

Project ID:

24-25J-261

1. Topic (12 words max)

AI-Driven Behavioral Assessment and Intervention for ADHD

2. Research group the project belongs to

Centre of Excellence for AI (CEAI)

3. Research area the project belongs to

Bio-Medical and Health Informatics (HI)

4. If a continuation of a previous project:

Project ID	
Year	

5. Brief description of the research problem including references (200 – 500 words max)  
– references not included in word count.

Attention-Deficit/Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder characterized by symptoms of inattention, hyperactivity, and impulsivity. It affects about 5% of children worldwide, making it one of the most common psychiatric disorders among youth. Accurate diagnosis and tailored interventions are essential for managing ADHD effectively, as the disorder manifests in three primary types: Predominantly Inattentive, Predominantly Hyperactive-Impulsive, and Combined Presentation [1]

Traditional ADHD diagnosis relies heavily on clinical evaluations using standardized questionnaires and behavioral observations. However, these methods can be subjective and influenced by cultural and socioeconomic factors, leading to potential misdiagnosis [2]. The need for objective, accurate, and early diagnosis has led to the exploration of advanced technologies, including artificial intelligence (AI) and machine learning.

AI-based diagnostic tools have emerged as promising alternatives to traditional methods. Machine learning algorithms, for instance, can analyze large datasets to identify patterns and predict the likelihood of ADHD with higher accuracy than conventional tools. Assessments also offer immersive environments that mimic real-world settings, allowing for more naturalistic observations of a child's behavior, which can improve diagnostic precision [3]

In addition to diagnosis, AI is being utilized to develop personalized interventions for children with ADHD. Digital platforms, such as mobile applications and serious games, have been designed to address specific symptoms of ADHD, such as inattention or hyperactivity [4]. These interventions are often gamified to increase engagement and can be tailored to the individual needs of the child based on their ADHD subtype. For example, cognitive training programs that focus on improving attention span and working memory have shown promise in managing symptoms of Predominantly Inattentive ADHD. Similarly, interventions targeting impulse control are being developed for children with Predominantly Hyperactive-Impulsive ADHD.

Our research project aims to develop a comprehensive web-based application that integrates AI to assess the probability of ADHD in children through interactive activities and questionnaires. The application will not only identify the likelihood of ADHD but also categorize the type of ADHD the child may have. Following diagnosis, the application will provide personalized intervention strategies designed to help the child overcome their specific challenges, whether they relate to inattention, hyperactivity, or impulsivity [5].

Moreover, the application will incorporate AI-based continuous monitoring and adaptive learning mechanisms. Real-time data on the child's interactions with the application will be collected, analyzing key indicators such as response times, completion rates, and engagement levels to evaluate the child's progress over time. Machine learning algorithms will detect patterns in the child's behavior and dynamically adjust intervention strategies, ensuring that the support provided remains effective and personalized. [6] The system will also provide tailored feedback and recommendations to both the child and caregivers, helping them understand areas of improvement and suggesting specific activities or strategies. By integrating these advanced AI-driven features, our project aims to offer a more precise, adaptable, and child-friendly solution for ADHD management, ultimately contributing to better outcomes for children with ADHD.

## References

- [1] Mark L Wolraich, Joseph F Hagan Jr, Carla Allan, Eugenia Chan, Dale Davison, Marian Earls, Steven W Evans, Susan K Flinn, "Clinical Practice Guideline for the Diagnosis, Evaluation, and Treatment of Attention-Deficit/Hyperactivity Disorder in Children and Adolescents," PubMed, 2019 Oct.
- [2] Débora Areces, Celestino Rodríguez, Trinidad García, Marisol Cueli, Paloma González-Castro, "Efficacy of a Continuous Performance Test Based on Virtual Reality in the Diagnosis of ADHD and Its Clinical Presentations," PubMed, 2018 Sep.
- [3] Steven Barnes, Julie Prescott, "Empirical Evidence for the Outcomes of Therapeutic Video Games for Adolescents With Anxiety Disorders: Systematic Review," PubMed, 2018 Feb.
- [4] Meng Cao, Elizabeth Martin, Xiaobo Li, "Machine learning in attention-deficit/hyperactivity disorder: new approaches toward understanding the neural mechanisms," Translational Psychiatry volume, 01 July 2023.
- [5] Jonathan Posner, Guilherme V Polanczyk, Edmund Sonuga-Barke, "Attention-deficit hyperactivity disorder," 2020 Jan 23..
- [6] Marina V. Sokolova, A. Fernández-Caballero, "A Review on the Role of Color and Light in Affective Computing," 5 August 2015.

6. Brief description of the nature of the solution including a conceptual diagram (250 words max)

Attention-Deficit/Hyperactivity Disorder (ADHD) is a complex neurodevelopmental disorder that requires precise identification and tailored interventions. Our research project aims to develop a web-based application that addresses the challenges of ADHD diagnosis and management by leveraging advanced AI techniques.

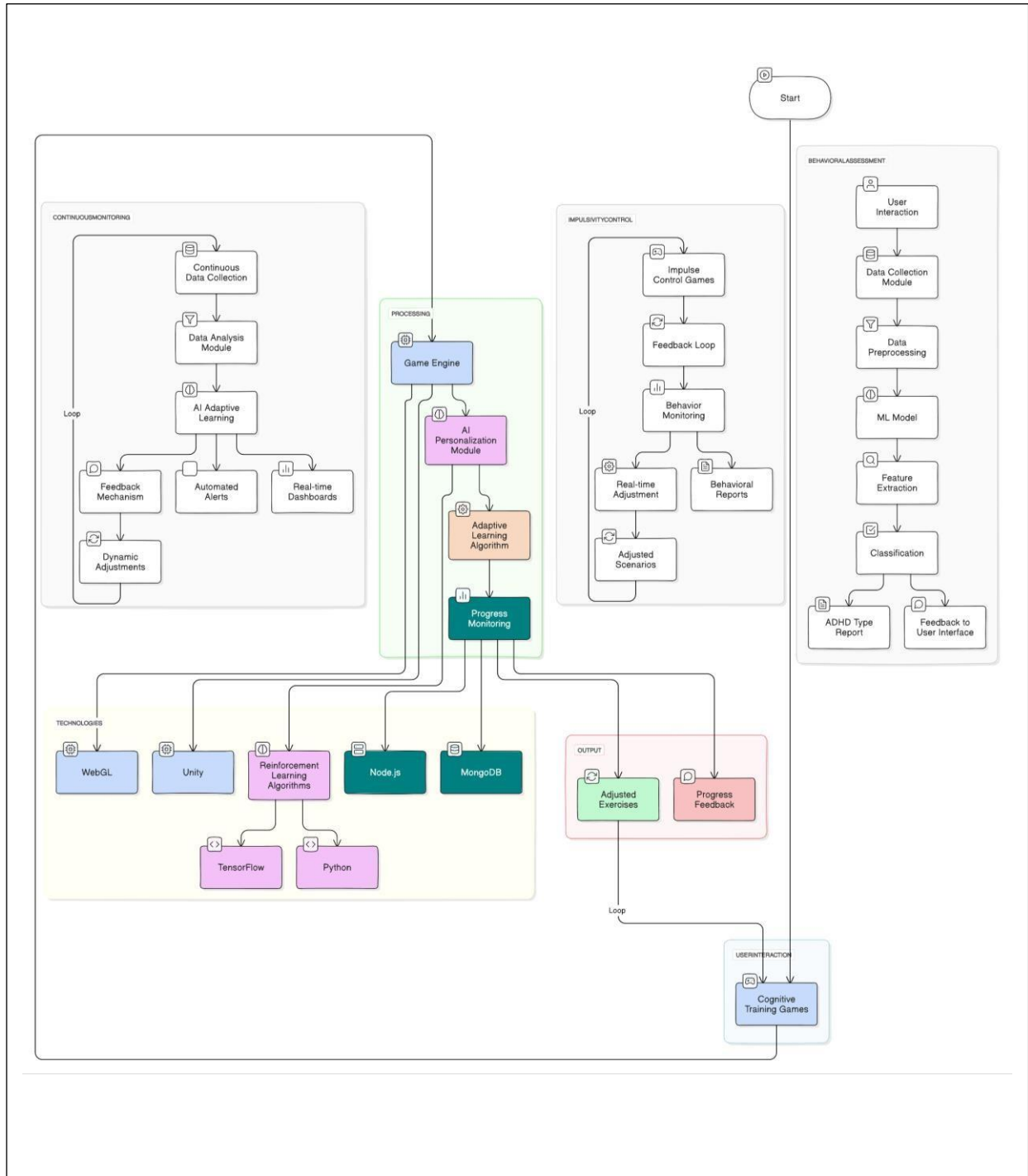
**Behavioral Assessment and ADHD Type Identification:** The foundation of our solution lies in using machine learning algorithms to enhance the accuracy of ADHD diagnosis. By analyzing data from interactive activities and questionnaires, the system assesses the probability of ADHD and identifies its specific type whether Predominantly Inattentive, Predominantly Hyperactive-Impulsive, or Combined Presentation.

**Inattention Management for Predominantly Inattentive ADHD:** For children identified with Predominantly Inattentive ADHD, the application provides targeted interventions designed to improve focus, attention span, and organizational skills. These personalized cognitive training exercises, such as working memory games and attention drills, are dynamically adjusted based on the child's progress.

**Impulsivity and Hyperactivity Control for Predominantly Hyperactive-Impulsive ADHD:** To assist children with Predominantly Hyperactive-Impulsive ADHD, the application offers behavior management tools that promote self-regulation. Interactive scenarios and impulse control games are designed to help children practice managing their impulses and channeling their hyperactivity in a controlled environment.

**AI-Based Continuous Monitoring and Adaptive Learning:** The application's AI-driven continuous monitoring component ensures that intervention strategies remain personalized and effective over time. Real-time data on the child's interactions with the application including response times, attention span, and engagement levels are continuously collected and analyzed. Machine learning algorithms detect patterns in the child's behavior, allowing the system to dynamically adjust intervention strategies. Personalized feedback is provided to both the child and caregivers, offering insights and recommendations tailored to the child's needs.

This project represents a significant advancement in ADHD management, offering a comprehensive tool to enhance diagnosis accuracy and provide personalized interventions, ultimately supporting children in reaching their full potential.



7. Brief description of specialized domain expertise, knowledge, and data requirements (300 words max)

**Domain expertise:** In this project, we are collaborating with medical professionals, particularly a Dr. Kamalini Wanigasighe who specializes in cognitive disorders. Her extensive knowledge and experience with children affected by ADHD have been instrumental in providing a comprehensive understanding of their unique characteristics and needs. Kamalini Wanigasighe, who has over 20 years of experience working with disabled children, including those with ADHD, brings invaluable expertise to our team. Additionally, the insights from the doctor help in refining our data collection strategies and ensuring that our methods are both ethical and effective in addressing the needs of these children.

**Knowledge:** Building this ADHD management system requires expertise across several technological and knowledge domains. Key areas include Psychology and Child Development for designing accurate diagnostic tools and evidence-based interventions, ensuring that assessments and activities are grounded in a deep understanding of neurodevelopmental disorders. Machine Learning and AI are critical for developing diagnostic algorithms and personalized interventions, leveraging techniques like Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) using libraries such as TensorFlow. Data Science plays a vital role in managing and analyzing the application's data, requiring skills in data preprocessing, feature engineering, and model evaluation while ensuring data security. Lastly, Software Engineering is essential for developing the web-based platform, with expertise in front-end frameworks like React.js, back-end development, and cloud computing platforms such as AWS, enabling robust infrastructure management and a seamless user experience.

**Data requirements:** This involve gathering a comprehensive dataset that covers various aspects of ADHD diagnosis and intervention. Specifically, we need behavioral data, questionnaire responses, and performance metrics related to attention, hyperactivity, and impulsivity in children. To gather this data, we will use a combination of primary and secondary sources. Primary data will be collected through focus groups and direct observations at specialized schools for students with disabilities. Secondary data will be sourced from existing datasets, such as those available on Kaggle, which contain information on ADHD-related behaviors and treatment outcomes.

## 8. Objectives and Novelty

### Main Objective

The main objective of this research is to develop a web-based application that enhances the accuracy of ADHD diagnosis and provides personalized intervention strategies for managing ADHD symptoms in children. The application utilizes advanced AI techniques, including machine learning, to assess ADHD types and continuously monitor and adapt intervention strategies based on real-time data, supporting children with Predominantly Inattentive, Predominantly Hyperactive-Impulsive, and Combined Presentation ADHD. Through tailored cognitive training and behavior management tools, the project aims to improve children's focus, self-regulation, and overall developmental outcomes.

Member Name	Sub Objective	Tasks	Novelty
Dharmasena U D S V	To accurately assess and identify the type of ADHD (Predominantly Inattentive, Predominantly Hyperactive-Impulsive, or Combined) in children through an interactive system that combines behavioral tasks, questionnaires, and machine learning-based classification.	<b>Interactive Questionnaire Development:</b> <ul style="list-style-type: none"> <li>Design an interactive questionnaire based on DSM-5 criteria to assess symptoms related to inattention, hyperactivity, and impulsivity. The questionnaire will adapt in real-time based on the child's responses, offering a more personalized assessment.</li> <li>Use research from existing ADHD diagnostic tools (e.g., Conners Rating Scale, Vanderbilt ADHD Diagnostic Parent Rating Scale) to inform the design of the questionnaire.</li> </ul>	<b>Personalized Assessment:</b> Unlike traditional ADHD assessments, this system dynamically adapts to the child's responses in real-time, offering a more tailored and accurate diagnosis.  <b>Multimodal Data Integration:</b> The combination of questionnaire responses and behavioral task performance for ADHD type identification is

		<p><b>Behavioral Task Design:</b></p> <ul style="list-style-type: none"> <li>• Develop gamified tasks that measure attention span, impulsivity, and activity levels. Tasks could include memory games, reaction time assessments, and impulse control exercises.</li> <li>• Reference studies on cognitive games and their effectiveness in assessing behavioral traits in children with ADHD.</li> </ul> <p><b>Machine Learning-Based Classification:</b></p> <ul style="list-style-type: none"> <li>• Implement machine learning models to analyze the collected data from questionnaires and behavioral tasks. Techniques like Support Vector Machines (SVM), Random Forest, and Neural Networks will be explored to classify children into ADHD types.</li> <li>• Train models using datasets from prior ADHD studies and validate them with new data.</li> </ul>	<p>novel and provides a comprehensive assessment.</p> <p><b>Machine Learning in Diagnosis:</b> Utilizing advanced machine learning algorithms in ADHD classification is a cutting-edge approach that enhances diagnostic accuracy and efficiency.</p>
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Manamperi R S	<p>To design and implement activities and tools that specifically address the challenges faced by children with Predominantly Inattentive ADHD, enhancing their focus, organizational skills, and attention span.</p>	<p><b>Focus Enhancement Games:</b></p> <ul style="list-style-type: none"> <li>• Develop interactive games that require sustained attention, such as progressively challenging memory games, puzzles, and task completion exercises. The difficulty level will adjust based on the child's performance to maintain engagement.</li> <li>• Explore the effectiveness of game-based learning in improving focus among children with ADHD.</li> </ul> <p><b>Task Organization Tools:</b></p> <ul style="list-style-type: none"> <li>• Create digital tools to help children plan and organize tasks. These tools could include digital to-do lists, step-by-step guides, and reminders tailored to the child's specific needs.</li> <li>• Integrate methods from the “Pomodoro Technique” and similar time management strategies into the design.</li> </ul> <p><b>Progress Tracking and Rewards:</b></p> <ul style="list-style-type: none"> <li>• Implement a system that tracks the child's progress in attention-related activities, offering rewards for consistent focus and</li> </ul>	<p><b>Adaptive Learning Environment:</b> The dynamic adjustment of game difficulty and task organization based on the child's performance provides a personalized learning experience that is rare in current ADHD interventions.</p> <p><b>Integrated Focus and Organization Tools:</b> Combining focus enhancement games with task management tools offers a holistic approach to addressing the specific challenges of Predominantly Inattentive ADHD.</p> <p><b>Behavioral Reward System:</b> The use of a tailored reward system to reinforce positive behaviors and maintain engagement is an innovative approach in ADHD management.</p>
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		<p>task completion. Rewards could include virtual badges, points, or unlocking new game levels.</p> <ul style="list-style-type: none"> <li>Reference studies on the effectiveness of reward systems in behavioral interventions for ADHD.</li> </ul>	
Dilshani H.T.D.P.	<p>To help children with Predominantly Hyperactive-Impulsive ADHD learn self-control and manage their energy through activities that channel hyperactivity positively and improve impulse control.</p>	<p><b>Physical Activity Channels:</b></p> <ul style="list-style-type: none"> <li>Develop engaging activities that channel hyperactive energy into productive tasks like exercise routines, dance games, or sports challenges.</li> <li>Ensure these activities are enjoyable and accessible.</li> <li>Highlight the role of physical exercise in managing hyperactivity in children with ADHD.</li> </ul> <p><b>Mindfulness and Relaxation Techniques:</b></p> <ul style="list-style-type: none"> <li>Integrate guided relaxation exercises, breathing techniques, and mindfulness activities to help children calm down and reduce impulsive behaviors.</li> </ul>	<p><b>Personalized Timetable and Features:</b></p> <p>The app features a highly customizable daily timetable tailored to the specific types of impulsive behaviors in children with ADHD. By offering five pre-designed timetables, each focusing on different impulse control challenges, the platform provides flexibility for parents and caregivers to select the most suitable schedule for their child. These timetables integrate a variety of carefully curated activities, including physical exercises, mindfulness techniques, and creative outlets, to help manage hyperactivity and improve self-</p>

		<ul style="list-style-type: none"> <li>Incorporate insights from mindfulness-based interventions that have been proven effective in managing ADHD symptoms.</li> </ul>	<p>regulation in an engaging, structured manner. The app's adaptability ensures that each child receives a personalized experience, making the management of their impulsivity more effective and enjoyable.</p> <p><b>Holistic Approach for ADHD Management:</b></p> <p>By establishing regular feedback loops, the platform addresses each child's unique needs, helping them stay engaged, focused, and active throughout the day. This fosters better self-regulation and promotes a balanced routine tailored to their individual requirements.</p>
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Halliyadda H U M S	To incorporate AI-based systems into the ADHD application to constantly monitor the child's progress and adapt dynamically. intervention strategies, ensuring personalized and effective support.	<p><b>Data Collection and Feature Engineering:</b></p> <ul style="list-style-type: none"> <li>• Gather data on the child's interactions with various activities and assessments within the application.</li> <li>• Monitor key indicators such as response times, completion rates, attention span, child's progress over time.</li> <li>• Implement machine learning algorithms that analyze the collected data to detect patterns and trends in the child's behavior and learning progress.</li> </ul> <p><b>AI-Driven Adaptive Learning and Future Predictions:</b></p> <ul style="list-style-type: none"> <li>• Use reinforcement learning to dynamically adapt intervention strategies, such as adjusting the difficulty level of tasks or introducing new challenges based on the child's performance.</li> <li>• Make future predictions and identify challenges that child may face in future according to his performance levels.</li> <li>• Suggest suitable methods to prevent from future ADHD levels.</li> </ul>	<p><b>Dynamic Adaptation to Child's Needs:</b> The use of AI to continuously monitor and adjust the intervention strategies represents a significant advancement in personalized ADHD management. Traditional methods often lack this level of adaptability, making this system particularly effective for long-term support. Furthermore, they are lack of predicting future challenges child may face because of ADHD.</p> <p><b>Comprehensive and Ongoing Support:</b> By continuously analyzing data and adapting the support provided, the AI ensures that the interventions remain relevant and effective as the child grows and their needs change. This approach is more holistic than static, one-time assessments typically used in ADHD management.</p>
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		<p><b>Personalized Feedback and Recommendations:</b></p> <ul style="list-style-type: none"> <li>• Provide tailored feedback to both the child and caregivers, offering insights into areas of improvement and suggesting specific activities or strategies.</li> <li>• Integrate Natural Language Processing (NLP) to understand and interpret the child's responses in real-time, enhancing the personalization of interventions.</li> </ul> <p><b>User Interface and Experience:</b></p> <ul style="list-style-type: none"> <li>• Develop a user-friendly dashboard that displays the child's progress, highlighting key achievements and areas needing further attention.</li> <li>• Ensure seamless integration between the AI system and the application's core features, enabling smooth transitions between different modules and activities based on AI recommendations.</li> </ul> <p><b>Automated Alerts and Updates:</b></p> <ul style="list-style-type: none"> <li>• Implement an automated notification system that alerts caregivers or educators to significant changes in the child's progress or if the AI detects potential areas of concern.</li> </ul>	
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		<ul style="list-style-type: none"><li>• Enable regular updates to the AI model based on new data, ensuring the system evolves with the child's development.</li></ul>	
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**9. Supervisor checklist**

a) Does the chosen research topic possess a comprehensive scope suitable for a final-year project?

Yes ☒ No ☐

b) Does the proposed topic exhibit novelty?

Yes ☒ No ☐

c) Do you believe they have the capability to successfully execute the proposed project?

Yes ☒ No ☐

d) Do the proposed sub-objectives reflect the students' areas of specialization?

Yes ☒ No ☐

e) Supervisor's Evaluation and Recommendation for the Research topic:

*Recommend.*

**10. Supervisor details**

	Title	First Name	Last Name	Signature
Supervisor	Dr.	Sanvitha	Karthurarachchi	<i>[Signature]</i>
Co-Supervisor	Ms.	Mihiri	Samaraweera	<i>[Signature]</i>
External Supervisor	Dr.	Kamalani	Wanigasinghe	<i>[Signature]</i>
Summary of external supervisor's (if any) experience and expertise				
24 yrs experience in child mental health disorders. in ministry of Health.				

This part is to be filled by the Topic Screening Panel members.

Acceptable: Mark/Select as necessary



Topic Assessment Accepted	
Topic Assessment Accepted with minor changes (should be followed up by the supervisor)*	✓
Topic Assessment to be Resubmitted with major changes*	
Topic Assessment Rejected. Topic must be changed	

\* Detailed comments given below

Comments

Customize the timetabling considering the severity level of attention deficit and impulsivity.  
 Dataset for prediction is something to come  
 ↳ By the proposal stage mandatory to finalize the dataset

The Review Panel Details

Member's Name	Signature
Dr. Nathani Silva	
Ms. Sanjeevi Chandrasiri	 02/10/2024



**\*Important:**

1. According to the comments given by the panel, make the necessary modifications and get the approval by the **Supervisor** or the **Same Panel**.
2. If the project topic is rejected, identify a new topic, and follow the same procedure until the topic is approved by the assessment panel.