Gesture Recognition using Leap Motion for Deaf and Dumb

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Abstract— Sign language is the way through which deaf and dumb people can communicate with each other. It has been observed that impaired people find it very difficult to interact with the society. Normal person cannot able to understand their sign language. This system uses Leap Motion Controller to capture the signs. Thus, the method is proposed for feature extraction of dynamic gesture of Indian sign language. This proposed method extract feature from the sign and convert to the intended textual form and audio form. This integrated feature improves the performance of the system, the system serves as an aid to disable people. The purpose is to design a Sign Language switch into speech Translation system for gesture based on a 3-dimensional (3D) motion detector referred to as Leap Motion device. The leap motion device consists of three infrared sensors and two inbuilt cameras which is capture 3D images or hand gestures.

Index Terms— Gesture Recognition, Leap Motion, Sign Language.

1 INTRODUCTION

Sign language is widely used by people who cannot speak and hear or people who can hear but cannot speak. A sign language is composed of various gestures formed by different hand shapes, movements and orientations of hands or body, or facial expressions. These gestures are used by the deaf people to express their thoughts. But the use of these gestures is always limited in the deaf-dumb community, normal people never try to learn the sign language. This causes a big gap in communication between the deaf–dumb people and the normal people. Usually deaf people seek the help of sign language interpreters for translating their thoughts to normal people and vice versa. But this system is very costly and does not work throughout the life period of a deaf person. So, a system that automatically recognizes the sign language gestures is necessary. Such a system can minimize the gap between deaf people and normal people in the society.

There are various sign languages across the world. The sign language used at a place depends on the culture and spoken language in that place. Indian sign language (ISL) is used by the deaf community in India. It consists of both word level gestures and fingerspelling. Fingerspelling is used to form words with letter by letter coding. Letter by letter signing can be used to express words for which no signs exist, the words for which the signer does not know the gestures or to emphasis or clarify a word. So, the recognition of fingerspelling has key importance in sign language recognition.

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2 LITERATURE SURVEY

Researchers have used one of the means for acquiring hand Signs like Web Camera, instrumented Glove, Depth Camera and Kinect sensor. In this paper, an Indian Sign Language recognition system is developed which recognizes ISL (with both hands) using Leap Motion sensor. This sensor overcomes the major issues in real time environment like background, lightening condition, and occlusion. The leap motion sensor captures the hand gesture and gives finger position in 3D format (X, Y, Z axis values). The positional information of five finger tips along with center of palm for both the hand is used to recognize sign posture based on Euclidean distance and Cosine similarity [1].

In this paper, the gestures illustrated by the Indian Sign Language symbols will be conquered with the support of the flex sensors and accelerometer. The movements included during gesture representation are rotation, angle tilt, and direction changes. The flex sensor and the accelerometer are incorporated over fingers and wrist respectively to acquire their dynamics, these sensors are fitted over the data glove. These voltage signals will then be proposed by microcontroller and sent to voice module, where the words voice outputs are stored and play backed equivalent to each word values to produce the appropriate voice words with the help of the speaker [2].

Sign language recognition is a promising application that breaks the barrier between deaf and normal people. To make it a practical application it needs to exist in a free environment. Previous developed systems suffered from the controlled environment constraint, if one of the control assumptions is violated. The recognition accuracy dramatically decreases. A post processing module based on Natural Language Processing rules is needed to detect and correct expected errors resulting from recognition system. A semantic-orientation approach which can correct semantic level errors as well as lexical errors and is more accurate especially for domain specific sign language recognition error detection and correction [3].

The Sign Language Recognition system capable of recognizing 26 gestures from the Indian Sign Language by using

MATLAB. The proposed system having four modules such as: pre-processing and hand segmentation, feature extraction, sign recognition and sign to text and voice conversion. Segmentation is done by using image processing. Different features are extracted such as Eigen values and Eigen vectors which are used in recognition. The Principle Component Analysis (PCA) algorithm was used for gesture recognition and recognized gesture is converted into text and voice format [4].

A system is designed as a sign language teaching aid and it is capable of generating the sign language equivalent of an input phrase or sentence in textual or audio form, with automated processing for language construct such as tenses and plurals. For words or phrases, especially named entities not present in the repository, the system strings together images or video clips of alphabets to transcribe the input. The system also has the provision for user to record their version of phases and words as video clips to augment the systems repository. This particularly useful for pedagogy in Indian sign lanuages, since most schools have their own vocabulary. The system was designed with inputs and continuous feedback from faculty at the mathru center for deaf, dumb and differently abled in Bangalore. We envisage continuing to test the system and augment features to eventually open this up as a useful avenue for the pedagogy of sign language [5].

3 PROPOSED METHODOLOGY

1. Data Collection:
The proposed system will take 3D dynamic signs as input. The data is collected using Leap Motion Controller. The Leap Motion Controller is a small USB peripheral device which is designed to allow users to control their computers with hand gestures alone. This sensor is 3D non-contact motion sensor which can detect and track hands, fingers, bones and finger like objects reporting discrete position and motion. The heart of the device consists of two monochromatic IR cameras and three infra-red LED's. The device has a large interaction space of eight cubic feet and viewing range is approximately 1 inch to 2 feet (60 cm) above the device. The Leap Motion system employs a right-handed Cartesian coordinate system. The origin is centered at the top of the Leap Motion Controller. The x-axis lies in the horizontal plane and running parallel to the long edge of the device. The y-axis lies in vertical plane, with positive values increasing upwards. The z-axis has positive values increasing toward the user and it is lie in the horizontal plane.

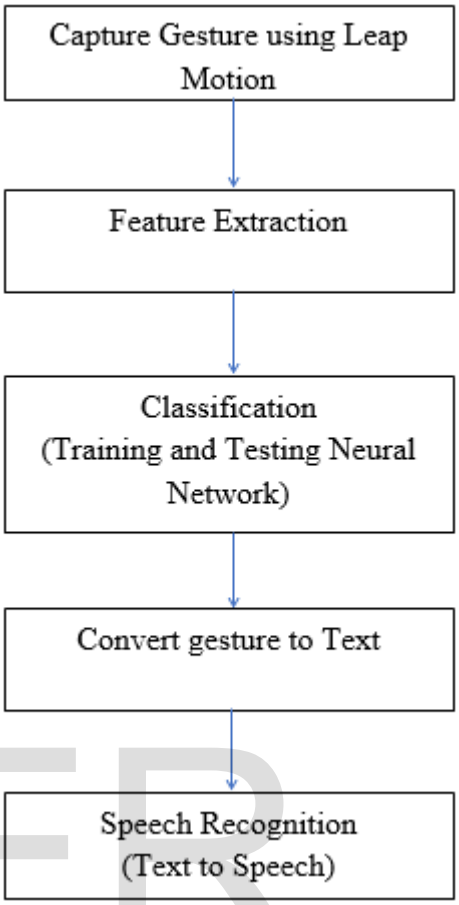

Fig.1. Block diagram of Proposed System

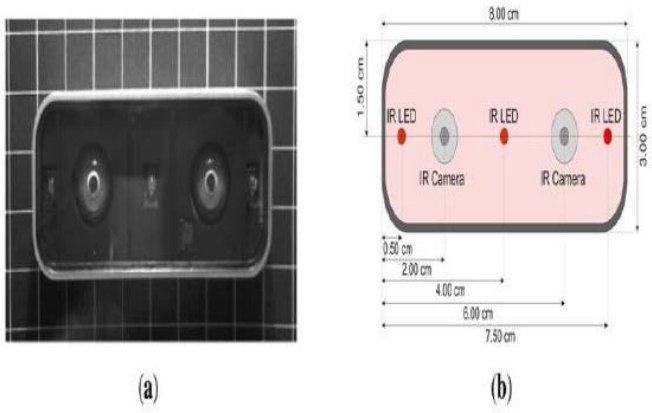

Fig.2. Leap Motion

2.Feature Extraction:
Leap motion API include different features for hand, fingers, bones and gesture. Some of them as follow:
Hand: The hand model provides information about the type (left, right or both hand), position (the centre position of the Palm in millimetres), velocity (in millimetre per second) and

other characteristics of a detected hand, the arm to which the hand is attached, and lists of the fingers associated with the hand.
Fingers: Fingers related features include finger direction (a unit direction vector), finger length (in millimetre), width, tip position, tip velocity, dip position, pip position, mcp position.
Gestures: Certain movement patterns recognized by leap motion controller. LMC recognizes the motion of a finger tracing a circle in space as a Circle gesture, linear movement of a finger as a Swipe gesture, downward tapping movement by a finger or tool i.e. tapping a keyboard key as a Key Tap gesture, forward tapping movement by a finger or tool i.e. tapping vertical computer screen as a Screen Tap gesture.

3.Classification:
The feature vector obtained from the feature extraction step is used as the input of the classifier that recognizes the sign. Neural network is used as classification tool. Classification step involves two phases Training phase and testing phase.

A data base of all hand signals is created using tensor flow in Python Language. The feature points are extracted using feature extraction technique. The extracted points are stored in CSV file. Using tensorflowmachine learning framework, the classification is done using deep learning neural network. The data is splitted using sykit learn model in which most of the data is used for training and rest is used for testing. The trained model is then used for the evaluation of the test data which is obtained from sykit learn split function. The data is read from CSV file which is used to predict the function. Alist is obtained which contains probability of various classes and based on this probability class is determined. The text is then converted into speech using google text to speech.

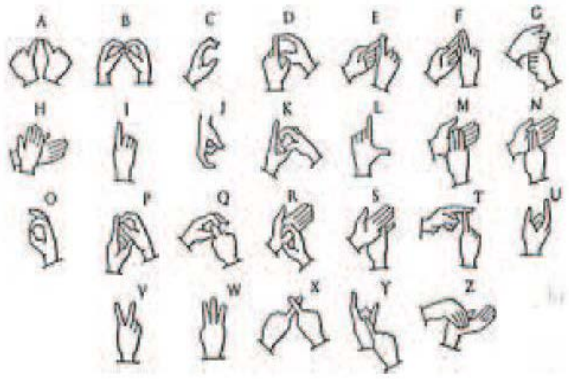

Fig.3. Postures in ISL

4 Results and Discussion

The proposed system was implemented using leap motion and the code is written using python programming language. Data is collected from gesture using leap motion sensor. A data base of all hand signals is created using tensor flow in Python Language.

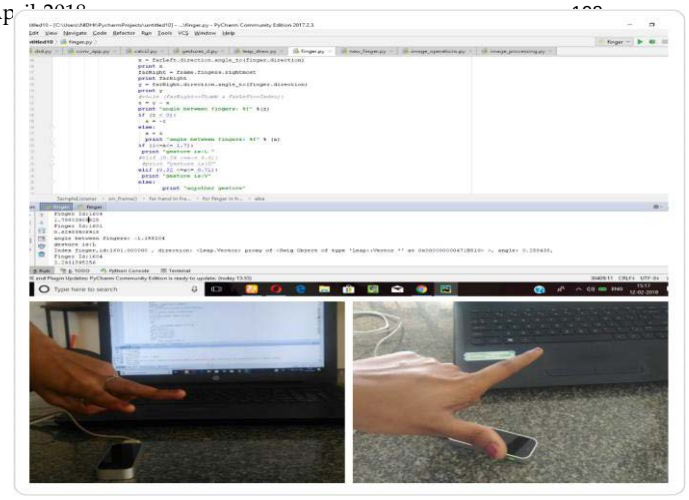

Fig.4. Recognized Gesture

All the gestures are trained into the Neural network and text is assigned to each gesture using recurrent neural network. The Neural network is the input for Microprocessor and the input is given using leap motion controller. The neural network code running in the microprocessor detects the hand signals. The convolutional neural network converts images to vector. The vector is fed to recurrent neural networks which gives output in the form of text. Then using a third-party software, the text is converted into speech.

5 Conclusion

Sign language recognition is essential for the deaf and dumb people to communicate with other people. Leap motion controller is used to recognize the Indian sign language. Leap motion controller is 3D non-contact motion sensor which detects and tracks hands, finger, bones and finger like objects reporting discrete position and motion. It has some advantages like robustness, requires less memory, fast processing. It does not require any specific background and environmental condition.

6 References

[1] Rajesh B. Mapari, Govind Kharat, "Real Time Human Pose Recognition Using Leap Motion Sensor", 2015 IEEE International Conference on Research in Computational Intelligence and Communication Networks (ICRCICN).

[2] NeelaHarish, Dr. S. Poonguzhali, "Design and development of hand gesture recognition system for speech impaired people", 978-1-4799-7165-7/15/$31.00 2015 IEEE.

[3] M. F. Tolba, A.S. Elons, "Recent Developments in Sign Recognition System",978-1-4799-0080-0/13/$31.00 2013 IEEE.

[4] Shreyasi Narayan Sawant, M.S. Kumbhar, "Real Time Sign Language Recognition using PCA", 978-1-4799-3914-5114/$31.00 2014 IEEE.

[5] Tejas Dharamsi, Rituparna Jawahar, Kavi Mahesh, Gowri Srinivas, "Stringing Subtitles in Sign Language",978-1-5090-6115-0/16 $31.00 2016 IEEE.

[6] P. Subha Rajam, Dr. G. Balakrishnan, "Real Time Indian Sign Language Recognition System to aid Deaf-Dumb People", 978-1-61284-307-0/11/$26.00 2011 IEEE.

[7] Deepali Naglot, Milind Kulkarni, "Real Time Sign Language Recognition using the Leap Motion Controller".
[8] Adithya V, Vinod P. R, "Artificial Neural Network Based Method for Indian Sign Language", 978-1-4673-5758-6/13/$31.00 2013 IEEE.