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Age and Gender detection using Image Processing

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Abstract - The authentication methods have a wide range of application. Image authentication methods are proving to be an effective substitute then a conventional authentication method. Every authentication technology requires action by user. Biometric technology requires to place thumb on scanner which verify and grant access to user if its data base is already recorded or else it denies in case it didn't match the identification. Face recognition method using camera for identification has several external advantages compared to the other biometric methods. Face recognition method can be done passively without any action by the user and due to systems portability the camera can obtain and process from certain distance. Such methods can be useful for supervision. This system is a website which has image recognition system for sign-in using the laptop camera, which stores the image of user and keeps the record. The image recognition system uses the Haar Cascade algorithm, alignment process that contains face features normalization process, feature extraction process, and classification process using LBPH algorithm. The system will replace the authentication method of online access to institutional or commercial websites. The result shows that the website captures the image of user automatically and accurately and stores. The website allows only those who has sign-in to website and denies the rest.

Keywords— camera identification, face detection, Haar Cascade, LBPH

I. INTRODUCTION

The website sign-in method is very useful to know users, understand their preferences and provide seamless experience. Websites are several types like commercial, business, educational, Government, etc. The website has a different role according to the administration that has developed it. The website displays the data as per the privileges of user. The information may be classified or unclassified. The classified information is accessible to specific user. This work proposes the authentication process based on face recognition. The User with a sign-in will add its details and whenever the person visit website he will be analyzed and compare the data to the database which allow or denies the user. Using the laptop camera we could capture the image, verify it with stored id and grant access to those who are authorized.

II. PROCEDURES FOR PAPER SUBMISSION

The Proposed system shown in Fig.1.starts with the user visit to website and click on sign-in then the camera captures the face of the user. The face is detected with camera and tacking of face done by system. The parameters like location, size & pose of face are extracted. The user also enters the roll number or identification number provided by institution to verify the user during sign-in. Localization of eyes, lips, and face border positions is carried out after capturing the image.

Furthermore, the face alignment process is performed, including the face size normalization process and variations of lighting on the face. The next step was the face feature extraction, which later would be used in the matching process.

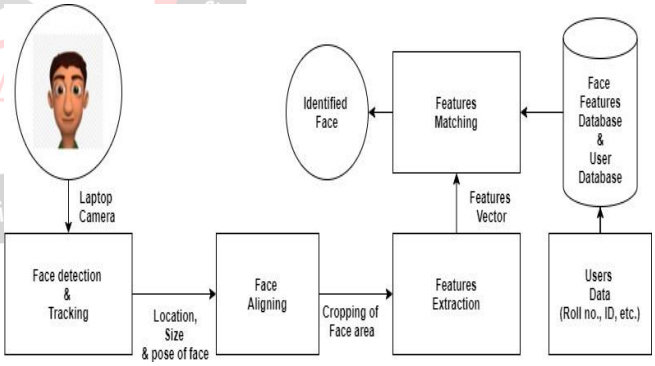

Fig.1.Block diagram of proposed system

A. Face Detection and Tracking

The image captured by the camera will be stored in the memory buffer for further detection process. This process aimed to detect skin color of an image captured. To simplify the skin color detection process, the RGB format was converted to a YCrCb format to separate the intensity of Y using colors (chromaticity) expressed in two variables, Cr and Cb. In modeling the skin colors, only Cr and Cb information were used, thus the change effect in lighting intensity could be minimized. The saturated area of the light caught by the camera had stable Cr and Cb value, thus the values of Cr and Cb were reliable information for the color

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classification process. Converting the RGB format to YCrCb used the following equation:

$$\begin{bmatrix} Y \\ Cb \\ Cr \end{bmatrix} = \begin{bmatrix} 0.29900 & 0.587000 & 0.114000 \\ -0.168736 & -0.331264 & 0.500000 \\ 0.500000 & -0.418688 & -0.081312 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

where Y is the luminance (color intensity), Cb is the blue component, and Cr is the red component **Verify once meaning of Cb and Cr** [9]. This method was also used to eliminate the background image which usually has colors other than the face skin. The next step is the conversion from RGB format to Gray scale.

The face detection process was performed to determine the face location using Haar Cascade algorithm, as shown in the flow diagram in Fig. 2.

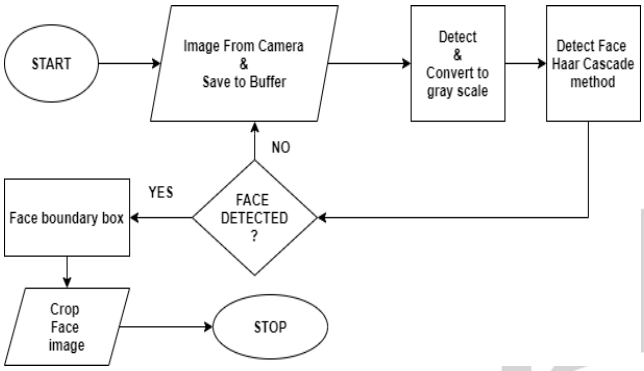

Fig.2. Face Detection and tracking process.

Face Image detected would draw a box that covers face with box as an ROI (Region of interest). This ROI is box used to crop the image, thus only the face image would be processed by the next process to save the computation time. The Fig.3. Shows the result of user face detected in box.

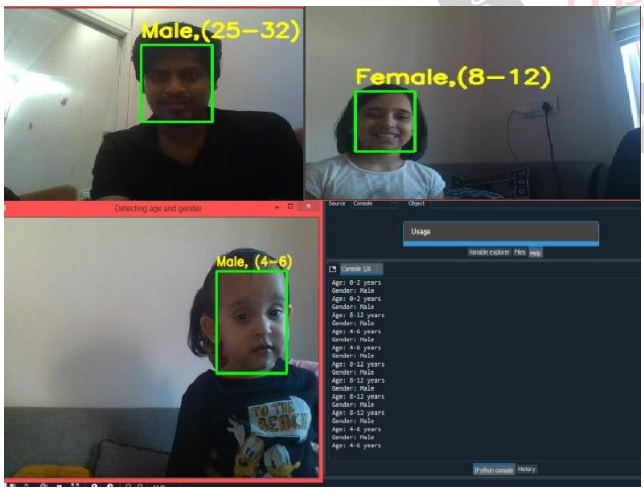

Fig.3.Face detection Result of user

B. Features Extraction and Matching

This process began by aligning the ROI face input from the previous face detection process as shown in Fig. 4. The alignment process consisted of normalizing and adjusting the face size due to the variations of the ambient light. This process was necessary thus in the next process there would be no too far result difference because of the detected facial size, due to the different distances between the face and the camera and difference variations of the environmental light intensity during capturing the image.

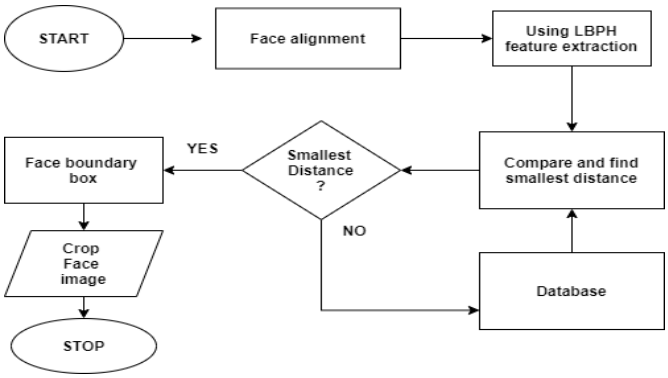

Fig.4. Feature extraction, alignment and matching process

The feature extraction was performed using LBPH algorithm. The detected face would be compared to all faces in the database to find the most similar face to the detected face. The database was stored using CSV file format to show the names and directories of the faces that exist in the database.

III. RESULT AND DISCUSSION

The system performance testing was performed in 2 stages *viz.* face detection stage and face recognition stage.

A. Face Detection

The Haar cascade algorithm is used to detect face. The performance of the face detection system within frontal conditions initially tested. The system indicator could detect the face captured by the camera by the appearance of a green box enclosing the detected face, as shown in Fig. 5.

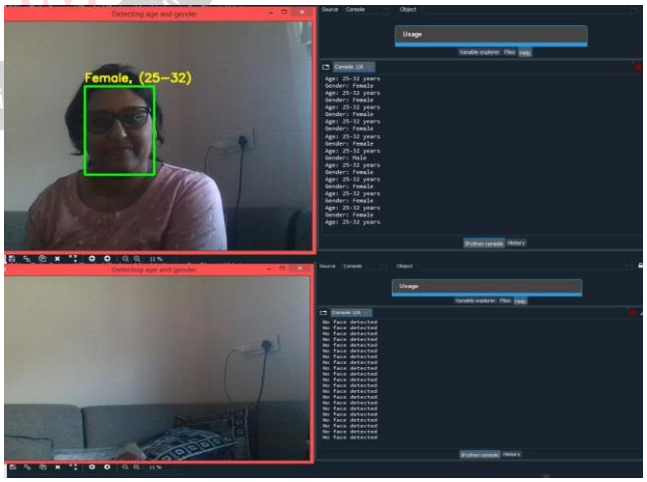

Fig.5. Face detected and no face detected by webcam

The next test is to determine the system capability which can detect faces that user not directly facing camera. The testing with various face angles is done until the system unable to detect the face of user. The test outcomes were the face angle more than 35 degree was not detected by camera and the face detected within 35 degree was

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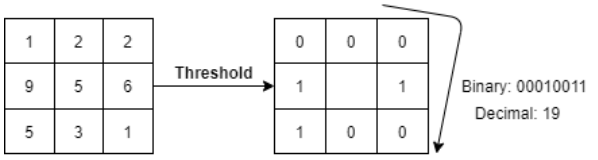
detected.

The next test is about head position tilted to left or tiled to right. The test with various angles is done which shows that face is detected the face up to 30 degree. If the face exceeded 30 degree angle the face can no longer be able to detect by system. The web page login depends on such angles to be kept by the user during the sign-up. The system will only allow those whose face has been detected properly so such angle is important to study.

B. Face Recognition

The LPBH Algorithm is used to recognition face due to its smaller computation load, which makes is relatively fast and used for real-time process. The LBPH concept is to not look the whole image as a high dimensional vector but to only review the local features of the important objects. The face recognition system has ability to extract features and detect the age, eye location, nose location, etc. by its features.

The basic idea of LBPH is to make a summary of the local image structure by comparing each pixel with the neighbor pixel by taking a pixel as the center and developing (threshold) of the neighbor pixel's value. If the intensity value of the center pixel is greater or equal to its neighbor, it will be marked with a value of 1 and if it will not be marked with a value of 0. This process can generate the binary values for each pixel, such as 11001111. Thus with 8 pixels surrounding the center pixel, there would be 28 possible combinations called as Local Binary Pattern or often referred as LBP code. The example of LBP operators used a 3 x 3 pixels neighbors can be illustrated as in Fig. 9.



$$LBP(x_c, y_c) = \sum_{P=0}^{P-} 2^P s(i_p, i_c)$$

Fig.6. Local Binary Pattern with 3x3 neighboring pixels. In general, the LBP operator is given by the equation:

where (xc, yc) is the center pixels with intensity *ic*, and *ip*is the intensity of the neighbor pixels. S is a symbol function defined as:

$$s(x) = \begin{cases} 1 & if\ x \geq 0 \\ 0 & otherwise \end{cases}$$

The face identification process was performed by extracting the face features which is, in this case, was the position of the eyes and the mouth. The structure position, the eyes, and mouth position between one person and another is unique, thus it could serve as a feature for identification and classification or recognition process. The very important part is the recognition or classification process. The database of faces is needed to be created that contain some different face positions you want to recognize. For each person minimum of 15 face pose would be stored in database, shown below. Give some figure number below:

Fig.7. Images for authentication.

The face database will be collected in a folder that later would called by application to compare the captured face by the camera. The result of comparison would determine whether the face is same with face stored in database. For each face in the database, it would be labeled as a number indicating the identity of a person. Afterward, the face file location in the folder and the label would be arranged in a matrixstored in CSV format.

C. Intensityanddistance Intensity:

This is the result of using the YCrCb color system which creates a separation between the intensity element (Y) and the chrominance element (Cr and Cb). Thus, the change of the environment light intensity only affects the intensity component of Y and less affects the chrominance component. Therefore, the recognition accuracy level does not have much difference. Table 1 shows if the light intensity decreases that directly affect the accuracy of the recognition of the captured image.

TABLE 1: The effect of light intensity on face recognition accuracy.

Video Sample	Light Intensity		
	24 Lux	*15 Lux*	*7 Lux*
	Level of Face Recognition Accuracy (%)		
1	100	99	99
2	97	97	100
3	96	98	97
4	96	95	90
5	100	98	100
6	96	95	82
7	97	99	95
Average	**97.4%**	**97.2%**	**94.7 %**

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Distance:

Then the distance the user is sitting from the camera matters the most for the recognition of face. The farther the distance of the face to the camera, the detection accuracy will also decrease. This is because the further distance of the camera to the face, the size of the face area caught by the camera will also be smaller, which means the number of pixels in the face area becomes less. The number of pixel on the face area will affect the number of features that can be extracted. The fewer the number of pixels in the face area or the smaller the resolution of the face, the fewer extractable features will be. Thus, the detection and face recognition accuracy will decrease even more.

TABLE II: Testing of effect of face distance variation to camera on accuracy.

Video Sample	Distance (cm)			
	40	***60***	***80***	***90***
	Level of Face Recognition Accuracy (%)			
1	98	99	100	100
2	100	96	0	0
3	100	100	64	33
4	97	100	24	0
5	100	75	80	62
6	96	99	66	0
7	90	98	49	66
Average	**90.3**	**85.8**	**65.2**	**52.3**

IV. CONCLUSION

The age and gender of the user was successfully observed, tested and results were drawn. The system has ability to store data, locate face and recognize the gender. The accuracy depends on various factors. The Face recognition accuracy is 90.3% for 40cm and 24lux intensity of light. So, the system can be used in website authorization system.

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