Face Detection & Recognition on Virtual Platform

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Abstract— Face detection has been proven one of the most interesting topics in research in the past few decades. It holds great importance in the field of Information and Communication. It is rapidly entering in all the sectors and aspects of our life. Technologies can be used in developing environments where people interact with smart electronic devices. Face detection can act as basis for face recognition which is further used in intelligent security systems, smart home systems etc. It opens doors for the applications where face recognition is used and security is the key issue. Criminal recognition in jails, password in phones, computers etc. are few example of such a system. Face detection is a key to improve the way we interact with machines. As the needs grow the applications can be explored. The paper presents the concept of face detection using edge detection. Edge is one of the basic features of an image. An image is a combination of edges.

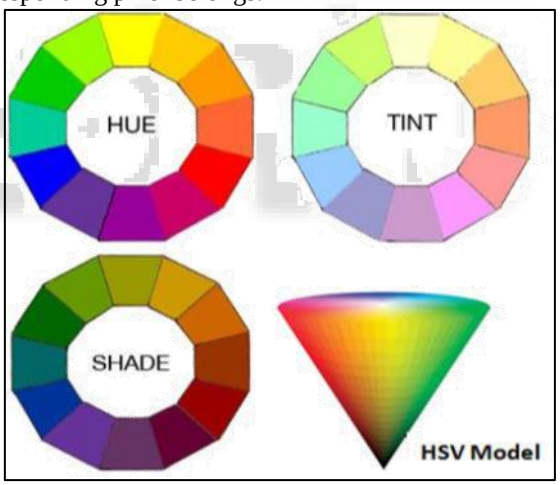
Key words: Edge Detection, Face Detection, HSV, Image Segmentation, MATLAB

I. INTRODUCTION

Face detection is a technology that uses set of mathematical rules to describe landmarks to identify human face. It typically determines the precise face area. The human face plays crucial role in social interactions and conveying one's identity. It is an important early step in many computer systems and face processing system. Some current applications where face detection is being used are autofocus cameras, practical security systems, people counting system, lecture attendance system etc. Several US states now use face detection and recognition while issuing driving license. As a result of such systems person sensing and recognition become of fundamental importance hence such systems should be highly user-friendly. The idea of face detection can be combined with almost every smart system as face being a biometric identifier they ensure a better secure and immune to intrusions. Biometric is the use of distinctive physical features (e.g., iris, fingerprints, face, and retina) and behavioral feature (e.g., gait, signature), called biometric identifiers, for automatic recognition of an individual. These identifiers cannot be easily misplaced, forged, or shared; they are more reliable for recognizing a person rather than other knowledge-based methods. It allows recognition without any physical contact with the sensor. The paper aims to present a face detection system based on edge detection and simple morphological steps in MATLAB.

II. LITERATURE REVIEW

The detection is used as the base for face detection. Among several techniques available Sobel operator is used
The Sobel operator performs a 2-D spatial gradient quantity on an image and therefore highlights regions of high spatial frequency which correspond to the edges. Ge nearly it is used to find absolute gradient magnitude at each point in a grayscale image. The Sobel technique is similar to the Roberts Cross algorithm. The main difference is the kernels that each uses to obtain the image. The Sobel kernels are more appropriate in detecting to edges along the horizontal and vertical axis on the other hand that of Roberts's are suitable to detect edges running along the vertical axis of 450 and 1350. HSV (hue, saturation, value) is used for extraction of skin color. Hue is basically the range of colors or shades exists between two colors, for example between red and yellow hue there exist a range of orange hues. Saturation is the purity of a particular color. High saturation colors are rich and brighter where as Low saturation colors look dull and grayish. Value or brightness is nothing but the lightness or darkness of a color. Light colors are called tints, and dark colors shades. In the face detection algorithm using the skin color, one knows whether a pixel is skin pixel or not but it is difficult to anything about whether that pixel belongs to face or other part of the body. Hence it becomes important to make groups in order to represent the part of body to which the corresponding pixel belongs.



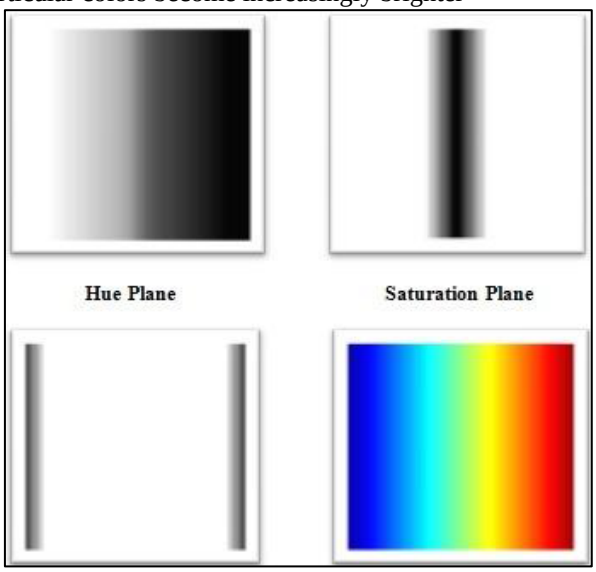
III. PROPOSED SYSTEM

The proposed algorithm will detect the faces in an input image. It consists of the following steps. The first step is to extract the face color and find the intensity of the corresponding pixel. This is done by converting RGB image to HSV image and calculating constant values accordingly. The next step is to compare the constant values and identify the face region.

A. HSV (Hue, Saturation, Value)

The HSV also known as HSB (B-brightness) color space is often used by people who intent to select colors (e.g., of paints or inks) from a color wheel or palette, because it corresponds better to how people experience color than the RGB color space. The functions rgb2hsv and hsv2rgb convert images between the RGB and HSV color spaces. The hue varies from 0 to 1 and corresponding colors are follow through red,

yellow, green, cyan, blue, magenta and finally back to red. The shades are classified as saturated, unsaturated (grayscale) and fully saturated (no white component). The value basically corresponds to brightness and as it varies from 0 to 1.0, the particular colors become increasingly brighter



Given an image, each pixel in the image is classified as the skin or non-skin using color information. If H and S values of a pixel exceeds a threshold called skin threshold (obtained empirically), then that pixel is considered a skin pixel. Otherwise the pixel is considered a non-skin pixel. A skin detected image is one in which only the skin pixels are shown. As a result an image and the face are shown in figure 2(a) and figure 2(b) respectively.

B. Using Edge Detection

Edge detection techniques can be classified under two broad categories, gradient and Laplacian. The gradient method detects the edges by considering the minimum and maximum in first derivative of an image and Laplacian on the other hand look for zero crossing in second derivative of an image to detect the edges. Different gradient based method is Prewitt, Roberts, Sobel operators while Marrs-Hildreth and LoG are a Laplacian method.

The Sobel operator is fast, detects the finest edge and has smoothing along the direction of edge, this avoids noisy edges. Sobel is a row-edge detector which has 3x3 convolution kernels. An input image 'A' when convolved with the kernels gives GX and GY images which contain the horizontal and vertical derivate. The kernel can be applied separately to the input image for obtaining gradient component in each orientation i.e. GX and GY.

-1	0	+1
-2	0	+2
-1	0	+1

+1	+2	+1
0	0	0
-1	-2	-1

Kernels

The gradient magnitude is given by:

$|G|=\sqrt{GX}$

$2 + GY$

2

And its approximation is done by:

$|G|=|GX| + |GY|.$

The orientation of angle i.e. direction of gradient is given by:

$O = \arctan(GX/GY).$

Figure 3(a) and Figure 3(b) shows original image and its edge detection respectively. The false edges can result in error as the edge Threshold value will get changes. Hence choosing an appropriate edge detection method plays important role in the face detection.

C. Proposed Algorithm

The algorithm explains the steps briefly

Step 1: Load the image and preprocess it.
Step 2: Convert the RGB image to HSV image and calculate the H and S values.
Step 3: Compare the pixel value of the face and cr and cb constants (H and S values).

```
if 140<=cr(i,j) && cr(i,j)<=185 &&
140<=cb(i,j) && cb(i,j)<=205 &&
0.01<=hue(i,j)&& hue(i,j)<=0.1
Segment (i,j)=1;
Else
Segment (i,j)=0;
```

Step 4: Apply edge detection using Sobel operator.
Step 5: Perform binarization and morphological operations to reconstruct the false edges by calculating a mean value.
Step 6: Fill the boundaries of hole (used to represent the face region).

```
BW_filled = imfill(BWa,'holes');
boundaries = bwboundaries(BW_filled);
```

Step 7: Plot shape over the face.

D. Analysis of Algorithm

1) Camshift Algorithm

Color probability distribution varies accordingly whenever the video frame sequences changes over time [6]. Maintaining proper size and location of the search window required for various experimentation purposes. Camshift algorithm is used to adaptively meet that requirement. Camshift Algorithm principal has been properly explained in [7]. 2D probability distribution image is employed by the Camshift Algorithm. The back projection of the target histogram is produced by the Camshift algorithm with image to process [9]. The Meanshift Algorithm is called by the Camshift algorithm whose purpose is to calculate the target center of the image employed by the Camshift algorithm, i.e. the probability distribution image. The flow of Camshift algorithm operation studied and used during the analysis in this paper is shown in Fig. 1. C. Comparison Study

The objective of the experiment is to evaluate the performance of the facial features detection and face tracking algorithms KLT and Camshift. Viola Jones algorithm is used for Face detection before invoking face tracking algorithms KLT and Camshift. The study has been completed on MATLAB R2016a, Intel i5 fourth generation processor of 3.50 GHz and 4.00 GB Ram. The resulted images of the experiment are shown below.

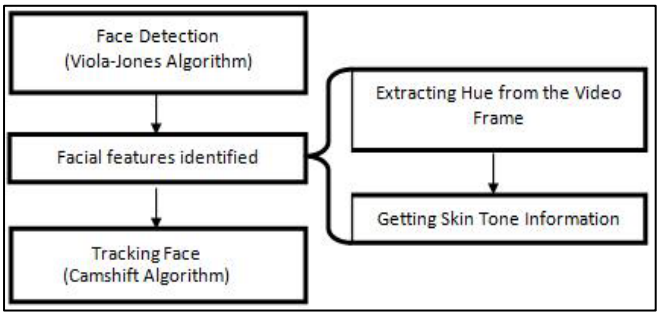


Fig. 1: Camshift Face Tracking Algorithm

2) KLT Algorithm

The movement of the objects in the video frames is tracked by the KLT tracking. This approach calculates this when the brightness constancy constraint of the image is fulfilled and the movement of the image is small [11]. A set of object points is detected by this algorithm through the video frames. After face detection been completed then the facial feature points to be identified that can be tracked constantly [11]. The point tracker tracks the point throughout the number of frames one by one referring the previous frame. After the face detection, the next process is extracting information of the facial expressions that is present there [12]. Several permanent facial features on which the several approaches depend upon are the eyebrows, eyes, mouth, etc. and also the facial lines [12]. The flow of KLT algorithm operation that is studied and used during the analysis in this paper is shown in Fig. 2.

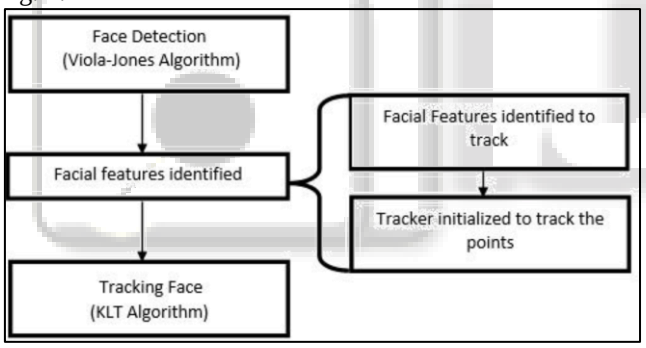


Fig. 2: KLT Face Tracking Algorithm

3) Comparison Study

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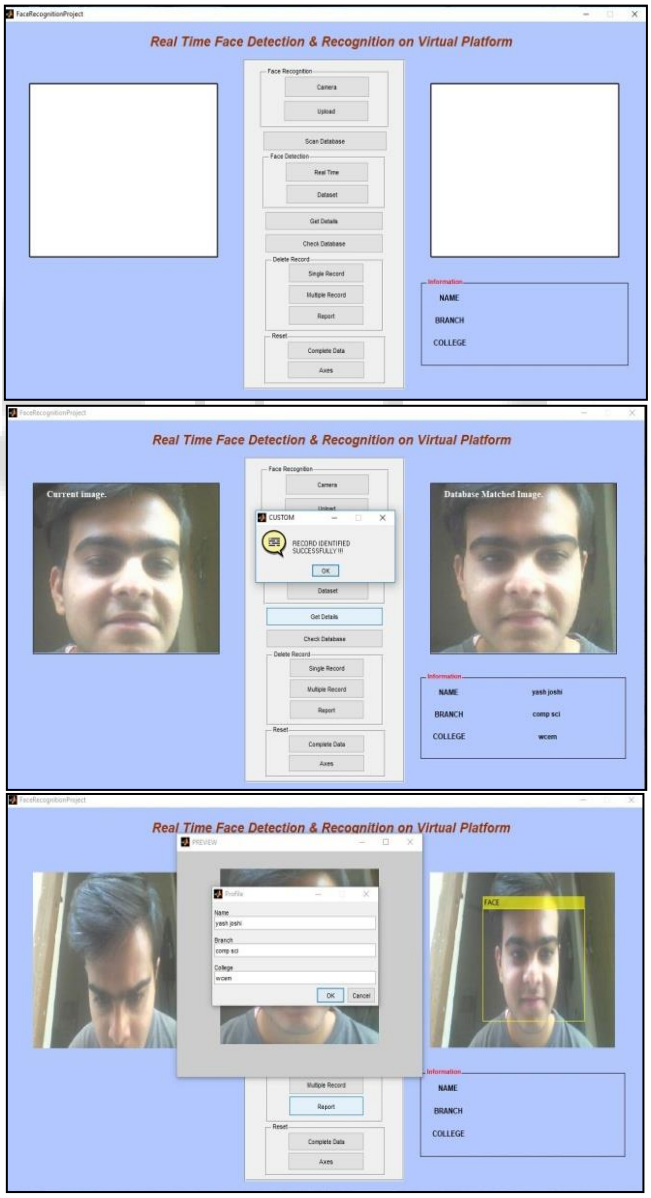
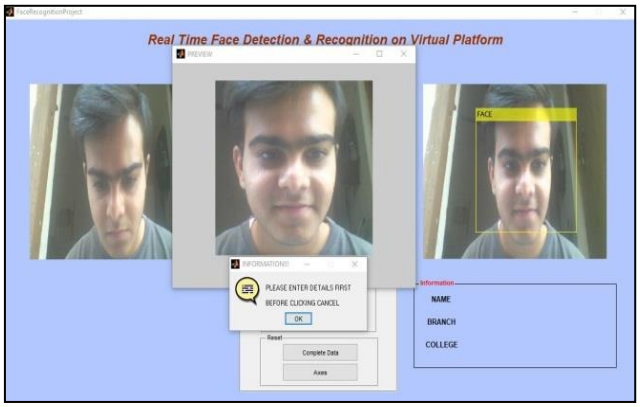
IV. EXPERIMENTAL RESULTS

In this paper, face detection test training samples only contains positive sample of human face, not contains negative samples of human face, under the same conditions fed Adaboost classifier to train and get two cascade [7] classifier. One use 263103 Haar-Like features, named Haar-Like classifier, another use Haar-Like feature and new Haar-Like feature, features a total of 2969 59, classifier is named new Haar-Like classifier[8]. On the Internet randomly downloaded 139 contains 601 face image for algorithm face detection experiments. Figure 6 shows the new Haar-Like classifier and Haar-Like classifier test results on the part of the test sample, on the left is the new Haar-Like classifiers test results, right is Haar-Like classifiers test results. Compared two groups of detection results, the number of new Haar-Like classifier false face detections significantly reduced, it shows that new Haar-Like classifier have better Detection.





V. CONCLUSION

The objective of this research work is to perform a comparative study between Camshift and KLT tracking algorithms. In this process, initially face is detected using Viola Jones algorithm. Several facial features have been identified in order to track the face across the frames by Camshift and KLT algorithms. Camshift and KLT algorithm applied for tracking the face. Comparative study is performed to analyse for finding better performing algorithm. The Camshift algorithm includes other objects along with the face and part of the face is excluded while tracking the face. The experimental results show that the KLT algorithm performs better than the Camshift algorithm. Though we have seen that KLT algorithm also have one problem in tracking though the tracking process of the same perform much better than Camshift algorithm. The Camshift algorithm will be improved with new methodologies or functions for tracking face accurately and precisely. To improve the performance of both so that the time of computation decreased and the accuracy increased much more which in return will result in less memory consumption.

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