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A Novel Based Approach for Face Recognition

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ABSTRACT: Face Recognition has been an active area over many years in domain of pattern recognition, image processing and computer vision. In general, principal component analysis, quadratic discriminant analysis, linear discriminant analysis, statistical approaches are used for processing face recognition. Generally this reduces the number of features to be evaluated for the particular image, but it will degrade the accuracy of recognition because some feature will be helpful to recognize the faces. In this paper, we proposed the SIFT and SVM is used to recognize the faces with calculation of the fiduciary points that are used to tackle the face recognition problem. Also, we compare the performance of the proposed method with different available data-sets and real time faces.

KEYWORDS: SIFT, SVM, PCA, Gabor Filter, Morphology

I. INTRODUCTION

In current world scenario automation is becoming more popular in our day-to-day life. Face recognition is such a kind of system that provide solutions for the applications used by the civilians, companies, hospitals and army require effective face recognition in different ways to target automation. The significant purpose of face recognition is identification and verification of the human face. The face plays a major role in social conveying identity and emotion. We can recognize more number of faces learned throughout our lifetime and it is very effective using face recognition system. But, sometimes it is difficult to recognize faces, in case of change in face expressions. When a person wants to register for examination, he/she is, asked to upload photo and the person has to answer for some preliminary questions for registration of hall tickets. After registering the photo the candidate's photo will be compared with the aadhar card photo for checking the basic details of the candidate. This process will run in the backend. Then the hall ticket will be created, issued and the date of the exam will be announced. It is recommended to prepare the database of all candidates in the entry premises deployment of high resolution camera and the face recognition software at the entry premises. So whenever a candidate enters the entry premises his/her photograph will be taken to permit the access after it is being matched with the stored photo from the database. This application is used to collect the accurate details of the candidate by the information collected provide by the government such as aadhar card. This will be useful in many occasions like when the candidate misses his/her hall ticket, when the bad quality of photo copy is printed in the hall ticket. Similarly if any malpractice happens then the particular candidate will never be appearing exam in his/her life. This remaining of the paper is organized as following section II gives out related work, section III is about structure of the proposed system, section IV is describe algorithm, section V is about experimental result, section VI is about conclusion and section VII is about the references.

II. RELATED WORK

This related works provides the overview of an image processing started with semi-automated systems to locate the major features on face Semi automated systems used features of faces like mouth, eyes and nose. Ningthoujam

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Sunita [1] proposed Principal Component analysis, Linear Discriminant Analysis, and Independent Component Analysis constitutes a major part in the facial expression recognition techniques. PCA algorithm is used to evaluate the covariance of the matrix for particular image. K.C.Lee [2] described about Yale database is used to store the images. In neural networks a huge training database of faces is needed which required too much time to train the whole system to get the results. It gives the 60% of recognition rate. Javier Galbally [3] provided information about Image quality assessment for fake biometric detection: application to iris, fingerprint, and face recognition uses the Quadratic discriminant analysis classifiers method which is used to identify the Fake biometric detection can be seen as a two-class classification problem. Ashish Chittora [4] proposed Face Recognition Using RBF(Radial Basis Function) Kernel Based Support Vector Machine paper in which Support Vector Machine(SVM) is used as a basic concept which is used to seen the face recognition problem as binary tree recognition strategy are used to tackle the classification problem. R.Soundararajan [5] presented RRED indices: Reduced Reference Entropic Differencing for image quality assessment paper used Reduced Reference Quality Assessment (RRQA) algorithm. The algorithms differ in the nature of the distortion measurement and the quantity of the information required from the reference to compute quality. W. Lin, and M. Narwaria[6] proposed Image quality assessment based on gradient similarity, used Gradient similarity scheme to increase the Robustness and efficiency with six publicly available subject-rated benchmark IQA databases. C.Ding [7] proposed Face images captured in unconstrained environments usually contain significant pose variation, which degrades the performance of algorithms designed to recognize frontal faces. This novel face identification framework capable of handling the full range of pose variations within ±90° of yaw. Lai ZR [8] presented Extensive experiments on four benchmark data sets in controlled and uncontrolled lighting conditions show that the proposed method has promising results, especially in uncontrolled conditions, even mixed with other complicated variations. Xiao yang Tan [9] presented a simple and efficient preprocessing chain that eliminates most of the effects of changing illumination while still preserving the essential appearance details that are needed for recognition. FAN X [10] focused facial geometries including the co-linearity and those on a larger scale involving more points for more facial components.

In this work, SIFT and SVM algorithm is used to reduce the number of features to be evaluated for the particular image and reduces the processing time for face recognition. This also improves the accuracy of recognition process without the use of specialized equipment. This result compares with the statistical approaches (Quadratic discriminant analysis, linear discriminant analysis and etc...) which gives more output. Guodong Guo[14] proposed with faces that are subjected by correlation mapping between makeup and non-makeup faces on features extracted from local patches. Four categories of features are proposed to characterize cosmetics, including skin color tone, skin smoothness, texture and highlight. A patch selection scheme and discriminative mapping are presented to enhance the performance of makeup detection.

III. STRUCTURE OF THE PROPOSED METHOD

It is adequate and efficient method to be used in face recognition due to its simplicity, speed and learning capability. In order to develop a useful and applicable face recognition system several factors are needed. This is a form of signal processing for which the input is an image, such as a photograph or video frame. Gabor filter and Elastic Bunch Graph Map that dynamically makes Bunch Graph Map on the face. In the existing system the EBGM is predefined that's why the results are not matched, whereas in proposed system first Gabor filter is applied on image and after that face points are calculated. After getting the face points, the distance between points is found. The key points of faces are first extracted using SIFT from which a set of reference images and stored in a database [8]. An object is recognized in a new image by individually comparing each feature from the new image to this database and finding candidate matching features based on Euclidean distance of their feature vectors.

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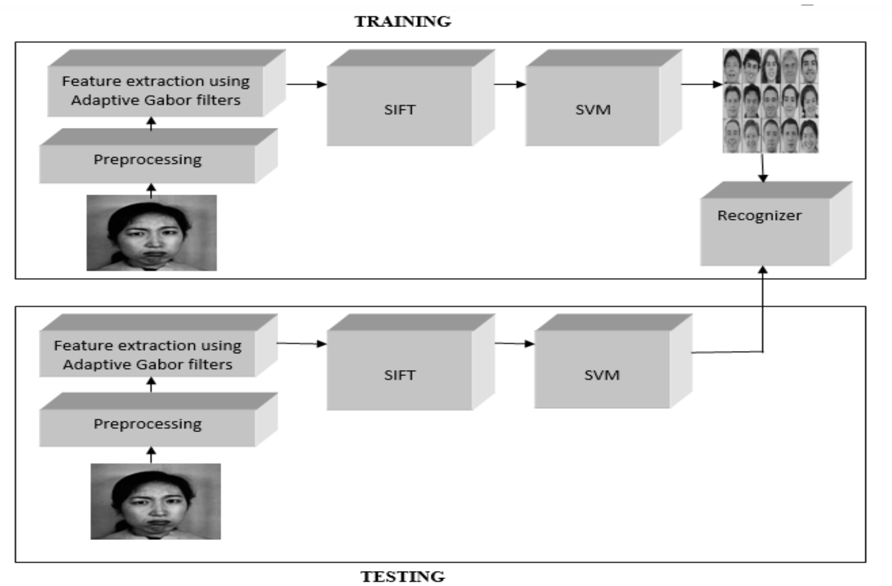

Fig.1. Overview of proposed method

From the matches, Subsets of key points that agree on the faces and its location, scale, and orientation in the new image are identified to filter out good matches. The determination of clusters is performed rapidly by using an efficient hash table implementation of the generalized Hough transform. Each cluster of features that agree on an object and its pose is then subject to further detailed model verification and subsequently outliers and noise are discarded. Finally the probability that a particular set of features indicates the presence of an object is computed, given the accuracy of number of probable false matches. Face matches that pass all these tests can be identified as correct with high confidence. Support Vector Machine (SVM) is a supervised learning models with associated learning algorithms that analyze data and recognize patterns, used for classification and regression analysis [2]. In this proposed system of image processing, the following is enhanced, 1. The overall speed of the system from detection to recognition should be acceptable. 2. The system should be easily updated and enlarged, that is easy to increase the number of subjects that can be recognized.

IV. ALGORITHM

A. Scale Invariant Feature Transform

SIFT key points of objects are first extracted from a set of reference images and stored in a database. An object is recognized in a new image by individually comparing each feature from the new image to this database and finding candidate matching features based on Euclidean distance of their feature vectors.

$$\mathrm{dist}((x,y),(a,b)) = \sqrt{(x-a)^2+(y-b)^2} \qquad (1)$$

According to the Euclidean distance formula, the distance between two points in the plane with the coordinates(x,y) and (a,b). From the full set of matches, subsets of key points that agree on the object and its location, scale, and orientation in the new image are identified to filter out good matches. The determination of consistent clusters is performed rapidly by using an efficient hash table implementation of the generalized Hough transform. Each cluster of 3 or more features that agree on an object and its pose is then subject to further detailed model verification and subsequently outliers are discarded. Finally the probability that a particular set of features indicates the presence of an object is computed, given the accuracy of fit and number of probable false matches. Object matches that pass all these tests can be identified as correct with high confidence. Object recognition using SIFT features:

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1. These features are matched to the SIFT feature database obtained from the training images. This feature matching is done through a Euclidean-distance based nearest neighbor approach. To increase robustness, matches are rejected for those keypoints for which the ratio of the nearest neighbor distance to the second nearest neighbor distance is greater than 0.8. This discards many of the false matches arising from background clutter. Finally, to avoid the expensive search required for finding the Euclidean-distance-based nearest neighbor, an approximate algorithm called the best-bin-first algorithm is used. This is a fast method for returning the nearest neighbor with high probability, and can give speedup by factor of 1000 while finding nearest neighbor (of interest) 95% of the time.

2. Although the distance ratio test described above discards many of the false matches arising from background clutter, we still have matches that belong to different objects. Therefore to increase robustness to object identification, to cluster those features that belong to the same object and reject the matches that are left out in the clustering process. This is done using the Hough transform.

$$R=x\cos\theta+y\sin\theta \quad (2)$$

Where r is the distance from the origin, θ the angle between the x axis. This will identify clusters of features that vote for the same object pose. When clusters of features are found to vote for the same pose of an object, the probability of the interpretation being correct is much higher than for any single feature. Each key point votes for the set of object poses that are consistent with the key point's location, scale, and orientation. Bins that accumulate at least 3 votes are identified as candidate object/pose matches.

3. For each candidate cluster, a least-squares solution for the best estimated affine projection parameters relating the training image to the input image is obtained.

Scale space: In order to search for image blobs at multiple scale, the SIFT detector construct a scale space, defined as follows. Let $I_0(x)$ denote an idealized infinite resolution image. Consider the Gaussian kernel as,

$$g_\sigma(x)=\frac{1}{2\pi\sigma^2}\exp\left(-\frac{1}{2}\frac{x^T x}{\sigma^2}\right) \quad (3)$$

The Gaussian scale space is the collection of smoothed images as,

$$I_\sigma=g_\sigma * I,\ \sigma\geq 0 \quad (4)$$

The image at infinite resolution I_0 is useful conceptually, but is not available to us; instead, the input image $I_{\sigma n}$ is assumed to be pre-smoothed at a nominal level σ_n=0.5 to account for the finite resolution of the pixels. Thus in practice the scale space is computed by,

$$I_\sigma=g\sqrt{\sigma^2-\sigma_n^2} * I_{\sigma_n},\ \sigma \geq \sigma_n \quad (5)$$

Scales are sampled at logarithmic steps given by,

$$\sigma=\sigma_0 2^{o+s/S},s=0,..s-1,o=o_{min},\ldots o_{min}+O-1 \quad (6)$$

where σ_0=1.6 is the base scale, σ is known as sampling scale value, omin is the first octave index, O the number of octaves and S the number of scales per octave. Blobs are detected as local extrema of the Difference of Gaussians (DoG) scale space, obtained by subtracting successive scales of the Gaussian scale space as,

$$DoG_{\sigma(o,s)}=I_{\sigma(o,s+1)}-I_{\sigma(o,s)} \quad (7)$$

At each next octave, the resolution of the images is halved to save computations. The black vertical segments represent images of the Guassian Scale Space (GSS), arranged by increasing scale σ.

B. Support Vector Machine (Svm):

It is a supervised learning models with associated learning algorithms that analyze data and recognize patterns, used for classification and regression analysis. Given a set of training examples, each marked with more than two categories.

Training an SVM Classifier:

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Train, and optionally cross validate, an SVM classifier using fitcsvm. This function syntax is:

SVMModel=fitcsvm(X,Y,'KernelFunction','rbf','Standardize',true,'ClassNames',{'negClass','posClass'}); (8)

Matrix of predictor data X, where each row is one observation, and each column is one predictor Array of class labels Y with each row corresponding to the value of the corresponding row in X. Y can be a character array, categorical, logical or numeric vector, or vector cell array of strings. Column vector with each row corresponding to the value of the corresponding row in X. Y can be a categorical or character array, logical or numeric vector, or cell array of strings. The default value KernelFunction is 'linear' for two-class learning, which separates the data by a hyper plane. The value 'rbf' is the default for one-class learning, and uses a Gaussian radial basis function. An important step to successfully train an SVM classifier is to choose an appropriate KernelFunction. Flag indicates whether the software should standardize the predictors before training the classifier. The ClassNames distinguishes between the negative and positive classes, or specifies which classes to include in the data. The negative class is the first element (or row of a character array), e.g., 'negClass', and the positive class is the second element (or row of a character array), e.g., 'posClass'. ClassNames must be the same data type as Y. It is good practice to specify the class names, especially if you are comparing the performance of different classifiers .The resulting, trained model (SVMModel) contains the optimized parameters from the SVM algorithm, enabling to classify new data. For more name-value pairs you can use to control the training. The classifying new data using a trained SVM classifier (SVMModel) has:

[label,score] = predict(SVMModel,newX) (9)

The resulting vector, label, represents the classification of each row in X. score is an *n*-by-2 matrix of soft scores. Each row corresponds to a row in X, which is a new observation. The first column contains the scores for the observations being classified in the negative class, and the second column contains the scores observations being classified in the positive class.

To estimate posterior probabilities rather than scores, first pass the trained SVM classifier (SVMModel) to fitPosterior, which fits a score-to-posterior-probability transformation function to the scores. The syntax is:

zScoreSVMModel=fitPosterior(SVMModel,X,Y) (10)

The property ScoreTransform of the classifier ScoreSVMModel contains the optimal transformation function. Pass Score SVMModel to predict. Rather than returning the scores, the output argument score contains the posterior probabilities of an observation being classified as both values.

V. EXPERIMENTAL RESULTS

In this work two different set of datasets such as Yale dataset and Jaffe dataset have been used. The Yale database consists of images of male persons. It consists of faces of 15 unique persons with 11 different conditions for each person. The conditions are such as center-light, w/glasses, happy, left-light, w/no glasses, normal, right-light, sad, sleepy, surprised, wink. It consists of gray-scale images with the image size of 320 x 243 resolution. The JAFFE database contains 213 images of 7 facial expressions (6 basic facial expressions and 1 neutral expression) posed by 10 Japanese female models. Each image has been rated on 6 emotion adjectives by 60 Japanese subjects.

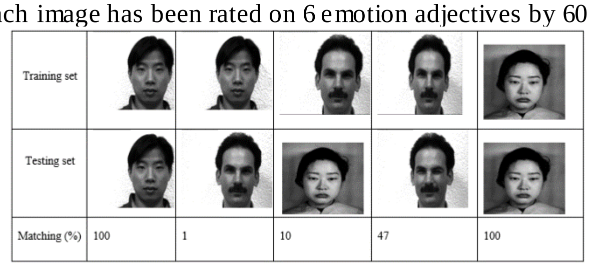

Fig.2a. Matching percentage of Yale &Jaffe dataset

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The Fig 2a represents the testing set and training set images with the matching percentage using sift algorithm. We also practiced this with the real dataset images for comparison of matching percentage.

Training set					
Testing set					
Matching (%)	100	21	100	100	8

Fig.2b. Matching percentage of real dataset

The Fig 2b represents the testing set and training set images with the matching percentage of a real dataset. This real dataset consists of colored images of 50 subjects with the image size of 320 x 243 resolution. The feature matching is done through a Euclidean-distance based nearest neighbor approach. To increase robustness, matches are rejected for those key points for which the ratio of the nearest neighbor distance to the second nearest neighbor distance. Finally, to avoid the expensive search required for finding the Euclidean-distance-based nearest neighbor, an approximate algorithm called the best-bin-first algorithm is used.

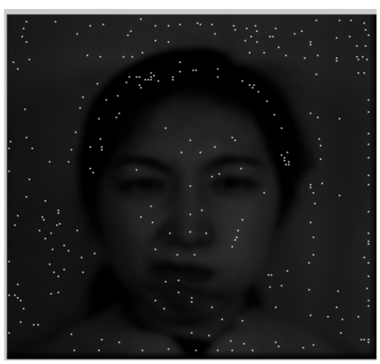

Fig 3. Image in fiducial points

Fig 3 represents the fiducial points marked in an image. The fiducial points are plotted by calculating the Euclidean distance using SIFT algorithm and the images of testing and training set are classified using SVM classifier.

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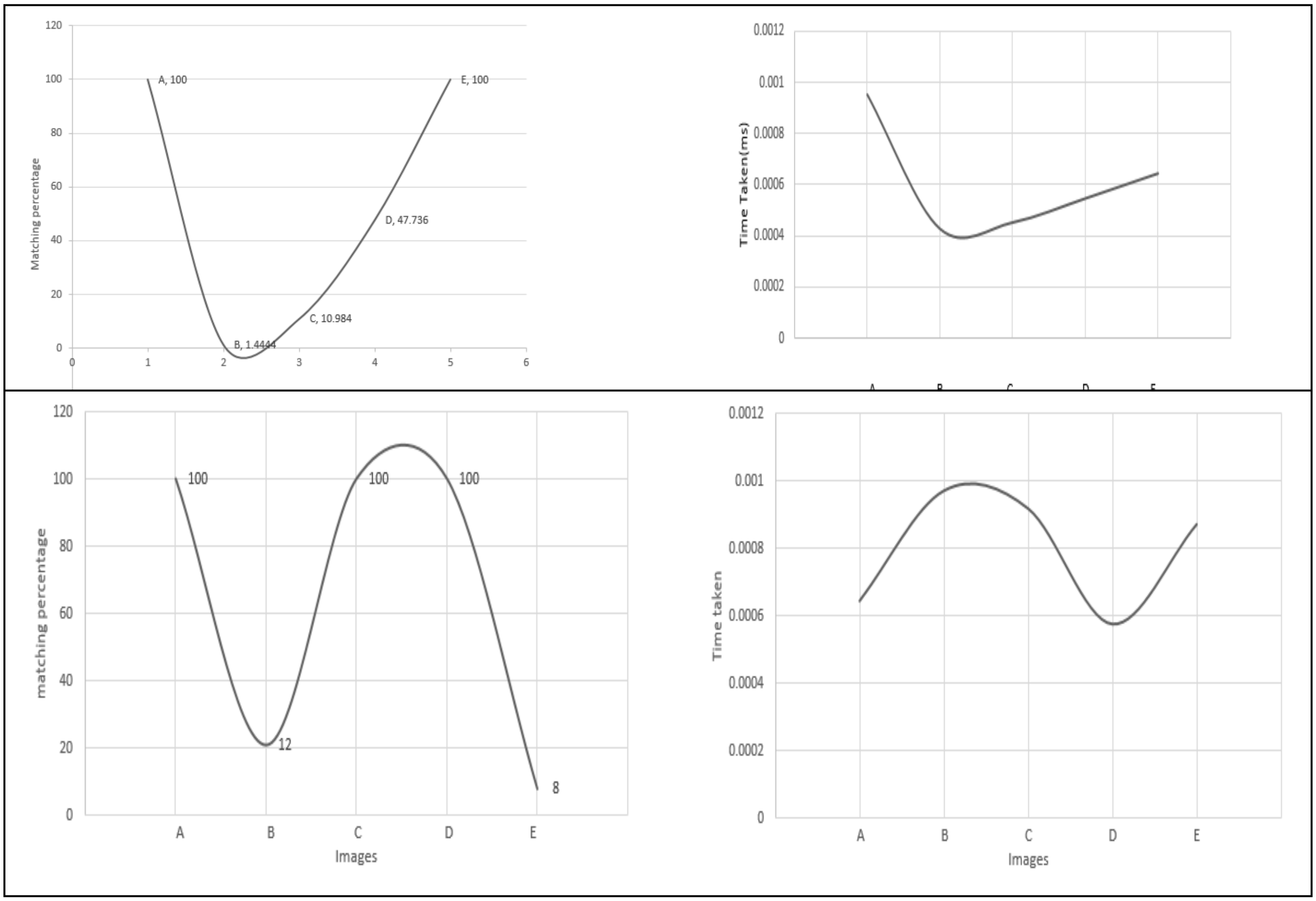

images with various expressions for each image. Fig 5b represents the time taken for the matching process of the Real dataset which takes milliseconds to recognize the faces from the dataset.

VI. CONCLUSION

This proposed work presents the face recognition approach using by preprocessing the images, extracting features using Gabor filters, applying SIFT algorithm in order to find the Euclidean distance, and SVM algorithm in order to classify the images. In proposed system, the speed and efficiency of the system is enhanced and the novelty here is the usage of SIFT algorithm.

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