Recognition of Expression Variant Faces – A Principle Component Analysis Based Approach for Access Control

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Abstract—**Machine automated face recognition has gained significant importance due to its scientific challenges and its potential applications. However, most of the systems designed to date can only successfully recognize faces when images are obtained under constrained conditions. The success of face recognition systems rely on a variety of information in images of human faces such as pose, facial expression, occlusion and presence or absence of structural components. The proposed model targets an approach for the recognition of expression variant faces since there are very few face recognition solutions to address this problem and this is a key research area in face recognition.**

This model proposes an approach to face recognition where the facial expression in the training image and in the testing image diverge and only a single sample image per class is available to the system. The input to the system is a frontal face image with neutral expression and identical background where the subjects' hair is tied away from the face. The proposed model is based on Principal Component Analysis approach. This approach has been applied on a set of images in order to extract a set of Eigen-images known as Eigen faces and weights of this representation are used for recognition. For the classification task, distance metric Euclidean Distance has been used to find the distance with the weight vectors associated with each of the training images. When tested with eight subjects and six basic expressions the overall recognition rate was 89%, for trained faces.

Keywords-Face Recognition, Expression-variant faces, Image Processing, Principal Component Analysis, Euclidean Distance

I. INTRODUCTION

The human face provides a large range of information about a person's identity such as race, age, sex and emotions. Our faces are complex objects with features that can differ all the time. However, we humans have the natural capability to detect, recognize faces and identify a person. Unfortunately machines do not have this natural ability.

It is stated that one of the key challenges for face recognition is finding efficient and discriminative facial appearance descriptors that are resistant to large variations in illumination, pose, facial expression, ageing, partial occlusions and other changes [11]. Further research [5] states that success of face recognition systems rely on a variety of information in images of human faces such as pose, facial expression, occlusion, imaging conditions and presence or absence of structural components. Current systems have advanced to be fairly accurate in recognition under constrained scenarios, but extrinsic imaging parameters such as pose, illumination, and facial expression cause great difficulty in correct recognition [4]. Thus, the machine related recognition of expression variant faces is a significant problem; which can be formulated as follows: how can we robustly identify a person's face for whom the learning and testing images differ in facial expressions [8].The importance of solving the above problem lies in its capability to identify criminals, suspects and employees of an organization, even if only one image exists in the database.

When applied to a practical scenario such as security, a police officer should be able to match the face image taken from video cameras with all the face images stored in the database, in order to identify a suspect or criminal. This is a major challenge in face recognition because the facial expressions of a person while capturing an image can make a significant difference in accurate recognition. The same person may have different expressions at different time [10] There are some drawbacks existing solutions for face and expression recognition, the proposed solution will satisfy some of those drawbacks such as support for single training face image.

II. FACE RECOGNITION AS A MEANS OF ACCESS CONTROL

Face recognition is a part of pattern recognition technology. The first semi-automated face recognition system was developed in the 1960s by Woodrow W.Bledsoe. This system required the administrator or operator to locate the major face features such as nose, eyes, ears and mouth on the photographs.

In the early 1970s Goldstein, Harmon and Lesk had developed an automated recognition system with 21 subjective markers such as hair color and lip thickness. The problem with these two early approaches was that the location and measurement of distances were completely manually computed.

In 1988 Kirby and Sirovich had used a new approach, principal component analysis. This is a standard linear algebraic technique to solve face recognition problems. This was a milestone in the face recognition research.

In early 1991 Turk and Pentland applied Eigen faces technique, it was an innovation of real-time automated face

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