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Automatic Face Detection Using Color Based Segmentation and Morphological Operation

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Abstract— *Face is our important focus of attention forconveying identity. Human face detection by computer systems has become a major field of interest. Detecting the multiple faces in a digital image has gained much importance with application in many areas. Automated human face recognition has mainly divided two parts one is face detection and second one is recognition of detected faces. A paper proposes a color based segmentation algorithm for face detection in color images with detection of multiple faces in an image and separate the skin & non-skin regions using various color models i.e. HSV and YCBCR, after that the Morphological operation is used to smooth the object boundary without changing the respective area using erosion and dilation.*

Keywords- **Color space model, Skin color detection, Edgedetection model, Morphological operation**.

I.INTRODUCTION

Image Processing is one out of many areas that wants to understand the human functionality and copy that functionality with intension to complement human life with intelligent machines. Face detection is defined as to detect the human faces from their background in an image and exactly locate their position in an image. Unique algorithms based on the approaches, like Knowledge based, template matching, face decomposition, support vector machine, pattern recognition, neural network etc. are effectively applied in detection of faces. Each and every algorithm has its own Pros and Cons in terms of efficiency, fast, complexity based on the prior information and knowledge. The present paper uses a mixed approach that is, color based segmentation followed by Morphological operation which take care the object boundary of the image. The color based approached usually take care of either RGB or HSI or YCbCr uses , but in this algorithm we take different values from two color spaces i.e. Hue value from HSV model and Y, Cb & Cr value from YCbCr model is used to detect the skin or non-skin regions. The algorithm developed was found to be reasonably fast taking on an average of 20 seconds to run with the accuracy of nearly 90%. The paper

is organized as follows the color based segmentation where different color spaces, HSI and YCrCb, are considered to determine the skin/not-skin.

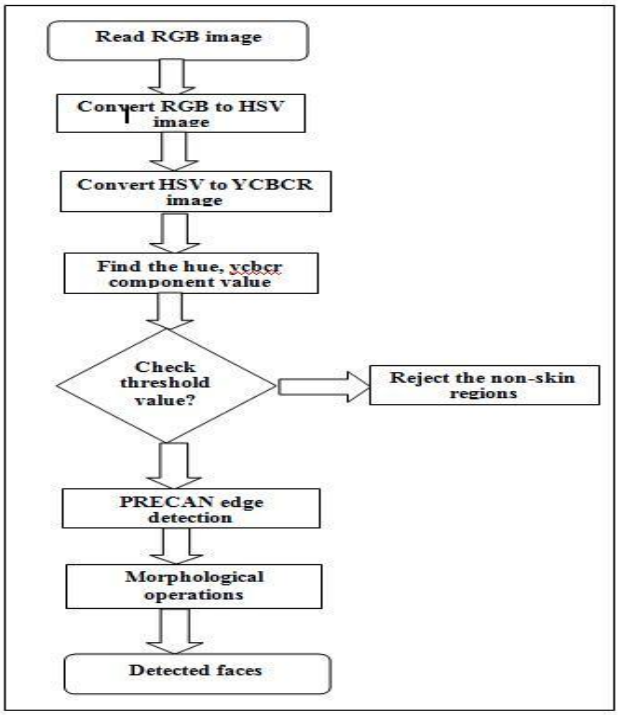

Fig1.1 Flow diagram

II.RELATED WORK

2.1 HUMAN FACE DETECTION USING COLOR SPACE MODELS AND MORPHOLOGICAL PROCESSING

Automating the process to a computer requires the use of various image processing techniques. In the present paper, a face detection method based on color based segmentation and morphological processing is proposed with detailed experimental results. The algorithm designed uses color based segmentation and some morphological processing like open, closed and connected operation. The color based segmentation takes the advantage of patterns developed in only two color spaces i.e. HSV and YCrCb, followed by the morphological operations and a template matching. The present algorithm is applied to Indian faces. Experimental results show that the proposed algorithm is good enough to detect the human face taken through video with an accuracy

90% and recognition of the detected face with an accuracy of 86-90%.

2.2 Face detection using color local binary pattern from mutually independent color channels

A high performance face detection system based on local binary pattern (LBP) using the probability distribution function (PDF) of pixels in different mutually independent color channels which are robust to frontal homogeneous illumination and planer rotation is proposed. The Human faces is enhanced by using the state of art technique which is using discrete wavelet transform and singular value transmission. After equalization, face images are segmented by using local successive mean quantization transform followed by skin color-based face detection system. The distance between the concatenated PDFs of a given face obtained by LBP and the concatenated PDF of each face in the database is used as a metric in the detection process. Various decision fusion techniques have been used in order to improve the detection rate. The proposed system has been tested on the Hp,and Bosporus face databases. The proposed system is compared with conventional and the state of art techniques. The detection rates obtained using Fvf approach for Feret database is 99.78% compared with 79.60 and 68.80% for conventional Grey-scale LBP and principle component analysis based face detection techniques, respectively.

2.3 Automatic Face Detection Using Color Space Models and Template/Energy Thresholding

The purpose of this project has been to try to replicate on a computer that which human beings are able to do effortlessly every moment of their lives, detect the appearance or non-appearance of faces in their field of vision. While it is something that to a layman appears trivial, to implement the necessary steps leading to the successful execution of this in an algorithm is difficult and still an unsolved problem in computer vision. We initially attempted to devise a system that linked Eigen face based front-end with a neural network based back-end, but the neural network machinery proved rather difficult to train and develop in a manner that allowed us to understand the inner workings of our system.

Hence we decided to abandon that approach and pursue a method based on color segmentation followed by template/energy matching. This system has been shown to be reasonably fast, taking on the average of 40 to 90 seconds to run, depending on the internal down sampling rate applied to the input image and various other parameters that can be adjusted. Performance accuracy was found to range from approximately 85% to 100%.

2.4Face Detection with Human Skin Color Segmentation & Recognition using Genetic Algorithm

Face recognition in video has gained wide attention as a covert method for surveillance to enhance security in variety of application domains (e.g., airports, traffic, Terrorist attack).A storage contains temporal information as well as multiple features of a face, so it is expected to lead to better face detection performance compared to actual face images. A human faces appearing in a video have substantial variations in pose and lightening. The paper propose a face recognition system that identifies faces in storage. The detection system utilizes the rich information in video. The

Overall description of proposed method and preliminary results are provided.

2.5Automatic Face Detection Using Color Based Model Segmentation

The increasing instances of identity theft and terrorism incidences in few years ago,security based biometric system has been an area of quality research. A modern biometric system is a cutting edge technology which enables the automated system to distinguish between a genuine person and another image. Automated face detection is one of the areas of biometrics which is widely used because of the uniqueness of one human face to other human face. To detect a human face from an on-line system or an offline image system, the main component that is used to detect only the skin areas in an image. This paper proposes a human skin based segmentation algorithm for face detection in color images with detection of multiple faces and skin regions. Human Skin color has proven to be a useful and robust cue for detecting, recognizing, and tracking.

2.6 A Robust Face Detection Method Based on Human Skin Color and Edges

A paper propose a method to detect human faces in RGB images. Many existing systems use a window classifier that scans the entire image for the presence of the human face and such systems suffers from scale variation, pose variation, illumination changes, etc. It propose a lighting face detection method based upon the edge and skin tone information of the input RGB image. First, enhancing the image, especially if the image is taken from an unconstrained condition. Next, color segmentation in YCbCr and RGB space is conducted. The result of skin segmentation is refined using the skin tone percentage index method. The edges of the input image are combined with the skin tone image to separate all non-face regions from human faces. Human verification using primitive shape features of the face is applied to decide which of the candidate regions corresponds to a face. The advantage of the proposed method is that it can detect faces that are of different sizes, in different poses, and that are making different illumination conditions.

2.7 Human Face detection system using HSV color space and morphological operations:

Skin detection is the process of finding skin-colored pixels and regions in a sample image. First a per-processing step to find regions that potentially have human faces in a sample images. A computer vision approaches have been developed for human skin detection. A different color space model are on shelf for deployment. A face detection procedure which has normally two steps to be done, first to segment skin region from an sample image, and second, to decide these regions contain skin region or not. The procedure is based on human skin color segmentation and human face features. For human skin color segmentation HSV color model has been used. Unique color space model along with threshold, helps to remove non-skin regions like pixels from a sample image. The skin region is actually

represents a human face or not. Then the morphing operations are used to smooth the object boundary without changing their respective area based on shapes. Two major operations such as erode, dilated are used to execute the process of face detection which improves the efficiency rate.

III.EXISTING SYSTEM

In existing system using color based segmentation has includes two color spaces are Hsv, Ycbcr which is used to detect the faces and non-faces region according to the range of two color spaces and morphological operation includes erosion and dilation which is used to smoothened the object boundary without changing the respective area, but these methods having many limitations occurs such as

1.Each and every people have different skin color based on intensity luminance.

2.Variation in scale, pose and shape.

3.Only one face template is not enough to detect the faces in an image.

4.Edge detection quality is highly dependent on lighting conditions.

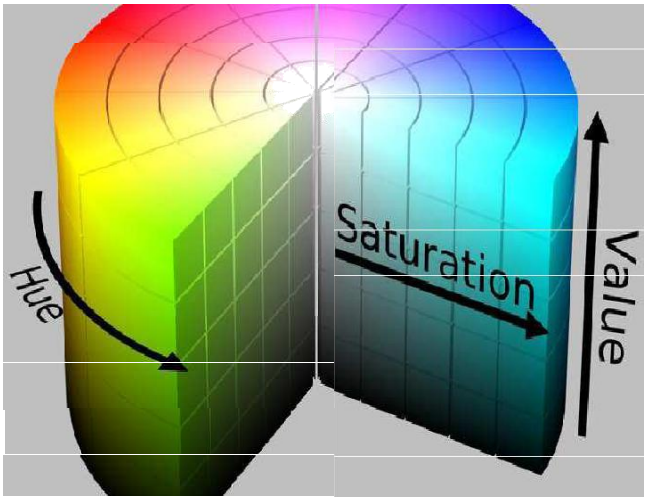

Fig4.1 HSV color model

IV .PROPOSED SYSTE M

In the proposed method, the goal is to detect the presence of faces in an image using color based Segmentation and Morphological operation to detect faces uniform and non-uniform background color of the image. The edge detection of canny and prewitt algorithm using with a combination of color spaces to identify the skin pixels for good segmentation is proposed and an algorithm to check whether the segmented region is face or not. The experimental result shows that the proposed method gives more accurate and efficient results as compare to previous approaches. The efficiency of this proposed method is 94% **.**

4.1 Color based segmentation:

Segmentation is subdividing an image into its essential regions or object. The level up to which the subdivision is carried out depends on the problem being solved. While different ethnic groups have different levels of the melanin and colors, the range of colors that human facial skin takes on is clearly a subspace of the total color space, assuming that a people framed is not having face with any unwanted color. The algorithm takes the advantage of face color correlation to limit face search to areas of an input image that have at least the correct color components. In the survey there are many color based segmentation algorithm, but the proposed method uses the two color spaces only namely, HSI and YCbCr. The bounding ranges calculated for the values of H, Y, Cb and Cr were used to generate the binary images.

4.1.1. HSV:

HSV color model is the cylindrical representation of RGB color model. The angle around the central vertical axis corresponds to "hue" or it form the basic pure color of the image, the distance from the axis corresponds to "saturation" or when white color and black color is mixed with pure color it forms the two different form " tint" and "shade" respectively, and the distance along the axis corresponds to "lightness", "value" or "brightness" or it provides an achromatic notion of the intensity of the color or brightness of the color.

The HSV color model is often better over the RGB model. The HSV color space model explain colors similarly to how the human eye tends to obtain the color. RGB defines color in terms of a combination of red, green, blue whereas, HSV describes color using more familiar comparisons such as brightness, color and vibration. The robot having color camera uses the RGB model to determine color. The camera has read these values at once then it is converted to HSV values. The code of HSV values are used to determine the location of a specific object/color for which the robot is searching. The pixels values are checked individually to determine if they match a predetermined color threshold.

A. Equations

H.S.V color space can be defined as

$$H = COS^{-1}\left(\frac{\frac{1}{2}((R-G)+(R-B))}{\sqrt{(R-G)^2+(R-B)(G-B)}}\right)$$

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

$$V = \frac{1}{3}(R+G+B)$$

B. Abbreviations and Acronyms

"R.G.B"-Red,Green,Blue

"H.S.V"- Hue,Saturation,value
"Y.CB.CR"- Component blue ,Component red

4.1.2. YCBCR:

A reliable skin color model that is adaptable to people of different skin colors and different lighting conditions is necessary if we want to segment skin regions from non-skin regions .The input image is s kin segmented using YCbCr color model and also by HSV color Model. After performing that got two col or space images. One from YCbCr color model and second from HSV color model.

After calculating the likely skin images we calculate the segmented images from both color models. Face regions are brighter than the other parts of the image, the Facial regions can be segmented from the rest of the image through a process called thresholding.

Segmented images obtained are combined into single segmented image called Grey scale image. The result of the enhancement is subjected to skin segmentation, which contains the possible facial candidate, followed by the face tone percentage index method for adjust the region and removal of noise. In contrast, the component of the Grey enhanced image is subjected to detect the edge.

4.2 Morphological operations:

The color segmentation generates a binary mask with the same size of the actual image. However some regions similar to skin also appear white:pseudo color pixels like buildings. The aim of the algorithm connected component is to analyse the connection property of skin regions and detect the face, which are explained by rectangular boxes.

The connection is thin compared to the inside regions of the face and it can be broken by i mage morphology operations. After color segmentation the left over noise in the background can be smoothened using morphological processing.

It is necessary to remove the unwanted specs in order to speed further processing. Hence the erode followed by dilate operation was performed using an arrangement element. It was observed that the open operation has resulted in huge reduction in the number of small noisy specs.

Erode shrinks the selected area and expands the background, whereas dilate operation does the reverse of this. In particular, one row direction and one column direction image erosion operations are applied so that more pixels are eroded in column directions. This is based on the observations that faces are usually connected more horizontal.

In addition, within a face, connections between the parts above and below the eyes are fragile and it is desired not to erode this connection. As erosion operation act similar to median filter, and can remove pixels of pseudo-skin because of their scattered and weak connection property. Between first and second level erosions, holes are removed so that later erosions only happen at edges of the connected components and will not cause regions inside face to fall apart.

V.PRECAN EDGE DETECTION ALGORITHM

Canny and Prewitt edge detection using with a combination of color spaces to identify the skin pixels for efficient segmentation is proposed. All the segmented skin regions are not face regions, then every segmented region is send through an algorithm to check whether the region segmentation is face or not.

Step-1: The input image is skin segmented using YCbCrcolor model. Apply various morphological operations such as erosion and dilation on this skin segmented regions.

Step-2: The input image is also skin segmented using HSIcolor model. On this skin segmented regions various morphological operations such as erosion and dilation.

Step-3: The original image is converted into grayscaleimage. " Canny" and "Prewitt" edge detection of gray-scale is obtained. Then Edge-images obtained by both the methods are combined and complemented to obtain region boundaries.

Step-4: Segmented images obtained in Step-1 and Step-2 iscombined into single segmented image. On this image connected component analysis is carried out to obtain a Combined-Segmented image.

VI.EXPERIMEN TAL RESULTS

The principle of basic design behind the approach is to find whether a particular pixel belongs to skin or Non-skin range of Hue (H), luminance (Y), difference between the blue component and a reference Value (Cb) and changes between the reference value (C r) and a red component.

Fig6.1 Image Acquisition

Fig6.2 Applying HSV Segmentation Rule

The experimental result shows that the proposed method gives more accurate and efficient results as compare to previous approaches and methods. See the table1 out of 21 faces from the digital image, 19 were correctly detected by the color based segmentation and morphological operations. The detection rate was 94.61% and false detection rate was 5.39%, here we calculated labeled region 23, number of correctly detected faces was 19 and number of lost faces was 2, but here 1 false positive was also detected. The efficiency of this proposed method is 95%.

In the future work, we will improve this algorithm combined with more edge detection algorithm to achieve better performance and future reduce the negative missing faces. In my current algorithm , get more accuracy in our implementation then one miss hit is detected, it is came due to the shrinkness of the shirt so it is calculated as a hole in the region and the method treated this area as a human face so, to overcome this problem you can apply more edge detection approaches on it.

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