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REAL TIME SIGN LANGUAGE DETECTION

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ABSTRACT

To overcome communication barriers between hearing individuals and the deaf community, this paper presents the development of an AI-based application that enables real-time translation of sign language into both speech and text. The system incorporates Convolutional Neural Networks (CNNs) along with MediaPipe for accurate real-time gesture recognition, supported by a user-friendly interface and a feedback mechanism for continuous improvement. The proposed solution enhances accessibility and promotes inclusivity across sectors such as public services, healthcare, and education. Future enhancements aim to expand support for additional sign languages and integrate the system with wearable devices for improved usability and convenience.

Keywords:- *Sign Language Recognition, Artificial Intelligence, Gesture Recognition, Human-Computer Interaction, Inclusivity, Real-Time Translation*

INTRODUCTION

Sign language is the primary means of communication for millions of deaf people world- wide. However, the general public inability to use sign language effectively creates a continuous communication gap. Interpreters and written communication are examples of traditional solutions that are either resource intensive or lack expressiveness and immediacy.

By enabling real-time, automated translation of signs into spoken language or readable text, the proposed AI-powered sign language translator seeks to close this gap. This system encourages accessibility, social integration, and deaf community empowerment through inclusive design and cutting-edge AI techniques.

LITERATURE SURVEY

Research on automated sign language recognition has long been a priority. While more recent developments make use of CNNs, RNNs, and transformer-based architectures, earlier techniques depended on manually created features. Among the noteworthy contributions are:

Koller et al. (2016) examined the development of methods for recognizing sign language.

Transformer-based gesture sequence interpretation was introduced by Camgoz et al. (2018).

Hu and Wang (2019): highlighted how well deep learning can identify intricate patterns of visual language.

Even with great advancements, problems like real-time performance, multiple sign languages, and dynamic gestures still exist. By emphasizing usability, cultural relevance, and user engagement, our work expands on earlier initiatives.

EXISTING SYSTEM

Avatar-based mobile applications for simple sign translation are among the current systems. Human interpreters for video relay services. Static gesture to text translators with a small vocabulary.

These solutions frequently don't support multiple languages, scale, or respond in real time. Moreover, their affordability and accessibility are restricted. Our system's scalable, AI- driven architecture solves these issues.

PROPOSED SYSTEM

The suggested system uses a tiered architecture to translate and recognize gestures in real time:

Input: Hand gestures are captured by a webcam or smartphone camera.

Processing: The frames are processed by a CNN model, which also recognizes gestures. Text-to-Speech (TTS) engine-based text and speech synthesis is the output.

Feedback: Corrections made by users are saved for future retraining and accuracy improvement.

METHODOLOGY

Architecture Overview

The user interface is easy to use and includes gesture input, output display, and feedback.

Gesture Recognition: Media Pipe/Open Pose is used for tracking, and CNN is used for classification.

Translation Engine: Natural Language Processing (NLP) ensures grammar accuracy.

Speech Synthesis: Converts text to speech using TTS tools. B. SLR and RWTH-PHOE- NIX-Weather 2014T are publicly accessible datasets.

Custom: Over 1,000 manually recorded Indian Sign Language (ISL) gesture samples.

Model Training: CNN was trained using TensorFlow. Approximately 92% accuracy was attained under various lighting and back- ground conditions.

Real-time response latency: roughly 800 ms per sign.

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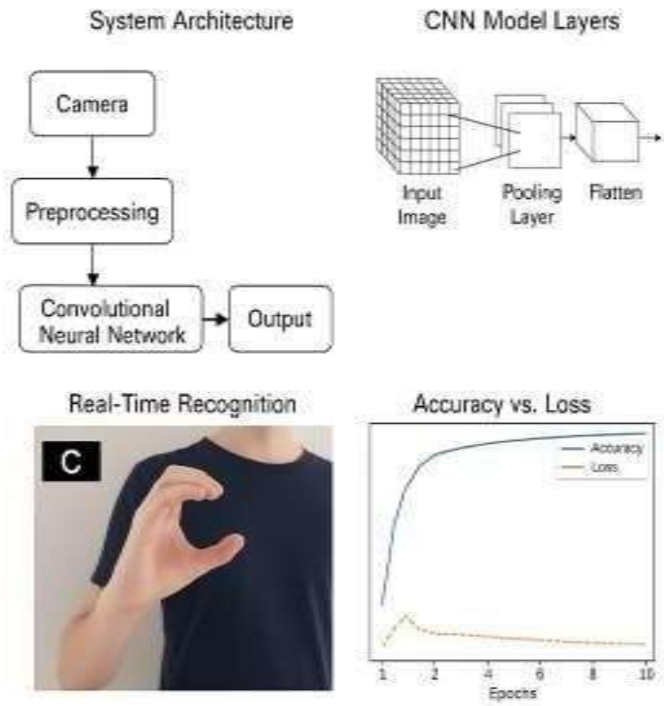

***Fig.1:**-System Architecture*

System Workflow

1. **Gesture Input:** The user makes gestures in sign language.
2. **Preprocessing:** Key point extraction, normalization, and frame resizing.
3. **Classification:** The gesture class is predicted by CNN.
4. **Translation:** TTS is used to speak and display the output.
5. **Feedback:** Users validate or fix output, and the changes are recorded for upcoming model enhancements.

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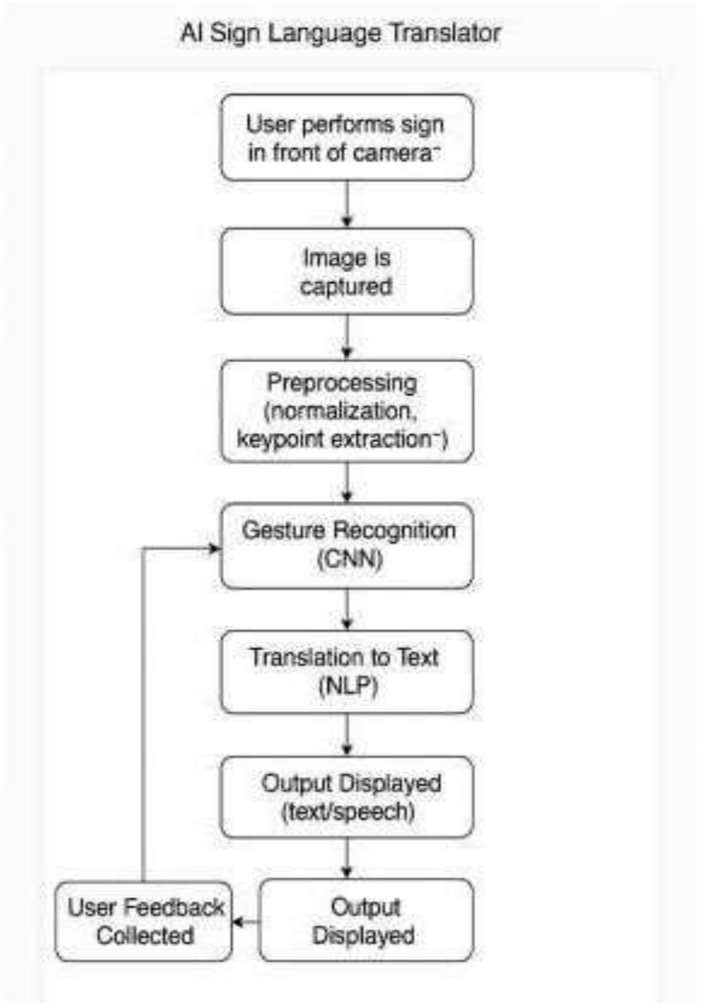

Fig.2:-*System Flow Diagram*

RESULTS AND DISCUSSION

Accuracy of Recognition: 91–94% for 25 typical ISL signs. Each gesture's latency was kept to less than one second. 30 participants (15 hearing and 15 deaf) participated in the user study; the system received a usability rating of 4.5 out of 5.

FUTURE SCOPE

Increase support for both British Sign Language (BSL) and American Sign Language (ASL).

Connect to wearable technology (smart glasses, for example). Improve semantic interpretation by incorporating facial expression recognition. Turn on multilingual voice output and offline processing.

CONCLUSION

This study shows how artificial intelligence (AI) can help hearing and deaf people communicate more effectively. Effective sign-to- speech and sign-to-text conversion

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is pro- vided by the real-time translator, increasing user confidence and independence.

The system promotes inclusive communication and digital accessibility with a user-centered and culturally aware approach.

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