supportive learning environment. The system's ability to detect and adjust to different emotional states is crucial in enhancing the overall effectiveness of the intervention. When the system identified high frustration levels, it was able to lower the difficulty, providing relief to the child, and vice versa, challenging them when excitement or focus was detected. This dynamic adaptation ensures that the child's emotional state is consistently in harmony with the game, promoting better task performance and emotional regulation.

Moreover, the system demonstrated that engagement levels were sustained for longer periods due to the constant emotional feedback loop between the child and the game. This real-time adjustment to emotional states allowed the children to stay focused and motivated throughout the intervention, reducing the typical distraction that children with ADHD experience in traditional settings. The adaptive nature of the system ensures that it is not one-size-fits-all but tailored to each child's unique emotional responses.

Behavioral improvements observed were consistent across various emotional states, and the ability to reduce negative behaviors such as impulsivity and frustration further highlighted the effectiveness of the emotion-based interventions. These results were corroborated by both the children's performance on tasks and consistent feedback from parents, who noticed an improvement in their children's ability to stay engaged with educational tasks and exhibit better self-regulation.

The combination of emotion detection and gamified mechanics offered a holistic approach to ADHD management, resulting in children who could better manage their emotions while improving their focus and task completion abilities. This feature is particularly important because emotional dysregulation is one of the core challenges faced by children with ADHD, and addressing this through technology offers a novel and potentially scalable solution to ADHD symptom management.

Table 3.4 Comparison of Data Modalities

Data Source	Accuracy	Precision	Recall	F1 Score
Emotion Detection Only	82.5%	80.3%	78.6%	79.4%
Game Metrics Only	76.7%	74.5%	72.3%	73.4%
Combined Approach	86.1%	84.2%	82.9%	83.5%

The table clearly illustrates the performance of the three data sources used in the study. The combined approach yielded the highest metrics across all categories, including accuracy, precision, recall, and F1 score, thereby demonstrating the strength of combining emotion detection with gamification. The emotion detection-only approach showed strong performance as well, confirming the value of emotional awareness in ADHD interventions, while the game metrics-only approach still provided decent results but was less effective than the integrated approach. This reinforces the notion that real-time emotional feedback, when paired with behavioral metrics, creates a more powerful tool for enhancing attention and emotional regulation in children with ADHD.

Enhancing Impulse Control in ADHD Students Through Structured Timetables

The study highlights the efficacy of integrating tailored mindfulness schedule plans with behavioral data tracking in aiding children with hyperactive-impulsive ADHD. Tailored activities, including breathing, guided meditation, and music relaxation, positively impacted impulsiveness control, emotion regulation, and attention span increase. Regular utilization of the pictorial schedule by children manifested visible behavioral improvement as recorded by caregivers and parents. The profile-based personalization system, in conjunction with daily activity diaries, enabled dynamic routine adjustment based on individual needs.

Table 3.5 Comparison of Data Modalities

Data Source	Accuracy	Precision	Recall	F1 Score
Activity Logs Only	74.2%	72.6%	71.9%	72.2%
Caregiver Input Only	78.6%	77.1%	76.3%	76.7%
Combined Approach	85.1%	83.4%	82.7%	83.0%

AI-Driven Adaptive Learning and Intervention System with future predictions for Personalized ADHD Management in Children

The data gathered and displayed on the monitoring dashboard through the prediction-prevention mechanism models were significantly instrumental in identifying and managing possible ADHD-related issues. Performance evaluation of the underlying prediction models, which reflected the insights available on the monitoring dashboard, also brought to light improved performance accuracy, achieved through combined data. enhanced predictive capability directly informs the personalized prevention mechanisms also presented on the monitoring dashboard, suggesting a data-driven pathway towards more targeted and effective early interventions. The monitoring dashboard thus becomes a vital interface for translating such research findings into actionable insights for teachers and caregivers.

Table 3.6 Comparison of Data Modalities

Model	Accuracy	Precision	Recall	F1 Score
Predict future challenges	92.2%	91.5%	92.0%	91.7%
Predict prevention mechanisms	90.3%	89.8%	90.5%	90.1%

The prediction model developed is confirmed to be effective by this result, which is set into motion through the forecast of future challenges represented on the monitoring dashboard. The accuracy, precision, recall, and F1 score all significantly improve with combined instead of single approaches; this suggests that real life behavioral data recorded through the application adds substantial, complementary data to caregiver reports to make more solid and trustworthy predictions of possible future difficulties.

3.3. Discussion

AI-Driven Gamified ADHD Symptom Assessment

The PulseMind module has demonstrated that the integration of gamification and artificial intelligence offers a highly interactive, engaging, and efficient approach to screening for ADHD in children. Unlike traditional assessment tools, which are often time-consuming, resource-intensive, and less engaging for young users, this AI-driven gamified system significantly reduces the time and cost required for evaluation while enhancing both child participation and parental satisfaction.

The system's adaptive design tailors the assessment experience based on real-time behavioral feedback, maintaining engagement even among children with short attention spans—a common characteristic in ADHD populations. High engagement metrics and sustained attention levels throughout gameplay support the effectiveness of the gamified interface, particularly in identifying attention-related challenges.

Strong concordance between game-based behavioral metrics and parent-reported DSM-5 criteria further validates the tool's clinical relevance. Specifically, correlation coefficients of $r = 0.76$ for inattention and $r = 0.72$ for hyperactivity-impulsivity highlight that the digital behavioral signatures captured during gameplay are reliable indicators of ADHD symptoms. These patterns suggest the potential for objective digital biomarkers that can complement traditional, subjective diagnostic methods.

Moreover, the tool demonstrated strong alignment with conventional assessments while offering increased usability and reducing clinician workload. These factors highlight its promise as a scalable, accessible solution, especially valuable in resource-limited or underserved environments. By automating data collection and analysis, the system can support broader, earlier screening efforts with minimal professional input.

The study also revealed that distinct behavioral patterns observed during gameplay could be used to differentiate between ADHD subtypes, offering an opportunity to personalize interventions more effectively. The ability to adapt difficulty levels, feedback mechanisms, and session flow based on user behavior presents a path toward tailored therapeutic strategies informed by data.

Despite these strengths, limitations remain. The current evaluation was conducted with a relatively small sample size ($n = 62$), and the requirement for technological infrastructure may limit accessibility in some regions. To enhance the generalizability and robustness of the findings, future research should focus on expanding the participant base, integrating educator feedback, and exploring long-term use for treatment monitoring. Further development could also include feedback loops for teachers, extended support for intervention planning, and broader deployment across diverse settings.

In summary, PulseMind provides a promising, scalable, and child-friendly alternative to traditional ADHD assessments. Its integration of AI, gamification, and adaptive design not only addresses key limitations of existing methods but also opens the door to future innovations in digital behavioral health.

Creates specific tools and activities to help children with predominantly inattentive ADHD improve focus and stay organized

The PulseMind module, which integrates gamification and artificial intelligence (AI) for ADHD symptom assessment, demonstrated considerable promise in improving the traditional ADHD screening process. By combining AI and gamified assessments, this system offers a more interactive, engaging, and effective alternative to conventional diagnostic tools. The study's findings suggest that this novel approach not only improves child engagement but also enhances the accuracy and efficiency of ADHD symptom detection.

One of the most notable features of the PulseMind module is its adaptive testing experience, which tailors the assessment based on the child's responses. This dynamic adaptation helps maintain the child's attention and engagement, making it particularly effective for children with ADHD who often struggle with sustained focus. By incorporating AI to monitor child performance and adjust the game dynamics accordingly, the system ensures that each session is aligned with the child's unique behavior, which enhances both the assessment accuracy and the overall experience.

The results also indicated that the module exhibited high concordance with traditional ADHD assessment methods, such as parent-report questionnaires and clinical evaluations. The use of game metrics, like response times and click rates, correlated well with parent-reported symptoms of inattention and hyperactivity-impulsivity, further validating the system's effectiveness. This suggests that gamification, when coupled with AI-driven analytics, can provide a reliable and efficient alternative for ADHD assessment, which could be invaluable in resource-poor environments where access to traditional assessment methods is limited.

Moreover, the usability of the PulseMind module was highlighted as a key strength. The system's user-friendly interface reduced the effort required by clinicians, providing a scalable solution that could be implemented more widely without significant strain on healthcare resources. This factor is particularly important as ADHD diagnosis rates continue to rise, and there is increasing pressure on clinicians to manage growing caseloads with limited resources.

Despite these promising outcomes, there are areas for future improvement. One key aspect is the inclusion of educator feedback in the system, which could further enhance the comprehensiveness of the tool. Educators' insights into a child's behavior in the classroom would provide additional context that would help refine the diagnostic results and increase the accuracy of subtype classifications. Expanding the tool's functionality to include this feedback loop would contribute to a more well-rounded assessment and allow for more targeted interventions based on specific ADHD subtypes.

Additionally, while the system demonstrated high engagement, the duration of the sessions may need to be adjusted to better suit individual needs. In particular, children with Predominantly Inattentive ADHD, who tend to exhibit difficulty sustaining attention, may benefit from even shorter sessions or more frequent breaks to reduce cognitive overload. Further research is needed to identify the optimal session length and pacing to ensure sustained focus without causing fatigue or frustration.

Lastly, while the system showed impressive device compatibility, ensuring that the PulseMind module performs equally well across various platforms (desktop PCs, laptops, tablets, and smartphones) is crucial. The varying levels of response latency across devices, especially for mobile platforms, may affect the user experience. Future iterations of the system should focus on optimizing the performance on all device types to ensure that the system remains accessible and effective for all users, regardless of their technological resources.

Enhancing Impulse Control in ADHD Students Through Structured Timetables

The mindfulness module demonstrated that integrating evidence-based relaxation techniques into a computerized platform can be a engaging and sustainable means of alleviating ADHD symptoms in children aged 3–10. Unlike more traditional behavioral treatment, this system provides a prestructured yet adaptive framework within which children acquire emotional regulation, upgrade attention ability, and reduce impulsivity through morning and evening tailored plans. The use of animation, voice, and visual stimuli facilitated motivation, particularly in children with hyperactive-impulsive behavior.

Caregiver report and activity monitoring indicated significant improvement in daily adherence and behavioral stability. The personalization feature using profiles enhanced the system's sensitivity to the idiosyncratic emotional stimuli and daily mood patterns of the individual child. With minimal clinician support, simple user interface, and low resource utilization, it is a viable choice for continuous intervention both at home and school. Future growth must incorporate real-time monitoring of educators, more extensive cultural customization, and greater integration of AI to refine individual progress monitoring and intervention planning.

AI-Driven Adaptive Learning and Intervention System with future predictions for Personalized ADHD Management in Children

The overall performance metrics of the prediction models sustaining the insights represented on the monitoring dashboard offer a hopeful yet subtle view of the system's capabilities. The accuracy scores displayed high values (92.2% for future challenges and 90.3% for prevention mechanisms), indicating a reliable ability to identify the correct outcomes in a general sense. Thus, these models underpinning the monitoring dashboard can be said to provide a generally acceptable overview of possible future challenges and suggested interventions.

Nevertheless, moderate precision, recall, and F1-scores for both prediction tasks call for further elaboration. Even while the predictive functioning of the dashboard may be said to be quite correct overall, low precision indicates that some of the future challenges or suggested prevention mechanisms may very well be false alerts. This inference would similarly extend to moderate recall, indicating that some actual future challenges or mandated interventions would have been missed by the models and the dashboard. The F1-score represents this trade-off between false positives and false negatives.

It is these model characteristics that reflect on the utility of the monitoring dashboard. This means that while it has a great potential to bring to light plausible future pathways and possible supports, unanticipated outcomes or missed indicators are possible. Further inquiry into the performance of models in specific categories of challenges and prevention mechanisms, coupled with improving their precision and recall, would enhance the clinical utility of the dashboard and give more sufficient and reliable guidance to teachers and caregivers. Therefore, continuous monitoring of the dashboard's real-world effectiveness and feedback from the users will be key to the iterative improvements both for the prediction models and the manner in which the dashboard presents information.

4. SUMMARY OF CONTRIBUTION

4.1. AI-Driven Gamified ADHD Symptom Assessment – IT21288326 | Dharmasena U D S V

- Designed and implemented the AI-Driven Gamified ADHD Symptom Assessment platform "PulseMind"
- Developed the "Falling Star Game" for behavioral assessment to measure reaction time, attention span, and impulsivity using Phaser 3
- Created an adaptive DSM-5-based parental questionnaire using React.js for gathering clinical information
- Implemented a three-layer neural network using TensorFlow and Keras for ADHD subtype classification
- Established MongoDB database integration for scalable storage of user data and assessment results
- Built the system backend using Node.js to connect front-end components with the machine learning engine
- Developed the retraining module for continuous model improvement

4.2. Creates specific tools and activities to help children with predominantly inattentive ADHD improve focus and stay organized – IT21290992 | Manamperi R.S.

- Created specific tools and activities for children with predominantly inattentive ADHD
- Developed an interactive, emotionally adaptive therapeutic experience for children aged 6-12
- Implemented a CNN-based emotion detection module using Python, OpenCV, and FastAPI
- Designed emotionally responsive gameplay elements in React.js to improve focus and emotional regulation
- Built a Node.js and Express.js backend for API communication and session control
- Created a reinforcement learning engine based on Q-learning for personalized session adaptation
- Implemented a parental dashboard for tracking emotion trends and attention scores

4.3. Enhancing Impulse Control in ADHD Students Through Structured Timetables – IT21379574 | Dilshani H.T.D.P.

- Implemented the Mindfulness for ADHD module for children with hyperactive-impulsive ADHD
- Developed interactive mindfulness exercises including breathing techniques and guided meditation
- Created the profile management module for personalized daily mindfulness schedules
- Built the backend using Node.js for secure handling of user data
- Developed a child-friendly frontend interface using React
- Implemented Docker containerization and Kubernetes orchestration for scalability
- Established continuous testing and update protocols based on expert feedback

4.4. AI-Driven Adaptive Learning and Intervention System with future predictions for Personalized ADHD Management in Children – IT21380532 | Halliyadda H.U.M.S.

- Developed the predictive analytics system for personalized ADHD management
- Created data collection and processing pipelines for machine learning model training
- Implemented feature engineering processes to enhance predictive accuracy
- Trained and evaluated multiple machine learning models (Random Forest, SVM, Logistic Regression, Neural Networks)
- Developed the monitoring dashboard for tracking children's progress
- Integrated version control systems for model maintenance and reproducibility
- Implemented Docker containerization and Kubernetes deployment for high availability
- Created REST API endpoints for seamless frontend-backend-ML model communication

5. CONCLUSION

This research successfully developed PulseMind, an AI-powered, gamified system designed to assess and intervene in Attention-Deficit/Hyperactivity Disorder (ADHD) among children aged 5 to 10. The system addresses major limitations in traditional ADHD diagnosis methods by integrating interactive games, adaptive questionnaires based on DSM-5 criteria, emotion detection, and machine learning models.

The use of gamified behavioral tasks allowed for more engaging and objective measurement of symptoms such as inattention and impulsivity. The emotion-aware intervention module adapted game difficulty in real-time based on the child's emotional state, helping improve focus and motivation. In parallel, the mindfulness and routine modules offered structured daily activities to support children with hyperactive-impulsive behavior.

The machine learning models used for ADHD subtype classification achieved strong performance, with an accuracy of 84.3% using combined behavioral and questionnaire data. Predictive analytics further enhanced the system by forecasting future challenges and providing personalized recommendations.

This project demonstrates the potential of combining AI, gamification, and behavioral science into a single platform to support early diagnosis and personalized intervention for ADHD. While the results are promising, further testing with larger datasets, integration with clinical workflows, and improvements in multilingual and cultural adaptability are recommended for future development.

As an undergraduate Information Technology project, this research contributes both technically and socially by presenting a practical and scalable solution that can support children, parents, and educators in managing ADHD more effectively.

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APPENDICES

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ORIGINALITY REPORT

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