Personalized Educational Assistant for Students with Learning Disabilities

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

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

Pooja Gowda
Department of Artificial Intelligence
Amrita School of Artificial Intelligence, Bengaluru
Amrita Vishwa Vidyapeetham, India
g_pooja@blr.amrita.edu

***Abstract*—This paper presents the development of an Virtual Educational Assistant for Students with Learning Disabilities such as ADHD, Dyslexia, designed to enhance learning experiences for them by providing real-time feedback on attention and comprehension. The system integrates two key 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, Streamlit, Personalized Education, Operating Systems, Real-Time Processing, Distraction detection, Speech Processing**

I. Introduction

Learning disabilities 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 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 may 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 research 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.

The traditional approaches to overcoming the challenges, like taped lectures and outside tutoring, provide limited assistance, primarily after the lecture has taken place. These resources do not give instant, real-time support which is required to assist students in remaining attentive during classes. Additionally, these approaches do not address individual needs during the learning process, which is important for students with attention difficulty. There exists an obvious gap in solutions on the market that this research aims to fill by offering a system to monitor and improve student interest during lessons in real-time.

This paper suggests a virtual learning 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 and gives live summaries. 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 classroom discussions, offer summaries and key takeaways from the lesson. These objectives aim to create a more effective learning environment by providing personalized support for students with learning disabilities in real-time.

The primary contribution of this paper is the combination of distraction detection and speech processing technologies to offer real-time assistance to students with learning disabilities. In contrast to conventional tools that only provide post-session intervention, this system offers constant support, enabling students to stay focused and attentive throughout the lesson. By using a combination of attention-tracking and speech-to-text technologies, this work contributes to a more adaptive and personalized approach to learning for students with attention difficulties.

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

The paper [1] 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 paper 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 paper [2] explores a cutting-edge educational tool called the Personalized AI Learning Assistant, designed to reshape how students engage with learning materials. By harnessing technologies like machine learning, natural language processing, and adaptive learning algorithms, the assistant offers a highly tailored educational experience. Built using tools like React, Node.js, Flask, and TensorFlow.js, this platform personalizes content delivery based on each student's unique preferences, progress, and learning style. It doesn't just provide content—it also gives interactive exercises, real-time feedback, and performance analytics to ensure learners stay engaged and on track. The system is cloud-based and accessible across devices, emphasizing user-friendly design, data security, and scalability. Ultimately, the paper highlights how this AI assistant bridges the gap between generic education and personalized support, offering students a smarter, more responsive path to achieving their academic goals.

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

The paper [3] addresses the problem statement of ensuring accessible e-learning platforms for visually impaired students, emphasizing the need for tailored approaches to overcome their unique educational challenges. It discusses various methodologies and strategies proposed in prior research to enhance the online learning experience, including the integration of learning technology, innovative teaching techniques, and the development of voice-driven tools. While the review doesn't explicitly detail Operating System (OS) concepts, it implicitly touches upon the importance of OS accessibility features and voice-based interaction capabilities as crucial considerations for the design and implementation of inclusive e-learning systems. The review underscores the significance of ongoing research to evaluate the impact of these technologies on the educational journey of visually impaired students.

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

This paper [4] 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) 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 research hopes to fill these gaps 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 and Speech Processing.

A. Distraction Detection

The *Distraction Detection* 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: To monitor the student's attention, the system uses a webcam to capture video feeds. The first step involves detecting the largest face in the frame. *MediaPipe's face mesh model* is utilized to identify and track the facial landmarks, focusing primarily on the eyes to determine the attention state of the student.

2) Eye Aspect Ratio (EAR) Calculation: The system then calculates the Eye Aspect Ratio (EAR), which helps to detect when the student's eyes are closed or when they are blinking excessively. If the EAR falls below a predefined threshold for a specific duration, it is marked as a possible distraction. This serves as an indication that the student is not paying attention and requires intervention.

3) Face Orientation Detection: In addition to the eye tracking, 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* 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. 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. 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.

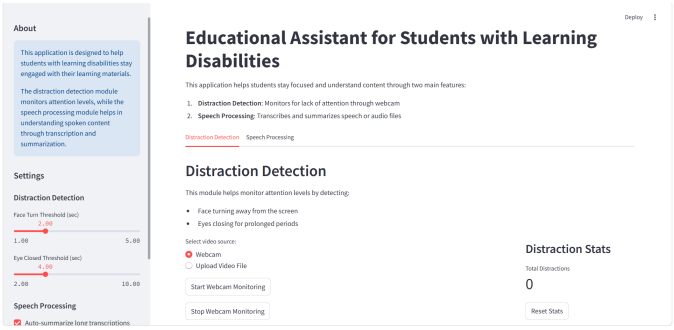

Fig. 1. Distraction Detection interface

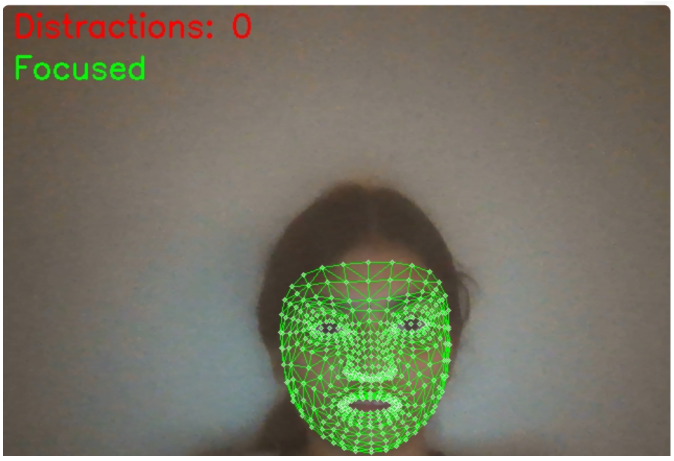

Fig. 2. Distraction Detection webcam

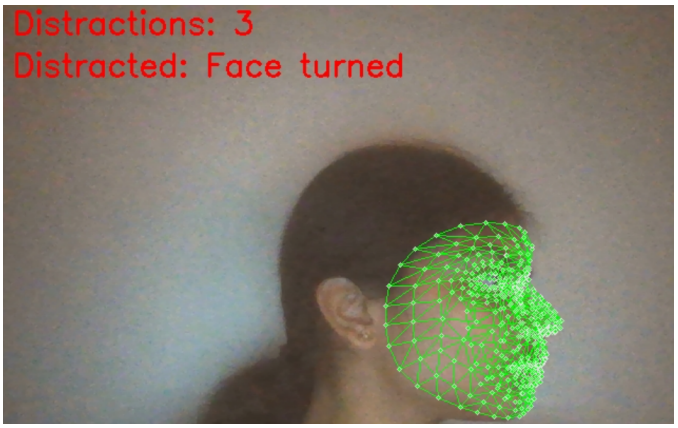

Fig. 3. Distraction Detection webcam

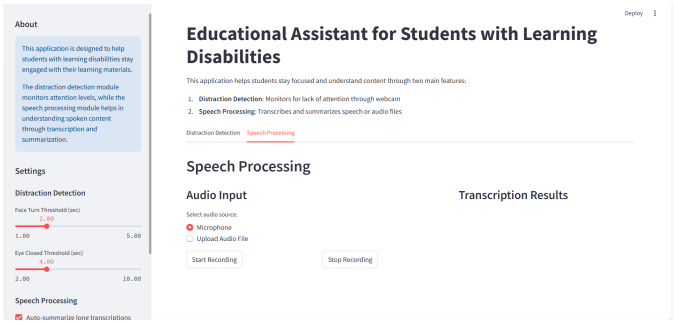

Fig. 4. Speech processing interface

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.

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 project 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] 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.

[2] 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.

[3] 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.

[4] 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.