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# An Effective Framwork for Face Recognition using PSO and Eigen Filtration

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***Abstract:*** ***Face Recognition System (FRS) is a computer application, which can detect, verify and recognize the faces. This paper gives the literature survey of the related work. The area is still an active area of research and new algorithms are being published with increased accuracy and reduced recognition time. All FRS algorithms have the same objective of achieving high accuracy in face recognition and use different methods for this purpose. A FRS should be good enough to recognize from face images which have different lighting conditions, poses and expressions. Since face recognition system plays a vital role in security and authentication it is important to use a system, which can provide high accuracy. In this paper an overview of different FRS algorithms is presented. Also, this paper presents a new approach based on Particle Swarm Optimization (PSO) method and Eigen Filtration. Eigen filtration is used for extracting feature points (white points) from canny edge detected image. PSO will iteratively search for best candidate solution among the population in the search space. In this approach uses 200 CMU face images from UCI machine Learning Laboratory.***

***Keywords: Face Recognition System(FRS); lighting conditions; Accuracy; 3-D pose; Training set; Face image; Testing (Minimum 5 to 8 key words must be phrases).***

## I. INTRODUCTION

Face recognition system is a computer application to recognize face. This document gives an overview of the different techniques, which can be used in the Face recognition system to recognize faces from images and also presents analysis study on different face detection and recognizing techniques. All techniques may have the same objective of producing an efficient system using different approaches. A good FRS is one, which can use an effective approach, which often can give an optimized solution within a fraction of second with 100% accuracy. Here we will analyse various techniques used so far. FRS can be used in multiuser devices, hotels, public places, hospitals and automatic unlocking system. Here we propose a system which uses PSO optimization technique and Eigen filtration. For this system we are using feature points called white points for finding a nearly identical image of training image. Training Image from subfolder of training set is compared with respective subfolders of set gallery; hence we get 100% accuracy for this method.

## II. LITERATURE REVIEW

Many people worked on FRS till today. All of them used digital images for their FRS, either some of them converted colored digital images to gray-scale images or some of them directly fed colored images to the system. To reduce the time complexity it is preferred to use grayscale images. There are some techniques which are fully dependent on the color of the skin of a face in the face images, in this scenario; system extracts the features such as skin texture, color, marks on the skin etc. Before proceeding with the approach, which we have used for FRS, we will analyze some previous approaches, this section explains the approaches used in existing system. Review of existing approached is presented below

 

*A. Existing System*

FRS got its first invention done by 1960. Since then there are a lot of innovations were made decade by decade. Each method for recognizing face has its own advantages. FRS is coming up with the efficient approaches, which leads to reduction of the time complexity and enhancement in the performance.

Two decades ago, Nefian, Ara, and Monson H. Hayes II proposed a Hidden Markov Model(HMM) based system[1], where for each landmark such as forehead, eyes, nose, lips, chin, they have assigned a hidden markov state in HMM. A hidden markov model is an one dimensional chain but in this scenario, it acts as a two dimensional chain by each state of hidden markov model often containing another hidden markov model. In paper [2], G. C. Feng et al. Proposed a new idea of converting an image, which has an unknown pose to the virtual frontal view by using an algorithm, which makes use of facial landmarks for creating virtual frontal view. In paper [3], Author explained about polynomial kernel, which is used for extracting the principle components from face images from the region of highly co-related input pixels. Bai-Ling Zhang et al., shows in paper [4] that FRS using Independent Gabor Features(IGF) gives 100% accuracy, Gabor features vector is derived using Gabor wavelet representations of face images and then dimensionality of the vector is reduced. Then it finds the independent Gabor features using Independent Component Analysis (ICA). In paper [5] Zhang, Bai-Ling et al., explained FRS using two-dimensional (2D) wavelet sub-band coefficients and classification method, These Wavelet sub-band coefficients are used to capture necessary facial features. In this method they have constructed separate associative memory (AM) model for individual person. This paper also shows that performance of AM models can be increased using kernel methods.

In Real time representing face in computational model is very complex task. In paper [6], Lu, Jianming et al., explained about using fuzzy clustering and parallel neural networks (NN's) for face recognition. As the number of neural networks increase, computation efficiency is decreased. Each neural network represents individual face pattern based on fuzzy clustering. Results from individual neural network are combined to get the final result. This proposed method achieved 98.75% of performance for 240 patterns of faces. In paper [7, 2007], Zhang, Wenchao, et al., proposed that the partial occlusion is one of the major problem in the face recognition system. To solve this problem, author proposed a new method, Kullback-Leibler Divergence (KLD)-based on their previous work on Local Gabor Binary Patterns (LGBP). By using KLD in between the LGBP features, they tried estimating the probability of occlusion.

In the same year, Paper [8] , Li, Stan Z., et al., presented a novel method, which could solve the problem of recognizing illumination invariant face images. So it is not limited as a indoor application. Author used Near Infrared (NIR) system for recognition and convert captured faces into gray-scale, This simplifies the task and produce good face images regardless of lighting conditions of capturing environment. In paper [9], Singh, Richa, et al., described a face mosaicing scheme that generates a composite face image using frontal and semi-profile face images. In this method there is no need to use multiple face images with different poses. This technique has used combination of frontal and side profiles of individual. A registration algorithm is used for relating two images of individual. In paper [10], Zhiming Liu and Chengjun Liu presented a idea of using hybrid Color and Frequency Features (CFF) for face recognition. This method used Enhanced Fisher Model (EFM) to extracts features from a new hybrid color space and also used *RIQ* color space, which is a combination of *R* component of *RGB* color space and I, *Q* components of *YIQ* color space. In paper [11], author presented an approach which can identify the faces using linear regression. In this method author represented the image patterns on a linear subspace, by using least-squares method. Inverse problem can be solved with the minimum reconstruction error. It used the nearest subspace classification. This algorithm has been tested on number of different face image dataset.

In paper[12], Tan, Xiaoyang, and Bill Triggs proposed a method of using Enhanced local texture feature set which normalize the illumination level of images. In this method kernel based feature extraction has been used for extracting multiple features and used local ternary patterns (LTP), which is less sensitive to the noise. They have also added kernel Principle Component Analysis (PCA) for feature extraction. This provided state-of-the-art performance. In paper [13], Berretti et al.,

 

presented a new approach of recognizing face using 3D face images which often have different expressions. Facial geometrical information is used for distinguishing individuals. This information is represented as graph. Where each arc between the nodes represent the weights and nodes in the graph represented equal width isogeodesic facial stripes. This technique can be used with large dataset. In paper [14], Zhang, Baochang, et al., proposed a novel method called local derivative pattern (LDP), This method extract the local pattern features from face images and encode the spatial relationship from a local region.

In addition, authors Yang, Meng, and Lei Zhang. Explained Gabor feature based sparse representation in paper [15] in the year 2010. In this correspondence it is given that how sparse representation of testing image can be used with the occlusion dictionary. Even though Huge number of atoms in the occlusion dictionary can make the sparse coding computationally complex. Sparse representation classification can lead to robust performance. In the same year another method was proposed by Qiao, Lishan, Songcan Chen, and Xiaoyang Tan., this method explains a new idea of using unsupervised method called sparsity preserving projections (SPP). This approach was proposed in paper[16], Unlike local preserving projection (LPP) and neighborhood preserving embedding (NPE) approach, which aims at preserving neighborhood information while reducing the dimension, SPP aims at preserving the sparse reconstructive relationship of the data. These projections were often invariant in scaling, rotation. Paper [17], proposed an approach called Kernel Sparse Representation (KSR). However encoding the features with sparse representation has been already proposed in previous papers, this approach encodes high dimensional feature space and captures the nonlinear similarities of features. In paper [18], discriminative model is proposed which is used for recognizing faces, where face images have variation in ages. Here they have represented individual face by local feature description, where scale invariant feature transform (SIFT) and multi-scale local binary patterns (MLBP) are used. In paper [19], Histograms of Oriented Gradients (HOGs)has been proposed for face recognition. This histogram is a descriptor, used for object recognition. This method reduces the error rate when face images are under different lighting conditions and poses and captures important features of face images.

Till now we have seen recognizing from still images, Paper [20] explains about recognizing faces from video frame, which have common matching background. In this approach author used video of face images. Uniqueness of this approach holds in finding matching face from video. In paper [21], Author explained a method of self organizing map, which is based on neural network.

In paper[22], Chirag I Patel and Sanjay Garg, presented an approach of Robust Face Detection using Fusion of Haar and Daubechies Orthogonal Wavelet Template. This wavelet uses the image details and multidimensional representation of images. This In paper[23], author explained an approach of recognizing 3-D faces from face images which are based on number of facts such as degree of 3-D images, number of different expressions and poses. In paper [24], Sparse Representation-Based Classification (SRC) has been explained.. In this paper, they have used a single training image for a class. This approach used an intra-class variant dictionary, which represented the variation between the training and testing face images. In paper [25], novel approach called discriminative multi-manifold analysis (DMMA) has been explained which used a single training sample for an individual person. Face image is divided into number of face patterns and use these overlapping patterns for learning the features. In Paper [26], novel geometric framework has been explained for analyzing 3D faces, which estimates missing facial parts using PCA. This approach compares, matches, and averages the shapes of face images. Here author represented facial surfaces by radial curves.

Paper [27] proposes a local feature descriptor, local directional number pattern (LDN), for face analysis, this approach aimed at recognition face and expressions. Here directional information is extracted and encoded. This approach performs consistently under illumination, noise, expression, and time lapse variations. Paper [28], proposed a approach called Heterogeneous face recognition (HFR), which matches two face images. For example a sketch image to a digital image. In this method set gallery images are represented as nonlinear similarities to a collection of prototype face images. Li, Billy YL, et al., proposed a method in paper[29] for face recognition, which has different variations. This method used 3-D sensor to obtain a

 

canonical frontal view and also reduces the noise produced by the sensor. Texture from RGB space is converted to Discriminative color and then sparse coding is done. Paper [30], in this paper author proposed a coarse-to-fine face recognition approach, which is similar to sparse representation method and uses linear combination of all training samples, which is often equal to the test sample. Paper [31, 2014] explained how independent component from edge detected image can be used. Till now we have seen the methods of extracting features of facial landmarks. In this approach they have used canny edge detection algorithm for detecting contour of the images.

From paper [32], it has been shown that how deep neutral network can be used for face representation. In this method author used nine-layer neural network. This deep network contains more than 120 million parameters and several locally connected layers without weight sharing. Paper [33], explain the approach of identifying a person from video track, media footage. This approach is suitable to recognize person by using low resolution samples. Verbally described person can also be recognized from still images of video track by converting it into the sketch. In paper[34], author presented a recognition system, known as FaceNet, which learns mapping from digital face images to a Euclidean space, where distances describes the similarity in the faces. This method used a deep convolutional network, which was trained to directly optimize the embedding itself. To train network, they have used face patches, which has been derived using a online triplet mining method. This system gave an accuracy of 99.63%. In paper [35], author explained how a large face dataset can be used as a training set by providing a end-to-end learning for the convolution neural network. It extends previous paper with addition of more features , which helps while using huge data set.

### *B. Proposed System*

Face Recognition system is a computer application, which is used to recognize faces from digital images. In this project face image is a digital gray-scale image. The proposed approach uses the Particle Swarm Optimization method for searching the best candidate solution from the search space. In this method a single training sample has been used, then we will use wiener filter to remove noise from gray-scale image. Wiener filter will remove the noise and will make the intensities of all pixels in the image nearly equal. We can see the intensity level from imhist() function of image processing toolbox(MATLAB). After removing noise a edge detected image with black and white image is created using canny edge detection algorithm. In this image all edges are represented with white pixels and rest of the image is represented with black. This approach uses the feature points called white points of this edge detected image for detecting and recognizing nearly identical image from set gallery.

Iterative calculation is done in this approach for finding white points of each image from subfolder of the set gallery. Each subfolder in the training set is associated with each subfolder of set galley (t1 is associated with s1 folder). Training set subfolder contains only one image sample and set gallery subfolder contains 9 images for comparing. These 9 images are belongs to same class or person. This implementation aims at recognizing nearly identical image to the training image. Since we are using optimization technique for finding best solution which belongs to same class, this approach gives the 100% accuracy.

### *I. Particle Swarm Optimization(PSO)*

PSO is an optimization technique, which iteratively searches the solution space for finding candidate solution. There is several kind of PSO methods exist for various scenarios. PSO selects a parameter and calculates value for this parameter and returns real value as the output.

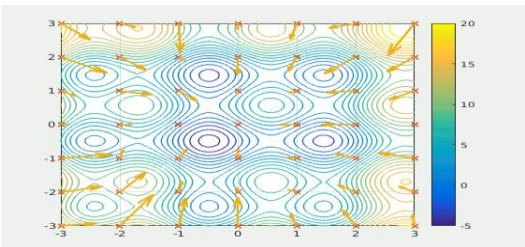


Fig 1: Particle Swarm Optimization[36]

II. Feature points ( white points)

In this approach, Feature points called white points are being extracted from edge detected image, which is a result of Canny edge detection algorithm. All strong and weak edge can be easily detected by canny algorithm. Images being used in this approach should be of same size. In this method, images with length of 211 and width of 300 pixels have been used.

III. Block Diagram of the proposed method

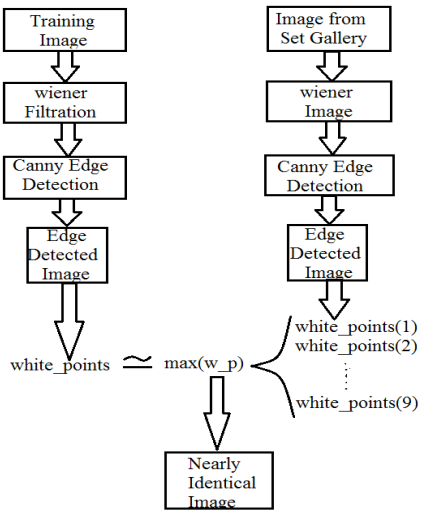


Fig 2 : Block Diagram of FRS using PSO and Eigen Filtration

In the Block Diagram shown above, it is shown that how a face recognition system in this approach works. There are four stages this approach follows for giving nearly identical image as an output. They are explained below.

- Removing noise from training image and respective images from set gallery
- Finding Canny Edge detected image for training image and associated images from set gallery
- Calculating white points of training image and iteratively calculating white points of images from set gallery
- Returning image from set gallery, which has highest number of white points

## III. Results and Analysis

This approach used feature points called white points for recognition purpose. Noise will be removed from each image by using wiener filter and then Canny edge detection algorithm is used for finding edge detected image. White points are calculated for each edge detected image from the set gallery. Pipeline of taking input from training image and giving the output, which is nearly identical to the training image has two layers as shown in the figure 3. Upper part indicates training image and lower part indicates output which is selected from set gallery. Since this approach finds person of the same class as in the training set, it provides perfect(100%) accuracy. Set gallery images have already stored in the system.

 

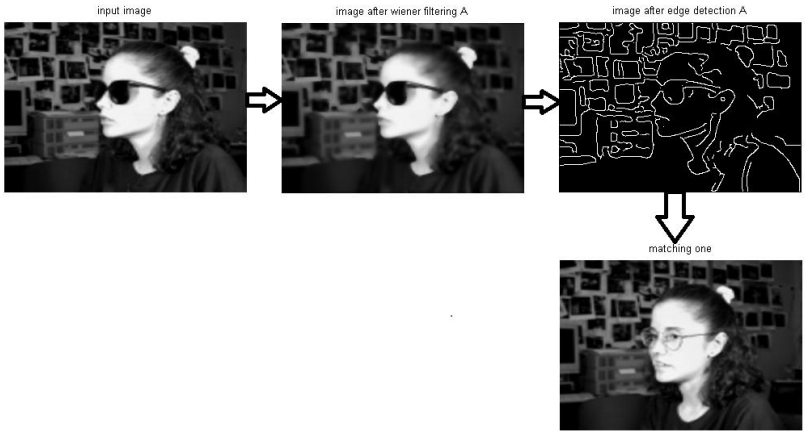


Fig 3: Pipeline methods in FRS

## IV. CONCLUSION

The FRS is an application for finding face from digital face images. Till now we saw different methods of face recognition using number of different feature extraction techniques and proposed an approach of using canny edge detected image for face recognition. This proposed approach uses PSO optimization technique and Eigen filtration. Eigen Filtration is used for finding the feature points(white points), which helps in getting nearly identical image of training image. Since this approach compares a single training sample with the class from set gallery of same person, which often have various poses and expression, it will not give any other person's face as outcome. This leads to 100% accuracy. This FRS system can be used in the areas, where security and authentication is important such as multiuser devices, automatic unlocking systems.

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