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Lingoleap: A Web Application for Therapy Materials

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ABSTRACT—

Lingoleap is an interactive web application designed to help users improve pronunciation, comprehension, and flu- ency in language learning. Many learners, especially those with speech difficulties, struggle with traditional methods that lack engagement and real-time feedback. To address this, Lingoleap provides structured speech therapy exercises, including quizzes, speech recognition tasks, and listening activities, allowing users to practice and refine their pronunciation in an interactive way. To enhance user engagement, the platform integrates gamification techniques such as streaks encouraging consistent learning. The frontend of Lingoleap is built using Next.js and Tailwind CSS, ensuring a smooth and user-friendly experience, while the back- end is powered by Node.js and Express.js, with MongoDB Atlas for secure and scalable data management.This research explores the effectiveness of Lingoleap in enhancing speech clarity and increasing user engagement. The study examines how interactive tools and gamified learning can improve language skills compared to traditional methods. Additionally, future improvements such as advanced analytics, AI-driven pronunciation feedback, and a dedicated mobile application are considered to further enhance the platform's capabilities.

Index Terms—Speech therapy, language learning, pronunci- ation enhancement, web application, gamification, interactive education.

Introduction

Learning a new language can be challenging, especially when it comes to pronunciation and fluency. Many traditional language learning methods rely on repetitive exercises that may feel boring and ineffective over time. As a result, learners often struggle to stay motivated and engaged.

With the rise of technology, interactive learning tools have become an essential part of education. Lingoleap is designed to make language learning more engaging and effective by com- bining structured speech therapy with gamification techniques. By integrating fun elements like quizzes, speech recognition tasks, and listening exercises, Lingoleap helps users practice pronunciation in an interactive way.

The platform rewards users with streaks encouraging con- sistent learning. It is built using Next.js and Tailwind CSS for a smooth and responsive frontend, while the backend is powered by Node.js and Express.js. The data is stored in MongoDB Atlas, ensuring scalability and security.

This paper explores how Lingoleap enhances language learning by making pronunciation improvement both effective and enjoyable. It also discusses the technical architecture, features, and potential future developments, such as adding advanced analytics and launching a mobile application.

Literature Survey

- **Salanti & Neman (2024)** explored the effectiveness of *tongue twisters* in improving students' English pronun- ciation. Their study, conducted in 30 university students, found that 90% of the participants showed greater in- terest and engagement in learning pronunciation using this method, highlighting its potential as an interactive learning tool.
- **Chiaramonte & Vecchio (2020)** conducted a systematic review and meta-analysis on speech rehabilitation in post- stroke patients with dysarthria. Their findings indicated that speech therapy significantly improved acoustic pa- rameters, particularly *alternating and sequential motion rate (AMR & SMR)* and *maximum phonation time*, high- lighting the effectiveness of rehabilitation in enhancing speech abilities.
- **Kember et al. (2017) and Mankekar (2018)** investigated the use of *tongue twisters* as a diagnostic tool for *evaluat- ing speech disorders* in individuals with *dysarthria*. Their findings indicate that *prosodic emphasis* on specific words reduces speech errors, suggesting that *focused*

pronun- ciation training can enhance articulation. This supports the potential of using *interactive speech applications*, such as Lingoleap, for *real-time speech assessment and improvement*.

- **Greenwell et al. (2022)** explored the application of *tongue twisters* in *speech therapy* for *school-age chil- dren* with *speech-sound disorders*. Their findings suggest that tongue twisters provide an *engaging and effective* approach to improving pronunciation, especially for com- mon speech errors such as W for R, W for L, T for K, D for G, and S for Sh. This supports the idea that *structured repetition and prosody-based exercises* can significantly enhance articulation, aligning with prior research on dysarthria therapy.
- **Saz et al. (2009)** developed a *semi-automated system* for *Computer-Aided Speech and Language Therapy (CASLT)* to assist individuals with speech impairments. Their study evaluated *Automatic Speech Recognition (ASR)* and *Pro- nunciation Verification (PV)* techniques for diagnosing
- and treating *dysarthria*. The findings indicate that ASR and PV systems trained on impaired speech data achieved performance comparable to expert evaluations, supporting their application in *interactive speech therapy* for children and young adults.
- **Belen et al. (2018)** developed *Tingog*, a mobile appli- cation designed for *children with repaired cleft palate* to aid in speech therapy. The system integrates *Speech Recognition* and *Text-to-Speech* technologies to improve pronunciation and reading skills. Their findings indicate that *interactive learning tools* can provide accessible and cost-effective speech therapy, addressing challenges such as the high cost and limited availability of professional speech services.

Methodology

A. System Architecture

Lingoleap is designed using a modular and scalable system architecture, ensuring efficient handling of user interactions, data management, and real-time processing. The architecture consists of three primary components: frontend, backend, and database, each serving a distinct role in the system's functionality and performance

- **Frontend:**The frontend of Lingoleap is developed using Next.js, a React-based framework that enhances perfor- mance through server-side rendering (SSR) and static site generation (SSG). These techniques help in optimizing page load times and improving SEO. The user interface (UI) is designed with Tailwind CSS, which provides a flexible, utility-first approach for responsive and interac- tive design. This ensures a seamless experience across various devices, including desktops, tablets, and mobile phones.
- **Backend:**The backend is implemented using Node.js with Express.js, a lightweight and flexible framework
- .The backend is responsible for processing user in- puts, managing authentication, handling speech recogni- tion tasks, and integrating gamification features such as streaks.
- **Database:** For data storage, Lingoleap utilizes MongoDB Atlas, a cloud-based NoSQL database that ensures scal- ability, reliability, and security. MongoDB's document- oriented structure allows for flexible data modeling, making it well-suited for handling dynamic user data, including speech progress records, quiz results, and user engagement metrics.

B. System Flow

- **Start:** This is the beginning of the process when the user opens the Lingoleap application.
- **Login:** The user needs to enter their details (like user- name and password) to access their account.
- **View Dashboard:** After logging in, the user lands on the dashboard, which shows different options, like pronunci- ation practice, quizzes, and progress tracking.
- **Pronunciation Practice:** The user can practice pronounc- ing words correctly with the help of Lingoleap's tools.
- **Take Quizzes:** To check their learning progress, users can take quizzes related to pronunciation and vocabulary.
- **Update Progress:** After completing practice sessions and quizzes, the user's progress is updated, helping them track improvements.
- **Manage Profile:** The user can edit their personal details, such as name, preferences, or progress history.
- **Logout:** When finished, the user logs out of the applica- tion.
- **End:** The process ends after the user logs out.

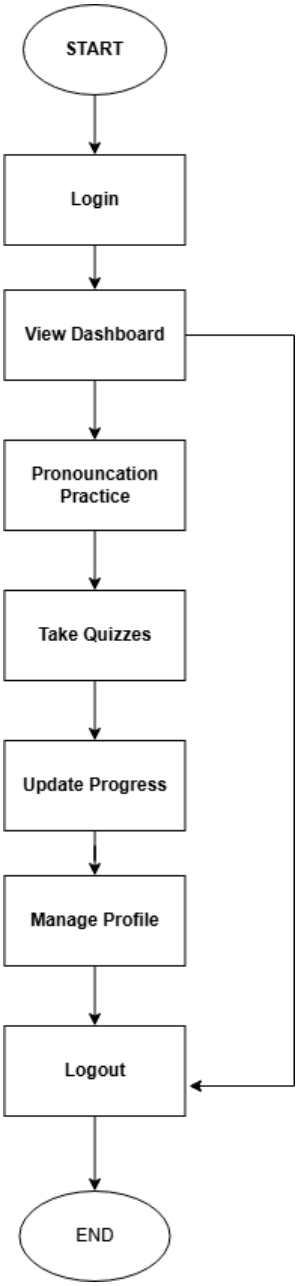


Fig. 1. System Flowchart of Lingoleap

C. Gamification Features

Lingoleap incorporates a range of gamification strategies to enhance user engagement and motivation. By integrating in- teractive elements, the platform ensures an immersive learning experience. The key features include:

- **Learning Modules:** The platform offers structured learn- ing modules categorized into words, characters, tongue twisters, and sentences. These modules help users grad- ually build their pronunciation and fluency skills.
- **Interactive Quizzes:** Users participate in various quizzes, including speaking and listening exercises, to reinforce their learning. The system evaluates pronunciation and listening comprehension in real time.
- **Accuracy Checker:** The platform provides immediate feedback on word pronunciation accuracy. This feature helps users identify areas of improvement.
- **Transcription Feature:** Lingoleap includes a speech- to-text transcription tool that allows users to visualize their spoken words, aiding in pronunciation correction and fluency development.
- **Streak Tracking:** The platform records daily activity and rewards users for maintaining consistent practice, fostering a habit of continuous learning.
- **Scoring System:** A structured scoring mechanism evalu- ates users' performance in exercises and quizzes, offering insights into their progress over time.

D. Backend Working& Pronunciation Accuracy

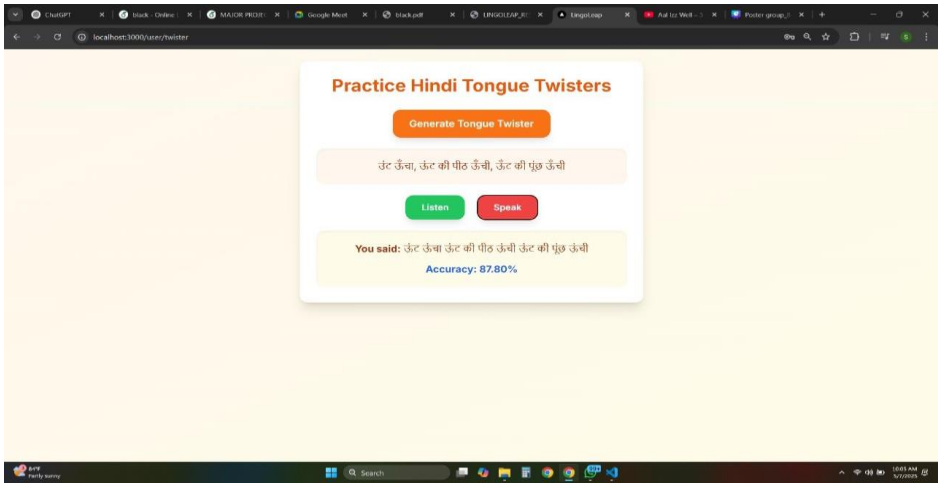
The backend of Lingoleap handles all the logic behind the scenes to make the application function smoothly. It is built using Node.js and Express.js, which together manage tasks like receiving user data, updating progress, and handling login or registration. For the pronunciation checking feature, the actual speech recognition happens on the frontend using the browser's built-in Web Speech API (specifically webkit- SpeechRecognition). This tool listens to the user's voice and converts it into text in real-time, using the Hindi language setting (hi-IN) for accurate transcription. Once the user's spoken input is converted to text, we compare it to the correct word. The method we use is a basic letter-by-letter comparison:

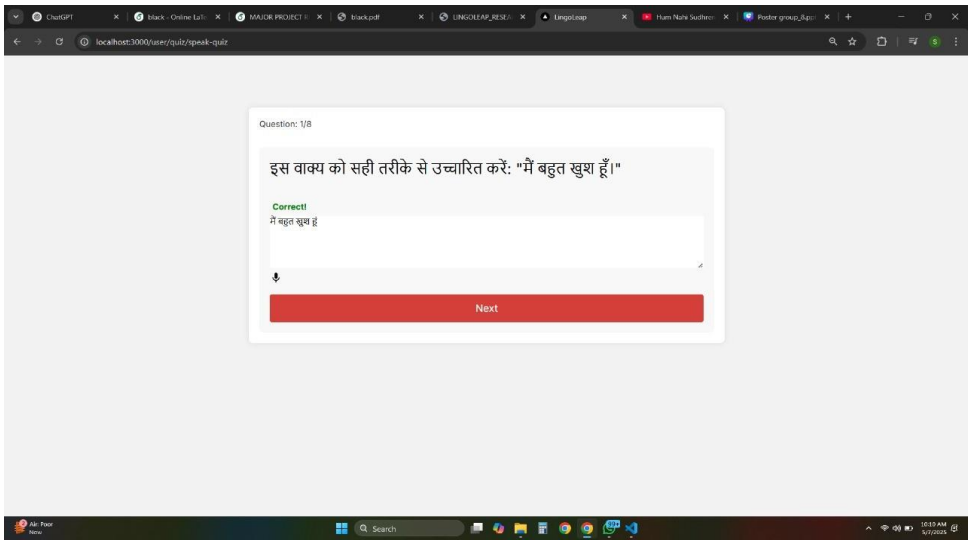
- We split both the correct word and the user's spoken word into individual letters.
- We then compare each letter one by one, in order.
- For every letter that matches in the correct position, we increase the score.
- Finally, we calculate the accuracy percentage by dividing the number of correct letters by the total number of letters in the original word.

This approach helps the user get instant feedback on how accurately they pronounced the word. While it's a simple method, it works well for early learners and real-time practice. These gamification features work collectively to transform language learning into an engaging and rewarding experience, ensuring users stay motivated while improving their pronun- ciation and fluency.

Results and Discussion

Lingoleap demonstrates the potential to enhance pronuncia- tion learning and engagement through its structured approach and gamification features. The interactive learning modules, coupled with real-time feedback, provide users with an intu- itive and effective experience. Preliminary evaluations indicate that the integration of speech recognition and gamification elements creates an engaging learning environment. The ac- curacy checker and transcription features help users identify pronunciation errors .However, certain challenges have been identified, such as variations in speech recognition accuracy due to background noise or differences in pronunciation styles. Future improvements will focus on optimizing recognition algorithms and expanding multilingual support to ensure a seamless learning experience.These findings highlight the ef- fectiveness of Lingoleap's approach and pave the way for future enhancements, including refined speech recognition models and a broader range of interactive exercises.





Conclusion and Future Work

Lingoleap presents a structured and interactive platform designed to enhance pronunciation, comprehension, and flu- ency in language learning. By integrating speech recognition, gamification, and interactive exercises, the platform offers an engaging alternative to traditional learning methods.
Moving forward, several enhancements are planned to fur- ther improve the platform's effectiveness and accessibility:

- **AI-Powered Personalized Learning:** Implementing ma- chine learning algorithms to analyze user performance and provide customized exercises tailored to individual needs.
- **Multilingual Support:** Expanding language options to cater to a more diverse audience, allowing users to practice pronunciation in multiple languages.
- **Mobile Application Development:** Creating a dedicated mobile app to improve accessibility, enabling users to engage with learning materials anytime, anywhere.
- **Enhanced Speech Recognition:** Refining the speech recognition model to handle diverse accents, pronunci- ations, and noisy environments more accurately. These future developments aim to make Lingoleap a more adaptive and comprehensive tool for language learners, ensuring an effective and enjoyable learning experience.

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