© 2016 IJEDR | Volume 4, Issue 3 | ISSN: 2321-9939

Facial Skin Segmentation Using SURF & SIFT with Parameters

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***Abstract*—In this research, facial skin segmentation is performed by using SURF (Speeded Up Robust Features technique) & SIFT (Scale-Invariant Feature Transform) with image parameters. These are used in order to recognize and extract face skin. First of all the face skin is recognized and extracted using skin segmentation and a bounding box was made around the face of person then SIFT features are detected then SURF features. The feature points were then extracted and lastly were matched. If various features matches then the system recognize the face skin. The parameters like accuracy and matching time are calculable and results obtained are used to validate the proposed approach.**
***Index Terms*— Skin segmentation; SURF; SIFT; parameters; face recognize; keypoints.**

I. INTRODUCTION

Identification of the human face is a fundamental step in PC vision and numerous bio-metric applications, for example, automatic face recognition, video surveillance, human-PC correspondence and huge scale face picture recovery system. The as a matter of first importance essential step in any of these frameworks is the precise discovery of the nearness and the position of the human appearances in a picture or video. The principle challenges experienced in face discovery is to adapt to a wide assortment of varieties in the human face, for example, stance and scale, face introduction, outward appearance, ethnicity and skin shading. Outside components, for example, impediment, complex foundations conflicting enlightenment conditions and nature of the picture may likewise contribute fundamentally to the general issue. Face recognition in shading pictures has additionally increased much consideration and notification as of late. Shading is known not a valuable prompt to concentrate skin locales and it is just accessible in shading pictures. This permits simple face confinement of potential facial locales with no thought of its surface and geometrical properties. Most strategies up and coming are pixel-based skin location techniques, which characterize every pixel as skin or "non-skin" exclusively and autonomously from its neighbors. A portion of the early techniques utilized different measurable shading models, for example, a solitary Gaussian model, Gaussian blend thickness model and histogram based model.

For image coordinating, extraction of such data (i.e. features) is required from the image which can give dependable coordinating between various perspectives of the same picture. Highlight identification happens inside a picture and tries to portray just those parts of that picture where we can get extraordinary data or marks (i.e. feature descriptors).During preparing, feature descriptors are removed from test pictures and stored. In grouping, feature descriptors of a question picture are then coordinated with all prepared image features and the prepared picture giving most extreme correspondence is viewed as the best match. Feature descriptor coordinating can be founded on separations, for example, Euclidean or distance ratio.

The search for particular features from pictures is separated into two primary stages. To start with, "keypoints" are removed from particular areas from the pictures, for example, edges, blobs and so on. Keypoint locators ought to be profoundly repeatable. Next, neighborhood districts are picked around each keypoint and particular element descriptors are figured from every area.

Many feature detection algorithms have been proposed in the writing to compute reliable descriptors for image matching SIFT and SURF descriptors are the most encouraging because of good execution and have now been utilized as a part of numerous applications. In this paper, facial skin segmentation is performed by using SURF (Speeded Up Robust Features technique) & SIFT (Scale-Invariant Feature Transform) with image parameters. These are used in order to recognize and extract face skin. First of all the SIFT features are detected then SURF features. The feature points were then extracted and lastly were matched. If a number of features matches then the system identifies the face skin and a bounding box was made around the face of person.

II. METHOD

SKIN COLOUR SEGMENTATION

Starting with a colour image, the principal stage is to change it to a skin-probability picture. This includes changing each pixel from RGB representation to Chroma representation and deciding the probability esteem taking into account the condition given in the past area. The skin-probability picture will be a dark scale picture whose dim qualities speak to the probability of the pixel having a place with skin. To distinct skin color from non-skin color we are utilizing K-means clustering algorithm.

Cluster analysis is one of the essential methods for exploring the fundamental structure of a given information set and is being connected in a wide variety of engineering and scientific disciplines and image processing. The essential goal of cluster analysis is to segment a given information set of multidimensional vectors (designs) into purported homogeneous clusters such that patterns inside a cluster are more similar to each other than patterns having a place with different clusters. Clusters may be depicted as associated regions of a p-dimensional space containing a generally high density of points, isolated from other such area by area containing a relatively low density of points. The k-means clustering is an algorithm to characterize object based on features or characteristics into k number of group.

The quantity of classes influences the order result. If K is very small, the desired skin color may be classified into a class with other non-skin color; if K is very large, skin color may be delegated more than one single class which comes about that no class can show the skin color solely. To pick an appropriate K is crucial to get a classification which is adequate for the accompanying distinguishing proof work. Probes different pictures that contain human skin content likewise demonstrate that the outcomes are agreeable when K=5[5].

Figure 1: (a) Input Image, (b) Image Segmentation, (c) Recognize Face Skin, (d) Extract Face Skin

SIFT

SIFT features comprise of four important stages in location and representation; they are (1) finding scale space extrema; (2) key point localization and separating; (3) orientation assignment; (4) keypoint descriptor. The first stage is to create the key points of images by utilizing Difference-of Gaussian (DoG) function. The second stage, key points are limited to sub-pixel exactness and evacuated if observed to be temperamental. The third stage shows the dominant introductions for every key point of the pictures. The last stage builds a descriptor for every key point area relies on the picture slopes in its nearby neighborhood. At that point the SIFT descriptor is tolerating the 128- dimensional vector which used to distinguish the area around a pixel. The SIFT extricates the key focuses (areas and descriptors) for all the database pictures. At that point given a modified picture SIFT removes the key point for that picture and analyzes that point to the dataset [2].

Figure 2: SIFT Features

SURF

The SURF likewise removes the keypoints from both the database pictures and the modified pictures. This strategy coordinates the key point between adjusted picture and every database picture. In 2008, H. Cove creates SURF descriptor which is invariant to a scale and in-plane revolution features. It comprises of two phases, for example, interest point detector and interest point descriptor. In the main stage, find the interest point in the picture. Utilize the Hessian network to locate the inexact recognition. SURF is a scale and in-plane revolution invariant indicator and descriptor. SURF locators are discover the interest focuses in a picture, and descriptors are utilized to separate the component vectors at every interest point pretty much as in SIFT. SURF utilizes Hessian-lattice guess to find the interest focuses rather than distinction of Gaussians (DoG) channel utilized as a part of SIFT. SURF as a descriptor uses the principal request Haar wavelet reactions in x and y, though the inclination is utilized by SIFT [18]. SURF for the most part uses 64 measurements in SURF to lessen the time cost for both component coordinating and calculation.

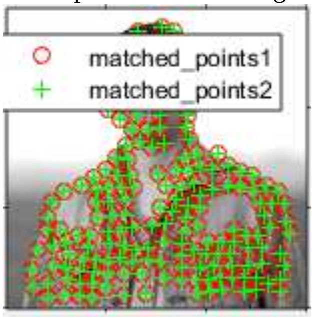

Figure 3: SURF Features

III. QUALITY FACTORS AND MEASURES FOR FACE IMAGES

Different Image Quality have been accounted in research that were utilized for face recognition. The most as often as possible utilized ones are those measuring the accompanying quality components: (a) brightness, (b) contrast, (c) focus, (d) sharpness and (e) illumination. Ayman et.al, developed and evaluated a unified technique that combines various IQs and generates a single value that can be used to represent the level of overall quality of query face images when used in practical face recognition scenarios[19].

Brightness

Wyszecki and Stiles characterize brightness as a characteristic of a visual phenomenon as indicated by which a given visual stimulus has appears to be in a superior way or minority intense; or, as per which the region in which the visual boost is displayed seems to transmit pretty much light, and range variety in brightness from "bright" to 'diminish'.

The face picture brightness measure (let us signify it by B1) can be computed as the normal of the brightness component after changing over it into the HSB (hue, saturation and brightness) space. To change over from RGB (red, green and blue) hues to HSB range, every segment is initially standardized to the [0, 1] territory as takes after

$$\begin{bmatrix} r \\ g \\ b \end{bmatrix} = \frac{1}{255} X \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

$$B_1 = \frac{1}{MN} \sum_{x=1}^{M} \sum_{y=1}^{N} [\max(r, g, b)]$$

Bezryadin et al.[19] suggested another image brightness measure

$$B_2 = \sqrt{D^2 + E^2 + F^2}$$

Contrast

Image contrast is the distinction in colour intensities that makes an object (face) recognizable. The face image contrast can be measured utilizing the following equation.

$$C_{RMS} = \sqrt{\frac{\sum_{x=1}^{M} \sum_{y=1}^{N} [I(x,y) - \mu]^2}{MN}}$$

where μ is the mean power estimation of the test face picture I(x,y) of size N × M

Another method for picture differentiation is the Michelson contrast measure

$$C_{Mic} = \frac{I_{max} - I_{min}}{I_{max} + I_{min}}$$

where I_{min}, and I_{max} are the minimum intensity value and maximum intensity value respectively of the test face image I.

Focus and Sharpness

Image focus refers to the level of blurring of face pictures. For a slim lens, given an item (confront) at separation O_d, and the picture is shaped at separation Id; the central separation of the lens f is given by: $1/f = 1/O_d + 1/I_d$. On the off chance that the face is dislodged from O_d, the vitality from the face through the camera lens is appropriated over a roundabout patch on the picture plane, in this manner will shape an blurred face picture.

Yap and Raveendran [19] exhibited a few picture center measures, for example, the L1-standard of the picture angle, and the vitality of the Laplacian. The L1-standard of the picture is characterized as

$$F_{L1} = \sum_{x=1}^{M} \sum_{y=1}^{N} |G_{xx}(x,y)| + |G_{yy}(x,y)|$$

and the energy of the Laplacian of the image as

$$F_{EL} = \sum_{x=1}^{M} \sum_{y=1}^{N} [G_{xx}(x,y) + G_{yy}(x,y)]^2$$

where G_{xx} and G_{yy} are the second derivatives in the horizontal and vertical directions, respectively.

Image sharpness portrays the clarity of point of interest in a face picture, and it alludes to the level of clarity in both coarse and fine subtle elements. A few picture sharpness measures have been proposed in the writing. Kryszczuk and Drygajlo characterized picture sharpness measure as

$$S_1 = \frac{1}{2}[\frac{1}{(N-1)M} \sum_{x=1}^{M} \sum_{y=1}^{N} |I_{x,y} - I_{x,y+1}| + \frac{1}{(M-1)N} \sum_{x=1}^{M-1} \sum_{y=1}^{N} |I_{x,y} - I_{x+1,y}|]$$

Gao et al. defined the image sharpness measure as

$$S_2 = \sum_{x=1}^{M-2} \sum_{y=1}^{N-2} G(x,y)$$

where G(x, y) is the gradient value at (x, y)

The Tenengrad sharpness [19] measure is defined as

$$S_3 = \sum_{x=1}^{M}\sum_{y=1}^{N}(L_x . I_x^2 + L_y . I_y^2)$$

$$L_x(x,y) = [I(x+1,y) - I(x-1,y)]^P$$
$$L_y(x,y) = [I(x,y+1) - I(x,y-1)]^P$$

where L_x, L_y are the weights in the horizontal and vertical directions, and I_x, I_y are the horizontal and vertical gradients obtained by applying the Sobel filter

The adaptive Tenengrad sharpness measure is defined as

$$S_4 = \sum_{x=1}^{M}\sum_{y=1}^{N} L(x,y)\left[I_x^2 + I_y^2\right]$$

$$L(x,y) = [I(x-1,y) + I(x+1,y) - I(x,y-1) - I(x,y+1)]^P$$

where L(x, y) is the non-separable weight, and P is a power index that can define the degree of noise suppression.

Illumination

Luminance distortion is one of the measures of the picture component identified with enlightenment. The expression luminance is used to depict the amount of light that goes through or is radiated from a specific territory of the picture. The UQI is a mix of three principle variables: loss of connection, luminance bending and complexity twisting. The luminance twisting is characterized as

$$I_1 = \frac{2\sigma_{rt}\bar{r}\bar{t}}{[\bar{r}^2 + \bar{t}^2]}$$

where $\bar{r}$ and $\bar{t}$ are the variances of the reference (r) and test image (t), respectively, and σ_{rt} is the covariance of (r) and (t). Another image illumination measure is calculated as the weighted sum of the mean intensity values of the image divided into (4 × 4) blocks

$$I_2 = \sum_{x=1}^{4}\sum_{y=1}^{4} w_{ij}.\bar{I}_{ij}$$

MEASURE PROPERTIES OF IMAGE

Centroid

Gives back a 1-by-Q vector that indicates the center of mass of the locale. The principal component of Centroid is the level direction (or x-direction) of the focal point of mass, and the second component is the vertical direction (or y-coordinate). Every single other component of Centroid are all together of measurement. This figure delineates the centroid and bouncing box for a discontinuous district. The district comprises of the white pixels; the green box is the bounding box, and the red dot is the centroid.

Eccentricity

Gives back a scalar that determines the eccentricity of the ellipse that has that second-minutes as the locale. The eccentricity is the proportion of the separation between the foci of the ellipse and its real hub length. The quality is somewhere around 0 and 1. (0 and 1 are savage cases. An eccentricity whose unconventionality is 0 is really a circle, while an ellipse whose eccentricity is 1 is a line portion.).

Area

Gives back a scalar that determines the genuine number of pixels in the locale. (This worth may contrast marginally from the quality returned by bwarea, which weights distinctive examples of pixels in an unexpected way.)

Extrema

Gives back a 8-by-2 matrix that indicates the extrema focuses in the district. Every column of the matrix contains the x-and y-directions of one of the focuses. The arrangement of the vector is [top-left upper right-upper right base right base left-base left-top]. This figure represents the extrema of two unique areas. In the district on the left, each extrema point is particular. In the area on the privilege, certain extrema focuses (e.g., upper left and left-top) are identical.

IV. LITERATURE REVIEW

In order to begin the project, the initial step is to study the research papers that have been already published by other researchers. Papers related to this work are chosen and studied. With the help of literature review, it becomes easier to understand.

Prashanth Kumar G et al. 2014[15] are presenting an algorithmic program for face detection for face recognition in a picture utilizing coloring segmentation and area properties. To start with division of skin areas from an image is finished by utilizing diverse colour models. Skin areas are isolated from the picture by utilizing thresholding. At that point to choose whether these areas contain human face or not. They utilized face highlights. Their system depends on skin colour division and human face highlights (learning based methodology). They have utilized RGB, YCbCr, and HSV shading models for skin colour division. These shading models with limits, expel non skin district from a picture. Each portioned skin districts are tried to know whether locale is human face or not, by utilizing human face highlights in view of learning of geometrical properties of human face.

Han Yanbin et al. 2008[2] proposed an algorithm of face introduced is presented taking into account SIFT. Firstly, the face Gaussian image is calculated in various scale; furthermore, the face is represented by the keypoints which are computed in scale image; finally, the info face is recognized by the key-points matching. The algorithm in this paper obtains 96.3% right rate. The experiment demonstrates that the feature extracted by SIFT has superior on face definition, and it has a high strength in facial expression.

Swapnali Bhosale et al. 2014[18] proposed object recognition scheme is executed to assess the execution of the scheme. The SURF algorithm is utilized as a part of this scheme for recognizing multiple objects, calculation of thresholds and measuring the object recognition accuracy under variable states of scale, orientation & illumination.

Shruti D Patravali et al. 2014[8] present segmentation algorithm for face recognition in colour imaages is created. From their examination they infer that the new approach in demonstrating skin shading can make great location progress rate. The calculation gives computationally an extremely productive and also an exact methodology for skin identification which might be connected progressively. The skin hues shape a different bunch in the RGB shading space. Thus skin colour can be utilized for skin division as a part of pictures and recordings. Looking at both the Models, it is recommended that with YCbCr model both the skin shading and composition of the picture can be utilized to distinguish the specific item in the picture, where as in RGB display just the skin shading must be utilized for recognizable proof of the individual. Thus the YCbCr model is superior to the RGB model. The execution of various shading space might be reliant on the strategy used to display the shading for skin pixel.

V. METHODOLOGY

Following are the phases for facial skin detection:

Phase 1: Firstly develop the code for the GUI and after that we develop a code for the creating database with face images.
Phase 2: After that develop a code for face detection.
Phase 3: Develop a code for face skin extraction and for performing filtering.
Phase 4: After that calculate Face Skin Parameters.
Phase 5: Develop a code for feature extraction and matching by using SURF and SIFT algorithms. Measure properties of image are also calculated.
Phase 6: Lastly develop the code for the calculation of the performances on the basis of accuracy and matching time. Finally comparison is performed with earlier approaches.

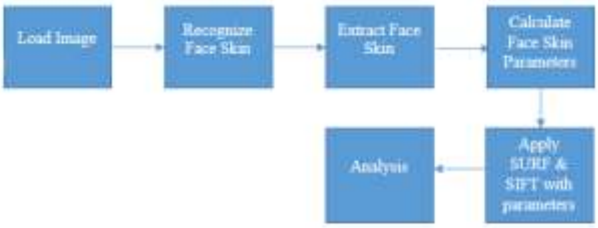

Figure 4: Flow Chart

VI. COMPARISON WITH PREVIOUS WORK

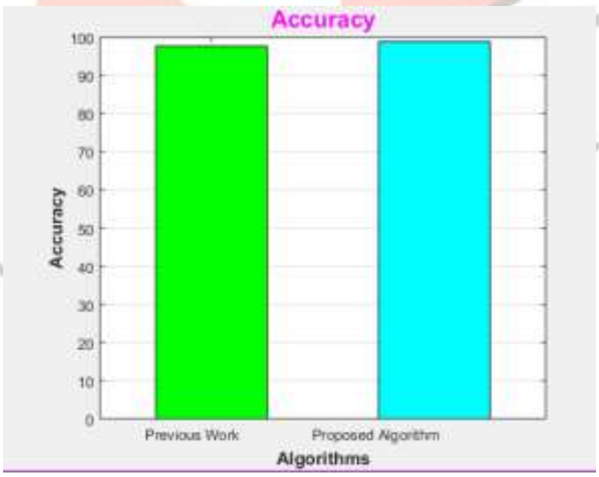

Figure 5: Bar graph comparison of Accuracy for previous and proposed algorithm

The bar graph in figure 5 shows the comparison of accuracy between proposed and previous work. Average accuracy of proposed work is more than previous work.

Comparison of Accuracy between Previous and our algorithm

	Previous Work	Proposed Work
Accuracy	97.6900	98.8636

Figure 6: Comparison of Accuracy between previous and proposed algorithm

The figure 6 shows the average accuracy of proposed work is 98.8636.

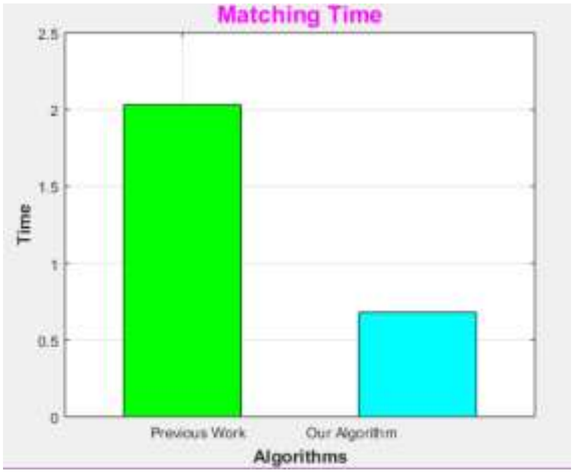

Figure 7: Bar graph comparison of Matching Time for previous and proposed algorithm

The bar graph in figure 7 shows comparison of matching time for previous and proposed algorithm. Matching time obtained in proposed approach is less than that of previous technique.

Comparison of Matching time between Previous and our algorithm

	Previous Work	Proposed Work
Time	2.0300	0.6786

Figure 8: Comparison of Matching time between previous and proposed algorithm

The figure 8 represent the comparison of matching time between previous and proposed algorithm. Matching time in proposed approach is 0.6786 and of previous algorithm is 2.0300.

CONCLUSION

I will conclude that there are different types of approaches used for facial skin classification and each has its advantages and disadvantages. We cannot say that one approach provides best result upon other. In this paper, facial skin segmentation is performed by using SURF (Speeded Up Robust Features technique) & SIFT (Scale-Invariant Feature Transform) with image parameters. These are used in order to recognize and extract face skin. First of all the face skin is recognized and extracted using skin segmentation and a bounding box was made around the face of person then SIFT features are detected then SURF features. The feature points were then extracted and lastly were matched. If various features matches then the system recognize the face skin. The parameters like accuracy and matching time are calculable and results obtained are used to validate the proposed approach.

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