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SIGN LANGUAGE RECOGNITION

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ABSTRACT

Sign Language is a form of language that enables communication among individuals who are deaf or hard of hearing. Every country has developed its own distinct sign language, including India, which has its own version known as Indian Sign Language (ISL). SLR an essential tool for communication with people who are speech impaired. In this article, we will discuss recent advancements in sign language recognition. We will begin by examining various techniques of gesture recognition and highlighting important methods in recent developments. Additionally, we will focus on the challenges and potential solutions associated with sign language recognition. We propose a method for creating an ISL dataset using a webcam and training a TensorFlow model using transfer learning to develop a real-time Sign Language Recognition system. It is important to learn sign language as it is a reliable and significant way of communicating with people who are hard of hearing or speech impaired without the need for an interpreter.

Keywords: SLR (Sign Language Recognition), Gesture Recognition, ISL (Indian Sign Language)

I. INTRODUCTION

Sign language is a unique visual-gestural language used for communication among deaf and hard-hearing people. It utilizes hand signals, body language and facial expressions as its primary modes of expression. It is the type of language that uses visual manual method to express something. Sign languages have their own grammar and vocabulary, making them full-fledged natural languages. Sign language plays a crucial role in facilitating communication within the deaf community, and it has contributed to the development of unique deaf cultures in various regions. Sign Language is the natural language having its grammar and lexicon. Different communities can develop their own gestures to convey messages, making sign language a flexible and adaptable communication method. Sign language plays a vital role in enabling individuals who are deaf or mute to communicate with others. It relies on a variety of hand and body gestures, including movements of the fingers, arms, hands, head, neck, and eyes, to convey meaning and information.

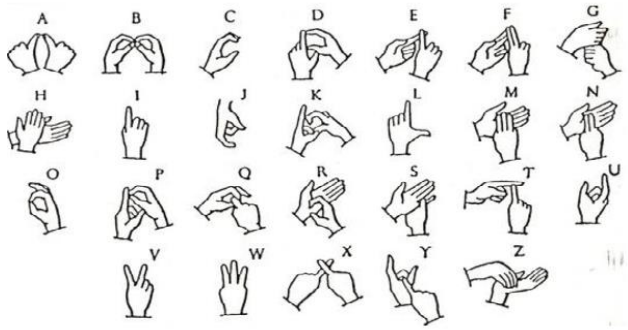

Figure 1. Representation of ISL Alphabets(A-Z)

Individuals with disabilities such as Autism, Apraxia of speech, Cerebral Palsy and Down Syndrome benefit greatly from sign language recognition (SLR) as a means of communication. Sign language is a highly effective method of communication used by deaf or hard of hearing individuals. However, those who do not understand sign language can have difficulty understanding it. To address this issue, sign language recognition systems have been developed. These systems provide a solution by predicting and converting sign language into text messages, making it easier for individuals who do not understand sign language to comprehend.

This technology has enormous potential to make communication more efficient and accessible for everyone, and can promote cultural awareness, literacy, and other intellectual benefits. With the development of more advanced sign language recognition systems, the future of communication for those who rely on sign language looks bright.

II. PURPOSE

Sign languages are a visual means of communication that involve a set of organized hand gestures, facial expressions, and body language used by people who are deaf or hard-of-hearing to convey their thoughts and ideas in their daily interactions with others. These visual languages utilize the movement of hands, face, and body as a means of communication. Unfortunately, the percentage of the population that knows any sign language is quite low, making it difficult for the hearing-impaired to communicate freely with others. The issue of communication barriers between those who know sign language and those who don't can be overcome with the help of sign language recognition (SLR) technology. It enables individuals to communicate in sign language without having to know the language, thus providing a solution to the problem. The SLR system recognizes a sign language gesture and translates it into a commonly spoken language such as English. This technology is an important step towards creating a more inclusive society where communication is accessible to everyone, regardless of their ability to use sign language.

III. METHODOLOGY

In this project, we aim to detect and recognize hand gestures, or sign language, using TensorFlow. Our approach involves leveraging MediaPipe's hand tracking capabilities to capture real-time hand gestures. By utilizing tracking points and analyzing angles between key points, we can identify specific gestures and match them with data from our gesture database. The dataset, provided in CSV format, was created based on point and angle counts associated with each gesture. Our model is pickled and saved on disk, allowing for seamless integration and loading within the system. Let's delve into the details of our methodology.

The sign language detection system being developed for Indian Sign Language will acquire data through the use of Python and OpenCV to capture images using a webcam. OpenCV is a library with functions aimed at real-time computer vision, enabling the acceleration of machine perception in commercial products and providing a common infrastructure for computer vision-based applications. The project aims to build a recognition model through various steps, including collecting images for deep learning using webcam and OpenCV, labeling the images for sign language detection, setting up TensorFlow Object Detection Pipeline Configuration, creating the deep learning model using transfer learning, and detecting sign language in real-time using OpenCV.

1. Hand Tracking with Media Pipe: We utilize Media Pipe's hand tracking solution to detect and track hand gestures in real time. This framework provides us with reliable tracking points that we can use to analyze and recognize gestures accurately.

2. Gesture Recognition: Once the hand is tracked, we extract relevant points and angles from the hand's position. These properties serve as the basis for gesture recognition. By comparing the extracted properties with our pre-constructed gesture database, we can determine the corresponding gesture.

3. Dataset Creation: Our dataset is constructed using the point and angle counts associated with each gesture. We carefully labeled and collected a diverse set of hand gestures, ensuring sufficient variations in hand position and orientation. Each gesture's properties were quantified and stored in a CSV file, providing a reference for recognition during real-time inference.

4. Model Training and Pickling: Using TensorFlow, we train a deep learning model on the labeled dataset. The model learns to recognize patterns in the hand gesture properties and associates them with their corresponding gesture names. Once trained, we pickle the model, allowing for easy storage and retrieval.

5. Loading and Recognition: To perform gesture recognition, we load the pickled model into our system. With the real-time input from MediaPipe's hand tracking, we extract the relevant properties from the tracked hand. The model then processes these properties and matches them with the stored gestures in the database. The recognized gesture is subsequently outputted, providing the user with the corresponding gesture name.

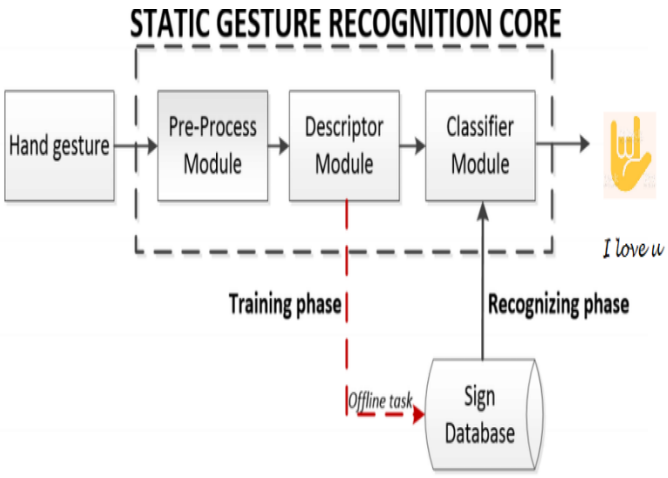

Figure 4. Proposed Work System

IV. MODELING AND ANALYSIS

GESTURE RECOGNITION APPROACHES

Gesture is a form of non-verbal communication that conveys a specific message through body language. Gesture recognition is a computational process that uses mathematical algorithms to interpret human gestures. It is not just limited to hand gestures, but can also recognize various body movements such as head nods and walking gaits. Gestures are an important means of expressing emotions, thoughts and ideas. Gesture recognition is primarily concerned with the movement of body parts, such as hands, limbs and head, to convey a message. Gesture recognition can improve human-computer interaction and can be achieved through touch screens, cameras or other peripheral devices. The main objective of gesture recognition is to enable Sign Language Recognition (SLR). SLR approaches are divided into two categories based on the device used for recognition: vision-based and data glove approach. Hand gesture recognition is performed using these two techniques.

1) Vision Based Approach (VBA)

The vision-based approach (VBA) is a method used for Sign Language Recognition (SLR) where images or videos are used as input. If a video is used, a sequence of frames is considered. In sign language recognition (SLR), a common method is to use a stationary camera that captures sign gestures performed by signers. From these captured images, features such as posture, location, and motion of the fingers, palms, and face can be extracted. The camera acts as the main input device used to capture images, and gloves are not typically used. The VBA method is relatively easy and has a lower computational cost.

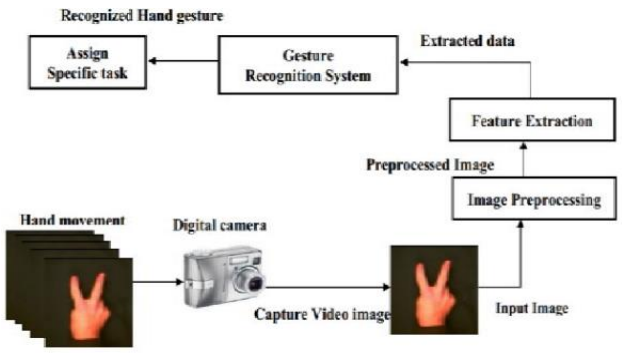

Figure 2. VBA

To create a gesture system database, relevant gestures with their corresponding meanings are selected, and multiple samples of each gesture may be taken to increase the accuracy of the system. Image preprocessing and signal preprocessing are performed to recognize the corresponding sign. The captured image is transferred to the preprocessor, and the feature vector of the image is compared with the stored data set. Probabilities are determined during this operation, and the final probability is used to classify the sign into its corresponding class. The VBA approach initiates a human-computer interface, as shown in Figure 2.

2) Data Glove Approach (DGA)

In order to precisely capture the hand movements and postures during sign language recognition, data gloves are frequently utilized. These gloves are equipped with numerous sensors that can accurately determine the position and orientation of the hands. Optical or mechanical sensors on the gloves convert finger flexions into electrical signals that indicate the hand posture. In the DGA approach, one or more data gloves are used to collect data on joint angles and Degrees of Freedom (DOF), which measure the position and orientation of the hand to track its movements. This approach has the advantage of fast reaction speed and high accuracy. However, the cost of the high-tech sensors in the data gloves makes it less affordable for everyday use by the deaf community. The DGA approach for SLR is illustrated in Figure 3.

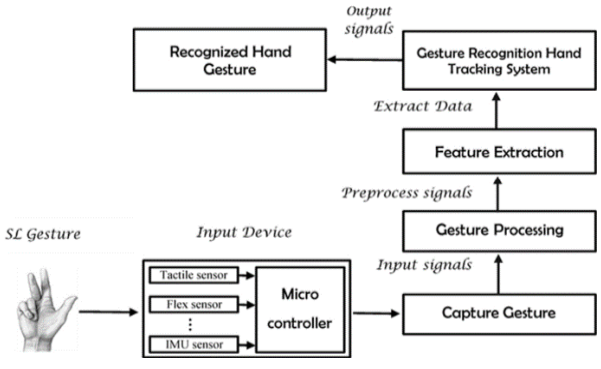

Figure 3. DGA

V. RESULTS AND DISCUSSION

The development of a real-time sign language detection system for Indian Sign Language is underway. Images are being captured through a webcam using Python and OpenCV for data acquisition. OpenCV is focused on real-time computer vision functions, allowing for machine perception to be utilized in commercial products, and

serves as a common infrastructure for computer vision-based applications. The goal of this project is to construct a recognition model. In this proposed project we will be building a recognition model.

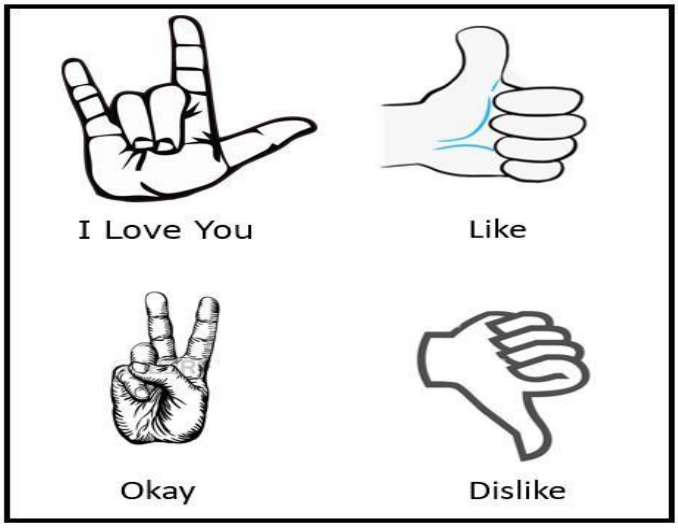

Figure 4. Few Common Hand Gestures

The model will capture the hand gesture in real time and will recognize the gesture through the Media pipe using its tracking points and will give out the gesture name. The available points and angles in hand will lead to the detection of gesture. The dataset is created using the point and angle count and if the gesture in the frame has such properties it will give out the gesture name having such particular properties. The model is pickled and saved in the disk to totally load the model in the system. Then the detection and recognition are done on the gestures.

VI. RELATED WORK

There are several methods and systems available at present for hand gesture recognition. Each system has its own unique features and uses different algorithms and methods for recognizing hand gestures. The use of hand gesture recognition systems is becoming increasingly popular as they are considered to be a more natural and effective tool for human-computer interaction.

An existing system for recognizing Indian Sign Language (ISL) uses Artificial Neural Network (ANN) and Support Vector Machine (SVM) classifiers. The system uses various feature extraction techniques such as shape descriptors, SIFT, and HOG, and a combination of these features is found to provide the highest accuracy of 57%. A combination of 100 and ANN achieves an accuracy as high as 99%.

The proposed scheme translates ISL numerals and alphabets into English. It uses a combination algorithm that includes Canny edge detection, YCbCr model for segmentation threshold, and tracking hand movements. The system achieves an accuracy of 97.5%. The complete system was developed in MATLAB and Graphical User Interface (GUI).

VII. CONCLUSION

This survey paper discusses the use of automated sign language recognition systems to improve human-machine interaction. These systems can overcome the limitation of communication by translating sign language gestures into commonly spoken language. The paper proposes the use of TensorFlow object detection API to recognize the Indian Sign Language alphabet in real-time using images captured by a webcam using Python and OpenCV, which makes it more cost-effective. The paper highlights the recent development in the area of static hand gesture recognition and the limited works related to dynamic hand gesture recognition. Most of the existing systems are dependent on signers, and facial expressions are not included in the most widely used systems. The main challenge is to develop a system that recognizes both facial and hand gestures together.

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