Real-Time Indian Sign Language Interpretation by Deep Neural Network and MediaPipe Framework

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***Abstract*—In a world where spoken language dominates, people who are deaf or hard of hearing often encounter communication barriers.To overcome these barriers, they have developed sign language—a visual form of communication using hand signs and movements. Sign language uses a combination of handsigns and movements to communicate. India has developed its own separate sign language called the Indian sign language (ISL). It currently has about 18 million day-to-day users. The Indian Sign language is recognized as one of the modern Indian languages. Therefore, it Is necessary to develop tools that can interpret these sign languages without the need of human interpreters.**

This work aims to establish a ML driven solution to interpret the Indian sign language to text using MediaPipe framework to detect the ISL handsigns using webcam through OpenCV and translate them in real-time. The MediaPipe framework was used to detect and extract about 36200 (about 1000 data points each for 0-9 and A-Z) data points which were used to train feed forward deep neural network resulting in a 99\% accuracy. Enabling translation in real-time using OpenCV in an effective manner. This method therefore can effectively be tried for other sign languages and enable an inclusive and better environment for deaf and mute people. A similar work was done by Jyotishman bora \cite{b13} on Assamese Sign Language for 9 static,single handed, different poses here we have extended the scope of their work to entire Indian Sign Language with 36 different pose recognitions.This work supports both one-handed and two-handed static ISL gestures in contrast to the previous work and achieves an average inference speed of 30 FPS on an AMD Ryzen 7 5000 series system. This real-time performance is enabled through an asynchronous multi-threaded processing pipeline combined with frame-skipping and stationarity-based temporal filtering, which reduces redundant inference during gesture transitions. This confirms its suitability for real-time applications.

***Keyword*—Sign Language Interpretation; Indian Sign Language (ISL); Gesture-Based Recognition; MediaPipe Framework; Deep Neural Networks**

Devesh Singh was born in India. He is currently pursuing his Bachelor's degree in Computer Science and Engineering at Shri Mata Vaishno Devi University, Katra, India. His major field of study includes computer vision, deep learning, and human–computer interaction.

He has worked extensively on real-time machine learning systems, with a primary focus on assistive technologies. During his undergraduate research and internship work, he developed a real-time Indian Sign Language (ISL) interpretation system using deep neural networks and the MediaPipe framework, achieving high accuracy and real-time inference on consumer hardware. His research experience includes model optimization, keypoint-based gesture recognition, and deployment-oriented AI system design. His current research interests include computer vision, deep learning, efficient neural network architectures, and accessibility-focused AI.

Mr. Singh is an undergraduate researcher with interests in applied artificial intelligence and inclusive technologies. He has submitted research work to international conferences and continues to work toward advanced research in AI-driven human–computer interaction systems.

Manoj Kumar Gupta received his doctoral degree in Computer Science and Engineering from a recognized Indian university. He is currently a Professor in the Department of Computer Science and Engineering at Shri Mata Vaishno Devi University, Katra, India. His academic background spans computer science, intelligent systems, and advanced computing technologies.

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Dr. Gupta is actively involved in academic research, curriculum development, and mentoring student researchers. He has served as a reviewer and committee member for conferences and journals and continues to contribute to research and development in the field of computer science and engineering.