



Signify Connect: An AI Based Mobile Assistive Systems For Sign Language Recognition

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Abstract

The present study focuses on a comprehensive stream hydrography analysis of the Thoppaiyar sub-basin, a significant tributary system of the Cauvery basin located in Tamil Nadu, India. The analysis integrates morphometric evaluation, hydrograph interpretation, and geospatial techniques to assess the hydrological behavior of the basin for sustainable development. The basin is characterized by dendritic to sub-dendritic drainage patterns developed over Precambrian crystalline formations, indicating minimal structural disturbance and relatively homogeneous lithology. Quantitative morphometric parameters such as stream order, drainage density, bifurcation ratio, elongation ratio, and relief characteristics were derived using GIS and remote sensing data, particularly Digital Elevation Models (DEM). Hydrograph analysis reveals that the basin exhibits a rapid hydrological response to rainfall, with a steep rising limb, short lag time, and high peak discharge, suggesting low infiltration capacity and significant surface runoff. The recession limb is relatively steep, indicating limited groundwater storage and baseflow contribution. These characteristics reflect the semi-arid climatic conditions, sparse vegetation cover, and soil properties of the basin. Spatial analysis of slope, land use/land cover, and drainage distribution further highlights areas prone to soil erosion, runoff concentration, and water scarcity. The study emphasizes the importance of integrating hydrography with watershed management practices such as artificial recharge structures, check dams, afforestation, and sustainable land use planning. The delineation of micro-watersheds enables prioritization of critical zones for intervention. The results demonstrate that scientific hydrography analysis can significantly contribute to sustainable basin development by improving water resource management, minimizing flood risks, enhancing groundwater recharge, and maintaining ecological balance. This research provides a valuable framework for regional planning and can be applied to similar semi-arid basins across India.

Keywords: Stream hydrograph, Eco-hydrology, Aquatic ecosystems, Biological response, Cauvery river system, Watershed management

1. Introduction

Individuals with speech and hearing impairments rely on non-verbal communication methods, primarily sign language, which is not universally known or interpreted by society. This gap creates social, educational, and professional barriers for mute and deaf individuals. While early assistive systems offered basic voice & images or text-to-speech support, they lacked scalability, contextual understanding, and real-time performance [1-5]. The rapid development of AI-driven technologies—such as convolutional neural networks (CNNs), transformers, multimodal learning, and lightweight mobile AI—has enabled more sophisticated

communication tools. These advancements form the foundation of Signify Connect: a proposed multimodal communication framework that integrates gesture analysis, semantic interpretation, natural language processing (NLP), and speech synthesis. Recent advancements in artificial intelligence have enabled computer vision and gesture-recognition systems capable of interpreting hand movements, body language, and facial expressions [6-8]. Main objective is to make them understand the sign language benefits. Signify Connect aspires to create an inclusive communication bridge that promotes equality, accessibility, and

empowerment for the deaf & mute. Shown in Figure 1.

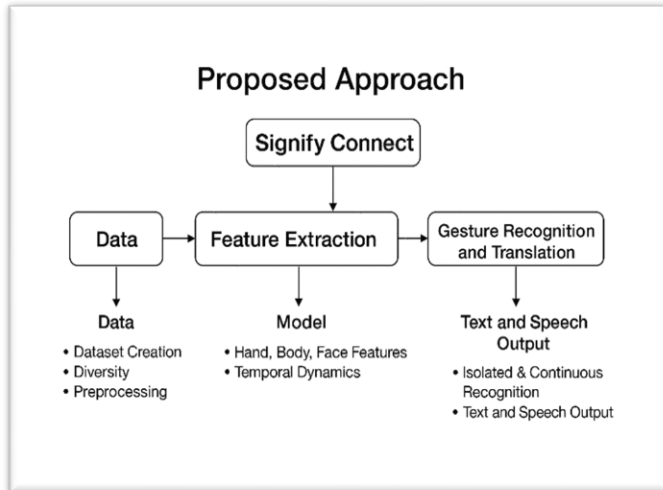


Figure 1 Flowchart of Signify Connect

2. Literature Review

2.1. Gayathri D. et al. (2024) proposed a vision-based machine learning approach for Indian Sign Language (ISL) recognition using Convolutional Neural Networks. A custom dataset was created by capturing ISL through a webcam and applying preprocessing steps such as hand segmentation, resizing, and normalization.

2.2. Elvin Lalsiambul Hmar et al. (2025) presented a comprehensive survey of sign language recognition research covering more than 100 studies published between 2018 and 2024 [9-12]. The survey analyses various techniques including CNNs, RNNs, LSTMs, and Transformer-based models, along with datasets and real-world applications.

2.3. Singhal R. et al. (2023) proposed the Cross-Modal Contextualized Sequence Transduction framework for continuous sign language recognition. The model integrates with linguistic context to improve sentence-level recognition.

2.4. Verma V. and Patil S. (2025) developed a Vision Transformer-based conversational agent for real-time Indian Sign Language accessibility in e-governance systems. The

model supports both isolated and continuous ISL recognition and adapts to domain-specific vocabulary used in government services.

2.5. Research Gap

- Limited datasets for continuous sign language, especially for Indian Sign Language (ISL) & American Sign Language (ASL).
- High computational cost for real-time deployment on mobile device.
- Lack of standardized global sign language representations [13-18].
- ISL datasets are still developing.

3. Methodology

3.1. Proposed System

- Provides real time text and voice output.
- Works on mobile devices using Flutter.
- Can be extended for multiple sign languages such as ASL & ISL.
- Helps in improving communication between deaf/mute individuals. Shown in Figure 2.

3.2. Experimental Setup

The selected studies were grouped into:

- Training dataset size.
- Model Training process.
- Testing Method.

3.3. System Architecture

3.3.1 Hardware

- Images of ASL & ISL sign language.
- Mobile phone is connected to the laptop.
- Laptop is connected to internet/Wi-Fi.

3.3.2 Software

- Flutter is used in Frontend program.
- Node.js is used in Backend program.
- MongoDB is used in Database program.
- Tensor Flow is used in Machine Learning program.

3.3.3 Dataset

- American Sign Language (ASL) dataset are used.
- Indian Sign Language (ISL) dataset are used.

3.3.4 Flowchart

Working flowchart of Signify Connect for System Architecture:

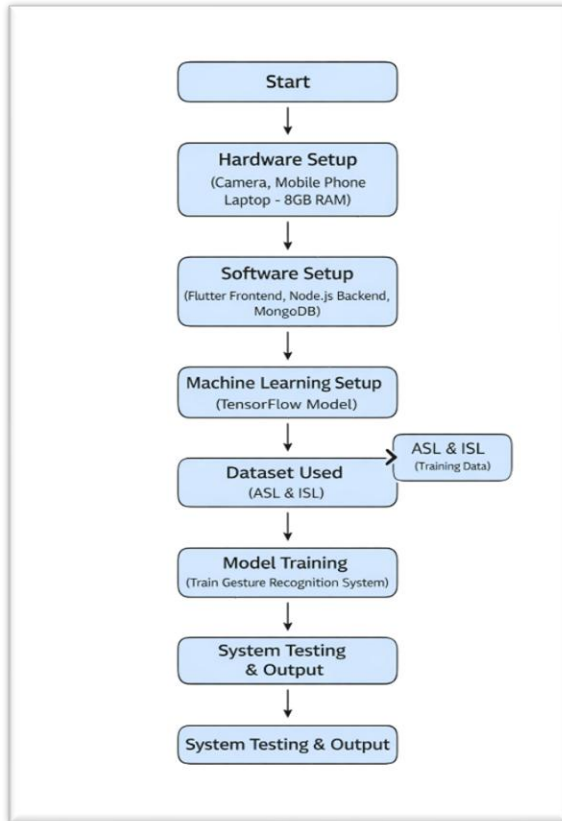


Figure 2 Architecture of Signify connect

4. Result and Discussion

4.1.Results

- The system was implemented using Tensor flow [19-25].
- 2.The mobile application developed using Flutter.
- 3.MongoDB and Node.js are used for voice and text output.

4.2.Experimental Results

- 1.Traditional image processing methods: 85%
- 2.CNN based Recognition model: 92%
- 3.Proposed System: 94-96%

4.3.Discussion

- 1.Real time voice and text output are used.
- 2.Context-aware sentence formation using transformer models
- 3.Multimodal detection of ASL & ISL

sign language recognition.

- 4.Offline capability for rural deployment.
- 5.Multilingual speech output for cross-cultural communication.
- Object detection system is also implemented in the program to detect & recognize the image detected is ASL or ISL image of sign language.

Conclusion and Future Work

Conclusion

This research presented a real time sign language recognition system designed to assist communication between deaf and mute peoples. The proposed system uses a mobile based platform developed with flutter and integrated deep module for learning [26-30]. The backend through Node.JS and frontend through MongoDB for recognition of ASL & ISL sign language images and convert them to voice and text output for quiz learning platform. Shown in Figure 3.

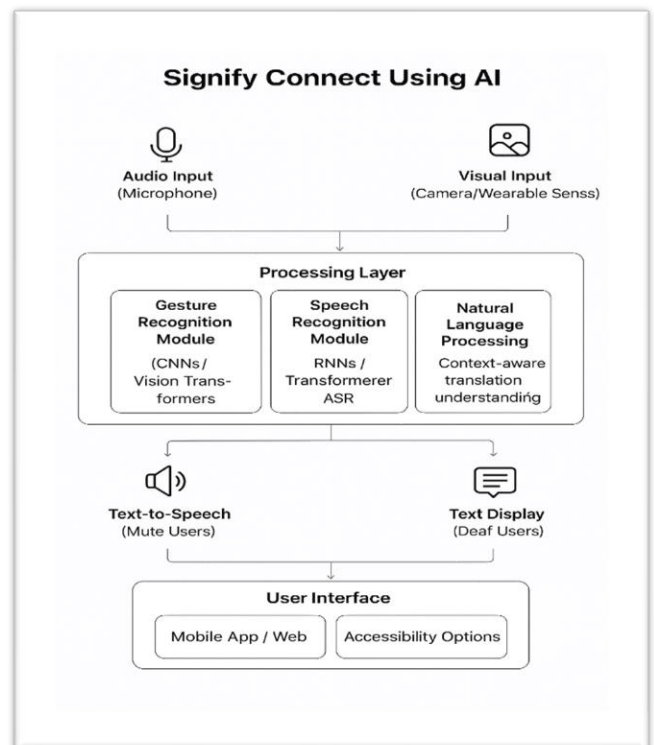


Figure 3 Signify Connect Text and Voice Output

Future Work

- The system can be extended to support continuous sign language recognition



sentences of ASL & ISL.

- Integration of voice and text output can allow to understand properly for better communication.
- Developing energy-efficient AI architectures for low-cost devices
- Model can be trained with larger and more diverse datasets to be converted for better voice communication.
- Integrating quiz-based learning platform of ASL & ISL sign images for better understanding,
- The system can be integrated with smart wearable devices.

Novelty

- 1. Mobile Based Recognition System.
- 2. Real Time Sign Language Recognition.
- 3. Multiple Language support like ASL & ISL.

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