

## **LITERATURE REVIEW**

### **Paper 1: Real – time Two Hand Gesture Recognition with Condensation and Hidden Markov Models**

A method for recognising two-hand gestures is presented in this paper. The two basic methods used here for identifying hands are hand tracking and gesture recognition. This study provides a system that can identify 8 movements from real-time stereo colour images. Enhancing gesture recognition to separate the hands areas in photos, skin segmentation is used. Prior to performing morphological operations to smooth the hand areas, an area-based method is employed to localise the hand regions. This work consists of three steps: face detection, background subtraction, and YCbCr skin colour detection. Using a feature-based approach like Haar, the head or face can be distinguished from the hands. The feature is created, and the AdaBoost approach is used for classification. Selecting the palm region is used to localise two hands. A Condensation Algorithm (Conditional Density Propagation Algorithm) is used to monitor the motion of the hands. The condensation function algorithm is resistant to computational load and capable of tracking objects with multiple locations. Model parameters are determined iteratively by the method. The performance of the system is significantly impacted by choosing effective features to recognise the hand gesture path. Three fundamental characteristics are position, orientation, and velocity. The system performs a classification as its last step. During this phase, the HMM forward-backward method and Viterbi path over its discrete vector are used to distinguish the isolated and continuous gestures paths. Additionally, a full training for the initialised HMM parameters by the discrete vector is performed using the Baum-Welch algorithm to create a gesture database.

The proposed algorithm for distinguishing hands, localisation of the hands and classification of the gestures gives good results. It is possible to try out the same algorithms for gesture recognition in our project too.

### **Paper 2: Gesture Recognition System**

In this paper, they focus on posture and gesture recognition. An algorithm using Singular value Decomposition - Principal Component Analysis (SVD- PCA) and a feed-forward artificial neural network is designed. Posture Recognition features are extracted using the SVD-PCA approach and used for training and classifying.

Data is prepared that shows an image containing the hand and upper body portion and through this image skin pixels and edges are detected which are used in gesture-posture recognition. Skin pixels are detected using RGB colour space and then some specific morphological operations are performed.

Gray conversion is done on the input image and then a canny edge detection algorithm is used for the detection of edges and contours are obtained. The proposed method tracks posture in the upper body only. It can be extended to complete body posture recognition. But here, in the proposed technique, the background is uniform and only some types of postures are recognized.

### **Paper 3: Recognition Based on Hand Postures and Trajectories by Using Dataglove: A Fuzzy Probability Approach**

Posture detection for sign language is mainly done in 2 ways: 1. Using image processing algorithms 2. Using embedded IoT based gloves. This paper has focused on 2<sup>nd</sup> method. A data glove has been designed which is capable of recording hand movements, both the position of the hand and its orientation as well as finger movements; it is capable of simple gesture recognition and general tracking of three-dimensional hand orientation. Many models have been reviewed in this paper.

Hidden Markov Models (HMM) are an ideal approach for hand gesture recognition. HMM is a statistical model where the distributed initial points work well and the output distributions are automatically learned by the training process. It is capable of modelling spatio-temporal time series where the same gesture can differ in shape and duration.

Spatio-temporal signal processing may be classified into three tasks. Each task involves trying to generate a particular output pattern when a specific input sequence is seen. This is appropriate for speech recognition and hand gesture recognition, for example. It also includes the task of generating the rest of a sequence after part of it has been seen.

P2DHMMs are made up of five levels of states, one for each significant facial region. A gesture is a specific combination of hand position, flexion and position observation at some time instance. The system identifies a gesture based upon the temporal sequence of hand regions in an image frame.

American Sign Language (ASL) is the language most commonly used by the American deaf community. ASL uses hand, body, and facial expressions to make signs and convey ideas or feelings. While sign language may be expressed manually, inclusion of other components makes it rich, pleasing, and informational. Neural networks are non-linear statistical data modelling tools. They are usually used to model complex relationships between inputs and outputs or to find patterns in data. Since 1990, Artificial Neural Networks have been used widely for solving engineering and industrial problems. Because of the popularity of neural networks, sign language researchers have applied them to solve their problems.

A fuzzy system implements a function (usually nonlinear) of  $n$  variables, given by a linguistic description of the relationship between those variables. Figure 7 illustrates the architecture of standard fuzzy systems. The fuzzificator computes the membership degrees of the crisp input values to the linguistic terms (fuzzy sets) associated to each input linguistic variable.

Sign languages, as spoken languages, have certain rules of grammar for forming sentences. These rules must be considered while translating a sign language into a spoken language. In the end, adding a speech engine to speak the translated text would help enhance ease of use.

### **Paper 4: Hand Gesture Recognition Using Deep Learning**

Gesture recognition - mathematical interpretation of a human motion by a computing device. This application belongs to the domain of hand gesture recognition which is generally divided into two categories i.e., contact-based, and vision-based approaches. It employs video image processing and pattern recognition of six static and eight dynamic Gestures.

For hand shape recognition, a CNN based classifier is trained through the process of transfer learning over a pretrained convolutional neural net which is initially trained on a large dataset. VGG16 as the pretrained model.

For hand shape recognition, the classifier transfer learning over a pre trained CNN that is initially trained on a large dataset work, VGG16 a CNN architecture 13 convolution layers followed by 3 fully connected layers. recognize eleven hand shapes, hence CNN is trained as a classifier using transfer learning methods. 55 thousand self-created image datasets out of which 70 percent were used for training and rest for testing. If recognized hand gesture is a dynamic hand gesture, then it will further be traced to detect motion. Static gesture requires only the hand shape. dynamic gesture requires both the hand shape as well as the motion of the hand. For tracing dynamic hand gestures, hand area is segmented out using HSV (Hue, Saturation, Value) skin colour algorithm in a frame, followed by cropping blob area.

Centroid of the blob is detected and traced. Five out of eleven hand shapes are used for dynamic hand gestures and rest for static hand gestures. These dynamic hand shapes are categorized into unidirectional and multidirectional hand gestures. Unidirectional hand gestures require shape and direction of motion of hand for commanding whereas multidirectional gestures require the position of hand along with its shape. Out of five dynamic hand shapes three are used for unidirectional gestures namely: swap, scroll and zoom, and remaining are used for multidirectional gestures of pointer and cursor.

### **Paper 5: An Efficient Approach for the Recognition of Hand Gestures from Very Low-Resolution Images**

The recognition of hand gestures has become an area of active research in the field of computer vision and machine learning. Our focus for this method has been to accommodate all these features so that the designed system can be used under all constraints of the system. The focus of the proposed method is the development of a simple, robust, and effective method for the recognition of hand gestures. The Information extracted is based on the geometrical structure of the hand and not on colour, size, or brightness. The low-resolution image containing the hand gesture needs to be pre-processed before the generation of the mask for the gesture. This involves the conversion of the RGB image to grayscale. Mask generation is the most critical step in the proposed method for the gesture recognition. Once the mask is obtained the next step is the extraction of the remaining information from the binary image. Post-processing is required to remove all small unwanted regions present in the binary image. For these morphological operations are applied to the image to enhance it information content. The final step is the recognition of the hand gesture. The proposed method recognizes the hand gesture from very low resolution images. The method is made robust to both the lighting conditions as well as the orientation of the hand gesture by taking into consideration the geometrical structure of hand. Hand gestures recognized by this method are the number of fingers raised by the person. Further work can be done in this area to accommodate even a larger number of gestures which considers the shape of hand or the motion trajectory of hand.

This idea of the recognition of the hand gesture can be extended further to generate sets of code from multiple images to develop even a larger number of applications for the human machine interaction. With the rapid pace of development and digitalization of the systems, the gesture recognition has gained a huge popularity for the human machine interface. The method is robust for the variable illumination conditions and orientation of the hand gesture. This type of systems can be

efficiently used for controlling various application like home automation by capturing image from a very far distance such as a corner of the room.