Signalyze

Niharika Jat
COMPUTER SCIENCE AND ENGINEERING
Acropolis institute of technology and research
Indore, India
niharikajat210153@acropolis.in

Sakshi Pachlaniya
COMPUTER SCIENCE AND ENGINEERING
Acropolis institute of technology and research
Indore, India
sakshipachlaniya210114@acropolis.in

Manvi Choudhary
COMPUTER SCIENCE AND ENGINEERING
Acropolis institute of technology and research
Indore, India
manvichoudhary210100@acropolis.in

Riya Pillai
COMPUTER SCIENCE AND ENGINEERING
Acropolis institute of technology and research
Indore, India
riyapillai210806@acropolis.in

Rashi Malviya
COMPUTER SCIENCE AND ENGINEERING
Acropolis institute of technology and research
Indore, India
rashimalviya210210@acropolis.in

Abstract— **Signalyze is an innovative platform aimed at bridging communication gaps between sign language users and those unfamiliar with it. By utilizing real-time, AI-driven gesture recognition and translation, Signalyze provides users with immediate and precise translations, supporting communication across varied sign languages. This project seeks to improve inclusivity and accessibility, enabling smoother interactions for the deaf and hard-of-hearing community. Signalyze focuses on real-time performance, adaptive recognition of signing styles, and a user-centric design to ensure reliable communication in diverse settings.**

Keywords— **Sign language, real-time translation, AI-driven feedback, gesture recognition, inclusivity, accessibility.**

I. INTRODUCTION

Signalyze represents an advanced solution to enhance communication between sign language users and non-signers. Existing tools fall short in delivering real-time, accurate sign language translations, often limiting interactions to text transcription without support for nuanced gestures or multiple languages. Signalyze combines AI-driven gesture analysis with a user-friendly interface, offering live translation of sign language to bridge these communication gaps. The platform's objective is to increase accessibility, supporting varied regional sign languages and adapting to unique signing styles.

By enabling real-time, reliable translation, Signalyze empowers users to connect seamlessly, fostering inclusivity and improving the quality of communication for the deaf community.

II. PROBLEM FORMULATION

The current solutions for sign language recognition face several constraints:

Limited Real-Time Feedback: Few platforms provide instant, precise translations, resulting in delays and communication breakdowns.

Language Constraints: Most tools only support one language, limiting accessibility across linguistic backgrounds.

High Costs and Hardware Requirements: Many platforms require specific devices or subscriptions, reducing accessibility.

Restricted Gesture Adaptability: Existing systems struggle to recognize varied signing styles and gestures.

Signalyze addresses these limitations by creating a scalable, cost-effective platform with multilingual support and adaptive gesture recognition, making it an accessible solution for diverse users.

III. LITERATURE REVIEW

Several sign language translation tools have been evaluated to understand their limitations in providing comprehensive solutions:

A. Google Live Transcribe Limitations: Primarily focused on spoken language transcription, without sign language recognition support.

B. *Ava Limitations:* Offers speech-to-text transcription but lacks the ability to recognize or translate sign language gestures.

C. *SignAll Limitations:* While offering sign language recognition, it is hardware-dependent and limited to specific sign languages.

IV. METHODOLOGY

Signalyze follows a structured methodology to ensure reliability, accuracy, and ease of use.

A. Project Initiation

Objective Definition: Define key objectives, including real-time gesture recognition and multilingual support.

Stakeholder Communication: Establish communication channels with stakeholders to align project expectations.

B. Market Research

User Analysis: Identify the needs of deaf and hard-of-hearing users.

Platform Evaluation: Assess existing tools to identify necessary features that improve user experience and accuracy.

C. Requirement Gathering

Feature Prioritization: Emphasize real-time gesture recognition, user interface design, and language adaptability.

D. Design and Architecture

System Architecture: Develop a responsive architecture with seamless backend integration for efficient gesture recognition.

User Interface: Design an intuitive, accessible interface that provides real-time feedback and visualizations.

E. Technology Stack Selection

Frontend: JavaScript and HTML/CSS for a responsive and accessible interface.

Computer Vision: MediaPipe for hand and gesture detection, OpenCV for real-time processing.

Machine Learning: Scikit-learn for gesture classification using extracted features.

F. Development

Frontend Implementation: Build components for real-time video processing and gesture visualization.

Backend and AI Integration: Integrate AI models for gesture recognition, hand tracking, and response feedback.

G. Testing

Unit Testing: Conduct modular testing for accuracy and performance.

System and Scalability Testing: Ensure the platform can handle high-traffic scenarios and varied lighting conditions.

H. Deployment

Hosting: Deploy on cloud platforms, ensuring accessibility and reliability.

Performance Monitoring: Set up monitoring systems to track performance and user engagement.

I. Feedback and Iteration

User Feedback: Regularly gather feedback from users to refine and improve gesture accuracy and interface usability.

Updates: Plan for ongoing updates to expand language support and optimize gesture recognition.

J. Maintenance and Support

Regular Monitoring: Address any issues through continuous monitoring.

Periodic Updates: Regularly update the platform to maintain performance, accuracy, and data security.

This methodology ensures Signalyze remains user-focused, scalable, and capable of providing an inclusive communication experience.

V. RESULT DISCUSSIONS

A. Addressing Existing System Limitations:

Signalyze overcomes several common limitations of existing communication tools for the deaf and hard-of-hearing community, such as the lack of real-time sign language recognition and limited gesture accuracy. By providing immediate translation of gestures into text or speech, Signalyze addresses these gaps, offering a more inclusive and reliable solution.

B. User-Centric Design:

The platform's intuitive design prioritizes user experience, with simple navigation that allows users to easily access translation features. Visual feedback for detected gestures ensures a seamless interaction, empowering users to engage with the system confidently and independently.

C. Real-Time Feedback and Analytics:

Signalyze's AI-driven recognition system delivers instant, precise translations of sign language gestures, accommodating various signing styles and speeds. This real-time feedback significantly enhances communication flow and supports continuous, dynamic interactions between sign language users and non-users.

D. Enhanced Data Management:

The platform's use of MongoDB for data management ensures efficient storage and retrieval of user data, while Flask backend integration provides secure and fast processing. Signalyze also prioritizes user security with secure authentication measures, ensuring safe and reliable access to the platform.

E. Scalability and Accessibility:

Signalyze was designed to support accessibility and scalability, providing a responsive experience across devices, which aligns with the description of scalability and accessibility in this section.

F. Comparative Advantage:

This points to the unique aspects of *Signalyze*, such as its high accuracy and real-time translation capabilities, positioning it as superior to other systems that lack these features.

G. Future Implications:

The potential for *Signalyze* to grow and adapt with additional gestures and expanded features is reflected here, envisioning how it could become an essential tool in bridging communication gaps for a global audience.

VI. CONCLUSION

Signalyze significantly improves communication accessibility for the deaf and hard-of-hearing community by providing a real-time, AI-driven sign language translation platform. Unlike traditional tools that often lack gesture recognition capabilities, Signalyze delivers immediate and accurate translations from sign language gestures to text or speech, enabling effective communication for users in various environments. This system's intuitive design, featuring a user-friendly dashboard, real-time gesture feedback, and customizable settings, ensures a seamless and accessible experience for users.

With MongoDB for data management and secure user authentication via Flask, Signalyze upholds high standards of performance and data protection. The platform's responsive, adaptable architecture supports scalability, making it capable of serving a global audience. By offering reliable, real-time translation and a responsive interface, Signalyze sets a new standard for sign language translation tools, empowering sign language users and fostering a more inclusive society

REFERENCES

[1] OpenCV Documentation. Available: https://opencv.org/

[2] Mediapipe Hands Documentation. Available: https://google.github.io/mediapipe/solutions/hands
Available: https://www.postgresql.org/docs/

[3] Scikit-Learn Documentation. Available: https://scikit-learn.org/

[4] Flask Documentation. Available: https://flask.palletsprojects.com/