Automatic Face Detection using RGB Color Model for Authentication

Chiranjit Dutta, Ranjeet Singh

Abstract- The paper entitled Automatic face detection using RGB color model is the application developed to recognise the face and use it as a biometric security in the email protection. The face is captured through the webcam and stored in the database with the email id, password and then if we try to login then it again ask for face input and if the face matches then we can login . The face that we capture during login is matched with the image present in the database by matching the R,G,B component . This paper provides more secure and robust email security using biometric as a password. Biometric security comes with its own unique set of challenges. While face recognition have been used as a biometric security, which make the email more secure; its accuracy is still a problem. As it provide only 80 to 90 % accuracy. Therefore, we must find a way to make it more accurate and secure.This application may also be used to prevent various crimes going on in the country. Even it can be used in capturing the images of suspected person and matching it with the databases of criminals to catch them.Further, the algorithm can detect both dark skin-tone and bright skin-tone using YUC Color Space model

Keywords: Euclidean space, face Detection, Principal Component Analysis.

I. INTRODUCTION

To authenticate the identity are used to different aspects of human physiology. Different characteristics trait of human of ascertaining identity can be classified into two categories. Physiological and Behavioural traits like fingerprints, faces, iris, hand geometry, gait, ear pattern, voice recognition, keystroke pattern and thermal signature. In order to locate a human face, the system needs to capture an image using a camera and a frame-grabber to process the image, search the image for important features and then use these features to determine the location of the face [1][2]. The most important application area of face detection is biometrics. Face finding is often considered the first step of the face recognition process. Thus, most facial recognition systems, and the more complex biometric systems including face recognition components, use face detection techniques. Video surveillance represents another important application domain of face detection. This application uses face detection techniques for the biometric security. Face detection is used to verify email and use it as a password which adds an extra layer of security to the email. As biometric is unique for each person and cannot be stolen or cannot be easily compromised. This application uses RGB color model for detecting faces by computing three components of the color space are computed as linear combinations of R, G and B components of the image[3][4].

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II. LITERATURE SURVEY

Human face perception is currently an active research area in the computer vision community. Human face localization and detection is often the first step in applications such as video surveillance, human computer interface, face recognition and image database management. Locating and tracking human faces is a prerequisite for face recognition and/or facial expressions analysis, although it is often assumed that a normalized face image is available. In order to locate a human face, the system needs to capture an image using a camera and a frame-grabber to process the image, search the image for important features and then use these features to determine the location of the face. For detecting face there are various algorithms including skin color based algorithms. Color is an important feature of human faces. Using skin-color as a feature for tracking a face has several advantages. Color processing is much faster than processing other facial features. Under certain lighting conditions, color is orientation invariant. This property makes motion estimation much easier because only a translation model is needed for motion estimation. However, color is not a physical phenomenon; it is a perceptual phenomenon that is related to the spectral characteristics of electromagnetic radiation in the visible wavelengths striking the retina [4]. Tracking human faces using color as a feature has several problems like the color representation of a face obtained by a camera is influenced by many factors (ambient light, object movement, etc.), different cameras produce significantly different color values even for the same person under the same lighting conditions and skin color differs from person to person. In order to use color as a feature for face tracking, we have to solve these problems. It is also robust towards changes in orientation and scaling and can tolerate occlusion well. A disadvantage of the color cue is its sensitivity to illumination color changes and, especially in the case of RGB, sensitivity to illumination intensity. One way to increase tolerance toward intensity changes in images is to transform the RGB image into a color space whose intensity and chromaticity are separate and use only chromaticity part for detection. Our detection technique works for RGB color images only and it is based on the skin regions of the image. Thus, in the first stage, our approach performs a skin segmentation process, extracting the human skin regions from the analyzed image.

A. RGB Color Model

The RGB color model is an additive color model in which red, green, and blue light are added together in various ways to reproduce a broad array of colors. The name of the model comes from the initials of the three additive primary colors, red, green, and blue.

The main purpose of the RGB color model[4] is for the sensing, representation, and display of images in electronic systems, such as televisions and computers, though it has also been used in conventional photography. Before the electronic age, the RGB color model already had a solid theory behind it, based in human perception of colors. RGB is a device-dependent color model: different devices detect or reproduce a given RGB value differently, since the color elements (such as phosphors or dyes) and their response to the individual R, G, and B levels vary from manufacturer to manufacturer, or even in the same device over time. Thus an RGB value does not define the same color across devices without some kind of color management. Typical RGB input devices are color TV and video cameras, image scanners, and digital cameras. Typical RGB output devices are TV sets of various technologies (CRT, LCD, plasma, etc.), computer and mobile phone displays, video projectors, multicolor LED displays, and large screens such as jumbotron. Color printers, on the other hand, are not RGB devices, but subtractive color devices (typically CMYK color model). To form a color with RGB, three colored light beams (one red, one green, and one blue) must be superimposed (for example by emission from a black screen, or by reflection from a white screen). Each of the three beams is called a component of that color, and each of them can have an arbitrary intensity, from fully off to fully on, in the mixture.

The RGB color model is additive in the sense that the three light beams are added together, and their light spectra add, wavelength for wavelength, to make the final color spectrum. Zero intensity for each component gives the darkest color (no light, considered the black), and full intensity of each gives a white; the quality of this white depends on the nature of the primary light sources, but if they are properly balanced, the result is a neutral white matching the system's white point. When the intensities for all the components are the same, the result is a shade of gray, darker or lighter depending on the intensity. When the intensities are different, the result is a colorized hue, more or less saturated depending on the difference of the strongest and weakest of the intensities of the primary colors employed.

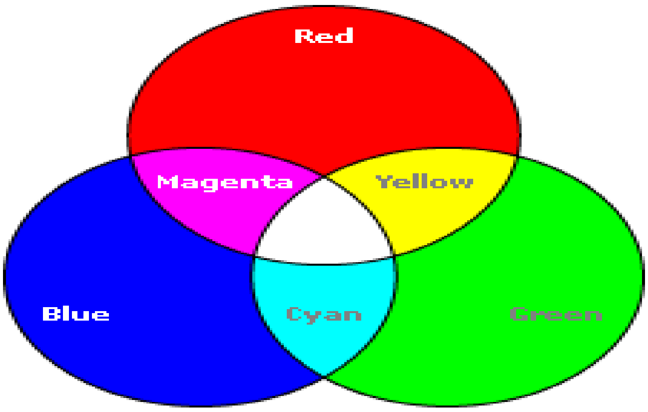

Figure 1: RGB Color Model

When one of the components has the strongest intensity, the color is a hue near this primary color (reddish, greenish, or bluish), and when two components have the same strongest intensity, then the color is a hue of a secondary color (a shade of cyan, magenta or yellow). A secondary color is formed by the sum of two primary colors of equal intensity: cyan is green+blue, magenta is red+blue, and yellow is red+green. Every secondary color is the complement of one primary color; when a primary and its complementary secondary color are added together, the result is white: cyan complements red, magenta complements green, and yellow complements blue. The RGB color model itself does not define what is meant by red, green, and blue colorimetrically, and so the results of mixing them are not specified as absolute, but relative to the primary colors. When the exact chromaticities of the red, green, and blue primaries are defined, the color model then becomes an absolute color space, such as srgb or Adobe RGB. The RGB model is represented by a 3-dimensional Cube with red green and blue at the corners On each axis (Figure 1). Black is at the origin. White Is at the opposite end of the cube. The gray scale Follows the line from black to white. In a 24-bit Color graphics system with 8 bits per color channel, Red is (255, 0, 0). On the color cube, it is (1, 0, 0).

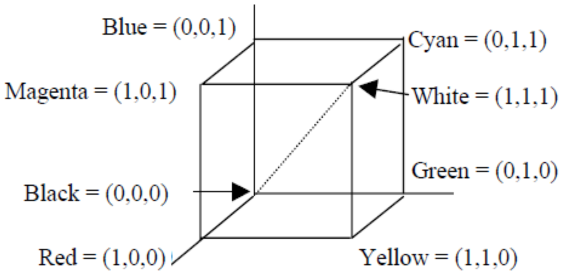

Figure 2: RGB Color Cube

A color in the RGB color model is described by indicating how much of each of the red, green, and blue is included. The color is expressed as an RGB triplet (*r*,*g*,*b*), each component of which can vary from zero to a defined maximum value. If all the components are at zero the result is black; if all are at maximum, the result is the brightest representable white. These ranges may be quantified in several different ways:

- From 0 to 1, with any fractional value in between. This representation is used in theoretical analyses, and in systems that use floating point representations.
- Each color component value can also be written as apercentage, from 0% to 100%.
- In computers, the component values are often stored as integer numbers in the range 0 to 255, the range that a single 8-bit byte can offer. These are often represented as either decimal or hexadecimal numbers.
- High-end digital image equipment are often able to deal with larger integer ranges for each primary color, such as 0..1023 (10 bits), 0..65535 (16 bits) or even larger, by extending the 24-bits (three 8-bit values) to 32-bit, 48-bit, or 64-bit units (more or less independent from the particular computer's word size).

B. SKIN DETECTION APPROACH FOR RGB IMAGES

Human skin color is proven to represent a very useful face detection and localization tool.

A skin-based face finding approach identifies the skin regions of the image, then determine those of them which represent human faces. Besides face detection, there exist other important application areas of skin detection, such as image content filtering and finding illegal internet content , content-aware video compression or image color balancing. Many skin color localization techniques have been developed in recent years. In Figure 3 A robust and very known skin finding method is the algorithm proposed by fleck and forsyth in 1996, that Uses a skin filter .we are interested in color images only and do not perform skin and face detection in grayscale images [5]. Obviously, the color images are usually in the rgb format. While it is one of the most used color spaces for processing and storing of digital image data, rgb is not a favorable choice for skin color analysis, because of the high correlation of its three channels and the mixing of luminance and chrominance data . For this reason, most skin segmentation algorithms work with other color spaces, such as the normalized rgb, hsv (and other hue saturated based spaces) and ycrcb formats

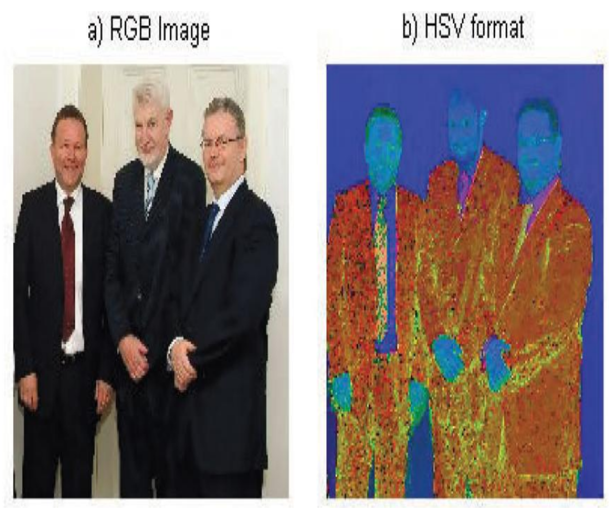

Figure 3: Digital color image conversion: RGB to HSV

III. PROPOSED ALGORITHM

The Proposed model for face detection using Skin Segmentation and morphing is shown in the Figure 4. The input RGB image is taken for the detection process. After then to detect the human face for authentication purpose store the database. We ought to develop an application where face recognition is used as email account password. This can be used basically as a biometric security. The basic instance of our proposed system is that once this application is used as a password setting for the email account verification which uses face as a biometric security then our email security becomes more secure and robust. Our application also uses the most basic color model for detecting face which does not require any special software and hardware. NRGB is a non-linear transformation of the RGB space. They are obtained by normalizing the color parameters of linear RGB model with linear intensity (RGB first norm):

$$I=R+G+B,$$

$$r= R/I,\ g=G/I,\ b=B/I \qquad (1)$$

This normalization reduce pixel brightness dependence

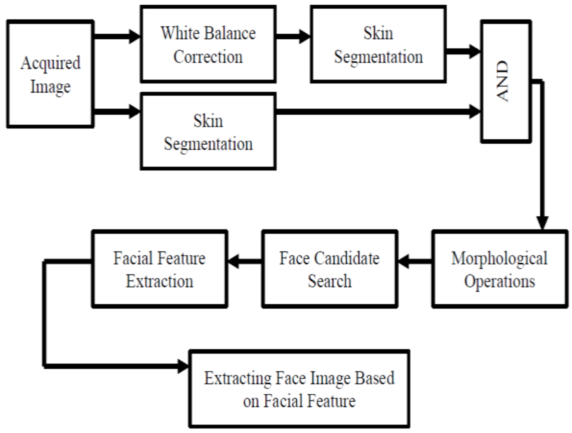

Figure 4: Face Detection Algorithm using Balance

YCbCr color space has been defined in response to increasing demands for digital algorithms in handling video information, and has since become a widely used model in a digital video.

The Y in YCbCr denotes the luminance component, and Cb and Cr represent the chrominance factors. In YCbCr, the Y is the brightness (luma), Cb is blue1 minus luma (B _ Y) and Cr is red minus luma (R _ Y). If R, G and B are given with 8 bit digital precision, then YCbCr from ‘‘digital 8-bit RGB’’ can be obtained from RGB [14].

Chai and Ngan in [16] first proposed YCbCr algorithm, which is comprised of a skin segmentation step followed by a set of regularization processes to reinforce those skin regions that are more likely to belong to the facial regions. The conversion of RBG to YCbCr is done by the equation given as in equation (2):

$$Y=0.299R+0.587G+0.114B$$
$$Cb=B-Y$$
$$Cr=R-y$$

The skin segmentation step thus employed exploits the 2D chromatic subspace to reduce the dependence of illumination. A skin color map is derived and used on the chrominance components of the input image to detect pixels that are of skin color. According to the authors the most suitable ranges of Cb and Cr that can be used to represent skin color pixels are shown in equation (3) as:

$$77<=Cb<=127; \quad 133<=Cr<=173$$

we found that the following rule will work well in removing some unnecessary pixels: $0.836G - 14 < B < 0.836G + 44$ = Skin with other pixels being labelled as non-face and removed Skin color like pixel conditions are given below[12]:

$$R>95,\ G>40,\ B>20$$
$$Max(r,g,b)-min(r,g,b)>15$$
$$|r-g|>1 \qquad R>g$$

“R”, “g”, and “b” parameters are red, green and blue channel values of pixel. If these seven conditions are satisfied, then pixel is said to be skin color and binary image is created from satisfied pixels.

The implemented white balance algorithm is given Below :

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- Calculate average value of red channel (Rav), green channel (Gav), and blue Channel (Bav)
- Calculate average gray Grayav=(Rav+Gav+Bav)/3
- Then, KR=Grayav/Rav, KG=Grayav/Gav, and KB=Grayav/Bav
- Generate new image (newi) from original image (orji) by
  New(R)=KR*Orj(R), New(G)=KG*Orj(G),
  and New(B)=KB*Orj(B)

After calculating the pixels of R,G,B component of the face then match it with the sample image pixels:

- If the pixels of both the images are same then the both faces are same.
- If the pixels of both faces are not same then faces are different.

A complete hardware and software system is designed and installed in the system. The ultimate goal of the project is to develop a application which provide a secure and robust face biometric which provide a more security to our email id. The developed application has been tested for many live acquired images and results are satisfactory. Improvements are required for better performance and more security. First image is captured with the webcam and then the face are detected in the acquired image. Then face detection has started with skin like region segmentation. Then the r,g,b component value are calculated from the acquired image.

Figure 5(a)
Original Image

Figure 5(b)
Segmented Image

Besides RGB gives the best result, colors of wall inside laboratory can be skin like Color due to white balance value of camera. Unwanted skin like color regions can Affect detection and distort face shape. This color problem can be eliminated by White balance correction of acquired image. Then the face R,G,B value are calculated and then the results are matched with the face which are captured during login. if the r, g ,b value are matched the home page opens and if the value of both faces not match then they continue to be on the login page.

IV. CONCLUSION

RGB skin color segmentation is performed in the algorithm. It performs well in recognizing face and matching which helps well in making email id more protected and secure. Although its accuracy is only 80 to 90 %.This area needs to be improved. Many methods use ycbcr color space. Also, ycbcr and HSV color spaces are tested but best results are obtained with RGB color space. RGB color space works well at indoor conditions but performance is not tested for outdoor condition. If modelling of skin color is performed with statistical model, skin color segmentation may be more accurate. Segmentation is performed on both acquired image and white balance corrected in acquired image. Then, logical "and operation" is performed on both segmented images to reduce color problem.

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