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Hand Gesture Recognition Using Clustering Based Technique

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Abstract: ***Hand Gesture Recognition play vital role for developing human computer interaction and sign language recognition. Sign language recognition is used for deaf and dump people. Existing system based on vision based static hand gesture recognition. Proposed work performs Dynamic Hand Gesture Recognition using clustering based technique. Clustering based technique provides good classification accuracy. Fourier Descriptor method is used for feature extraction in the proposed method. This method will reduce time complexity and it will improve accuracy.***

Keywords: Hand Gesture Recognition, Human Computer Interaction, Sign Language, Clustering, Fourier Descriptor.

1. Introduction

Image Processing is a type of signal dispensation in which input is image, like photograph or video and output may be image or characteristics or attributes associated with that image. Image is function f(x, y) and gives intensity at position (x, y) [1]. Hand gesture is a body language provides specific meaning is established through our language centre by palm and finger position and shape. Hand gesture provides a natural and expressive communication mode for human dialog or speech. Gesture consists of static hand gesture and dynamic hand gesture. In Static hand gesture shape of hand gesture is used to express meaning or feeling. Dynamic Hand Gestures are composed of series of hand movements for track motion of hand [6]. There are many applications regarding hand gesture like human to computer interaction and sign language for deaf and dump people. Main idea behind gesture recognition is identify human gesture and provide its meaningful information which is used in HCI [5].

The vision based method is less expensive then glove based method because it has not required wear glove but it is directly interact with system. A development of accurate classification technique and significant feature set in based method use k-means based radial basis function neural network for static hand gesture. By using clustering technique recognize dynamic hand gesture and for more accurate result also include gray scale algorithm, improved segmentation algorithm and apply rotation invariant using Fourier Descriptor and track moment using velocity and angle of rotation. Classifier has important role in hand gesture. Variety of classification method has existed but use neural network. In based method used k-means clustering algorithm for cluster of feature set. It is best clustering method than other like, fuzzy clustering based method.

In this paper, Existing system recognizes only static hand gesture without any frame extraction. The problem here to develop dynamic hand gesture using clustering based technique. Dynamic hand gesture with good classification is very useful in sign language. Most of dynamic HGR is provided low accuracy and take more time for recognition. So, this limitation is reduced in Proposed Work. Some existing system use Hu 7 moment function for dynamic HGR but it gives low accuracy and tale more time than Fourier Descriptor.

The rest of paper is divided as follow: Section2 discuss related work on hand gesture recognition, Section 3 presents proposed work on hand gesture, Section 4 deals with implementation results of hand gesture recognition. Section 5 concludes the paper.

2. Related Work

Dipak et. al. [9] proposed Otsu segmentation algorithm for segmentation of hand gesture region. Perform morphological operation filter noise. It is use contour tracking algorithm and local contour sequence. Classification is done using radial basis functional neural network. It is provide high accuracy and take more time. It is very complex.

Mohammad et. al. [10] proposed the HGR using in 3D environment using depth camera. For segmentation it is uses YCrCb color space for accurate skin detection. It is use encoded nonlinear RGB. After detecting hand remove noise from image. For contour detection find boundary region of detected hand then draw rectangular box around the contour and find center of hand. Three features are effectively used to recognize the gesture: orientation, Area of hand, Angle of Box. Calculate orientation of hand then check current hand area with previous are if previous area is greater than current are then moving away from camera else moving towards camera. After find area of hand find angle of box by using draw box around hand contour area. Classification is done using Hidden Markov Model (HMM). In this markov chain emits a sequence of observable outputs. It is model parameter $\lambda = (A, B, \pi)$ Where A is transition Matrix, B is Observation Matrix and π is initial probability distribution. Probability of each class sequence can be computed and highest probability is considered as output. After that polling method is used for classify gesture. This proposed method is provide 80.67% accuracy. It is not more dynamic.

Rajat et. al. [11] proposed system provide dynamic HGR by using intel image processing OpenCV. It has three stage: 1. detection & tracking: Lαβ color space is used for hand detection where α component represents pixel position between red and green and β is component represents between yellow and blue. Thresholding combined with color space to extract information. CAMSHIF (Continuously Adapted Mean Shift) Algorithm to track hand. 2. Feature extraction: Hu moment invariant has 7 moments which are invariant to rotation and translation. 3. Training & recognize. HMM with left- right banded model (LRB) technology. In this model state is not directly visible but output is visible and it is dependent on state. HMM has three topologies and it is fully connected and each state can be go back to itself. After completion of process maximal likelihood from gesture set selected. It has 90% accuracy. It is focus on speed not recognition rate.

Saad [12] proposed the process for detecting, understanding and translation sign language gesture to vocal language. There are two mode recording and translation mode. In recording mode, user adds gesture to dictionary. I n translation mode, gesture is compared with gesture stored in dictionary. In this method call this gesture "Recording Translation Gesture" or "RTG". This method contains four steps: 1.Getting joint of interest 2. Normalize the skeleton frame data 3. Build link list of temporary storage data 4. Detecting gesture. Dynamic Time Wrapping algorithm is used to compare gestures. It is provide 91% accuracy. It is not suitable for finger movement.

Jaya [13] proposed method for HGR using Microsoft Kinect Sensor. In preprocessing stage, Kinect depth feature for background segmentation of hand gesture. Feature Extraction is done using find contour of hand then calculate convex hull, convexity defects. After calculating defects extract image features. Classification is done using naïve Bayesian classifier. As a feature set Convex hull and convexity defects are are considered as two attributes to classify data. Number of images for each attribute set is considered as weighted sum. It is provide good classification rate. It is not recognize hand orientation and not recognize dynamic gesture.

Archana [14] introduces a HGR system to recognize the alphabets of Indian Sign Language. There are five modules:

1) Hand tracking: Camshift algorithm is used to hand tracking.
2) Hand Segmentation: HSV color space is applied on track hand for segmentation.
3) Feature Extraction: Shape representation techniques are used for feature extraction and define relationship between features.
4) Recognition: Genetic algorithm is better choice for managing randomness for natural samples and hand gesture analysis. In this algorithm first initialize population and evaluate fitness of each individual. Choice of parent based on fitness. Create new individual using 2 point cross over. Chose elements randomly and choose worst one and replace with new individual and check stop if best solution. It is easy to use and inexpensive approach but not more dynamic and applies on all.

Ayan [15] proposed hand gesture recognition under varying illumination. Overall process has two step: 1. Segmentation: To achieve segmentation of hand from complex background using Information Measurement Ratio based threshold technique. It is work more efficient in manner. 2. Training & recognition: Principle Component Analysis (PCA), Euclidian distance is used for recognize hand accurately and efficiently. In training phase, first convert image matrix to column vector and calculate average matrix and difference matrix. Find covariance matrix using Difference matrix and calculate Eigen value and Eigen vector. In recognition phase, transform image into its components and compute vector and its Euclidian distance. PCA is fast, simple and accurate. It has also reduced dimensionality of picture and cheaper in terms of time. It is give reduce time complexity but not apply on orientation of hand gesture recognition.

Parul [16] This paper provide method for recognize sign language. It has three steps: 1. Pre-processing: First input sign image in RGB to convert into Lab colour space where L is lightness a and b are two colour channel. Lab color space for convert image into binary image and hand region is cropped and perform filter for remove noise.2. Feature Extraction: It is done using Area, height, centered-origin Euclidance distance, Average height. 3. Classification: Feed forward back propagation algorithm is used for training and classification. Feed forward back propagation training algorithm is supervised learning algorithm. In this input and output vector are provided for training network. Target vector is provided for each input gesture. It is provide 85% accuracy. It is not recognize dynamic gesture.

3. Proposed Work

In this section, Dynamic Hand Gesture Recognition using clustering based technique. Flow chart of proposed work is as follow in figure 1:

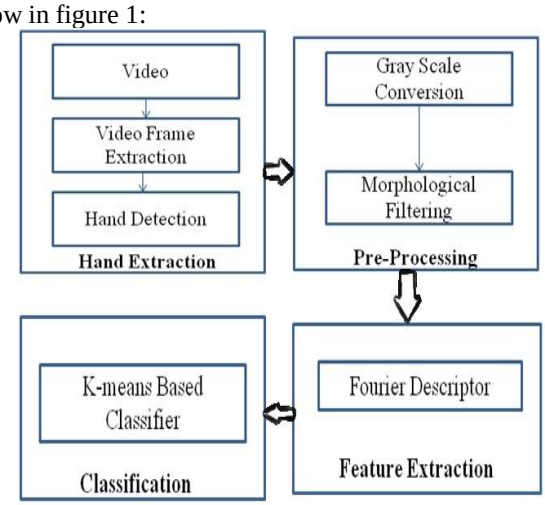

Figure 1: Proposed Dynamic Hand Gesture Recognition

Proposed Work is based on Dynamic Hand Gesture Recognition (HGR). Dynamic HGR is performed with 4 steps:

1) Hand Extraction
2) Pre-Processing
3) Feature Extraction
4) Classification or Recognition

3.1 Hand Extraction

Image frames are being retrieved from the video at 25 or 29 frames per second (fps), depending on video type. This image is in rgb form. It is then passed to the next step for applying skin color detection using YCrCb skin color detection function for detect hand region from frame.

3.2 Pre-Processing

After hand extraction pre-processing step are performed on hand gesture. First convert hand region into gray scale. Greyscale is performed using inbuilt function of EmguCv library. For filter noise in Gray scale hand region performed morphological filter. Morphological filter is performed using dilation, erosion.

3.3 Feature Extraction

Feature extraction is performed using Fourier descriptor method. Fourier descriptor contains boundary pixels, signature function and computation of Fourier descriptor (FD). Edge detector and boundary tracing are used for computation of boundary pixel. From boundary pixel shape signature function compute. Shape signature function contains complex coordinate, curvature, cumulative and cumulative angular function. Centroid distance method first compute centroid of shape for set pixel set by taking average of all pixels. Shape signature is formed by taking distance between centroid pixels to pixels in boundary. Apply Discrete Fourier transformation on shape signature. It is generate Fourier transformed coefficient of transformed phase. All Fourier transform coefficient standardized by first Fourier transform coefficient. Normalized coefficient is invariant translation, scale, rotation and change start point of contour. Shape feature vector contain in FD. Shape feature vector contains rotation, scale, translation invariant and change of start point. FD provides high accuracy and less time for computation. It is easy to normalize and also overcome the noise sensitivity in shape signature representation.

3.4 Classification

Classification is done using clustering technique. It is provided fast computation and high classification accuracy. It is unsupervised method. K-means based method is find center of two cluster and find euclidance distance between them. Then from that distance is find out finger calculation.

4. Test Results

In proposed method take input using video file. Input Video is 25 or 29 frame/sec. Using frame grabber frame extract from video file. On extracted frame apply skin color detection for detect hand. In pre-processing stage apply gray scale conversion on skin result and then apply morphological operation on that for remove noise. In feature Extraction stage apply Fourier descriptor on hand. Fourier descriptor is invariant to rotation, scale, translation and starting point of hand. On that feature apply k-means based clustering technique. Clustering method create different class of each sign and assign label to each and based on that detect sign. Proposed method is give 97.03% classification accuracy with reduce time complexity 53 msec. All operation results with its detected sign (0 to 5) is as shown in figure 2 and figure 3.

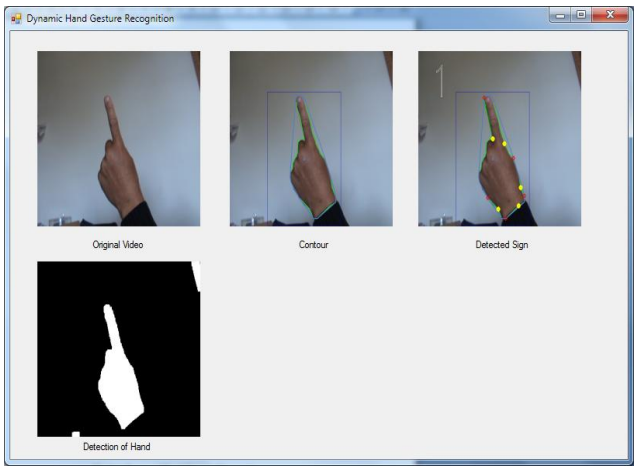

Figure 2: Proposed Hand Gesture Recognition (Detected Sign One)

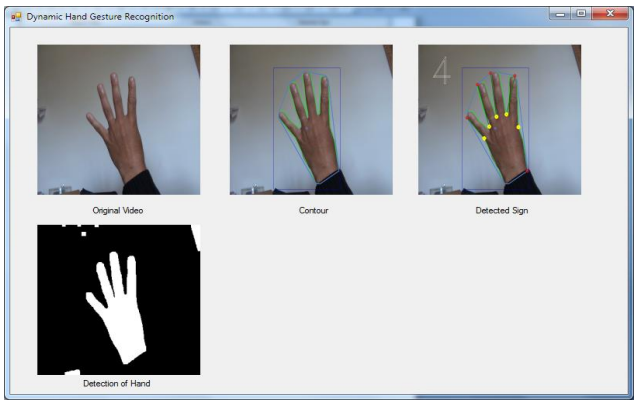

Figure 3: Proposed Hand Gesture Recognition (Detected Sign Four)

5. Conclusion

This paper implements dynamic hand gesture recognition. In Proposed dynamic hand gesture recognition, Fourier descriptor method is proposed for feature extraction and normalize that feature and provide to K-means based clustering technique for classification. Dynamic hand gesture recognition using clustering based technique is provided better accuracy and reduce time complexity than other methods. Future work is extended with better hand detection technique with varying background condition.

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