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Sign Language Recognition For Deaf and Mute

Dr.M.P. Chitra[1], Vaishnavi Devi. R[2], Shalini M[3], Sriee Sathana. L.B[4]

[1] Head of the Department, Dept. of Electronics and Communication Engineering, Panimalar Institute of Technology, Tamil Nadu, India.
[2 3 4] Student, Dept. of Electronics and Communication Engineering, Panimalar Institute of Technology, Tamil Nadu, India.

Abstract - *The sign language recognition system is brought into existence for recognizing the gestures of various sign languages. Usually, sign language consists of hand gestures. The signs are recognized by identifying and tracking the Regions of Interest (ROI) using the skin segmentation feature of OpenCV. The training and prediction of hand gestures are performed by applying Convolutional Neural Network (CNN) which is a machine learning algorithm. The recognized gestures are compared with the trained models and their equivalent words are predicted, thus a complete sentence can be formed. This can now be displayed on the Blynk app and also the recipient can respond with the equivalent sign language videos. The various applications of sign language recognition are gesture controlled robots and home automation, game control, Human- Computer Interaction (HCI) and sign language interpretation. The proposed system is used to recognize the real-time signs. Thus this system is very much useful for hearing and speech impaired people to communicate with normal people.*

Key Words: Sign language recognition, ROI, CNN, HCI.

1.INTRODUCTION

World Health Organization's (WHO) survey says that about 6 percent of the world's population is suffering from hearing disabilities. In March 2018, the number of people with this disability is 466 million, and it is expected to be 900 million by 2050. Also, the 2011 survey of India states that 7 million Indians are suffering from hearing and speech disability. They do not think these as their disabilities; it is another way of a different life. However, their circle is very much limited. They should not be part of the deaf world alone. Text messaging, writing, using visual media and finger spelling are a few methods used to establish communication between normal and hearing and speech impaired people. However, they choose sign language only because they can express their emotions and feelings through signs only. So conversing in their regional sign language makes it easier and more comfort for the people to share their ideas and thoughts.

Sign languages are a visual representation of thoughts conveyed through our hand gestures, facial expressions, and body movements [11]. Sign Languages also have several variants, such as American Sign Language (ASL), Argentinian Sign Language (LSA), British Sign Language (BSL) and Indian Sign Language (ISL). The hearing and speech disabled people prefer the sign language, which is mostly used in their region. Moreover, in India, there is no universal sign language. Though there exist many sign languages, the normal people do not know about sign languages. Hence communicating with deaf and mute people becomes more complex thus the normal people can type their text and the relevant video of the sign language will be displayed thus communication becomes little more efficient.

Recognition of sign language can be done in two ways, either glove based recognition or vision based recognition. In glove based recognition a network of sensors is used to capture the movements of the fingers. But the drawback is that wearing a glove always is uncomfortable for the users and also the data gloves are very much expensive.

So, the proposed system uses the non-invasive vision based recognition method. The vision-based recognition are of two ways. They are Static recognition or Dynamic recognition. We use Static recognition system, the input given is an image of hand pose. It is provided as a 2D representation of the gesture, and this can be used to recognize numbers, alphabets and words. Thus sentence formation is also possible here.

To establish intercommunication the reply to the people with hearing disability can be established through videos of their sign language. Information Technology with its emerging methodologies such as AI and cloud computing has a major role in improving intercommunication among people with vocal disabilities and normal people.

2. RELATED WORKS

There are several technologies like wearable communication devices, online learning systems for making deaf and mute communication easier. The common among these techniques found such as image acquisition, skin segmentation, background subtraction and gesture identification. The drawbacks of these systems are they require sensors, accelerometer and external device to interpret the message and the online learning cannot be accessed by the illiterates.

So Sign language recognition scheme came into existence. This sign language recognition scheme using databases has achieved maximum of about 99% of effective communication. Hand gesture recognition considers similarities of human hands shape, thus provides user friendly interaction. In sign language each gesture has specific meaning, the complex meanings can be expressed by combination of simpler gestures. By using all these techniques deaf and mute people can share their thoughts freely without any restrictions.

In general, hand gestures are recognized using two different approaches. One is sensor based approach and the other is vision based approach.

In sensor based approach the system records the data of hand's position with the help of different sensors. The analysis of this data is done first and then the results are drawn. In order to recognize the hand's position the sensors are placed on hand. When any gesture is shown by the hand the data gets recorded and the analysis is done further. Data glove was the first use sensor then LED's came into existence. The first data glove was invented in 1997.The damage of natural motion of hand occurs in sensor based approach due to the use of external hardware .The major drawback is complex gestures are not recognizable.

In vision based approach images are captured through camera as a data of hand's position. This approach mainly focuses on captured image of gesture. Then the main features are extracted and recognized. In this approach color bands were used earlier. The major drawback of this approach was that standard colour should used on the finger tips. Rather than using color bands bare hands were preferred.

Though lots and lots of technologies and systems are in existence, there is a lack in establishing dual communication. This makes partial fulfilment in exchanging of information. In all the existing system, data sets of very few hand gestures have been trained. Due to this, the users are restricted with the words.

3. METHODOLOGY

The proposed system has a camera unit for capturing and creating followed by training of the gestures of the hearing and speech impaired people. The images scanned from the raw videos with the proper environmental setup are given as the input to the system. The image frames are resized in order to maintain equality among all the videos. OpenCV (Open Source Library for Computer Vision) is used for feature extraction and Convolutional Neural Network(CNN) for video classification.

Data Pre-Processing – In this module, based on the object detected in front of the camera its binary images is being populated. Meaning the object will be filled with solid white and background will be filled with solid black. Based on the pixel's regions, their numerical value in range of either 0 or 1 is being given to next process for modules.

Scan Single Gesture – A gesture scanner will be available in front of the end user where the user will have to do a hand gesture. Based on Pre-Processed module output, a user shall be able to see associated label assigned for each hand gestures, based on the predefined Indian Sign Language (ISL) standard inside the output window screen.

Create gesture – A user will give a desired hand gesture as an input to the system with the text box available at the bottom of the screen where the user needs to type whatever he/she desires to associate that gesture with. This customize gesture will then be stored for future purposes and will be detected in the upcoming time.

Formation of a sentence – A user will be able to select a delimiter and until that delimiter is encountered every scanned gesture character will be appended with the previous results forming a stream of meaning-full words and sentences.

Exporting – A user would be able to export the results of the scanned character into an ASCII standard textual file format.

Sending via Blynk - The converted textual file format is sent to receiver's blynk app.

Reply Video - The receiver can respond to the message sent by deaf and mute. This is converted into video for better understanding of illiterate people.

4. EXPERIMENTAL SETUP

4.1 Create Gesture

Fig -1: Gesture Creation Window

Using create gesture option, the user can create their own gesture and can save it with relevant name. The created gesture is stored as dataset in the specified folder. For example, the created samples are shown below.

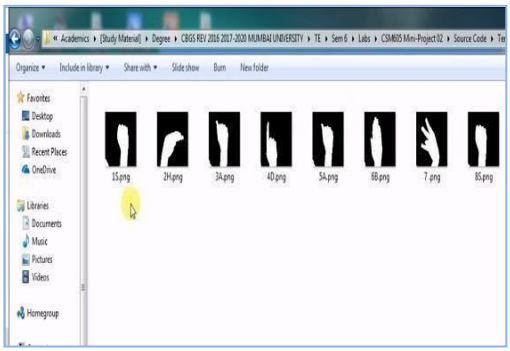

Fig -2: Sample Gestures

4.2 Scan Gesture

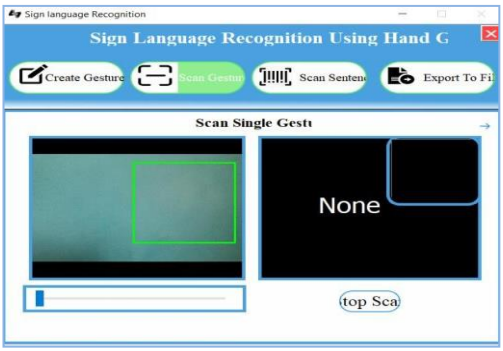

Fig -3: Gesture Scanning Window

Using scan gesture option, the user can show their hand gesture in ROI (Region of Interest). The Gesture is now scanned and compared with pre-defined datasets. Only one gesture can be scanned at a time using this option. If the user wants to scan multiple gestures and frame it in the form of sentence, scan sentence option can be used which is shown below**.**

4.3 Scan Sentence

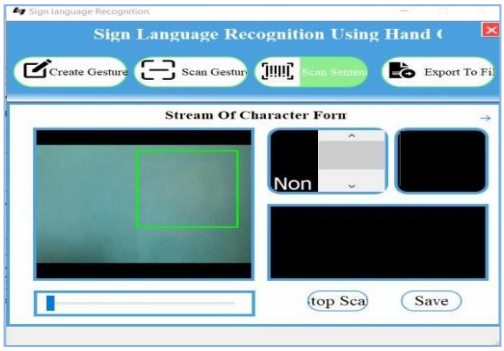

Fig -4: Scan Sentence Window

Using scan sentence option, the user can now show multiple hand gestures by pressing ‘c’ after each hand gesture. The scanned images are then compared with the trained data sets and their relevant word or letter is displayed in the form of sentence.

4.4 Export to File

Fig -5: Export to File Window

In export to file there are two options:

i. Gesture viewer
ii. Export

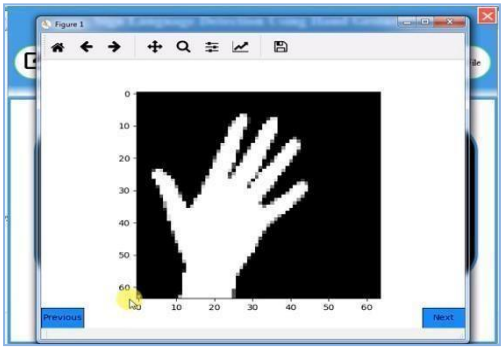

Fig-6: Gesture viewer

Fig-7: Export

Here the sentence gets exported to the particular file directory and it is shown through the blynk app for the end user.

4.5 Blynk app

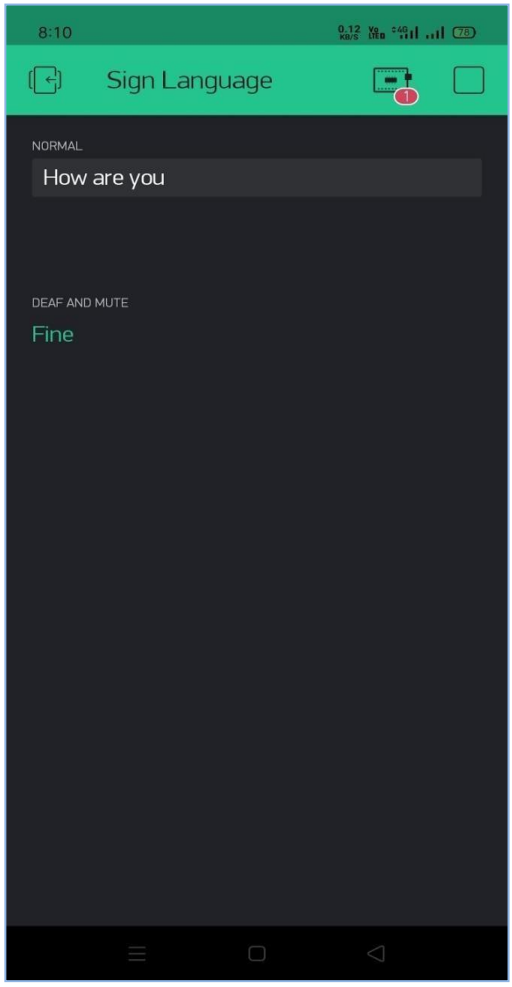

Fig -8: Hand Gesture equivalent text from deaf and mute, Reply from normal people.

4.6 Reply Video

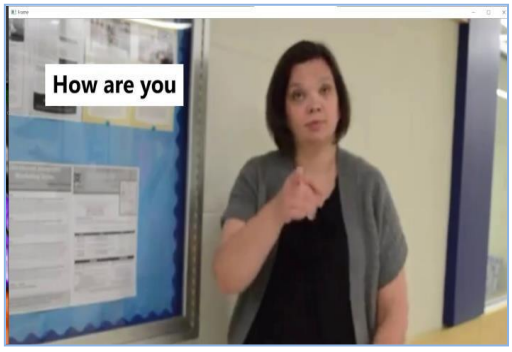

Fig -9: Reply sent in the form of Video

In this step, as per the input given as the reply by the receiver the corresponding file directory gets opened and the video with the gesture equivalent to the input will be played.

5. RESULTS

This CNN based real-time sign language recognition system, for recognising the words of Indian Sign Language has produced better results and this is somewhat higher than the similar systems. Also, the developed system is much better than other systems, since it is capable of recognising 40 words of ISL in real-time. The CNN is more efficient and reliable than the other clustering algorithms in many applications by its performance.

6. CONCLUSION

From this project, we have tried to find the root cause and also tried to overshadow some of the problems faced by disabled persons in terms of talking and hearing. Thereby this application serves the person who wants to learn and talk in sign languages. With this application a person will quickly adapt various gestures and their meaning as per ISL standards. Add-on to this custom gesture facility is also provided along with sentence formation. Additionally, an export to file module is also provided with TTS(Text-To-Speech) assistance meaning whatever the sentence was formed a user will be able to listen to it and then quickly export along with observing what gesture he/she made during the sentence formation.

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