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Face Detection Using Modified Viola Jones Algorithm

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Abstract: **This paper presents a new face parts information analyzer, as a promising model for detecting faces and locating the facial features in images. The main objective is to build fully automated human facial measurements systems from images with complex backgrounds. Detection of facial features such as eye, nose, and mouth is an important step for many subsequent facial image analysis tasks. The main study of face detection is detect the portion of part and mention the circle or rectangular of the every portion of body. In this paper face detection is depend upon the face pattern which is match the face from the pattern reorganization. The study present a novel and simple model approach based on a mixture of techniques and algorithms in a shared pool based on viola jones object detection framework algorithm combined with geometric and symmetric information of the face parts from the image in a smart algorithm.**

Keywords: **Face detection, Video frames, Viola-Jones, Skin detection, Skin color classification, Face reorganization, Pattern reorganization. Skin Color.**

1. INTRODUCTION

It's a true challenge to build an automated system which equals human ability to detect faces, recognized estimates human body dimensions or body part from an image or a video. The conceptual and intellectual challenges of such a problem, faces are non-rigid and have a high degree of variability in size, shape, color and texture. Auto focus in cameras, visual surveillance, traffic safety monitoring and human computer interaction [2].

Face reorganization will be following a pattern, which is focus on face or body. Face detection is the step stone to the entire facial analysis algorithms, including face alignment, face modeling head pose tracking, face verification authentication, face relighting facial expression tracking/recognition, gender/age recognition, and face recognition and lots of more. Only when computers can recognize face because computer is compute the logic and facial expiration and match the expiration according to the facial structure. They begin to truly understand people's thoughts and intentions. Given an arbitrary image, the goal of face detection is to determine whether or not there are any faces in the image and if the image is present then it return the image location and extent of each face [3].

Face Detection:

Face detection is one of the visual tasks which humans can do effortlessly but in computer vision this task is very difficult. Given a single image, detect the face regardless of pose, illumination and expression. A simple face detection block diagram is shown in fig.1.

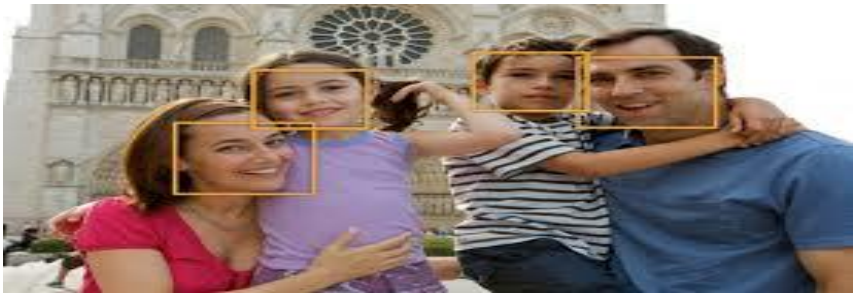

Figure 1: Face Detection

In image preprocessing unit, data prepare for next module. Image normalization and illumination adaptation are some of the processes which is done on data in this module and based on the given face expression and face pattern. Face feature extraction module, is performed to provide effective information from the detection of the eye and noise. That is useful to distinguish faces and non-faces and stable with respect to the geometrical and photometrical variations. Finally face is detect or detect eye and noise classification module is considered for classify face and non-face images based on the extracted features. In term of accurate image and high accuracy or low false alarm, appearance based methods which use learning machine algorithms as a classifier are very successful for face detection applications.

2. THE VIOLA–JONES FACEDETECTION

The Viola–Jones face object detection frame work [4] is the first object detection framework to provide competitive object detection rates in real-time proposed in 2001 by Paul Viola and Michael Jones.

This algorithm is implemented in Open CV as cv Haar Detect Objects().Viola Jones face object detector become famous due to its open source implementation in the Open CV library. In order to find and trying to match from an object of an unknown size is usually adopted to work this field that possesses a high efficiency and accuracy to locate the face region in an image.

The Viola - Jones method for face object detection contains three techniques:

1. Integral image for feature extraction the Haar-like features is rectangular type that is obtained by integral image[4]

2. Ad a boost is a machine-learning method for face detection [5], The word “boosted” means that the classifiers at every stage of the cascade are complex themselves and they are built out of basic classifiers using one of four boosting techniques (weighted voting).

3. Cascade classifier used to combine many features efficiently. The word “cascade” in the classifier name means that the resultant classifier consists of several [6].

Simpler classifiers (stages) that are applied subsequently to a region of interest until at some stage the candidate is rejected or all the stages are passed. Finally, the model can obtain the non-face region and face region after cascading each of strong classifiers

2.1 Viola Jones Upper body objects detection:

Accurate upper body object detection improves the robustness of face and reduces the challenging task of object detecting upper bodies from unconstrained still images and video.

The cascade object detector uses the Viola-Jones face detection algorithm to detect people's upper body and face object detection. The model detects the upper-body region, which is defined as the head and shoulders area as well as reorganization of upper body and face object. This model uses Haar features and object detection [6] to encode the details of the head and shoulder region. Because it uses more features around the head and face object, this model is more robust against pose/image changes, e.g. head rotations/eye blinking tilts To Detect Upper Body in an Image Using the Upper Body Classification Model.

1- Create a detector object and set properties.

2- Read input image and detect upper body.

3- Annotate detected upper bodies.

2.2 Viola-Jones Face objects Detection Algorithm:

Early efforts in face object detection have dated back as early as the beginning of the 1970s, where simple heuristic and anthropometric techniques [7] Face detection techniques can be categorized into two major groups that are feature based approaches and image based approaches. Image and video based approaches use linear subspace method, neural networks and statistical approaches for face object detection.

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Face feature based approaches can be subdivided into low level and high level analysis, feature analysis and active shape model analysis.

Face detection is controlled by special trained scanning window classifiers Viola-Jones Face Detection Algorithm is the first real-time face detection system.

2.3 Viola-Jones Eye Detection Algorithm:

Eyes are detected based on the hypothesis that they are darker than other part of the face, finding eye analogue segments searching small patches in the input image that are roughly as large as an eye and are darker than their neighborhoods. a pair of potential eye regions is considered as eyes if it satisfies some constraints based on anthropological characteristics of human eyes [8] .To discard regions corresponding to eyebrows, the model uses the fact that the center part of an eye region is darker than other parts. Then a simple histogram analysis of the region is done for selecting eye regions since an eye region should exhibit two peaks while an eyebrow region shows only one. A final constraint is the alignment of the two major axis, so the two eye regions belong to the same line. The study propose a new algorithm for eyes' detection that uses Iris geometrical information for determining the whole image region containing an eye, and then applying the symmetry for selecting both eyes.

2.3.1 Pupil detection in iris recognition system:

The iris has many properties which makes it the ideal biometric recognition component. The pupil is the dark circle at the center of your eye as shown in figure 2. It is surrounded by the iris, which is the colored part of eye. The pupil allows light to enter the eye. Light enters through the pupil, passes through the lens, and is focused onto the retina.

Most commercial iris recognition systems use patented algorithms developed by Daugman [9] and these algorithms are able to produce perfect recognition rates. However, published results have usually been produced under favourable conditions, and there have been no independent trials of the technology.

The boundary of pupil is not quite circle and a small error in detecting this boundary will lead to lose some information surrounding the pupil. Another problem that makes most of the iris segmentation method fail to detect the pupil boundary is the head rotation or the eye rotation.[10]

2.3.2 Viola-Jones nose Detection Algorithm:

Nose has three different local characteristics used as follows [11]

(i) Similarity of both sides: The left and right sides of nose are similar in a front-view face as shown in Fig. 3a .this property of similarity can be measured using Euclidean distance between both sides.

(ii) Dark-White-Dark (DWD) property: the lower part of nose region is characterized by two dark nostrils and a light sub region due to the reflection of light on the nose as shown in "Figure 2".

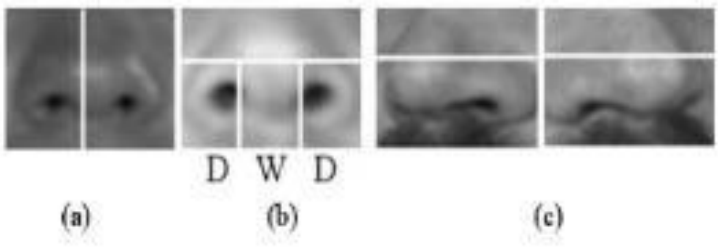

Figure 2: To the reflection of light on the nose

The two nostrils regions are less than the average of middle lighter sub region containing nose tip.

(iii) The variation in lower/upper parts property: When the face is rotated some degrees for these two properties are despaired and the only clear property is the variation between lower part and upper part as shown in "Figure 2c". This variation can be measured by the variance in each part. Based on this analysis, a search is done for a certain region among the ten highest regions detected due to reflection of light at nose tip. Nose tip region is very bright as compared to other part of nose region. Due to the presence of very bright region, this region appears as black in binary image obtained in

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previous step because binary image and is generated by marking only dark pixels as white. To locate this region the algorithm find large connected black region in central region of localized nose image. Once this region is identified, lowest tip of this region is considered to be nose tip. On both sides of nose tips, same binary image is searched for nose edges and distance between these edges, is considered as nose width.

2.4 Viola-Jones mouth Detection Algorithm:

Detection and Extraction features from the mouth region; this model is composed of weak classifiers, based on a decision stump, which uses Haar features to encode mouth details. Experimental results show that the algorithm is Face image division based on physical approximation of location of eyes, nose and mouth on face and can find out the mouth region rapidly. It is useful in a wide range; moreover, it is effectual for complex background such as public mouth detection.

2.4.1 Lip Detection:

The basic concept of the proposed algorithm is to extract and then verify the desired components, including skins, lips, by applying some kind of color segmentation in addition to some geometry. Based on the color distribution of the lips and normal skins The lip detection method based on RGB chromaticity diagram is used to separate lip color from other colors (face skin color) by a simple effective color segmentation method [12] .Observing the pixels of lips found that the colors of lips range from dark red to purple under normal light condition. From the perspective of human visual perception, the lips are very easy to be differentiated from the face skins for any races of people because of their different contrasts in color. One of the advantages of these color spaces in skin detection is that they allow users to intuitively specify the boundary of the skin color class in terms of the hue and saturation. Similarly, RGB to YCbCr color space conversion is performed to find out threshold for skin region using the following equation. In order to detect skin color following set of rules have been found to be more accurate than other models

3. PROPOSED METHOD

In terms of speed and reliability for face detection from an image we use ratio between sum of black rectangle and sum of white rectangle and with this I am using some better features except those which are used in previous algorithm. These features are better in identifying black and skewed faces. They also work for tilde faces in some images.

3.1 Face Detection:

In this paper, Open Source Computer Vision Library (OpenCv) [3] is used to implement the haar cascade classifier. It is originally given by Paula voila and Michael jones [13]. For the detection of the face, haar features are the main part of the haar cascade classifier. Haar features are used to detect the presence of feature in given image. Each features result in a single value which is calculated by subtracting the sum of pixels under white rectangle from the sum of pixels under black rectangle as shown in figure 3. Haar like features are the rectangle features for rapid face detection. Some haar like feature are shown in fig 3.

P(x) = Sum black rectangle / Sum White rectangle (1)

Figure: 3. Haar features

The Haar feature starts scanning the image for the detection of the face from the top left corner and ends the face detection process bottom right corner of the image as shown in fig 4.

The image is scanned several times through the haarlike features in order to detect the face from an image.

To compute the rectangle features rapidly integral image concept is used. It need only four values at the corners of the rectangle for the calculation of sum of all pixels inside any given rectangle. In an integral image the value at pixel (x,y) is the sum of pixels above and to the left of (x,y). Sum of all pixels value in rectangle D is shown in fig 4:

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G1=A,

G2=A+B,

G3=A+C,

G4=A+B+C+D

G1+ G4 - G2- G3=A+A+B+C+D-A-B-A-C=D

Figure: 4. Calculation of integral image

Voila Jones algorithm uses a 24×24 window as the base window size to start evaluating these features in any given image. If we consider all the possible parameters of the haar features like position, type and scale then we have to calculate the 160, 000 features in this window but this is practically impossible.

Ad a boost is a machine learning algorithm which helps us to find the best features among the 160,000. These features are the weak classifiers. Ad a boost constructs a strong classifier as a linear combination of these weak classifiers as shown in (2).

F(x) = α1F1(x) + α2F(x) + ·····(2)

The face detection can be performed by cascade using haar like features as shown in fig 5**.** In that cascade, an image will be a human face if it passes all the stages. If it is not passed any one of the stage it means the image is not a human face

[15].

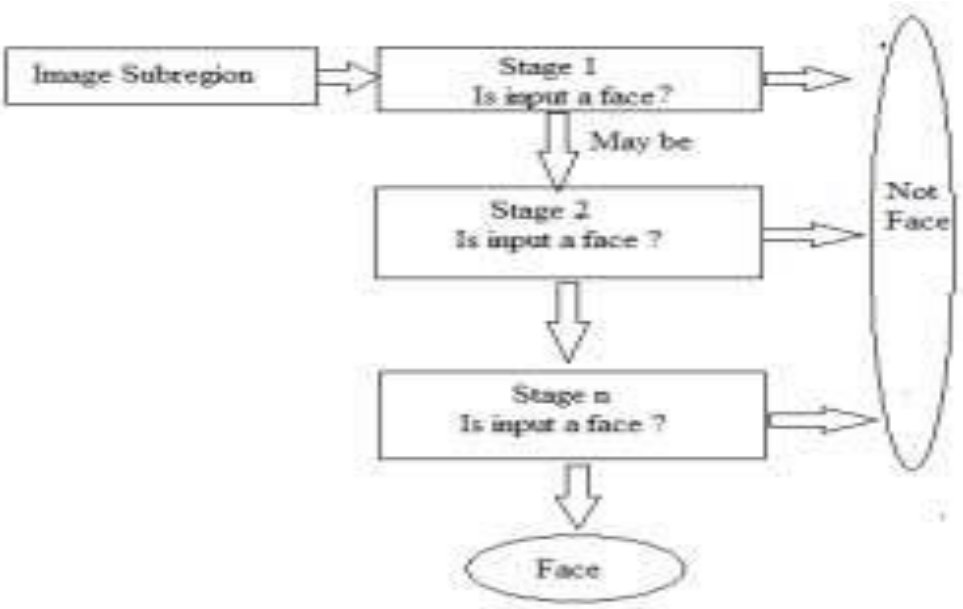

Figure: 5. Cascade classifier

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4. EXPERIMENTAL RESULT

We have evaluated on several face image Databases, containing different photo collection. Face database named CMU usually contain grayscale images and it is not useful for colorful algorithms. And other databases such as grimace, FERET, face only have images with single face and it is more proper for face recognition and trains our classifier. So we search for a database that contains colorful and also complex images to run our program. We find a database named Bao Database and it has 21 images with face and none face objects. So it is a proper database to test our hybrid algorithm. Our algorithm can detect multiple faces of different size. It use for complex images.

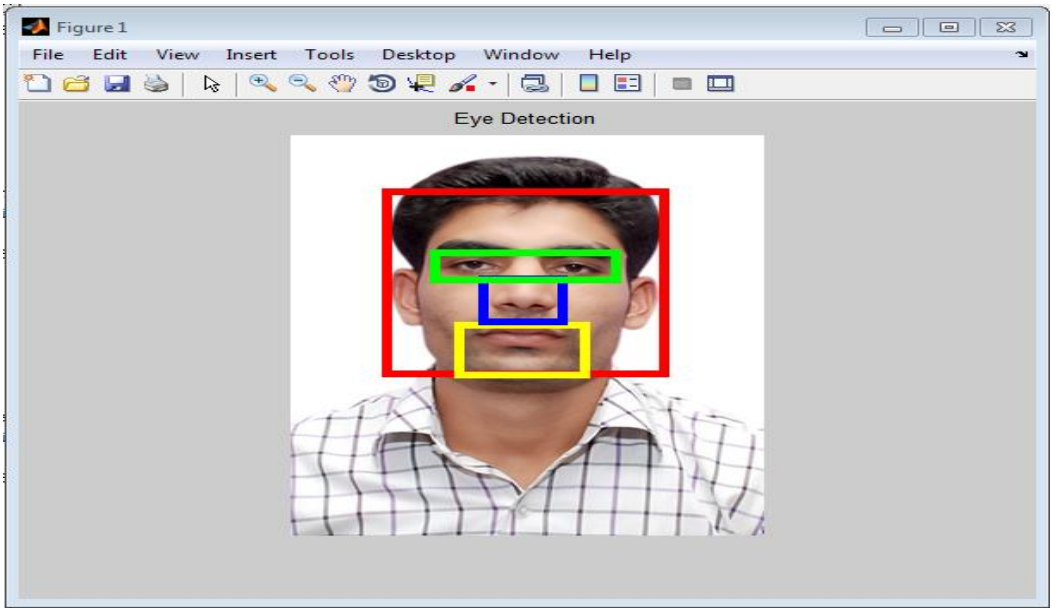

Figure: 6. Experimental Result

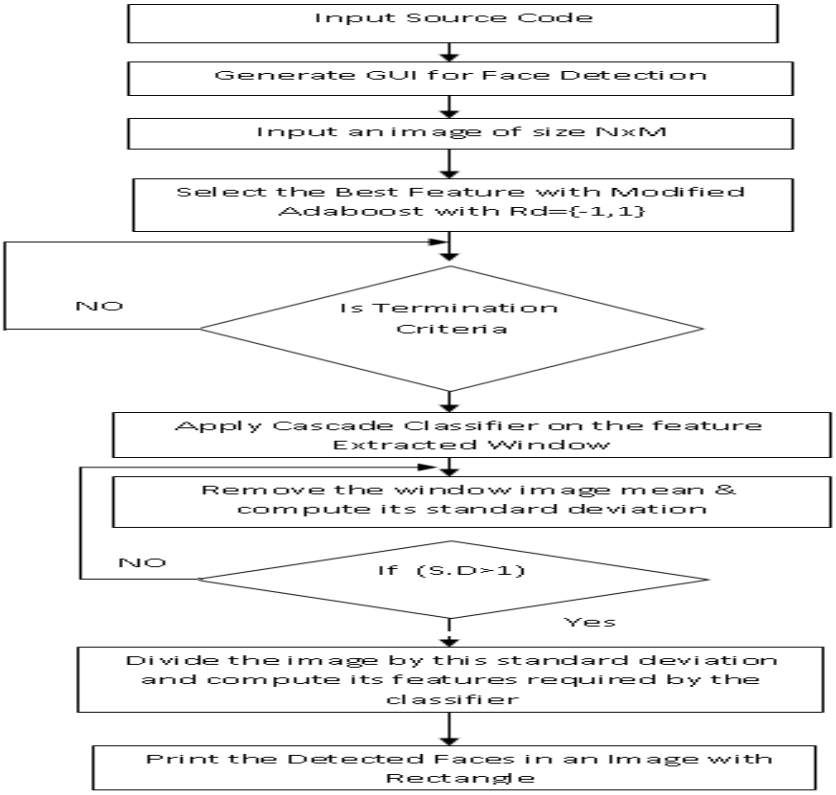

Figure: 7. Flow Chart

In figure 6 we see the results of converting image from RGB space to HSV space.

Figure 7 shows detected faces using HSV color model. As we can see, it has detected all the faces but it detects 3 none-faces as human face too.

In figure 8 we use HAAR classifier to detect primary face regions, so we use this as an instrument to detect all possible areas for faces. It hasn't a good performance and it has detected 7 none-face regions as human face.

In figure 7 we see the selected face regions from HAAR classifier by blacken the none-faces areas.

Figure 7 show the result HAAR classifier in HSV color space. Shows the result of HSV method on HAAR classifier results. And shows the result of our hybrid method on main image, as you can see it has better performance and it has no error. As you can see again, HAAR classifier has 7 errors, HSV method has 2 errors and they detect none-face as human face but in our algorithm we have no error.

5. CONCLUSION AND FUTURE SCOPE

In This Paper, image will be distribute for eyes, nose, mouth and face detection.

These description are given below-

- Check for eyes distance and matching pupil for two eyes
- Nose with two holes and nose tip
- Mouth
- Face detection with several points

In this algorithm, already define the distance between two eye when any image will be coming then processing the algorithm and matching the eyes distance and pupil distance then eyes will be detected.

Same follow the processor match the serial eye , noise, mouth and face.

The second contribution of this study , is to build fully automated accurate human facial measurements systems from images or video with complex backgrounds . The experimental part in the study was implemented using Matlab environment, presenting a set of experiments on a difficult face detection dataset which has been widely studied. This research work was initiated as a part of research project for Human Actions Detection In Content-based Video Retrieval System. In the future this algorithm will be an essential part of a system which will identify human presence in video stream.

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