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A Survey paper on face detection and recognization with Genetic Algorithm

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Abstract— ***In this digital world Face recognition in video has got wide focus as a covert method for surveillance to enhance security and reliability in variety of application domains (e.g., car accidents, airports, traffic, Terrorist attack). A video contains temporary information and multiple instances of a face, so expection from this is to lead to better face recognition performance with respect to still face images. However, faces appearing in avideo have substantial variations in pose and light. Face detection has been done by several people and in addition to that we are studying about the Genetic algorithm and their application with face recognition and detection.***

Keywords— ***Face detection, Image Enhancement, Skin Color detection, Feature Extraction, Pattern Recognization, Luminance, Color transform***

I. INTRODUCTION

Face is an important component of human body so valuable to human life. Humans make use of face as an important hint 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. Even if the resolution of the images/video is high (which is usually not the case), the face model generated by the known techniques is usually far from perfect which makes this approach often not practical for face recognition. Recently, methods based on multiple images/video sequences that do not involve creating an explicit 3-D model have been suggested. Such an approach is supported by many psychophysics works like, where authors argue that a 3-D object is represented as a set of 2-D images in our brains. Leaving out the algorithms based on simple voting, most of these methods make use of either the natural variability in a face or the information present in the temporal variation of face. In, book all recognize a face from a sequence of rotating head images by computing the Euclidean distances between trajectories formed by face sequences in PCA feature space. The Mutual Sub-space Method (MSM) considers the angle between input and reference subspaces formed by the principal components of the

image sequences as the measure of similarity [12]. This approach discounts the inherent temporal coherence present in a face sequence that might be crucial for recognition. Face recognition is cast as a statistical hypothesis testing problem, where a set of images is classified using the Kullback-Leibler divergence between the estimated density of the probe set and that of gallery sets [14]. This method is based on the underlying assumption that face recognition can be performed by matching distributions. However, two such distributions for the same subject might look very different depending on the range of poses and expressions covered by the two sets. Moreover, this approach is sensitive to illumination changes.

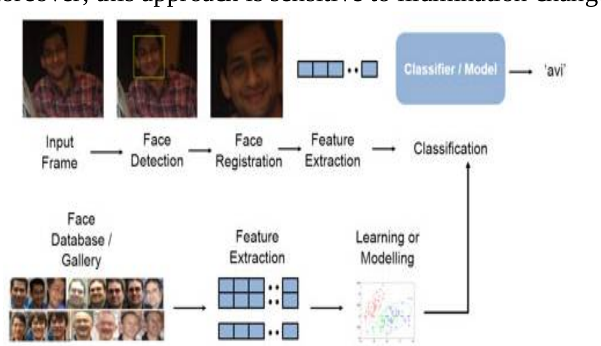

Fig 1. Face Detection System

II. LITERATURE REVIEW

Liu learn temporal statistics of a face from a video using adaptive Hidden Markov Models to perform video-based face recognition [20]. Kernel principal angles, applied on the original image space and a feature space, are used as the measure of similarity between two video sequences. Zhou proposes a tracking-and-recognition approach by resolving uncertainties in tracking and recognition simultaneously in a probabilistic framework. Lee in their recent work, represent each person by a low-dimensional appearance manifold, approximated by piece-wise linear subspaces. They present a maximum a posteriori formulation for recognizing faces in test video sequences by integrating the likelihood that the input image comes from a particular pose manifold and the transition probability to this manifold from the previous frame [19].
Among the methods mentioned, Lee method seems to be the one most capable of handling large 2-D and 3-D rotations.

A. Eigen Face-Based Recognition

2D face recognition using eigenfaces is one of the oldest types of face recognition. Turk and Pentland published the groundbreaking “Face Recognition Using Eigenfaces” in 1991. The method works by analyzing face images and computing eigenfaces which are faces composed of eigenvectors. The comparison of eigenfaces is used to identify the presence of a face and its identity. There is a five step process involved with the system developed by Turk and Pentland. First, the system needs to be initialized by feeding it a set of training images of faces. This is used these to define the face space which is set of images that are face like. Next, when a face is encountered it calculates an eigenface for it. By comparing it with known faces and using some statistical analysis it can be determined whether the image presented is a face at all. Then, if an image is determined to be a face the system will determine whether it knows the identity of it or not. The optional final step is that if an unknown face is seen repeatedly, the system can learn to recognize it. The eigenface technique is simple, efficient, and yields generally good results in controlled circumstances [1]. The system was even tested to track faces on film. There are also some limitations of eigenfaces. There is limited robustness tochanges in lighting, angle, and distance [6]. 2D recognition systems do not capture the actual size of the face, which is a fundamental problem [4]. These limits affect the technique’s application with security cameras because frontal shots andconsistent lighting cannot be relied upon.

B. 3D Face Recognition

3D face recognition is expected to be robust to the types of issues that plague 2D systems [4]. 3D systems generate 3D models of faces and compare them. These systems are more accurate because they capture the actual shape of faces. Skin texture analysis can be used in conjunction with face recognition to improve accuracy by 20 to 25 percent [3]. The acquisition of 3D data is one of the main problems for 3D systems.

C. Holistic Approach

In holistic approach, the whole face region is taken into account as input data into face detection system. Examples of holistic methods are Eigenfaces (most widely used method for face recognition), probabilistic Eigenfaces, fisherfaces, support vector machines, nearest feature lines (NFL) and independent component Analysis approaches. They are all based on principal component analysis (PCA) techniques that can be used to simplify a dataset into lower dimension while retaining the characteristics of dataset.

D. Feature Based Approach

In feature based approaches, local features on face such as nose, and then eyes are segmented and then used as input data for structural classifier. Pure geometry, dynamic link architecture, and hidden Markov model methods belong to this category.

E. Hybrid Approach

The idea of this method comes from how human vision system perceives both local feature and whole face. There are modular Eigenfaces, hybrid local feature, shape normalized, component based methods in hybrid approach.

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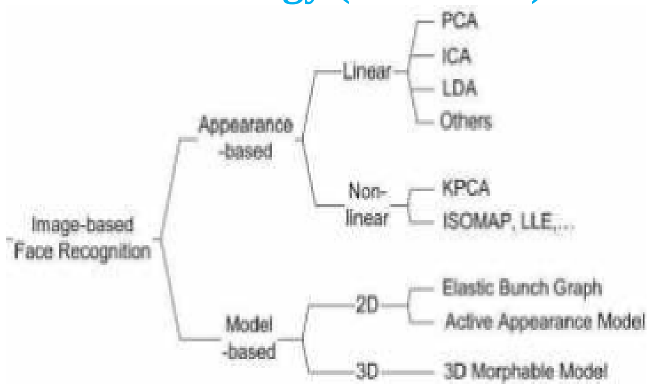

Fig 2 : Face Recognition Methods

F. Principal Component Analysis (PCA)

Derived from Karhunen Loeve's transformation. Given a dimensional vector representation of each face in a training set of images, Principal Component Analysis (PCA) tends to find a dimensional subspace whose basis vectors correspond to the maximum variance direction in the original image space. This new subspace is normally lower dimensional (t<<s). If the image elements are considered as random variables, the PCA basis vectors are defined as eigenvectors of the scatter matrix. The Eigen face algorithm uses PCA for dimensionality reduction to find the vectors which best account for the distribution of face images within the entire image space. These vectors define the subspace of face images and the subspace is called face space. All faces in the training set are projected onto the face space to find a set of weights that describes the contribution of each vector in the face space. To identify a test image, it requires the projection of the test image onto the face space to obtain the corresponding set of weights. By comparing the weights of the test image with the set of weights of the faces in the training set, the face in the test image can be identified 2.2 Principal Components (PC) of a two dimensional set of points. The first principal component provides an optimal linear dimension reduction from 2D to 1D, in the sense of the mean square error.

G. Independent Component Analysis (ICA)

Independent Component Analysis (ICA) is similar to PCA except that the distributions of the components are designed to be non Gaussian.ICA minimizes both second order and higher order dependencies in the input data and attempts to find the basis along which the data (when projected onto them) are statistically independent. Bartlett et al. provided two architectures of ICA for face recognition task:

1) Architecture I statistically independent basis images,
2) Architecture II factorial code representation.

H. Linear Discriminates Analysis (LDA)

Both PCA and ICA construct the face space without using theface class (Category) information. The whole face training datais taken as a whole. In LDA the goal is to find an efficient or interesting way to represent the face vector space. But exploiting the class information can be helpful to the identification tasks; Linear Discriminates Analysis (LDA) finds the vectors in the underlying space that best discriminate among classes. For all samples of all classes the between class scatter matrix SB and the within class scatter matrix SW are defined. The goal is to maximize SB while minimizing SW, inother words, maximize the ratio det|SB|/det|SW|. This ratio is maximized when the column vectors of the projection matrix are the eigenvectors of (SW^1× SB).

I. Evolutionary Pursuit (EP)

An Eigen space based adaptive approach that searches for the best set of projection axes in order to maximize a fitnessfunction, measuring at the same time the classification accuracy and generalization ability of the system. Because the dimension of the solution space of this problem is too big, it is solved using a specific kind of genetic algorithm called Evolutionary Pursuit (EP).

J. Kernel Methods

The face manifold in subspace need not be linear. Kernel methods are a generalization of linear methods. Direct nonlinear manifold schemes are explored to learn this nonlinear manifold.

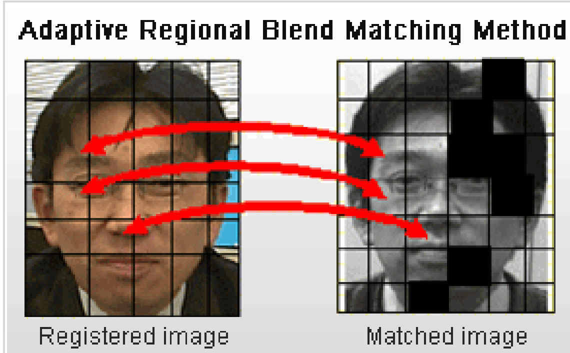

Fig 3. Matching face process

K. Trace Transform

The Trace transform, a generalization of the Radon transform, is a new tool for image processing which can be used for recognizing objects under transformations, e.g. rotation, translation and scaling. To produce the Trace transform one computes a functional along tracing lines of an image. DifferentTrace transforms can be produced 1 from an image using different trace functional.

L. Support Vector Machine (SVM)

Given a set of points belonging to two classes, a Support Vector Machine (SVM) finds the hyper plane that separates the largest possible fraction of points of the same class on the same side, while maximizing the distance from either class to the hyper plane. PCA is first used to extract features of face images and then discrimination functions between each pair of images arelearned by SVMs.

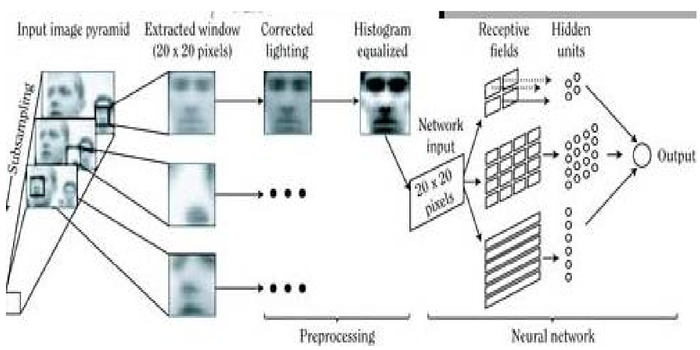

Fig 4. Complete Face Recognization Process

M. Elastic Bunch Graph Matching (EBGM)

Elastic Bunch Graph Matching (EBGM). All human faces share a similar topological structure. Faces are represented as graphs, with nodes positioned at fiducially points. (Exes, nose...) and edges labeled with 2D distance vectors. Each node contains a set of 40 complex Gabor wavelet coefficients at different scales 26 and orientations (phase, amplitude). They are called "jets". Recognition is based on labeled graphs. A labeled graph is a set of nodes connected by edges, nodes are labeled with jets, and edges are labeled with distances.

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 offspr ing is generated it does not duplicate any chromosome currently in the population or which has been previously built and tested.

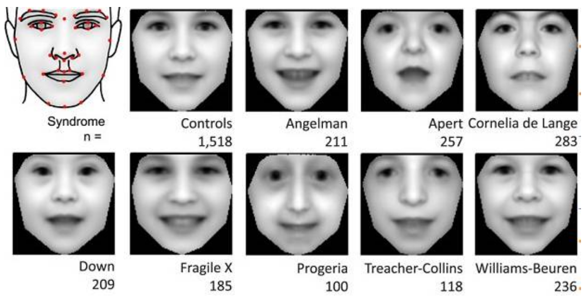

Fig 5: Genetic system face decetion

III. CONCLUSION

The main focus of this paper is to introduce an idea for those research associates who are interested to make a survey for face recognition and detection with a new technology Genetic algorithm. As we know that genetic algorithm has been used for a lot of research area, and now we used it for our paper.

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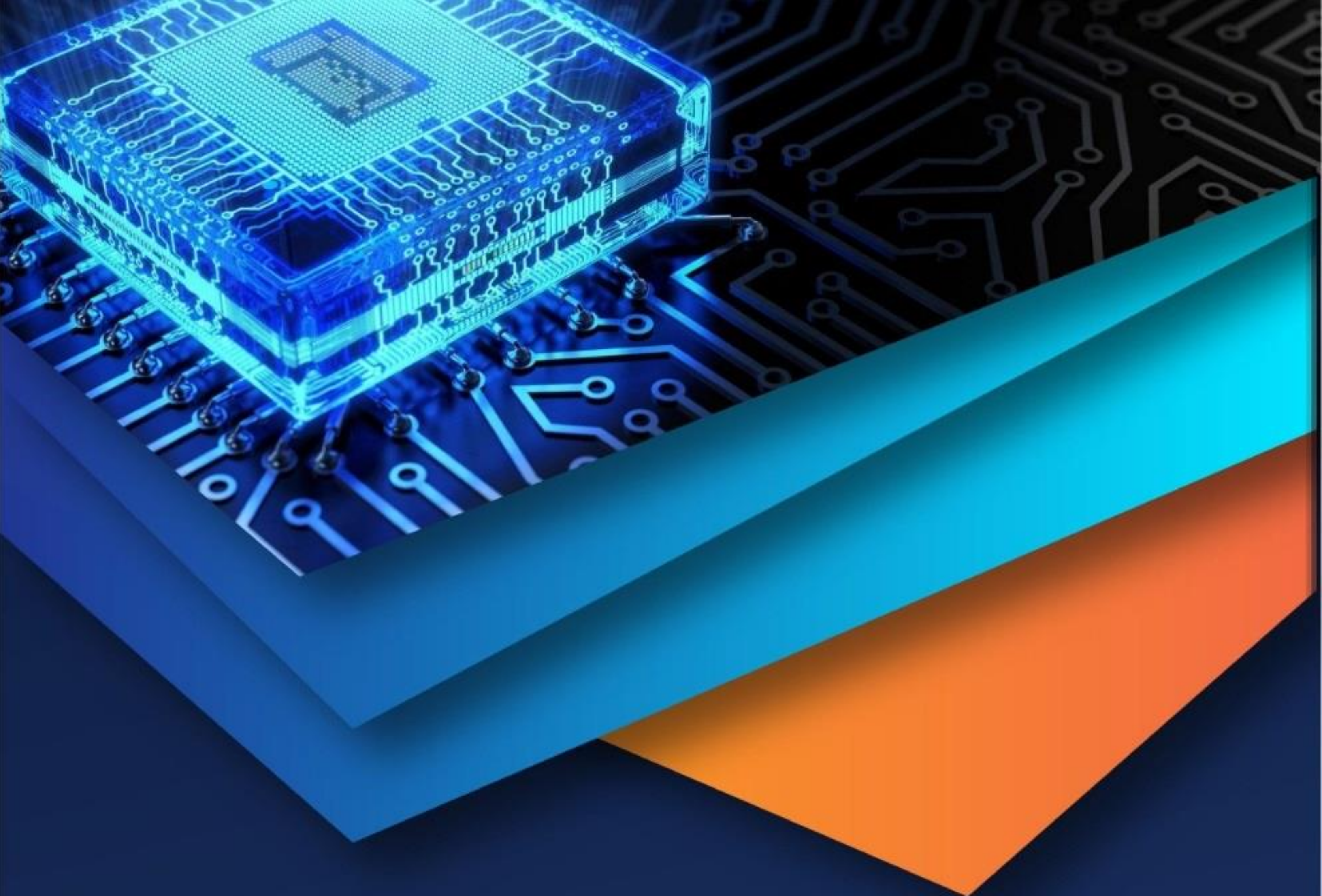

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