DETECTION & EXTRACTION OF HUMAN SKIN USING CONCEPT OF FUZZY LOGICS

Nalini[1], Shradha Verma[2]
M.Tech Scholar , Delhi college of Technology & Management Palwal, Haryana, MDU Rohtak
Bharti Tundwal[3], Tarun Thukral[4]
[3)]Assistant Professor [4)] M.TechScholar
Delhi college of Technology & Management Palwal, Haryana, MDU Rohtak

Abstract— In today's life security is a high concern. As crime is increasing day by day therefore security and surveillance become the need of any society. Our paper is based on automatic detection & extraction of skin part of any human face. In this paper a very robust algorithm for detection & extraction of human skin using fuzzy logics has been proposed. Primary color space model human acquire is RGB color space model as it is so handy and easy to use but it has a negative characteristic that each of its component i.e. R component G component & B component have different values for each coordinate which become so complicated to handle and also sometimes it doesn't provide the required information i.e. it doesn't detect the correct area of skin. Due to these reasons we are going to use HSV/HSI color space model. In this paper we are focusing only about skin detection as only by skin detection one can get the information that either any intruder enters in the premises or not.

***Keywords*- HSV/HSI, Segmentation, Morphological operations, membership function**

I.INTRODUCTION

Security starts from identifying an intruder. Security can be in indoor premises or outdoor premises, Indoor surveillance system work in any close premises like any school boundary, in shopping malls, In house etc. while outdoor surveillance system works in any open premises for example roads, railway stations, bus stands etc. Skin detection is mostly used in closed premises for open premises this work reaches up to facial feature extraction[2]. In our work we are going to fetch the skin part of any human being to detect the intruder. So to detect any outdoor person what we need the most is to detect whether a person enters in that premises or not and for that we have to detect and extract the human skin.

Color space model [1]

Here we focus on three colors spaces which are commonly used in the image processing field.

a. RGB color space
b. HSI /HSV color space
c. YC_bC_r Color Space

a. RGB color space model: It consists of tree planes each for different primary color red, green and blue. As it doesn't disassociate the effect of luminance.This color model is still able to remove certain colors that are surely out of the range of theany normal skin color. This color model is defined as an RGB triplet, each component of RGB color space model vary from zero to some defined value, most of the time that value is 255. i.e. each component contains 256 different values (2^3) the range that a single 8 byte offers. In this color space model if all components contain the value zero the result is black; while if all have a maximum value, the result is white the brightest represent able color.

b. HSV/HSI color space model: In this color space model H describe the hue part, hue part of this model describes that to which pure color it resembles. All shades & tones of blue have the same hue. S is for saturation part it describes how saturated is the color to the white color, any pure color has saturation value 1, while as impurity increase its value decreases and for pure white color its value is 0. Now last but not the least is value or intensity which describes the value of blackin any color it tells the darkness of color as we move from pure color towards black the value of v decreases from 1 to 0. Conversionof RGB image into HSV is little complicated.

H i.e. Hue value is given by:

$$H = \cos^{-1}\sqrt{\frac{1/2((R-G)+(R-B))}{(R-G)^2+(R-B)(G-B)}}$$

The saturation is given by:

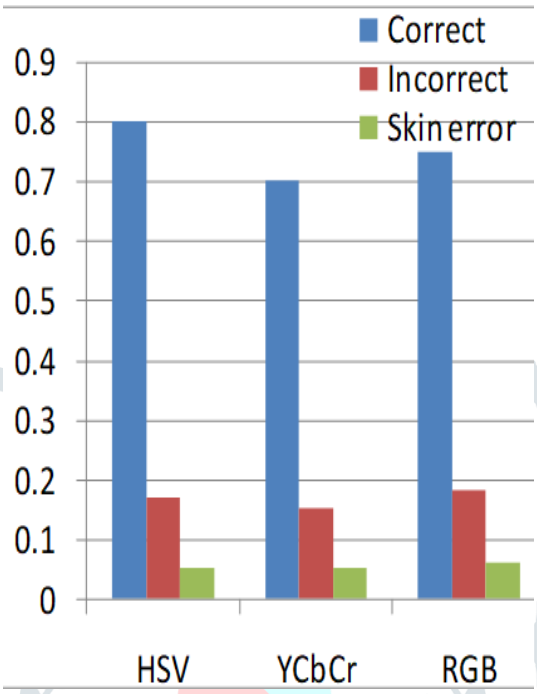
$$S = 1-\frac{\min(R,G,B)}{I} = 1-\frac{3}{R+G+B}\min(R,G,B)$$

Where the amount of white present is indicated bt the value min (RGB). If any of R, G or B are zero, there is no white and we have a pure color.

The intensity is given by

$$I = \frac{R + G + B}{3}$$

where the quantities R, G and B are the amounts of the red, green and blue components, normalized to the range [0,1]. The average of the red, green and blue components indicates the intensity value.



Graph 1: comparison of different color space model

HSV shows the best result. 80% of skin pixels detected correctly. In this research we are using HSV model to make the work easier and more robust. It is clear from the graph that hsv is providing best result out of these three color space model.

II **Methodology**

Methodology of our proposed work is shown in figure 2.

a. **Color space conversion:** first of all whole image (data) set would be trained and then processed step by step. Thencolor space model of image changed to desired color space model which is hsv in our case.

Fig.2: RGB to HSV conversion

b. **Segmentation:** After this conversion segmentation takes place. In segmentation any image is partitioned into multiple segments. Segmentation is the process of converting an image into more meaningful manner i.e. it became easier to analyze. It is used to boundary the image by lines and curves etc. according to one's requirement. There are various methods to segment any image but in our experiment, we use threshold method. Thresholding is very simple method of image segmentation , thresholding can be used to create a binary images [3].The simplest thresholding[4] method exchange every pixel in an image with a black pixel if the image intensity $I_{i,j}$ is less than some fixed threshold constant T (that is, $I_{i,j}<T$), or a white pixel if the image intensity is greater than that threshold value. For this segmentation let us assume the variable h2 having the membership function value so in order to retain the segmented image we have put the limit on intensity value so that if those values are higher than the threshold will be saved as 1 else 0.

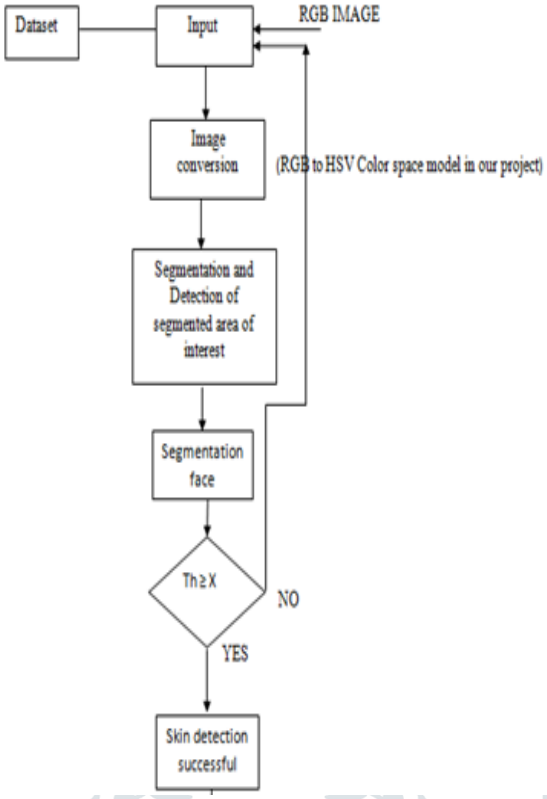


Fig. 3: Flow chart of proposed algorithm

And it can be given as: -

if h2(i,j)>=T;
h3(i,j)=1;

else h3(i, j) =0;

where i , j shows the position of intensity value and
h3(i , j) holds the values above threshold.

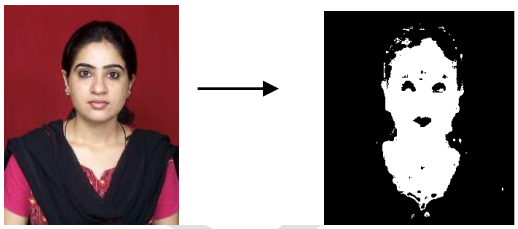


Fig.4 Extraction of image after segmentation

c. Morphological operations: After segmentation we get binary image which may contain numerous imperfection. Therefore after segmentation morphological operations are processed to reduce this imperfection. These operations relay not on the numerical values but to the pixel values of the image thereafter this operation is more suitable for binary images. Morphological techniques examine an image with a very small template or shape which is called a structuring element[5]. The structuring element is situated at feasible locations in that particular image and then comparison with the corresponding neighborhood of pixels takes place. Then operations find out whether the element "hits" the neighborhood, while others find whether it "fits" within the neighborhood[6].

d. Membership function: Membership function[7] is defined as a curve which explains that how every point in input space is mapped to a particular membership value also called degree of membership between 0 & 1. The condition every membership function must satisfy is its value which should vary between 0 & 1. Fuzzy sets describe indistinct concepts.A fuzzy set acknowledge the possibility of limited membership in it. For any fuzzy set a degree (an object belongs) is describe by a membership value between 0 & 1. Any membership function corresponding with a described fuzzy set maps an input value to its adequate membership value. In our paper we are going to explain only trapezoidal membership function as we would use only trapmf in our work.

e. Trapmf: Trapezoidal-shaped membership function

h2 = trapmf(H,[a b c d])

The trapezoidal curve depends upon four scaler values i.e. a, b, c, & d and this curve is a function of a vector value H. This curve can be given by

$$f(H,a,b,c,d) = \begin{cases} 0, & H \le a \\ \dfrac{H-a}{b-a}, & a \le H \le b \\ \dfrac{d-H}{d-c}, & c \le H \le d \\ 0, & d \le H \end{cases}$$

or, much neatly, it can be given by

$$f(H,a,b,c,d) = \max(\min(\tfrac{H-a}{b-a},\ 1,\ \tfrac{d-H}{d-c},\ 0))$$

The "feet" of the trapezoid are located by parameters *a* and *d* whilethe "shoulders" are located by the parameters *b* and *c* .

Thereafter we have to select the values of a,b,c,d . In our project work we have tried various values as our method is hit and trial method. And finally we get the best result at following values. In that equation a, b,c,d are :

a = 0.02; b =0.04;c =0.06; d=0.10

For example:

```
m = (0:0.2:10)';
n1 = trapmf(m, [1 2 6 9]);
n2 = trapmf(m, [2 4 5 8]);
n3 = trapmf(m, [3 6 4 7]);
n4 = trapmf(m, [4 8 3 6]);
plot(m, [n1 n2 n3 n4]);
```

Plotting is shown in figure 5

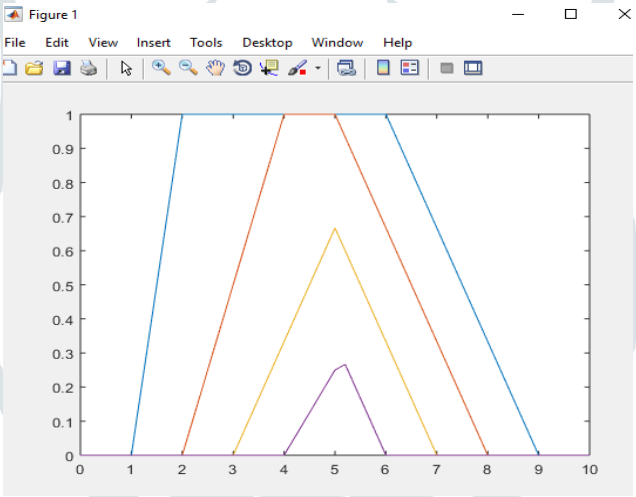


Fig.5: Plot of trapezoidal function[8]

In next figure we have shown the result of our project i.e. skin detection. In this we have also done statistical analysis, i.e. result is following which condition. Is it TP,TN FP or FN? Here Image size we have taken is 1.20"x1.0". and other results are taken in pixels of 200x180. All results came from MATLAB software. For that we had done programming in MATLAB.

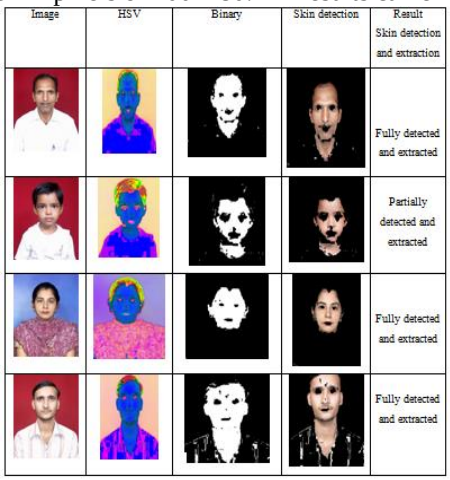


Fig. 6: Result of skin detection and extraction

III.Conclusion:

Now We are going to wrap up this section as we have get our result successfully. We had completed the task but nothing is ideal therefore in this case also we don't get 100% accuracy. In this part of work we had taken 100 images on which we perform all experiment. We Train all the images and calculate for final result. In 100 images database we get 78 images fully detected i.e. with true Positive value in this we get the result what we want accurately i.e. we get the skin part totally. In 12 Images we get the result True Negative i.e. we don't get the value which is not present. In 8 Images we get the False Positive values as in these images we are getting the result which is actually not present. As in this case some time its detecting a cloth as a skin part and not able to differentiate between skin and non skin part fully. In 2 Images we don't get our result anymore i.e. the system fails there. So the final result is:

78% TP (value we get what we want accurately)
12% TN (value we don't get we don't want)
8% FP (value we get we don't want)
2% FN (value we don't get while it was present)

It is our result of skin detection and extraction.

IV Future Scope

In today's environment image processing is applied in various fields. Some of them are as follows:

- **Automotive industry**: Image processing is useful to develop advanced drivers assist for semi-autonomous cars and also heavily used in autonomous/driver-less cars
- **Surveillance System**: In today's life image processing is used for surveillance and security purpose to identified intruder by detecting and extracting skin and facial features[9].
- **Enhancement of images:** Image processing is used in camera apps in digital cameras and smart phones to improve the video stabilization, quality of image, and removal of noise etc.
- **Gaming:**Image processing is used to analyze the motion of any human playerin Advanced gaming consoles.
- **Problem finding solutions:** To find out variety of issues image processing is used, issues may start from facial detection to defect identification in any automobile vehicle.
- **Manufacturing Industry:** Identification of defects in the processes is done by image processing and also robots are controlled in performing certain tasks. For example high resolution image processing can be used to observe defects in manufacturing of a VLSI circuit, or any other manufacturing industry.
- **Machine & Human interface:** machines are made smarter by adding human action response interfaces, or gestural interface, the actions are decoded for the human user to perform a particular task.

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