FACE RECOGNITION USING MANHATTAN DISTANCECORRELATION ALGORITHM

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ABSTRACT-The face expression recognition problem is challenging because differentindividuals display the same expression differently. Here PCA algorithm is used for thefeature extraction. Distance metric or matching criteria is the main tool for retrieving similarimages from large image databases for the above category of search. Two distance metrics,such as the L1 metric (Manhattan Distance), the L2 metric (Euclidean Distance) have beenproposed in the literature for measuring similarity between feature vectors. In content-basedimage retrieval systems, Manhattan distance and Euclidean distance are typically used todetermine similarities between a pair of images. Here facial images of three subjects withdifferent expression and angles are used for classification. Experimental results arecomparedand the results show that the Manhattan distance performs better than theEuclidean Distance.

KEY WORDS: - FaceRecognition, Dimensionality Reduction, Feature extraction, PCA based approach, Manhattan Distance, Correlation, FACES94 Image Database, MATLAB.

1. INTRODUCTION

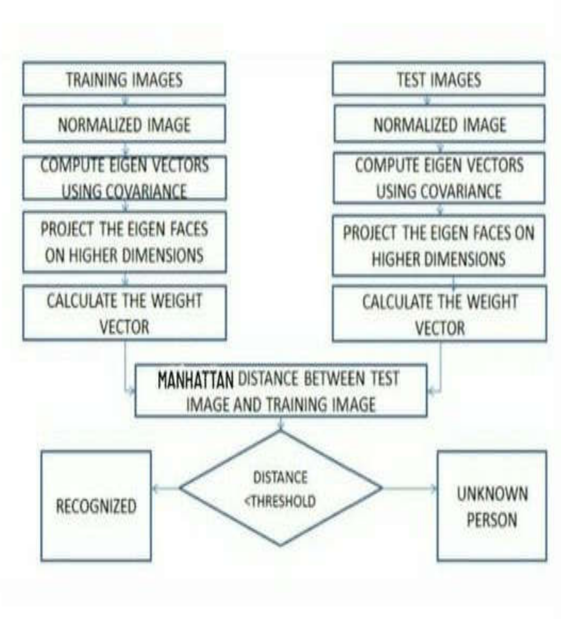
Computer Vision and image processing has been one ofthe most exciting and importantresearch fields in theearlier three decades. A complete review of all facerecognitionSystemswas not a simple task. Hence, only acluster of the most useful systems will bediscussed in thispaper. The reasons come from the need of automaticrecognitionsandsurveillance systems, the interest inhuman visual system on face recognition, and thedesignof human-computer interface.The Principal Component Analysis (PCA) is one ofthe most successful techniques that have been used in image recognition and compression.The purpose of PCA is to reduce the large dimensionality of the data space (observedvariables) to the smaller intrinsic dimensionality of feature space (independent variables),which are needed to describe the data economically. The jobs which PCAcan do areprediction, redundancy removal, feature extraction, data compression, etc. communications,etc. Face recognition has many applicable areas. Moreover, it can be categorized into faceidentification, face classification, or sex determination. The main idea of using PCA for facerecognition is to express the large 1-D vector of pixels constructed from 2-D facial imageinto the compact principal components of the feature space. This can be called eigenspaceprojection. Eigenspace is calculated by identifying the eigenvectors of the covariancematrixderived from a set of facial images(vectors).

2. PROPOSED METHODOLOGY

Our proposed methodology consists of the following steps:

- Applying Principal Component Analysis(PCA) algorithm
- Do testing between training image and test image.
- Analyze the performance of the system in term of accuracy rate, false positive and false negative of recognition.
- Matlab will be used for coding and simulation, testing and analysis of results.

- Face databases will be used – ORL database which available for public used from internet.
- Serves the crime deterrent purpose due to recorded image is provided.
- Visual perception of familiar faces.



- ❖ Consider a training set containing M images of N*N Matrix.
- ❖ Convert the 2D image vector in 1D image (face vector) formofN^2*1 Matrix.
- ❖ Calculate the average image vector from all trained images.

$$Avg = \frac{1}{k}\sum_{i=1}^{k} M_i$$

- ❖ Subtract the average image vector from each ID image vector to get the unique image vectors. Resultant vectors are also known as Normalized image vectors.

$S_i = M_i$- Avg

- ❖ Calculate a covariance matrix.

$$C = \frac{1}{k}\sum^{k} S_i^T S_i$$

- ❖ Calculate Eigenvectors and Eigenvalues from the covariance matrix.
- ❖ Select the K best eigen faces. where k= 1,2, 3....M.
- ❖ Converting back into original dimensions.

$U_i = Av_i$

- ❖ The selected K eigen faces are converted back to their original dimensions.
- ❖ Each face from the training set can be represented a weighted sum of K eigen faces + mean face and the Manhattan distance is measured and the weighted image with minimum distance is recognized as a best image.

3. **False Acceptance Rate(FAR):**FAR is the probability that the system incorrectly matches the input pattern to a non-matching template in the database. It measures the percent of invalid inputs which are incorrectly accepted. In case of similarity scale, if the person is an imposter in reality, but the matching score is higher than the threshold, then he is treated as genuine. This increases the FAR, which thus also depends upon the threshold value.The FAR can be calculated using following equation.

FAR=No. of persons accepted out of database / Total No. of persons in databaseFAR=(IA / I)
Where
IAnumber of imposters accepted
Inumber of imposter's trials.

4. **False Rejection Rate(FRR):**FRR is the probability that the system fails to detect a match between the input patternanda matching template in the database. It measures the percent of valid inputs whichare incorrectly rejected.

FRR= No. of correct persons rejected /Total No. of persons in database

5. **MANHATTAN DISTANCE:**Manhattan distance is also called city block distance. It computes the distance that wouldbetravelled to get from one data point to the other, if a grid-like path is followed. The Manhattan distance between two items is the sum of the differences of their corresponding components.

Manhattan distance is also called the L1 distance.The distance between a point x=(x1, x2…xn) and a point y=(y1, y2 ,…yn) is:

Where n is the number of variables, and xi and yi are the values of the ith variable, atpoints x and y respectively. The distance measure plays an importantroleinacquiring the exact image. The differentdistance measures are to be consider for the segmentation. In this work, the Manhattandistance is considered.

Manhattan Distance Algorithm

The Manhattan algorithm is as follows.

Step 1: x and y are two objects with vector sets Vx and Vy.

Step 2: Cx(j) and Cy(j) are the two jth columns of VxandVy; j denotes the one dimension.

Step 3: Sorted Cx(j) in ascending order and resultsare stored in Csx(j);

Step 4: Sorted Cy(j) in ascending order and resultsare stored in Csy(j);

Step 5: Sum = 0;

Step 6: for i from 1 to m do

Vxs

i;j from column Csx.

(j);

Vys

i;j

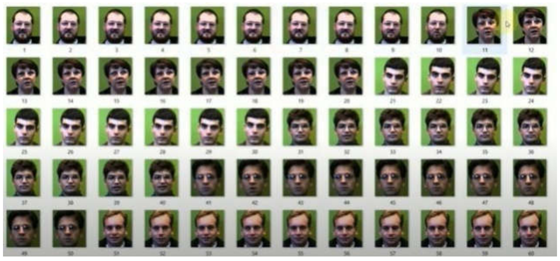
$$MD_{(x,y)} = \sum_{i=1}^{n} | x_i - y_i |$$

from column

Csy.

y(j);

sum +=j Vxs



i;jivys

i;j; j;

endfor

Step 7: Return the sum value.

6. IMPLEMENTATION:

In this implementation part, the recognition rate reflects the percentage of faces recognized correctly as known (or) unknown when text database faces are evaluated. It is desirable to have maximum recognition rate by using less number of Eigen faces, because it clearly makes the procedure simple and fast. The recognition rate of the image is more accurately with the resulting percentage is 97%.

When compared with the Euclidean distance the recognition rate is very high with less number of dimensions. In Euclidean distance the images are to be recognized with the high dimension. But in Manhattan distance produce accuracy. Recognition rate is higher for Manhattan distance of 5 and 10 Eigen vectors (or) dimensions with the rate is 80% and 94% respectively. Wherein the case of 45 Eigen vectors (or) dimensions with the rate is 97%. The comparative recognition rate of Euclidean distance required to take 40% of Eigen faces with highest Eigen values but for Manhattan distance around 30% of the Eigen faces (or) dimensions are sufficient.

After recognize the faces with Manhattan, the input images are to be displayed depend upon the user requirements. For segmented, if the user wants the nose area of the face, that part to be produced clearly, similarly for the eye, lip and mouth area to be processed and produced with accurate results. This part is to be implemented through the MATLAB environment.

7. RESULTS:

The experiment is performed using face database from ORL2 [9]. The sample images of the ORL database is given in Fig 1.

Fig. 1. ORL database images

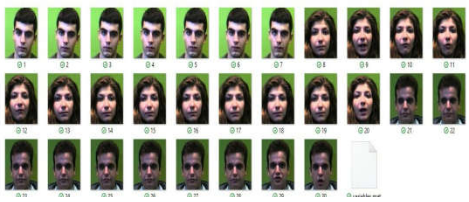


Fig 2. Train images

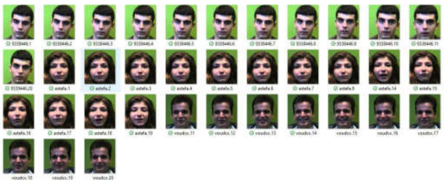


Fig 3. Test images

Fig 4. Mean image

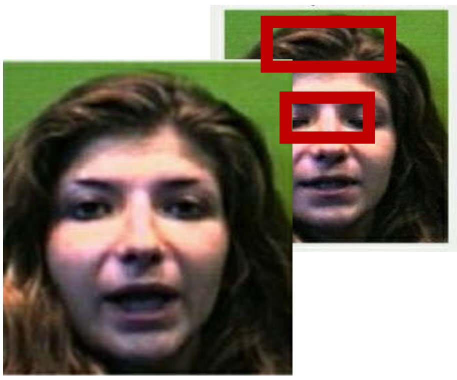


Fig 6. Recognized image

Table 1. Result of Face Recognition Rate

No. of dimensions	RECOGNITION RATE	
	Manhattan	Euclidean
5	73.33%	66.66%
15	94%	87%
30	97%	93%
45	97%	96%

Table 2.FAR and FRR

Distance	FAR (%)	FRR (%)
Manhattan	25.9	24.3
Euclidean	26.2	24.5

8. CONCLUSION

The Segmented part of the given input image is recognized. Compared with the Euclidean, the Manhattan segmented recognition rate is accurately with 97% with less level of dimensions. It is observed that Manhattan was the best recognition rate and also calculated the FAR and FRR. The sample data are used in the ORL2 database. In future work, the algorithm is to modify or update with the enhanced recognition rate of 100% accuracy. The modified algorithm also to support colour images with better accuracy. It develops further for the 3D face recognition and also to produce the segment part from the video image.

Fig 5.Segmented image (a) eye part (b) nose part (c) mouth part (d) face part

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