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"Development of Smart Assistive Tools for Screening and Assessing Dyslexic Children in Primary Schools"

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Abstract - Dyslexia is a common learning disorder that affects a child's ability to read, write, and understand language, despite having normal intelligence. Without early identification, it can lead to academic struggles and low selfesteem. This project presents a smart, user-friendly mobile application designed to screen young children in primary schools for signs of dyslexia and provide personalized support. The application uses artificial intelligence and multimedia tools to create an engaging learning environment. It features an interactive screening module with game-based tasks to detect early signs of dyslexia. If indicators are found, the app recommends a customized learning plan tailored to the child's needs. A key feature is the inclusion of remedial content in regional languages, allowing children to learn comfortably in their mother tongue. The app provides lessons in reading, writing, and basic math through interactive videos, rhymes, and games. An adaptive learning system adjusts difficulty based on the child's progress, while regular updates keep parents and teachers informed. This application aims to make dyslexia screening and support accessible, personalized, and inclusive, ultimately helping children gain confidence and succeed academically.[10][12]

Key Words: Dyslexia Screening, Assistive Technology, Adaptive Learning, Mobile Application, Gamified Assessment, Inclusive Education.

1 INTRODUCTION

Dyslexia is a widely recognized neurodevelopmental learning disorder that significantly impairs a child's ability to read, write, and comprehend language. Despite having normal intelligence and access to standard educational resources, children with dyslexia face persistent challenges in literacy-related tasks. These difficulties often lead to poor academic performance, low self-esteem, and emotional distress. Although early diagnosis and intervention are critical for improving outcomes, dyslexia remains under identified in many educational settings, particularly in developing countries where awareness and screening infrastructure are limited.[3]

In multilingual countries like India, the problem is further complicated by linguistic diversity. Most existing screening and intervention tools are designed in English or other widely spoken languages, making them less effective for children who receive education in regional or native languages. The absence of culturally and linguistically appropriate resources often delays identification and intervention, leading to missed opportunities for timely support. Consequently, a large number of children remain undiagnosed and unsupported during the most formative years of their education.[4]

This study proposes the development of a smart assistive mobile application aimed at the early screening and support of children with dyslexia in primary schools. The application integrates artificial intelligence, multimedia elements, and gamified learning modules to create an engaging platform for young learners. It provides interactive assessments to detect early signs of dyslexia and generates personalized remedial learning plans. One of the distinguishing features of the application is the inclusion of content in regional languages, ensuring better accessibility and comprehension for children in diverse linguistic settings. Additionally, functionality enables usage in remote or low-connectivity areas.[7]

The application is not intended to replace professional clinical diagnosis but rather serves as a preliminary screening tool that bridges the gap between symptom onset and formal intervention. It includes progress monitoring features for both parents and educators, promoting a collaborative approach to support. The project contributes to the broader vision of inclusive education by offering an accessible, adaptable, and culturally responsive solution. Key outcomes include a prototype mobile application with AI-driven assessments, regional language support, and a scalable framework suitable for widespread implementation in schools. By addressing a critical gap in early learning support, this research seeks to empower children with dyslexia to succeed academically and emotionally within an inclusive learning environment.[9]

2 LITERATURE SURVEY

Speech recognition technologies have been widely studied for their potential to improve accessibility for students with reading disabilities. Smith and Brown (2020), in their paper published in the International Journal of Educational Technology, investigated how speech-to-text tools enhance classroom engagement and help reduce the learning gap for dyslexic students. Their findings indicate that such technologies facilitate better participation and confidence among learners with dyslexia, which supports the integration of similar assistive technologies in educational applications.[1]

Patel and Kumar (2019) explored the application of Internet of Things (IoT)-based interactive notice boards for enhancing communication on smart campuses. Published in the Journal of Smart Campus Solutions, their study emphasizes the benefits of real-time notifications and interactive audio-visual cues. Although their focus was on higher education settings, the principles of interactive engagement can be adapted to develop educational tools for young learners with special needs, particularly for those requiring multisensory learning support.[2]

In the context of inclusive education, Chakraborty and Sen (2021) reviewed the use of Artificial Intelligence (AI) to customize learning experiences for children with special needs. Their research, featured in the Journal of Cognitive Learning Technologies, highlights AI's ability to adapt instructional content and monitor learner progress dynamically. This supports the use of AI-driven adaptive learning models in applications designed to screen and assist children with dyslexia by providing personalized remediation.[3]

Reddy and Naidu (2020) underscored the critical role of regional language content in facilitating learning for students with difficulties, as reported in the Indian Journal of Educational Innovation. Their study advocates for localized educational materials that enhance comprehension and retention. This finding underlines the necessity for regional language support in educational tools aimed at multilingual populations, such as those targeted in this research.[4]

Nair and George (2018) investigated gamification techniques in early childhood education in their study published in the Journal of Educational Games & Technology. Their results demonstrate that incorporating game elements like rewards, points, and interactive challenges significantly boosts motivation and cognitive skills development. These insights inform the design of gamified screening and learning modules that foster engagement among dyslexic children.[5]

Ahmed and Tanveer (2019), in the Journal of Language and Literacy Education, examined the impact of digital storytelling on language acquisition and literacy development in young learners. The study revealed that multimedia storytelling enhances vocabulary, which aligns with the proposed integration of storytelling as a pedagogical tool within the application.[6]

Iyer and Krishnan (2022) conducted a review of mobile applications for special education, emphasizing the importance of user-friendly interface design to support dyslexic users. Their findings, published in a recent journal, stress that effective UI/UX design improves usability and engagement, which is crucial for the success of educational apps aimed at children with learning difficulties.[7]

Finally, Mehta and Srinivasan (2021) explored cloud-based monitoring systems for educational progress in the Journal of Cloud Education Platforms. They highlighted how cloud integration enables efficient tracking and analysis of student learning outcomes, facilitating communication between teachers and parents. This research provides a foundation for incorporating cloud-based performance monitoring in applications designed to support dyslexic students.[8]

3 PROBLEM STATEMENT

The Dyslexia is a prevalent learning difficulty affecting children's reading, writing, and comprehension skills, often leading to academic challenges and reduced self-confidence. Early identification and intervention are critical but remain inadequate, especially in regions with limited awareness and screening resources. In multilingual countries like India, the lack of dyslexia assessment tools in regional languages further complicates timely diagnosis and support. Consequently, many children miss early intervention opportunities, impacting their educational outcomes. There is a pressing need for an accessible, adaptive, and language-inclusive screening and learning platform to assist children, parents, and educators in managing dyslexia effectively from an early stage.[3] [10] [11] [12]

4 PROPOSED METHODOLOGY

The proposed project involves the development of an Android-based assistive application aimed at primary school children with dyslexia. The app integrates early screening tools with a personalized remedial curriculum, supporting multiple regional languages within a user-friendly interface. Screening includes gamified quizzes, phonetic tests, and comprehension exercises designed to identify dyslexic traits while reducing stress. AI-driven analysis assesses each child's cognitive and linguistic abilities, allowing dynamic adaptation of learning content. The curriculum incorporates multimedia resources such as videos, interactive number games, animal sounds, and text-to-speech features to enhance engagement and accessibility.[1][10]

A cloud-based backend enables parents and educators to monitor student progress in real-time, supported by AI algorithms that provide tailored suggestions to improve learning outcomes. The app's interface is optimized with large touch areas, voice prompts, and minimal text to accommodate children with reading challenges. This inclusive design promotes effective learning by addressing both educational and emotional needs. The development process follows an iterative methodology involving requirement analysis, module design, AI integration, and testing in real educational environments, with user feedback guiding continuous improvements.[8]

The app offers numerous advantages, including early identification of dyslexia, personalized and adaptive learning paths, and increased engagement through gamification. Its regional language support makes the tool accessible and culturally relevant, enhancing comprehension and retention. Parental and teacher involvement is encouraged through progress tracking, fostering consistent support. The availability of offline content ensures flexibility in low connectivity areas. Ultimately, the app empowers dyslexic children by improving foundational skills such as reading, phonics, vocabulary, and auditory memory, while boosting confidence and promoting academic success.[12][14]

4.1. MODULES

This section outlines the key modules of the app, including user interface, screening and adaptive learning, content management, AI-based analytics, and cloud data integration, all working together to support dyslexic children's education.

a. User Interface Layer (Presentation Layer):

The user interface serves as the primary point of interaction for all user categories—children, parents, and teachers. Built using Android Studio with Java and XML, it delivers a responsive and intuitive design that is both user-friendly and device-optimized Gamification elements such as animations, reward points, and sound effects are used to maintain the child's interest and enhance learning motivation. These dashboards also incorporate AI-generated suggestions for targeted intervention, fostering a collaborative and supportive learning environment.[1][5]

b. Application Logic Layer (Processing Layer):

This module forms the core of the application by handling all logic and processing tasks that govern the flow and functionality of the learning system. It hosts several specialized engines, including the Dyslexia Screening Algorithm, which employs rule-based logic and pattern recognition to analyze a child's responses in phonics and reading comprehension tasks. Additionally, the Text-toSpeech and Audio Playback Engine aids auditory learners and improves accessibility by converting written content into voice and replaying instructions or stories as needed.[3][9][10]

c. Content Management Layer:

The content management module is responsible for the storage, organization, and delivery of all multimedia and educational resources used in the app. It includes both preloaded and dynamic content such as phonics drills, vocabulary games, comprehension passages, and story-based animations. All resources are meticulously categorized by age group, difficulty level, and regional language compatibility. A key feature of this layer is its hybrid approach to content delivery, offering offline access to essential materials while enabling real-time updates and additions when an internet connection is available. Interactive and multimedia elements, including soundboards and animated sequences, help in reinforcing phonemic awareness and conceptual understanding in an engaging manner.[5][6][11]

d. AI & Analytics Layer:

This module leverages AI models and analytics tools to interpret learner data and provide actionable insights. By integrating Google Analytics for Firebase along with custom trained AI algorithms, the application monitors real-time learning behavior, quiz performance, engagement patterns, and module completion rates. The AI system further supports teachers and parents by generating performance reports and recommending personalized learning paths, ensuring that each child progresses at a pace suitable to their capabilities. The insights generated by this layer not only aid in refining the educational content but also improve overall app usability and effectiveness.[9][15]

e. Cloud Integration Layer (Data Layer):

The cloud integration module acts as the backbone of the application's data handling and synchronization capabilities. Using Firebase cloud services, this layer securely manages user profiles, learning records, assessment scores, and app settings. It ensures that data is persistently stored and synchronized across devices, thereby allowing uninterrupted access to user information. Furthermore, the architecture is designed to scale efficiently, making it suitable across schools, educational institutions without compromising performance or reliability. It also facilitates real-time updates, enabling features like push notifications and instant progress tracking. Role-based access ensures that parents, teachers, and administrators can securely view and manage relevant data. The cloud module supports multi-device login, promoting seamless learning continuity across platforms. [8][9]

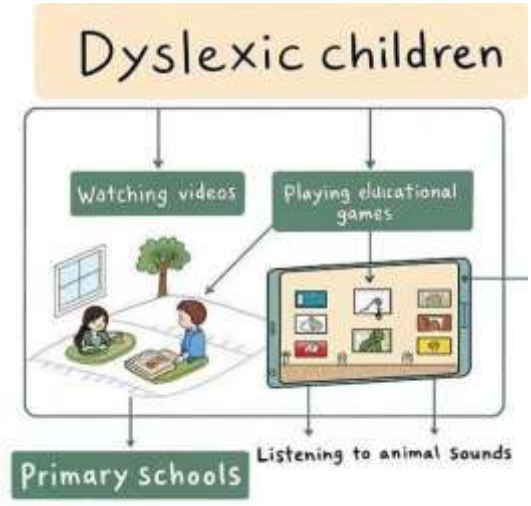

Fig 4.2: System Architecture

As per the fig 4.2, it illustrates a supportive learning environment designed specifically for dyslexic children in primary schools. It highlights how integrating technology and multimedia tools can assist in overcoming learning challenges associated with dyslexia. At the center of the image are two children engaging with educational content through a digital tablet, representing a shift from traditional learning methods to more interactive and inclusive approaches.

One part of the illustration shows children watching videos, which serve as a valuable visual aid for understanding new concepts. These videos simplify complex ideas and present them in a more digestible format, helping dyslexic learners follow along without the stress of decoding written text. Another section focuses on playing educational games. These games are designed to reinforce literacy skills through engaging, hands-on activities that encourage participation and repetition. By presenting tasks in a game format, children stay motivated and can learn at their own pace.[3][9][14]

Additionally, the image shows the use of audio elements, such as listening to animal sounds, to support auditory learning. This feature strengthens sound recognition and phonemic awareness, essential areas for children with dyslexia. The inclusion of familiar and enjoyable content like animal sounds

not only captures attention but also helps form sound-letter associations in a fun and memorable way.

All of these learning methods are set within the context of primary schools, emphasizing the importance of early intervention and accessibility in educational settings. The use of tablets and mobile devices signifies how technology can bridge learning gaps, offering personalized, multisensory experiences that make learning more effective and enjoyable for dyslexic children.

4.2.1 Algorithm

1. Initial Screening

- Evaluates phonics, reading, and comprehension skills through structured tests.
- Uses rule-based logic and pattern recognition to assess risk levels.
- Helps identify early signs of dyslexia before formal diagnosis.

2. Adaptive Learning

- Analyzes performance to adjust content difficulty instantly.
- Updates learning paths to focus on weak areas.

3. Recommendation Engine

- Tracks user behavior and progress to suggest suitable activities.
- Leverages AI insights to personalize learning recommendations.

4. Gamification Layer

- Introduces points, badges, and levels to motivate consistent learning.
- Keeps learners engaged through interactive and rewarding experiences.

5. Real-Time Error Detection

- Detects errors in real-time and gives instant feedback.
- Offers custom fixes based on mistake type.
- Promotes self-correction and learning from mistakes.

6. Multilingual Support

- Supports multiple regional languages for inclusive access.
- Maintains consistent algorithm behavior across all language modes.
- Expands reach to linguistically diverse student populations.

7. Evolution and Scalability

- Uses collected user data to improve detection and personalization.
- Enables long-term scalability across diverse educational settings.

4.3. RESULTS:

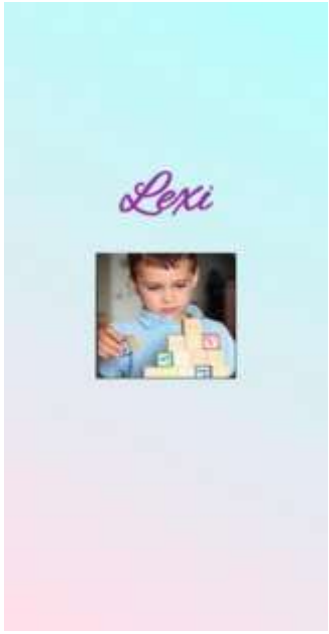

Fig 4.3.1: Splash Screen

As per Fig 4.3.1**,** The splash screen of the Lexi application appears briefly when the app is launched, displaying the app's name and child-friendly graphics designed to create a welcoming and comforting experience for young children with dyslexia.
Implemented in the SplashActivity class, it shows this introductory interface for two seconds before automatically transitioning to the main screen (Module Selection).

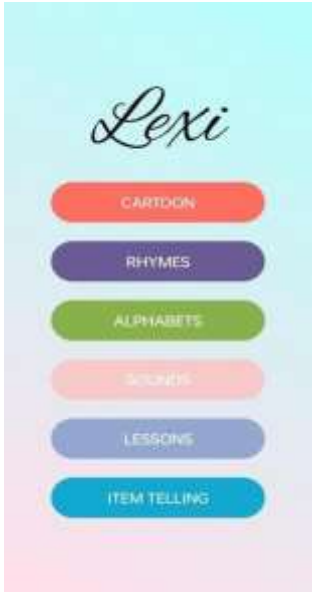

Fig 4.3.2: Module Selection

As per Fig 4.3.2**,** The Module Selection screen is the central navigation interface of the Lexi application. It is designed with a soft, pastel background and colorful buttons, creating an engaging and visually soothing experience for young users, particularly children with dyslexia. This screen presents six distinct learning modules—Cartoon, Rhymes, Alphabets,

Sounds, Lessons, and Item Telling—each represented by a uniquely colored button. Transitions between modules are smooth and animated, adding a playful touch that keeps the learning experience engaging and enjoyable.

Each button is large, clearly labeled, and icon-supported to ensure easy recognition and usability. The layout is intentionally minimalistic to reduce cognitive overload and help users focus on one option at a time. Audio prompts or voice-overs guide children in selecting modules, enhancing accessibility for early or non-readers. The design encourages independent exploration, allowing children to navigate the app confidently with minimal external assistance.

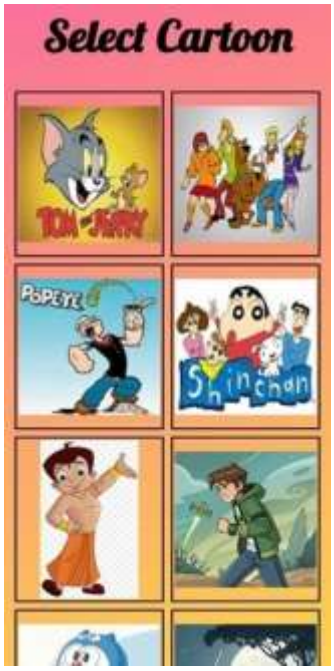

Fig 4.3.3: Cartoon Interface

As per Fig 4.3.3**,** The Cartoon module in the Lexi application serves as an engaging and entertaining learning aid for children with dyslexia. This module provides a visually rich interface that displays a grid of popular cartoon characters such as Tom and Jerry, Scooby-Doo, Popeye, Shinchan, Chhota Bheem, Ben 10, Doraemon, and Ninja Hattori. Each cartoon is represented using an intuitive image button, making it easy for children to recognize and select their favorite shows.

The module is implemented in the Cartoon.java activity. When a user taps on any cartoon image, the app launches the corresponding YouTube video using an Intent. This direct linking to familiar, age-appropriate content helps build a positive association with the app and encourages children to engage more confidently. The use of cartoons not only makes the experience enjoyable but also helps in improving attention span, auditory processing, and language acquisition among dyslexic children. This playful integration of entertainment and education supports Lexi's goal of creating a welcoming and motivating learning environment.

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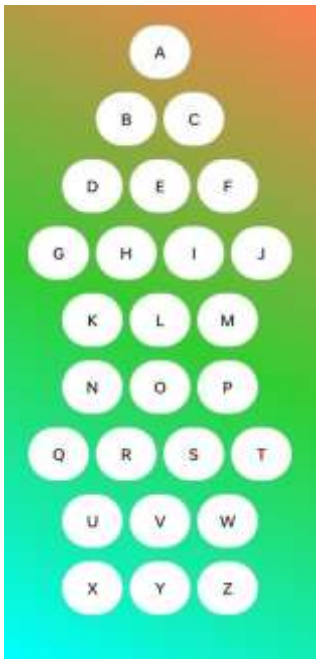

Fig 4.3.4: Alphabets Interface

As per Fig 4.3.4, This Alphabets module in our app is designed to help young children, especially those with dyslexia, learn the English alphabet in an interactive and engaging way. The interface displays all 26 letters (A–Z) arranged neatly in a pyramid pattern on a colorful background. Each letter is placed inside a circular button to make it visually appealing and easy to tap.

When a user taps on any letter, the app uses a speech feature to read aloud phrases like "A for Apple," "B for Ball," and so on. This feature uses a built-in text-to-speech function which helps children hear the correct pronunciation of each word along with the letter. It is especially helpful for children with learning difficulties as it uses sound, visuals, and repetition to reinforce learning.

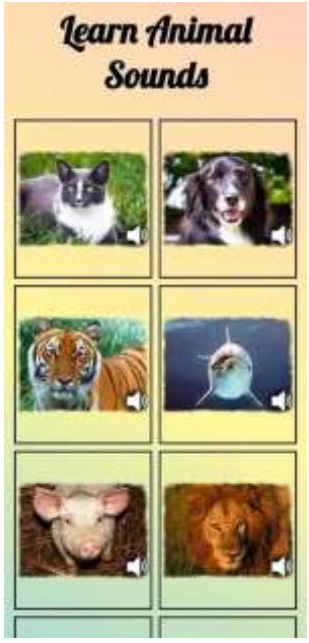

Fig 4.3.5: Animal Audio Module

As per Fig 4.3.5, The Animal Audio module helps children, especially those with dyslexia or learning challenges, learn to identify animals and their sounds. It shows bright images of animals like a cat, dog, tiger, dolphin, pig, lion, elephant, and goat, each with a speaker icon. By linking pictures to sounds, the module improves sound recognition, visual memory, and listening skills.

This multisensory method reduces learning pressure and boosts confidence, making education fun and effective for children with special learning needs. Interactive features like repeat and slow playback allow children to listen at their own pace, reinforcing auditory processing and improving retention.

5 CONCLUSION

This project demonstrates how thoughtfully designed educational technology can support dyslexic children through an inclusive and intelligent mobile application. Acting as both a screening and remedial platform, the app integrates AIbased progress tracking, adaptive curriculum planning, and multimedia learning resources such as phonics games, videos, and interactive assessments. Its child-friendly interface—with large icons, voice prompts, and minimal text—ensures accessibility and independent use, while support for regional languages caters to diverse linguistic backgrounds.[5][7]

The platform empowers parents and educators through a cloud-based dashboard that enables real-time monitoring and timely intervention.

Future enhancements aim to expand the app's capabilities to support other learning disabilities such as dysgraphia and dyscalculia. Planned features include multilingual AI voice assistants, integration with wearable devices for emotional and cognitive monitoring, and advanced machine learning models for personalized learning.[8][9][15]

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