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Vision Based User Authentication System for Industrial Application

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***Abstract*— In this paper we are presenting the scheme of better authentication system using vision based approach to handle various activity in industrial application environment. While going through various scholar's research work and article, the human face plays an important role in our social interaction and conveying individual identity. Using the human face as a key to security, face recognition technology has received significant attention in the past several years due to its potential for a wide variety of applications. In this paper method for better vision based authentication is included with lowest cost of implementation using the OpenCV haar cascade Classifiers.**

***Keywords*— Artificial Neural Networks (ANN), face recognition, OpenCV, haar classifiers, AdaBoost, Integral Image.**

I. INTRODUCTION

Face recognition is done apparently done by humans. However, designing the computer algorithm to do the same work is very challenging [1]. Human face recognition is one of the dynamic area of research and it is a initial step to a varied range of practical applications which comprises image processing, pattern recognition, personal identity verification, video-surveillance, advanced human and computer interaction, computer vision etc.[2]. Most of these applications are using Artificial Neural Networks (ANN) classifiers methods together with suitable feature extraction for recognition of human faces. Face detection is essential first-step in face recognition systems, with the determination

Of localizing and extracting the face region from the relative background [3].The human face is an active dynamic object, has a great high degree of variability in its appearance, which creates face detection a challenging task in computer vision. Gesture recognition is an area in computer science and language technology with the objective of understanding human gestures via accurate algorithms. Gestures can initiate from any bodily gesture or state however usually initiate from the face or hand. A principal objective of gesture recognition exploration is to build a system which know how to recognize unambiguous human gestures and use them to carry facts or for device control and work promptly.

We emphasis on face detection, head position approximation ,various scholars' works which are restricted to identifying straight, frontal faces, many studies only permit one degree of liberty, which is not appropriate for the estimation of head incline positions [4]. In latest years, face recognition has fascinated much responsiveness and its study has quickly extended by not only engineers but also neuroscientists, since it has many prospective applications in computer hallucination communication and programmed or automatic access control system. Particularly, face detection is an essential part of face recognition as the first stage of involuntary face recognition.Though, face detection is not straight forward mechanism for detection, for the reason that it has lots of variations of image presence, such as pose disparity (front, non-front), imageOrientation, enlightening condition and facial expression and appearance. [5].

A lot of pioneering methods have been recommended to resolve each disparity. For example, the template-matching approach are used for face localization and detection by calculating the correlation of an input image to a standard face pattern. The feature invariant methods are used for feature detection of eyes, mouth, ears, nose, etc. [6] [7].Face recognition is used for two principal works [8]:

1. **Verification (one-to-one matching):** When offered through a face image of an indefinite individual along with a right of identity, determining whether the indefinite individual is who he/she privileges to be as he/she claimed.
2. **Identification (one-to-many matching):** Given an image of an unidentified individual, decisive that person's uniqueness by matching (possibly after encoding) that image with a databank or database of images of (possibly encoded) images of identified individuals.

In the rotation invariant centred face detection assessment interconnected study we found that, for identifying the face in an image general technique to create template-based face detector rotation in variant centred neural network-algorithm in gray-scale images is used. The system offered in Rowley et al used two different network system for face detection viz. router network for manipulating the head tilt angle and detector network, which derotated the image given by router network and identify the face within the image. To eliminate any further irregularities in the detection of face the heuristic approach is used. This system is able detect about 70% of two large test set. The main shortcoming of

this system is the necessity of very large database for template matching, which comprise of both negative and positive image. The positive image are those images which comprise thhe face, and negative are the one who does not comprise any faces [9].

In the head angle approximation associated exploration, scholar's presented a vigorous approach to evaluation of the 3D pose of human heads by means of a single image. Their process only makes use of the statistics about the skin and hair region of the heads. Chen et al gives the robustness and the consistency of facial feature tracking. This system uses two global evidence as area and centre of skin and hair region. This system uses a perceptually unchanging colour space to define the colour information of images. It uses two global tables to describe the skin colour likeness and the hair colour likeness of all visible colours. These tables are named as SCDM (Skin Colour Distribution Model) and HCDM (Hair Colour Distribution Model). It first convert the colour information of each pixel (R,G,B) to the chromaticity in perceptually unchanging colour space (uf,vf) and the luminance (y):

$$(R, G, B) \rightarrow (y, uf, vf) \quad \text{.....(i)}$$

The skin region and the hair region in an image are then removed by estimating the skin color likeness and the hair color likeness for each pixel with SCDM and HCDM.

$$SCSM(p) = SCDM(uf(p)), vf(p)) \quad \text{.....(ii)}$$

$$HCSM(p) = HCDM(y(p), uf(p), vf(p)) \quad \text{.....(iii)}$$

Where SCSM and HCSM are the skin color likeness and the hair color likeness of pixel p. y(p), uf(p) and vf(p) are the luminance and the chromaticity of pixel p. The face detection is carried out by comparing every rectangle region of SCSM and HCSM with several prebuilt head shape model. After finding the skin and hair colour likeness region, this system find the area, center and axis of skin/ hair region and then center for face and hair region. This system also calculate the depth in three dimension in X-axis, Y-axis and Z-axis [10].

This following section of this paper covers more as, Section-II covers the detail concepts pf Haar classifiers based cascade Feature , Section-III covers the implemented system with some outputs of system , Section-IV covers the conclusion and future work in this system and final Section-V covers references that are usefull while going for this research work development.

II. Haar Classifiers based cascade features

The human face postures even more difficult to recognize than other objects since the human face is an active and dynamic object that arises in a several forms and color. But however, facial detection and stalking offers many benefits and profits for face recognition. Facial recognition is not possible if the face is not desolate or removed from the background. Human Computer Interaction (HCI) field could significantly enriched by using gesture recognition particularly face recognition, which naturally require face and facial feature detection and tracking mechanism Although various algorithms and techniques are exist to perform face detection, each has its own Weaknesses and strengths which we are already discuss in section-I. Most of the algorithms that we are discuss are very expensive in terms of computational processing. An image is solitary a group of color and/or light intensity values, which can benefitted for computer programmer to use its various aspects for enhancing and updating it. Image is a composition of pixels and analysing these pixel are very time consuming and difficult to accomplish because of the wide variations of shape and pigmentation within a human face.

We are using Haar classifiers for face gesture recognition, devised by Viola and Jones. Viola and Jones presented a method to precisely and rapidly detect faces with in an image within an image. This algorithms and visions to idea to develop a framework for robust and extremely rapid object detection. Viola and Jones devised an algorithm, called Haar Classifiers, to rapidly detect any object, including human faces, using AdaBoost classifier cascades that are based on Haar-like features and not pixels [11].

A. Haar Classifiers

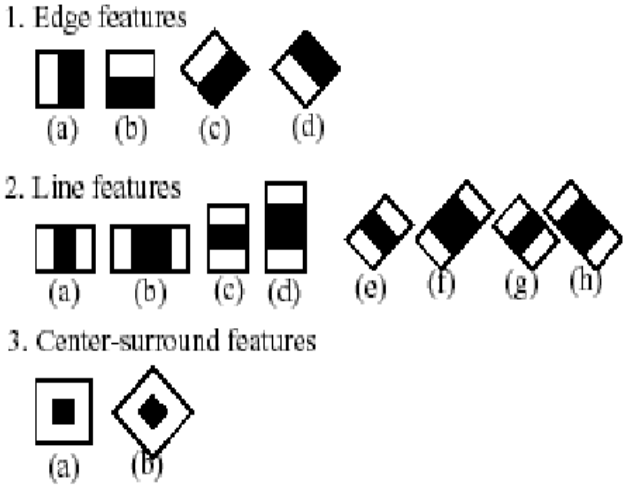


***Fig 1:*Common haar features**

The core basis for Haar classifier object detection is the Haar-like features. These features, rather than using the intensity values of a pixel, use the change in contrast values between adjacent rectangular groups of pixels.The contrast variances between the pixel groups are used to determine relative light and dark areas. Two or three adjacent groups with a relative contrast variance form a Haar-like feature which are shown in Fig-1.

B. Integral Image

The simple rectangular features of an image are calculated using an intermediate representation of an image, called the integral image. Integral image allows for precise and very rapid feature evaluation. Motivated in part by the work of *Papageorgiou et al*. Viola and Jones, detection system does not work directly with image intensities [12], butt instead of these use a set of features which are significant of Haar Basis functions. In order to work out with these features very rapidly at many scales we introduce the integral image representation for images. The integral

image can be computed from an image using a few operations per pixel. Once computed, any one of these Harr-like features can be computed at any scale or location in constant time.The integral image is an array containing the sums of the pixels' intensity values located directly to the left of a pixel and directly above the pixel at location (x,y) inclusive. So if A[x,y] is the original image and AI[x,y] is the integral image then the integral image is computed as shown in equation.

$$AI[x,y] = \sum_{x' \le x, y' \le y} A(x', y') \qquad \text{C.}$$

Cascade classifiers

We generally divide image into 24×24 sub-pixeled image, the calculating feature for this 24×24 sub-pixeled image also require lot of computational power and it is time consuming process. But only small fraction of features form this image is required if this sub-image contains the desired object, as face in this case. In order to eliminate as many sub-images as possible, only a few of the features that define an object are used when analysing sub-images. The goal is to eliminate a substantial amount, around 50%, of the sub-images that do not contain the object. This process continues, increasing the number of features used to analyse the sub-image at each stage. The cascading of the classifiers allows only the sub-images with the highest probability to be analysed for all Haar-features that distinguish an object. It also allows one to vary the accuracy of a classifier, as shown in fig-2.

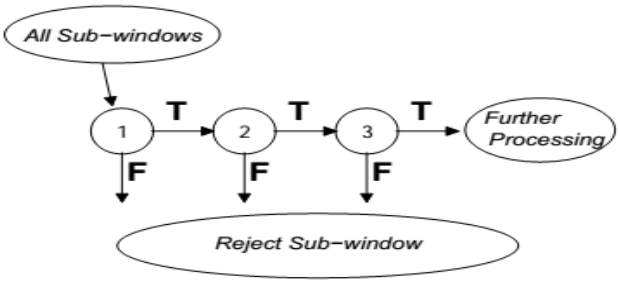


Fig 2: **Cascade of classifiers**

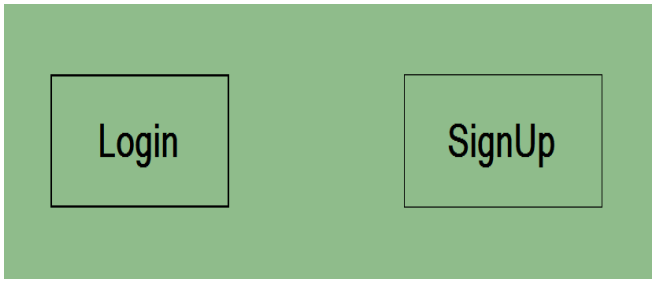
III. IMPLEMENTED SYSTEM

We are only focusing on the software implementation of authentication system rather than actual hardware implementation. We are focused on developing the simple system using haar cascade feature of Emgu OpenCV library of image processing and C# as language of coding in .NET framework environment.

In our implemented model system, the face recognition is done with single web camera and the process of recognition is very fast as, small amount of data processing is required. The most of face recognition system uses template based approach, but instead of this apprach we use simple feature based approach of face recognition. The implemented model system provide two way authentication to user, first is based on the simple username, password authentication with the database which is designed in Microsoft SQL server 2008 which is very light application server for this model application. The process of working of this model can be grouped into two different section as-

A. User registration and Login:

The new user to model system is first need to sign up using



the "SignUp" button as shown in fig-3 , while already registered user can directly go for "Login" button as shown in fig-3.

Fig3:Login and SignUp page

In SignUp process user need to choose proper username and password and he/she has to register or give training of face to model system for dedicated period of time, we choose 20sec.The registration process capture per/sec frame from current live video frame and stored it with training of its gesture feature using Emgu OpenCV in files.The already register user can provide the proper username and password to get access of user face recognition. After matching the username and password with stored database password, user ready to for recognition process. After competion of face registration the message is shown as shown in fig-4.

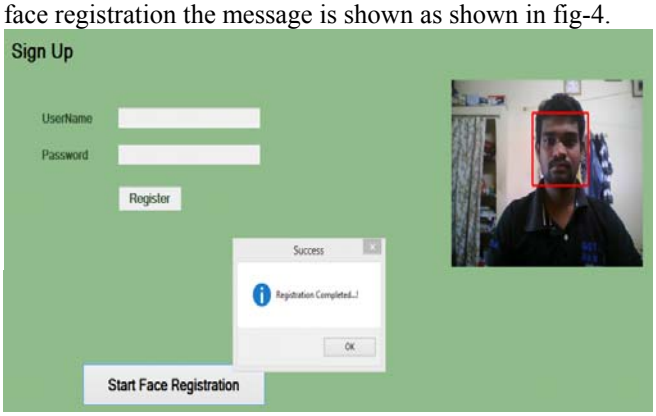


Fig 4: **face registration process with completion message**

B. User Face Recognition

The authenticated user is now ready for face recognition, after user clicks on "Start Face Recognition" button as shown in fig-5 .

The recognition is again done with the images which are stored in registration process with its features, the process is carried out with the help of Emgu OpenCV library object detection method. The feature of each image is stored with the image name, and at a time of face recognition.

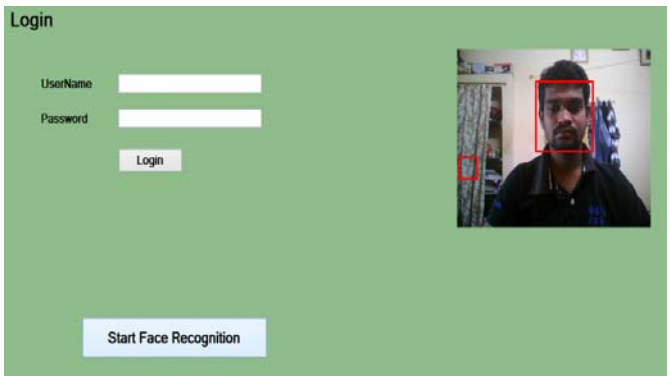


***Fig 5:*Face Recognition Process**

This feature are match one at a time and the feature which are most alike with current image frame is given as output. For E.g.: the feature of image piyush17 which is stored at time of registration is most alike feature for the current frame then it will show as an output as shown in fig-6 .After the face recognition is completed then it will show welcome message with the, name of user and now user will able to perform different task depending on the applications in the industry.

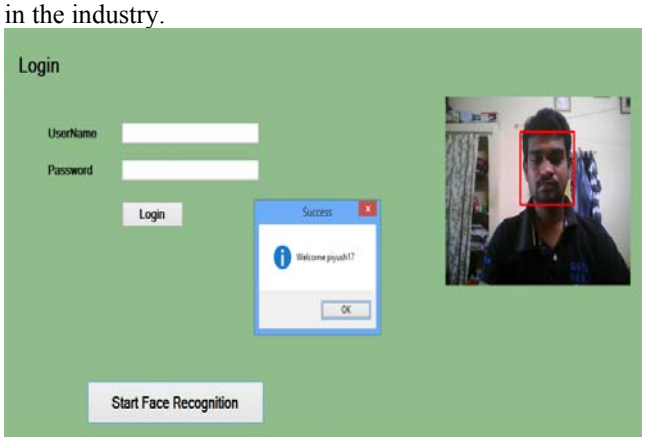


***Fig 6:* Face Recognition success message**

IV. CONCLUSION AND FUTURE WORK

The future work includes to build a system to for interacting the human with robot, where the authentication of user to robot is done with the help of face recognition and the control movement of robot is done with the hand gestures. The application of this system building is on various domains, including; sign language translation,virtual environments ,medical systems, smart surveillance, robot control, etc. The robot can be built to act as per the instruction given by the authorized person to control its activity.

This paper propsed a better approach of human computer interaction with vision based control of various application in industrial domain, this model is robust and can be implemented with low cost of processing and minmum requriement of hardware.The model can also be imlemented various kind of indusrty where the vision control based authentication is reqiured.

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