Advances in Computer Science and Information Technology (ACSIT)
Print ISSN: 2393-9907; Online ISSN: 2393-9915; Volume 2, Number 6; April-June, 2015 pp. 517-521

http://www.krishisanskriti.org/acsit.html

# Hand Gesture Recognition with Shape and Color for HCI

**Deepali Kaushik[1] and Ankur Bhardwaj[2]**

*[1,2]KIET (Department of computer science engineering) Ghaziabad*
*E-mail: [1]kaushikdeepali61@gmail.com, [2]ankurbhardwaj2002@gmail.com*

**Abstract—***In this paper, HCI based hand gesture recognition with shape and color is presented which requires no special hardware other than webcam. This paper presents a real time system, which includes detection and recognition using skin detection and hand postures algorithm. Hand gestures HCI is the study of interface between users and computers. The study presents get likelyhood method based on principal component analysis, support vector machine and sobel filter. The set of hand postures images with dissimilar scales, rotation and dimensional are trained in the training stage. In the testing stage, for every structure captured from a webcam, the hand gesture is detected using our algorithm. Finally, the minimum Euclidean distance is determined between the test weights and the training weights of each training image to recognize the hand gesture. The overall working is based on the shape and color which uses the technique sobel filter to detect the edge and HSV detect the object color. The principal components analysis (PCA) method is used to reduce the dimensionality of the feature space. The get likelyhood approach produce better result than other method in the terms of timing, accuracy and computational complexity.*

## 1. INTRODUCTION

Human computer interaction (HCI) refers to the interaction between human and computer [1]. There should be 2 characteristics to design a HCI system such as functionality and usability. System functionality means the services and functions that the system equips to the human while system usability means level and scope that the system can perform efficiently and fulfil the specific requirement of the user [2].

Hand gesture has been most common media among human being [3]. Hand gesture recognition has achieved a lot of attention because of its application. Gestures are usually understood as hand and body movement that can pass information from one person to another person. Now we will only consider hand gesture, the movement of the hand that express an idea or attitude to belong to a gesture [4,5]. The work related to hand gesture recognition based on get likelyhood method which has been proposed detection, segmentation and recognition gestures. Most of recent works related to hand gesture technique as glove based. Glove based gesture interface require the user to wear a cumbersome device and carry a load of cables that connect the device to computer [6].

This paper introduces hand gesture recognition with shape and color unlike previous gesture recognition system. Our system neither uses instrumented glove nor any markers. The new method is derived get likelyhood method which is work on recognition of hand gesture easily. This method Get likelyhood method categorized as Sobel filter, PCA and SVM (classifier) to recognize the hand gesture.

We have design this project on fig. 1. In which each phase is implemented and produce the appropriate result. This structure is feasible to recognition hand gesture and produces the best result than other.

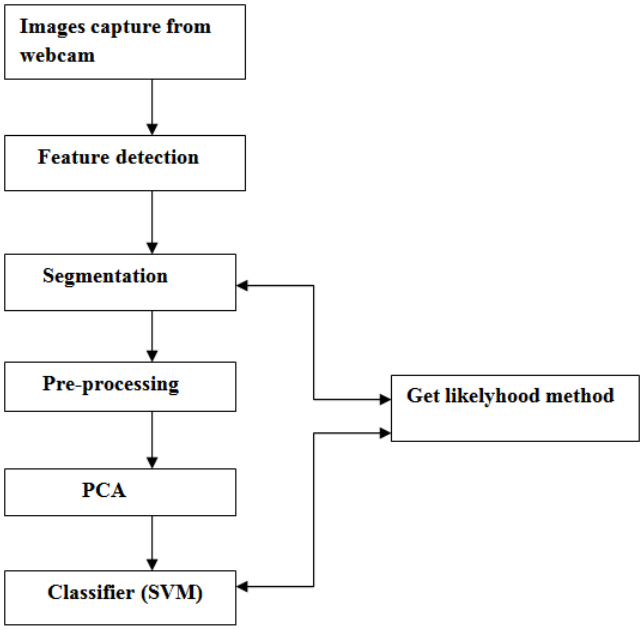



**Fig. 1**

## 2. METHODOLOGY

Classified gesture recognition system into mainly three steps after acquiring the input image from camera(s). These steps are: Extraction Method, pre-processing and classification or recognition.

**(1)Extraction Method**

It is the process of dividing the input image (in this case hand gesture image) into regions separated by boundaries. The segmentation process depends on the type of gesture, if it is dynamic gesture then the hand gesture need to be located and tracked, if it is static gesture (posture) the input images have to be segmented only [7]. The hand should be located firstly, generally a bounding box is used to specify the depending on the skin color and secondly, the hand have to be tracked, for tracking the hand. We will apply HSV color model which concentrates on the pigments of the pixel, used YCbCr color space used normalized r-g color space.

HSV color model is used to detect the color object from original RGB image. It can find out properly pixels of hand with the help of color model [8]. We will show this with the help of image fig. a and fig. b.

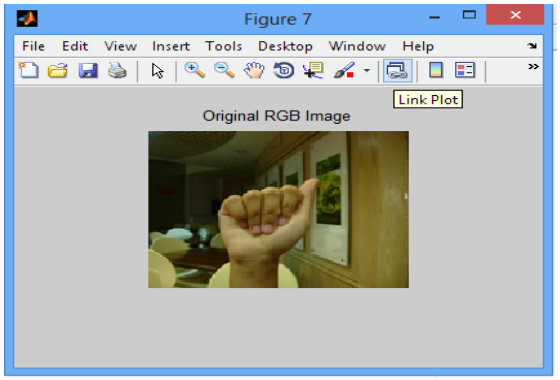



**Fig. a**

After using HSV color model we can easily identify the hand skin color and process further implementation.

**(2)PRE-PROCESSING**

Good segmentation process leads to perfect features extraction process and play an important role in a successful recognition process. Features vector of the segmented image can be extracted in different ways according to particular application.

These are necessary steps to segment the hand from the original frame as edge detection and skin segmentation.

**2.1 EDGE DETECTION**

We will use sobel filter for edge detection. Edge detection is applied to separate the complete region from the hand region. Here, we use a sobel filter for simple edge detection to obtain different direction edges, and then choose the absolute maximum value of each pixel to form the edge image of ith frame: this technique is used to detect the edge of object from complete region without any error and useful for easily find the object [9]. After the implementation of edge detection algorithm (sobel filter), we find edge detected image as shown in fig. d. After this process we can precede further implementation for hand recognition.

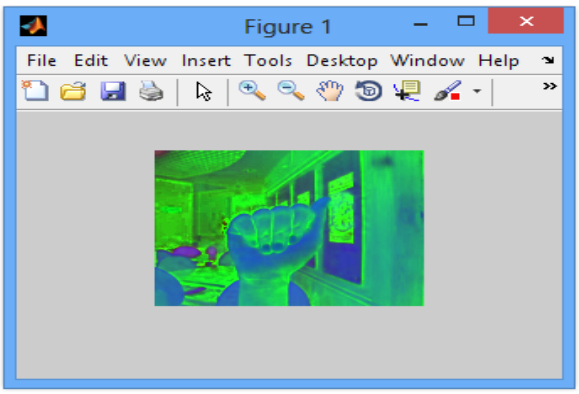



**Fig. b**

**Pseudo-codes for Sobel edge detection method**
**Input:** A Sample Image
**Output:** Detected Edges
Step 1: Accept the input image
Step 2: Apply mask *Gx*, *Gy* to the input image
Step 3: Apply Sobel edge detection algorithm and the gradient
Step 4: Masks manipulation of *Gx*, *Gy* separately on the input image
Step 5: Results combined to find the absolute magnitude of the gradient

$$G = \sqrt{Gx2 + Gy2}$$

Step 6: the absolute magnitude is the output edges.

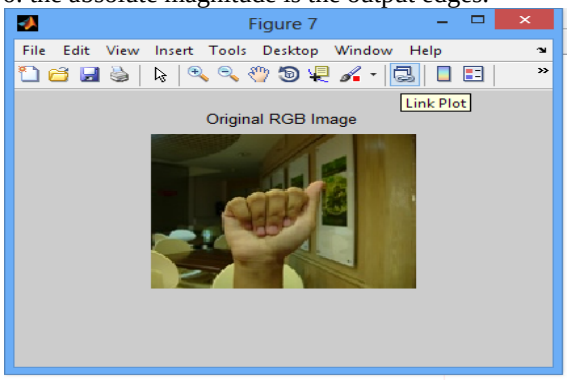



**Fig. c**

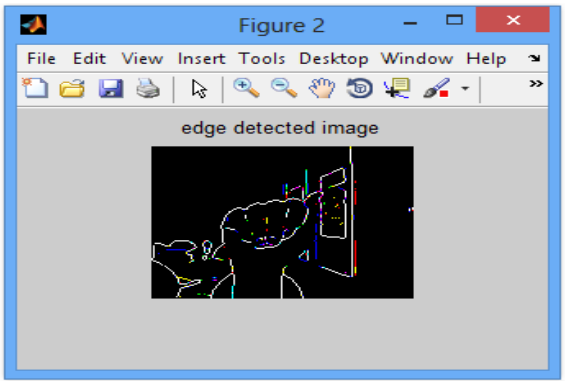



**Fig. d**

### 2.2 SKIN SEGMENTATION

To recognize the hand gesture, we will use skin segmentation method in which we can find skin color of hand.

Skin color segmentation is very important to recognise the hand gesture while we check the gesture is performed by hand then we will check the skin color of the hand. If skin color is match from database then hand is recognise. After that we will check the gesture perform by that hand.

So skin color is essential part to recognise the hand. We have 13 skin colors in database, which is shown below-

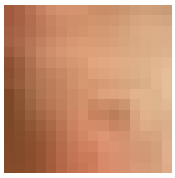


**(i)**

**(ii)**

**(iii)**

**(iv)**



**(v)**

**(vi)**

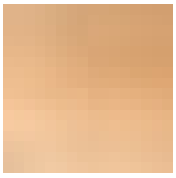
**(vii)**

**(viii)**

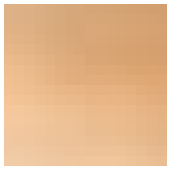


**(ix)**

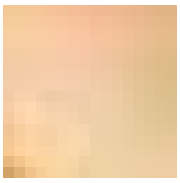
**(x)**



**(xi)**



**(xii)**



**(xiii)**

To skin segmentation we will take the edge detection image and apply this technique. Firstly it subtract the edge detected image from the original image as we can see in fig. (e).after that we can apply skin segmentation technique which can find the skin color. Therefore, we will find many regions other than the skin regions. However, those non-skin regions satisfy our constraint will be to find the skin regions, we compare the colors in the regions with the pre-stored sample color [7]. If they are similar, then the region

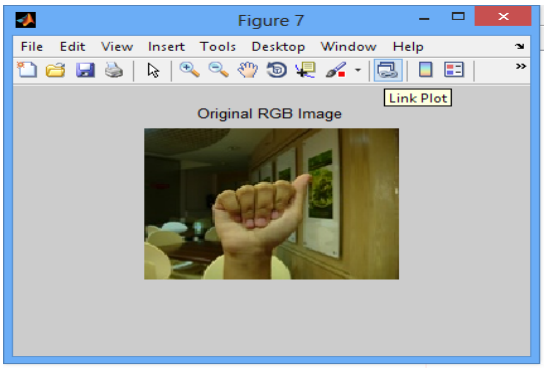



**Fig. e**

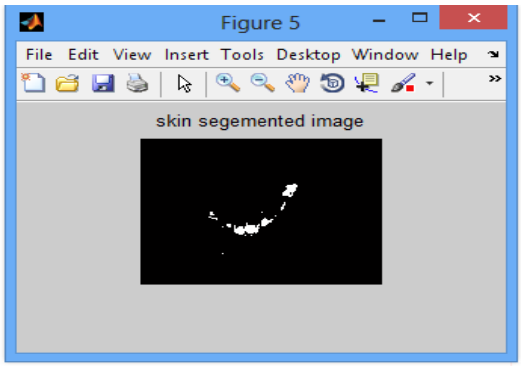



**Fig. h**

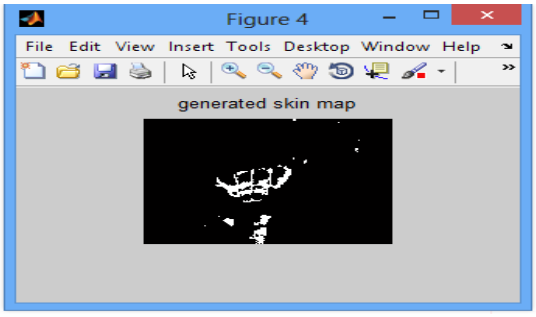



**Fig. g**

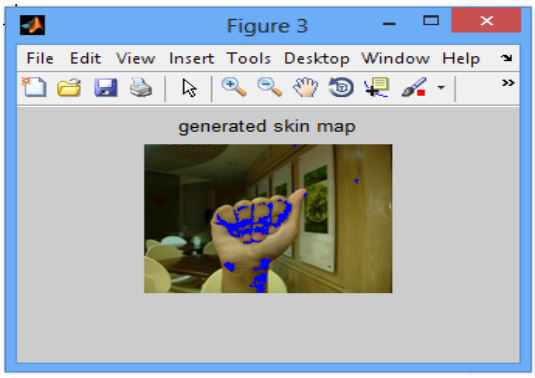



**Fig. f**

we compare the colors in the regions with the pre-stored sample color [7]. If they are similar, then the region must be skin region. Fig (f), (g), (h) shows our skin detection results.

## 3. RECOGNITION

### 3.1Feature extraction

To extract the features from training images, we use the principal component analysis (PCA) algorithm [10]. This methodology is applied to our approach as below:

**Step 1**: obtain a set S with M training images; each image is transformed into a vector of size N = 10000 (100×100) and placed into the set.

$$S = \{\Gamma_1, \Gamma_2, \Gamma_3 \ldots \Gamma_M\} \quad (7)$$

**Step 2**: compute the mean image

$$\Psi = \frac{1}{M}\sum_{i=1}^{M} \Gamma i \quad (8)$$

**Step 3**: find the difference between each training image and the mean image

$$\Phi_i = \Gamma_i - \Psi \quad (9)$$

**Step 4**: obtain the covariance matrix $C$ in the following manner

$$C = \frac{1}{M}\sum_{i=1}^{M} \Phi i\, \Phi_i^T = \frac{1}{M} AA^T \quad (10)$$

Where $A = [\Phi_1, \Phi_2, \Phi 3 \ldots \Phi_M]$

**Step 5**: we seek a set of $M$ orthonormal vectors $u_i$ which best describes the distribution of the data. The size of the matrix $C$ is too big (10000×10000). So to find $u_i$, we seek eigenvectors $v_i$ of the matrix $L = A^TA$ with size $M \times M$.

**Step 6**: compute eigenvectors of the matrix $C$ based on eigenvectors of the matrix $L$.

$$u_i = Av_i \quad (11)$$

**Step 7**: each training image $\Gamma$ is transformed into new space and represented as a vector $\Omega$.

$$\Omega = u_i^T(\Gamma - \Psi) \quad (12)$$

$$\text{With } \Omega^T = [\Omega_1, \Omega_2, \Omega_3 \quad \Omega_M]$$

The obtained vectors are the feature vectors used for training. To recognize an image, the input is transformed into new space using the formula (12) and the obtained feature vector is put into the neural network.

### 3.2Classification

The **Support Vector Machine** is a theoretically superior machine learning methodology with great results in classification of high dimensional datasets and has been found competitive with the best machine learning algorithms. SVMs have often been found to provide better classification results that other widely used pattern recognition methods, such as the maximum likelihood and neural network classifiers. Thus, SVMs are very attractive for the classification. An SVM approach for multi-class classification was followed, based on primitive image. The segmentation algorithm produced primitive objects of variable sizes and shapes. Then, a feature selection step took place in order to provide the features for classification which involved spectral, texture and shape information [11]. The SVM procedure produced the final object classification results in fig. i which were compared to the Nearest Neighbour classifier results, of the recognition software, and were found satisfactory.

## 4. RESULT

The experimental results are presented to show the effectiveness of the proposed system. Our hand gesture recognition system was carried out on a 2.33 GHz Intel (R) Core i3 2Duo CPU 2 GB RAM on Windows 8 platform using MATLAB R2010a. We have tested 12 different hand gestures. Each gesture is tested 40, 80 and 100 times with three different persons. There are 11 different gestures, and 275 image sequences used. The recognition rate of this system is 98.9%.

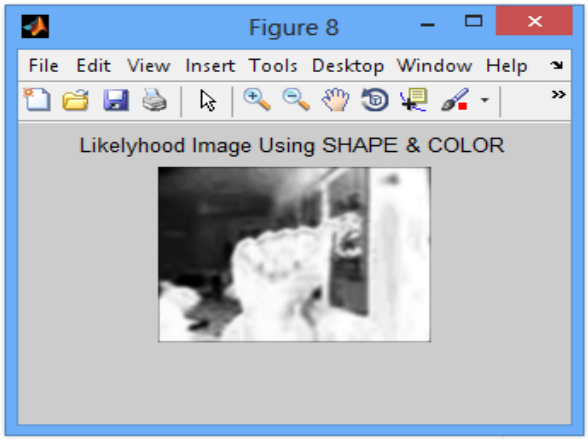



**Fig. i**

**Comparison of classification method:**

| Classification method | Classification rate |
|---|---|
| SVM | 98.9% |
| Multivariate Gaussian Distribution | 88.5% |
| Neural network | 90.45% |
| Hidden Markov Models | 98.3% |

## 5. CONCLUSION

A new technique get likelyhood has been proposed to increase the adaptability of a gesture recognition system. We have implemented a real-time version. This technique consists following process such as: segmentation, pre-processing, feature extraction, recognition etc. In the detection step, color information (hue and saturation) is used to highlight the skin in the image. The pre-processing enhances image quality and gets the hand. Then the characteristics of each hand are extracted based on PCA method. SVM is used for hand gesture recognition. Future work will be tracking and recognizing two hands postures; this will provide a large set of gestures. Two hand tracking can be exploited by using one hand to make gestures for generating events and the other hand to carry out all the motions required.

## REFERENCES

[1] G. R. S. Murthy, R. S. Jadon. (2009). "A Review of Vision Based Hand Gestures Recognition,"International Journal of Information Technology and Knowledge Management, vol. 2(2), pp. 405-410.

[2] Fakhreddine Karray, Milad Alemzadeh, Jamil Abou Saleh, Mo Nours Arab, (2008) "Human-Computer Interaction: Overview on State of the Art", International Journal on Smart Sensing and Intelligent Systems, Vol. 1(1).

[3] Mokhtar M. Hasan, Pramoud K. Misra, (2011). "Brightness Factor Matching For Gesture Recognition System Using Scaled Normalization", International Journal of Computer Science &Information Technology (IJCSIT), Vol. 3(2).

[4] T. Baudel, M. Baudouin-Lafon, Charade: remote control of objects using free-hand gestures, Comm. ACM 36 (7) (1993) 28–35.

[5] A. Bobick, A. Wilson, A state-based technique for the summarization and recognition of gesture. In Proc.IEEE Fifth Int. Conf. on Computer Vision, Cambridge, pp. 382-388, 1995.

[6] T. Takahashi, F. Kishino, A hand gesture recognition method and its application, Systems and Computers in Japan 23 (3) (1992) 38–48

[7] N. Ibraheem, M. Hasan, R. Khan, P. Mishra, (2012). "comparative study of skin color based segmentation techniques", Aligarh Muslim University, A.M.U., Aligarh, India.

[8] M. M. Hasan, P. K. Mishra, (2011). "HSV Brightness Factor Matching for Gesture Recognition System", International Journal of Image Processing (IJIP), Vol. 4(5).

[9] Al-Bashish, D., M. Braik and S. Bani-Ahmad, 2011. Detection and classification of leaf diseases using K-means-based segmentation and neural-networks-based classification. Inform. Technol. J., 10: 267-275.

[10] L. I. Smith, A Tutorial on Principal Component Analysis, Cornell University, USA, 2002.

[11] Gualtieri J.A. and R. F. Cromp, 1999. Support vector machines for hyperspectral remote sensing classification," in Proceeding of the SPIE, vol. 3584, 1999, pp. 221–232