International Journal of Multidisciplinary Research and Development

IJMRD 2015; 2(3): 72-74
www.allsubjectjournal.com
Impact factor: 3.672
Received: 11-02-2015
Accepted: 25-02-2015
E-ISSN: 2349-4182
P-ISSN: 2349-5979

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Face expression recognition using score level fusion method

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Abstract
A facial recognition system is a computer application for automatically identifying or verifying a person from a digital image or a video frame from a video source. One of the ways to do this is by comparing selected facial features from the image and a facial database. In this project intend to develop a new robust system for Facial expression recognition using fusion of three sub-space techniques, namely Principal Component Analysis (PCA), Singular Value Decomposition (SVD), Independent Component Analysis (ICA) and along with the combination of the score value of all the above techniques for better results. The system developed would perform Facial expression recognitions. The six major expressions considered are anger, disgust, fear, happiness, sadness and surprise. Given an input facial image using various techniques the facial features are extracted and its score level is noted and finally Score level of each technique are integrated to develop a new robust facial expression recognition system.

Keywords: Face expression recognition, sub-space technique, PCA, SVD, ICA

Introduction
Facial expressions and gestures complement verbal communication in everyday life, conveying information about emotion, mood and ideas. The facial expressions play central role in an everyday conversation. Even the voice intonation present lower impact on efficient communication than the facial expressions. A successful automatic facial expression recognition system is expected to significantly facilitate the human–computer interaction. Furthermore, it could be integrated in many technologies of this kind, bordering behavioral science and medicine. Research in psychology has indicated that at least six emotions (anger, disgust, fear, happiness, sadness and surprise) are universally associated with distinct facial expressions. According to this approach, these are the basic emotional states which are inherently registered in human brain and are universally recognized. Several other facial expressions corresponding to certain emotions have been proposed, but remain unconfirmed as universally discernible.
In image-based face recognition, given a picture taken from digital camera, we'd like to know if there is any person inside, where his/her face locates at, and who he/she is. Towards this goal, we generally separate the face recognition procedure into three steps: Face Detection, Feature Extraction, and Face Recognition (shown at Fig. 1.1).

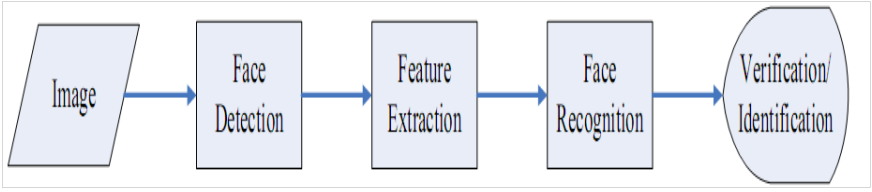

Fig. 1 Configuration of a general face recognition structure.

In this research intend to develop a new robust system for Facial expression recognition using fusion of three sub-space techniques, namely Principal Component Analysis (PCA), Independent Component Analysis (ICA), and Singular Value Decomposition (SVD).

Literature Survey

This chapter includes some papers survey regarding some of the subspace technique required for face recognition. Also include a paper telling why to use score level fusion technique.

In PCA and Support Vector Machine (SVM) approach proposed by Chengliang Wang, Libin Lan, Minjie Gu, and Yuwei Zhang [8], PCA is used to extract the essential characteristics of face images, SVM as classifier. One against one classification strategy for multi-class pattern recognition is used based on 2D static face image. The experimental results show that recognition rate of this method, under small samples circumstance, is better. It shows that, for face recognition, sending PCA features to SVM classifiers is feasible and correct. But the problem was PCA has poor recognition for illumination variations and works better only for small samples.

In "Comparative Assessment of Independent Component Analysis (ICA) for Face Recognition" by Chengjun Liu and Harry Wechsler [9], Comparative assessments are made regarding (i) ICA sensitivity to the dimension of the space where it is carried out, and (ii) ICA discriminant performance alone or when combined with other discriminant criteria such as Bayesian framework or Fisher's Linear Discriminant (FLD). The sensitivity analysis suggests that for enhanced performance ICA should be carried out in a compressed and whitened space where most of the representative information of the original data is preserved and the small trailing eigen values discarded. ICA provides higher or more powerful data representation than PCA and also performs well for change illumination. ICA has poor performance foe pose variation.

In "Singular Value Decomposition Applied to Digital Image Processing" by Lijie Cao, Division of Computing Studies [10], to perform face recognition with SVD, we treated the set of known faces as vector in subspace, called "face space", spanned by a small group of "base-faces". The projection of new images onto the base-face is then compared to the set of known faces to identify the face. It provides good compression ratio and that can be well adapted to the statistical variation of the image. SVD is not faster from the computational point of view, and the problem of which its application is strongly conditional due to the excessive work of associate calculation.

In "Face Verification Across Age Progression", by Narayanan Ramanathan, and Rama Chellappa[1], says that they develop a Bayesian age difference classifier that classifies face images of individuals based on age differences and performs face verification across age progression. While the method presented in this paper is suitable to handle age progression in adult face images, since it does not account for shape variations in faces it may not be effective for handling age progression in face images. But the problem was modeling the complex shape variations human faces undergo during one's younger years or the textural variations that are observed during the later years is a very challenging task.

In "A Principled Approach to Score Level Fusion in Multimodal Biometric Systems" by Sarat C. Dass, Karthik Nandakumar, and Anil K. Jain [11] says that a multimodal biometric system integrates information from multiple biometric sources to compensate for the limitations in performance of each individual biometric system.

Proposed System

Performing face recognition in the presence of noise and motion blur is a challenging task. Hence we have developed a new robust score level fusion algorithm.

Problem Statement

Faces undergo gradual variations due to aging, periodically updating face databases with more recent images of subjects might be necessary for the success of face recognition systems. Since periodically updating such large databases would be a tedious task, a better alternative would be to develop face recognition systems that verify the identity of individuals from a pair of age separated face images. Understanding the role of age progression in affecting the similarity between two face images of an individual is important in such tasks. This manuscript is intended to address the following problem: The manner in which similarity between two images of an individual is affected by age progression and the confidence associated with establishing the identity between two face images of an individual of different age.

i. Objectives

The main objective of the proposed project work is to develop new robust different age variations facial expression method using sub-space methods, namely Principal Component Analysis (PCA), Independent Component Analysis (ICA),), and Singular Value Decomposition (SVD), The new method would be tested against standard public databases, like, JAFEE, YALE B. FGNET. The following approaches shall be used to address the main objective are of the research work.

- To study and implement Principal Component Analysis (PCA). This would be used for dimensionality reduction and face recognition.
- To study and implement Independent Component Analysis (ICA) for dimensionality reduction and face recognition.
- To study and implement Singular Value Decomposition (SVD) for dimensionality reduction and face recognition.
- To develop new robust face recognition for different age variations based on score level fusion of PCA, ICA and SVD for dimensionality reduction subspace methods.
- Comparing subspace methods with new robust face recognition under different age variations method.

ii. Methodology

- The methodology include the process of working or what are the steps that the project might under go.
- First facial image is given as input.
- By using the various subspace technique (PCA, ICA, SVD) dimension of the image is reduced.
- By using the same subspace technique the feature extraction is done.
- Using the score level fusion i.e., by combining the different scores obtained from the 3 technique the image is compared for matching.
- Also the FRR (False Rejection Ratio) is calculated for each technique which is used to do the comparison between the three techniques.

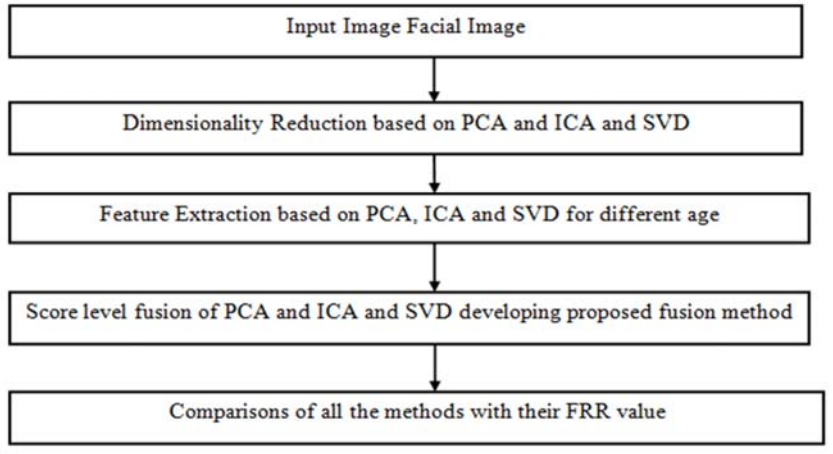

Fig. 2 Block diagram for methodology

Applications.

The various applications of face recognition are described in this chapter. Face recognition can be used to verify a person or also identify a person.

The following are various applications listed:

i. Access control: Face verification, matching a face against a single enrolled example, is well within the capabilities of current Personal Computer hardware. Since PC cameras have become widespread, their use for face-based PC logon has become feasible, though take-up seems to be very limited. Increased ease-of-use over password protection is hard to argue with today's somewhat unreliable and unpredictable systems, and for few domains is their motivation to progress beyond the combinations of password and physical security that protect most enterprise computers. As biometric systems tend to be third party, software add-ons the systems do not yet have full access to the greater hardware security guarantees afforded by boot-time and hard disk passwords.

ii. Surveillance: The application domain where most interest in face recognition is being shown is probably surveillance. Video is the medium of choice for surveillance because of the richness and type of information that it contains and naturally, for applications that require identification, face recognition is the best biometric for video data. Though gait or lip motion recognition have some potential.

iii. Identification Systems: Two US States are testing face recognition for the policing of Welfare benefits. This is an identification task, where any new applicant being enrolled must be compared against the entire database of previously enrolled claimants, to ensure that they are not claiming under more than one identity.

iv. Pervasive Computing: Another domain where face recognition is expected to become very important, although it is not yet commercially feasible, is in the area of pervasive or ubiquitous computing.

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