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Skin colour information and Haar feature based Face Detection

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Abstract
In today's world security of data, person and information is very important aspects.So biometric systems for user authentication are becoming increasingly popular due to the security control requirement in identity verification, access control, and surveillance applications. For authentication various recognition techniques are used e.g. vein pattern recognition, face recognition. For face recognition accurate face detection is primary need. Here we present two different approaches for face detection. First face detection approach is based on skin colour detection. Second approach is Haar feature based face detection.

Keyword: Skin colour detection, Haarfeatures

I. INTRODUCTION

Authentication of user is increasingly popular due to the security control requirement in identity verification, access control, and surveillance applications. Face recognition, among other conventional biometric authentication techniques is most suitable option because it is non-intrusive and economic with low cost cameras and embedded systems. Over the past few years, various research works on various aspects of face recognition by human and machines have been conducted by psychophysicists, neuroscientist and engineering scientists.

Face recognition is one of the most studied topics in computer vision and one of the most successful applications of image analysis, pattern recognition and machine learning. Though there are many successful applications already, accurate face recognition is still a challenge. This is due to the variance in face images e.g. viewpoint, illumination, expression, occlusion, makeup and aging.

The first step of face recognition is accurate face detection. There are varietyof approaches present for face detection such as skin colour based face detection, template matching method based face detection, haar feature based face detection etc.

Skin detection has an important role in a wide range of image processing applications starts from face detection up to large number ofhuman computer interaction areas. Many researchers invents various skin colour detection models but these are applicable over small number of colour spaces. There are many colour spaces have been used by researchers with different ways to label pixels as skin or non-skin. But still, there is not a fixed opinion about which colour space is the best choice to achieve perfect skin detection.

Template matching methods use the correlation between pattern in the input image and stored standard patterns of a whole face / face features to determine the presence of a face or face features (predefined templates). These predefined templates or deformable templates or both can be used. The face detection method using template matching chooses whole face feature as the matching template, with which the stress of computing of face area search is relatively large. However, most human faces have symmetry obviously. So we can choose half of the full face-template that is choosing the left half or the right half of faceas the template of face matching which can reduce the relatively large computation for face area search.

In face detection process, images are classified based on values of sample features instead of pixels. These feature values are calculated using haar features, originally given by Viola & Jones. This technique quickly rejects the regions which are highly unlikely to contain the face.

In this paper we are presenting two face detection approaches one is based on skin colour detection and another is based on haar feature based approach.

II. SKIN COLOUR BASED FACE DETECTION

For skin colour based face detection it is important to choose proper colour space.The distribution of skin colour of different people has proven to be grouped into a small area of the colour space, there are different colour spaces available YUV(Y- luminance component, U and V chrominance component), YCbCr(Y- luminance, Cb-blue chrominance, Cr-red chrominance), RGB(red, green, blue), Normalised RGB(normalised red, green, blue), HSV(hue saturation value) [11]. Out of these colour spaces HSV colour space is suitable for face detection based on skin colour.

1. *RGB:- Red Green Blue*

RGB is the most commonly used colour space for storing and representing digital images, since the data captured by a camera is normally provided as RGB. RGB correspond to the three primary colours: red, green and blue, respectively. To reduce the dependence on lighting, the RGB colour components are normalized so that sum of the normalized components is unity *(r + g + b = 1)*. Since the sum of these components is 1, the third component does not hold any significant information and is normally dropped so as to obtain a reduction in dimensionality. It has been observed that under certain assumptions, the differences in skin-colour pixels due to lighting conditions and due to ethnicity can be greatly reduced in normalized RGB (*rgb*) space. Also, the skin-colour clusters in *rgb* space have relatively lower variance than the corresponding clusters in RGB and hence are shown to be good for skin-color modelling and detection. Due to the above advantages, *rgb* has been a popular choice for skin-detection.[11]

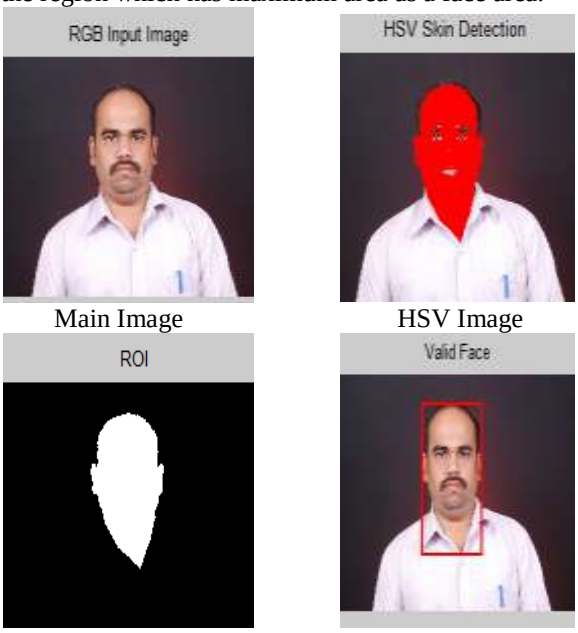
2.*HSV:- Hue Saturation Value*

The perceptual features of colour such as hue (H), saturation (S) and intensity (I) cannot be described directly by RGB. Many non-linear transformations are proposed to map RGB on to perceptual features. The HSV space defines colour as *Hue*—the property of a colour that varies in passing from red to green, *Saturation*—the property of a colour that varies in passing from red to pink, *Brightness* (also called *Intensity* or *Lightness* or *Value*)—the property that varies in passing from black to white. The transformation of RGB to HSV is invariant to high intensity at white lights, ambient light and surface orientations relative to the light source and hence, can form a very good choice for skin detection methods.[11]

3. *YCbCr:-*

The mostly used colour space is YCbCr where Y is luminance component, Cb is blue chrominance and Cr is red chrominance. The chroma component is represented only by blue and red as the sum of chroma value of red, green and blue component is always constant. The separate luma and chroma component makes this model illumination invariant. Using the raw input image in the RGB colour space is not suitable tool for skin detection. This is due to that the RGB colour space is highly sensitive to intensity difference. The YCbCr colour space is commonly used in image processing as it separates the luminance, in Y component, form the chrominance described through Cb and Cr components [11].

To determine skin points, first human skin colour is calculated through HSV colour space. Many more experiments shows different ranges for Hue (H-range) and Saturation (S-range). By experiment here we take H- rage is 0-0.1100 and S- range 0.2000-1.5000. First step of presented method is to set skin parameters in terms of H-range and S-range. Next take input image specify its parameter (i. e. height and weight). Next convert input image which is in the form of RGB to HSV. In this step we obtain H and S data into new variables. Now using new data available detect the skin pixel from predetermined h-range and s-range values. Mark the skin pixel obtained from entire image using red mark and also form binary image. Remove the unwanted pixels from image. After this we can get many object in specified area calculate the area of all objects. Select the region which has maximum area as a face area.



Main Image HSV Image

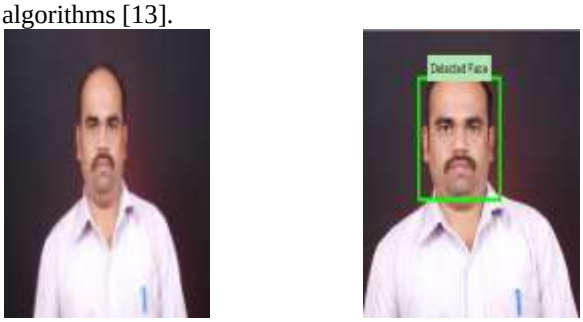
ROI Detected Face

Fig 1. Skin Colour Based Face Detection

III. HAAR FEATURE BASED FACE DETECTION

P.Viola presented an Adaboost algorithm which can be used for fast image retrieval and face detection. The Adaboost algorithm was often used to detect face area in an image. The main idea of this algorithm is to boost up a large number of generally weak classifiers to form strong classifier, and the strong classifier has strong classification ability [2]. Adaboost algorithm implemented using haar cascade feature. This technique quickly rejects the regions which are highly unlikely to contain the face.For more accurate results we use P.Viola presented an Adaboost algorithm which can be used for fast image retrieval and face detection. The Adaboost algorithm was often used to detect face area in an image. The main idea of this algorithm is to boost up a large number of generally weak classifiers to form strong classifier, and the strong classifier has strong

classification ability [13]. Adaboost algorithm implemented using haar cascade feature. This algorithm develops a new approach for extremely fast detection in domains where the distribution of positive and negative examples is highly skewed (e.g. face detection or database retrieval). In such domains a cascade of simple classifiers each trained to achieve high detection rates and modest false positive rates can yield a final detector with many desirable features: including high detection rates, very low false positive rates, and fast performance. Achieving extremely high detection rates, rather than low error, is not a task typically addressed by machine learning algorithms [13].



Main Image Detected Face

Fig 2.Haar feature Based Face Detection

IV. CONCLUSION AND FUTURE WORK

The paper presented an automatic face detection approach can be considered as the first step in any human computer interaction applications. The paper started with studying and deciding which colour space is best for the human skin-base applications and database in hands. We found that the HSV space is the most optimum in case of using normal lighting and different lighting conditions. Also we study another method for face detection i.e. haar feature based face detection using Adaboost algorithm presented by P. Viola. This approach gives more accurate result than that of skin colour based approach.

In the future research, we are planning to integrate the proposed face detection approach with a user authentication element in order to represent a new face recognition system. This system may also combine with a depth map calculation to represent a secure and accurate face recognition system.

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