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Cluster base face recognition

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Abstract

Face recognition is the process of recognizing face either from video or an image. Face recognition has grabbing extensive attention due to its wide application in many areas like criminal identification, home automation system, surveillance system and many more. Face recognition has received substantial attention from researches in biometrics, pattern recognition field and computer vision communities [1][2]. In many applications image database is very large for example criminal database contain image of all criminals of country and there are many criminals in the country. To identify criminal from this large database it take large processing time Many face recognition algorithms have been developed by researchers. Here we have proposed Cluster based Principal component analysis (PCA) for face recognition. Our goal here is to recognize face from large database with minimum delay.

Keywords: *Eigen face, PCA, MPICH, face recognition.*

I. INTRODUCTION

The face is our primary focus of attention, playing major role in conveying identity and emotion. Human can identify thousands of faces meet throughout life and even recognize them at a glass even after separation of years. The computational model for face recognition can be useful in different areas like information security, criminal identification, access management, biometric, personal security and entertainment. Although the ability to infer intelligence or character from facial appearance is quite difficult task as faces are complex, multidimensional and meaningful visual stimuli [3].Therefore, face recognition is a very high-level computer vision task, in which many early vision techniques can be involved.

The first step of human face identification is to extract the relevant Features from facial images. Most face detection algorithms can be classified as feature-based or appearance-based.[4].

Feature based methods only exploit facial features like eyes, eyebrow, nose tip, lip etc and their geom
etric relation. *Appearance-based methods* use the models learned from a set of training images.

Face recognition is nothing but an technique to identify the person from still image or from video based on facial features. Face is very rich with facial features like eyes, eyebrow, lips, nose tip and many more. Facial features also change with the age, race, illumination, occlusions, face pose etc. Many algorithms have been suggested for face recognition. Here we have used PCA for face recognition.

II. Face recognition using PCA

Principal component analysis is statistical method that uses an orthogonal transformation to convert possibly correlated variables into a set of linearly uncorrelated variables called principal components. The main purposes of a principal component analysis are the analysis of data to identify patterns and finding patterns to reduce the dimensions of the dataset with minimal loss of information and retaining most of the variation in the data set. In case of face recognition whole process involve two steps 1)calculate Eigenface from the training images and keeping only highest Eigen values 2) recognise face image using feature space obtained form step 1.

For every training image, following steps are undertaken to calculate eigenface:

- Obtain face images I1,I2,I3….In of size N*M
- Transfer two dimension image to vector of N*M dimension. We get set of n vector of dimension N*M

  S=$\{v_1, v_2, v_{3\ldots\ldots} v_n\}$
- Calculate mean image

  $\mu=\frac{1}{n}\sum_{i=1}^{n} v_i$
- Subtract the Mean image from every image of training set.

  $\Theta_i = v_i - \mu$
- Stage 2: Calculate and form a covariance Matrix
- Stage 3: Calculate Eigenvectors and eigenvalues from the covariance matrix.

- Stage 4: Select the principal components and create Eigen faces.
  During recognition process following task are performed
  Staep1: for every test Image subtract mean from image and reshape it to get column major matrix
  Step2: project it into eigenface and find Euclidian distance. Image with minimum distance is our recognized image.

III. Implementation on cluster

The objective of cluster based face recognition is to efficiently find and retrieve query face image form the database base on feature space of face image. When database is very large, retrieval of image from database required very high computational time. To accelerate face feature matching process we have used cluster based approaches. This can be also used to increase storage capacity as all the faces need not be store on one machine.

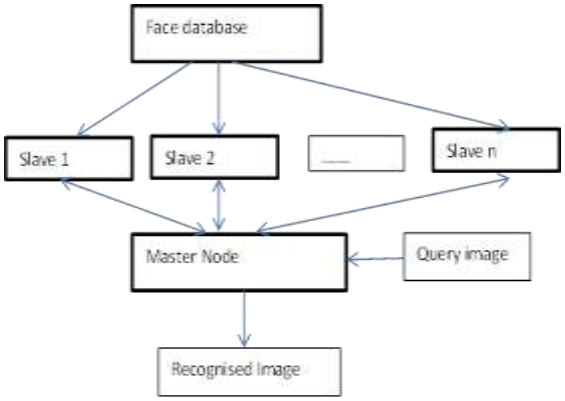

Fig 1: cluster architecture

In our system, we have divided face database into small sub databases and are distributed among cluster slave computers. We have apply Principal component analysis (PCA) on each sub database. To recognize face, test image is given to master node which transfers it to slaves and find nearest match image form database. The experiment result shows that cluster base face recognition improve recognition speed.

In our architecture we have configure MPICH cluster which is master slave model where one master node and many slave nodes. We have divided face database on to slave nodes. And on each slave machine we have applied PCA on face images. We submit query image to master node. Master node perform following steps

1)Send it to slave node using MPICH write function. Slaves find nearest match of query image from its dataset and send it to master node.

2)Master compare received result from each slave. Image with maximum confidence is selected as recognized image.

IV. RESULTS

We have carried out our experiments on Cambridge Olivetti Research Lab (ORL) face dataset. It contains total 400 images, 10 expressions of each of 40 individual[4]. Each image contains different face gesture and constant illumination environment in grey scale mode. Size of each image is 112 X 92 pixels. Variable numbers of images are chosen for training and testing. Variable numbers of images are chosen for training and testing. Fig. 2 shows second expression of all forty subjects.

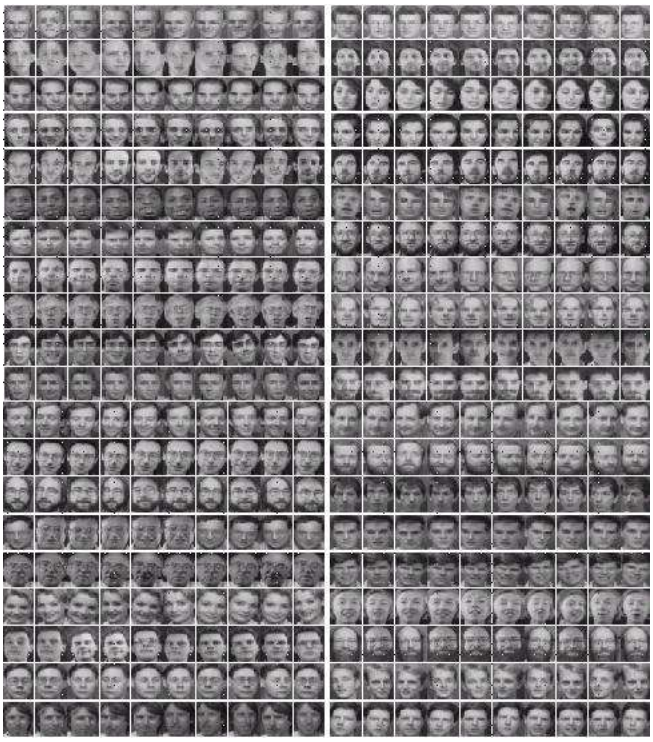

Fig2: ORL Dataset

We have use 5 images of all 40 people for training set and remaining we have kept for testing face . We have randomly select 5, 10, 15 images from testing dataset and measure accuracy of our algorithm as show in Table 4.1

No of testing images	No of training images(200)		
	True	False	Accuracy
5	4	1	80
10	9	1	90
15	12	3	80

Table 4.1 Accuracy of PCA

We have also configured 3 node and five node MPICH cluster. We have implemented parallel PCA

which runs on cluster. We observe that when PCA runs on single machine it take more time compare to when it runs on cluster. The comparison of their execution time is shown in the following table. The execution time on cluster is less than the single PC. When the dataset becomes larger the execution time is also increased for single PC. When the cluster is of more nodes the execution time becomes very less then single node as shown in Table 4.2.

Dataset	Single PC	Cluster of 3 PCs	Cluster of 5 PCs
100	1.38	0.5423	0.2547
400	41.12	13.350036	4.785652

Table 4.2 Comparison of execution time

IV. CONCLUSION

Principal component analysis approaches to the face recognition problem by means of information theory concepts. The most relevant information that is contained in a face image is extracted. Eigen faces method is a principal component analysis approach, where the eigenvectors of the covariance matrix of a small set of characteristic pictures are sought. These eigenvectors are called Eigen faces due to their resemblance of face images. Recognition is performed by obtaining feature vectors from the eigenvectors space. For classification phase Euclidean distance method is implemented to recognize image from dataset.

If proposed face recognition is implemented on cluster of PCs which gives higher performance. It is useful when dataset of person's images are very large then we can divide dataset on different machines. Execution time of this program is less on the cluster then the single computer.

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