Project ID: 24-25J-209

1. Topic (12 words max)

GlowJourney : Enhancing autistic children's abilities using machine learning techniques based on domains of learning

2. Research group the project belongs to

Centre of Excellence for AI (CEAI)

3. Research area the project belongs to

E-learning and Education (ELE)

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.

By creating dynamic learning strategies that incorporate the four key learning domains- cognitive, metacognitive, affective, and psychomotor; using machine learning techniques, this research seeks to improve learning and problem-solving abilities in autistic children. The cognitive domain is concerned with the development of intellectual abilities and knowledge, such as critical thinking, memory, and problem-solving.

The metacognitive domain focuses on goal setting, monitoring, and evaluation and encompasses self-awareness and management of cognitive processes. While physical skills and coordination are covered by the psychomotor domain, emotions, motivation, and attitudes toward learning are addressed by the affective domain. **[1][2][3][4]**

Comprehensive data on each child's performance in each of these domains will be analyzed using machine learning techniques to find important signs and patterns that are associated with successful learning outcomes. Using supervised learning methods, the model will be trained, and using reinforcement learning, it will dynamically modify suggestions based on performance data and real-time feedback. A probability check will guarantee that the suggestions consider the needs and circumstances of every child, considering their abilities, preferred methods of learning, and continuous development. Creating interactive teaching resources, educating teachers and caregivers, and putting in place ongoing support and monitoring systems are all part of the implementation.

Through pilot and longitudinal studies that evaluate the model's effects on learning and problem-solving abilities over time, the efficacy of the approach will be confirmed. Anticipated results encompass observable enhancements in the specific learning domains, enhanced customization and interactivity of learning encounters, and a flexible model that can be adjusted to many educational environments.

References:

[1] S. Jaleel and Premachandran. P., "A Study on the Metacognitive Awareness of Secondary School Students," *Universal Journal of Educational Research*, vol. 4, no. 1, pp. 165–172, Jan. 2016

[2] Gunathilake Y. A. G. U. T. ,Fasliya R. F. ,Premarathne R. D. A. R.,Pasan Kalhara D.,Anuradha Karunasena, Pradeepa Senani Bandara, "A technological intervention for improving cognitive abilities based on the preferences of Autistic children", 27-28 October 2021

[3] L. Gratz, C. Eckley, S. Schwantes, and E. Mattson, "Ambient Mercury Observations near a Coal-Fired Power Plant in a Western U.S. Urban Area," *Atmosphere*, vol. 10, no. 4, p. 176, Apr. 2019

[4] C. Le Menn-Tripi, A. Vachaud, N. Defas, J. Malvy, S. Roux, and F. Bonnet-Brilhault, "Sensory-psychomotor evaluation in Autism: A new tool for functional diagnosis", vol. 45, no. 4, pp. 312–319, Sep. 2019

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

A web application that makes use of machine learning to provide customized development recommendations for kids with autism is the suggested remedy. The program will gather comprehensive data on every child, apply advanced machine learning algorithms to analyze this data, and deliver actionable insights to enhance the children's affective, cognitive, psychomotor, and metacognitive abilities.

Impacts:

- Tailored Interventions - By focusing on the special needs and strengths of autistic children, tailored recommendations can greatly improve the developmental results for these kids.
- Empowerment of Parents and Caregivers - Parents and carers are empowered when they receive actionable insights that enable them to make wise decisions and take initiative for their child's development.

- Support for Educational Institutions - By leveraging the system, educational institutions can provide autistic students with enhanced support, resulting in more inclusive and productive learning environments.
- Continuous Improvement - The ML model's adaptive nature makes sure that recommendations change and get better over time, producing ever-better results.
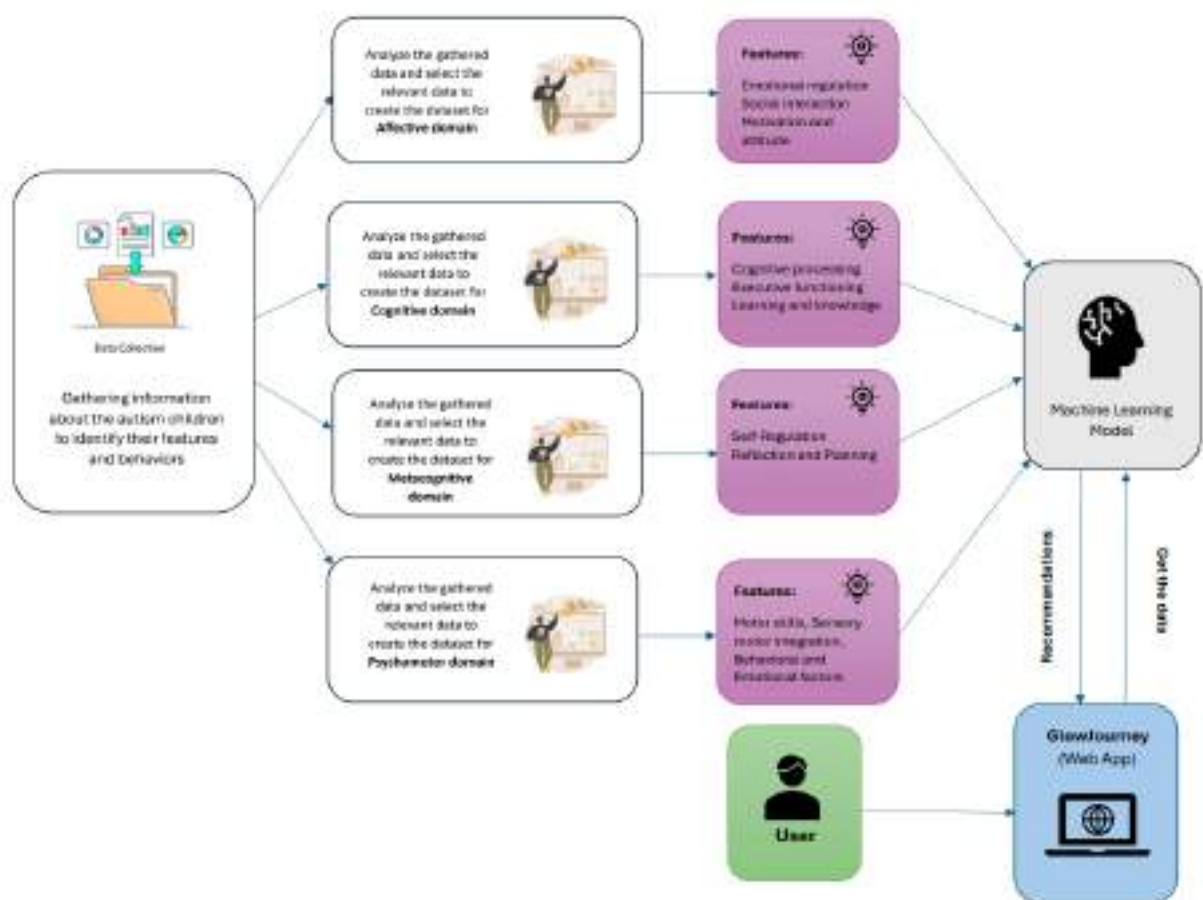
7. Brief description of specialized domain expertise, knowledge, and data requirements (300 words max)

Autism spectrum disorders (ASD) are a diverse set of conditions. They are distinguished by some level of difficulty in social interaction and communication. Other characteristics include atypical patterns of activities and behaviors, such as difficulty transitioning from one activity to another, a preoccupation with details, and unusual reactions to sensations.

The abilities and needs of autistic people vary and can change over time. While some people with autism can live independently, others have severe disabilities and need lifelong care and support. Autism frequently has an impact on educational and career opportunities. Furthermore, families providing care and support may face significant demands.

Improving the learning and problem-solving abilities of autistic children is a multifaceted challenge that necessitates a thorough understanding of the cognitive, metacognitive, affective, and psychomotor domains. To tailor learning approaches to autistic individuals' unique needs, effective intervention strategies require specialized domain expertise, comprehensive knowledge, and precise data acquisition.

An expert was contacted and discussed about how this solution can be tailored according to the autistic children's needs. There, it was identified that there are several stages of this spectrum mainly: mild, moderate, and severe.

To build an accurate solution to develop the four learning domains the following features are required.

1. Language & Communication Skills: Receptive Language, Expressive Language and Pragmatic Language.
2. Social Skills: Joint Attention, Social Reciprocity and Understanding Social Norms.
3. Attention & Executive functioning: Attention Span, Planning & Organization, and Inhibition & Self-Regulation.
4. Memory & Learning Skills: Working Memory, Long-term Memory, and Learning Styles.
5. Problem-solving & Reasoning Skills: Logical Reasoning, Abstract Thinking and Pattern Recognition.
6. Sensory Processing Skills: Sensory Sensitivity, Sensory Seeking or Avoiding Behaviors
7. Motor Skills: Fine Motor Skills, Gross Motor Skills
8. Academic Skills: Reading and Literacy, Mathematics, Writing
9. Special Interests & Hyperfocus

8. Objectives and Novelty

Main Objective Focused on enabling children with Autism Spectrum Disorder (ASD) to reach their full potential while ensuring equal access to education and social participation for children with disabilities.			
Member Name	**Sub Objective**	**Tasks**	**Novelty**
Rupasinghe Y.S. (IT21160820)	Enhance the problem-solving and critical thinking skills through improving the cognitive domain of children by providing valuable recommendations.**[2]**	- Conduct a literature review on personal development of children with Autism Spectrum Disorder (ASD) using machine learning techniques. - Collect data about cognitive skills of children with ASD such as behavioral patterns, thinking and problem-solving patterns, and medical history. - Gather information from parents, caregivers,	Revolutionize the cognitive development of children with Autism Spectrum Disorder (ASD) by leveraging advanced machine learning techniques. Designing game-like activities that dynamically adjust difficulty levels based on the child's performance using machine learning techniques such as **Reinforcement Learning** or **Supervised Learning**. The recommendations are based on each child's specific cognitive profile

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<td>counselors, and educators using structured forms.</td>
<td>and needs, resulting in highly individualized interventions.</td>
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			counselors, and educators using structured forms. • Sophisticated data preprocessing and augmentation techniques can significantly improve the dataset's quality and robustness. This ensures that machine learning models are trained using high-quality, comprehensive data, resulting in more accurate and reliable analysis. • Train the model using the gathered data and with the help of machine learning models, accurately analyze the outputs received. • Implementing a user-friendly application makes it more practical and accessible. It enables non-experts, such as parents and caregivers, to actively participate in the cognitive development of	and needs, resulting in highly individualized interventions.

		children with ASD by providing actionable insights and recommendations based on advanced machine learning analysis.	
Ruhunuge R.S.D.P. (IT21227486)	Help children understand and share emotions in the affective domain through fun activities that teach them to recognize and express feelings. **[3]**	- Explore how autistic children regulate emotions, pinpointing areas needing attention. - Gather data on how autistic children express and understand emotions, using surveys, observations, articles, and school of the autistic children. - Use stats to identify what affects emotional expression, potentially creating new ways to measure it. - Pick machine learning models to predict emotions accurately, using tests to ensure they work well.	Utilized machine learning model, that studies how autistic children react to emotional situations and social interactions on a digital platform. Based on their reactions, I create personalized activities to help them understand emotions better, improve how they interact with others, and adjust as they progress. In here used, **Transfer Learning**: This method uses models that have already learned similar tasks and adjusts them for your specific needs. It helps recognize and understand the emotions of autistic children

		- Check if chosen models can predict emotions accurately by evaluating them with real data. - Make an easy-to-use app for parents and therapists to track and support emotional development in autistic children.	more quickly and accurately, even with less data.
Pehesarani W.A.K. (IT21259470)	Develop a model to predict and recommend strategies to improve psychomotor domain in autistic children.**[4]**	- Perform a literature review on the personal development of children with ASD utilizing machine learning methods. - Gather comprehensive data on autistic children's motor skills, including fine and gross motor skills, sensory preferences, behavioral data, and medical history. - Collect data from parents, caregivers, therapists, and	Developing **an algorithm** to capture the activeness of autistic children, this technique provides guardians with a quantifiable score to monitor and understand their child's progress, aiding in the enhancement of their overall development. Additionally, using **ensemble methods** to develop a single predictive model, the system enhances the accuracy and reliability of intervention strategies.

		teachers through structured forms.

- Train the model using real-world data from experts, such as Professor Hemamali, clinic patients, and organizations.
- Use machine learning models to accurately analyze the inputs and extract relevant information.

- Design an attractive and user-friendly interface for parents and caregivers to input data about the child's age and other relevant details.
- Ensure the interface is accessible and easy to use, even for users with limited technical skills.

| Tharaki D.H.D. (IT21254970) | Exploring Strategies to Enhance Metacognitive Development in Autistic Children [1] | • Perform a comprehensive analysis on the development of metacognition in autistic children. Determine the needs and any gaps in this field.
• Collect information about the behavior and metacognitive processes of children with autism. When appropriate, self-report measurements, behavioral observations, and cognitive evaluations may be included.
• Determine and pick the right characteristics or factors by performing preprocessing techniques and using statistical properties(Correlation, ANOVA, chi squared tests).This could entail creating new metrics or | Personalization of application using hybrid model

• **Behavioral Classification**: Uses supervised learning models to categorize behaviors, such as task engagement, focus levels, and self-regulation, based on interaction data from the app.
• **NLP**: Analyzes verbal data to understand metacognitive reflections, planning, and self-assessments, providing insights into a child's emotional and cognitive states.

By integrating these two approaches, the hybrid model can identify metacognitive activities more accurately and provide personalized feedback and interventions. |

		modifying the ones that already exist. ● Select appropriate machine learning models that, using the features chosen, can accurately forecast or analyze. (using matrices such as accuracy, precision, recall, f1 score) ● Validate the performance of the chosen models after they have been trained on the data set. ● Create an application for public use to enhance understanding, personalize interventions, and track progress in metacognitive development for autistic children with the use of analysis and visualization techniques.	

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:

> The team is focusing a system to improve the learning of autistic children. The research has a sufficient novelty and a valuable application.

10. Supervisor details

	Title	First Name	Last Name	Signature
Supervisor	Mr	Samadhi	Rathnayake	
Co-Supervisor	Ms.	Thisara	Shyamalee	
External Supervisor				
Summary of external supervisor's (if any) experience and expertise				

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

The Review Panel Details

Member's Name	Signature

***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.