SLIIT UNI

THE KNOWLEDGE UNIVERSITY

Project ID: | 24-25j-281

1. Topic (12 words max)

> **AI-Enhanced E-Learning Platform for the Hearing impaired children**

2. Research group the project belongs to

> **Software Systems & Technologies (SST)**

3. Research area the project belongs to

> **Natural Language Processing (NLP)**

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.

> The research problem focuses on addressing the significant barriers encountered by hearing-impaired children aged 8 in accessing traditional e-learning environments, due to their specific needs and challenges. Traditional e-learning systems are predominantly auditory-based, which are inherently unsuitable for students with hearing impairments. This issue is exacerbated by the nature of sign language, which is not only gestural but also involves facial expressions and body language, elements that are often poorly transmitted through standard e-learning platforms [1].
>
> Moreover, the diversity of sign languages, each with its distinct syntax and grammar, requires solutions that are adaptable across different linguistic frameworks to be effective globally. Additionally, the variability in cognitive and developmental impacts of hearing impairment among children affects their learning processes and educational outcomes, necessitating a highly personalized educational approach that current e-learning tools fail to provide. These children need interactive and immersive learning experiences tailored to their specific needs, including real-time translation of educational content into sign language, interactive modules for teaching sign language, and an AI assistant capable of interacting with them in sign language to address their questions and monitor their progress [2].

The goal is to develop an AI-enhanced e-learning platform that not only overcomes these barriers but also creates an inclusive learning environment tailored to the unique needs of hearing-impaired children. The proposed solution seeks to integrate advanced technologies such as augmented reality for teaching sign language and real-time translation of speech to text and sign language, ensuring equal educational access for hearing-impaired children alongside their hearing peers.
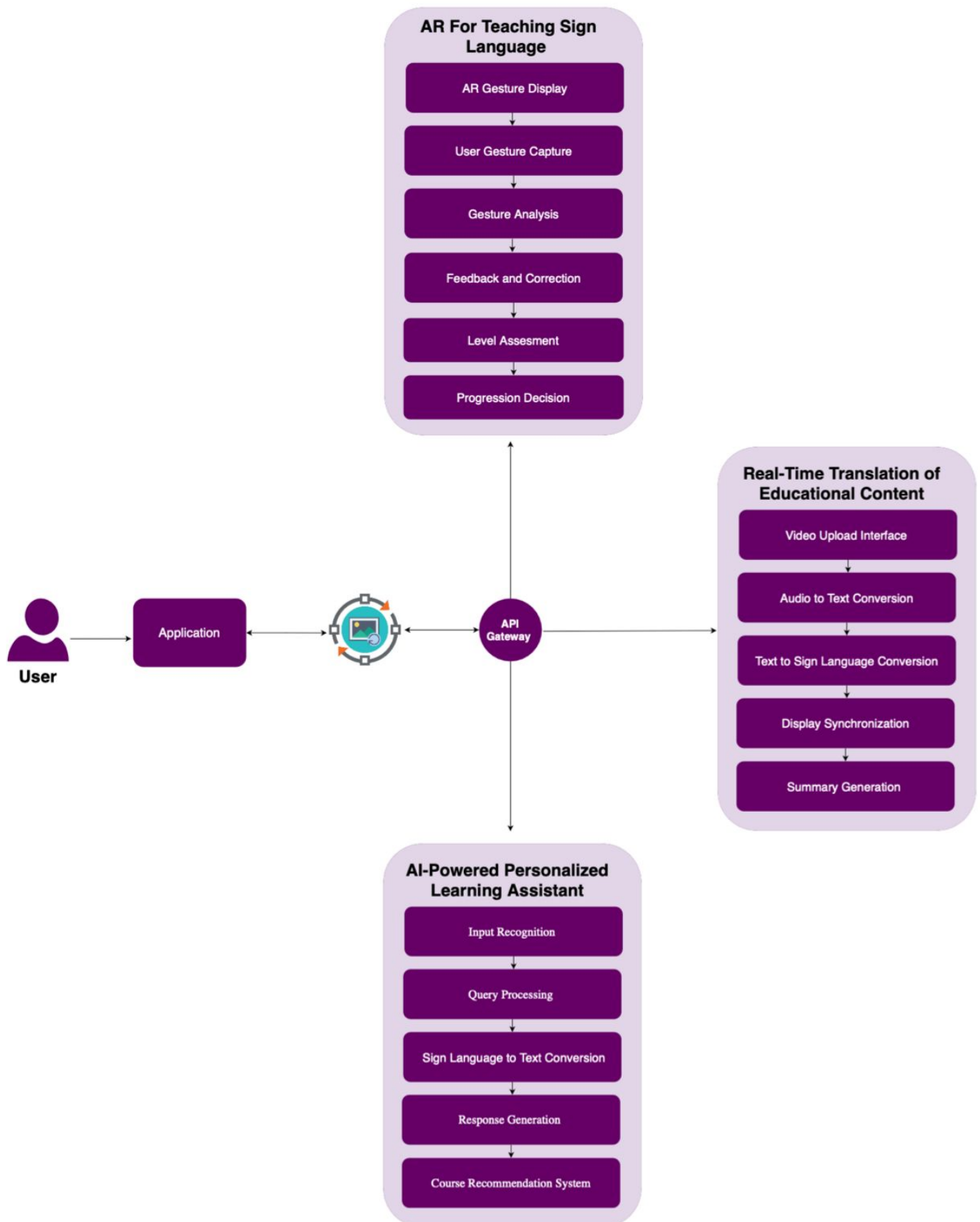
References in IEEE format:

[1]MMK Rowel#, ADAI Gunasekara, GAI Uwanthika and DB Wijesinghel., "An E-Learning Platform for Hearing Impaired Children," Faculty of Computing, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka.

[2] P. Martins et al, Henrique Rodriguesb, Tânia Rochaa,b, Manuela Franciscoc, Leonel Morgadoa,d "Accessible options for Deaf people in e-Learning platforms: Technology solutions for Sign Language translation," in Procedia Computer Science, vol. 67, pp. 263-272, 2015.

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

The proposed solution to address the educational challenges faced by hearing-impaired children involves the creation of an AI-enhanced e-learning platform tailored to their unique needs. This platform will integrate cutting-edge technologies to ensure full accessibility of learning materials through real-time translation of spoken and written content into sign language and captions. It will also feature an AI assistant capable of communicating in sign language, designed to facilitate interactive learning by responding to student inquiries, providing personalized feedback, and adapting educational content based on individual learning progress.

This comprehensive approach will utilize gesture recognition technology to allow the AI assistant to interact effectively with students, offering immediate support and enhancing the learning experience. The platform aims to remove traditional barriers present in e-learning environments by making educational content universally accessible and engaging for hearing-impaired students. By doing so, it supports their academic development and ensures they can participate fully in educational opportunities alongside their hearing peers. The ultimate goal is to create an inclusive, interactive, and adaptable educational platform that not only meets the specific communication and learning needs of hearing-impaired children but also promotes their long-term educational success.

AR For Teaching Sign Language
- AR Gesture Display
- User Gesture Capture
- Gesture Analysis
- Feedback and Correction
- Level Assesment
- Progression Decision

Real-Time Translation of Educational Content
- Video Upload Interface
- Audio to Text Conversion
- Text to Sign Language Conversion
- Display Synchronization
- Summary Generation

AI-Powered Personalized Learning Assistant
- Input Recognition
- Query Processing
- Sign Language to Text Conversion
- Response Generation
- Course Recommendation System

User → Application ↔ API Gateway

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

Developing an AI-enhanced e-learning platform for hearing-impaired children requires specialized domain expertise, knowledge, and specific data requirements that span several fields:

1. **Educational Psychology and Special Education**: Knowledge of educational psychology, particularly in the context of learning disabilities and sensory impairments, is crucial. Experts in special education can provide insights into the unique learning needs and challenges faced by hearing-impaired children. This includes understanding the cognitive, social, and emotional impacts of hearing impairments on learning.

2. **Sign Language and Linguistics**: Proficiency in sign language linguistics is essential to ensure that the translations and content are accurate and culturally appropriate. Experts must understand the syntax, grammar, and nuances of sign languages such as American Sign Language (ASL) to develop effective translation algorithms and content.

3. **Speech and Language Pathology**: Specialists in speech and language pathology can contribute knowledge about language development and communication disorders. Their expertise is vital for designing interfaces and interactions that accommodate non-verbal communication and for creating content that supports language learning and rehabilitation.

4. **Computer Science and AI**: Expertise in AI, machine learning, and computer vision is required to develop the platform's core functionalities, including gesture recognition, natural language processing, and adaptive learning algorithms. Knowledge in these areas will drive the creation of an interactive AI assistant and real-time translation systems.

5. **User Interface/User Experience Design (UI/UX)**: Designers with experience in accessible technology design are needed to ensure the platform is user-friendly and tailored to the specific needs of hearing-impaired users. This includes the development of visual interfaces that are easy to navigate and can display sign language and captions clearly.

6. **Data Requirements**: The development of this platform requires a robust dataset, including hours of sign language videos, text annotations, user interaction data, and feedback for training machine learning models. Data privacy and ethical considerations in collecting and using data from minors are also critical.

8. Objectives and Novelty

Main Objective
AI-enhanced e-learning platform specifically designed for students aged 8, those who are hearing-impaired. This platform will leverage Augmented Reality, real-time translation technologies, and adaptive AI assistance to create a fully inclusive and personalized educational experience. It aims to facilitate seamless access to learning materials through real-time captions, sign language interpretation, and interactive support, while dynamically adapting to the individual learning styles and needs of young learners to enhance their engagement and educational outcomes.

Member Name	Sub Objective	Tasks	Novelty
Rizan S - IT21311840	Interactive ASL learning sessions using AR and Machine Learning	• Develop an **Augmented Reality module** that displays virtual hands performing sign language gestures which will serve as the primary mode of instruction, showing students how to execute various signs correctly. • Implement **Machine learning algorithms** within an augmented reality framework to analyze students' gestures in real-time and provide instant feedback by detecting and highlighting discrepancies between the student's gestures and the correct sign language gestures taught during the sessions. • Design a structured learning curriculum divided into three levels: **beginner, intermediate, and advanced.** Each level should focus on increasingly complex sign language skills appropriate to the student's growing proficiency. • Integrate testing modules at the end of each learning level that require students to demonstrate the sign language gestures they've learned, use machine learning techniques to evaluate the accuracy and proficiency of these gestures during the tests, and assign scores based on their performance. Ensure students must achieve a preset threshold score to advance to the next level; otherwise, they must repeat the current level to reinforce their learning.	• Utilizes AR to create a dynamic, interactive learning environment that goes beyond traditional static video teaching methods, allowing real-time interaction and feedback using machine learning.

M.S.M Shazny - IT211736322	Real-Time Translation of Educational Content to captions, sign language and providing summary.	- Develop a **user-friendly interface** that allows students to upload educational videos easily, facilitating accessibility and interaction with the platform. - Implement **Machine learning algorithms** to automatically generate accurate **captions** from the audio content of the uploaded videos. These captions should be synchronized with the video playback, ensuring they appear at the correct time to match the spoken words. - Utilize advanced machine learning models trained on sign language data to convert spoken content into **sign language avatars**. These sign language translations should be displayed simultaneously with the video, providing a visual interpretation of the audio for hearing-impaired students. - Ensure that both the captions and sign language translations are integrated seamlessly with the video playback interface. This integration should maintain synchronization between the video and its translations to provide a cohesive viewing experience. - After the video ends, automatically generate a concise **summary** of the video content using **Natural language processing (NLP)** techniques. This summary should capture the key points discussed in the video, offering a quick recap for students to review the main concepts.	Real-time machine learning-driven translations seamlessly convert video content into **captions and sign language**, complemented by an integrated **summary** feature, enhancing accessibility and enriching comprehension for a dynamic and inclusive educational experience.

Z.F. Sahla - IT21159558	AI powered personalized learning assistant with sign language support	• Design and develop an **AI assistant** powered by **Natural Language Processing (NLP)** that serves as an educational support tool. This assistant will interact with students to address their educational queries and provide advice and solutions. • Create an **interface** that allows students to communicate their doubts and questions to the AI assistant either through **text input or via sign language** for those who are hearing impaired. • Implement advanced machine learning models capable of recognizing **sign language gestures** made by students. Automatically convert these gestures into **textual data** that appears in a text bar, allowing students to verify if their questions have been accurately captured by the system. • AI accurately understands their inquiries and provide relevant **responses and solutions** via **sign language and texts.** • Integrate a **recommendation system** within the AI assistant that analyzes students' interaction history, question patterns, and past course performances. Based on this data, the assistant will suggest suitable new courses or educational materials that align with their learning needs and interests. • Implement a **quiz module** within the AI assistant that allows students to take quizzes multiple times, tracks their **progress** across attempts using machine learning, and visually displays their improvement to assess their comprehension levels.	• This personalized AI-driven interaction model, powered by advanced **NLP**, acts as a real-time translator, seamlessly converting **sign language to text and text to sign language** for dynamic **two-way communication**. It adapts to individual user needs, providing **personalized support** and ensuring an intuitive, real-time learning experience in a fully inclusive environment.

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?
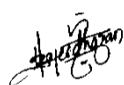
Yes		No	

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

Yes		No	

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

10. Supervisor details

	Title	First Name	Last Name	Signature
Supervisor	Ms.	Thamali	Kelegama	
Co-Supervisor	Ms.	Vindhya	Kalapuge	
External Supervisor	Ms.	Fathima Roshan Shafeedha	Rizan	
Summary of external supervisor's (if any) experience and expertise **Bachelor's Degree in Speech Language Pathology and Audiology**				

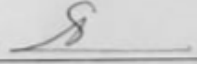## This part is to be filled by the Topic Screening Panel members.

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
Lakmini Abeywardhane	⊕
H.M.S.C. Rathnayake	S

***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.