



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Language Learning Assistant App

¹Mohasin Nadaf, ²Sanket Maindargikar, ³Sakshee Patil, ⁴Shifa Sayyad, ⁵Aishwarya Chavan

¹²³⁴Student, Dept. of Computer Science and Engg(Data Science), D. Y .Patil College of Engg, Kolhapur, India ,

⁵Assist. Professor, Dept. of Computer Science and Engg(Data Science), D. Y .Patil College of Engg, Kolhapur, India.

Abstract: The Language Learning Assistant App is a comprehensive mobile application designed to address the evolving needs of modern learners by offering a unified platform for acquiring **spoken and sign languages**. It leverages advancements in artificial intelligence and cloud computing to deliver a personalized, inclusive, and engaging learning experience. The application integrates multimodal interaction techniques such as speech recognition, sign language detection, and a conversational **AI chatbot** to cater to diverse user preferences and abilities. Key features include **adaptive learning** paths based on user performance, interactive vocabulary games, real-time quizzes, and **community-driven** learning modules. The inclusion of sign language functionality ensures accessibility for users with hearing impairments, promoting digital inclusivity. The app's backend is powered by scalable cloud services that facilitate real-time content updates, **progress tracking**. This paper delves into the architectural design of the system, explaining its modular components and data flow through diagrams and technical specifications. It further presents performance evaluations based on user testing, highlighting the effectiveness of adaptive techniques in improving retention and engagement. The study concludes with a discussion on the app's societal impact and outlines potential enhancements such as multilingual support, augmented reality features, and integration with educational institutions.

Keywords – Mobile App, Gamification, Language Learning, Sign Language, Adaptive Quiz, Firebase, AI Chatbot, Data Preparation, Feature Engineering, Mobile Learning.

I.INTRODUCTION

This project aims to develop an innovative, inclusive language-learning mobile application that integrates sign language education alongside traditional spoken and written language learning. While mainstream language-learning apps continue to grow in popularity, they often neglect the needs of individuals who are deaf or hard of hearing. This app bridges that gap by recognizing sign language as an essential communication tool, thereby promoting accessibility and equal learning opportunities for all users.

To ensure a rich, engaging, and effective learning experience, the app incorporates several advanced features. Adaptive learning algorithms dynamically tailor content based on the user's performance, ensuring learners are neither overwhelmed nor under-challenged. Gamification elements such as quizzes, badges, achievements, and leaderboards enhance motivation and make the learning process interactive and enjoyable. Social interaction modules foster peer collaboration through discussion forums, group challenges, and chat functionality—creating a connected community of learners.

A major highlight of the application is the integration of a smart, AI-powered chatbot assistant, which enhances user support and acts as a conversational practice partner. This chatbot is powered by the Gemini AI API developed by Google DeepMind. The Gemini API offers cutting-edge natural language understanding capabilities that enable real-time conversation, contextual awareness, and intelligent response generation. The chatbot supports multilingual interactions, helps clarify doubts, explains grammar, and can even simulate real-world conversation scenarios to strengthen communication skills.

To support sign language learners, the app features high-quality video-based tutorials and interactive sign language exercises, ensuring that users from all backgrounds receive equitable educational support. Offline accessibility and a comprehensive performance tracking system empower learners to continue their progress anytime, anywhere making this app not only powerful and inclusive but also convenient and practical.

II. PROPOSED SYSTEM

The proposed system is an inclusive language-learning application that integrates sign language education with traditional spoken and written language lessons. It features high-quality multimedia content and interactive exercises tailored for sign language instruction. Utilizing adaptive learning algorithms, the app personalizes content based on user performance, while gamification elements like quizzes and achievements enhance engagement. Social features, such as forums and chat functionalities, promote community interaction. An intelligent AI-powered chatbot, integrated using the Gemini AI API, acts as a virtual assistant to support learners by answering queries, providing grammar explanations, simulating conversations, and guiding users through lessons in real time. With offline accessibility and performance tracking, the app aims to deliver a comprehensive and engaging learning experience for all users.

III. EXISTING SYSTEM

Many popular language apps, like Duolingo and Babbel, focus only on spoken and written languages. They offer fun lessons and quizzes but do not include sign language. While some apps, like Lingvano and SignSchool, teach sign language, they are not as well-known or interactive. These apps also don't combine spoken and sign language learning in one place. Most current apps also don't adjust lessons based on how well you're doing, which can make learning harder. Some apps require constant internet access, which is a problem for those with limited internet. Community features and offline learning are often missing too. Most platforms don't give personalized feedback to help users improve. These limitations show that there is a need for a more inclusive, adaptive, and engaging language-learning app. A new app could solve these problems and provide a better experience for all learners.

IV. LITERATURE REVIEW

5.1 Computer-Assisted Language Learning (CALL): Computer-Assisted Language Learning (CALL) refers to the use of technology to facilitate and enhance the language learning process. Adaptive learning systems, such as those discussed by War Schauer & Healy (1998), allow learners to progress through content at their own pace, adjusting the difficulty based on their performance. This dynamic approach aids in better retention and understanding, as it targets individual learning needs. CALL systems often integrate multimedia elements like audio, video, and interactive exercises, which can make learning more engaging and provide real-time feedback, helping learners to address gaps in their language skills effectively. The evolution of AI and machine learning in CALL has further personalized learning experiences, offering tailored exercises that respond to a learner's unique challenges.

5.2 Mobile-Assisted Language Learning (MALL): Mobile-Assisted Language Learning (MALL) utilizes mobile devices, such as smartphones and tablets, to support language learning. This approach allows learners to access content anytime and anywhere, making language learning more accessible and flexible. However, as highlighted by Kukulska-Hulme & Shield (2007), MALL systems often lack the peer interaction necessary for fostering a comprehensive learning environment. While mobile apps provide great flexibility, they may miss the element of social interaction that can encourage collaborative learning, motivation, and the development of practical language skills in real-world contexts. Nevertheless, integrating features like chat groups, peer review systems, and virtual classrooms could bridge this gap, enhancing the social dimension of MALL and improving language acquisition through collaborative practice.

5.3 Gamification: Gamification has become a powerful tool in language learning platforms, leveraging game design elements like rewards, points, levels, and challenges to motivate and engage learners. Duolingo, as a prime example, uses gamification techniques to make learning enjoyable and rewarding. Loewen et al. (2019) emphasize that the use of gamification increases user engagement, making language learning feel more like a game than a traditional academic task. This not only enhances motivation but also encourages regular practice, which is essential for language retention. By integrating competition (e.g., leaderboards), achievement systems, and personalized challenges, gamified platforms help learners stay committed to their language learning goals. Moreover, as users advance through the levels, they encounter progressively challenging material, which aligns with adaptive learning principles and promotes skill development.

V. METHODOLOGY

The methodology for the app's functionality is organized into several key components. First, user access and authentication are managed through Firebase Authentication, which ensures secure sign-ups, sign-ins, and role-based access. The system supports multiple login providers, such as email and Google, thereby ensuring data privacy and restricting access to authorized users.

The user interface layer features a centralized dashboard that serves as the hub for users, displaying essential information such as lesson and quiz progress, achievements, personalized suggestions, and notifications. This design provides users with a comprehensive overview of their learning journey.

Core learning modules consist of modular, multimedia-enhanced lessons that are structured for either sequential or adaptive learning. Quizzes are integrated within the lessons or presented as standalone assessments, offering immediate feedback and tracking user performance. To enhance motivation, gamification elements, including badges and levels, reward users for their progress. A robust progress tracking system records user advancement in real-time, ensuring that the dashboard and backend are updated accordingly.

Interactive and social learning features further enhance user engagement. An AI-powered chatbot assists users with content navigation and support, utilizing natural language processing for intelligent responses. The app facilitates peer-to-peer chats and instructor communication to promote collaborative learning. Community forums enable group discussions, Q&A threads, and resource sharing, while social features such as user profiles and activity feeds encourage interaction among users.

The backend infrastructure leverages Firebase services for secure data storage, encompassing user data, chat logs, lesson content, and analytics, which ensures fast and scalable access. Offline syncing capabilities allow users to continue learning in low or no-internet environments by caching progress and updating data once reconnected.

The data flow begins with user login through Firebase Authentication, followed by the retrieval of lesson and quiz data from Firebase Storage. User activity, such as quiz attempts and chat messages, is saved in real-time, and the dashboard reflects updated data immediately. Offline actions are stored locally and synced to Firebase upon reconnection.

Finally, the app is built on Firebase's cloud infrastructure, designed for horizontal scalability. It incorporates secure data management practices, including encrypted storage and real-time access control, to protect user information. This systematic approach ensures a comprehensive, user-friendly, and secure language-learning application that effectively meets the needs of diverse learners.

VI. SYSTEM ARCHITECHTURE

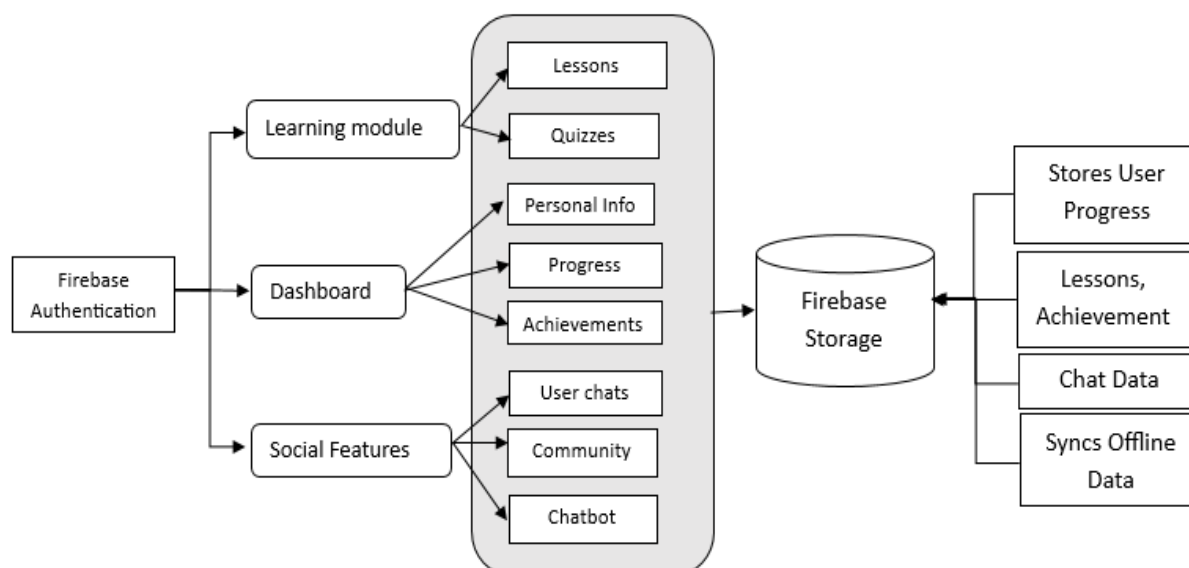


Fig 1. System Architecture of language learning assistant app

This DFD diagram shows a simple interaction between the user and the learning system. The user provides their performance input (such as quiz answers or activity results) to the learning system. The system then processes this input and sends performance tracking data back to the user, helping them monitor their learning progress. This creates a feedback loop that supports personalized learning and improvement.

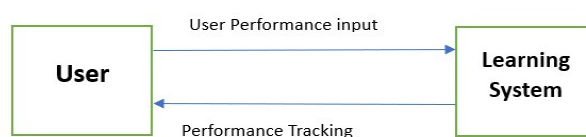


Fig 2. Data Flow Diagram Level 0

The Level 1 Data Flow Diagram represents the internal workings of a language learning application. The user begins by logging in using their Google account. This login request is sent to Firebase, which handles the authentication process. Once authenticated, the user is granted access to the application. From the main application, the user can navigate to their profile page or enter the language learning module. The profile page allows them to view their details and includes a sign-out option.

Within the language learning module, the user can interact with two main processes: "Set the Level" and "Quiz and Vocabulary." The "Set the Level" process allows users to choose their learning difficulty, which then influences the content shown in both the learning module and the quizzes. The "Quiz and Vocabulary" process provides exercises and vocabulary tests based on the selected level. Performance data from these quizzes is stored back in Firebase, ensuring progress is tracked and personalized. Overall, the DFD illustrates how data flows through authentication, user interaction, learning modules, and back-end storage using Firebase services.

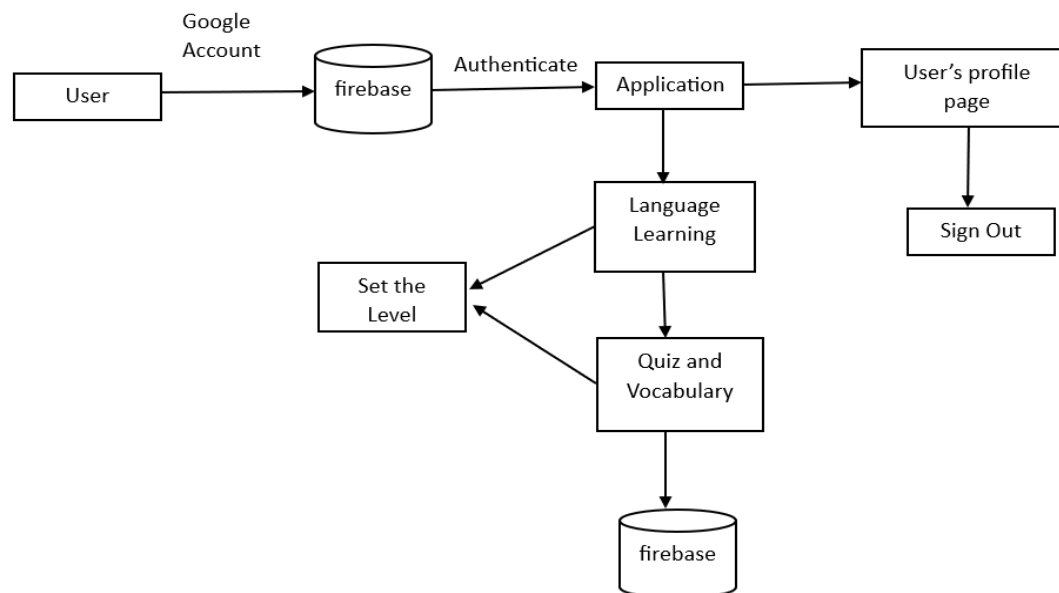


Fig 3. Data Flow Diagram Level 1

DFD Level 2 displays the user provides text or voice input to the Chatbot (Gemini AI), which processes the input and sends it to the API for generating an appropriate AI response. The response is then returned from the API back to the Chatbot. The Chatbot also records the chat history and forwards it to the Quiz Engine for context-aware question generation. The Quiz Engine and Vocabulary Trainer interact by exchanging questions and answers to facilitate vocabulary learning. Meanwhile, the API and Firebase Database continuously exchange data for storing and retrieving user information, scores, and learning progress, ensuring smooth and intelligent functioning of the overall system.

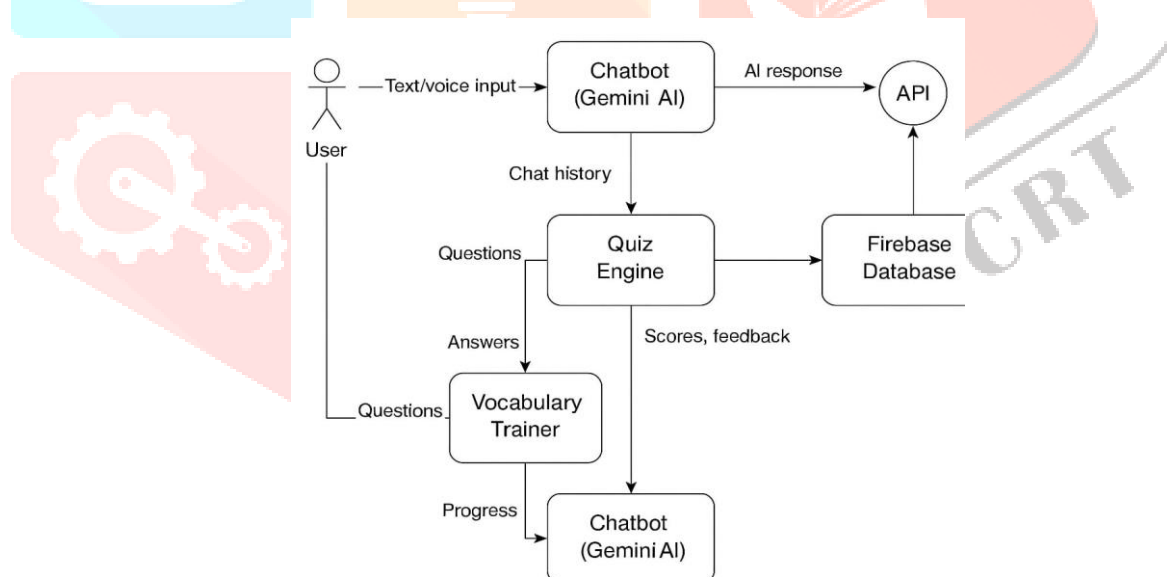


Fig 4. Data Flow Diagram Level 2

VII. IMPLEMENTATION DETAILS

1. Google Sign-In (Authentication)

- Firebase Authentication is used to handle user sign-up and login via Google Sign-In.
- The Firebase SDK is integrated to manage user sessions and securely store user credentials.
- Flow: On first login, user information is stored in Firebase, and a unique user ID is generated for personalized experiences.

2. Sign Language Module

- Lessons: Covers A–Z signs and common phrases (e.g., greetings); video content is stored in Firebase Cloud Storage.
- Interactive Quizzes: AI-based recognition system compares user inputs with correct signs.
- Offline Access: Lessons and videos are stored locally on the device via BLOB storage.
- UI/UX: Clean and intuitive interface for video learning, practice, and feedback.

3. Spoken Language Module

- Lessons: Basic English and Spanish vocabulary (nouns, verbs, adjectives) stored in Firestore.
- Quizzes: Adaptive multiple-choice quizzes based on vocabulary.
- Speech Recognition: (Upcoming feature) Users can practice pronunciation and receive real-time feedback.

4. Gamification Module

- Rewards System: Users earn badges and points for completing lessons and quizzes.
- Leaderboard: Displays global rankings based on user progress.
- Profile: Shows earned rewards, total points, and lesson progress.
- Database: Progress and rewards are stored in Firestore.

5. Adaptive Learning

- Quiz Adjustment: The app dynamically adjusts quiz difficulty based on performance metrics (accuracy, response time).
- Backend Logic: Firebase Functions track performance and update future question difficulty accordingly.

6. Offline Access

- Local Storage: All learning content is cached locally for offline usage.
- Data Sync: On reconnection, offline data (e.g., quiz results) is synced with Firebase.

7. Progress Tracking Module

- User Dashboard: Personalized overview of completed lessons, earned badges, and learning statistics.
- Firebase Analytics: Tracks usage, lesson completion, and quiz performance, displaying detailed progress reports.

8. Notifications

- Push Notifications: Powered by Firebase Cloud Messaging (FCM) to inform users about new lessons, reminders, and leaderboard changes.
- User Preferences: Users can configure notification types (e.g., progress alerts, daily reminders).

9. Social Features Module

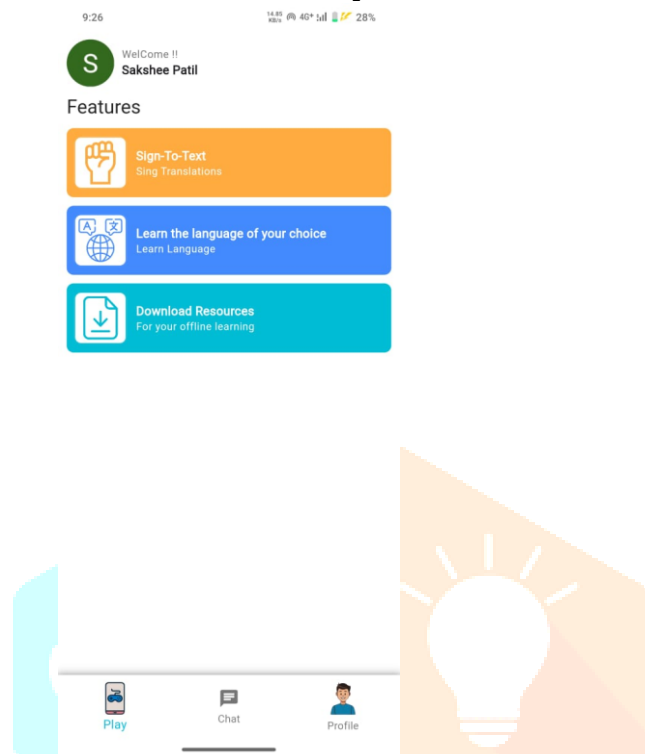
- User-to-User Chat:
 - Users can send and receive real-time messages using Firebase Firestore or Firebase Realtime Database.
 - Integrated with GetX (Flutter) for efficient state management and real-time UI updates.
 - Each user has a unique chat ID for 1-to-1 messaging.
- Community Forum:
 - A community section where users can post questions, share insights, and discuss topics.
 - Posts and comments stored in Firestore, allowing thread-based discussions.
 - Topics include: Language Learning Tips, Sign Language Practice, Grammar Help, etc.
- Chatbot Assistant:
 - Integrated using Gemini AI's GPT API to provide conversational learning support.
 - Features: Vocabulary definitions, grammar explanations, phrase translations. Roleplay conversations for practice (e.g., ordering food, introducing yourself). API calls managed securely using a backend service or Firebase Functions to protect the Gemini AI API key.

VIII. RESULT ANALYSIS

1. Screenshots

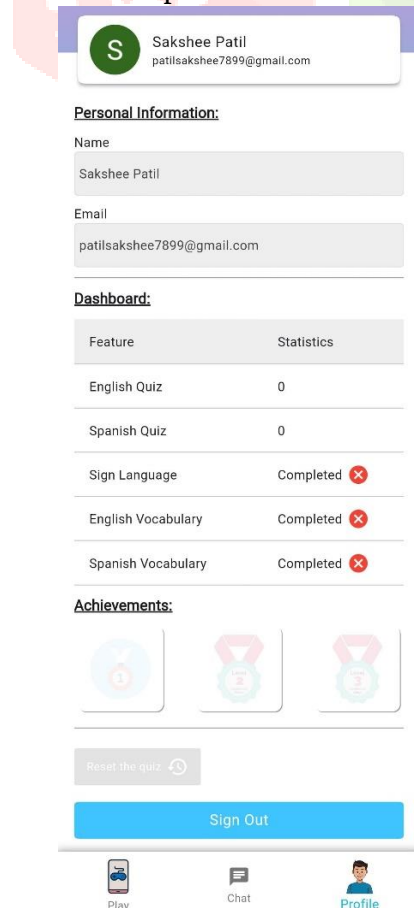
- Home Screen

Displays options for spoken and sign language learning. Simple, user-friendly layout with easy access to lessons, chat, and profile.



- Profile Screen

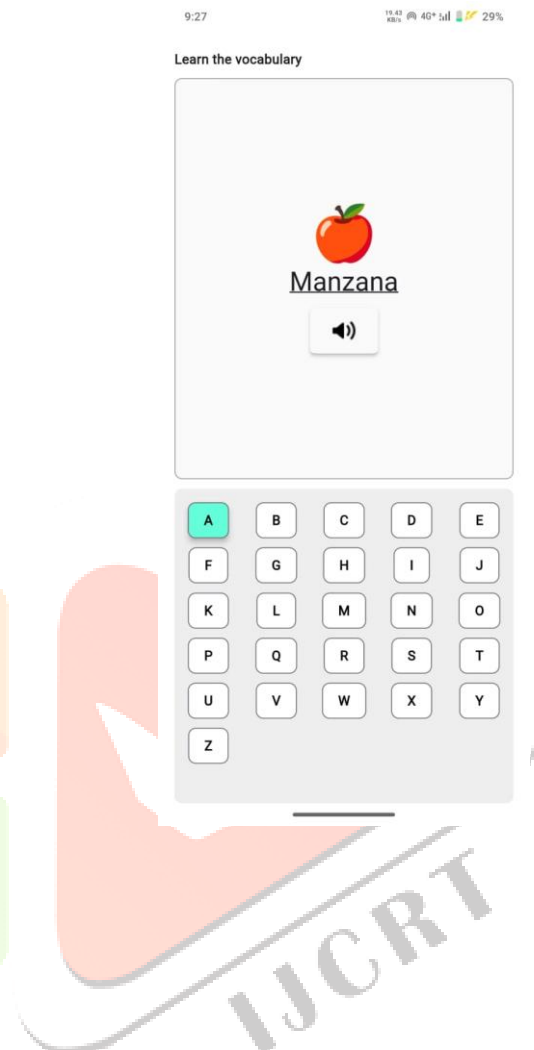
Shows user progress, badges earned, and lesson performance—helping learners stay motivated and track improvement.



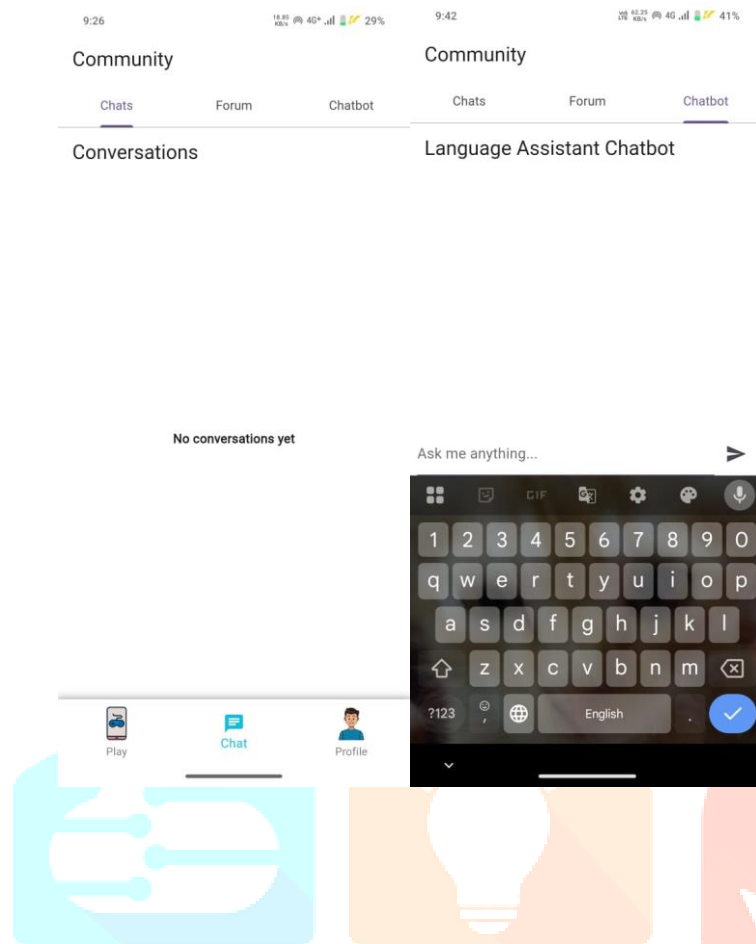
- Quiz Interface
Adaptive questions based on previous answers demonstrate AI-driven learning that adjusts to the user's level.



- Vocabulary Interface
Combines image, audio, and typing for effective language practice in a gamified style.



- Chat interface



2. Performance Metrics

- **Quiz Accuracy**
The app accurately tracks user performance and adjusts quiz difficulty, improving learning effectiveness through personalization.
- **Loading Times**
Quick loading of lessons, quizzes, and transitions between screens ensures a smooth and responsive user experience.
- **User Engagement**
Gamified elements like badge and interactive learning screens help maintain user interest and increase daily retention.
- **Offline Access**
Downloadable resources function smoothly without internet, supporting continuous learning in low-connectivity areas.
- **System Responsiveness**
Interactive elements such as quizzes and typing tasks respond in real time, with no noticeable lag.

IX. FUTURE ENHANCEMENT

To enhance the language-learning application, several key features are proposed. First, the language library will be expanded to support a wider range of regional and international spoken and sign languages, promoting inclusivity. Integrating voice and pronunciation training with speech recognition will provide real-time feedback, helping users improve their speaking skills. The chatbot will be upgraded to a smart AI tutor, utilizing advanced natural language processing for deeper interactions.

Gamification upgrades will introduce more achievements, challenge modes, and daily learning streaks to boost user engagement. An instructor panel will allow educators to create custom courses, monitor student performance, and interact with learners via chat. Additionally, cloud synchronization and multi-device support will enable users to access their progress seamlessly across devices.

Accessibility enhancements will ensure inclusivity for visually and hearing-impaired users. Data analytics dashboards will help learners track their performance and identify areas for improvement. Finally, cross-platform support will be expanded to include iOS and web platforms, ensuring unified user accounts and seamless syncing. These improvements will significantly enhance the app's functionality and user experience.

X. CONCLUSION

The Language Learning Assistant App is a complete, interactive mobile application designed to make language learning inclusive, adaptive, and accessible. By combining spoken language lessons with sign language support, the app fills a major gap left by most current solutions. It leverages Firebase for real-time data handling, secure authentication, and progress tracking, while incorporating features like gamification, adaptive quizzes, multilingual content, and chatbot support to enhance the user experience. The app enables learners to progress at their own pace, even offline, while also promoting community interaction through chat features. It demonstrates the practical integration of machine learning, cloud services, and educational design principles into a single, usable product. The app is scalable and ready for further development, making it a strong foundation for future language education tools.

XI. REFERENCES

- [1] Kukulska-Hulme, A. (2006). Mobile language learning now and in the future. In Svensson, P. (Ed.) From vision to practice: language learning and IT. Sweden : Swedish Net University, 295- 310.
- [2] Kukulska-Hulme, A., & Shield, L. (2008). An Overview of Mobile Assisted Language Learning: from content delivery to supported collaboration and interaction. ReCALL, 20(3), 249-252. Retrieved July 20, 2015.
- [3] Kukulska-Hulme, A. (2012). Language learning defined by time and place: A framework for next generation designs. In Diaz-Vera, Javier, E. (Eds.) Left to my own device: Learner autonomy and mobile assisted language learning. Innovation and Leadership in English Language Teaching, 6, Bingley, UK: Emerald Group Publishing
- [4] Levy, M. (2009). Technologies in use for second language learning. The Modern
- [5] Pachler, N., Bachmair, B., & Cook, J. (2010). Mobile learning: Structures, agency, practices. London, United Kingdom: Springer.
- [6] <https://ieeexplore.ieee.org/document/8286047>