Personalized Educational Assistant for Students with Learning Disabilities

Amara Pranav
Department of Artificial Intelligence
Amrita School of Artificial Intelligence, Bengaluru
Amrita Vishwa Vidyapeetham, India
bl.en.u4aid23003@bl.students.amrita.edu

Joshika Somisetty
Department of Artificial Intelligence
Amrita School of Artificial Intelligence, Bengaluru
Amrita Vishwa Vidyapeetham, India
bl.en.u4aid23019@bl.students.amrita.edu

Koduri Lakshmi Vinugna
Department of Artificial Intelligence
Amrita School of Artificial Intelligence, Bengaluru
Amrita Vishwa Vidyapeetham, India
bl.en.u4aid23026@bl.students.amrita.edu

Pooja Gowda
Department of Computer Science and Engineering
Amrita School of Computing, Bengaluru
Amrita Vishwa Vidyapeetham, India
g_pooja@blr.amrita.edu

***Abstract*—Students with disabilities often tend to struggle with attention and information retention during regular lessons. Although note-taking and attention tracking would bridge these gaps, actual learning necessitates continuous assistance based on individual needs. Through the implementation of real-time content processing, detection of distractions, this research seeks to facilitate easier and more individualized learning by keeping them attentive and noting key points. It introduces the development of an Virtual Educational Assistant for Students with Learning Disabilities like Dyslexia aimed at improving learning opportunities for them through real-time feedback on attention and understanding. The system incorporates two major functionalities Distraction Detection and Speech Processing. The Distraction Detection module uses computer vision techniques, such as face detection and Eye Aspect Ratio (EAR) calculation, to monitor the attention levels of the students. If any distraction is detected, a voice based alert is given to gain the focus of the student. The Speech Processing module transcribes audio content in real-time or audio file using automatic speech recognition and then summarizes the text for easier understanding. The integration of both modules offers a comprehensive tool that can significantly improve the learning experience for students with learning disabilities by ensuring they remain attentive and improve in academics.**

***Index Terms*—Learning Disabilities, Dyslexia, Streamlit, Personalized Education, Operating Systems, Real-Time Processing, Distraction detection, Speech Processing**

I. Introduction

Learning disabilities like Dyslexia [1],affects some portion of the student population globally, leading to various challenges in academic environments. Students with learning disabilities often struggle to stay focused during lectures, understand complex concepts, and understand the information presented. In traditional educational environments, where attention and focus were crucial for learning, these students faced greater difficulties in keeping up with the pace of instructions. As a result, their academic performance tends to decline, leading to a sense of dissapointment and frustration. The need for adaptive technologies that can support these students in real-time has become more relevant, as existing methods may not provide that much flexibility or support required to meet their needs.

The recognition of the fact that traditional teaching [2] methods were not always effective for students with learning disabilities, especially those who struggle with attention difficulty, motivated towards this respective research. In the common classroom, these students could find it challenging to maintain focus during long lectures, and without proper support, they may miss critical information. Additionally, the lack of real-time assistance can prevent these students from actively engaging with the material. Most existing tools for learning disabilities focus on post-session support, such as recorded lectures or textbook-based interventions, but they do not offer the level of real-time interaction needed to prevent students from losing focus in the first place.

Addressing this issue required a system that not only helps students stay engaged or attentive during lessons but also needed immediate support when distractions are detected. This study is motivated by the belief that a combination of real-time distraction detection and speech processing can provide an adaptive solution for students with attention difficulties. By integrating these technologies, the proposed system will allow for a continuous monitoring of students attention, making the learning experience more effective and personalized [3].

The conventional methods [4] such as taped lectures and extra tutoring, offer less help, mostly after the lecture has occurred. Such resources fail to provide real-time, immediate support needed to help students maintain focus in classrooms. Such methods also fail to meet individual needs during learning, which is vital in students with attention difficulty. There exists a gap in solutions on the market that this study aims to fill by offering a system to monitor and improve student interest during lessons in real-time.

This study suggests a virtual learning [5] aid designed to assist students with learning disabilities by tracking their level of attention and giving instant feedback when distraction is sensed. The system is composed of two main modules: the Distraction Detection module and the Speech Processing module. The Distraction Detection module monitors a student's involvement based on behavioral data, while the Speech Processing module converts class discussions into text,gives live summaries and important points. These are designed to collaborate and keep the students interested in the lesson and that they can be able to retrieve and access relevant information.

The key objectives of the proposed system are to develop a distraction detection system that monitors a student's attention during lessons, provide real-time transcription of classroomdiscussions, offer summaries and key takeaways from the lesson. These objectives aim to create a more effective learning environment by providing personalized support [6] for students with learning disabilities in real-time.

The primary contribution of this study is the combination of distraction detection and speech processing technologies to offer real-time assistance to students with learning disabilities [7]. As compared to the traditional tools that hardly offer any post-session intervention, this system provides constant guidance, allowing students to remain engaged and alert throughout the lesson. With a mix of attention-tracking and speech-to-text technology, this publication adds to more flexible and individualized learning for students with difficulties with attention.

The paper is structured as follows: Section II provides a review of related work in educational tools for students with learning disabilities and attention detection methods. Section III details the identified gaps and Section IV tells the methodology of the proposed system. Section V presents the results of the system's implementation, followed by a discussion of its effectiveness. Finally, Section VI concludes the paper and suggests potential directions for future work.

II. Literature Survey

A. Leveraging AI Technologies for Personalized Learning Support in Dyslexic Students

This work [8] takes a thoughtful look at how artificial intelligence can be used to support students with dyslexia in more meaningful ways. It points out that traditional teaching methods often don't work well for these learners, who may struggle with reading, writing, and comprehension. While assistive technologies exist, they're rarely tailored to individual needs. To change that, the authors propose a smart learning system powered by AI—using tools like natural language processing, machine learning, speech recognition, and text-to-speech—to create a personalized and adaptive learning experience. The system is designed to respond in real time to how a student is doing, offering content and support at just the right pace. Behind the scenes, it uses important operating system concepts like multitasking to handle simultaneous activities, resource management to keep things running smoothly, and real-time processing to ensure quick, helpful feedback. The work shows how combining smart software with OS efficiency can make learning more accessible—and a lot more empowering—for dyslexic students.

B. AI-Powered Personalized Learning Assistant

The work [9] examines a novel learning tool that was designated as the Personalized AI Learning Assistant, with the purpose to redefine the way students interact with learning materials. By employing the techniques such as machine learning, natural Language processing and adaptive learning algorithms, offers a highly customized learning experience. Developed using tools like React, Node.js, Flask, and TensorFlow.js Platform tailors content delivery according to the unique preferences of each individual student, and learning style. It does not just deliver content—and also interactive exercises, in real-time feedback, and per Performance metrics to keep learners on track and engaged. It is a computer-based system that is acces possible across devices, prioritizing ease of use, data security and scalability. Overall, the work emphasizes how this AI assistant fills the gap between impersonal education and individualized support, delivering students a smarter, more responsive path to attaining their academic aspirations.

C. An Adaptive E-learning Platform For Primary School Children With Visual Impairment

This work [10] deals with the problem statement of en Ensuring available e-learning platforms to visually impaired students, highlighting the importance of targeted solutions to overcoming their special learning challenges. It addresses a number of methods and approaches discussed in earlier search to enrich the online learning experience, including the incorporation of learning technology and new teaching techniques, along with the emergence of voice-based tools. While the review does not explicitly specify Operating System (OS) concepts, it touches on the relevance of OS Accessibility features and voice-based interaction capabilities as key factors in the design and application of inclusive e-learning systems. The review highlights the significance of continued research to gauge the influence of these technologies along the learning path of visually impaired students.

D. Artificial Intelligence-Enabled Intelligent Assistant for Personalized and Adaptive Learning in Higher Education

This work [11] addresses the demand for personalized and adaptive learning in higher education by developing an AI-enabled intelligent assistant to improve the learning experience. The focus is on reducing cognitive load and providing tailored support to students. The study employs advanced AI and natural language processing (NLP) techniques to create an interactive learning platform, which is evaluated for its effectiveness. Operating system concepts are applied in several ways: concurrency manages multiple real-time data processing tasks, memory management ensures efficient handling of large datasets, security and privacy measures protect sensitive student data, and integration with system APIs enables seamless communication between the assistant and educational platforms, collectively enhancing the system's functionality and user experience.

III. IDENTIFIED GAPS

Assistive learning tools have evolved a lot, yet there is still a perceivable shortfall when it comes to effectively harnessing the potential of operating system (OS) [12] principles. Concepts such as resource management, scheduling, and prioritization, that are pivotal in how contemporary Operating Systems operate efficiently are not applied to facilitate students with learning disabilities. Suppose that these tools were able to handle cognitive load like an OS manages system resources, it would make learning so much more accessible and tailored. And yet, while AI is increasingly being utilized in education, it's generally for the average student population. There's so much potential untapped in leveraging AI to customize content, pace, and assistance just for learners with special challenges. Combining these OS principles with careful, AI-based design might render assistive tools more responsive and inclusive.

This study hopes to fill these gaps [13] by creating a Personalized Educational Assistant that combines OS-level optimizations.

IV. METHODOLOGY

This section outlines the methodology used to develop the Educational Assistant for Students with Learning Disabilities. The methodology is divided into two key components: Distraction Detection [14] and Speech Processing.Fig. 1 is the workflow of these two modules.

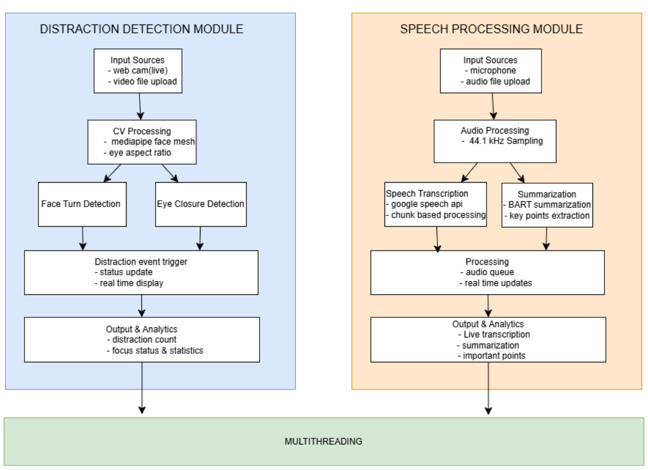

Fig. 1. Architecture Diagram

A. Distraction Detection

The Distraction Detection [15] module monitors the student's attention level during educational activities or lectures using real-time computer vision techniques. This module is essential for providing feedback on the student's focus level during tasks.

1) Face Detection and Landmark Tracking: For monitoring the the student's attention, the system captures video using a webcam feeds. First, the biggest face in the frame is recognized, then MediaPipe's face mesh model [16] is utilized to detect and follow facial movements, with the eyes in focus to check the student's attention state.

2) Eye Aspect Ratio (EAR) Calculation: The system continues to calculate the Eye Aspect Ratio (EAR) [17], which helps in identifying whether the eyes of the student are closed or if they blink excessively. If the EAR drops below a set threshold for some time, it is marked as a distraction. This is an indicator that the student is distracted and requires attention.

3) Face Orientation Detection: In addition to the eye tracking [18], the system also tracks the orientation of the face using the position of the student's nose. A deviation from the center of the frame indicates that the student's face has turned away, which is another sign of distraction. This additional measure ensures that the system accurately detects distractions related to both eye movement and face orientation.

B. Speech Processing

The *Speech Processing* [19] module enables the system to transcribe spoken content or live audio or any pre-recorded audio file into text and generate summaries of the transcribed content. This module helps students by providing real-time written notes and important highlights of the lecture useful for their studies.

1) Audio Capture and Speech Recognition: The system captures audio input through a microphone. Using the SpeechRecognition library, the system transcribes the captured speech into text in real-time. The transcription is displayed live on the screen, assisting students in following along with the spoken content.

2) Audio Segmentation and Transcription: For recorded sessions, the system segments the audio into manageable chunks to facilitate easier transcription [20]. The transcription process is performed non-concurrently, ensuring minimal delay in generating the text output.

3) Text Summarization: Once the transcription is complete, the text is passed through the BART model (Bidirectional and Auto-Regressive Transformers) for summarization [21]. The BART model summarizes the transcribed material, keeping the essential ideas while omitting non-essential information. This gives the student a summarized version of the spoken material, enhancing their attention to key information.

4) Key Points Extraction: In addition to summarizing the text, the system extracts key points from the summarized content. Important sentences and words are highlighted, helping students identify the most critical aspects of the lesson or discussion.

C. System Integration

The two components, *Distraction Detection* and *Speech Processing*, are integrated into a coordinated system. The *Distraction Detection* module provides real-time feedback to the student by alerting them if they are losing focus, while the *Speech Processing* module ensures that recorded content is transcribed and summarized for easier understanding.

D. User Interface and Accessibility

The system is made with an accessible user interface (streamlit) to accommodate learning-disabled students. The interface gives visual feedback, distraction alerts and status messages. The transcribed and summarized text is also presented in an easily accessible manner to facilitate student interaction and can also be downloaded and saved for future access of the notes.

Fig. 2 portrays the User Interface of the system using streamlit for the first module of Distraction Detection and Fig. 3 portrays the User Interface of the system using streamlit for the second module of Speech Processing.

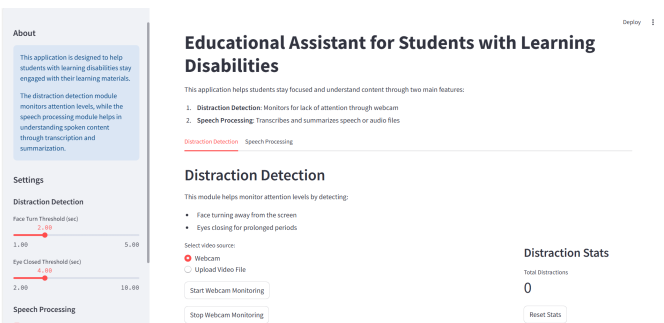

Fig. 2. Distraction Detection Interface

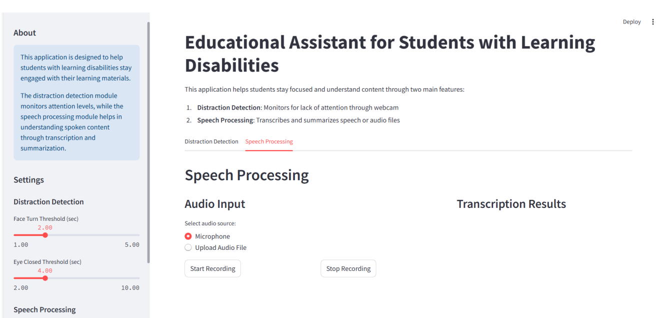

Fig. 3. Speech processing Interface

V. Results

The developed system was seen to accurately perform real-time distraction detection based on face orientation and eye closure analysis through webcam feed and MediaPipe library, accurately in test scenarios. There existed an embedded audio feedback mechanism of timely verbal prompts via pyttsx3 engine to remind students of refocusing as soon as symptoms of distraction were observed. The speech-to-text component, which utilized the Google Speech Recognition API, yielded low-latency and accurate transcriptions with high robustness to background noise. The transcribed lectures were efficiently summarized using the BART transformer model, producing coherent and concise outputs. Key points were determined by frequency of key words, enhancing content retention.The system also showed smooth multithreaded performance, executing distraction monitoring and speech summarization concurrently with efficient resource management. Last but not least, the implementation guaranteed clean and user-managed shutdown via a shared event flag, helping to make it robust and user-friendly.

Fig. 4 displays the virtual image of a student when attentive, as recorded by the webcam with the distraction detection system. On the other hand, Fig. 5 displays the virtual image of the same student when distracted, showing apparent facial orientation and eye movement changes. These images are the primary indicators employed by the system to identify attentive and inattentive states, upon which real-time feedback and alert mechanisms are based to enhance student engagement.

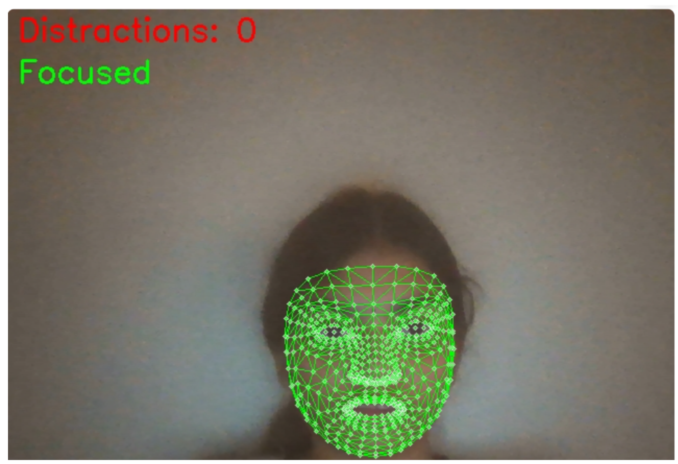

Fig. 4. Distraction Detection webcam showing Focused

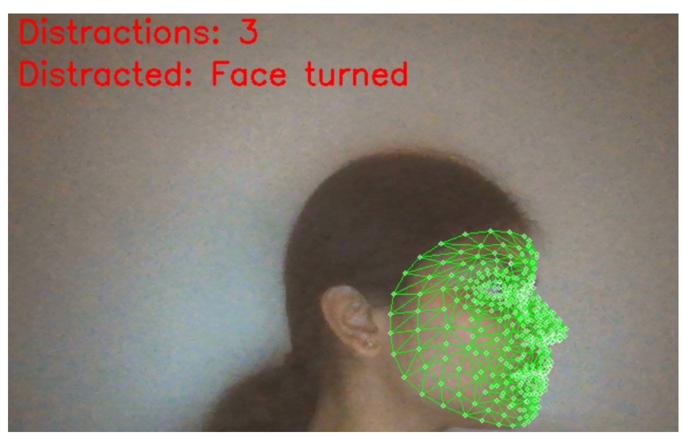

Fig. 5. Distraction Detection webcam showing Distraction

VI. Conclusion

The development of an educational assistant for students with learning disabilities has demonstrated how technology can assist and enhance the learning process of each student who has difficulty with attention and understanding. Through the incorporation of distraction detection using computer vision and speech processing for real-time transcription and summarization, the system provides a solution that caters to major learning engagement elements.According to experimentation,we can assert that the system proves useful in distraction detection and making content more accessible for students by means of automated summaries.Future research will involve fine-tuning these features, introducing customization options, and improving the system's applicability for application in online classes. Overall, this study has proven that intelligent systems have much to offer in the way of improving learning achievements among students with learning disabilities.

VII. Future Work

Future enhancements to our proposed system can include multi languages support to make it more efficient and emotion detection to measure student engagement more effectively. A system that can personalize content based on attention and performance metrics.Multi-device support and data continuity would be made possible by cloud integration, and cross-platform and mobile development could improve usability on smartphones and tablets. Introducing dashboards for parents and educators will provide a real-time feedback on student engagement. Additionally, ensuring data privacy and ethical compliance and integrating with existing platforms like Google Classroom or zoom would enhance usability and security.

References

[1] Andrea Zingoni, Juri Taborri, and Giuseppe Calabrò. A machine learning-based classification model to support university students with dyslexia with personalized tools and strategies. *Scientific Reports*, 14(1):273, 2024.

[2] J. Zhang and Z. Y. Zhang. ai in teacher education: unlocking new dimensions in teaching support, inclusive learning, and digital literacy. *Journal of Computer Assisted Learning*, 40:1871–1885, 2024.

[3] Ramteja Sajja, Yusuf Sermet, Muhammed Cikmaz, David Cwiertny, and Ibrahim Demir. Artificial intelligence-enabled intelligent assistant for personalized and adaptive learning in higher education. *Information*, 15(10), 2024.

[4] Linda Price, John TE Richardson, and Anne Jelfs. Face-to-face versus online tutoring support in distance education. *Studies in higher education*, 32(1):1–20, 2007.

[5] Harry Barton Essel, Dimitrios Vlachopoulos, Akosua Tachie-Menson, Esi Eduafua Johnson, and Papa Kwame Baah. The impact of a virtual teaching assistant (chatbot) on students' learning in ghanaian higher education. *International Journal of Educational Technology in Higher Education*, 19(1):57, 2022.

[6] Thomas K.F. Chiu, Benjamin Luke Moorhouse, Ching Sing Chai, and Murod Ismailov and. Teacher support and student motivation to learn with artificial intelligence (ai) based chatbot. *Interactive Learning Environments*, 32(7):3240–3256, 2024.

[7] Stefano D'Urso and Filippo Sciarrone. Ai4la: An intelligent chatbot for supporting students with dyslexia, based on generative ai. In Angelo Sifaleras and Fuhua Lin, editors, *Generative Intelligence and Intelligent Tutoring Systems*, pages 369–377, Cham, 2024. Springer Nature Switzerland.

[8] M Maragadhavalli Meenakshi, V Visakan, P Deepak, G Bhuvaneshwaran, and D Manoj Kiran. Leveraging ai technologies for personalized learning support in dyslexic students. *International Journal for Research in Applied Science and Engineering Technology*, 12(12):IJRASET65734, 2024.

[9] Reshma Lohar, Talha Shaikh, Avesh Momin, Adnan Sayyed, and Rohit Nagerwelly. Ai-powered personalized learning assistant. *International Journal of Innovative Research in Technology (IJIRT)*, 10(12):959–960, May 2024.

[10] M. Maragadhavalli Meenakshi, V. Visakan, P. Deepak, G. Bhuvaneshwaran, and D. Manoj Kiran. Leveraging ai technologies for personalized learning support in dyslexic students. *International Journal for Research in Applied Science and Engineering Technology (IJRASET)*, 12(12):1–6, December 2024.

[11] Ramteja Sajja, Yusuf Sermet, Muhammed Cikmaz, David Cwiertny, and Ibrahim Demir. Artificial intelligence-enabled intelligent assistant for personalized and adaptive learning in higher education. *Information*, 15(10), 2024.

[12] Brendan Robert Doney. Disdoc: Ai teaching assistant for computer science courses. Master's thesis, Virginia Tech, March 2025.

[13] Kristjan-Julius Laak and Jaan Aru. Ai and personalized learning: bridging the gap with modern educational goals, 2025.

[14] Adam A.Q. Mohammed, Xin Geng, Jing Wang, and Zafar Ali. Driver distraction detection using semi-supervised lightweight vision transformer. *Engineering Applications of Artificial Intelligence*, 129:107618, 2024.

[15] Sarker Monojit Asish, Arun K. Kulshreshth, and Christoph W. Borst. Detecting distracted students in educational vr environments using machine learning on eye gaze data. *Computers Graphics*, 109:75–87, 2022.

[16] Sumitra A. Jakhete and Nilima Kulkarni. A comprehensive survey and evaluation of mediapipe face mesh for human emotion recognition. In *2024 8th International Conference on Computing, Communication, Control and Automation (ICCUBEA)*, pages 1–8, 2024.

[17] Divya Venugopal, J Amudha, and C. Jyotsna. Developing an application using eye tracker. In *2016 IEEE International Conference on Recent Trends in Electronics, Information Communication Technology (RTEICT)*, pages 1518–1522, 2016.

[18] C. Jyotsna, J. Amudha, Amritanshu Ram, Damiano Fruet, and Giandomenico Nollo. Predicteye: Personalized time series model for mental state prediction using eye tracking. *IEEE Access*, 11:128383–128409, 2023.

[19] Nivedita Sethiya and Chandresh Kumar Maurya. End-to-end speech-to-text translation: A survey. *Computer Speech Language*, 90:101751, 2025.

[20] Sasikala D and Shaik Huzaifa Fazil. Enhancing communication: Utilizing transfer learning for improved speech-to-text transcription. In *2024 15th International Conference on Computing Communication and Networking Technologies (ICCCNT)*, pages 1–6, 2024.

[21] Poorva Agrawal, Kashish Sharma, Keyur Dhage, Isha Sharma, Nitin Rakesh, and Gagandeep Kaur. Speech-to-text conversion and text summarization. In *2024 First International Conference on Technological Innovations and Advance Computing (TIACOMP)*, pages 536–541, 2024.