# Image Mining with Neural Networks

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***Abstract*- The proposed work is based on extracting the dominating features of a set of human faces stored in the database. When a new image is fed into the system for recognition the main features are computed to find the distance between the input image and the stored images. We try to integrate the concept of artificial neural networks with the principle of data mining. A set of images are taken and trained which forms feature vector or properties for test images. Images considered are multi angled projections of facial images. Various experiments are carried out with input and output being single image or set of images with variations in facial angles. The trained images features are extracted only once and stored in database and can be reused for any test image or imageset.We finally emphasize on the importance on neural networks in the field of data mining .**

***Index Terms*— Data mining, Neural networks, feature extraction, Image classification, Training, Dataset**

## I. INTRODUCTION

Data mining is one of the processes in KDD is the application of data analysis and discovery algorithms that under acceptable computational efficiency limitations produce a particular enumeration of patterns over the data [1]. There are two types of data mining approaches, namely Descriptive data mining and Predictive data mining.

Due the black box nature of neural networks, they sometimes are not classified as data mining tools for discover interesting and understandable data mining definition. Information or knowledge embedded in trained neural networks is hard to be verified or interpreted by human beings.

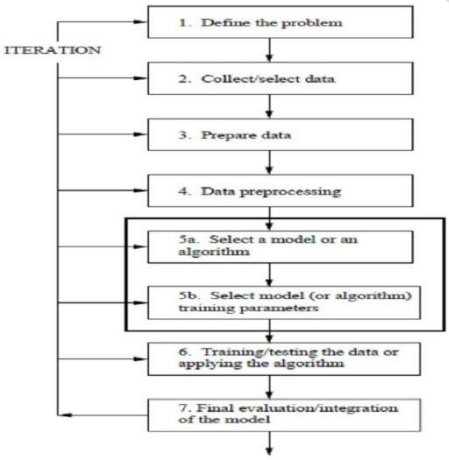



**Figure 1: Lifecycle of Data mining Process**

## II. STATE OF ART AND RELATED WORKS

Data mining is the process of automated extraction of hidden, predictive information from large databases.

In general solving a Data Mining Problem involves the following major stages:

- Defining the problem precisely
- Selection and forming a proper training dataset, .
- Transforming data to a specific format, or data cleansing.
- Preprocessing data to increase the data quality.
- Select an appropriate mining method, which consists of
  a) Choosing a model or an algorithm.
  b) Choosing the training parameters.
- Choosing a Proper Training / Testing data
- Validating and integrating the model**.**

When we think about applying the concept of neural networks for data mining we immediately think in mind the original data mining scope and challenges.

1. How can we meet the challenge of integrating neural networks principle to the field of data mining.
2. Is it feasible to run neural networks on a terabyte dataset as the training cost is very high if we do not take proper care.
3. Is it possible to explain the discovered patterns in feasible way and make out a difference in the extracted features.

The figure below [1]shows the stages involved in a typical data mining and modeling process

Neural networks have been successfully applied in a wide range of supervised and unsupervised learning applications. Neural-network methods are not commonly used for data- mining tasks, because they may have complex structure, long training time, and uneasily understandable representation of results and often produce incomprehensible models. However, neural networks have high acceptance ability for noisy data and high accuracy and are preferable in data mining.

At present, the field of data mining is gaining a lot of significant importance and important area of research, and neural network itself is very suitable for solving the problems of data mining because its features like good robustness, self- organizing adaptive nature, parallel processing, distributed storage and high degree of fault tolerance.

The combination of data mining method and neural network model can greatly improve the efficiency of data mining methods, and it will be gain significant importance the very near future and will receive more and more attention.

The objective of this paper is to explore application of Artificial Neural Network in Data mining techniques and we think neural network deserves a place in the tool boxes of data mining.

## III. PROPOSED METHOD

Face recognition has been studied by many researchers due to its importance in biometric authentication system. In pixel based system facial images are represented in the form of collection of vectors of large dimensionality forming input image space matrices.

Proposed approach is based on extracting the dominating features of a set of human faces stored in the database. When a new image is fed into the system for recognition the main features are computed to find the distance between the input image and the stored images. Back propagation algorithm is used for classification problems and principle of artificial neural network is applied in Data mining techniques.

The task of face recognition requires two steps to be performed:

1. Feature extraction and
2. Classification.

### A. Feature Extraction

The process of feature extraction is performed on input data space in order to extract those features which are important for discrimination between various classes defined. Among various feature extraction methods the appearance based techniques are quite popular which include Eigen faces and fisher faces techniques.

Principal component analysis provides Eigen faces while regularized linear discriminant analysis is another technique to obtain fisher faces of image sample. Principal Component Analysis is dimensionality reduction technique where eigenvectors of image space are calculated. These eigenvectors are projected on original data space to reduce the dimensions along with discarding null spaces and retaining important feature information. [2]

### B. Classification

The task of classification is performed by two widely used neural networks:

1. Back propagation neural network (BPANN) and
2. Radial basis function neural network (RBFNN).

#### B.1. Back Propagation Neural Network

Back propagation MLP is widely used neural network which is being utilized in many fields like pattern recognition, stock market prices forecasting, signal processing etc. BPA learns by propagating the error signals backward in order to update the weights and biases. These parameters are updated in batch mode such that the MSE is minimized.

In effect the Network is able to produce the almost desired output vector corresponding to input vector pair. [3]. Single hidden layer is used for function approximation where each neuron is using sigmoid functions which squash the output in the range of -1 to 1 in the case of transfer function as hyperbolic tangent function.

#### B.2 Radial Basis Neural Network

Contrast to BP RBF neural network is used for the problems where input vectors space is spanning in small regions. Radial Basis neural network is having activation level of its receptive fields neurons high if the distance between input vector and weight vector is small. Here we use Gaussian function as transfer function. Similarly activation level of RBF layer neurons will be high for relatively moderate values of distances.

To generalize the situation we select spread value such that the radial basis neural networks outputs strongly to the overlapping regions of input vectors. Each epochs of the network adds a neurons to minimize the sum squared error of the network. The addition stops after squared error is minimized to selected level.

### *C. Main Algorithm phases*

The processes can be summed up into three main phases.

*1) Face database formation phase:*

During this phase, the gathering and the preprocessing of the face images that are to be added to the face database are performed. Face images are stored in a face library in the system.

Every action such as training set or eigenface formation is performed on this face library. In order to start the face recognition process, the face library has to be filled with face images. Weight vectors of the face library members are empty until a training set is chosen and eigenvectors are formed.

*2) Training phase:*

Images that are going to be in the training set are chosen from the entire face library. After choosing the training set, Otherwise, a miss has occurred and the face image with its corresponding weight vector for later use. This process is called learning to recognize.

#### *4) Implementation*

The implementation process involves 2 phases

1. Training
2. Face Recognition

### *A. STEPS FOR TRAINING USING PCA*

The step by step instructions along with the formulas for the recognition of faces using (PCA) are as follows:

***STEP 1: Prepare the data***

This step involves obtaining a finite set S of face images. Each collected sample image is transformed into a vector of size N and placed into the set.

***STEP 2: Obtain the mean***

eigenface are formed and stored for later calculations. Eigen faces are computed from the training set, considering only the M images that correspond to the highest eigenvalues.

These M eigenface define the M-dimensional face space. When the new faces are acknowledged, the eigenface can be updated or recalculated. The corresponding weight vector of each face library member has now been updated.

Once a training set has been chosen, it is not possible to add need members to the face library with the established method that is presented in the "face database formation phase" because the system does not know whether this item already exists in the face library or not. Therefore, a library search must be performed.

*3)* ***Recognition and learning phase:***

After choosing a training set and constructing the weight vectors of face library members, now the system is ready to perform the recognition process. The recognition process is initialized by choosing the input image. The weight vector is constructed with the aid of the eigenface that were already stored during the training phase.

After obtaining the weight vector, it is compared with the weight vector of every face library member with a user defined threshold. If there exists at least one face library member that is similar to the acquired image within that threshold then, the face image is classified as known.

### *B. Recognition Procedure*

*STEP 1: Transform the new face*

The new face is transformed into its Eigen face components and the resulting weights form the weight vectors.

$$\omega k = ukt ( \Gamma - \Psi)$$

Where
**ω** = weight,
**μ** = eigenvector,
**Γ** = new input image,
**Ψ** = mean face

The weight vector **ΩT** is given by

$$\Omega T = [\omega 1, \omega 2, \ldots, \omega M ]$$

*STEP 2: Calculate Euclidean Distance*

The Euclidean distance between two weight vectors **d (Ωi, Ωj)** provides a measure of similarity between the corresponding images i and j.

If the Euclidean distance between the new and other faces exceeds on average some threshold value θ, one can conclude whether it is a known or unknown face.

It can be calculated as,

$$d(\Omega i, \Omega j) = || \Omega i - \Omega j ||2$$

After obtaining the set, the mean image **Ψ** has to be obtained as

$$\psi = 1/M \sum M = 1/\Gamma$$
$$n \quad n$$

***STEP 3: Subtract the mean from original image***

The difference between the input image and the mean image has to be calculated and the result is stored in **Φ**.

$$\Phi i = \Gamma i - \Psi$$
$$S = \{ \Gamma 1, \Gamma 2, \Gamma 3 \ldots . \Gamma n \}$$

***STEP 4: Compute the covariance matrix***

The covariance matrix **C** is calculated in the following manner

$$C = 1/M \; \Sigma Mn=1 \; \Phi n \; \Phi T n = AAT$$

***STEP 5: Computation of Eigenvectors and Eigen values of the covariance matrix***

The eigenvectors ui and eigenvalues λi is calculated. In M eigenvectors, only M' should be chosen, which have the highest Eigen values. After M'Eigen faces are determined, training phase of the algorithm is finished.

## IV. RESULTS

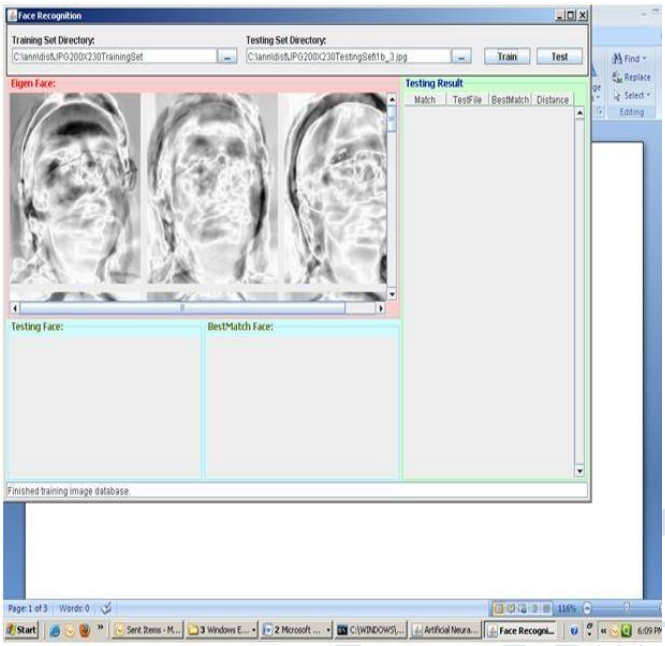
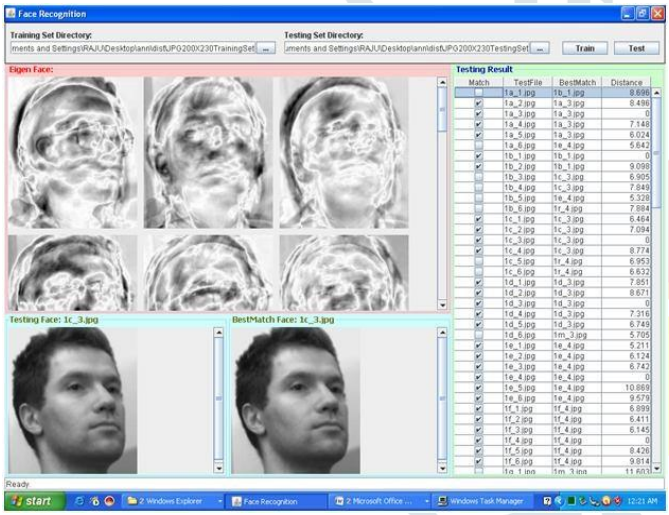



**Figure 2: Image- showing the Gray scale images after training**




**Completed from training set**

**Figure 3: Screenshot of the training and test results for set of training and Test set images**

## V. CONCLUSION

Data mining is an important area of research, and neural network itself is very suitable for solving the problems of data mining. The combination of data mining method and neural network model can greatly improve the efficiency of data mining methods and it will be widely used in near future and also will receive more and more attention. The objective of this paper is to explore application of Artificial Neural Network in Data mining techniques. Given the current state of the art, neural-network deserves a place in the tool boxes of data-mining specialists

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