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Human Face Identification by a Markov Random Field GroupWise Registration Technique

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Abstract— Face recognition is widely used in various applications like in bank applications, at airport or at ATM centre for security purposes etc. There are various methods used for face recognition problem. In this paper I propose new method known as Markov field GroupWise registration in which mean of all the faces from the database will be calculated first and then this mean will be compared with the testing image.

To implement these modules, four open source databases like FERET, CAS-PEAL-R1, FRGC ver. 2.0, and the LFW are required. My work will achieve good result as compared to previous methods.

Keywords- *Markov Random Field (MRF), Support Vector Machine (SVM), Linear Discriminant Analysis (LDA).*

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I. INTRODUCTION

A face recognition system is a technique which automatically identifying or verifying a person from a digital image or a video frame from a video source. One of the ways to achieve this is by comparing selected facial features from an image and a facial database. It is widely used in security systems. This concept is used in many applications like systems for factory automation, in bank application and security surveillance. The human face plays major role in our social interaction. Using the human face as a key to security biometric face recognition technology has put attention in the past few years due to its potential for a wide variety of applications in both law enforcement as well as non-law enforcement.

Face is the most common biometric technique used to identify human faces but there are some challenges of face recognition:

1. Automatically locate human face.
2. Recognize the face from a general view point under different illumination conditions, aging effects and facial expressions.

Many novel methods have been proposed in the literature for AFR, and they are of two types: holistic and local feature matching methods. The holistic methods used for whole facial regions as input and derive a salient subspace to find the similarity between different facial images. So, the core problem of holistic methods is about how to define the principles and optimization criteria to construct the subspace so the facial images might be projected to the subspace and their similarity can be measured. So Turk and Pentland. Used the (PCA) principle component analysis, which is called as ”eigenface” for project the facial images to the subspace with minimum least square error. The error is reconstruction error. Then Belhumeur et al proposed the (LDA) use of linear discriminant analysis to project facial images to the subspace which simultaneously maximizes the inter-class distances while minimizing the intra-class variations. Then Bartlett et al. proposed the (ICA) Independent Component Analysis to construct the subspace such that in which it captures higher order pixel-wise relationship. For analyzing facial images in the nonlinear high dimensional feature space, some methods like kernel based methods were also proposed an et al. proposed a general graph embedding framework, in which different dimensionality reduction and subspace learning methods such as PCA ISOMAP, and LLE can be reformulated in this framework. Recently, A Sparse Representation Framework for face recognition proposed by Wright et al. in the original facial space.

In local feature matching it extract image appearance features from various different local regions of facial images, and the features which are extracted are combined and served as input to the classifier which is used. It is necessary to understand that local feature matching methods generally are more robust than local illumination changes and expression variations. Gabor wavelet and local binary patterns (LBP) are two representative features used in local feature matching methods.

Regression Approach for face recognition proposed by Naseem et al.

Gabor wavelet can be viewed as band pass filters which analyze facial images in some different frequency bands, along with different orientations and scales. LBP is more powerful and efficient local image descriptor which is proposed for texture classification and has been widely extended to other classification problems by different researchers., Many local feature matching methods were developed in recent years which are based on Gabor wavelet and LBP. For instance, Zhang et al. extracts LBP features from the Gabor filtered responses for face recognition. Now days, there are some new methods proposed to model a facial expression process as diffeomorphic transformations to aim the recognition task. For instance, Guo et al. proposed a generative method to model the dynamic facial expression with a diffeomorphic growth model. As well as, image registration is served as a possible solution for pose-invariant face recognition problems.

In this paper, we propose a alternative and convenient method to tackle face recognition problem, which is known as Group wise image registration with feature matching. The main idea behind this technique is to first find out the common group mean facial image space on the Riemannian manifold, and the similarity among various facial images. The

main focus of the proposed method is summarized as follows. First, anatomical features are extracted from each pixel position of the facial images instead of using pixel intensity alone, from its corresponding most salient scale local regions. Then from each pixel position the anatomical signature calculated. a feature guided (MRF) i.e. Markov random field group wise registration framework is proposed to construct the group mean facial image space on the Riemannian manifold in hierarchical manner. At Last, the technique is an unsupervised learning method.

II. LITERATURE SERVEY

1. Automatic Face Recognition (AFR)

Jeffrey F and Ying-li Tian done this work. (AFR) Automatic face recognition plays an important role in computer world. AFR is very important and challenging research topic mainly due following three ireasons. First, facial expressions of the same person may affect large and deformable motions across different facial images. Second, Due to illumination changes the image appearances can be significantly altered. Third, Diffculty in achieving high recognition rates in different poses.

2. Principle Component Analysis (PCA)

Turk and Pentland done this work. They used (PCA) the principle component analysis, which is also called as eigenface to project the facial images to the subspace with minimum least square reconstruction error. PCA is used by them to compute a set of subspace basis vectors for a database of face images, and projected the images in a database in to the compressed subspace. It is used for subspace learning as well as dimensionality reduction.

3. Local Feature Matching Method

Jie Zou, Qiang Ji, Zhen Lei and Shengcai Liao took efforts on this work. Feature matching methods simply extract the image appearance features from the different local regions of the facial images, and extracted features are combined and given to classifier as a input. It is shown that local feature matching methods generally are more robust to local illumination changes and expression variations. Gabor and (LBPs) local binary patterns are two representative features. Gabor wavelets capture the local structure corresponding to specific spatial frequency, spatial locality, selective orientation which are demonstrated to be discriminative and robust to illumination and expression changes. The job of LBP operator is to describes the neighboring changes around a central point, it is the simple and effective way can be used for represent faces.

III. PROPOSED SCHEME

FACE recognition is one of the most important research topics in computer world. The applications of face recognition can be found at Air port, Police station, telecommunication, Banks, law enforcement, biometrics, school, colleges and surveillance. Although there have been some early successes in automatic face recognition, it is still far from being completely solved, especially in case of uncontrolled environments. Motivated is to formulate the face recognition problem as deformable image registration and feature matching problem. Proposed method will automatically detect the input image by using Group wise Registration in Markov Random Field. This method will also produce the encouraging results in achieving the recognition rate and verification rate of images.

Image registration process is different from all previous methods. Previous method uses Euclidean distance for classification. So these methods requires more time for execution as compared to this one. To improve the existing system we will use Support Vector Machine i.e. (SVM) for more accuracy and rapid execution for high resolution images. In proposed method we will take images of different poses and calculate the mean of these images. It replaces the pair wise registration which requires a little bit more processing time. Proposed method will improve execution time in less memory with the help of group wise registration. By calculating group mean and each image feature we will calculate discrimination using cross Survival Exponential Entropy i.e. (SEE).

a) System Functionality Requirements

This work has been evaluated on four open source databases mentioned below
a) FERET
b) CAS PEAL R1
c) FRGC version 2.0 and
d) LFW

System Architecture As shown in figure below the proposed system shows the group wise registration using Markov Random Field (MRF). The training images contains images of different poses and variations. The image is extracted from the database. Then group wise registration is apply on images.
System Architecture of proposed system as below:

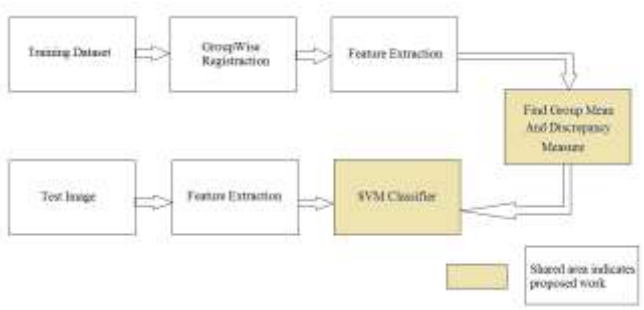

Fig. 1 System Architecture

Training Dataset To implementing this I am using training dataset FERET, CAS PEAL R1, FRGC version 2.0 and the LFW. Which are publicly available. Group wise Registration It is collection of face images from benchmark database. The role of image registration is to transform images taken from different times, sensors, view points, or different coordinate systems into a common coordinate system, such that comparisons can be made across various different images in a common image space. Now days, group wise registration are investigating for simultaneous alignment of images without selecting any individual image as a template, by avoiding the potential bias in image registration.

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b) Important stages of the proposed work

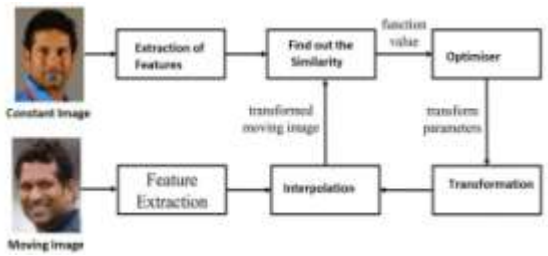

Fig. 2 pair wise registration process

In above image first features are extracted then similarity will be compared. Following are some important stages of the proposed work.

1) ***Preprocessing Of Input***

We have various trainee datasets like FERET, CAS PEAL R1, FRGC version 2.0 and LFW which contains various images The image which we are going to identify will be compared with the images presents in our trainee databases. Before that we have to do some work on that image i.e. preprocessing of images in which we will remove the noise from the image. For example black spot on white images or white spot on black images etc.

2) ***Group wise Image registration***

Group wise image registration is technique to find out sets of corresponding points on each of a group of images.

In group wise registration we will calculate the mean, to construct the group mean space is to first construct the group mean image of each subject, and then perform group wise registration among the subject-specific group mean mages to obtain the final group mean image.

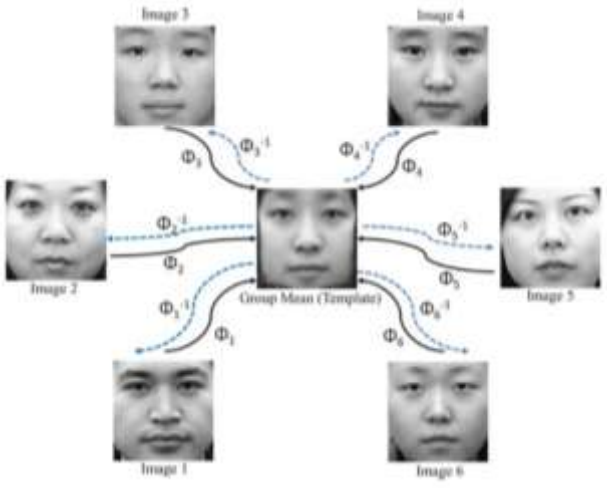

Fig. 3 Group wise image registration process

We calculated mean from various images as shown in above fig. and then we will got group mean template mentioned in fig below.

Fig. 4 Template formed by calculating group mean.

3) ***Feature Extractions***

The main contribution of proposed method is to first, instead of using pixel intensity alone, from each pixel position of the facial images and from its corresponding most salient scale local regions anatomical features are extracted. A new salient region detector is proposed based on the survival exponential entropy (SEE) theoretical measure. The saliency of features is very closely related to scale from which the features are extracted. Important structures in the facial images such as mouths, noses and eyes have different sizes and shapes. So, anatomical features have to be extracted with different scales of interest from different facial regions to ensure their saliency and representation power. We measure the saliency based on local image structural complexity. Especially, the survival exponential entropy is used as a statistical measure for local image structural complexity.

4) ***MRF GroupWise Registration Model***

Algorithm 1 Calculate Group mean

Input n input images I_i $(i = 1, \ldots, n)$.

Output: Group mean image $\hat{I}$, and transformation ϕ_i to warp each image I_i to $\hat{I}$.

1. Initialize $\hat{I} = \frac{1}{n}\sum_{i=1}^{n} I_i$.
2. FOR $i = 1$ to n
3. Perform the α-expansion algorithm to estimate the deformable transformation ϕ_i to warp I_i to $\hat{I}$ with the MRF labeling framework.
4. END FOR
5. Update $\hat{I} = \frac{1}{n}\sum_{i=1}^{n} \phi_i(I_i)$.
6. Repeat Operations 2 to 5 until $\hat{I}$ converges.
7. Return $\hat{I}$ and ϕ_i.

ALPHA-Expansion Algorithm

The a-expansion is a popular move-making energy minimization algorithm (Algorithm 1). From steps 2 to 4 form a cycle and the step 3 is iteration within a cycle. The algorithm starts from an initial labeling and makes a series of moves, which involve label change of the random variables, until there is no decrease in the energy. After each iteration of a-expansion, the random variable in the MRF retains either its current label or takes a new label a. One cycle of a-expansion algorithm involves iterating over all the labels.

*5) **SVM Classifier***

SVM means for Support vector machine. They are the learning models with associated learning algorithms that analyze data and recognize patterns, used for classification and regression analysis. It provide basic mechanism to robust surface of hyper plane to data through. Another advantage of the SVMs is low expected probability of the generalization errors. so, The data once classified into two classes, then an appropriate optimizing algorithm may be used if needed for the feature identification, depends on application. Support Vector Machine creates a hyper-plane between two sets of data for classification. In my work, I separates data into two classes: as follows a) Face belongs to the train database and b) Face does not belong to the train database [2].

IV. CONCLUSION

There are various face recognition methods but there is no single method which will work 100 percent correct. I.e. there are limitations of every method which are proposed. In this work I tried new method that is Markov Random GroupWise Registration. With the help of this technique I achieved good result for face recognition. Still I failed to give 100 percent accuracy for identifying images because human face is not a dead object, the expression will be change as per persons mood. So it's become complicated to identify particular image. But my work will achieve highest recognition and verification rates as compared to other methods.

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