

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320-088X

IJCSMC, Vol. 4, Issue. 5, May 2015, pg.401 – 406

RESEARCH ARTICLE



A Gaussian Feature Adaptive Integrated PCA-ICA Approach for Facial Recognition

Vaishali

Student, Dept. of ECE, ITM University Gurgaon Haryana
vvaishali91@gmail.com

Dr. Rekha Vig

Asstt. Prof, Dept. of ECE, ITM University Gurgaon Haryana
Rekhavig@itmindia.edu

Abstract: Facial Recognition can be used as the online and offline recognition system. But because of the integrated challenges, this recognition system requires lot of work to improve the efficiency and accuracy. In this work, a feature adaptive hybrid model is defined to perform the facial recognition. The work is here divided in three main stages. In first stage, the structural information extraction is performed using Gaussian filter. Later on the PCA is applied to perform the structural frequency map and energy analysis. This PCA will elect the effective mapped set of images with threshold specification. In final stage of this work, ICA is applied to perform the facial recognition on selected image pool. The ICA is based on the feature moment analysis to identify the maximum mapped facial object. The experimentation result shows that the work has provided the accuracy more than 95%.

Keywords: Biometric, PCA, ICA, Gaussian, Feature Adaptive

I. INTRODUCTION

Facial Recognition is one of the most popular and most required biometric approaches that is been used various application area. The facial recognition areas are online authentication, offline authentication system, age prediction, gender prediction, expression recognition etc. These all methods requires the improvement in terms of accurate recognition and classification with relative vector specification. The recognition system also suffers from various associated challenges. These challenges include illumination, pose variation, background variation, zooming etc. These facial recognition methods are defined with the specification of various integrated sequential steps. The standard model for the facial recognition is shown in figure 1. The accuracy of this kind of recognition process also depends on the dataset adapted for the recognition process. This dataset specification also includes the generation of global properties based on which the recognition process is applied. These kind of recognition systems are defined specific to the model so that the relatively effective recognition process will be obtained. According to this model, the first stage of processing is to accept the real time image. The input test face can be taken in the form of offline image or can taken in real time camera. In such case, the acquisition is performed in video form. This kind of extraction process also requires the processing relative

to recognition model. Once the input face is taken the next work is to identify the actual facial area on which the recognition process will be applied. This kind of facial ROI recognition comes under localization process. The localization is generally based on the structural and geometrical mapping. The statistical and mathematical formulas are applied to extract the facial area. In some approaches, the individual facial components such as eyes, nose, lips can be extracted based on the localization measurements.

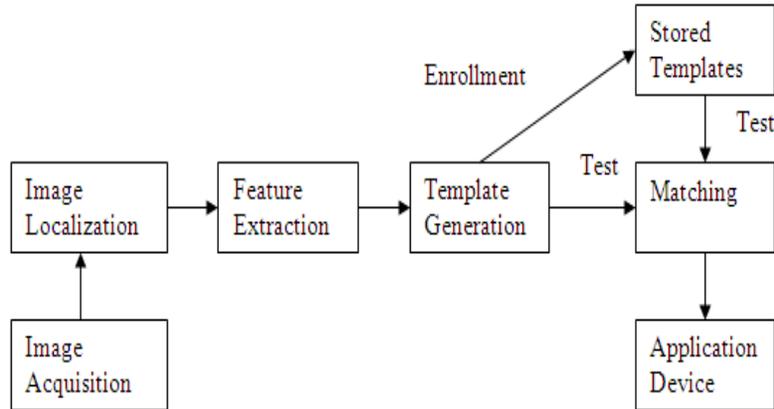


Figure 1 : Face Recognition Model

Once the facial components are obtained, the next work is to generate the facial features. To extract the facial features, the feature adaptive methods can be applied. These features can be statistical, edge based on the expression specific. The feature robustness also been achieved respective to the variation in terms of pose analysis, illumination analysis and complexion analysis. Once these all features are attained, the next work is to generate the common facial image based on the variation analysis. This stage will generate the template image based on which the recognition process will be applied. This normalized image will be then compared with database images. The classification algorithm will be here applied to identify the mapped image. Based on this mapping, the final recognized image will be presented as the final result.

In this paper, a feature adaptive hybrid model is presented to improve the recognition model. The work is here defined in three main stages. In first stage, the Gaussian filter is applied to extract the facial features from the image. Once the featured facial image is obtained, the PCA adaptive mapping is performed on featured training set. The selected image pool will be then compared with ICA approach to identify the most mapped image. In this section, the facial recognition model is defined along with the exploration of individual stage. In second stage, the work defined by the earlier researchers is presented. In section III, the proposed work model is presented. In section IV, the experimentation results are discussed and presented. In section V, the conclusion obtained from the work is presented.

II. EXISTING WORK

Different researchers provided lot of work on facial recognition and other biometric authentication. Some of such contribution of these researchers is explained in this section.

Sima Taheri[1] has defined a work to on facial expression recognition based on component based analysis. Author defined the facial expression identification based on dictionary level analysis. Author presented the expressive face view as the superposition to the neutral face extraction from the face. Marian Stewart Bartlett[2] has defined work on facial action based expression recognition on spontaneous data. Author analyzed the work on different poses in terms of muscle level change and the dynamic movement over the environment. Author provided the facial expression measurement under development and assessment under facial expression analysis. Author provided the encoding scheme to generate the facial features and provided the front face based video stream analysis to decode the frames and to perform the recognition. Zhiwei Zhu[3] presented a pose robust approach for facial recognition and expression recovery. Author provided the motion based analysis on region motion so that the pose level expression analysis will be obtained from the facial images. Xiaogang Wang[4] has defined photo sketch based analysis to perform the recognition so that face recognition. Author defined the work is here based on the face photo analysis so that random field model. The work is here defined as the facial components so that the markov model based analysis so that the work analysis will be defined in the form of face sketch drawing and synthesizing of a photol. Pranab Mohanty[5] has defined a work to improve the facial recognition using

subspace approximation method. Author provided the work in the form of study to generate the approximated pattern over the faical image. Author analyze the recognition based on the diverse set of the recognition process based on sub space modeling and spanned by the non orthogonal vectors. Author provided the facial image based analysis using PCA approach. Harin Sellahewa[6] has defined a work to analyze the facial quality based adaptive recognition so that the accuracy of recognition process will be obtained. Author provided the variation analysis between the image enrollment and identification so that effective facial recognition will be obtained.

Wonjun Hwang[7] has defined a facial model based Fourier recognition system applied on illumination infected dataset. Author provided the faical recognition on controlled images. Author provided insensitive preprocessing so that hybrid Fourier based facial feature extraction so that the score fusion will be obtained. Author defined the preprocessing stage over the faical image to generate the smooth gradients of the face. The feature extraction based classifier is defined to explore the facial features. Author provided the different frequency bandwidths to explore the facial discriminant analysis. Author provided the multi model analysis to improve the recognition. Zhifeng Li[8] has presented a work on age ineffective facial recognition. Author provided the aging various to the face irrespective to the variation in the facial pose. Author considered the aging to reduce the recognition rate error. Author proposed a discriminative model to perform facial matching under SIFT model. Author provided the sample local feature based analysis so that the binary pattern based local descriptors will be analyzed. Wilman W. W. Zou [9] has presented a facial recognition on low resolution images. Author analyzed the images under window specification based on the camera adjustment to the face. Author provided the performance statistics based analysis provided for super resolution method that is applied to generate the resolution of the facial image based on the learning method and provided the SR method to generate the facial features. Ngoc-Son Vu[10] provided a pattern analysis based work on edge magnitudes so that the facial recognition at the lower end will be performed. Author generated the feature descriptors to present the feature enhancement to the face and performed the facial information analysis. Author defined work on PCA and LDA approach. Author implemented work on FERET dataset under unconstrained data specification and gabor filters. Jae Young Choi[11] has defined a work on texture feature based facial recognition. Author presented the color model based analysis to explore the local features of face. Author defined the local binary pattern so that the effective facial recognition will be performed. Author defined the color model based texture feature and discriminative information derived so that the information so that the recognition to the recognition to the system will be obtained.

III. RESEARCH METHODOLOGY

In this present work, a improvement to the traditional facial recognition process modeling is defined using hybrid approach. The work is here presented as a three stage model. The work is defined adaptive to the image acquisition. This image is taken as the offline input to the system based on which the recognition process is defined. After the preprocessing, the normalized image form is obtained. Now the three stage model is here defined on improve the recognition process. The three stage model adapted in this work is shown in figure 2.

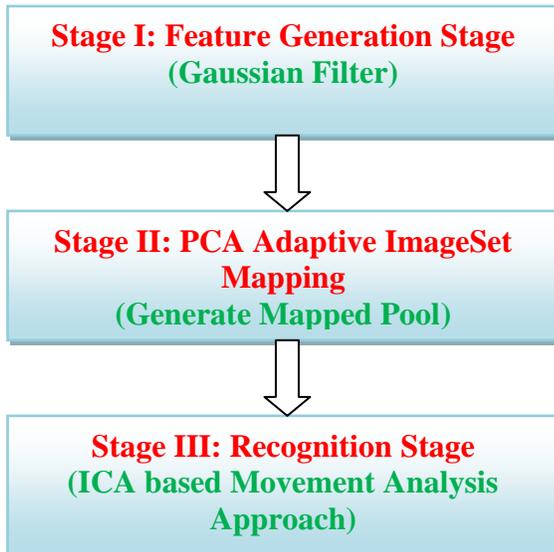


Figure 2 : Proposed Model

A) Gaussian Based Feature Analysis

To generate the facial features, the Gaussian filter is suggested in this work. The Gaussian filter is a window adaptive filter, used to extract the intensity value and intensity deviation and present it as the featured object. This model is effective to identify the highlight points over the image. This filter is considered as the neighbourhood analysis based model that identify the effective intensity specification in the particular window and obtain the effective block features. This model is also effective to provide the derivation under the specification of facial domain. In this work Gaussian filter is considered as the feature vector based on which the recognition process is performed. In this work, the featureset over the training set is obtained using Gaussian adaptive features applied on each image. In same way, the test image are also converted the Gaussian derived featureset. Finally, the recognition process is performed on this featureset.

B) PCA

In this work, the PCA is used as the adaptive mapping vector applied at second level to identify the mapped images. The work is here defined as the as the distance adaptive analysis to generate the covariance matrix obtained from the mapping. This mapping is defined under eigen vector generation specified with eigen values. The specifications are here done using the facial recognition so that the estimation of the eigen vector will be done. The eigen vector based mapping is applied with specification of associated feature vector. The distance adaptation is here applied on dimension specification. Once the mapping is done, a set of images is obtained as the mapped image pool. This image pool represents the expected recognized image. To identify the actual image from the pool there is the requirement of one more level of recognition process.

C) ICA

In this work, ICA is used as the integrated approach to perform the effective election of mapped faced image. The feature adaptive distance analysis is performed to recognize the facial image. The adaptive features are here obtained with the specification of ICA levels. Based on this level effective approach, the identification of image from the pool is done. The equational representation of ICA is given by

$$X(k) = A * S(k)$$

Where, A is matrix of size m'xm
 S is the matrix of size m'xn
 m is the level feature
 n is length of signal.

The work is defined here as the matrix based analysis to generate the signal feature based on basic signal vector. ICA can also given by

$$S(k) = W * X(k)$$

Where, W is the mixed matrix of mxm'

Here, W is actually the weighted matrix defined using the independent signal analysis composed in the linear combination.

The ICA is defined as the effective facial features defined with the column specification with different feature vectors. These vectors are obtained based on the distance level mapping applied to generate the effective signal derivation. This facial image recognition is here performed under specification of independent component. The problem specification based analysis is defined to generate the facial feature. Based on this the final matched image is identified from the pool

This section has explained all the associated stages for the facial recognition. To apply the model, the experimentation is done on authenticated dataset. The experimentation results are shown in section IV.

IV. RESULTS

The work is here been tested on larger facial dataset. This dataset is having the illumination problem and dataset is been collected and sponsored by DARPA program. This dataset is having about 403 images of 40 persons. The images are having different illumination and expression variation. Here the main consideration is given on illumination dataset. The characteristics of the experimental model applied in this work are shown in table 1. The sample dataset is shown in figure 4.

Table 1 : Experimental Model Characteristics

Properties	Values
Training Set Size	403
Size of Testing Set	100
Variation	Illumination
Resolution	200x200
Type	Color
Persons	100
Number of Instance	10
Recognized Successfully	97
Wrong Recognition	3
Recognition Ratio	97%

The results are applied on different training and testing sets. Some of such results are shown in table 2, table 3 and table 4

Table 2 : Experiment I

Properties	Values
Training Set Size	100
Size of Testing Set	10
DataSet Image	Yes
Correctly Recognized	10
Recognition Rate	100%
Failure Rate	0%

Table 3 : Experiment II

Properties	Values
Training Set Size	100
Size of Testing Set	30
DataSet Image	No
Correctly Recognized	28
Recognition Rate	93.33%
Failure Rate	6.66%

Table 4 : Experiment III

Properties	Values
Training Set Size	100
Size of Testing Set	40
DataSet Image	Mix
Correctly Recognized	38
Recognition Rate	95%
Failure Rate	5%

V. Conclusion

In this paper, a feature adaptive hybrid model is defined to perform the facial recognition. The model is here defined as a three stage model. In first stage of this model, the feature adaptation is performed. In second stage, the PCA based distance mapping is applied to identify the mapped image pool. In final stage, ICA is applied to perform the actual recognition. The results shows that the work has provided the recognition over 90% for different datasets

REFERENCES

- [1] Sima Taheri," Component-based Recognition of Faces and Facial Expressions", IEEE TRANSACTIONS ON AFFECTIVE COMPUTING , 1949-3045/13© 2013 IEEE
- [2] Marian Stewart Bartlett," Automatic Recognition of Facial Actions in Spontaneous Expressions".
- [3] Zhiwei Zhu," Robust Real-Time Face Pose and Facial Expression Recovery", Proceedings of the 2006 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR'06) 0-7695-2597-0/06© 2006 IEEE
- [4] Xiaogang Wang,"Face Photo-Sketch Synthesis and Recognition", IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE 2009, 0162-8828/09@2009 IEEE
- [5] Pranab Mohanty," Subspace Approximation of Face Recognition Algorithms: An Empirical Study", IEEE TRANSACTIONS ON INFORMATION FORENSICS AND SECURITY 2008, 1556-6013 © 2008 IEEE
- [6] Harin Sellahewa," Image-Quality-Based Adaptive Face Recognition", IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT 2010, 0018-9456 © 2010 IEEE
- [7] Wonjun Hwang," Face Recognition System Using Multiple Face Model of Hybrid Fourier Feature Under Uncontrolled Illumination Variation", IEEE TRANSACTIONS ON IMAGE PROCESSING 2011, 1057-7149 © 2011 IEEE
- [8] Zhifeng Li," A Discriminative Model for Age Invariant Face Recognition", IEEE TRANSACTIONS ON INFORMATION FORENSICS AND SECURITY 2011, 1556-6013 © 2011 IEEE
- [9] Wilman W. W. Zou," Very Low Resolution Face Recognition Problem", IEEE TRANSACTIONS ON IMAGE PROCESSING 2012, 1057-7149 © 2011 IEEE
- [10] Ngoc-Son Vu," Enhanced Patterns of Oriented Edge Magnitudes for Face Recognition and Image Matching", IEEE TRANSACTIONS ON IMAGE PROCESSING 2012, 1057-7149 © 2011 IEEE
- [11] Jae Young Choi," Color Local Texture Features for Color Face Recognition", IEEE TRANSACTIONS ON IMAGE PROCESSING 1057-7149© 2011 IEEE