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RESEARCH ARTICLE

# HUMAN COMPUTER INTELLIGENCE INTERFACEBASED ON VIRTUAL MOUSE

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ABSTRACT

In day to day life there are many different kinds of pointing devices for interaction between human and computer. One of the most developed pointing devices is the mouse. Also traditional input devices are mostly wired devices, except for some Bluetooth enabled ones. In this paper, we propose and develop an effective color tracking method based on a simple color classification i.e. Red, Blue, Green. We can use single piece of paper to handle mouse operation when user move his or her hand on piece of paper the mouse pointer will ne move on screen. This paper includes two major procedure training and tracking. In training procedure the user specifies a color distribution, the training data will be classified into several color cluster using randomized list structure and in color tracking procedure, the color will be segmented in real-time form the background and advantages of this procedure or paper is, It is fast because the image segmentation algorithm is automatically performed on a small region surrounding the hand.It is robust under different lighting condition. To additional control we can use microphone to handle the mouse operation i.e. left, right button. This proposed method has good potentials in many real application, such as virtual reality.



## INTRODUCTION

Basically human computer interaction, keyboards, mice, joysticks etc are most commonly used traditional devices for designing interactive applications. The disadvantage of the above devices is the absence of flexibility due to different spatial limitations. The interactive applications deals with interaction with different devices in a dynamic environment, therefore it becomes difficult for user to use mouse and keyboards which generated different limitations for interaction. Vision based techniques provides a solution for interaction in dynamic environment which uses one or more webcams and cameras for capturing users hand and body gestures and further processes and analyzes to generate a meaningful command or vocabulary. This vision based techniques helps in acquiring the user gestures in an easier manner which will play as an input for different interactive applications. This color tracking method is done with efficient color classification technique using randomized lists. This technique consists of two stages: training and tracking. In the first stage a region of interest is specified on a color marker for obtaining the trained data. The trained data will be categorized into number of color clusters using randomized list based on marker color. In the second phase the real time hand segmentation is done from the background using the trained randomized list. The implemented technique is fast and efficient under different illuminating conditions. The paper is further organized under different sections: Section 2 describes the mechanism of the color categorization. Section 3 shows the steps for real-time color segmentation technique. Section 4 shows the experimental results to check the validation of implemented technique. Section 5 shows the conclusion and with section 6 covering the references.

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### Colour Categorization

### L*a*b* Color Space

Colour categorization L*a*b* colour model the segmentation of skin colour not only depends on segmentation techniques but also relies on the distribution of different colour model. Basically in nonparametric skin-colour tracking techniques the HIS (Hue Saturation Intensity) colour model is implemented as the colour distribution which is more concentric than in the RGB colour model. The L*a*b colour model is used in the present implemented technique which is different from RGB and HSI colour model. In L*a*b, the L* denotes to lightness and a*, b* denotes to coordinates of chromaticity. It is proportional nearly with visual perception, which intends to equal distances in the colour model corresponding to equal perceived colour deviation. Values of the L*, a* and b* are computed by the following equations which is used to calculate L*,a*,b* value:

in which Xn, *Yn*and *Zn* denotes the CIE XYZ tristimulus values of a perfect reflecting diffuser. In the present implemented technique, they are set as 250.155, 255.000, and 301.410, respectively. X, Y, and Z are the tristimulus values which are computed from R, G, and B data of each pixel based on the following equations:

$$L^* = \begin{cases} 116\left(\frac{Y}{Y_n}\right)^{1/3} - 16 & if\ \frac{Y}{Y_n} > 0.008856 \\ 903.3\left(\frac{Y}{Y_n}\right)^{1/3} - 16 & if\ \frac{Y}{Y_n} > 0.008856 \end{cases} \quad (1)$$

$$a^* = 500\left[f\left(\frac{X}{X_n}\right) - f\left(\frac{Y}{Y_n}\right)\right] \quad (2)$$

$$b^* = 500\left[f\left(\frac{Y}{Y_n}\right) - f\left(\frac{Z}{Z_n}\right)\right] \quad (3)$$

where

$$f(t) = \begin{cases} t^{1/3} & t > 0.008856 \\ 7.787 * t + \frac{16}{116} & otherwise \end{cases} \quad (4)$$

$$X = 0.607^* R + 0.174^* G + 0.2^* B \quad (5)$$

$$Y = 0.299^* R + 0.587^* G + 0.114^* B \quad (6)$$

$$Z = 0.066^* G + 1.116^* B \quad (7)$$

## Marker-Color Classification

Generally color classification is done with help of LAB color model but the marker-color classification is done with the help of randomized list data structure. The intension of color distribution based on hand marker segmentation technique is to separate the hand marker color distribution into different color bunches using randomized list data structure. Generally in most color distribution based tracking technique, the number of bunches should be specified in advance. In the present work, the classifier is defined by randomized list data structure. Through implementing a randomized list data structure, the number of bunches will be automatically obtained, thus making the technique more efficient. As adverted in previous section 2.1, the color distribution is corresponded in the L*a*b* color model. The input vector, which is normally delimitated by a feature vector for color distribution, corresponds a feature of the incoming pattern and is of importance to the classification problem. In the present implemented technique, it will significantly bear on the classification performance, such as robustness to the complex environment conditions. The input vector in the present implemented technique is delimitated by a* and b* elements of each individual pixel, which is corresponded in the L*a*b* color model. From the experiments that we have carried on, a* and b* elements of the training data is sufficient and effective for the color distribution problem. Therefore, the L* component, that constitutes the lightness value in the L*a*b* color model, is not used for tracking techniques. This builds the hand tracking technique robust under different complex environment conditions.

The color distribution technique covers of the following steps, as shown in Figure. 1.

1. Specify the specific region(s) in the hand to be trained.
2. Use the target region to find the training data set in the L*a*b* color model.
3. Compute the minimum and maximum values for a* and b* components in the training data.

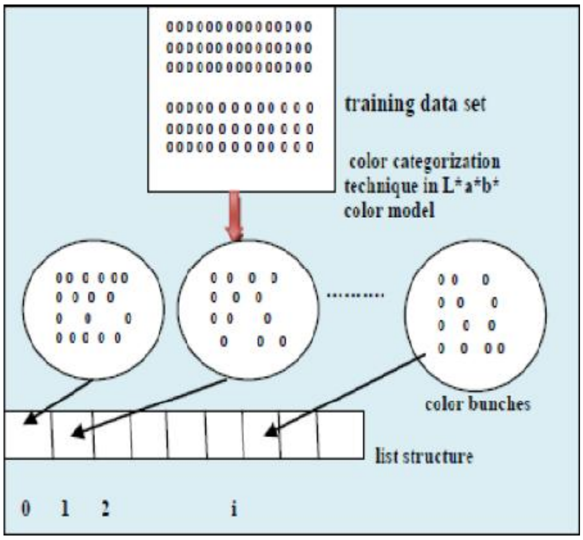


**Fig. 1. Color classification**

## REAL-time hand segmentation algorithm

### Flowchart

In a live video for each incoming frame, the system will directly place the pixels which may refer to the color-marker utilizing the randomized lists-based classifier that is generated during the training procedure. In the next stage some of the post-processing processes, such as pixel labeling, group connectivity, are needed to accurately segment the color-markers in a frame from the background. The figure 2 shows the process for hand segment.

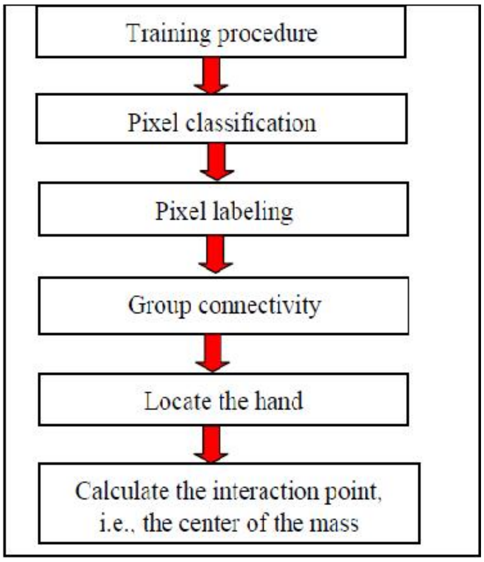


**Fig. 2. Flowchart of the hand segmentation**

### Initialization

At the beginning, the user is required to specify one or more regions on a hand to obtain the training data to generate a color classifier. The classifier is stored into a randomized data structure. The user is only required to execute the training procedure once. When the training procedure is completed, the training results will be saved automatically as a data file. Subsequently, when the user initiates the hand tracking algorithm using the similar physical environments, the system will automatically load the training results and execute the hand tracking procedure. This provides the advantage of automatic initialization and save processing time.

## Hand Localization

Through an incoming frame from a real time video, the main issue is localizing the color-marker and hand region accurately. In the first frame, the system obtains the complete color images that needs to be segmented and converted into L*a*b* color model. The randomized lists-based classifier takes the a* and b* elements of each pixel. Randomized list directly label the pixels belonging to the color-markers. Pixels with value within the thresholds are marked as 1 and output represents the color segmentation results. Once the pixels are labeled different techniques are applied to group the labeled pixels into several connected regions. During this stage, different regions need to be segmented which consist of a regions from the background similar to color distribution. The color-marker region retains the labeled pixel with largest number in the region. Then a feature point defined as interaction point will be extracted which will be used as a input device. In the present implemented technique, apply the center of the tacked color-marker region. This interaction can be used as an input for interactive application. By the next incoming frame, the system obtains a bounded region containing the tracked hand in previous frame, and further repeats the same procedure to segment the hand, thus making the segmentation faster.

## Experiments

The implemented hand tracking technique has been implemented using java, JMF library and number of experiments has been performed to test the robustness of the implemented technique. A normal web camera captures the image sequence from a real time environment. The user first concentrates a region on the color-marker by bringing the hand in front of camera to obtain the trained data in the L*a*b* color model.

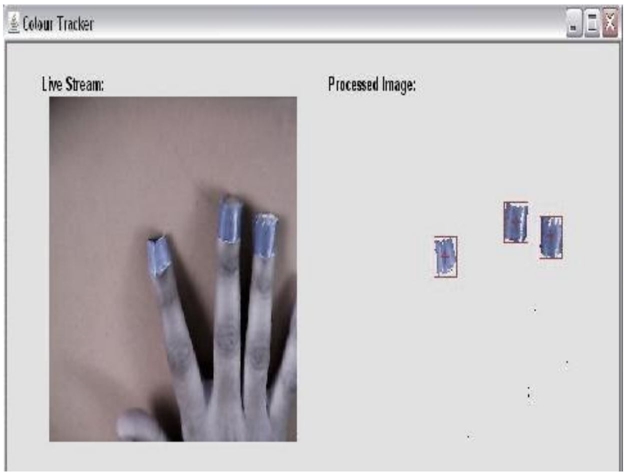


**Fig. 3. Examples of the real time tracking method**

The system will carry out the training procedure to obtain a color distribution using randomized lists which is further used for color-marker segmentation. This segmentation technique is used to segment the marker from the background in real-time. Figures 3-5 shows few hand tracking outputs in a real time environment. In the following experiments performed, the hand moved indiscriminately, by moving it very fast, or hand is moved in different directions and angles to check its robustness.

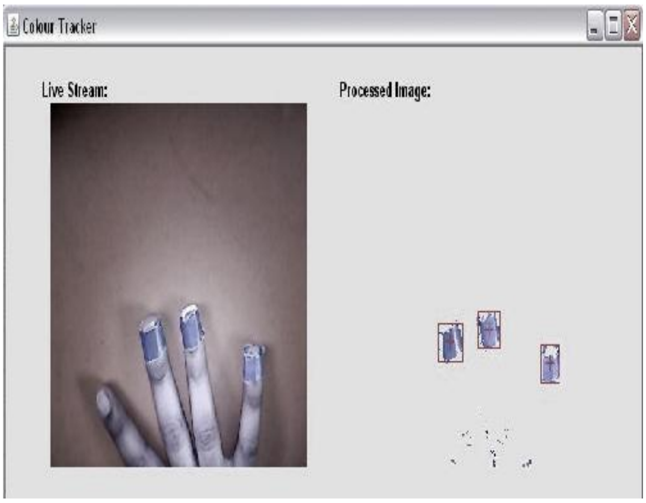


**Fig.4 Tracking under different lightening conditions**

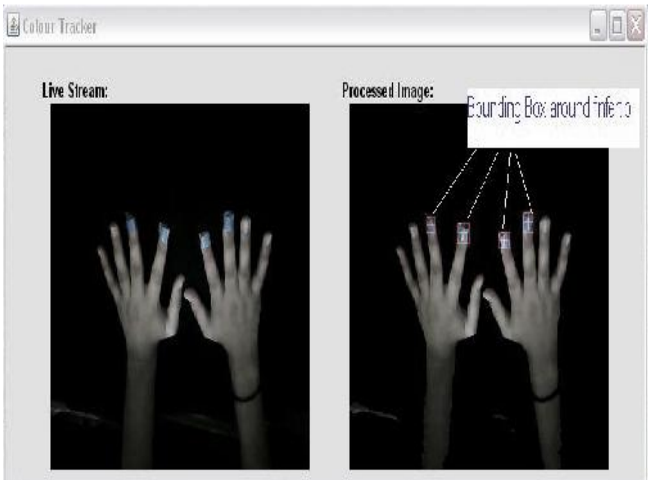


**Fig. 5. Segmentation of hand along with color markers**

## Conclusion

The main aim of the paper to implement and test a fast and effective real time hand tracking technique based on hand color segmentation and distribution using randomized lists. The technique is simple to run by moving the user's hand freely for interactive applications. Another advantage is that the implemented technique is its robustness under different illumination conditions. Few experiments have been performed to validate that the implemented technique is robust and stable. Moreover, the implemented hand tracking technique can be used further for designing interactive application like wireless mouse etc. Few examples where it can use are controlling video games in virtual reality or augmented reality applications. In the future work, more research and implementation will be performed to apply this technique for virtual reality and augmented reality game based applications.

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