HYBRID APPROACH FOR FACE AND EYE DETECTION

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ABSTRACT: A computer vision is subject or field which includes methods for processing and understandings of the images and produces the numerical or symbolic information in the form of decisions. There is difference between human and computer's perspective to see the scene. For human its easy to identify the person, objects, lighting effect from the scene but for the system it is only different set of group of pixels. To make computer understand that this particular set of pixel is for person, for object etc is computer vision field. Computer vision provides the facility to process the human images electronically by the computer, analyses the image, and produce the output. Face detection and eye detection are active research area since the last few decades which is highly oriented as specific case of object class detection. Early algorithms were more oriented towards the detection of frontal faces of the human, but newer algorithms are more towards to solve the problem by using the multi-view face detection algorithms. That is, face detection is basically the detection of human face by rejection of illuminations or background effect in the human images. The current newer algorithms are more accurate which takes into considerations of variations of image and affect of various parameters on image such different poses of the face, effect of lights, appearance etc. For this MATLAB is used and we have chosen the YCbCr Color Model for image representation.
Keywords: Computer Vision, YCbCr Color Model, Face Detection, Mat lab

I. INTRODUCTION

Face detection and eye detection are active research area since the last few decades which is highly oriented as specific case of object class detection. Early algorithms were more oriented towards the detection of frontal faces of the human, but newer algorithms are more towards to solve the problem by using the multi-view face detection algorithms. That is, face detection is basically the detection of human face by rejection of illuminations or background effect in the human images. The current newer algorithms are more accurate which takes into considerations of variations of image and affect of various parameters on image such different poses of the face, effect of lights, appearance etc. Earlier some algorithm only concern with Face detection by different technique such as Knowledge base, Template base, Appearance base and many more. Some algorithm takes care about Eye region also i.e. to detect the Eyes in the image by using different technique such as Template Matching, Appearance Base, Hough Transformation Method etc. Mostly it used for tracking the eye gaze and motion of the eye. Eye detection is used for security purpose for example authentication with the help of eye scanning. On the basis of earlier face detection and eye detection algorithms the next steps are being taken in this field as major research areas. Skin color segmentation is the process of separation of skin and non-skin pixels of the image. Similar to face detection, eye detection and eye state determination techniques, the skin detection is also important phase of the face detection to detect the skin.[39] However this depends upon the color models in which we are representing the human image. Therefore the selection of color model is very important in skin segmentation to make it more effective. In this research YCbCr color model is used.

This color model is very much effective to separate. The skin pixel and non skin pixel. A performance metric that others have used includes the computation of the separability of clusters of skin and non-skin pixels using scatter matrices. Another is to do a histogram comparison of the skin and non-skin pixels after color space transformation. The YCbCr color space was found to perform very well. Firstly all computer images by default are in RGB colour format, we have to convert that in YCbCr colour scheme because YCbCr colour scheme is best for digital images. YCbCr is digital colour system and very much useful for digital camera.

In YCbCr colour scheme Y is the luminance component and Cb and Cr are the Blue and Red Chrominance component. Chrominance is the signal used in video system to convey the colour information of the picture. Luminance is a photometric measure of the luminous intensity per unit area of light travelling in a given direction. In simple language Luminance is the unit which relate to the perceived brightness of a given object.

II. ALGORITHM FOR FACE AND EYE DETECTION WITH YCbCr COLOR MODEL

Here we present the system design and algorithm implemented during this research.

A. System Design

Here we discuss the system architecture of the system which we have implemented during the course of the research implementations. It include different module in the first module face detection is major concern. This image can be acquired by any camera and later stored in the system so that it may be retrieved for analysis purpose. We can also implement this experiment on already saved image. We can get image from any available database.

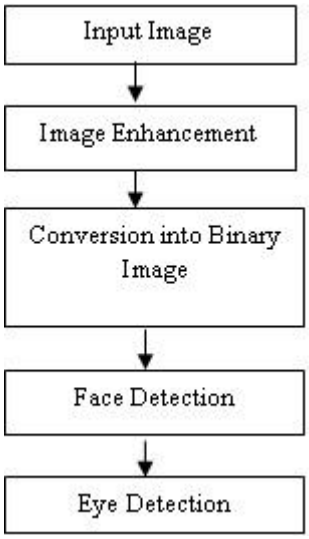

Figure1: Block Diagram of algorithm

As shown in the above block diagram:

Image input: It is the first step we have to take an image. We can take image from various sources such as open database.

Image Enhancement: In next step we enhance the image by increasing the luminance factor of the image i.e. by increasing the intensity (brightness) of the image. So that we can identify the skin colour easily.

Conversion in to Binary Image: Next step we convert our image in to Binary image because in binary each pixel is stored as a single bit i.e. 0 or 1 name Black and White. By doing this we become able to identify the skin colour is converted in to white pixel and rest of all colour is in black.

Face Detection: Now we are able to see an image with detected face shown with the help of bounded rectangle.

Eye Region Detection: Then the upper portion of the face is cropped from the extracted face image. This is done to speed up the detection speed of the algorithm. In general eyes are located in the upper 40% portion of the face hence the lower 60% portion which is unwanted is removed from the image. By doing this we become able to see the eye region.

B. Face Detection:

For accurate eye detection, the image should be in the form of face area which is completely isolated from background effects such as illuminations, light effects etc. The characteristics of face skin of different humans are almost similar. Here in this module, the face region is selected by rejecting the non-pixels of the image and retains only the pixels related to the face only. The binary image presented into color model is being submitted to this module which selects the face regions of the image.

Face Region Selection:

- Original Image
- Enhance of image by increasing the brightness of the image
- Representation of original image in color model
- Skin portion selection
- Binary Image
- Black and white image
- Fill the connected components of the image
- Image with face in rectangle shape

C. Eye Detection

As shown, after the selection of face region, and face are detection, next step is detection of eye regions. Eye detection is one of the important steps to determine the eye state of the human image. Therefore the accurate eye region selection is very important which should provide the enough and sufficient information for fatigue detection by analyzing the state of the eyes such close or open states. Following are the general steps of the eye detection algorithm:

- Original Image
- Image enhancement with 40% upper of face image.
- Binary Image
- Eye region candidates
- Selected left and right eye region.

Following diagram depicts the flowchart of the eye detection algorithm:

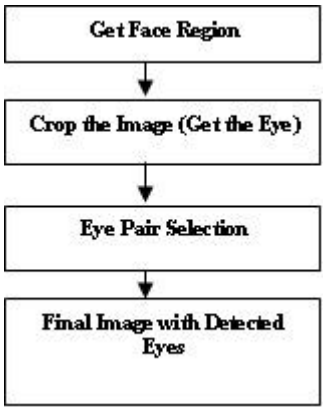

Figure2: block diagram of Eye Detection

III. EXPERIMENT AND RESULT

Here we discuss the experimental results; the results are shown as per the phases of the algorithm. Several experiments have been conducted to test the validity of our proposed algorithms with respect to various modules of the system such as face detection, eye detection. As discussed, first phase of the implementation is face detection with face region selection in human images, then the eye detection.

Tools and Techniques Used:

MATLAB software is used during the course of implementation to implement the face detection, eye detection and eye state analysis of the human image.

This algorithm is also able to find face from image having different type of skin color (skin tone). This algorithm detects the different skin color from an image. Mainly there are three types of skin color that are; fair, dark, and wheatish. Here, in this scenario different types of skin color are tested. In first image, fair skin tone is tested which is detected from an image. In second wheatish and in last dark skin tone is tested.

Here we have Result For Fair Skin color:

Original Image: The original image is the image from which face is needed to be detected. This image can be acquired by

any camera and later stored in the system so that it may be retrieved for analysis purpose.

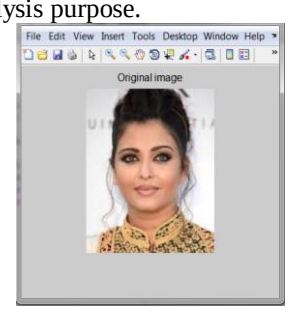

Figure3. Original Image with fair skin tone

Enhanced Image: When the original image is obtained it is first enhanced so that face may be easily detected from the image. For the enhancement of image, its brightness is enhanced by preserving rest of the image components. Image is converted RGB to YCbCr format for better detection of skin pixel.

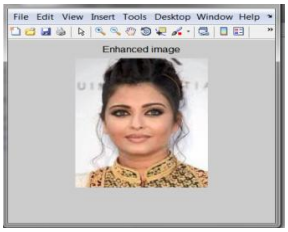

Figure 4. Image with enhancement

Binary Image: Then from the enhanced image skin portion is detected using YCbCr model and then the final obtained image is converted in to binary image. Binary image is an image having only two colors that is white and black.

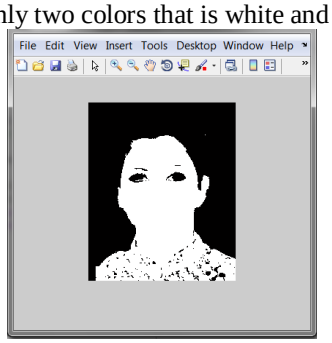

Figure 5. Binary image

Final Image with detected face: After the filling of holes an image with clear connected regions is formed. The obtained regions are compared to the specified range to find whether it is face or some small part. The finally an image with detected face shown with the help of bounded rectangle is obtained.

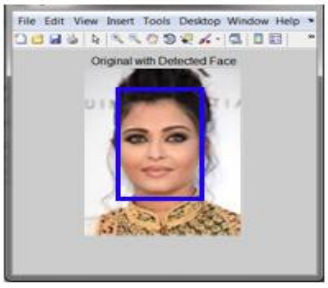

Figure 6.Original image with detected Face

Here is wheatish skin color

Original Image: The original image is the image from which face is needed to be detected. This image can be acquired by any camera and later stored in the system so that it may be retrieved for analysis purpose.

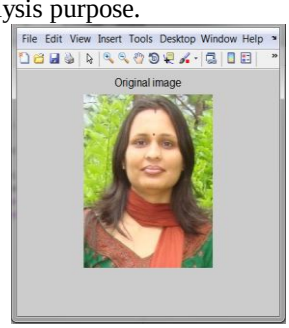

Figure 7. Original Image

Enhanced Image: When the original image is obtained it is first enhanced so that face may be easily detected from the image. For the enhancement of image, its brightness is enhanced by preserving rest of the image components. Image is converted RGB to YCbCr format for better detection of skin pixel.

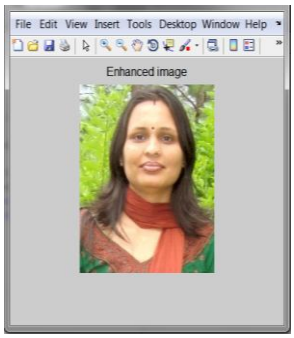

Figure 8. Enhanced Image

Binary Image: Then from the enhanced image skin portion is detected using YCbCr model and then the final obtained image is converted in to binary image. Binary image is an image having only two colors that is white and black. white color for skin pixel and black for non skin pixel.

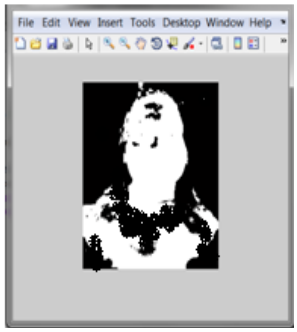

Figure 9. Binary Image

Final Image with detected face: After the filling of holes an image with clear connected regions is formed. The obtained regions are compared to the specified range to find whether it is face or some small part. The finally an image with detected face shown with the help of bounded rectangle is obtained.

Figure 10. Original Image with Detected Face

Here is dark skin color

Original Image: The original image is the image from which face is needed to be detected. This image can be acquired by any camera and later stored in the system so that it may be retrieved for analysis purpose.

Figure 11. Original Image with Dark Skin Tone

Enhanced Image: When the original image is obtained it is first enhanced so that face may be easily detected from the image. For the enhancement of image, its brightness is enhanced by preserving rest of the image components. Image is converted RGB to YCbCr format for better detection of skin pixel.

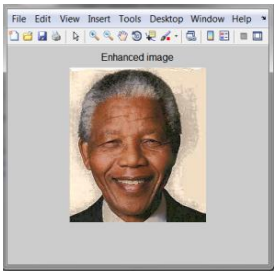

Figure 12. Enhanced Image

Binary Image: Then from the enhanced image skin portion is detected using YCbCr model and then the final obtained image is converted in to binary image. Binary image is an image having only two colors that is white and black. White color for skin pixel and Black for non skin pixel.

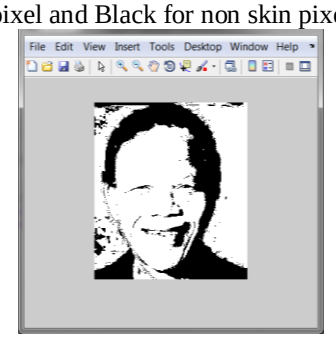

Figure 13. Binary Image

Final Image with detected face: After the filling of holes an image with clear connected regions is formed. The obtained regions are compared to the specified range to find whether it is face or some small part. The finally an image with detected face shown with the help of bounded rectangle is obtained.

Figure 14.Original Image with Detected Face

Eye Detection

This algorithm is also able to detect different eyes which include normal eyes, spectacle eyes and small size eyes. Here is some result done on different images having different type of eyes.

In first image, normal eyes is tested which is detected from an image. In second spectacle and in last small size eyes is tested.

For Normal eyes

Final Image with detected face: After the filling of holes an image with clear connected regions is formed. The obtained regions are compared to the specified range to find whether it is face or some small part. The finally an image with detected face shown with the help of bounded rectangle is obtained.

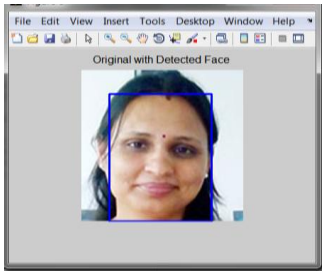

Figure 15.Original Image With Detected Face

Lower portion of face (60% of face region cropped): Then the upper portion of the face is cropped from the extracted face image. This is done to speed up the detection speed of the algorithm. In general eyes are located in the upper portion of the face hence the lower 60% portion which is unwanted is removed from the image.

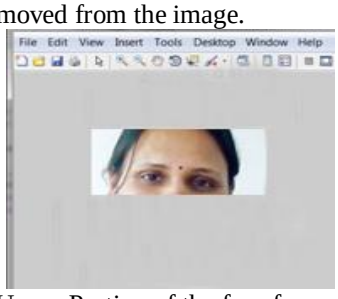

Figure 16.Upper Portion of the face for eye detection

Detected regions resembling eye: After enhancement of the image the candidate regions for the eye in the image are found. The regions in the image showing similarity with the eye region are considered as candidate regions and from these candidate regions eye region in the image is found.

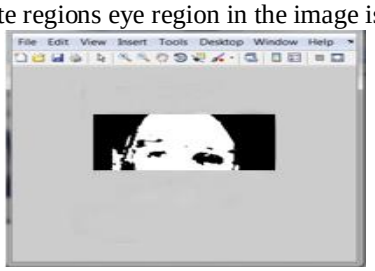

Figure 17. detected regions for Eye

Final Image with detected eyes: Then finally image with detected eye regions is obtained. The detected eye regions are bounded with the rectangles in the figure below.

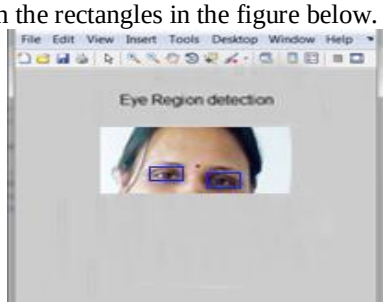

Figure 18. Detected Eyes.

Result for Spectacle eyes:

Final Image with detected face: After the filling of holes an image with clear connected regions is formed. The obtained regions are compared to the specified range to find whether it is face or some small part. The finally an image with detected face shown with the help of bounded rectangle is obtained.

Figure 19.Original image with Detected Face

Lower portion of face (60% of face region cropped): Then the upper portion of the face is cropped from the extracted face image. This is done to speed up the detection speed of the algorithm. In general eyes are located in the upper portion of the face hence the lower 60% portion which is unwanted is removed from the image.

Figure 20. Upper Portion of the face for eye detection

Detected regions resembling eye: After enhancement of the image the candidate regions for the eye in the image are found. The regions in the image showing similarity with the eye region are considered as candidate regions and from these candidate regions eye region in the image is found.

Figure 21. detected regions for Eye

Final Image with detected eyes: Then finally image with detected eye regions is obtained. The detected eye regions are bounded with the rectangles in the figure below.

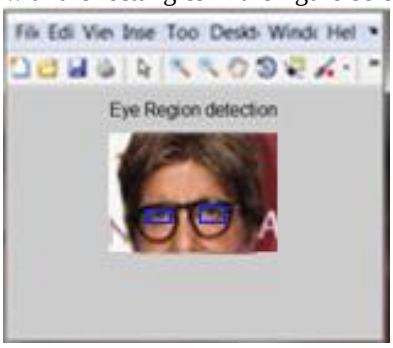

Figure 22. detected Eye

Result for Small size eyes:

Final Image with detected face: After the filling of holes an image with clear connected regions is formed. The obtained regions are compared to the specified range to find whether it is face or some small part. The finally an image with detected face shown with the help of bounded rectangle is obtained.

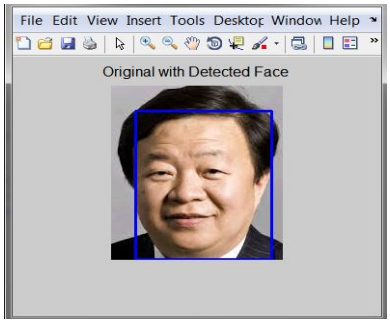

Figure 23. image with detected face

Lower portion of face (60% of face region cropped): Then the upper portion of the face is cropped from the extracted face image. This is done to speed up the detection speed of the algorithm. In general eyes are located in the upper portion of the face hence the lower 60% portion which is unwanted is removed from the image.

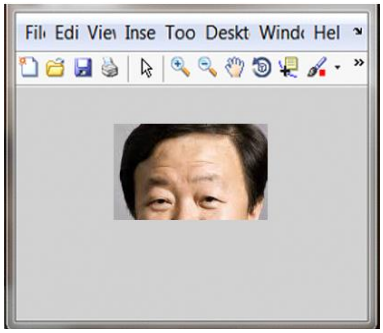

Figure 24. Upper portion of the face for eye detection

Detected regions resembling eye: After enhancement of the image the candidate regions for the eye in the image are found. The regions in the image showing similarity with the eye region are considered as candidate regions and from these candidate regions eye region in the image is found.

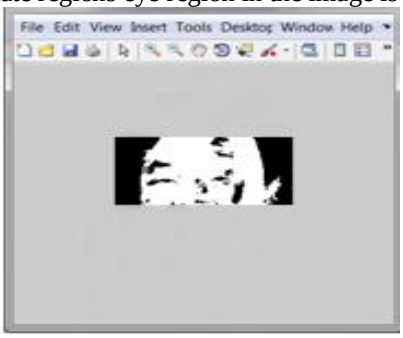

Figure 25. Detected regions for Eye

Final Image with detected eyes: Then finally image with detected eye regions is obtained. The detected eye regions are bounded with the rectangles in the figure below.

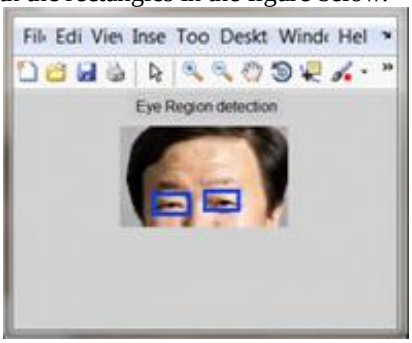

Figure 26. Detected eye

IV. CONCLUSION

During the course of this research implementation, we present our research for detection of different skin color face and different type of eyes. This research is a great combination of detection of Different skin color face and different set of eyes. This research can help in password and security purpose. With this proper authentications can take place.

V. ACKNOWLEDGMENT

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