# Hand Region Extraction by Saliency Based Color Component

**Aarthi R, S Harini, Hari Prasad V**

***Abstract*: Hand segmentation becomes a challenging task due to uncontrolled environmental conditions, lighting, rapid motion of the hand and skin colour detection. This paper's objective is to propose a saliency-based colour model algorithm for hand segmentation under constrained and non-constrained environments. We already have colour models for hand segmentation algorithms, but in this work, we are proposing a new model for the segmentation process. Researchers are actively engaged in hand segmentation to attain natural interaction with a machine. A secondary objective of this paper is to excel in the region of skin color detection for human-like interaction between the end user and the computer. Human-computer interaction is achieved by hand gestures. To make hand gesture identification accurate, we may need to segment the hand from the background. The proposed work in this paper leads to solving the first problem in human-computer interaction.***

***Index Terms*: color map, salient, feature, intensity, saturation.**

## I. INTRODUCTION

Human-computer interaction (HCI) plays a vital role in the interface between humans and computers.. There is a closed loop of interaction or in other words, communication between the human user and the computer [1]. During the previous century, computers were treated as machines to simplify tasks, whereas nowadays, machines are a replacement for humans to interact and play with machines. There are multiple channels through which humans interact with computers such as hand gesture, voice- interface, touch-sensitive (tactile) interface, eye gesture, etc.

Hand gesture system is recognized to be the most natural and easy option for humans to communicate with computers [2]. The elemental concept that facilitates creation of a hand gesture recognition system is the hand segmentation technique Hand segmentation technique can be defined as a method to separate the skin coloured pixels(human hand) from the background.One of the groundbreaking methods for hand segmentation is the skin color since human skin is consistently distinct from the other objects of the universe. A color model is an order for creating a radius of different colors from the primary colors ;red, blue and green. and green. The color models chosen include HSV(Hue Saturation Value), CMYK(Cyan Magneta Yellow Black), HSI(Hue Saturation Intensity) and salient model for prediction of the most efficient algorithm [3]. Hand Segmentation can be influenced by factors such as Brightness(in lx), Contrast(in ratio), Transparency(in transparency meter), Hue(in degrees), and Intensity(in watts) [4]..These factors differentiate human hand from the rest of the background pixels RGB(Red Green Blue) color model forms the base of skin detection since any color can be obtained by combination of red, green and blue color parameters. Similarly, any color can be broken down into components of red, blue and green. There are various color models derived from the RGB model which are being discussed further in the paper. The objective of this work lies in predicting the best color model for hand segmentation process. [5].

**Revised Manuscript Received on December 22, 2018.**

**Aarthi R**, Department of Computer Science and Engineering, Amrita School of Engineering, Amrita Vishwa Vidyapeetham, Coimbatore, India.
**S Harini**, Department of Computer Science and Engineering, Amrita School of Engineering, Amrita Vishwa Vidyapeetham, Coimbatore, India.
**Hari Prasad V**, Department of Computer Science and Engineering, Amrita School of Engineering, Amrita Vishwa Vidyapeetham, Coimbatore, India.

## II. COLOR MODELS FOR HAND SEGMENTATION

A. RGB Model:

The red, green and blue (RGB) color model has its key additive colors as red, green and blue which in different combinations will produce a wide range of distinct colors. It is the primary additive color model from which the following color models are defined.

B. HSV Model:

HSV color model is constituted of Hue; indicating the way in which RGB colors are mixed together to form new colors. Saturation measuring the limit of the color (how light green is separated from dark green) and Value indicating the level of light and dark colors [6]. This model is mostly used in web applications as a color selection tool but may prove ineffective in low brightness backgrounds for they cannot be differentiated from low contrast background. [7]

C. YCbCrModel(Yellow, Chromaticity of Blue, Chromaticity Of Red):

In the YCbCrcolor space, Y isthe luma component of the colour. Luma can be


*Published By:*
*Blue Eyes Intelligence Engineering*
*& Sciences Publication*

defined as brightness of a colour,for which the human eye is most sensitive toCb and Cr are defined as chromaticities with respect to green component. Cb is blue component relative to green and Cr is the red component relative to red.It is used for component digital video. [8]

D. HSI Model:

The HSI model represents color similar to humans perceiving it in the eyes. The Hue component describes the color which is measured in angle(0 degree means red),the Saturation color indicated the color's mixture with white color (measured in the range [0,1].The Intensity ranges from 0(black) to 1(white) [9]. When the input for the dataset (hand with an object ) is acquired through the webcam as video, the values of Hue for skin color for the same person changes in each frame. , The acquired frames are highly dependent on background illumination. In order to detect the skin region accurately, the range of Hue is varied by the device capturing the image in each frame with the help of information obtained from the previous frame. HSI is independent of luminance and

reflectance. [10]

E. Saliency Model:

Saliency describes how an object or region outstands from the rest of the background in an image. It was more frequently used to predict eye movements during image viewing. When humans view an image without any task in mind, their eyes are drawn towards objects that stand out amid the background, these areas are described as salient.

For the hand segmentation process, we used the Saliency model, noted in Figure 1, to predict the hand region from the background region. There are different combinations of saliency predicted.

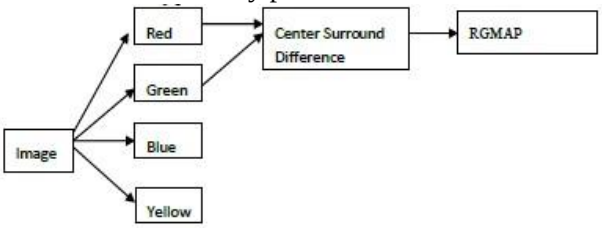



Fig. 1. Proposed model for Red and Green Saliency Map

RGMAP-red and green salient model

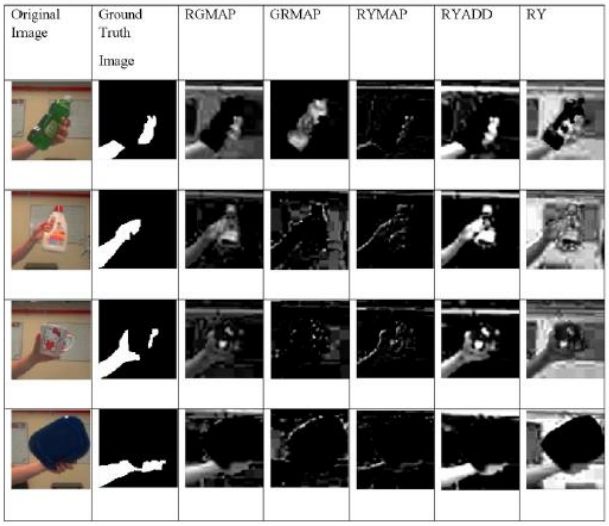
GRMAP-green and red salient model

RYMAP-red and yellow salient model

RY-red and yellow additive model

RYADD-red and yellow additive salient model

Table 1. Comparison between different salient models




With reference to Table 1., it can be determined that red and yellow additive performs better at hand segmentation than the other salient models. Therefore, this salient model can be chosen for further experiments.

F.CMYK Model:

CMYK is a subtractive color model used as one of the hand segmentation algorithms. The primary colours are cyan (C), magenta (M), and yellow (Y). Sometimes black (K) is also considered a primary colours, although black can be obtained by combining pure cyan, magenta, and yellow in equal and considerably large amounts. [11].

For proposing the best hand segmentation algorithm, we need to define the confusion matrix parameters for all the colour models we have discussed. The colour model with the best accuracy for iCub dataset will be chosen as the best color model for hand segmentation.

III.Experimental Results of Hand Segmentation Algorithms for iCub Dataset:

The various algorithms for skin segmentation were tested on more than 100 images. The -iCub image dataset was used. All the images are of the same size 128*128(pixels) in JPG format. Every image in the dataset is an object in the hand [12].The performance of the hand segmentation models were tested using factors like 'True positive rate (TPR)', 'false positive rate (FPR)', 'True Negative Rate (TNR)' and 'False Negative rate (FNR)'.The above mentioned factors are measured in percentage for comparison between ground truth image and image obtained from colour models.After experimentation with the three algorithms, the algorithm with the best accuracy will be interpreted

Accuracy:

Accuracy is a degree of loseness of measurements of the ground truth image and images after processing of hand segmentation

algorithms.Accuracy is a parameter which demonstrates how close the estimated image is to the original ground truth image. Among the three algorithms of HSV, CMYK and HSI, HSV outstands the other algorithms in the tests on accuracy. Figure 2, is a graph plotted with the images being the X-axis and the Y-axis being the corresponding values.Accuracy for the first quarter of the image dataset seems to be less since the object color overlaps with the hand color. Moving towards the last quarter, the accuracy seems to increasesince the objectcolor is completely different from the hand color. With reference to Table 3. we can infer that the first half of the image dataset has both the object and hand in the same order of hue and saturation while the second half has nothing in common between the object and hand. Also, that RY salient model performs the best in terms of accuracy.

What proportion of actual positives was identified correctly" is being demonstrated with recall parameter. With reference to Fig 3, denoting the graph of image dataset (X-axis) against the values (Y-axis), it can be inferred that HSI hand segmentation algorithm outstands the other algorithms to perform the best in estimating the positives or the or

There is no deep increase or decrease in case of HSI algorithm in estimating the positives for the graph is very regular and smooth for the entire image dataset. Recall values for HSI algorithm lie between the raranges.9-1 which makes it the

best algorithm in detecting positives correctly. HSV and CMYK fail to predict the positives correctly. High recall value of HSI denotes that we are not going to miss the hand in the hand segmentation process while lower and inconsistent values of recall infer that we might indeed lose the true positives of the image. It is better to choose an algorithm with high recall but not at the cost of accuracy.

Precision

It demonstrates how much percent of the results are relevant. Recall and precision are extremely important and poles apart since we have recall determining how much percent of the results are totally classified in the algorithm correctly. With reference to the Fig 4, there is graph plotted with image dataset on the X-axis and the precision values on the Y-axis. It can be inferred that HSV outstands the other algorithms. HSI might have a very high recall rate, but in terms of precision it's very low. Hence, HSI cannot be taken as the best algorithm since the recall and precision rate should betaken as a combined parameter for classifying the best and worst algorithms for hand segmentation. There is a gradual increase for the HSV algorithm with CMYK performing a little better than HSI but not as good as HSV.

## III. CONCLUSION

From the above experiments and observations with reference to Table 4, we can conclude that RY additive salient model performs the best among the hand segmentation algorithms. All the objects, irrespective of their color combination values, detected a non-hand area in this algorithm. With the new introduction of the salient model, this paper brings out the additive salient model for hand segmentation. It can also be inferred that HSV performs the second best. In order to choose the best algorithms, we can choose RY additive salient model followed by HSV algorithm. In general, salient models were proposed to find the region of interest ,the interesting observations from our experiments stated that different combinations of colours in the salient model can prove to be efficient for determining the skin coloured pixels from the background also. The identification of different coloured pixels lies in choosing the colours of the saliency model. RY salient model can be proposed as a hand segmentation colour model in the human-computer interaction field. The future work will be identify different objects based on salient models.

## REFERENCES

1. AashniHaria, Archanasri Subramanian, NivedithaAsokkumar, Shristi Poddar, Jyothi S Nayak. Hand Gesture Recognition for Human Computer Interaction, International Conference on Advances in Computing & Communications, ICACC-2017, 22-24 August 2017, Cochin, India
2. SonalSinghai, Dr C.S.Satsangi. Hand Segmentation for Hand Gesture Recognition, International Journal Of Innovative Research in Information Security Volume 1, Issue 2 August 2014
3. Meenakshi Panwar ,Pawn Singh Mehran," Hand gesture recognition for human computer interaction", 2011 International Conference on Image Information Processing
4. Ram Pratap Sharma, Gyanendra K Verma,"Human Computer Interaction using Hand Gesture", Eleventh International Conference on Image and Signal Processing, ICISP 2015, August 21-23, 2015, Bangalore, India
5. S. Kolkur , D. Kalbande , P. Shimpi, C. Bapat , and J. Jatakia," Human Skin Detection Using RGB, HSV and YCbCrColor Models", ICCASP/ICMMD-2016. Advances in Intelligent Systems Research. Vol. 137, Pp. 324332.
6. Chen Junhua, Lei Jing," Research on Color Image Classification Based on HSV Color Space", 2012 Second International Conference on Instrumentation, Measurement, Computer, Communication and Control .
7. Archana Ghotkar, Gajanan K. Kharate," Hand Segmentation Techniques to Hand Gesture Recognition for Natural Human Computer Interaction", International Journal of Human-Computer Interaction 3(1):15-25 · January 2012
8. Zhang Qiu-yu, Lu Jun-chi, Zhang Mo-yi, Duan Hong-xiang and LvLu,"Hand Gesture Segmentation Method Based on YCbCrColorSpace and K-Means Clustering",International Journal of Signal Processing,Image processing and Pattern Recognition,Vol. 8,No. 5(2015), pp. 105-116
9. Hemlata Chavan, Mr.PrateekGupta,"A Review on Hand Gesture Detection Using Combine HSI, YCbCr and Morphological Method with Recognition",International Research Journal of

Engineering and Technology (IRJET) ,Volume: 03 Issue: 05 |May-2016
10. Kathryn Koehler, Fei Guo, Sheng Zhang, and Miguel P. Eckstein," What do saliency models predict?", J Vis. Journal of Vision, 2014; 14(3).
11. S. Krishnan, B.A. Sabarish, Gayathri V., and Dr. Padmavathi S., "Enhanced Defogging System on Foggy Digital Color Images",Computational Vision and Bio Inspired Computing, Part of the Lecture Notes in Computational Vision and Biomechanics book series, pp. 488-495, 2018 Page | 10
12. R.M. Arunachalam, M. Ashok Gowtham, and R. Aarthi. Identifying Fingertips for Human Computer Interaction. International Journal of Research and Reviews in Computer Science (IJRRCS),Vol. 3, No. 1, February 2012, ISSN: 2079-2557
13. Rajesh, M., and J. M. Gnanasekar. "Path Observation Based Physical Routing Protocol for Wireless Ad Hoc Networks." Wireless Personal Communications 97.1 (2017): 1267-1289.
14. Rajesh, M., and J. M. Gnanasekar. "Sector Routing Protocol (SRP) in Ad-hoc Networks." Control Network and Complex Systems 5.7 (2015): 1-4.
15. Rajesh, M. "A Review on Excellence Analysis of Relationship Spur Advance in Wireless Ad Hoc Networks." International Journal of Pure and Applied Mathematics 118.9 (2018): 407-412.
16. Rajesh, M., et al. "SENSITIVE DATA SECURITY IN CLOUD COMPUTING AID OF DIFFERENT ENCRYPTION TECHNIQUES." Journal of Advanced Research in Dynamical and Control Systems 18.
17. Rajesh, M. "A signature based information security system for vitality proficient information accumulation in wireless sensor systems." International Journal of Pure and Applied Mathematics 118.9 (2018): 367-387.
18. Rajesh, M., K. Balasubramaniaswamy, and S. Aravindh. "MEBCK from Web using NLP Techniques." Computer Engineering and Intelligent Systems 6.8: 24-26.