Face Recognition using Singular-Value Decomposition

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I. ABSTRACT

Authentication based on a person's face is one of the most stringent measures to secure a place or system. In this report such a method has been proposed that successfully identifies a person. The proposed algorithm also identifies a person with emotions/varied face expressions. This algorithm first enhances the image and then computes its singular value decomposition(SVD) to yield a matrix containing singular values followed by its singular value decomposition which further yields a single numerical value, instead of a matrix, that has been employed to compare images.In this study we compare the test images and the trained images in the database and try to get the face recognized using SVD .

Key Terms- Singular-Value Decomposition(SVD),Principal Component Analysis(PCA),test images,trained images,gallery database

II.INTRODUCTION

The face recognition system should be able to automatically detect a face in images. This involves the extraction of its features and then recognizes it, regardless of lighting, aging, occlusion, expression, illumination and pose. The Singular Value Decomposition and Principal Component Analysis are very useful techniques in data analysis and visualization. Singular Value Decomposition approach is used in image compression and face recognition. In this report we have attempted to explain the applications of Singular-Value Decomposition for Face Recognition. This report tells us a method to identify if it's a face image or not. In video surveillance, the captured face images are usually of low resolution (LR). Thus, here we try to give a framework based on singular value decomposition (SVD) for performing both face identification and recognition simultaneously.Recognition is an important task in video surveillance.

The two primary tasks of face recognition are face identification and verification.

So given an image we have to identify if its a face image or not. If it’s not the image of a face then we display “Not a face”.If we identify that its the image of a face then we have to match/verify the corresponding query image with a similar image from the existing database. If the query image is matched with an image then we display “Image Matched” and display the image and if that particular query image does not exist in the training set/database then we display “Does not match”.Suppose if the input is an LR face, the corresponding LR and high-resolution (HR) face-image pairs can then be selected from the database. Based on these selected LR–HR pairs, the mapping functions for interpolating the two matrices in the SVD representation for the reconstruction of HR face images can be learned more accurately. So we apply the concepts of SVD and first try to classify if it's a face image. If we find out that it's a face image then verify this query image with the face gallery and display the image if matched.

III.REVIEW OF LITERATURE/LITERATURE SURVEY

So when an image is given the first thing we try to do is classify if the image is a face image or not. [1] describes a procedure using Singular Value Decomposition to accomplish this task. [2] uses a similar kind of approach for achieving this problem and this method also uses a few concepts of eigenvalues and eigenvectors. Then after we classify the image as a face image then we have to find out if its a low-resolution(LR) image or not. A framework based on singular value decomposition (SVD) for performing both face hallucination and recognition simultaneously is proposed in the paper[3]. Conventionally, LR face recognition is carried out by super-resolving the low resolution (LR) input face first, and then performing face recognition to identify the input face. By considering face hallucination and recognition simultaneously, the accuracy of both the hallucination and the recognition can be improved.

In this paper[3], singular values are first proved to be effective for representing face images, and the singular values of a face image at different resolutions have approximately a linear relation.

In the algorithm, each face image is represented using SVD.For each LR input face, the corresponding LR and high-

resolution (HR) face-image pairs can then be selected .[4] proposes an algorithm that identifies a person with emotions/varied facial expressions. This algorithm first enhances the image and then computes its singular value decomposition(SVD) to

yield a matrix containing singular values followed by its singular value decomposition which further yields a single numerical value instead of a matrix that has been employed to compare images. This uses frequency domain transformation followed by Singular Value Decomposition of the test image which is used to compare it with the original image in the database.

For the various classification tasks of several non-linear subspaces the kernel methods are preferable than the linear subspaces. In these methods some methods like KPCA and KSVD are based on a kernel approach. So this [5]paper discusses the hybrid scheme regarding the KPCA + SVD algorithm. The Kernel-PCA is extended from PCA to represent nonlinear mappings in a higher-dimensional feature space. The k-nearest neighbor classifier with Euclidean distance is used in the classification step. In this paper [6] Face Recognition is based on feature matrix and SVD.The singular values (SVs) contain little useful information for face recognition and most important information is encoded in the two orthogonal matrices of the Singular Value Decomposition (SVD). The experiments are carried out on a gallery database. Interestingly experimental results show that Kernel-PCA with Gaussian function can give a correct recognition rate similar to PCA and higher than Kernel-PCA with a polynomial function.

In [7], focuses on the algebraic features are stable and valid features in object recognition such as face recognition. He proposed a singular value decomposition(SVD) based method which uses the singular values as the feature extractor and obtains an acceptable recognition rate. This paper presents an algorithm for face recognition by performing singular value decomposition on the extracted feature of images and then training were done on those images.

IV. REPORT ON THE PRESENT INVESTIGATION

1.We take a dataset in S with N images.

2. Then calculate the mean of S and store it into imgm variable.

$$imgm = \frac{1}{N}\sum_{i=1}^{N} S_i \qquad (1)$$

3. Subtract imgm from the original faces Si gives

A=S*i - imgm Where 1=1,2,3 .. N*

4.Calculate the Singular Value Decomposition of A as shown in (1), obtain U,S and V. that is U is m x m right side matrix of singular value decomposition of matrix A m x n, S is an m x n diagonal matrix with singular values on the diagonal and V is n x n left side matrix of singular value decomposition of matrix A m x n.

5. Choose Singular Value range that is SV

6. Usv is m x SV matrix that are form from U.

7. Multiply A with transpose of Usv and assign to X,

X=USV’ * A

8. Get the query image(test image)

9. Subtract query image from imgm and assign it to qimgm variable.

10.Then multiply qimgm with transpose of Usv and assign to

x=USV’ * qimgm

11.Subtract x from X

12. Find the norm of all the columns

13. Sort the answer array and retrive the first element which will be minimum from all.

The minimum is the similar image in database to the test image.

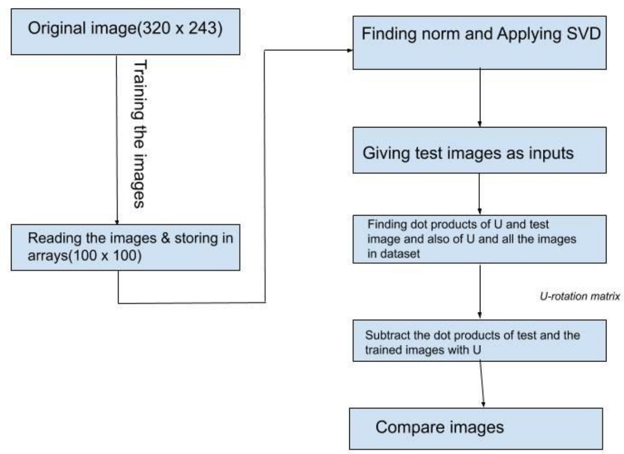

Figure I

V. RESULTS AND DISCUSSIONS

Experiments are performed using a face database, size of 320 x 243-color grayscale. The face database consisted of 40 images from 15individuals, each having 2-3 images with different expressions. We take an image of a person and train with a total of all images, and then recognize it with other images. So here we verify our test image or query image with the gallery database.We then take a test image and verify it with the existing database.If the image is matched then we display the output along with the values associated with the image.

The below image is used as input for testing

Fig.1 - test images

The subject is winking in the image,we find the eigenface value of the image and try to compare it with images in the database.

Fig.2

Fig.3

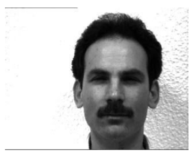

Fig.4

Database Images

The above three images are the different expressions of the subject with normal, rightlight, and sad faces along with other subjects. The model which we have built gives the output as Fig.4 which is the sad-faced expressions as the test image is more closely related to sad-face image rather than normal and rightlight image.

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[517.67267651 525.45313778 371.04986188 378.15869685 207.03622871
 323.77770152 206.11162024 514.53571305 508.62264991 330.46633717
 331.53732822 370.21210137 377.80418208 630.67741358 644.00698754
 515.35327689 522.64232511 509.37118097 510.72399591 532.2565171
 532.2565171  345.98554883 487.80426402 453.90307335 422.86877397
 324.16662382 420.43786699 458.03929962 406.31637919 607.18448597
 594.93781188 499.69690814 407.2615867 ]
```

Fig.5

Fig.5 depicts the comparison of the eigenface value of test image Fig.1 stored in a 1D array with all eigenface values of the images in the database, the lowest difference being 206.11162024495368 i.e., Fig.4 the closest to the test image Fig.1 hence the output. The accuracy achieved is 85%.

VI.SUMMARY AND CONCLUSIONS

In this paper, we have presented an effective method for 2D face recognition using facial representation, as the singular value feature has the stability, proportion invariance, and rotation invariance properties, it provides a way to extract the algebraic feature for the images and achieves the reduced dimension and compression of the images in a better way. We can get a group of singular value vectors by overlapping samples, which can represent the image feature by making use of this group vectors and achieve the effects of reduced dimension.So our test image verifies with all the images in the database and it will display the image which has the least difference with that of the test image.So if the test image is present in our existing database then it displays the output along with the associated values.These values are nothing but the differences between test image and the images present in the database.If the image is present in the gallery database then the difference will obviously be 0. So in this way we can easily get the images of a particular person even though his expressions keep changing.If the expressions change then the difference will increase only by a small margin and we will still be able to detect that particular person.But if the test image is not present in the database then after checking all the images it displays the image which has the lowest difference with that of the test image.After applying this concept to various experiments we will be able to decide on a threshold value for our theory.Hence if the difference is higher than the threshold then it means we have given some colour image or else the image of an animal as our test image and it won't be able to display any image because the difference is very high.If the difference is lesser than the threshold then it confirms that the test image is an image of a face and then displays the image which is closely related to the test image.

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