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EdTech Platform for Dyslexic students

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Abstract: Dyslexia is a neurological learning disorder that affects reading fluency, spelling, and comprehension, often hindering academic progress. This project proposes the development of an inclusive web-based educational platform tailored to the unique needs of dyslexic students in grades 1 to 10. Drawing inspiration from modern platforms like Coursera, the system integrates assistive technologies such as text-to-speech, visual learning aids, and dyslexia-friendly design principles to create an accessible, engaging, and personalized learning environment. The platform emphasizes foundational subjects like English and Mathematics and aims to minimize learning barriers through intuitive navigation and adaptive content delivery. By leveraging open-source technologies and Progressive Web App (PWA) capabilities, the solution ensures affordability, scalability, and offline accessibility—supporting equitable education for students in diverse environments.

Keywords: Dyslexia, Assistive Technology, Adaptive Learning, Progressive Web App.

I. INTRODUCTION

Dyslexia is a neurological learning disorder that significantly impacts reading fluency, spelling, and the ability to process written and spoken language. Although individuals with dyslexia often possess average or above-average intelligence, they tend to struggle in conventional educational settings that heavily depend on text-based instruction and standard assessment formats. These environments rarely cater to diverse learning needs, leading to frustration, low self-esteem, and academic disengagement among dyslexic students.

To address these challenges, this project introduces a web-based educational platform tailored to the needs of dyslexic learners from grades 1 to 10. The platform leverages inclusive design principles and assistive technologies to reduce barriers to learning. Key features include dyslexia-friendly fonts, reduced visual clutter, structured content layouts, and text-to-speech functionality. The platform also integrates visual aids, color-coded elements, and interactive tools to reinforce understanding and engagement through multiple sensory channels. By prioritizing accessibility, personalization, and user-friendly navigation, the platform aims to create a more inclusive and effective learning experience. It empowers dyslexic students to better comprehend academic material, build confidence, and thrive in their educational journey.

II. LITERATURE SURVEY

Recent research highlights the growing importance of assistive technologies in addressing the educational challenges faced by students with dyslexia. Studies have explored a range of tools—from text-to-speech systems and voice navigation to immersive virtual platforms—demonstrating their potential to enhance reading comprehension, engagement, and learning independence. The following literature reviews and research findings offer valuable insights into how these technologies are being utilized, their effectiveness, and areas where further development is needed to support dyslexic learners more comprehensively.

A. Assistive Technologies for Students with Dyslexia:

This study, authored by C. Smith and M.J. Hattingh and published on ResearchGate, evaluates various assistive technologies aimed at aiding students with dyslexia. The focus is on tools like text-to-speech (TTS) and voice navigation systems. The research found that TTS and voice tools significantly improve reading comprehension and overall academic performance for students with dyslexia. Additionally, the simplicity of the interfaces associated with these tools encourages greater adoption in educational settings. The study highlights that these tools are practical and relatively easy to implement. However, it primarily focuses on individual tools rather than broader systems or combinations of tools, which could have offered deeper insights. Moreover, the research lacks long-term data on the sustained effectiveness of these tools. The impact of this review is that it promotes the use of TTS and intuitive design in classrooms, offering practical solutions for helping students with dyslexia.

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B. Impact of Audio on Navigation Strategies in Children and Adults with Dyslexia
Authored by Carolien Knoop-van Campen, Eliane Segers, and Ludo Verhoeven, and published in the Annals of Dyslexia, this study investigates the role of audio narration in multimedia learning environments. It specifically looks at how audio effects navigation strategies for children and adults with dyslexia. The findings show that audio narration enhances structured navigation and comprehension, with adults benefiting more than children. This suggests that age and developmental factors may influence how individuals with dyslexia engage with audio-based learning tools. The study offers valuable insights into the effectiveness of audio support but is limited in scope as it focuses only on navigation and short-term comprehension improvements. The impact of this research supports the integration of audio options in e-learning interfaces to help individuals with dyslexia.

C. Does Use of Text-to-Speech and Related Read-Aloud Tools Improve Reading Comprehension?
This meta-analysis, authored by S.G. Wood, J.H. Moxley, E.L. Tighe, and R.K. Wagner, and published on PubMed Central, examines the effectiveness of text-to-speech (TTS) and related read-aloud tools in improving reading comprehension. The analysis reveals that TTS provides moderate improvement in reading comprehension, with an effect size of 0.35. It also improves reading fluency and boosts student confidence in their reading abilities. The study presents strong quantitative evidence that supports the use of TTS as an effective literacy aid. However, it does not explore other non-reading skills that could benefit from such tools, and the variability of different TTS tools is not fully addressed. The impact of this study is that it validates TTS as a key tool for enhancing literacy, providing evidence for its use in educational contexts.

D. Technology-Based Interventions for Dyslexic Children: A Systematic Review
In this systematic review, Hasni Yaacob, Nor Zulaikha Zakariya, and Syar Meeze Mohd Rashid evaluate various technology-based interventions for dyslexic children, including tools such as audiobooks, e-books, and virtual learning platforms. The review found that a multi-tool approach, which combines different assistive technologies, leads to better reading outcomes and increased motivation for children with dyslexia. The integration of virtual tools was particularly noted to enhance engagement, making the learning experience more interactive and immersive. Despite the positive findings, the review points out that the research lacks a focus on how these tools align with specific curricula, and there is insufficient long-term data on their impact. The study advocates for the use of integrated, multimodal learning methods and calls for future research on the long-term effects of these tools. The impact of this review lies in its promotion of multi-modal learning environments and its suggestion for further longitudinal studies to better understand the tools' lasting effectiveness.

III. PROPOSED SYSTEM

The proposed system is a web-based educational platform designed to provide an inclusive and interactive learning experience specifically for dyslexic students. The platform integrates several advanced features to support students in overcoming the challenges associated with dyslexia, aiming to make learning more accessible, engaging, and effective.

A. AI-powered OCR (Tesseract.js) for Text Recognition
This feature uses Optical Character Recognition (OCR) powered by Tesseract.js to convert images of text—such as scanned pages or photographs—into machine-readable text. Once the text is extracted, the platform allows students to adjust its presentation in dyslexia-friendly formats. Students can modify font sizes, styles, and color contrast to suit their individual needs. This feature eliminates the dependency on traditional textbooks, allowing students to access educational materials more comfortably and efficiently. It is particularly beneficial for those who struggle with standard printed text, providing a more flexible and customized learning experience.

B. Gamification Elements
Gamification is integrated into the platform to enhance student engagement and make learning more enjoyable. By introducing game-like features such as challenges, quizzes, badges, leaderboards, and rewards, the system encourages active participation and motivation. As students progress through learning modules, they earn rewards for completing tasks, answering questions correctly, and achieving learning milestones. This gamified approach not only increases student engagement but also improves information retention and academic performance. It transforms the learning experience into something interactive and fun, making it less stressful and more rewarding for dyslexic students who may otherwise struggle with traditional learning methods.

C. Progress Tracking
The progress tracking feature allows students, educators, and parents to monitor and assess the student's learning journey. The system provides detailed insights into milestones, test scores, time spent on activities, and the completion rate of

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learning modules. A personalized dashboard is created for each student, showcasing their strengths and areas that need further improvement. This feature empowers students by giving them a sense of ownership and control over their learning. It also enables educators and parents to provide timely interventions, ensuring that students stay on track and receive the necessary support to succeed.

D. Progressive Web App (PWA) Support

The platform is developed as a Progressive Web App (PWA), ensuring that it functions seamlessly even in low-connectivity or offline environments. This means that students can install the platform on their devices and access it directly from their browser without requiring a constant internet connection. The ability to use the platform offline is especially advantageous for students in areas with unreliable internet access, ensuring uninterrupted learning. PWA support guarantees that students can continue their educational activities regardless of their internet availability, making it a highly reliable option for learners who may face connectivity challenges.

E. Adaptive Learning Techniques

Adaptive learning is a core feature of the platform, allowing it to tailor the learning experience to each student's unique needs. The system continuously assesses the student's strengths, weaknesses, and learning patterns. Based on this analysis, the platform adjusts the difficulty level of tasks, suggests specific exercises, and recommends targeted content that matches the student's learning pace and style. By offering personalized learning experiences, the platform reduces frustration and helps prevent students from feeling overwhelmed. This approach ensures that each student progresses steadily, receiving the right level of challenge and support to maximize their potential.

IV. ARCHITECTURE

This section outlines the architecture of the proposed EdTech platform, focusing on the key components and user interactions. The flowchart and use case diagram below illustrate the structure and flow of the system, showcasing how users interact with the platform and the roles of administrators in managing content and user engagement.

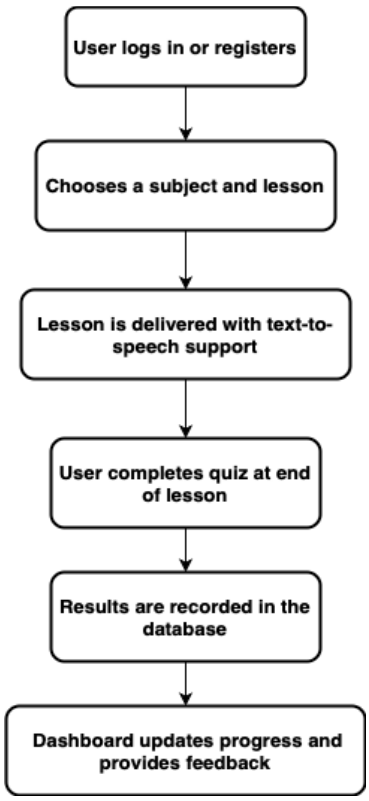

Fig. 1. Flowchart of the Learning System

The flowchart in Fig provides a visual representation of the user journey within the proposed learning system. It begins with the user logging in or registering, followed by selecting a subject and lesson. The lesson is then presented with

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integrated text-to-speech support to enhance accessibility. Upon completion of the lesson, the user takes a quiz, and the results are stored in the database. Finally, the dashboard updates the user's progress and provides feedback based on performance. This structured flow ensures an interactive, accessible, and personalized learning experience for all users.

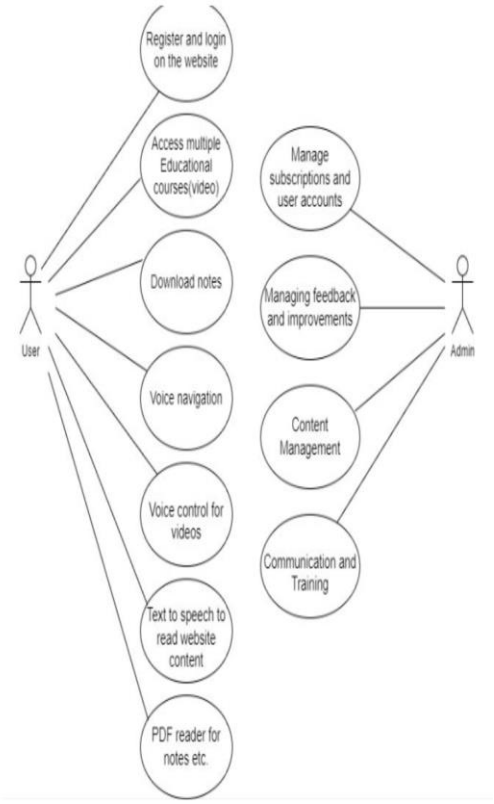

Fig. 2. Use Case Diagram

The use case diagram represents the key interactions between the two primary actors of the proposed EdTech platform—Users (Learners) and Administrators (Admins). The platform is developed with a strong focus on supporting learners with dyslexia by integrating accessibility-enhancing features and inclusive learning mechanisms.

User (Learner) Interactions: Learners with dyslexia face challenges in reading and comprehending traditional text-heavy content. To address these difficulties, the platform provides the following features for users:

- **Register and Login**: Secure user authentication and access to personalized content.
- **Access Educational Videos**: Visual and auditory alternatives to text, aiding better comprehension.
- **Download Notes**: Allows users to save study material for offline use, potentially formatted in dyslexia-friendly styles.
- **Voice Navigation and Voice Control**: Enables hands-free interaction and media control, improving ease of use.
- **Text-to-Speech Functionality**: Converts text content into audio to reduce reading strain and cognitive load.
- **PDF Reader for Notes**: Provides integrated support for reading and understanding PDF-based learning materials.

These features aim to create an inclusive, empowering environment that reduces frustration and enhances the learning experience for dyslexic users.

Admin Interactions: Administrators manage the platform's operational aspects and continuously improve the system. Their roles include:

- **Manage User Accounts and Subscriptions**: Oversee user access and subscription services.
- **Managing Feedback and Improvements**: Collect user feedback and implement system improvements to enhance the platform.

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- **Content Management**: Ensure the availability of accessible, dyslexia-friendly educational materials.
- **Communication and Training**: Facilitate community support and offer training resources for educators and guardians.

This use case diagram serves as a blueprint for the platform's functionality, highlighting its commitment to accessibility, inclusivity, and user-centered design for neurodiverse learners.

The combination of the flowchart and use case diagram provides a clear overview of the system's operation and the interaction between users and administrators. The platform is structured to ensure ease of use and accessibility for learners with dyslexia, emphasizing user-centric design and inclusivity.

V. RESULTS

This section presents the results of testing the "EdTech Platform for Dyslexic students" application, which has been designed to support dyslexic learners by offering accessible features such as text-to-speech, OCR, and interactive grammar exercises. The following figures illustrate the core functionalities of the application, including its main interface, text extraction process, and grammar input/output capabilities. Each screenshot highlights a specific aspect of the user experience, showcasing how the application facilitates a more inclusive and user-friendly learning environment.

1. Main Page

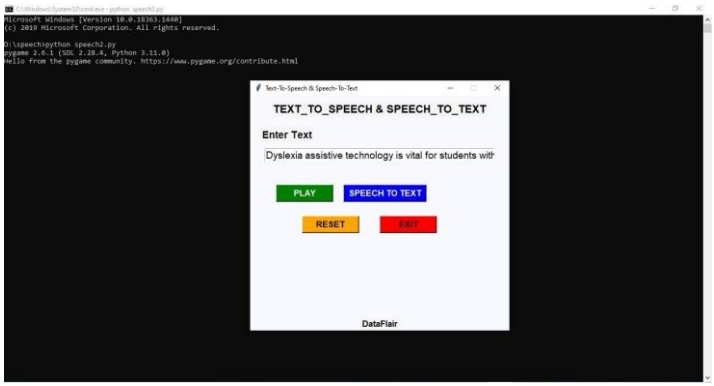

Fig. 3. Main Page

Fig.3 shows the main interface of the "Text to Speech & Speech to Text" application. The simple, user-friendly layout allows users to input text, use speech-to-text features, or play back entered text as speech. The buttons are color-coded to ensure clarity, and the interface is designed to be intuitive, especially for users with dyslexia.

2. Home Page

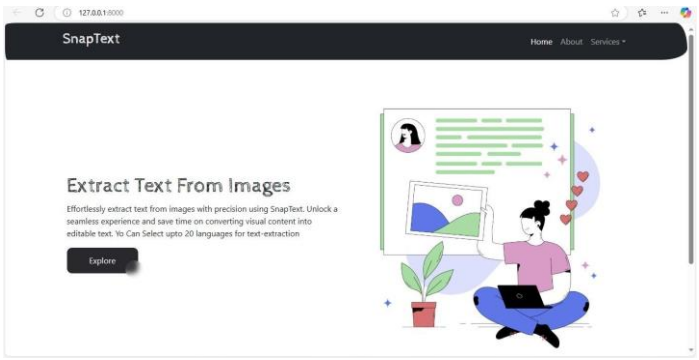

Fig. 4. Home Page

Fig.4 showcases the home page of the web application, which serves as the landing page where users are introduced to the core functionality—extracting text from images using OCR (Optical Character Recognition). This serves as the starting point for users to interact with the app.

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V.A.1 3. Steps for Text Extraction

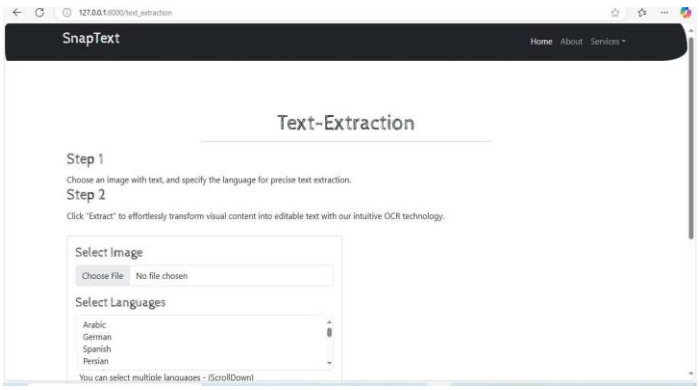

Fig. 5. Upload Image and Select Language

Fig.5 illustrates the initial step in the text extraction process. Here, users can upload an image and select the desired language(s) for text extraction. The application supports multiple languages, which makes it accessible to a diverse audience.

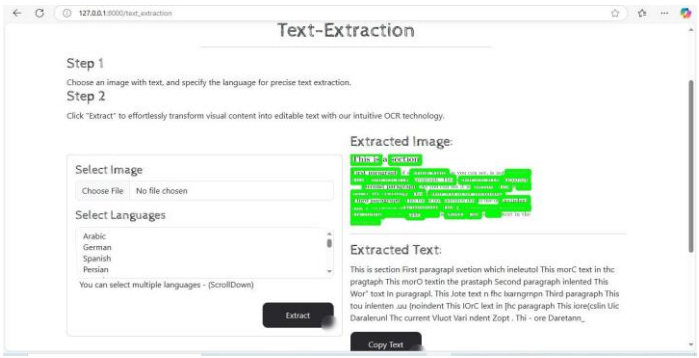

Fig. 6. Extracted text with copy option

After the text extraction process, Fig.6 shows the output screen. On the left, the uploaded image is displayed, with the detected text regions highlighted. On the right, the extracted text is shown in a readable format, with a “Copy Text” button provided for easy access. This feature is essential for users who wish to reuse or edit the extracted content.

V.A.2 4. Input and Output for Grammar Section

Fig.7 displays the grammar input page, where students from different standards (1st, 4th, and 7th–10th) can answer questions on basic grammar topics like verbs, tenses, and conjunctions.

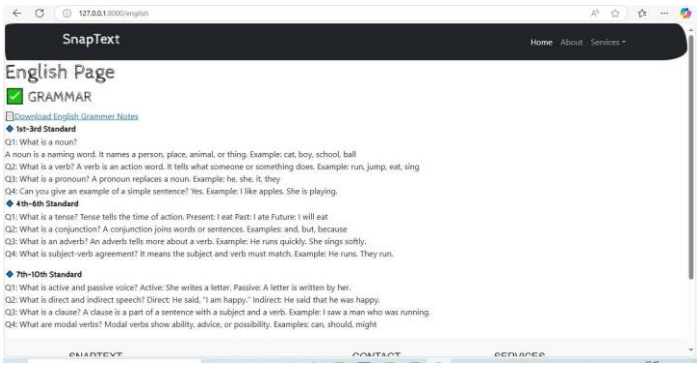

Fig. 7. Grammar questions interface

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Fig.8 shows the output result of a downloadable grammar notes file. After clicking the "Download English Grammar Notes" button, a PDF file named "englishnotes (1).pdf" is successfully downloaded, confirming that the download feature works as expected.

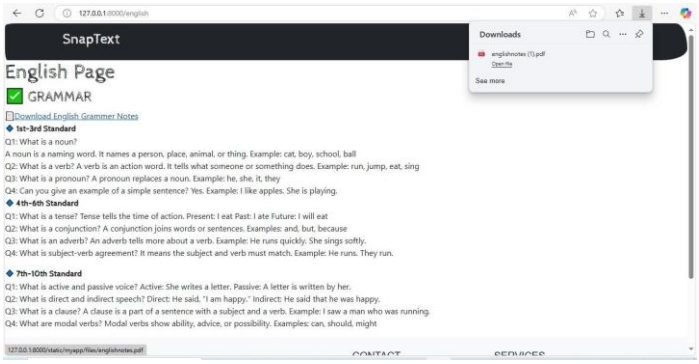

Fig. 8. Notes file download confirmation

The results presented above demonstrate that the application successfully fulfills its intended objectives—providing a simple and inclusive platform for text-to-speech, speech-to-text, and grammar learning. Each feature was tested and validated through a user-friendly interface, with special attention to accessibility for users with dyslexia. The seamless integration of OCR, multi-language support, and downloadable educational content further strengthens the application's usability and effectiveness in real-world scenarios.

VI. CONCLUSION AND FUTURE WORK

Conclusion

This project highlights the transformative potential of educational technology in assisting dyslexic learners. By integrating text-to-speech functionality, an intuitive interface, and gamified quizzes, the platform fosters an engaging, inclusive, and accessible learning experience. It simplifies content delivery, enhances motivation, and encourages independent learning through real-time feedback and progress tracking.

Leveraging open-source tools and enabling offline access through Progressive Web App (PWA) features ensures cost-efficiency and scalability, making it a viable solution for widespread implementation in educational settings. The project lays a strong groundwork for developing more inclusive digital learning tools.

Future Scope

To expand and enrich the platform, future developments may include:

- AI and Machine Learning: Implement adaptive learning techniques to personalize content and recommend lesson paths based on user behavior and performance.
- Mobile Application: Develop cross-platform mobile apps to increase accessibility and allow learning anytime, anywhere.
- Cloud-Based Hosting: Deploy the system on cloud platforms to enhance scalability, enable seamless remote access, and ensure reliable data storage.
- Multilingual and Localization Support: Introduce support for multiple languages and regional settings to broaden the platform's reach and usability across diverse user groups.

These advancements would significantly strengthen the platform's impact, ensuring long-term effectiveness in addressing learning challenges.

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