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A Study on 2D PCA Face Recognition Method

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Abstract: Face Recognition Technique is a most interesting and growing research topic in now a days. Due to its simplicity and user friendliness this technology is used tremendously in mobile phones, Laptops etc. Several technics are there to recognize face both 2D & 3D. In this paper, we try to review the existing two-dimensional principal component analysis (2D PCA) that is used for image representation and face recognition in senthil. As opposed to PCA, 2D PCA is based on 2D image matrices rather than 1D vector, so the image matrix does not need to be transformed into a vector prior to feature extraction. Instead, an image covariance matrix is constructed directly using the original image matrices and its Eigen vectors are derived for image feature extraction. To test 2D PCA and evaluate its performance Senthilface databases. The experimental results also indicated that the extraction of image features is using 2D PCA is more efficient than PCA.
Keywords:Eigenfaces, Face recognition, Feature extraction, Principal component analysis (PCA), Recognition accuracy.

I. INTRODUCTION

Principal component analysis (PCA), also known as Karhunen–Loeve expansion, is a classical feature extraction and data representation technique widely used in the areas of pattern recognition and computer vision. Turk and Pentland [1,2] presented the well-known Eigenfaces method for face recognition. Recently, two PCA-related methods, independent component analysis (ICA) and Kernel principal component analysis (Kernel PCA) have been widely used. Barlett et al. proposed ICA for face representation and found that it is better than PCA when cosines are used as the similarity measure. Yang et al. [3] used Kernel PCA for face feature extraction and recognition and showed that the Kernel Eigenfaces method outperforms the classical Eigenfaces method. However, ICA and Kernel PCA are both computationally more expensive than PCA. As opposed to conventional PCA, 2D PCA is based on 2D matrices rather than 1D vectors. Here an image covariance matrix can be constructed directly using the original image matrices. As a result, 2D PCA has two important advantages over PCA. First, it is easier to evaluate the covariance matrix accurately. Second, less time is required to determine the corresponding Eigenvectors.

II. CONVENTIONAL FACE RECOGNITION MODELS

This section details the different face recognition models. First model one dimensional PCA (1D PCA) derives desirable features characterized by Eigen vectors. Second model Fisher discriminant analysis (FDA) [4, 5], achieves greater scatter between-classes. Third model independent component analysis (ICA) [6] is performed on face images under two different architectures,
one which treated the images as random variables and the pixels as outcomes, and a second which treated the pixels as random variables and the images as outcomes. The fourth model, Kernel PCA (KPCA) [6] applies kernel functions in the input space to achieve the same effect of the expensive nonlinear mapping. As opposed to PCA, 2D PCA [7] is based on 2D image matrices rather than 1D a vector so the image matrix does not need to be transformed into a vector prior to feature extraction.

III. 2D PCA ALGORITHM

Two dimensional principal component analysis (2D PCA) is based on 2D Eigen vectors. In this method the image covariance matrix is a 2D matrix and it is directly calculated from the 2D original image matrices.
Therefore, this method has the advantage of easier evaluation of the covariance matrix and less time required to find out Eigen vectors and Eigen values.

IV. EXPERIMENTS AND ANALYSIS

The 2D PCA method is used for face recognition and tested on two well-known face databases (ORL, Yale) and an our own face database (Senthil face database). The ORL database [8] is used to evaluate the performance of 2D PCA under conditions where the pose and sample size are varied. The Senthil database [9] is employed to test the performance of the system under conditions where there is a variation in facial expressions, and in brightness conditions.
The Yale database [10] is used to examine the system performance when both facial expressions and illumination are varied.

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V. EXPERIMENT ON THE SENTHIL DATABASE

The Senthil face database contains 80 colour face images of five people (all are men), including frontal views of faces with different facial expressions, occlusions and brightness conditions. Each person has 16 different images. The face portion of the image is manually cropped to 140X188 pixels and then it is normalized. The normalized images of one person are shown in Fig. 1. Figure1c, d, g, k, l, o involve variations in facial expressions. Figure1a, b, e, f, h–j, m–p involve variations

Fig. 1 Sample images for one subject of the Senthil database

in pose. The top recognition accuracy and the time consumed for feature extraction are listed in Table4. Again 2D PCA is more efficient and effective than PCA. PCA and 2D PCA are compared under varying facial expressions, pose and brightness conditions. Table 1 shows Comparison of recognition time in seconds for 1D PCA and 2D PCA for Senthil face database

Training Samples/ Classes	8	8
1D PCA	0.65025(37)	0.152948(all 40 features)
2D PCA	0.387230 (188X2)	0.408033 (188X3)

Table 1: Comparison of recognition time in seconds for 1D PCA and 2D PCA for Senthil face database

VI. CONCLUSION

In this paper, 2D PCA model is compared with conventional face recognition model. It has many advantages over conventional PCA (Eigenfaces). In the first place, since 2D PCA is based on the image matrix, it is simpler and more straightforward to use for image feature extraction. The advantage of 2D PCA over PCA is that the former evaluates the covariance matrix more accurately. Finally, there are two disadvantages in 2D PCA model. First, when a small number of the principal components of PCA are used to represent an image, the mean square error between the approximation and the original pattern is minimal. But 2D PCA needs more coefficients for image representation than PCA. Second, 2D PCA takes larger recognition time compared to all other conventional recognition models for small face databases like Senthil Face database (which is having\100 facial images) as shown in table1.

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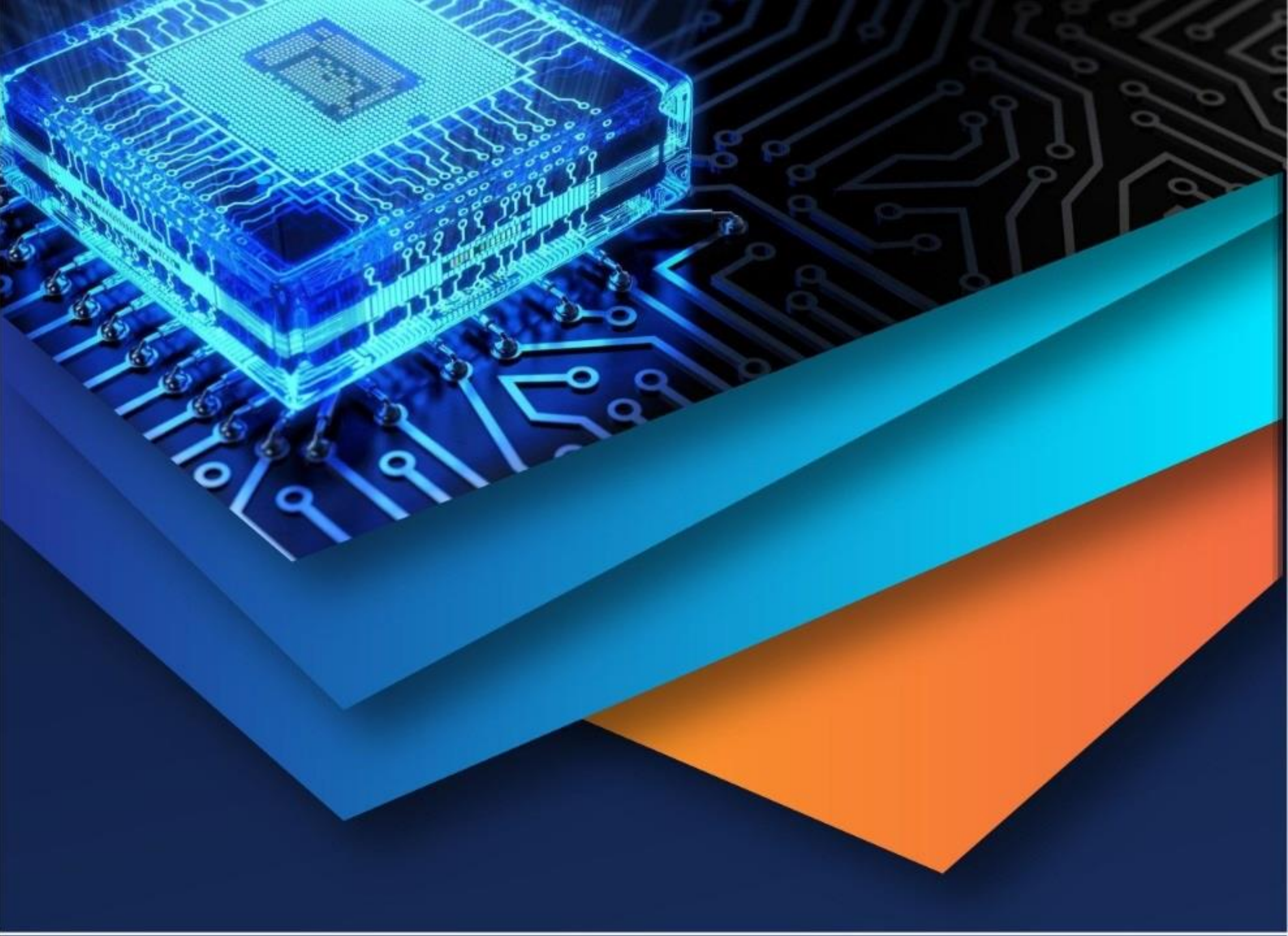

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