M.Kumarasamy College of Engineering
NAAC Accredited Autonomous Institution
Approved by AICTE & Affiliated to Anna University
ISO 9001:2015 Certified Institution
Thalavapalayam, Karur - 639 113, TAMILNADU.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE

(18AIP302L) MINOR PROJECT IV - FINAL REVIEW

Class : III AIDS

Team No : 17

Date : 12.05.2025

WordsUrActs (WUA) Real-Time Sign Language Translation System

TEAM MEMBERS

DHARSAN K (927622BAD010)

GURUTHARAN C (927622BAD015)

RITHISH R M (927622BAD046)

Dr. K. V. NITHYA M. Sc. , M. Phil., Ph. D

Name of the Supervisor

Objectives of the Project

Real-Time Translation: Converts spoken language into Indian Sign Language (ISL) using NLP, speech recognition, and 3D animation for seamless communication.

Expressive Sign Representation: Utilizes speech-to-text APIs, motion capture, and keyframe animation to create natural and intuitive sign language gestures.

Enhanced Inclusivity: Empowers individuals with hearing and speech disabilities by providing equal access to communication and professional opportunities.

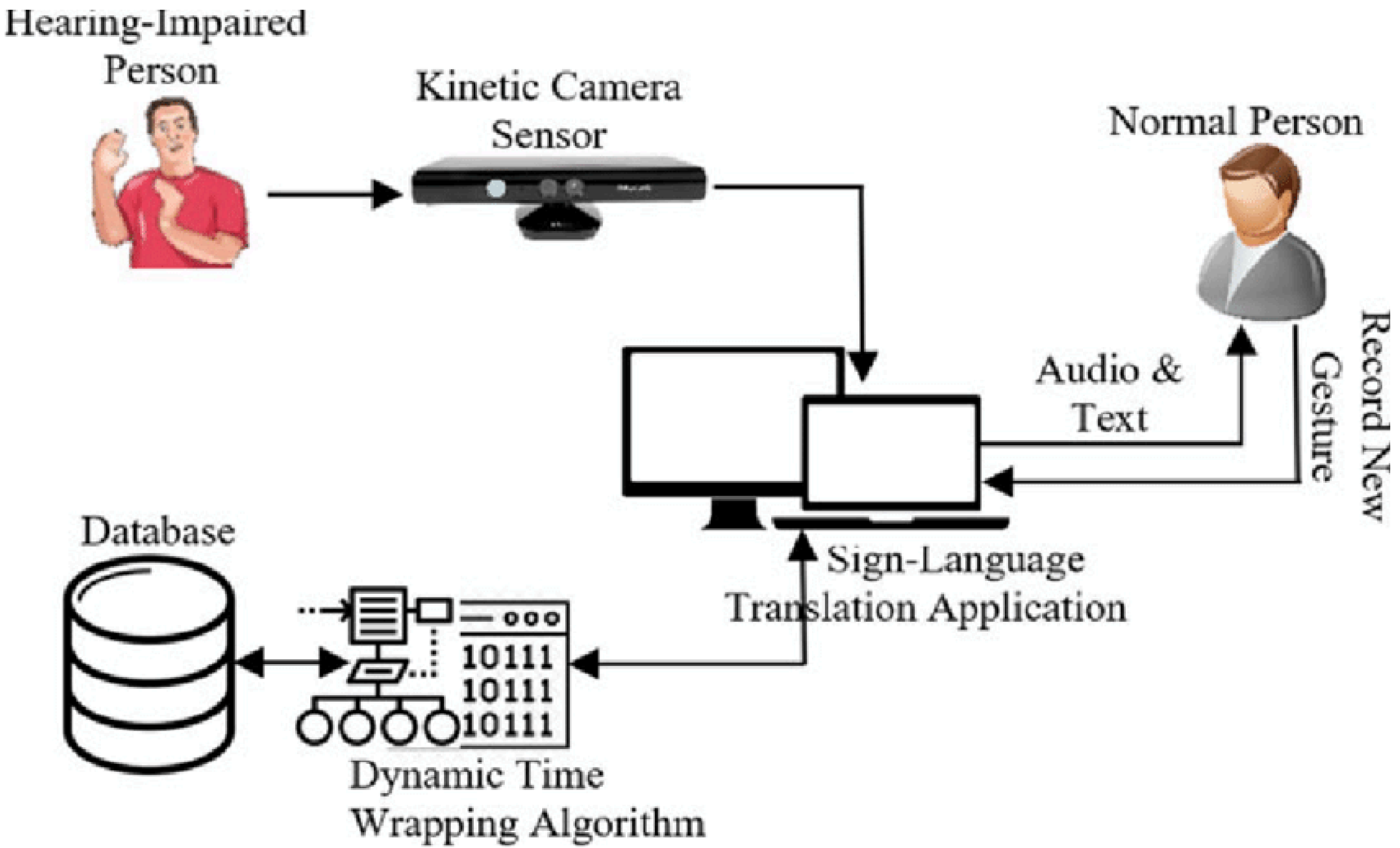
Problem Statement

Despite the growth of communication technologies, individuals with hearing and speech impairments continue to face significant challenges in real-time conversations. Existing systems such as text-to-sign converters and interpreter tools often fall short in handling complex sentences, real-time audio, and expressive gestures. These limitations result in frequent miscommunication and reduced usability in daily interactions. The WordsUrActs (WUA) project addresses these gaps by providing an AI-powered solution capable of accurately converting spoken English into Indian Sign Language (ISL) in real time. Through the use of NLP, speech recognition, and 3D animation, WUA ensures natural, expressive, and context-aware translations—enhancing inclusivity across educational, professional, and social domains.

Literature Review

S.NO	NAME OF THE PAPER	AUTHOR NAME	ALGORITHMS USED	KEY FINDINGS
1	A Robot-based Arabic Sign Language Translating System	Dr.Dina A. Alabbad,Nouha O. Alsaleh,Naimah A. Alaqeel	Rule-based NLP for Arabic text analysis, Sensor-based gesture recognition	Successfully demonstrated translation of Arabic sign language using a robot, highlighted the challenge of dialectal variations in Arabic signs& Effective in educational settings for deaf students.
2	Two-Way Sign Language Conversion for Assisting Deaf-Mutes Using Neural Network	Dr.Rishi K,Prarthana A,Pravena K S,S. Sasikala,S. Arunkumar	CNN for gesture recognition,LSTM for sequence learning and prediction	Enabled real-time two-way communication, Achieved high accuracy in ISL interpretation and Supports both static and dynamic gestures, improving interaction quality.
3	Sign Language Recognition and Translation Method based on VTN	Wuyang Qin,Xue Mei,Yuming Chen,Qihang Zhang,Yanyin Yao	Vision Transformer for spatial-temporal gesture analysis	Achieved state-of-the-art accuracy on continuous sign language datasets., better performance than CNN-RNN and Reduced dependence

Existing System Architecture

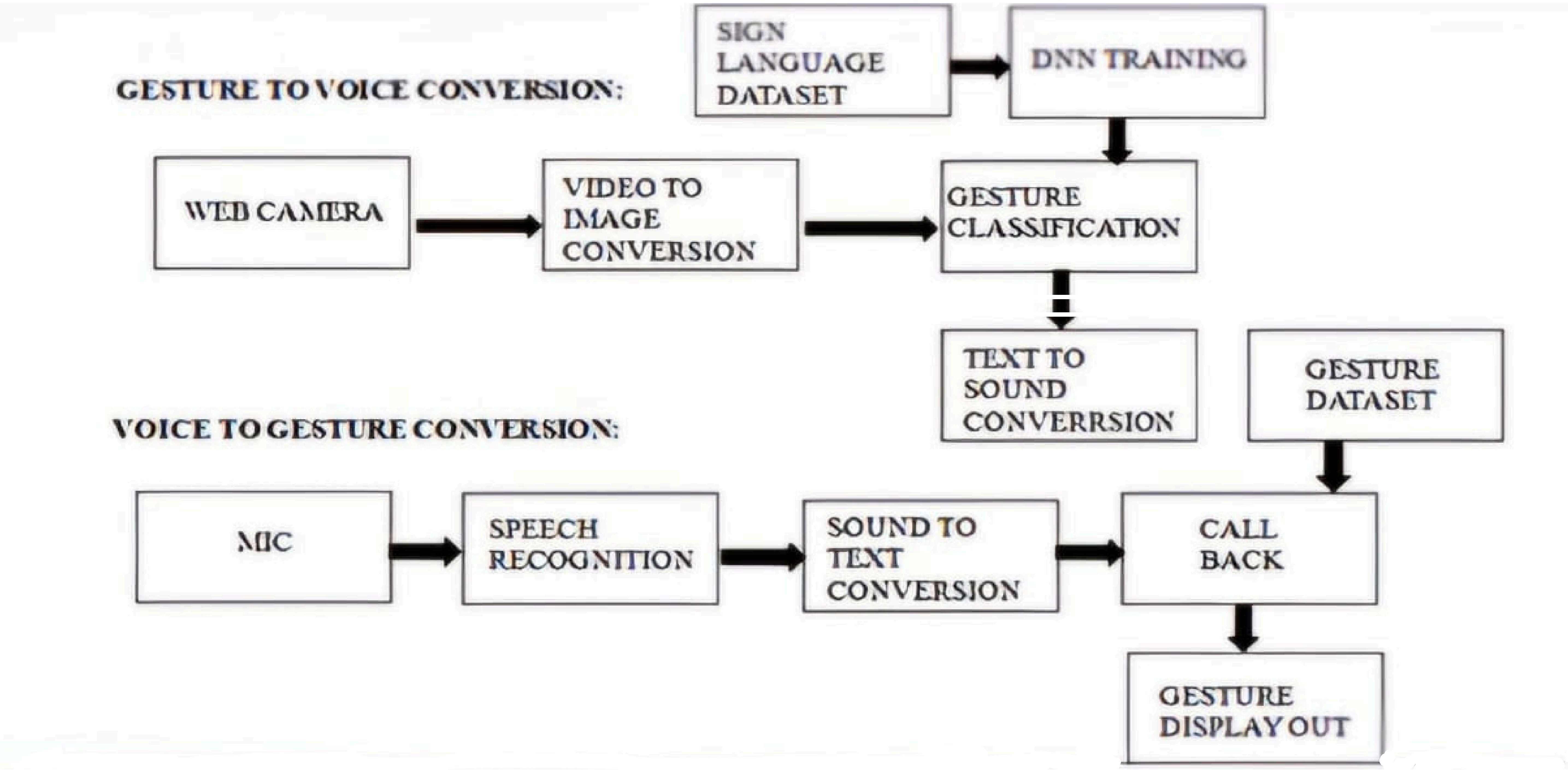


Existing System Findings

Text-to-sign conversion systems translate typed text into sign language using predefined sign animations. While they provide a basic level of translation, they lack real-time speech processing and often struggle with complex sentence structures, limiting their effectiveness in dynamic conversations.

Avatar-based sign language translators utilize pre-animated 3D avatars to display sign language based on input text or speech. While they enhance accessibility, these systems often lack natural fluidity and expressive gestures, making interpretation difficult for users who rely on nuanced sign language communication.

Proposed System Architecture



METHODOLOGY

The development of the WordsUrActs (WUA) system follows a modular and systematic methodology to ensure efficient, scalable, and high-quality implementation. The methodology is structured into multiple phases, each focusing on specific aspects of the system such as input processing, language translation, sign generation, and visualization. This structured approach ensures that each module can be developed, tested, and optimized independently while maintaining seamless integration with the complete system.

Input Module

The cornerstone of the system lies in the input mechanisms. The image presents two: a webcam to capture gestures and a microphone to record voice. These correspond directly to the Input Module in a modular design. By abstracting the hardware dependency, the Input Module can later be extended to support new devices (e.g., depth cameras or wearable sensors). This enhances scalability and future-proofing.

Animation & Visualization Module

A unique feature in our architecture is the Animation & Visualization Module, which is hinted at in the image as “Gesture Display Out.” This is where the system becomes interactive and accessible.

Here, gestures are animated using 3D avatars, robotic hands, or graphical overlays. Libraries like Blender, Unity, or WebGL could be used to create realistic visual feedback. This is vital for the hearing-impaired, providing not just output, but intuitive, human-like representation.

In a professional system, visual gestures can be fine-tuned to regional dialects of sign language (e.g., ASL vs ISL), which boosts cultural relevance and effectiveness.

Translation & Customization Module

Beyond simple conversion, a robust system supports multilingual translation, voice personalization, and gesture variation. In the image, we see text-to-sound conversion and callback logic, which trigger appropriate outputs. However, this stage can be significantly enhanced.

Imagine the system offering:

- Choice of voice (male/female, tone, language).
- Region-specific gesture variants.
- Speed adjustment for gesture playback.
- Custom vocab addition (e.g., names, technical terms).

Output Module

Finally, the Output Module delivers results. Whether it's synthesized speech from gesture input or animated gestures from spoken commands, this is where the system closes the loop.

Outputs can be multimodal:

- Audio playback using TTS (Text-to-Speech).
- Visual gestures using animation.
- Haptic feedback for blind-deaf communication (in advanced systems).

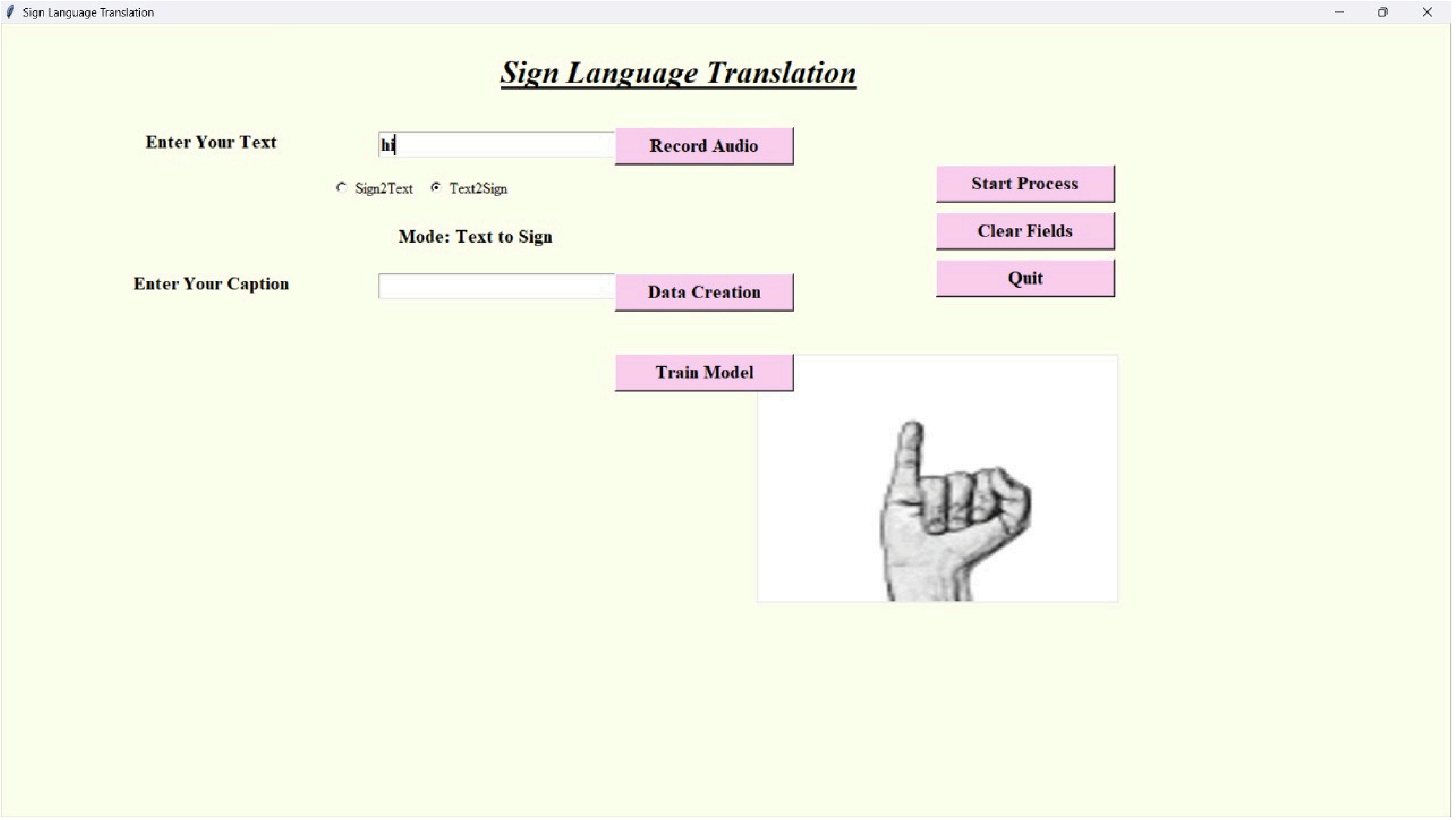
The image shows the two types of output clearly: voice from gesture and gesture from voice. These match your Output Module precisely and reinforce the need for bidirectional functionality

Software Requirements Specification

Software Requirements:

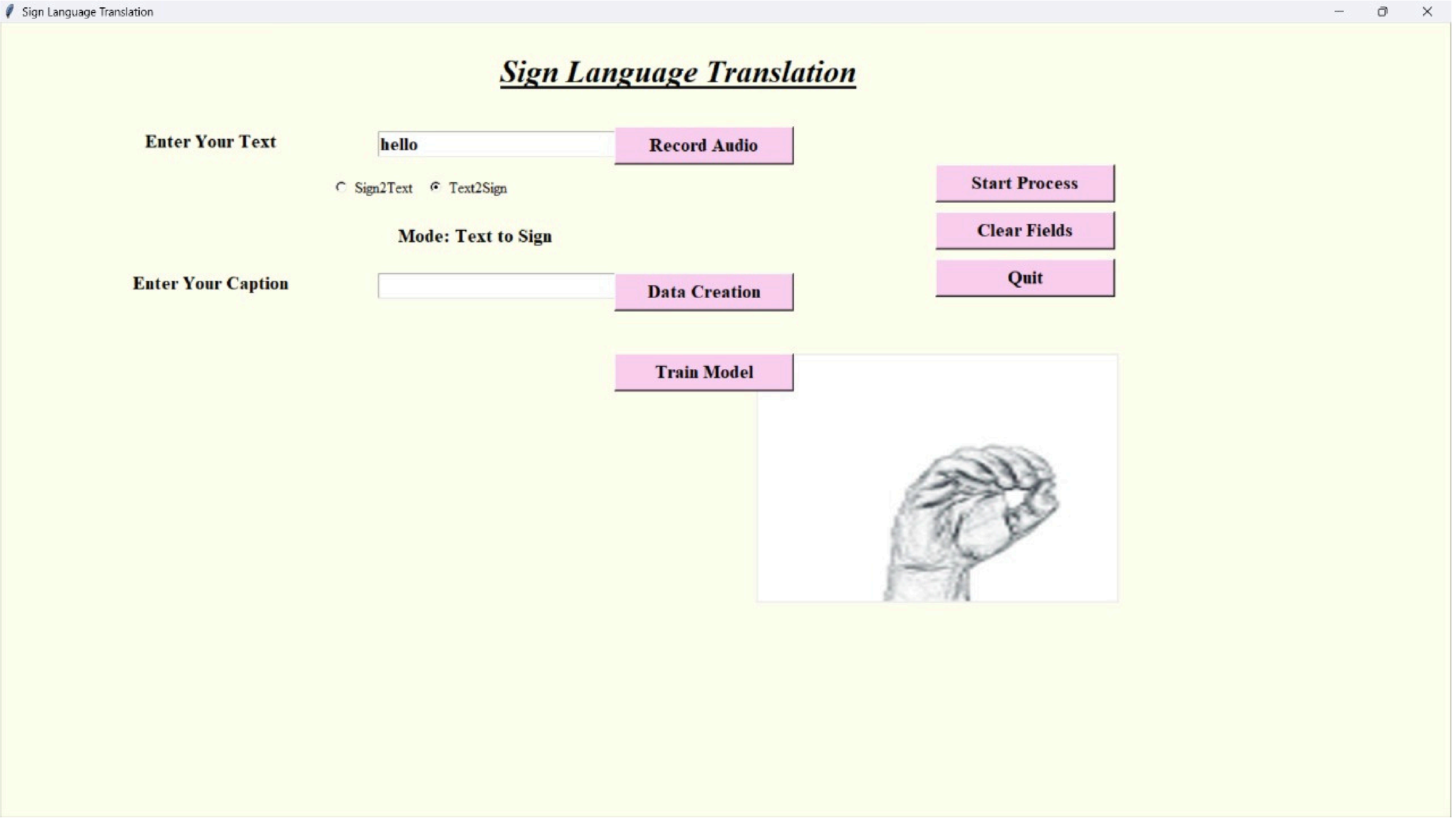
- Operating System
- Programming Languages & Frameworks
- Speech Recognition & NLP Tools
- Sign Language Processing Tools
- Animation & Rendering Software
- Database Management
- Deployment & UI Frameworks

OUTPUT:

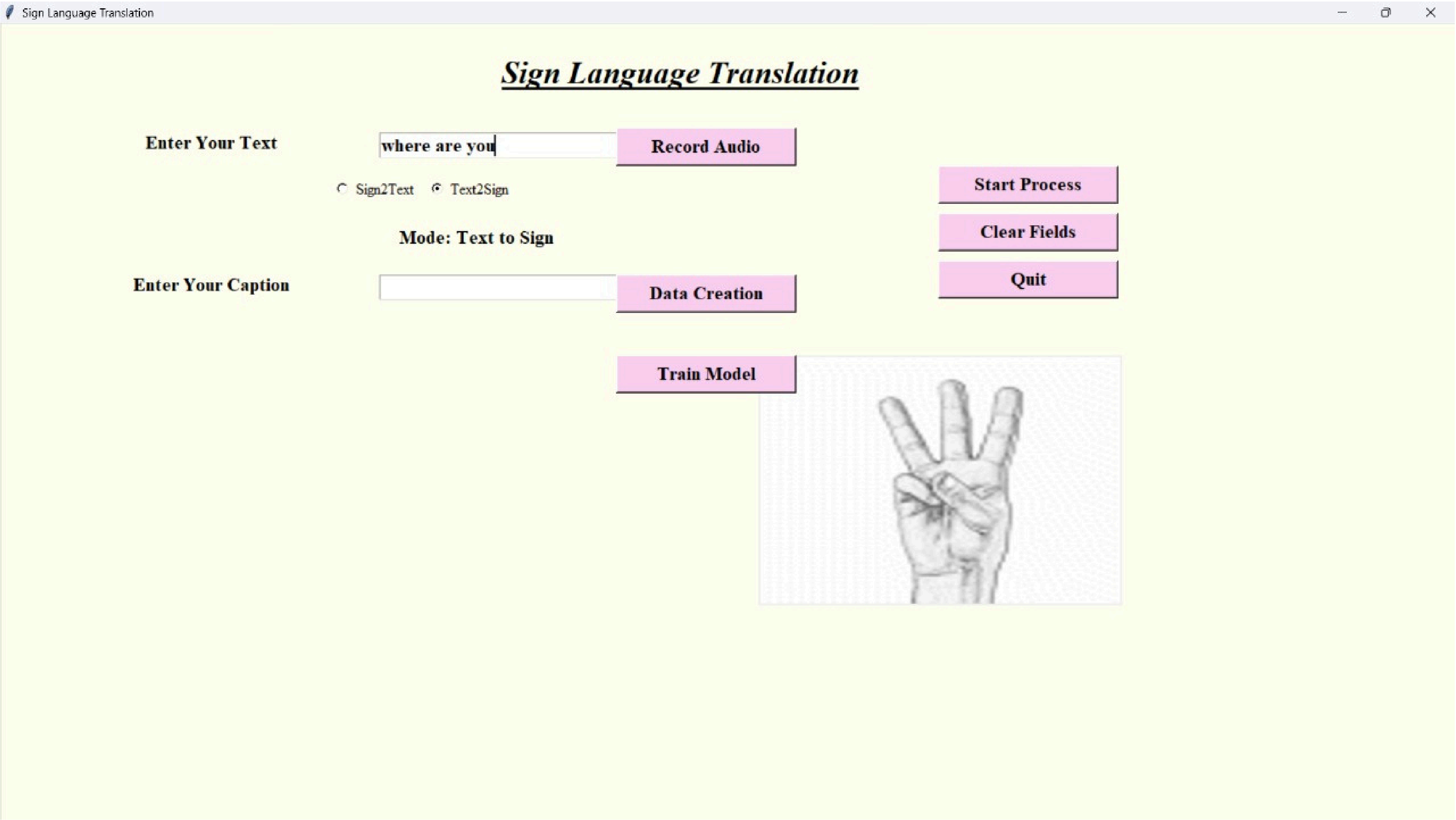


Sign Language Translation
Sign Language Translation
Enter Your Text
hi
Record Audio
Sign2Text
Text2Sign
Mode: Text to Sign
Enter Your Caption
Data Creation
Train Model
Start Process
Clear Fields
Quit

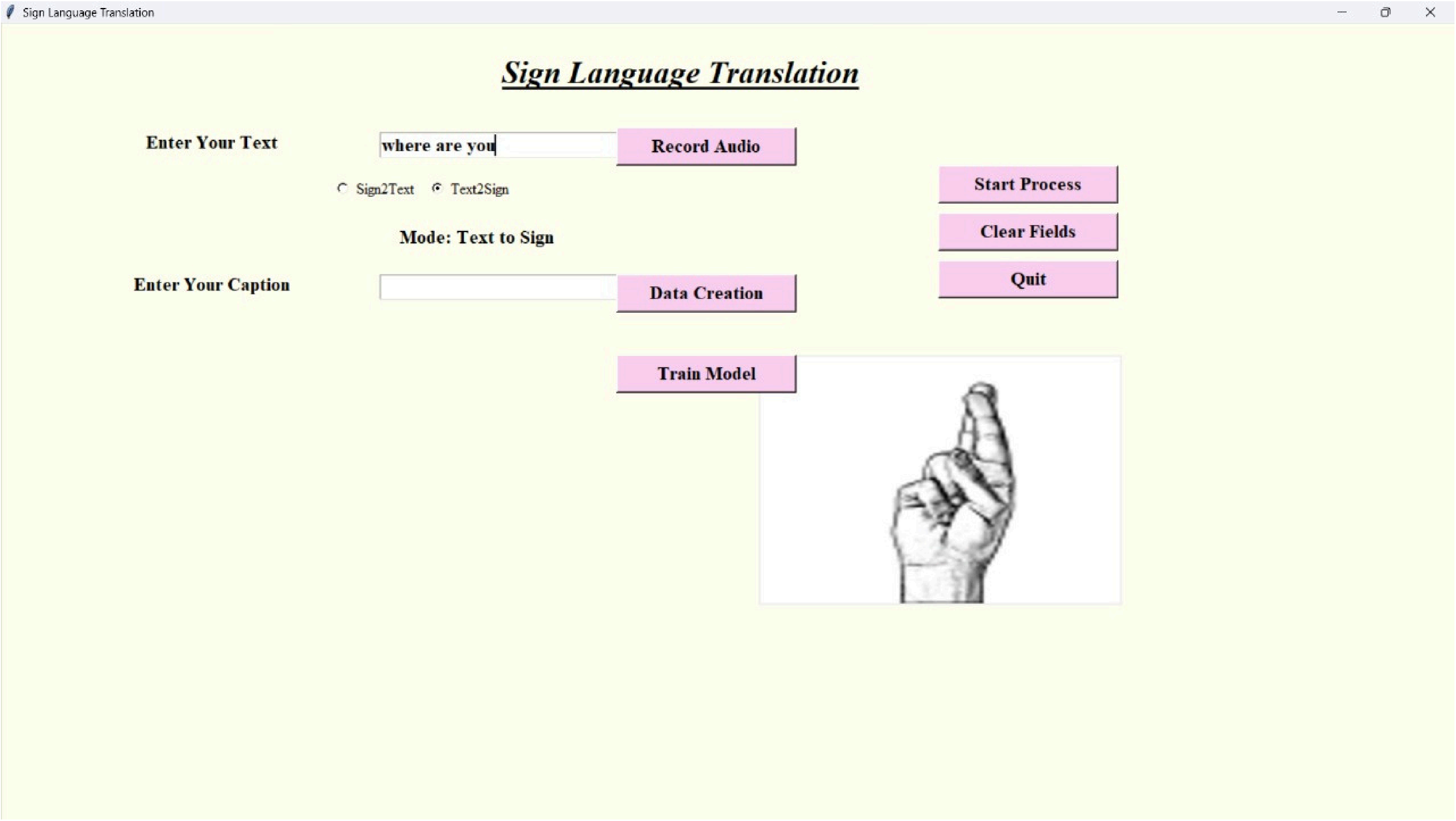
OUTPUT:


Sign Language Translation
Sign Language Translation
Enter Your Text
hello
Record Audio
Sign2Text
Text2Sign
Mode: Text to Sign
Enter Your Caption
Data Creation
Train Model
Start Process
Clear Fields
Quit

OUTPUT:


Sign Language Translation
Sign Language Translation
Enter Your Text
where are you
Record Audio
Sign2Text
Text2Sign
Mode: Text to Sign
Enter Your Caption
Data Creation
Start Process
Clear Fields
Quit
Train Model

OUTPUT:


Sign Language Translation
Sign Language Translation
Enter Your Text
where are you
Record Audio
Sign2Text
Text2Sign
Mode: Text to Sign
Enter Your Caption
Data Creation
Train Model
Start Process
Clear Fields
Quit

Conclusion

The Sign Language Avatar project successfully bridges the communication gap between hearing individuals and those with speech impairments by providing real-time, accurate, and accessible translation of spoken language into Indian Sign Language (ISL). By leveraging advanced technologies such as speech recognition, Natural Language Processing (NLP), and AI-driven 3D animation, the system offers a seamless and natural communication experience. The project enhances social inclusion, empowers individuals with hearing and speech impairments, and promotes equal opportunities in education, social interactions, and professional settings.