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AN INVENTIVE APPROACH FOR FACE DETECTION WITH SKIN SEGMENTATION AND MULTI-SCALE COLOR RESTORATION TECHNIQUE USING GENETIC ALGORITHM

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Abstract - To increase the security in range of application domains Face recognition in video has gained wide attention as a covert method for surveillance. As compared to still face images it is expected that a video which contains temporal information as well as multiple instances of face leads to improved face recognition performance. Here we should investigate the aspects of genetic in face recognition. Genetic Algorithms (GA's) are characterized as one search technique inspired by Darwin Evolutionist Theory. This paper deals with the combinations basics of Genetic Algorithm (GA) and Back Propagation Neural Networks (BPNN) and their applications in Pattern Recognition for Face Recognition problems. These models are expected to deal with problem solving in a manner different from conventional computing. The neural network has the ability to adapt to unknown situations & it trains itself by learning through datasets and is fault tolerant while the Genetic algorithm is an optimization technique used in computing to find the exact or approximate solutions. It handles large & poorly understood search spaces easily and handles noisy functions well.

Keywords: Genetic Algorithm, Back Propagation Neural Networks, Pattern Recognition, Conventional Computing.

1. INTRODUCTION

Face detection is the essential front end of any face recognition system, which locates the face regions from images. It also has numerous applications in areas like surveillance and security control systems, content-based image retrieval, video conferencing and intelligent human-computer interfaces [1]. Humans make use of face as an important clue for identifying people. This makes automatic face recognition very crucial from the point of view of a wide range of commercial and law enforcement applications. Although significant work has been done the current systems are still not close to the human perceptual system [3]. Traditionally, face recognition research has been limited to recognizing faces from still images. Most of these approaches discount the inherent 3-D structure of the face and therefore are very susceptible to pose changes [5]. One way to overcome this is to generate 3-D models using multiple still images or video and then use them while testing any probe image. Here, we propose an investigation of the Genetic Algorithms technique application in facial detection, which will solve the one step for face recognition. According to the Genetic Algorithms (GA's) are characterized as one search technique inspired by Darwin Evolutionary Theory, shaped using some selection mechanisms used in

Nature, according with that individuals who are abler in a population are those who have more survival possibility, when adapting themselves more easily to the changes that occur in their habitats. Human problem solving is basically a pattern processing problem but merely a data processing problem. In any pattern recognition task humans perceive patterns in the input data and manipulate the pattern directly. Here we discuss attempts at developing computing models based on artificial neural networks (ANN) to deal with various pattern recognition situations in real life with the help of Genetic Algorithm.

Digital images and video are becoming more and more important in the multimedia information era. The human face is one of the most important objects in an image or video. Detecting the location of human faces and then extracting the facial features in an image is an important ability with a wide range of applications, such as human face recognition, surveillance systems, human computer interfacing, video-conferencing etc.

2. LITERATURE REVIEW

There are various approaches proposed by various researchers for face recognition. We can broadly classify these approaches or techniques based on the face on which they can be applied.

A. Eigen face-based Recognition Approach:

The information theory approach of encoding and decoding face images extracts the relevant information in a face image, encode it as efficiently as possible and compare it with database of similarly encoded faces. The encoding is done using features which may be different or independent than the distinctly perceived features like eyes, ears, nose, lips, and hair [3]

Mathematically, principal component analysis approach will treat every image of the training set as a vector in a very high dimensional space. The eigenvectors of the covariance matrix of these vectors would incorporate the variation amongst the face images. Now each image in the training set would have its contribution to the eigenvectors (variations). This can be displayed as an eigenface representing its contribution in the variation between the images. These eigenfaces look like ghostly images and some of them are shown in figure 2.In each eigenface some sort of facial variation can be seen which deviates from the original image.

The high dimensional space with all the eigenfaces is called the image space (feature space). Also, each image is actually a linear combination of the eigenfaces. The amount of overall variation that one eigenface counts for, is actually known by the eigenvalue associated with the corresponding eigenvector. If the eigenface with small eigenvalues are neglected, then an image can be a linear combination of reduced no of these eigenfaces. For example, if there are M images in the training set, we would get M eigenfaces. Out of these, only M eigenfaces are selected such that they are associated with the largest eigenvalues. These would span the M-dimensional subspace _face space out of all the possible images (image space). When the face image to be recognized (known or unknown), is projected on this face space (figure 1), we get the weights associated with the eigenfaces, that linearly approximate the face or can be used to reconstruct the face. Now these weights are compared with the weights of the known face images so that it can be recognized as a known face in used in the training set. In simpler words, the Euclidean distance between the image projection and known projections is calculated; the face image is then classified as one of the faces with minimum Euclidean distance.

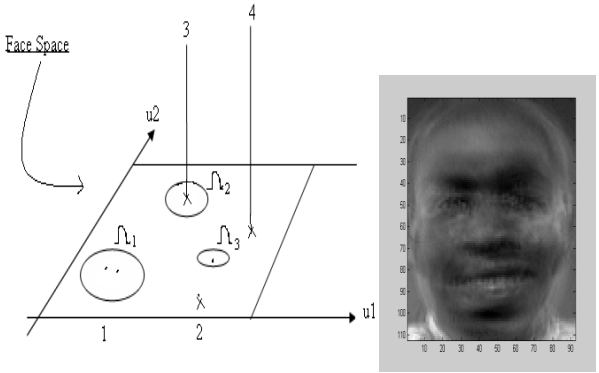


Figure 1
(a) The face space and the three projected images on it. Here u1 and u2 are the eigenfaces.
(b) The projected face from the training database.

B. 3D Face Recognition Approach:

Three-dimensional face recognition (3D face recognition) is a modality of facial recognition methods in which the three-dimensional geometry of the human face is used. It has been shown that 3D face recognition methods can achieve significantly higher accuracy than their 2D counterparts.3D face recognition has the potential to achieve better accuracy than its 2D counterpart by measuring geometry of rigid features on the face [4]. This avoids such pitfalls of 2D face recognition algorithms as change in lighting, different facial expressions, make-up and head orientation[4] The main technological limitation of 3D face recognition methods is the acquisition of 3D image, which usually requires a range camera. Alternatively, multiple images from different angles from a common camera may be used to create the 3D model with significant post-processing. This is also a reason why 3D face recognition methods have emerged significantly later (in the late 1980s) than 2D methods.

C. Principal Component Analysis (PCA):

Principal Component Analysis (PCA) PCA also known as Karhunen-Loeve method is one of the popular methods for feature selection and dimension reduction. Recognition of human faces using PCA was first done by Turk and Pentland [5] and reconstruction of human faces was done by Kirby and Sirovich [6]. The recognition method, known as eigenface method defines a feature space which reduces the dimensionality of the original data space. This reduced data space is used for recognition. But poor discriminating power within the class and large computation are the well known common problems in PCA method. This limitation is overcome by Linear Discriminant Analysis (LDA). LDA is the most dominant algorithms for feature selection in appearance based methods [6]. But many LDA based face recognition system first used PCA to reduce dimensions and then LDA is used to maximize the discriminating power of feature selection. The reason is that LDA has the small sample size problem in which dataset selected should have larger samples per class for good discriminating features extraction. Thus implementing LDA directly resulted in poor extraction of discriminating features. In this [7] Gabor filter is used to filter frontal face images and PCA is used to reduce the dimension of filtered feature vectors and then LDA is used for feature extraction. The performances of appearance based statistical methods such as PCA, LDA and ICA are tested and compared for the recognition of colored faces images in [8]. PCA is better than LDA and ICA under different illumination variations but LDA is better than ICA. LDA is more sensitive than PCA and ICA on partial occlusions, but PCA is less sensitive to partial occlusions compared to LDA and ICA. PCA is used as a dimension reduction technique in [9] and for modelling expression deformations in [10].A recursive algorithm for calculating the discriminant features of PCA-LDA procedure is introduced in [11]. This method concentrates on challenging issue of computing discriminating vectors from an incrementally arriving high dimensional data stream without computing the corresponding covariance matrix. The key procedure in PCA is based on Karhumen Loeve transformation. If the image elements are considered to be random variables, the image may be seen as a sample of a stochastic process [12]. The PCA basis vectors are defined as the eigenvectors of the scatter matrix *ST*, $ST = \Sigma Ni=1 (xi - \mu)(xi - \mu)T$.

D. Support Vector Machine (SVM):

Support Vector Machines (SVM) are one of the most useful techniques in classification problems. One clear example is face recognition. However, SVM cannot be applied when the feature vectors defining samples have missing entries. A classification algorithm that has successfully been used in this framework is the all-known Support Vector Machines (SVM) [13], which can be applied to the original appearance space or a subspace of it obtained after applying a feature extraction method [14] [15] [16]. The advantage of SVM classifier over traditional neural network is that SVMs can achieve better generalization performance.

E. Active Appearance Model (AAM):

An Active Appearance Model (AAM) is an integrated statistical model which combines a model of shape variation with a model of the appearance variations in a shape normalized frame. An AAM contains a statistical model if the shape and gray level appearance of the object of interest which can generalize to almost any valid example. Matching to an image involves finding 27 model parameters which minimize the difference between the image and a synthesized model example projected into the image. The AAM is constructed based on a training set of labelled images, where landmark points are marked on each example face at key positions to outline the main features [17, 18].

3. PROPOSED METHODOLOGY

In this proposed work, the training phase consists of following steps—

a) Input an image by web camera.
b) Skin region detection and enhance in an input images.
   i. Resize image
   ii. Invert image
   iii. Convert image to gray scale.
c) Crop skin region.
d) Save Image into training directory.
e) Train Neural Network using genetic algorithm on training Images directory.
f) Detect skin region in an input images.
   i. Skin area
   ii. Skin area after removing noise
   iii. Detected face area.
g) Now add and update the image to database.
h) Display result.
i) Compare with Existing result and get comparative analysis

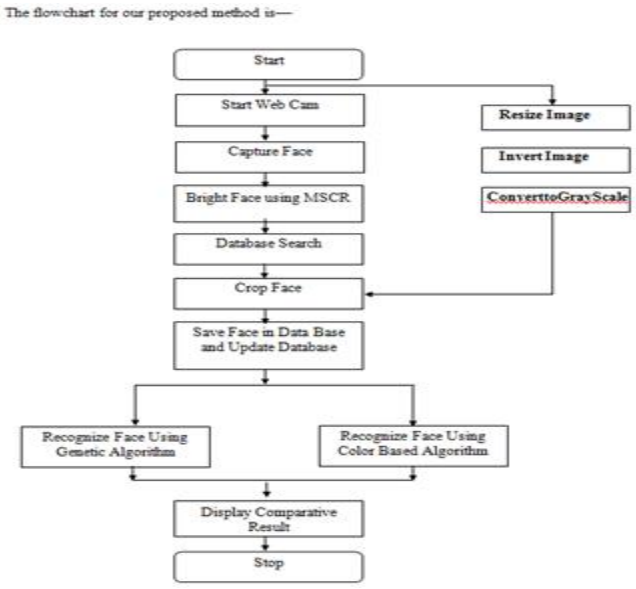


Figure 2: Proposed Flowchart for our system.

Input Image—

A system camera is used to capture an image and to provide an input to this current project. A camera must be of 2.0 or 3.5 pixel resolution to get a more precise result.

Detect Skin Region—

To avoid unnecessary image region (region other than face), we first of all detect skin color in input captured image. From the previous study it is observed that skin color pixels are in the range of 121 to 179 of their decimal value.

$$121 \leq sp \leq 179$$
Where $Sp = (Pr + Pg + Pb) / 3$

The face detection base on skin color is vital step of project that illuminates processing of wrong input image. The below data flow diagram shows the face detection base on skin color. Detection of skin color in color images is a very popular and useful technique for face detection. Many techniques have reported for locating skin color regions in the input image. While the input color image is typically in the RGB format, these techniques usually use color components in the color space, such as the HSV or YIQ formats. That is because RGB components are subject to the lighting conditions thus the face detection may fail if the lighting condition

changes. In the skin color detection process, each pixel was classified as skin or non-skin based on its color components.

Crop the skin region—

Cropping refers to removing unwanted areas from a photographic or illustrated image. One of the most basic photo manipulation processes, it is performed in order to remove an unwanted subject or irrelevant detail from a photo, change its aspect ratio, or to improve the overall composition. Once the skin region is identified, we crop skin region into rectangular area of dynamic size.

Apply Multi-Scale Color Restoration on Cropped Region (MSCR)—

Multi-scale color restoration is technique to restore original color of image whose pixels are distorted because of noise induction. We propose this MSCR method that work on following principle—

1. The image pixels should not be fully 0 or 1 i.e. white and black pixels.
2. Pixels should have to be in proper range.
3. In order to find which are closer to either dark or white colours, need to collect all those pixels cluster wise.
4. Set all those pixels closer to either dark or white color to average skin color without affecting internal contains of skin region.
5. Repeat step 3 until all cluster of identified skin region is set to average skin color.

Before applying MSCR technique on Image Pixels, an Image is segmented into region to identify an area where to apply MSCR.

$$Si = \int_1^n \int |Pi - Pi + 1|.n$$

Where
Si=Image Segment
N=Total Number of Pixels in an Image
Pi=Current Pixel value.
Setting New Value to Custer pixels as per equation

$$Si = e^{n} \sqrt{\frac{Sin\big(P(i) + P(i+1) + \ldots\ldots + P(n)\big)}{n}}$$

If
$10 \leq Si < 245$
Then

$$Si = e^{n-1} \sqrt{\frac{Sin\big(P(i)+P(i+1)+ \ldots\ldots + P(n)\big)}{\frac{n}{2}}}$$

Finally user can modify MSCR image enhancement by setting thorough program code.

Training Neural Network using Genetic algorithm (Training Phase) –

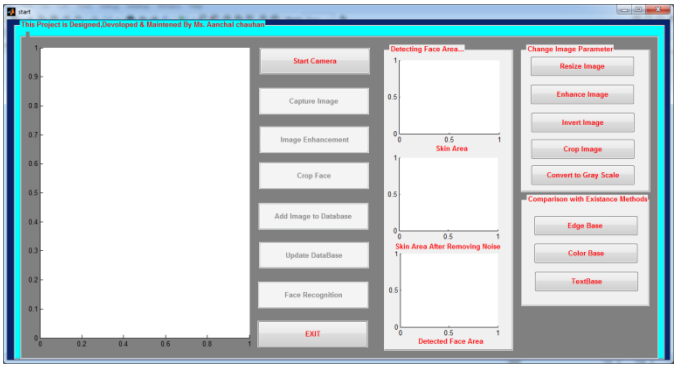
The training of feed-forward Neural Networks (NNs) by back propagation (BP) is much time-consuming and complex task of great importance. To overcome this problem, we apply Genetic Algorithm (GA) to determine parameters of NN automatically and propose efficient GA which reduces its iterative computation time for enhancing the training capacity of NN. Proposed GA is based on steady-state model among continuous generation model and used the modified tournament selection, as well as special survival condition. To show the validity of the proposed method, we compare with conventional and the survival-based GA using mathematical optimization problems and set covering problem. In addition, we estimate the performance of training the layered feed forward NN with GA. Genetic algorithms are often thought of, discussed and implemented using binary strings, or bit strings. Each gene or bit represents the expression of a state. If the bit is turned on, then the gene corresponding to that bit can be said to be "expressed". In this application a bit represents the state of either a variable being included ("1") or not included ("0") in the final solution. Genetic algorithms sometimes require the use of special operators in order to simulate the evolutionary processes which they emulate. The most

common operators are crossover and mutation. The crossover operator takes two parent chromosomes and combines them to produce an offspring. A common form of crossover operator is uniform crossover. In uniform crossover, if a specific gene is turned on in both parents, then it will be turned on in the offspring. If a gene is turned on in only one of the parents, then it may be turned on in the offspring. Uniform crossover was used in this project. The mutation operator is applied independently but immediately following the crossover operator. A mutation is a random change of a gene in a chromosome, and is applied according to a preset mutation rate. A survival rate that determines what percentage of the population i.e. the fittest members would survive into the next generation was employed. Because the computational cost of building and training neural network models from scratch can be high, another feature employed in this work was to guarantee that when a new offspring is generated it does not duplicate any chromosome currently in the population or which has been previously built and tested .

Face Reorganization with Trained Directory Images (Testing)—

The pattern set of images are obtained and the mean faces is taken as the reference for a face structure. All the images in the training directory are compared with the input face and the correlation between them is found out. Non-face areas will have low correlation while face areas will have high correlation. Then the training images (Except first three) having less value of correlation are discarded. Since the training images can be of any size, the face is stored in different sizes starting from 30 pixels to 220 pixels at the step of 10 pixels (boxes are square boxes).

4. PROJECT GUI



5. RESULT ANALYSIS

Time Complexity—

Sr. No	Face Images	Face Recognization with Genetic Algorithm	Face Recognization Edge Base	Face Recognization Color Base	Face Recognization using Text Base
1	10	0.001 Min	0.0015 Min	0.0018 Min	0.0017 Min
2	20	0.010 Min	0.018 Min	0.019 Min	0.020 Min
3	30	0.035 Min	0.045 Min	0.055 Min	0.075 Min
4	40	0.5 Min	0.58 Min	0.78 Min	0.98 Min
5	50	1 Min	1.50 Min	1.30 Min	1.58 Min

TABLE: 7.1

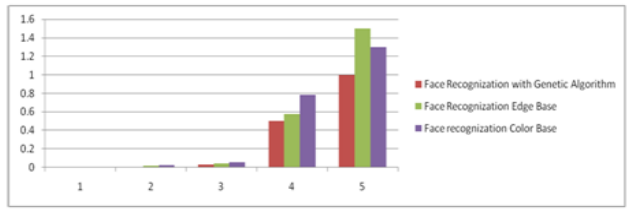


FIGURE: Time Complexity

6. CONCLUSION

Many number of the research paper has been studied thoroughly for face recognition and detection algorithm. Also performed many test with different values as images at different condition. Above test performed are used the real time data that is picture captured by laptop web camera.

The proposed approach has got feature of taking image and image sequence as input and has applied our method. More time video sequences that captures an image sequence from a camera, detects efficiently a human face. It is an optimal model likely to be performed at every hardware as per criteria. We have used Matlab as a tool to implement our concept and make it live. Also genetic algorithm has used in our implementation because we have got experimental results which shows that genetic algoritm is even faster than BPN Neural network. So this justify that overall performance of our project is not only reliable but also gives faster and accurate output.

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