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Face & Facial Expression Recognition Using Combinational Techniques

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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 three sub-space techniques, namely Principal Component Analysis (PCA), Independent Component Analysis (ICA), Local Binary Pattern (LBP), 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: PCA, LBP, ICA, Feature extraction, Score level fusion.

I. 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).

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 Local Binary Pattern (LBP).

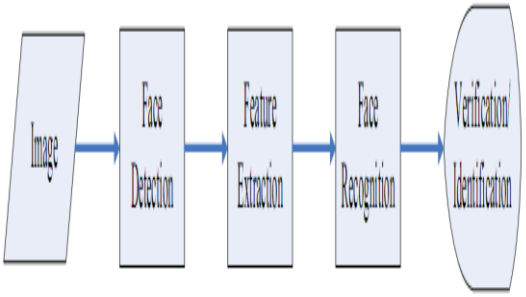

Fig. 1: Configuration of a general face recognition structure

II. 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.

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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 for pose variation.

In "Facial expression recognition based on Local Binary Patterns: A comprehensive study"[10], by Caifeng Shan, Shaogang Gong, Peter W. McOwan, they empirically evaluated facial representation based on statistical local features, Local Binary Patterns, for person-independent facial expression recognition. Different machine learning methods are systematically examined on several databases. 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.

III. 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.

A. Problem Statement

Faces undergo gradual variations due to aging, recognizing face is a toughest challenge. A better alternative would be to develop face recognition systems that verify the identity of individuals from a pair of age separated face images along with the expression. This manuscript is intended to address the following problem: The manner in which similarity between two images of an individual and the confidence associated with establishing the identity between two face images of an individual along with the expression at different ages.

1. 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 Local Binary Pattern(LBP) . 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 Local Binary Pattern (LBP) 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 LBP for dimensionality reduction subspace methods.
- Comparing subspace methods with new robust face recognition under different age variations method.

2. 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, LBP) 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.

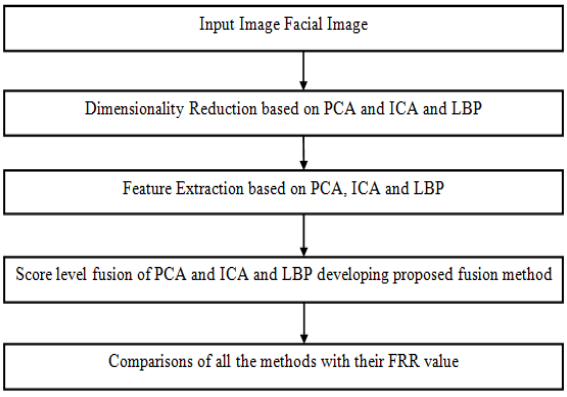

Fig. 2: Block diagram for methodology

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IV. IMPLEMENTATION

In the project it intends to recognize the face and also display the expression on the recognized face. Here there will two folder called training and the test. Firstly the training is selected and a database is created. Next one of the test image is selected from the test folder and compared with the training database created. Finally the equivalent image along with the expression is displayed on the screen.

The PCA (Principle Component Analysis) is implemented which recognizes the equivalent face along with the expression on it.

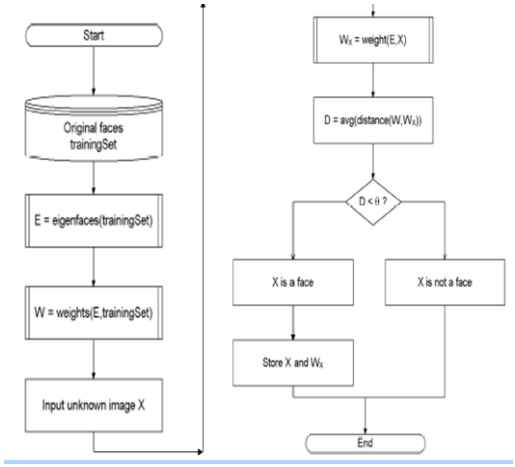

Fig. 3: Flow diagram of PCA

V. 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:

A. 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.

B. 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.

C. 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.

D. 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.

VI. CONCLUSION AND FUTURE WORK

In this project a test image will be matched against the training images present. If there is a match the equivalent image along with its expression is displayed. For better results we have used score level fusion method where the scores are combined to get a better recognition of the face.
In future we can Implement new robust facial expression recognition subspace method and non subspace methods under various noises and blurring effects and tested with various facial expression databases and quality assessment is carried out.

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