AI -Driven Behavioral Assessment and Intervention for ADHD

Project Id:24 -25J -261

Project Proposal Report

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DECLARATION

This declaration confirms that the proposal is the original work of the author and does not include, without acknowledgment, any material previously submitted for a degree or diploma at any other university or institution of higher learning. It also certifies that the proposal does not contain any material previously published or written by another person, except where proper acknowledgment has been made within the text. The statement reflects the author's commitment to academic integrity and originality in the work presented.

Name	Student ID	Signature
Dilshani H.T.D.P.	IT21379574	

The above candidate has carried out research for the bachelor's degree dissertation under my supervision.

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Signature of the supervisor:

.........18/11/24.............

Date:

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Signature of the co-supervisor:

.........05/12/24.............

Date:

ACKNOWLEDGEMENT

Working on this final-year research project has been an immensely enriching academic experience for me. Through the process of developing my research proposal, I have gained valuable insights into the research process, including how to formulate research questions, design suitable methodologies, and anticipate potential challenges. I owe my heartfelt gratitude to my supervisor, Dr. Sanvitha Kasthuriarachchi, for their invaluable guidance, encouragement, and expertise, which have been instrumental in shaping this work. I wish to extend my heartfelt gratitude to my co-supervisor, Ms. Mihiri Samaraweera, for her unwavering guidance, feedback, and support throughout the project. I am profoundly grateful to all the lecturers at SLIIT for their invaluable guidance and support throughout this journey. Their encouragement has been instrumental in shaping my research approach. I am eager to further refine my skills and contribute impactful insights through this project.

Abstract

Attention Deficit Hyperactivity Disorder (ADHD) significantly impacts children's ability to focus and manage impulses, presenting challenges for parents and caregivers. This research aims to address these challenges by developing a customizable daily timetable app for children aged 3–10 with hyperactive-impulsive ADHD. This research focuses on developing innovative strategies to assist children with predominantly hyperactive-impulsive ADHD in managing their energy and improving impulse control. The app integrates physical activities and mindfulness techniques.

The customizable daily timetable app offers an innovative and accessible approach to managing hyperactivity and impulsivity in children with ADHD. By combining structure, engagement, and holistic support, the research promises to enhance quality of life for children and their families, setting a foundation for future advancements in ADHD management solutions.

Further, the inclusion of a customizable daily timetable and a holistic management approach addresses individual needs, encouraging better self-regulation and fostering a balanced routine for children. The expected outcomes include improved impulse control, enhanced focus, and better management of hyperactivity, offering a holistic solution to ADHD management for families.

Keywords – Customizable Daily Timetable, Impulse Control, ML Model, Physical Activities, Mindfulness training.

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1.0 Introduction

Attention Deficit Hyperactivity Disorder (ADHA) is a global epidemic with millions of children suffering from this neurodevelopmental disorder. ADHD symptoms and improving self-control pharmacological treatment are likely to protect the parent-child attachment relationship and child mental health.[1] This condition appears as an enduring pattern of difficulties with inattention, hyperactivity, or impulsive behavior, which can greatly affect one's development and everyday functioning. Students falling under the Hyperactive-Impulsive ADHD subtype have their own unique problems, including overactivity, inability to stay seated, and acting without thinking, which in the absence of management can have a negative impact on their education, relationships, and overall health.

Classification methods have been used to investigate heterogeneity within groups. In ADHD research, community detection (CD), a graph-theoretical measure, has been applied to identify clusters of children with different neuropsychological performance profiles across a battery of tasks.[2]

The focus in this research component is to resolve these issues by developing a comprehensive framework which incorporates physical activity avenues, mental activity aspects, and custom-made schedules. These interventions are aimed at enabling children with hyperactive-impulsive ADHD to utilize this excessive energy in a constructive manner, enhance self-regulation as well as increase the level of emotional control and responsiveness. Combining evidence-based interventions and cutting-edge technology, this project aims at creating a flexible, active and effective intervention that meets the specific needs of such children.

Because of their overactive-impulsive behavior, children with hyperactive-impulsive ADHD have difficulty inhibiting their emotions and movement, which causes them to be disruptive and damage their relationships. Prescription drugs and behavioral therapy which are the standard approaches for managing ADHD may be too broad and not address specific aspects. The incorporation of physical exercise, mindfulness, and individual scheduling into one strategy is an effective way to bring all areas together, giving better self-regulation and a brighter future for these children.

In the end this study will benefit a child who suffers from which one of the most cutting-edge features of this study is the system of suggesting a focused set of activities to the child. There are, however, children with ADHD who respond differently to focus activities and what is effective for one ADHD will not work for another. Further, this platform includes a feature that suggests activities based on the child's preferences and previous responses.

For instance, consider a situation where a child in the classroom does not seem to respond positively to an activity suggested. The system will provide other options aimed at making the child pursue other possibilities. In addition, children also have the opportunity to suggest activities that they would like to engage into allowing them to take control of their own development. With these sorts of interactive and dynamic strategies, it can be ensured that the child does not get

demoralized and becomes disconnected, but actively participates and enhances his self-awareness and decision-making capabilities.

1.1 Background and Literature Review

1.1.1 Background

Attention-Deficit/Hyperactivity Disorder (ADHD) is a neurodevelopmental condition that significantly impacts a child's ability to regulate impulses, attention, and hyperactive behavior. The main problem faced by children who have an ADHD diagnosis of primarily hyperactive-impulsive presentation is the lack of self-restraint, which results in underperformance at school with peers, and in emotional aspects as well. As a rule, helping methods for such children have been behavioral training, organized activities, and sensory therapy.

Studies show that children's impulsive behaviors can be reduced by having them take part in organized physical activities like sports, dance, or martial arts, which not only allows children to expend excess energy, but also fosters self-control and emotional maturity. In the same vein, hyperactive energy can be involved in creative and calming activities such as music therapy or art. For example, drumming or performing dance routines are enjoyable for children because they also help develop discipline and thinking.

The past few decades, though, have been remarkable in terms of technology as educators and parents supervise children with ADHD using new approaches. Wearing fitness wrist trackers, for example, enables monitoring of activity levels and such biofeedback opens possibilities for people to modify their behavior without any guesswork. Other erudite platforms employing game-based learning interfaces can make practicing impulse and anger control more exciting by incorporating achievements and additional incentives.

Despite these advancements, there remains a gap in systems that adapt activities dynamically based on the child's response or interest. Integrating adaptive feedback mechanisms, personalization features, and activity tracking ensures interventions remain relevant and effective for each child. This research builds upon these practices by creating a web-based system combining physical activities, mindfulness exercises, and personalized schedules tailored to ADHD children's unique needs.

1.1.2 Literature Survey

1.2 Research Gap

In recent years, the advancement of web-based applications and ML models has taken over how ADHD is managed. Most modern solutions are focused on creating adaptive, accessible platforms that would offer personalized interventions and structured activity plans. This literature review explores how these advancements apply to the management of hyperactivity and impulsivity in ADHD children.

ADHD management systems have reached a whole new level of personalization and adaptability with the use of machine learning models. ML algorithms recommend activities by analyzing user behavior and responses. ML models also engage in predictive analytics related to impulsivity levels, activity preferences, and emotional states. Several studies illustrate that integration of wearable data, like heart rate or amount of activity, with ML algorithms serves as a perfect means to track hyperactivity and suggest appropriate interventions accordingly.

This research will fill these gaps by designing an integrated web application incorporating physical activities, mindfulness exercises, and adaptive scheduling for ADHD children. By utilizing ML models, the platform will offer dynamic recommendations and feedback, ensuring personalized and effective interventions tailored to each child's unique needs. This approach does not only enhance the current management practices of ADHD but also lays the foundation for future advancements in the same field.

Research Paper A showed how well the current approach has gone so far in trying to handle symptoms of ADHD, especially with certain activities to keep impulsivity in check. Yet, there are major drawbacks that such activities are not integrated and cannot provide individual solutions. While it stresses that enjoyment and engagement are very important, it does not provide personalized timetables in detail for every specific need. The lack of such a feature limits its scope for practical implementation in addressing diverse impulsivity challenges. This system bridges the gaps through the introduction of an integrated platform incorporating various activity types into one cohesive framework, thus assuring accessibility and effectiveness for children with ADHD.[3]

Research Paper B introduces personalization through adaptive technologies and user-specific features to overcome some of the limitations identified in Research Paper A. However, it does not fully explore seamless integration of multiple activity types. Furthermore, it has limited insights on keeping the user engaged and amused consistently for long-term adherence to ADHD management practices. While the paper does take some good steps toward personalization, it falls short of providing detailed timetable mechanisms. The system proposed here extends these developments by using machine learning models to personalize timetables and recommend dynamically, ensuring adaptability and sustained user engagement.[4]

Research Paper C narrows the scope to engagement and enjoyment through activity design to keep children motivated and attentive. It shares the same drawback with other papers in not identifying any need for integrating various activity types into one framework. It also mentions the use of timetables but does not describe any personalized approach or recommendation based on machine learning. This does not fully address the challenges of developing holistic management systems for ADHD. These gaps are filled by this proposed system, which introduces gamified elements to increase engagement and embeds mindfulness activities into personalized schedules, providing fun, structure, and effectiveness in equal measure toward the needs of the individual.[5]

Table 1.0. component table 1

Component	Research Paper -A [3]	Research Paper -B [4]	Research Paper -C [5]	Proposed System
Current Approaches	✓	✗	✗	✓
Limited Integration of Activities	✓	✗	✗	✓
Lack of Personalization	✗	✓	✓	✓
Engagement and Enjoyment	✓	✓	✗	✓
Need for Personalized Timetables	✗	✗	✗	✓

1.3 Research Problem

Hyperactive-impulsive ADHD is very different in that it challenges children in terms of controlling impulsive behaviors, sustaining focus, and managing excessive energy. Personalized, structured activities have been found to be a very effective intervention in dealing with these challenges. Such activities are tailored according to the child's interests, strengths, and developmental goals to ensure motivation and engagement while minimizing frustration.

Predictability and stability are given to the child by structured activities, which they really need in case of impulsive problems. In this respect, the routines and schedules introduced by these activities lower the chances of impulsive reactions. Children learn how to predict what comes next and thus can navigate their day with more self-regulation and concentration.

Such structured activities often incorporate mindfulness practices, such as guided breathing exercises, progressive muscle relaxation, and short meditative sessions. These practices enhance attention, reduce impulsivity, and improve emotional regulation. With time, mindfulness helps children take control of their behavior and enhances resilience and self-regulation. Mindfulness training is an innovative treatment for children with ADHD that targets the core symptoms of the disorder, whereas most psychosocial interventions focus on behavioral consequences of ADHD[9].

Personalized and structured activities also use adaptive learning and feedback mechanisms to ensure efficiency. By being dynamic, activities never become either boring or frustrating for a child, while the adjustment may consider the progress of the child, his interests, and needs.

Integrate adaptive technologies and dynamic feedback in the success of these interventions; tools for tracking progress provide suggestions for modification. Such approaches keep children engaged even in the long run, whereby managing symptoms is not enough but rather a way of equipping a child with life skills and building their confidence to excel in whatever they get themselves into in life.

2.0 Objective

2.1 main objective

The main goal for this is to develop a personalized, structured activity-based intervention system that enhances impulse control and enables children with hyperactive-impulsive ADHD to manage their energy effectively while fostering emotional regulation, focus, and essential life skills.2.2 Sub Objectives

The following are sub-objectives of this research.

• Design Tailored Activities

Create personalized activities, mindfulness practices, and creative tasks that cater to the child's interests, strengths, and developmental goals to boost motivation and participation.
• Structured Routines

Establish structured timetables that provide predictability and
stability, enabling children to establish routines that reduce impulsive behaviors and improve focus.
• Integrate Mindfulness Techniques

Utilize evidence-based mindfulness interventions such as breathing exercises, progressive muscle relaxation, and meditative sessions to improve emotional regulation and self-awareness.
• Evaluate Impact and Effectiveness

Continuously evaluate the system's performance, its effectiveness
in successfully handling ADHD symptoms, and enhancing a child's general well-being. Make improvements iteratively with measurable results.

3.0 Methodology

This research component consists of a few main tasks.

1. Data Collection and Analysis

2. Developing a Machine Learning Model

3. Creating Personalized Timetables

4. Integrating Cloud Computing

5. Feedback and Adaptation Mechanism

6. Implementation of Mindfulness Practices

7. System Validation and Testing

The current study is aimed at providing recommendations tailored to each child's impulsiveness and preference, based on a machine learning model that is trained. This approach ensures that the system will remain scalable and accessible with cloud computing, facilitating data storage and processing. Together, these form the major pillars of the solution and deliver a robust adaptive system to support children with hyperactive-impulsive ADHD effectively.

3.1 System Diagram
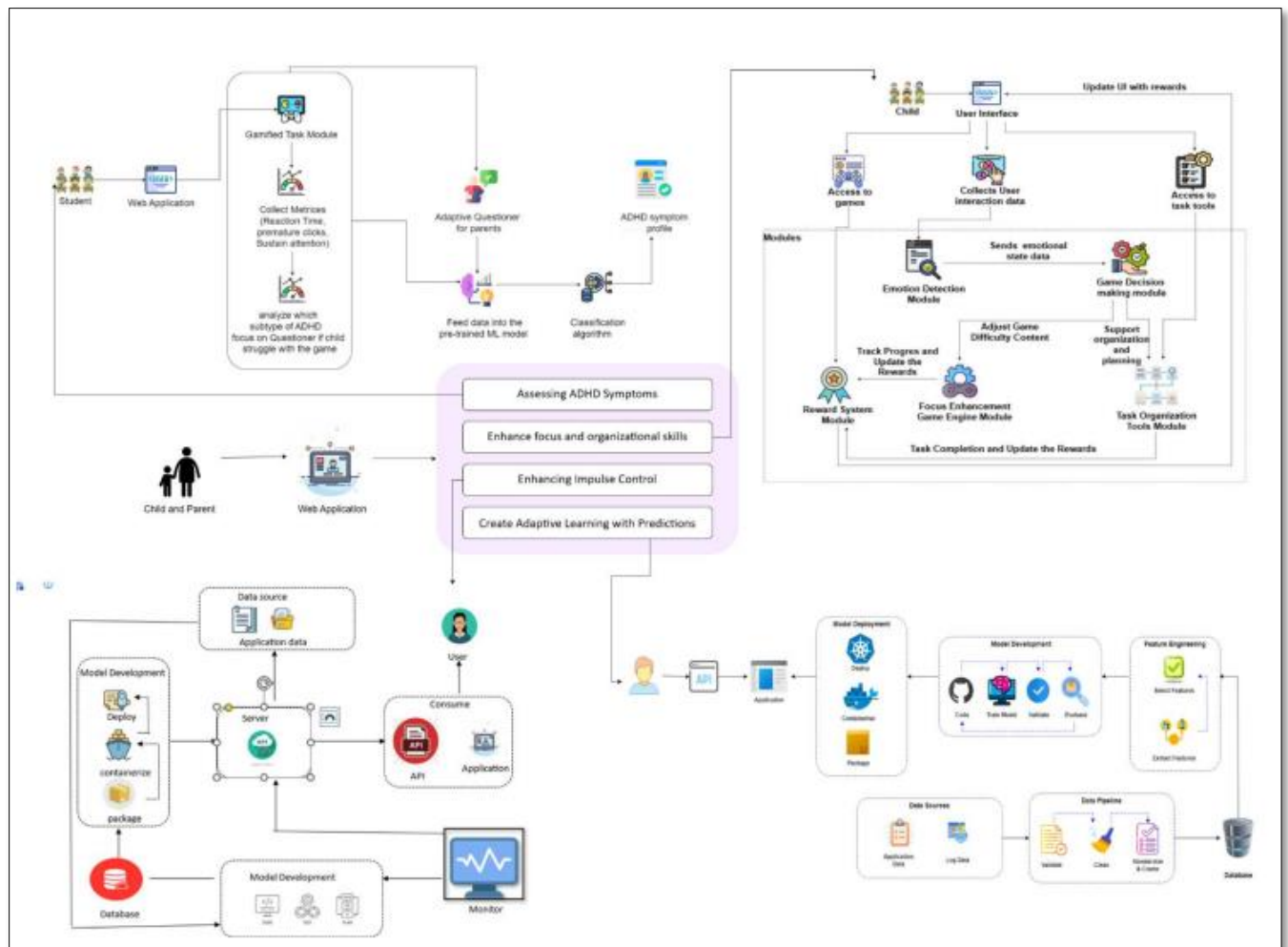
3.1.1 Overall System Architecture Diagram

Figure 3.0 Overall System Architecture

The decision to use the ADHD assessment and intervention application for Sri Lankan primary school students has been done with a strong system architectural focus to enable proper diagnosis as well as assessment and management of the ADHD students in the schools. The design comprises four main modules, with each capable of offering functions based on clinical and The following is a technological best practice. Gaming-inspired application for culturally informed, fun, and evidence-based approaches to ADHD for children, parents, and teachers by the incorporation of gamified modules, adaptive learning, and intervention-based daily routines, supported by AI-based predictive analytics.

The first module presents an AI-powered gamification approach for ADHD symptom assessment, according to the criteria of DSM-5, It's increased the precision and interactivity of the diagnostic process. This module uses a game-like format, such as a "falling star" reaction time game, in order to collect quantitative data on crucial ADHD indicators, including response time, attention span, and impulsiveness (as shown by premature clicks). The gamified approach makes it easier for children to participate actively, while their performance during gameplay provides valuable self-reported symptom data. The interactive game and DSM-5-based questionnaire, the Vanderbilt ADHD Diagnostic Parent Rating Scale, are combined to evaluate child gameplay data and parental observations. A machine learning model processes the collected data to identify ADHD subtypes, providing insights for intervention programs.[6]

The second module is intended to enhance attention and organizational skills in predominantly inattentive ADHD children. It deploys adaptive educational strategies for every child's unique learning style, attitude, and mood by being able to personalize the various activities that are presented. Reinforcement systems, such as stars, trophies, passing to higher levels, or a daily achievement badge, were embedded in the activities to encourage consistent participation.

Using adaptive technology, this system monitors behaviors and emotions in real time to adjust the content and challenges based on the current mood and attentiveness of the child. This makes for a dynamic approach that better aligns interventions with the cognitive and emotional needs of the child, thus increasing their effectiveness. The module promotes reward-based reinforcement in conjunction with personalized adjustments to ensure sustained attention and improvement in organizational skills for long-term positive changes in focus and learning habits

The system focuses on the enhancement of impulse control through structured routines in children with predominantly hyperactive-impulsive ADHD. This module will give parents a range of different timetables and schedules, tailored and designed to help children regulate their hyperactivity and improve self-regulation. Every aspect of this module is designed to enhance positive energy outlets while developing better self-control. The key activities include engaging in physical exercises, practicing mindfulness techniques, and following structured routines that give a sense of order and predictability to the child's day.

Accordingly, five carefully preplanned schedules are available for caregivers and educators, easil y adaptable to each child's needs and preferences. These flexible routines are built to balance structure with adaptability, ensuring they align with individual behaviors and requirements. This module aids children in learning discipline, how to handle impulses, and how to incorporate compliance into their daily life through enjoyable yet structured activities, while developing a supportive and interactive environment for positive behavioral development.

The final component is an AI-Powered Adaptive Learning and Intervention System that continuously monitors a child's progress and dynamically adjusts interventions based on real-time data. Key performance metrics such as response time, task completion rates, attention span, and behavioral patterns are tracked to provide a comprehensive view of the child's developmental progress. This data is processed using advanced algorithms to predict potential challenges and refine intervention strategies accordingly. The system provides an intuitive interface for caregivers and educators to understand a child's strengths, areas for improvement, and learning achievements. It offers personalized feedback and actionable recommendations.[7]

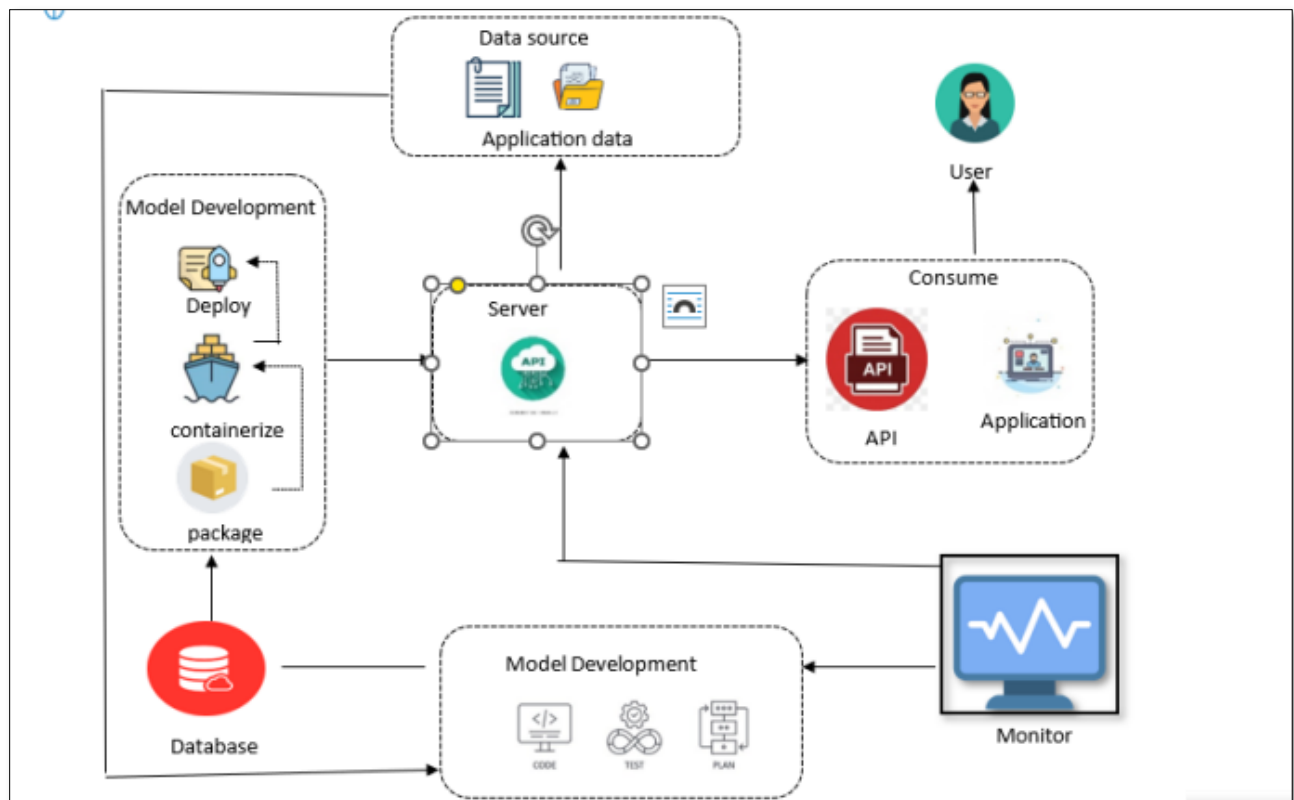### 3.1.2 Component Specific System Architecture Diag

Figure 3.1System Architecture Diagram 1

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4.0 Project Requirements

4.1 Functional Requirements

- Personalized Timetable Generation
- Machine Learning Model Integration
- User Feedback Mechanism using questioner
- Activity Recommendations

4.2 Non-Functional Requirements

- **Scalability**
  The system should be scalable to handle multiple users (children with ADHD) without performance degradation.
- **Security and Privacy**
  The system must ensure data security and privacy, especially regarding sensitive child-related data
- **Usability**
  The system should have an intuitive and user-friendly interface that is easy for parents and caregivers to navigate.
- **Reliability**
  The system should be reliable, with minimal downtime or errors, ensuring consistent access to the personalized recommendations and activities.

4.3 Software Requirements

- Python
- Machine Learning
- AWS
- SQL
- Pandas

5.0 Description of Personal and Facilities

5.1 COMMERCIALIZATION PLAN

1. Identify the Target Market

The core market focus of this system comprises children aged 3-10 with ADHD, especially those residing in neglected portions of Sri Lanka and South Asia, where knowledge and availability of intervention is scant. The system intends to enhance the digital healthcare trends as well as support the caregivers, schools, and clinics with respectively new solutions.

Primary Audience:

- Parents and teachers are looking for tailored solutions for the management of ADHD.
- Children in preschool and kindergarten as well as children with disabilities attending preschool and special schools who may participate in the research.
- Doctors, mainly the child's or family doctor, psychologist or psychotherapist - ADHD specialists.

Secondary Audience:

- Non-profit organizations and government agencies focused on mental health.
- Health insurance companies offer services for behavioral health.

2. Value Proposition

The ADHD management system offers:

- **Customized daily schedules** - A daily timetable customized to each child's needs, incorporating physical activities, mindfulness exercises, and creative outlets.
- **Design focused on engagement** -Interactive activities that hold attention and interest for active participation.
- **Parent and Educator Support-** Easy-to-use tools for creating, monitoring, and adapting schedules, facilitating easier management of ADHD.

- **Preventive strategies-** Predictions and recommendations to address potential challenges before they escalate
- **cost-effective alternative**- Access to schedules and updates anytime, ensuring consistency in implementation across home and school environments.

3. Revenue Streams

- **Subscription Model**

  Monthly or annual subscription fees for parents and caregivers to access premium features. This offers different subscription tiers:
  Basic: Progress Tracking, Generalized Reports, User-Friendly Interface, Automated Alerts
  Premium: Advanced AI-Powered Insights, Future Predictive Analysis, Dedicated Support

- **Freemium Model**

  Free access to basic features to build a user base, with paid upgrades for advanced AI-driven analytics and interventions.

- **Licensing to Educational Institutions**

  Provide licenses to schools to use this application with many of the students, at cheaper prices.

- **Partnerships with Healthcare Providers**

  Revenue through partnerships with hospitals, clinics, and therapists who integrate the system into their services.

Pricing Strategy: Basic Plan

1.Price: Free

Features:
✓ Interactive screening of ADHD symptoms.
✓ Basic inattention and hyperactivity monitoring.
✓ Progress reports are limited and only available in-app.

✓ Basic tips on managing ADHD-related behaviors, including suggestions for physical activities, mindfulness exercises, and creative outlets to channel hyperactivity effectively.

✓ Suitable for parents or teachers who do not require professional-level assessments for their child or student but wish to implement basic strategies to support ADHD management.

2.Premium Plan

- **Price:** $9.99 per month (or $99.99 annually)
- **Features:**
  ✓ Advanced ADHD screening, offering deep insights powered by AI.
  ✓ Detailed monitoring of attention span, hyperactivity, and task completion rates, with actionable insights.
  ✓ Unlimited access to progress reports with personalized recommendations, including tailored physical activities, mindfulness exercises, and creative outlets to address specific needs.
  ✓ Predictive analytics to anticipate future challenges and suggest preventive strategies.
  ✓ Dedicated customer support for app-related inquiries and assistance.
  ✓ Ideal for parents or educators seeking comprehensive ADHD management tools and in-depth behavioral insights.

3.Group Plan

- **Price:** Custom pricing based on group size (starting at $49.99 per month for up to 10 users).
- **Features:**
  ✓ Bulk access for schools, clinics, or therapy groups with group tracking capabilities.
  ✓ Centralized dashboard for monitoring multiple children's progress and generating reports.
  ✓ Institution-grade feature set, including group activity tracking and aggregated performance analysis.
  ✓ Tools to create custom intervention strategies, including tailored timetables with physical activities, mindfulness exercises, and creative outlets for individual students within the group.
  ✓ Premium features access for all users in the group plan.
  ✓ Account management support for organizations and dedicated technical support.
  ✓ Best suited for schools, clinics, or support groups managing ADHD interventions at scale.

4. Marketing Strategy

1. **Digital Marketing:** Use social media marketing and Google Ads and SEO strategies
2. **Collaboration with Experts:** Partner with child psychologists, caregivers and ADHD specialists to promote the system.
3. **Community Engagement:** Host webinars and workshops for parents and educators about ADHD management, Build an online community for users

6. Scaling and Growth Plan

1. **Phase 1 (0-6 months):**

   Launch the application with a focus on individual users (parents/caregivers) and gather feedback and refine features based on early user data.

2. **Phase 2 (6-12 months):**

   Target schools and clinics with institutional licensing packages and build partnerships with healthcare providers and therapists.

3. **Phase 3 (12-24 months):**

   Expand to international markets, focusing on developed nations with established ADHD awareness and introduce local customization features.

4. **Phase 4 (24+ months):**

Collaborate with insurance companies to include the system in mental health coverage plans and develop additional features, such as integration with wearable devices for real-time physiological monitoring.

5.2 BUDGET

Table 5.0 Budget 1

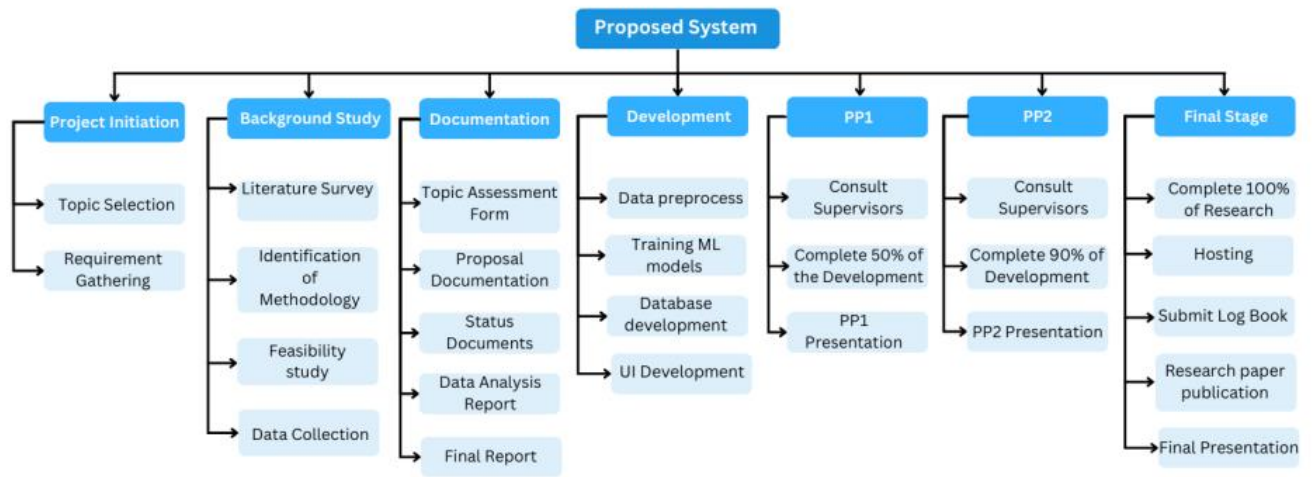| Component	Amount
Cloud deployment	Rs.10000
Travelling charges	Rs.10000
Internet charges	Rs.20000
Computational resources	Rs.5000
Total	Rs.45000

5.3 Work Breakdown Structure

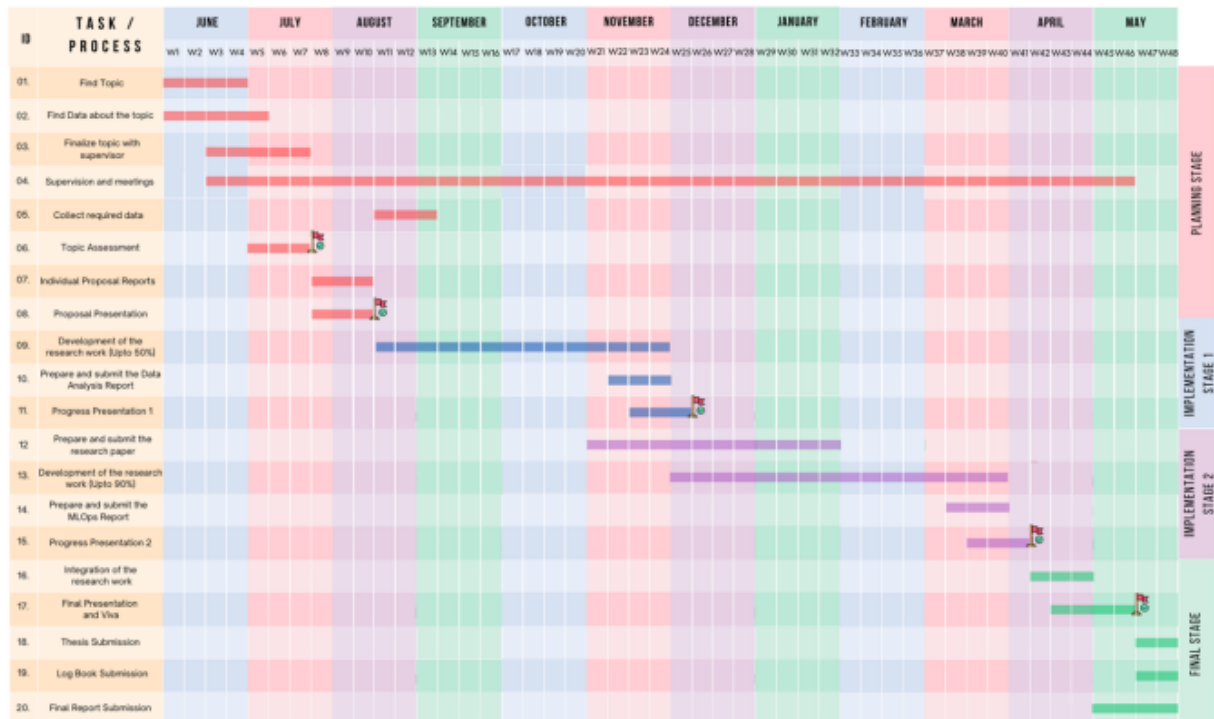*Figure 5.0 Gantt Char 1*

5.4 Timeline

Figure 5.1 Timeliner 1

6.0 References

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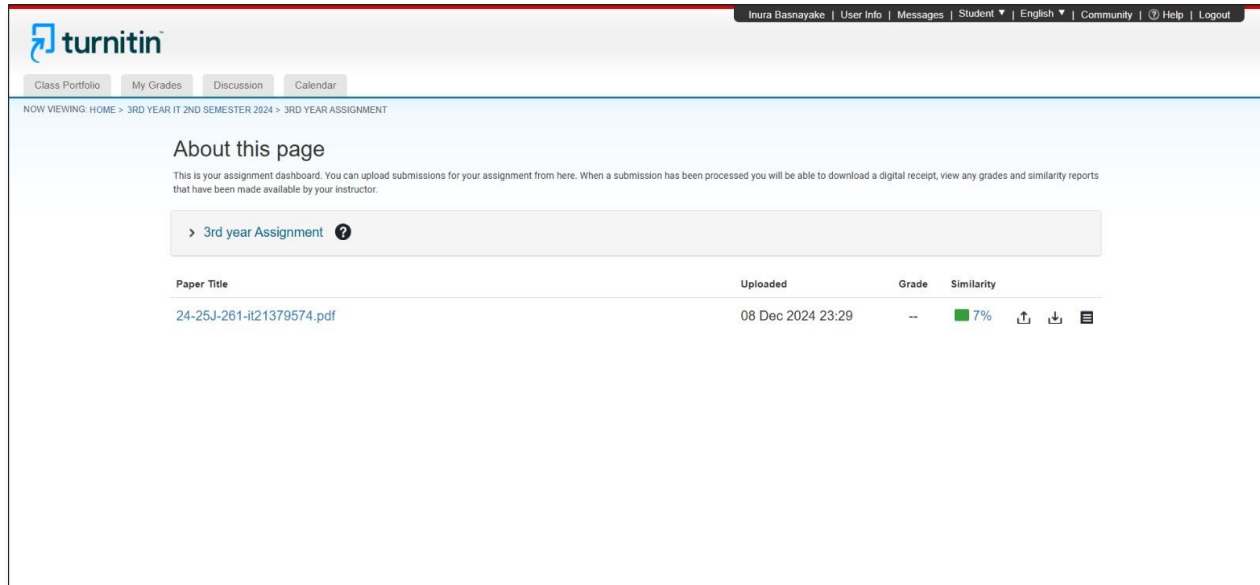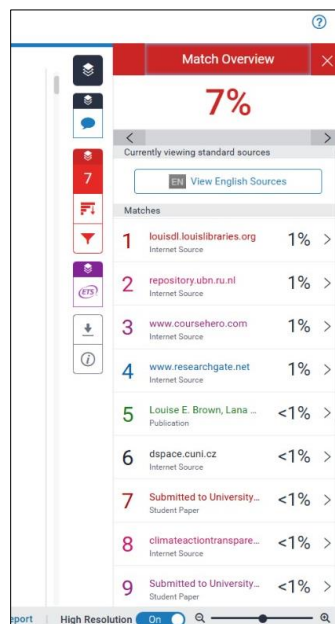
APPENDICES

Figure 0.1 Turnitin Report

Figure 0.2 Turnitin Report