Hand Gesture Recognition for Indian Sign Language: A Review

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***Abstract*— Gesture recognition is a technique to analyze the human body movement. It helps humans communicate with machines (HCI) naturally without any mechanical devices. There has been always considered a challenge in the expansion of a natural interaction interface, where people interact with expertise since they are used to cooperate with the real world, this technique is called as Human Computer Interaction (HCI). Here, we are going to have a study on Hand Gesture Recognition. It has really vast area to research where we have select the very interesting topic Indian Sign Language. ISL has got standardised recently, so there is little research work that has happened in this area. In this area we have many developed methods to recognize alphabets and numerals of ISL. There are various approaches for recognition of ISL and we have done a comparative study among Hidden Markov Model (HMM), Naïve Bayes' Classifier, YUV Colour space and CAMSHIFT Algorithm and Back Propagation Neural Network (BPNN).**

***Keywords*— Indian Sign Language, Human computer Interaction, Hidden Markov Model, Naïve Bayes' Classifier, CAMSHIFT algorithm, Back Propagation Neural Network..**

I. INTRODUCTION

Today, the most growing research technology is gesture recognition technique. It has just changed the human's life by automating the system. Gesture recognition technique has made the easy way to act together with the computer to interpret the information given by the human body movements and recognize the particular gestures. Gestures can develop by any human body movement basically:

- Face Movement and Facial Expression
- Hand Movement

In our review, we are basically concentrated on Hand movements or gestures recognition. In Hand Gesture Recognition research area the interesting and prominent topic is Recognition of Indian Sign language. Hand gesture recognition system can be work as an interface to converse with speech impaired and will link the communication gap between hearing impaired and normal people.

ISL is a standard language used by the deaf and dumb people to speak with the normal people. Hand gesture recognition system makes it possible to decode the gestures and identify the signs to produce the result as a text or voice. Developing a hand gesture recognition system for ISL is more challenging than other different sign languages due to the following reasons [1]:

- ISL uses both single hand and double hands to make gestures to represent most of the alphabets,
- ISL uses both static and dynamic type hand gestures.
- One hand moves faster than the other at times in dynamic hand gestures.
- Facial expressions are also included in this language.
- Many of the gestures result in hindrance.
- Locations of the hand with respect to body throw in to the Sign.
- Complex hand shapes.
- Head/Body postures.
- ISL has both global and local hand action.

Because of these challenges, a very little research work has been done in ISL recognition system. Considering all the points, this review presents four different techniques for hand gesture recognition system in ISL.

II. RELATED METHODOLOGY

A. Hidden Markov Models

Hidden Markov Models (HMMs) are used for data which contains temporal information and they are also known to have high classification rates, and because of these qualities this technique is quite popular for classifying dynamic gestures. HMMs is an easy and straight forward manner for gesture classification. HMMs is basically to sense pointing gestures and after that it uses Gaussian Process Regression to calculate approximate pointing direction [2].

This technique (Hidden Markov Model) works with the dynamic nature of gestures. Gestures are taken from a video frames by tracking the skin-colour blobs responding to the hand into a body – face space centered on the face of the user. The objective is to make out two classes of gestures: deictic and emblematic. The image is get filter using a fast look–up indexing table of skin colour pixels in YUV colour space.

After this, skin colour pixels are getting assembled into blobs. These are statistical objects based on the location (x,y) and the colorimetric (Y,U,V) of the skin colour pixels in a way to find out homogeneous areas. This skin colour pixel belongs to the blob which has the similar location and colorimetric component. Deictic type gestures are pointing movements in the direction of the left (right) of the body–face space and emblematic (symbolic) gestures are projected to perform commands (grasp, click, rotate) on the left (right) of shoulder [3].

B. *Naïve Bayes' Classifier*

This is an effective and fast technique for static hand gesture recognition. This method is based on classifying the gestures according to geometric-based invariants which are obtained from picture after segmentation. Like any other method, this method is not dependent on skin colour technique. The gestures are extracted from each frame of the video which has still background.

The next, segmentation is made by dynamic extraction of background pixels depend upon the histogram of each image. Gestures are classified by a weighted "K-Nearest Neighbours Algorithm", which is shared with a Naïve Bayes approach to calculate the probability of each gesture type [6].

When the following technique was experienced in the area of the JAST Human Robot dialog system, it classified even more than 93% of the accurate gestures. This algorithm proceeds in three main steps:

1. 1st step is to segment and tag the objects of interest and to extract geometric invariants from them.
2. Next, the gestures are classified using a" K-nearest neighbour algorithm" with distance weighting algorithm (KNNDW) to present suitable data for a locally weighted Naïve Bayes' classifier. For this classifier the input vector consists of invariants of each region of interest, while the output is the type of gesture.
3. After getting the classified gesture, the last and final step is to establish the specific properties of gesture that are required for processing in system like: the fingertip for a pointing gesture or the centre of the hand for a holding-out gesture [3].

C. *YUV Color Space and Camshift Algorithm*

This deals with recognition of hand gestures. This has the following five steps [3]:

1. First, need a video stream of hand gestures through the digital camera.
2. The various frames are taken into consideration and then segmentation is performed by YUV colour space skin colour. This YUV colour system is working for separating chrominance and intensity. The symbol Y indicates intensity and intensity. The symbol Y indicates intensity while UV specifies chrominance components.
3. After that, the hand is segmented using CAMSHIFT algorithm. Since the hand is the largest connected region, we can segment the hand from the body.
4. When this process id done the position of the hand centroid is calculated in each frame. And for this we need to calculate the zeroth and first moments and then using this information the centroid is calculated.
5. At last different centroid points are combined to figure a trajectory. Then the trajectory shows the path of the hand action and by all these applied procedures the hand tracking procedure is determined.

D. *Back Propagation Neural Network*

The Back Propagation Algorithm [5] is an algorithm for layered feed-forward ANNs. In this the artificial neurons are prearranged in layers, and transmit their signals forward, and then the errors are propagated backwards. The network receives inputs by neurons in the input layer, and the output of the network is given by the neurons on an output layer. There may be one or more intermediate hidden layers. The BPNN algorithm is supervised learning. Meaning, that the algorithm knows the inputs and outputs of the network we want to compute, and then the error (difference between actual and expected results) is calculated. In this to make image in neural network form we use hand tokens [7].

The idea of the BPNN algorithm is to decrease the error until the ANN learns the training data. The training begins with random weights, and the target is to adjust them to get minimal error [4].

III. CONCLUSIONS

The Hand Gesture Recognition has various approaches, all approaches have their own specifications but we find the cheapest and faster method is BPNN algorithm which is most easy and simplest method for static images. BPNN has minimal error rate which makes it reliable for the system. Whereas HMM method is good for dynamic gesture recognition but in this method we need a good quality of device which needs to be able to detect the proper movement of hand and should have proper light effect to access the perfect skin colour to classify it. If we see the YUV Color Space and CAMSHIFT Algorithm it seems a good and cheapest method for dynamic gestures as it only needs to calculate the centroid. Naïve Bayes' classifier method is fast and effective for static gesture and it gives approximately 93% accurate result.

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