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REVIEW ON PARALLEL IMPLEMENTATION OF PRINCIPAL COMPONENT ANALYSIS FOR FACE RECOGNITION USING MPI AND OPENMP

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Abstract - ***PCA is a statistical approach that analysis a data table in which observations are describes by several inter correlated quantitative dependent variables. It uses mathematical principals to transform number of possibly correlated variable into a smaller number of variable called principal component. One of compute intensive application of PCA is face recognition. In PCA, every image in the training set is represented as a linear combination of weighted eigenvectors called eigenfaces. These eigenvectors are obtained from covariance matrix of a training image set. The weights are found out after selecting a set of most relevant eigenfaces. Recognition is performed by projecting a test image onto the subspace spanned by the eigenfaces and then classification is done by measuring minimum Euclidean distance. Some of the modules such as Covariance Module, Jacobi Module, Eigenface Module required more time for execution. These modules will be made parallel with the help of parallel programming models such as OpenMP and MPI and performance & evaluation will be made between sequential and parallel implementation.***

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I. INTRODUCTION:

Principal component analysis (PCA) is one of the most popular techniques in multivariate statistics, providing a window into any latent common structure in a large dataset. The central idea of PCA is to identify a small number of common or principal components which effectively summarize a large part of the variation of the data, and serve to reduce the dimensionality of the problem and achieve parsimony. PCA is also called "Hotteling transform" or "Karhunen-leove (KL) Method". PCA is one of the most frequently used multivariate data analysis. Principle Component Analysis can be considered as a projection method which projects observations from a p-dimensional space with p variables to a k-dimensional space (where k < p) so as to conserve the maximum amount of information (information is measured here through the total variance of the scatter plots) from the initial dimensions. Principal component analysis (PCA)
involves a mathematical procedure that transforms a number of (possibly) correlated variables into a (smaller) number of uncorrelated variables called principal components.

There are many applications of PCA such as Face Recognition, Interest Rate Derivatives Portfolios, Neuroscience,

Nonlinear inverse problems etc. Face Recognition is most important application for the Security.

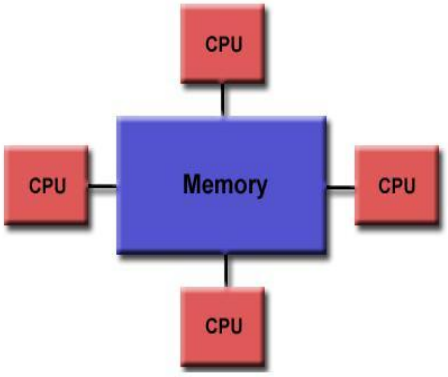
Face is a complex multidimensional structure and needs good computing techniques for recognition. The face is our primary and first focus of attention in social life playing an important role in identity of individual. We can recognize a number of faces learned throughout our lifespan and identify that faces at a glance even after years. There may be variations in faces due to aging and distractions like beard, glasses or change of hairstyles. Face recognition is an integral part of biometrics. In biometrics basic traits of human is matched to the existing data and depending on result of matching identification of a human being is traced.

To solve large problem in high performance MPI and OpenMP programming technique is used. MPI has emerged as the standard for message passing in both C and FORTRAN programs. MPI primarily addresses the message passing parallel programming model data is moved from the address space of one process to that of another process through cooperative operations on each process. OpenMP is an Application Program Interface (API), jointly defined by a group of major computer hardware and software vendors. OpenMP provides a portable, scalable model for developers of shared memory parallel applications.

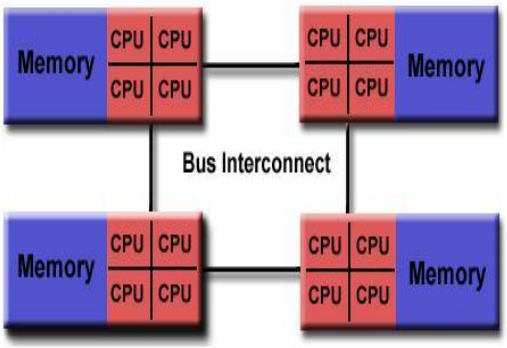
OpenMP Programming Model

I.Shared Memory Model:

OpenMP is designed for multi-processor/core, shared memory machines.The underlying architecture can be shared memory UMA or NUMA.



Uniform Memory Access



Non Uniform Memory Access

Thread Based Parallelism:

- OpenMP programs accomplish parallelism exclusively through the use of threads.
- A thread of execution is the smallest unit of processing that can be scheduled by an operating system. The idea of a subroutine that can be scheduled to run autonomously might help explain what a there is.

Explicit Parallelism:

- OpenMP is an explicit (not automatic) programming model, offering the programmer full control over parallelization.
- Parallelization can be as simple as taking a serial program and inserting compiler directives.
- Or as complex as inserting subroutines to set multiple levels of parallelism, locks and even nested locks.

Message Passing Interface(MPI)

The MPI standard has gone through a number of revisions, with the most recent version being MPI-3. Interface specifications have been defined for C and Fortran90 language bindings: C++ bindings from MPI-1 are removed in MPI-3 MPI-3 also provides support for Fortran 2003 and 2008 features. The way MPI programs are compiled and run on different platforms will also vary.

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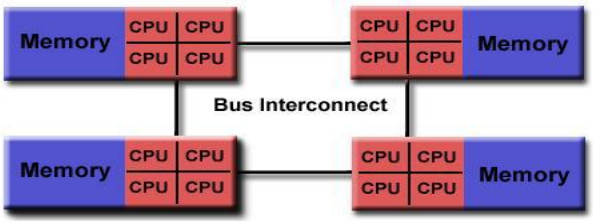
MPI implementers adapted their libraries to handle both types of underlying memory architectures seamlessly. They also adapted/developed.



MPI Programming Model

II. LITERATURE REVIEW

[1] In this paper author mainly addresses the building of face recognition system by using Principal Component Analysis (PCA). PCA is a statistical approach used for reducing the number of variables in face recognition. In PCA, every image in the training set is represented as a linear combination of weighted eigenvectors called eigenfaces. These eigenvectors are obtained from covariance matrix of a training image set. The weights are found out after selecting a set of most relevant Eigenfaces. Recognition is performed by projecting a test image onto the subspace spanned by the eigenfaces and then classification is done by measuring minimum Euclidean distance

[2] In this paper author predicted that Traditional 2D methods give satisfying result on frontal view or any single view. In order to extend the capability of 2D method to identifying faces in multiple views, multiview face databases are needed to train face recognition algorithm to identifying faces in different view. FRAV face database has been used in this paper for multiview faces of same person. Murase and Nayar proposed a parametric eigenspace‘method to encode both the identity and pose information using a single set of eigenvectors.

[3] In this paper author mainly discussed about Face is considered to be one of the most important visual objects for identification. Recognition of human face is complex and it converts the face into a mathematical model. Face recognition is the most efficient and sophisticated method for the security systems. It is a biometric technology with a wide range of applications such as use in ATM machines, preventing voter’s fraud, criminal identification, human computer interaction, etc. This paper describes the building of a face recognition system by using Principal Component Analysis method. PCA is the method for reduce the data dimension of the image.

[4] In this paper author told about Face recognition is a key biometric technology with a wide range of potential applications. The idea of feature extraction using eigen faces. Dimensionality reduction techniques using linear transformations have been very popular in determining the intrinsic dimensionality of the manifold as well as extracting its principal directions (i.e., basis vectors). The most prominent method in this category is Principal Component Analysis PCA. In this we determine the Euclidean distance.

[5] In this paper author says Face recognition is one of the major challenge and is the most popular research areas in the computer vision. The research is focused to develop the computational model of face recognition that is fast, simple and accurate in different environments. In this study, author has developed an improved recognition strategy based computational model to identify the face of an unknown person. The proposed computational model makes use of the well-known eigenfaces approach. A given set of face images are processed to compute eigenfaces. The eigenfaces are then projected into a number of unique features vectors. These features vectors form a database of vectors and are used to identify an unknown face. The feature vector of the unknown face is compared with vectors in the database using the improved recognition strategy described in this paper.

III. METHODOLOGY

One of the simplest and most effective PCA approaches used in face recognition systems is the so-called eigenface approach. This approach transforms faces into a small set of essential characteristics, eigenfaces, which are the main components of the initial set of learning images (training set). Recognition is done by projecting a new image in the eigenface subspace, after which the person is classified by comparing its position in eigenface space with the position of known individuals.

A. Initialization process
B. Recognition process

A. The Initialization process involves the following operations:

i. Acquire the initial set of face images called as training set.

ii. Calculate the Eigenfaces from the training set, keeping only the highest eigenvalues. These M images define the face space. As new faces are experienced, the eigenfaces can be updated or recalculated.

iii. Calculate distribution in this M-dimensional space for each known person by projecting his or her face images onto this face-space.

These operations can be performed from time to time whenever there is a free excess operational capacity. This data can be cached which can be used in the further steps eliminating the overhead of re-initializing, decreasing execution time thereby increasing the performance of the entire system.

B. Recognition process:

i. Calculate a set of weights based on the input image and the M eigenfaces by projecting the input image onto each of the Eigenfaces.

ii. Determine if the image is a face at all (known or unknown) by checking to see if the image is sufficiently close to a ―free space.

iii. If it is a face, then classify the weight pattern as either a known person or as unknown.

iv. Update the eigenfaces or weights as either a known or unknown, if the same unknown person face is seen several times then calculate the characteristic weight pattern and incorporate into known faces. The last step is not usually a

requirement of every system and hence the steps are left optional and can be implemented as when the there is a requirement.

Eigenfaces are the set of features in the form of vector that denotes the variation between faces. The basic idea behind eigenface is that think of the face as a weighted combination of some component or base faces. These components are the principal components of the face image. The training face images and the new face image can be represented as linear combination of eigenfaces. Each image in the training set has its own contribution on making the eigenfaces. So the eigenface represents the significant variation between all the faces.

IV. CONCLUSION:

Principal Component Analysis(PCA) is statistics approach used for large dataset. One of the is face recognition. The system receives the input face and it is recognized from the training set. Recognition is done by finding the Euclidean distance between the input face and our training set. By using eigenfaces approach, we try to reduce this dimensionality. PCA is one of the concept which require more time for execution. MPI and OpenMP are the techniques which can be used for making application parallel and reduce the execution time. The problem statement can be implemented with the help of OpenMP and MPI.

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