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Sign Language Recognition using Hidden Markov Model

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ABSTRACT*: Gestures are the motion of the body or physical action form by the user in order to convey some meaningful information. Hand gesture recognition system can be used as an interface to communicate with speech impaired and will bridge the communication gap between hearing impaired and normal people. Gesture recognition is very challenging research area and different methods such as hidden Markov models (HMM), particle filtering and condensation, finite-state machine as statistical modeling, optical flow, skin color, etc. are being used to obtain better results. Among these methods, HMM has proved to be the most frequent tool. It is statistical model and has been successfully applied for spatial-temporal processes with finite number of states. In a particular state one can use an outcome or observation according to an associated probability distribution which is used in robot movement, bioinformatics, speech and gesture recognition.*

Keywords- *Gesture recognition, Hidden Markov Model, spatial-temporal process.*

I. INTRODUCTION

Gesture is nothing but movement of hands, face and other part of body which is used to communicate specific message to express thoughts, ideas, emotions, etc. Though other parts can used for gesture but the hand is most easiest body part. So, in the field of Human-Computer Interaction (HCI) hand gesture recognition is an active area of research. The hand gesture recognition can be mainly divided into Data-Glove based and Vision Based approaches. The Data-Glove based methods use sensor devices for digitizing hand. Due to extra sensors it is easy to collect hand configuration and movement. It gives good performance but the devices are quite expensive. The other approach is the Vision Based methods which require only a camera, thus it gives a natural interaction between humans and computers without the use of any extra devices. Therefore it is efficient to use and also cost effective.

HMM is nothing but Markov process with hidden states. And this hidden parameters are obtained from observable parameters. Basically HMM has capability of modeling spatio-temporal information. Each gesture is modeled by a different HMM and given unknown gesture is tested by each HMM that is main advantage of HMM and The HMM output with maximum probability matching is nothing but the final recognized result. .The present paper focuses on the diverse stages involved in hand posture recognition, from the original captured image to its final classification. The flow of paper is presented as Literature review in section II, Methodology in section III, Results and Implementation in section IV and Concluded in section V.

II. LITERATURE REVIEW

S.Ahmed et al [1] presented a statistical method which converts image contour to orientation based hash codes in order to project it to 3D space bounded by hamming distance.

N. Tahir et al. [2] investigated an overview of the main research works based on sign language recognition system and developed system into sign capturing methods and recognition techniques are discussed.

Zhong yang et al. [3] introduced an HMM based method to recognize complex single Hand Gestures. Gesture images are gained by a common webcamera, skin color is used to segment hand ,spotting algorithm to splitting continuous gesture and then HMM is trained alone for each gesture.

F. Wong et al. [4] used kalman filter to identify overlapping of hand-head or hand-hand region. After having extracted the feature vector , hand gesture trajectory is represented by gesture path in order to reduce system complexity, then HMM is applied to recognize the image.

M. Panwar et al.[5], presents a real time system forhand gesture recognition on the basis of detection of some meaningful shape based features like orientation, centroid, status of fingers, thumb in terms of raised of folded fingers of hand and their respective location of image.

B. Michaelis et. al[6] represented an automatic system that executes hand gesture spotting and recognition simultaneously without any time delay based on hidden markov models(HMM).

III. METHODOLOGY

1. Hand Gesture Detection based on Shape Parameters:

The Proposed system consists of following steps to interpret the gesture from the input image.

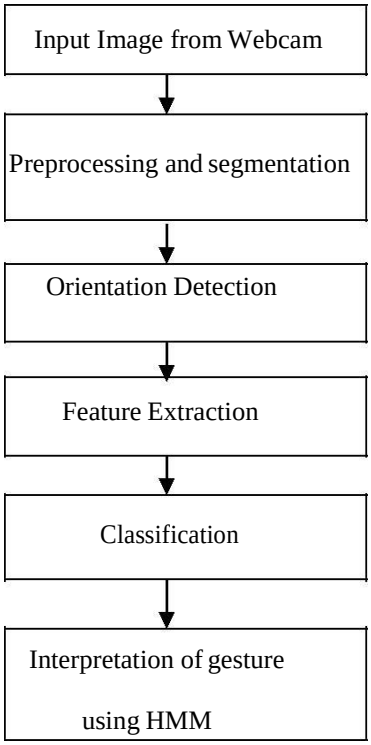

Figure 1: Block Diagram of Hand Gesture Recognition System

1.1. Input image from Webcam:

laptop.

The image is captured by the laptop webcamera. We can also connect the external USB camera to

1.2 Preprocessing and segmentation:

Image Preprocessing is necessary for image enhancement and for getting good result. During Preprocessing RGB image is converted into L*a*b colour space because it has larger colour gamut and it is device independent. To obtain the good result smoothing and filtering is done i.e removal of unwanted object using the biggest BLOB. Image segmentation is basically performed to locate the hand object in image. The K- mean clustering algorithm is used to segment the image into K clusters. This algorithm first computes centroid of each cluster to minimize the sum of distance from each object to its cluster centroid as possible. The result of K-mean clustering is a set of clusters that are separated from other clusters. In hand recognition system we having two clusters that is cluster 1 is hand having pixel value 1 and cluster 2 is background having pixel value 0. After hand segmentation boundary contours are calculated to locate the hand region. This process is done by scanning the image from top to bottom and left to right after that first white pixel is detected and it is set as left most point of hand. Then similarly right to left in top to bottom manner and first white detected pixel set as rightmost point.

1.3 Orientation Detection:

It is very important step for successful result. It identifies whether hand is horizontal or vertical. For that purpose length to width ratio of bounding box is calculated. If hand is vertical then length of bounding box is greater than width of bounding box and their ratio is greater than 1. If hand is horizontal then width of bounding box is greater than length of bounding box. And their ratio would be lesser than 1.

1.4 Feature Extraction:

1.4.1 Centroid:

Centroid is calculated for partitioning the hand into two halves, one which represents the finger portion and other which represents non finger region and it is calculated using image moment, which is weighted average pixel‘s intensities of the image.

$M_{ij} = \Sigma x \Sigma y\ x^i y^j I(x,y)$ ……(1) Where, M_{ij} is image moment, I(x,y) is intensity at coordinates (x,y).

1.4.2 Thumb detection:

Thumb detection step is calculated to detect the presence or absence of thumb in hand gesture.To detect the presence of thumb in hand, we proceed with the previously calculated bounding box and consider the left side and right side of this bounding box. After having these two boxes we count the total number of white pixels presents in binary image which represent the hand object. Then we count number of white pixels present in each box. If the no. of white pixels present in any of the box is less than 7% then thumb is present in that box only. If both boxes having more than 7% of total white pixels then thumb is not present any of the box and if both boxes having less than 7% total white pixels, thumb is not present any of the box.[6]

1.4.3 Finger region detection:

In this step we denote tip of the finger as peak. For getting the total number of finger raised in hand gesture we need to process only finger region of the hand that we have got in previous step by computing centroid. To complete this task there is need to trace the entire body matrices of hand.

1.4.4 Euclidean distance:

After marking the detected peaks or tip of the fingers in the hand we must find out the highest peak in the hand image. For this we calculate the distance between all tip of the fingers (detected peaks).

1.5 Classification:

Classification of hand is done with the help of various features calculated previously. The five bit binary sequence is thus generated to uniquely recognize and utilize these recognized hand gesture for supporting human computer interaction. By the feature extraction significant peak is encoded as 1 while insignificant peak is encoded as 0 based on intersection to the threshold line[6].

2. HMM-Based Feature Matching:

A hidden Markov model (HMM) is a statistical Markov model capable of modelling spatio-temporal time series with unobserved (hidden) states. In an HMM, the state is not directly visible, but output, dependent on the state, is visible. It has finite no. of states.

It has three topologies:

i) Fully Connected(Ergodic model): Any state in it can be reached from any other state.

ii) Left-Right: Each state can go back to itself or following states.

iii) Left-Right Banned: Each state can go back to itself to itself or following state only.

We choose LRB because it is good for modelling-order constrained time series and its properties also change over time in sequence and the no. of states are decided on the basis of complexity of gesture.[8].

A discrete HMM's parameter set λ is represented by one vector π and two matrices A and B. For 1st order process if M states are their then there are M^2 transitions. Associated with each transition is a probability called state transition probability. These M^2 probabilities may collected together in obvious way to state transition matrix i.e. matrix A. Vector π defines initial conditions that is at time=0 and Matrix B defined as Confusion matrix contains probabilities of the observable states given a particular hidden state.

IV. RESULTS AND IMPLEMENTATION

1) Original Image:

Figure 2: Input image captured by webcamera

2) Gray Scale Image:

Figure 3: Original image is converted to gray scale image

3) Histogram:

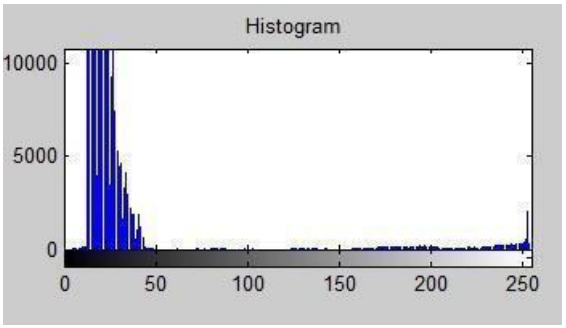

Figure 4: Histogram is plotted according to intensities of the image

4) Cluster I :

Figure 5: Hand is separated as a Cluster I

6) Cluster II:

Figure 6: Background is separated as a cluster II

7) Desired object

Figure 7: Desired object selected as a hand.

V. CONCLUSION

In this paper, we introduced hand gesture recognition system which has the capability of recognizing complex gestures .The system performs the hand gesture segmentation and recognition tasks simultaneously. It is mainly suitable for real-time applications and solves the issues of time delay between the segmentation and the recognition tasks. Features such as centroid, thumb detection, finger detection, Euclidean distance are extracted and given for further HMM matching.

There are some challenges for gesture recognition. In the general circumstance, a number of issues are to be addressed, such as complex background, background disturbance, object reappearance, illumination change and running in real time. To cope with these challenges the singular value decomposition can be used to extract minimum number of features.

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REFERENCES

[1] Ahmad, S.U.-D.; Akhter, S., "Real time rotation invariant static hand gesture recognition using an orientation based hash code," *International Conference on Informatics, Electronics & Vision (ICIEV),* vol., no., pp.1,6, 17-18 May 2013.

[2] Al-Ahdal, M.E.; Tahir, N.M., "Review in Sign Language Recognition Systems," *IEEE Symposium on Computers & Informatics (ISCI),* vol., no., pp.52,57, 18-20 March 2012

[3] Zhong Yang; Yi Li; Weidong Chen; Yang Zheng, "Dynamic hand gesture recognition using hidden Markov models," *7th International Conference on ,Computer Science & Education (ICCSE),* vol., no., pp.360,365, 14-17 July 2012.

[4] Gaus, Y.F.A.; Wong, F., "Hidden Markov Model-Based Gesture Recognition with Overlapping Hand- Head/Hand-Hand Estimated Using Kalman Filter," *Third International Conference on ,Intelligent Systems, Modelling and Simulation (ISMS),* vol., no., pp.262,267, 8-10 Feb. 2012.

[5] Panwar, M., "Hand gesture recognition based on shape parameters," *International Conference on, Computing, Communication and Applications (ICCCA),*vol., no., pp.1,6, 22-24 Feb. 2012.

[6] Khurana, G.; Joshi, G.; Kaur, J., "Static hand gestures recognition system using shape based features,"*Recent Advances in , Engineering and Computational Sciences (RAECS),* vol., no., pp.1,4, 6-8 March 2014.

[7] Menix, M.; Miskovic, N.; Vukic, Z., "Interpretation of divers' symbolic language by using hidden Markov models," *37th International Convention on , Information and Communication Technology, Electronics and Microelectronics (MIPRO),* vol., no., pp.976,981, 26-30 May 2014

[8] Shrivastava, R., "A hidden Markov model based dynamichand gesture recognition system using OpenCV," *IEEE 3rd International, Advance Computing Conference (IACC),* vol., no., pp.947,950, 22-23 Feb. 2013.

[9] Mitra, S.; Acharya, T., "Gesture Recognition: A Survey," *IEEE Transactions on ,Systems, Man, and Cybernetics, Part C: Applications and Reviews,* vol.37, no.3, pp.311,324, May 2007.

[10] Gaus, Y.F.A.; Wong, F.; Teo, K.; Chin, R.; Porle, R.R.; Lim Pei Yi; Chekima, A., "Comparison study of Hidden Markov Model gesture recognition using fixed state and variable state," *IEEE International Conference on, Signal and Image Processing Applications (ICSIPA),* vol., no., pp.150,155, 8-10 Oct. 2013.

[11] Byung-Woo Min; Ho-Sub Yoon; Jung Soh; Yun-Mo Yang; Ejima, T., "Hand gesture recognition using hidden Markov models," *IEEE International Conference on, Systems, Man, and Cybernetics, Computational Cybernetics and Simulation,* vol.5, no., pp.4232,4235 vol.5, 12-15 Oct 1997.

[12] Agrawal, A.; Raj, R.; Porwal, S., "Vision-based multimodal human-computer interaction using hand and head gestures," *IEEE Conference on Information & Communication Technologies (ICT),*vol., no., pp.1288,1292, 11-12 April 2013.