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Artificial Neural Network based Face Recognition

Biju V.G.[1], Anu S. Nair[2], Prajinlal P[3], Sajna B. John[4], Arun P.M.[5], Akhila K.A[6]

Associate Professor, Electronics & Communication Engg., College of Engineering, Munnar, India[1]

Assistant Professor, Electronics & Communication Engg., College of Engineering, Munnar, India [2]

UG Scholar, Electronics & Communication Engg., College of Engineering, Munnar, India [3,4,5,6]

Abstract: The paper focused to reduce the computational complexity in face detection and improve the accuracy rate of face recognition. Face detection is one of the method that uses biometric features which detect the face automatically by compressed system by taking the image or video. The system utilizes Viola-Jones algorithm is detecting face from given image. The main challenging problems in face detection are illumination, noise reduction and low resolution. Viola Jones algorithm have the highest accuracy in face detection. Artificial Neural Network used for face recognition. ANN has the highest accuracy in face recognition.

Keywords: Face extraction, Face recognition, Face Detection, Biometric Features.

I. INTRODUCTION

During the past few years, considerable progress has been made in face detection and face recognition on video based system. Many algorithms and methods have been developed for detection and recognition of face. In face recognition system the first step is face detection. The face detection can be based on skin color, motion, facial appearance or combination of all these parameters. Face detection locate the exact position and size of the human face in the image or in video frame. And then second step is features extraction. It is to extract the features of eyes, nose and mouth to normalize the detected face. Most of the facial feature extraction methods undergo certain difficulties such as illumination, noise, low resolution, orientation, time consuming and color space. The third step is face recognition. It involves one to many matches that compare a query face image/video frame in the database to determine the identity of the query face. The extracted features from the input faces is stored in the database [1]. It outputs the identity of the face when a match is found with sufficient confidence or indicates as unknown face otherwise. Two methods are proposed in this paper Viola-Jones algorithm for detection and artificial neural network for face recognition Face detection has become an interesting and active area in study and research, in recent years because of the increase in the security demands and low good working of the present applications [2]. Biometric is the science and technology of measuring and analyzing the biological features of human. Face detection is one of the method to find the presence of face in the image (usually in the gray scale).If there is the presence of the image, the content of each face and image location is returned. This is the first step of any fully automatic system, which analyses the information contained in faces (identity, gender, expression, which the locations and sizes of all objects in an image that belong to a given class are found. Through the step of face detection and recognition, we recognize the relative position of eyes, noise, ears from an individual face. Face detection is an almost unique biometric identity. The chance for having similar faces particularly is very few. Still for increasing the security demands and security factor we can combine this biometric technique [3].The application of face recognition can be combined with the fingerprint system, iris or any other biometric system to increase the level of security. There are two parts in the face recognition system. First one is the face region extraction (face detection) and the second is the face recognition. Both of the components of the face recognition system should be initially accurate to offer the higher level of user satisfaction with low response time.

II. METHODOLOGY

The whole system is divided into mainly four parts and it is shown in fig.1. They are: 1) Data base creation 2) Neural network training 3)Test image using Viola Jones 4)Face recognition

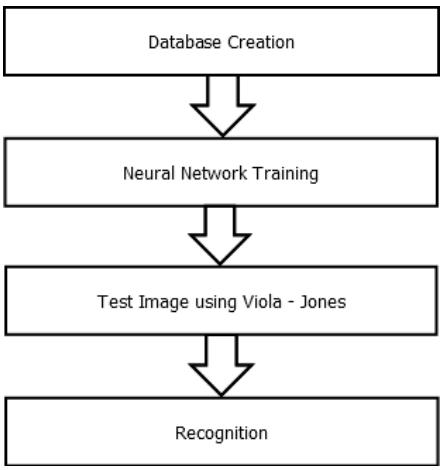

Fig 1:Block Diagram of proposed system

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A. Database Creation

This block processes the input image. The input image is an image frame grabbed from the video stream transmitted by the camera [4]. This block will serve as the starting point of the system and feeds the succeeding block with an image which is derived from the original image. This step processes the image in such a way where that it first tries to determine whether a human face is present in the image or not. If not, it then takes the succeeding image frame from the video and conducts the same process repeatedly until a face is detected. The data base consists of the images which is grabbed from the video stream with a 2 second delay .i.e ,in every 2 second frames are captured and stored in the data base. This data base is used for the further training section and the same is used for the face recognition too.

B. Neural Network Training

This block begins after the Data base creation. It accepts, as input, the processed image produced by the previous block. This block is a crucial part of any face recognition system. One of the important factors for this part is the measurement of certain biometric facial features which can be considered as unique for every person [5]. These are then detected, extracted, and measured from the persons processed face image. These measurements are then passed through processes which will produce a representation of these characteristics in numerical vector form. These are large number of very simple processing neuron-like processing elements in ANN [6]. There is a large number of weighted connections between the elements. Distributed representation of knowledge over the connections Knowledge is acquired by network through a learning process [7].The network is provided with a correct answer (output) for every input pattern. The basic working principle of a neural network is shown in the Fig.2. Weights are determined to allow the network to produce answers as close as possible to the known correct answers.

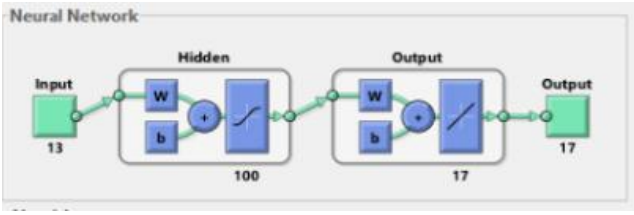

Fig 2: Neural Network

C. Test Image using Viola-Jones

The Viola Jones object detection framework is the first object detection framework to provide competitive object detection rates in real-time proposed in 2001 by Paul Viola and Michael Jones[8]. Although it can be trained to detect a variety of object classes, it was motivated primarily by the problem of face detection. This algorithm is implemented in Open CV as cvHaar Detect Objects. The feature employed by the detection framework universally involves the sums of image pixels within rectangular areas. As such, they bear some resemblance to Haar basis functions, which have been used previously in the realm of image-based object detection. However, since the features used by Viola and Jones all rely on more than one rectangular area, they are generally more complex. The figure illustrates the four different types of features used in the framework. The value of any given feature is always simply the sum of the pixels within clear rectangles subtracted from the sum of the pixels within shaded rectangles. The cascade object detector uses the Viola-Jones algorithm to detect people's faces, noses, eyes, mouth, or upper body. The Classification Model property controls the type of object to detect. By default, the detector is configured to detect faces. The features sought by the detection framework universally involve the sums of image pixels within rectangular areas. As such, they bear some resemblance to Haar basis functions, which have been used previously in the realm of image-based object detection. However, since the features used by Viola and Jones all rely on more than one rectangular area, they are generally more complex. The figure on the right illustrates the four different types of features used in the framework. The value of any given feature is the sum of the pixels within clear rectangles subtracted from the sum of the pixels within shaded rectangles. Rectangular features of this sort are primitive when compared to alternatives such as steerable filters. Although they are sensitive to vertical and horizontal features, their feedback is considerably coarser. Haar Features All human faces share some similar properties. These regularities may be matched using Haar Features. A few properties common to human faces are, the eye region is darker than the upper-cheeks and the nose bridge region is brighter than the eyes. Composition of properties forming matching facial features are, Location and size of eyes, mouth, bridge of nose. The four features matched by this algorithm are then sought in the image of a face .Rectangle features can be calculated as per the equation

$$Value = \sum(pixels\ in\ black\ area) - \sum(pixels\ in\ white\ area) \quad (1)$$

An image representation called the integral image evaluates rectangular features in constant time, which gives them a considerable speed advantage over more sophisticated alternative features. Because each feature's rectangular area is always adjacent to at least one other rectangle, it follows that any two rectangle feature can be computed in six array references, any three-rectangle feature in eight, and any four-rectangle feature in nine. The integral image at location (x,y), is the sum of the pixels above and to the left of (x,y), inclusive. In this block, the data taken from the images are simulated through an ANN which has been previously trained using a set of n training images for every person to be recognized by the system. The input to this part will be a vector array with 14 values which was produced by the previous block.

D. Face Recognition

Facial recognition (or face recognition) is a type of biometric software application that can identify a specific individual in a digital image by analyzing and comparing

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patterns. Facial recognition systems are commonly used for security purposes but are increasingly being used in a variety of other applications [9].The face authentication is done if the input images are matched each other. However, if the matching is not done then un authentication is done automatically [10]. The whole data flow through the entire system is shown as a flow chart in Fig.3.

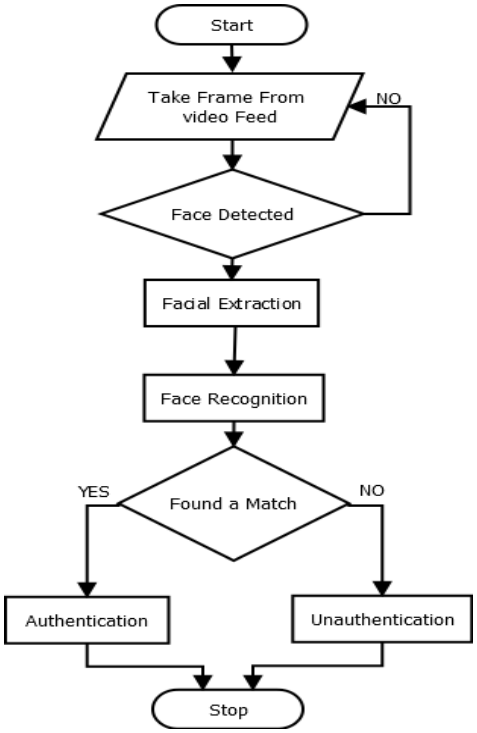


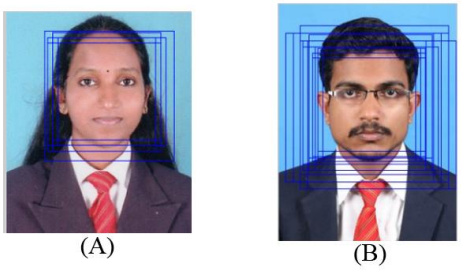
Fig 3: Flow Chart

III. RESULTS AND DISCUSSION

There are different steps involved in the face recognition process. The system begins with grabbing the image from a video stream provided. The input for this process, which comes directly from the camera and the continuous stream of images is given to the system, and the system take a frame at a time for the further processing and that input image is shown in the Fig.4. The system determines through a set of steps if a person's face is present in the image or not. In case if no faces are found from the image, the system will automatically continue to repeat the previous sequence until a face is detected. The feature extracted image is shown in the Fig.5. The face authentication is done if the input images are matched each other. However, if the matching is not done then un authentication is done automatically.

(A) (B)

Fig 4: Input Images



(A) (B)

Fig 5: Feature Extraction

The testing was done for 40 test images. Out of 40 test images 34 images were detected correctly and 37 images were recognised successfully.

The accuracy rate of face detection and recognition as shown in the Table 1. The accuracy calculated by inputs different images with different illumination focusing conditions.

Table 1

Accuracy Rate (%)	
Face Detection	85%
Face Recognition	92%

IV. CONCLUSION

The simulation part of a Security System using face recognition technique is presented in this paper. It increases the security of the system from being accessed by unauthorized persons. It is a cost effective and extendible security system which also allows easy identification of intruders trying to break into a secured locker. Also it is much cheaper and smarter than the traditional systems. The overall system will provide much more improved features than conventional systems, with high level of accuracy and reliability. This system was tested on a number of face images with variations in illumination and orientation and it was observed that the recognition rate was improved on the application of ANN algorithm. For further advancement, we can include a GPS and an MMS module to easily identify the intruder and can trace the current location of the vehicle that they are travelling. Also, once the face of the user is identified as the authorized user, we can create different profiles for each user and different driver modes can be set according to the comfort of the user.

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