Face Recognition by GroupWise Registration Technique

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ABSTRACT

Face recognition is a technology in which a human face is automatically identify through a digital image. It is basically used in all kind of security systems. Recently face recognition is playing very important role in society of network and multimedia information access. Areas like network security, retrieval and video compression benefits from face recognition because "people" are center attention in this field.

In this paper we give an introductory of new face recognition technology known as "Markov Random Field Groupwise Registration Framework" in this method similarity among various facial images are determined on the basis of deformable transformations. The proposed system requires four publically available databases like: FERET, CAS-PEAL-R1, LFW and FRGC. Our experimental result indicates that the proposed system achieving better recognition rates comparing to other methods.

Keyword – *Markov Random Field Groupwise Registration, Group mean, Anatomical Signature.*

1. INTRODUCTION

Face recognition is one of the widely used biometric methods that possess merits of both low intrusiveness and high accuracy. It has accuracy of a physiological approach without being intrusive, so since the early 70's face recognition has drawn attention of the researchers in the fields from psychology, security, and image processing to computer vision. Various algorithms have been proposed for the face recognition.

Face recognition is area of bioengineering. It is a method of recognizing human face based on a physiological or behavioral characteristic. Already there are lot of existing biometric systems such as finger prints, signature, voice, iris, hand geometry and face. All among these techniques, facial recognition is one of most universal and accessible techniques or (AFR) Automatic Face Recognition [1], is a particularly better biometric approach. It basically focuses on identifier that humans usually use to distinguish one person from another: their "faces". Its main motto is to understand complex human visual system as well as basic knowledge about how humans represent faces to discriminate different identities with high accuracy.

Basically face recognition technique can be divided in two main stages: 1) face verification (or authentication), 2) face identification (or recognition). A detection stage is the first stage which includes identifying and locating the face from an image. Recognition stage is second stage which contains feature extraction, where the basic information for discrimination is saved, and recognition result is given by face database. There are some different types of existing techniques 1) Holistic method and 2) Local feature matching method. In holistic method the entire face image is used as raw input for recognition the system. For example: well-known PCA-based systems which is introduced by Sirovich and Kirby, and followed by Turk and Pentland. [5], [7], [10]. In local feature matching method local features are extracted, like nose, eyes and mouth etc. their local statistics (appearance), locations are basic input to recognition stage. (EBGM) Elastic Bunch Graph Matching is an example for this technique. [2], [6], [3].

Face recognition technique has been rapidly enhancing. In this paper we are going to discuss about new way for face recognition method, i.e. Markov Random Field GroupWise Image registration. The principle of proposed method is to build group mean facial image, and then similarity among facial images are compared by warping facial images into the common group mean space. The main contributions of proposed method are 1) Anatomical features are extracted of facial images from its most salient scale local regions. 2) Based on anatomical signature a feature guided (MRF) Markov random field groupwise registration technique is proposed to build group mean facial image space.

2. PAIRWISE IMAGE REGISTRACTION PROCESS

The main role of groupwise image registration is to transform the images which are taken from sensors, times, viewpoints, or different coordinate system in common coordinate system, So comparisons can be done across various images in the common image space.

Suppose n are the given input images $I_1 \ldots I_n$, then for conventional pairwise registration strategy first selects an image from $I_1 \ldots I_n$, then named it as the fixed image I_{fix} , Now I_{fix} will serve as group mean. Now, transform each image $I_i (i = 1 \; to \; n)$ named it as moving image I_{mov} to space of the fixed imageI_{mov}. Following figure shows pairwise image registration process.

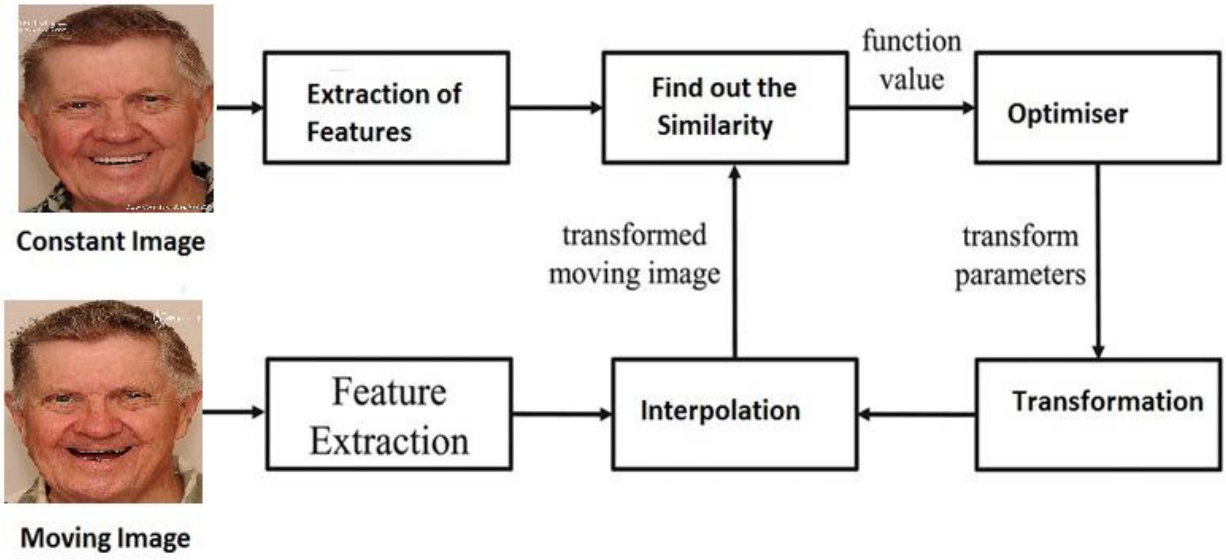

Fig -1 Pairwise Registration Process.

First, image features are extracted from the input image, and then optimal transformation $\emptyset_{opt}$ is measured on the basis of deformable transformation. $\emptyset_{opt}$ can be estimated by optimizing the value of similarity measures function E, then it reflects registration quality at current iteration. Optimization scheme is needed to the optimize E. Interpolation of moving the image is also required in case that some pixels of transformed moving image don't fall exactly on the image grid of fixed image. So the registration process can be expressed as below.

$$\emptyset_{opt} = \arg \min_{\emptyset} \sum(\psi \otimes I_{fix}, \Phi(\psi \otimes \Phi(I_{mov}))) \quad \text{(I)}$$

Where ψ denote feature extraction kernel and ⊗ denote convolution operation.

By selecting any of the images as the fixed image will lead to the problem in registering all of the other images to it. The reason behind that the geodesic distance between fixed image and moving images can be very large and it is difficult to register. So, groupwise image registration strategies have become widely used [4], [9], [8].

Groupwise image registration framework doesn't explicitly select an image as the template. But, instead it simultaneously estimates template $\hat{I}$. (group mean) and transformation $\emptyset_i$ to wrap each of the image. The general groupwise image registration technique is illustrated in following Fig. 2.

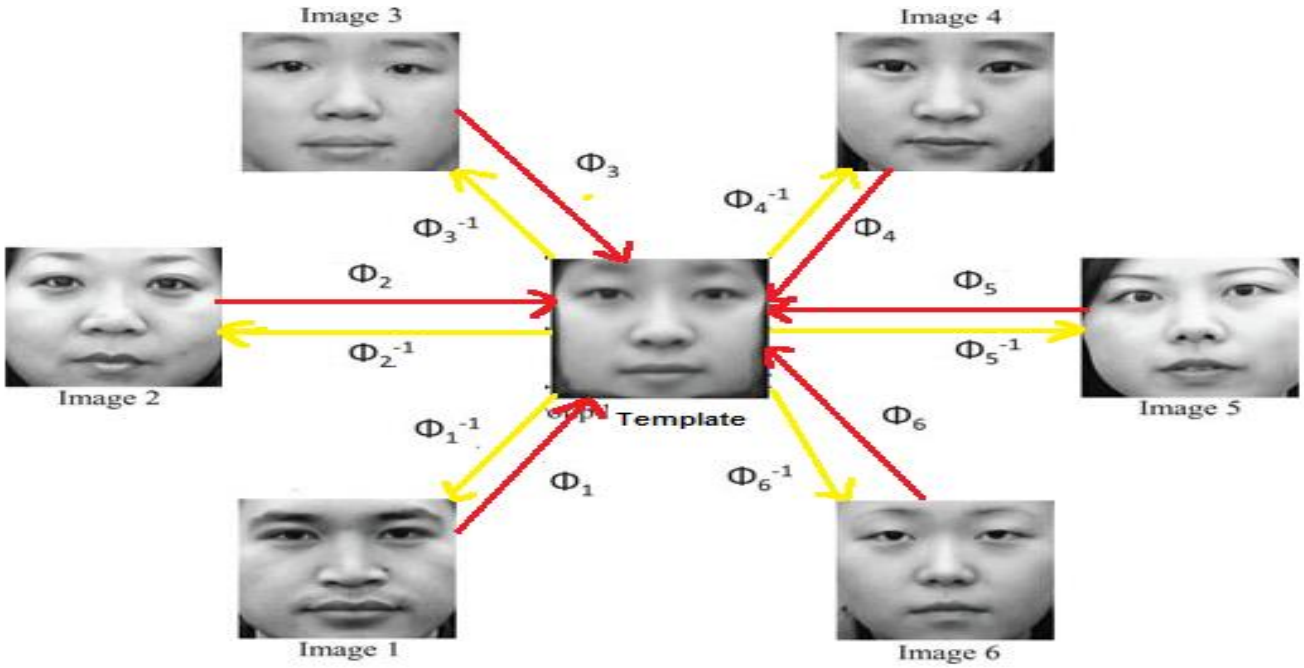

Fig -1 The Schematic Illustration of Groupwise Registration.

In the above figure template image is build having smallest geodesic distances among all of the six input images. Each image I_i is transformed to group mean space with transformation Φ_i (red arrows). Group mean can also be warped to each of individual image's space by Ackward transformation Φ_i^{-1} (yellow arrows).

3. THE GROUPWISE REGISTRATION PROCESS

We have formulated face recognition problem as deformable image registration and the feature matching problem. Most straightforward solution is to register each query image with each of the training image in pairwise manner, classify query image to person which has resulting smallest energy function value as in Equation (I). There are two problems in this way 1) Query image is to be transform each of the individual training image's space for comparison, comparing energy function value obtained in different image space is very problematic. 2) This process is sensitive to outliers. To overcome these problems we have proposed novel groupwise image registration for the face recognition, Basic principle of proposed method is summarized in following algorithm.

Algorithm 1 -The Group wise registration Process

(Step 1)
Input: - Test the image I_{new} n training images (I_1 to n).

(Step 2)
Output: - Class label I_{new} assign I_{new}.

(Step 3)
Build group mean by performing group wise registration among training images I_1 to I_n. Label this template as $\bar{I}$ and the deformable transformation from I_i(i=1 to n) to $\bar{I}$ as $\emptyset_i$.

(Step 4)
Now register the I_{new} to $\bar{I}$, label this query image as $\emptyset_{new}$ (I_{new}). Where $\emptyset_{new}$ is optional transformation to wrap I_{new} to $\bar{I}$.

(Step 5)
Now calculate similarity between each $\emptyset_i$ (I_i). and $\emptyset_{new}$ (I_{new}), now set (I_{new}). as class label of training images (transformed) which is similar to $\emptyset_{new}$ (I_{new}).

(Step VI)
At ends return I_{new}.

4. ESTIMATE THE GROUP MEAN

With Algorithm II, we may build template image based on the input training images. We have proposed the hierarchical groupwise image registration strategy which have basic principle is that, all the facial images with the similar appearance are clustered together in group. If group contains much more facial images and have large variations across each other, then it may be further clustered in the different smaller groups. So, pyramid of the groups is formed, and template image can be formed in hierarchical bottom-up manner.

Algorithm 2- Estimate group mean and transformation of each image.

(Step 1)
Input: - n images I_i (i=1 to n).

(Step 2)
Output: -The group mean image $\hat{I}$, and transformation $\emptyset_i$ to wrap each image I_i to $\hat{I}$.

(Step 3)
First set $\hat{I} = \frac{1}{n}\sum_{i=1}^{n} I_i$.
for $i = 1$ *to* n *do*

Perform α expansion algorithm to estimate deformable transformation $\emptyset_i$ to warp I_i to $\hat{I}$. With MRF labeling framework.
end for

(Step 4)
Update $\hat{I} = \frac{1}{n}\sum_{i=1}^{n} \emptyset_i(I_i)$.

(Step 5)
Now repeat the same operation 2 to 5 until $\hat{I}$ converges.

(Step 6)
Finally return $\hat{I}$ and $\emptyset_i$.

5. SVM CLASSIFIER

SVM stands for Support vector machine. They are learning models along with associated learning algorithms that analyze data and recognize patterns, used for classification and regression analysis. The SVMs provides generic mechanism to robust surface of the hyper plane to data through. Another benefit of SVMs is low expected probability of generalization errors. Once data is classified in two classes, an appropriate optimizing algorithm can be used if needed for the feature identification, depending on the application. Support Vector Machine creates hyper-plane between two sets of data for the classification. In proposed system, we separate the data in two classes: as follows 1) Face belongs to train database and 2) The face does not belong to train database.

6. CONCLUSION

Already there are many face recognition methods but yet there is no single method which gives best result, because is some limitations of every method which are proposed. In this proposed work new way that is Markov Random Group Wise Image Registration Framework is used. With the help of this technique it achieves better result for the face recognition. But still it fails to give best results for identifying accurate images because human faces is not dead object, expression will be changed as per the persons mood and atmosphere. So it's become very complicated to identify particular face. This proposed work will achieve highest recognition rate and verification rates as compared to previous methods.

7. REFERENCES

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