Real Time Face Recognition Using Step Error Tolerance BPN

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Abstract— **The ever-increasing volume in the collection of image data in various fields of science, medicine, security and other fields has brought the necessity to extract knowledge. Face classification/recognition is one of the challenging problems of computer vision. This paper presents details development of a real time face recognition system (FRS) aimed to operate in less constrained environment. Firstly, it is reviewed the well-known techniques used in face recognition then the details of every step in recognition process and explains the ideas, which leaded to these techniques. Being widely used in pattern recognition tasks, neural networks have also been applied in face recognition. In this study, we developed a face recognition system based on Step Error Tolerance Back-propagation Neural Network (SET-BPN). SET-BPNs supply flexibility and straightforward design by reducing error in each step of learning which make the system easily and rapidly operable along with the successful classification results. In order to analyze the system in practice we ran several tests using real data. Empirical results show that proposed approach greatly improves recognition speed in feature matching step. From the experiment it is found that the system correctly recognizes 91% of the faces, using less then one second of test samples from each face image.**

Index Terms— **Recognition, Back-propagation Neural Network, Step Error , Feature Extraction**

VI. Introduction

With the advent of electronic medium, especially computer, society is increasingly dependent on computer for processing, storage and transmission of information. Computer plays an important role in every part of life and society in modern civilization.

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With increasing technology man is involved with computer as the leader of this technological age and the technological revolution has taken place all over the world based on it. Therefore, the advancement of multimedia technology and the progress of information society have lead to ample increase of image collections in great volumes. To analyze these large collections of images and to acquire new knowledge has lead the data mining communities to take up the challenges.

The variations in lighting condition, viewpoint, pose and facial expression have risen to severe challenges in analyzing the face images. The problems with existing technology [1][3] relates to the overall accuracy, particularly in large databases, sensitivity to changes in lighting, camera angle, pose and computational load of searches. The necessity for a new system to recognize new images of known faces and insensitive to nuisance variations in image acquisition comes into demand. The Data mining approaches of neural network [4] has expended its knowledge to efficiently explore these large collections of image. Image data mining is an area with applications in numerous domains including space images, medical images and geological images. The image data mining process consists of four major processes as depicted in Fig. 1**.**

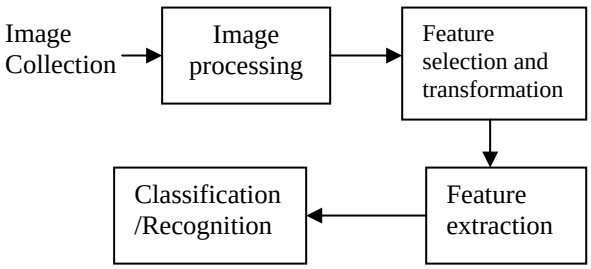

Fig. 1 Image data mining process

Face recognition is the identification of a person from an image of his face. The need to address heightened security in face recognition and biometrics are the major concerns of 21st century. Humans have an innate ability to recognize faces in cluttered scenes with relative ease, having the ability to identify distorted images, coarsely quantized images and faces with occluded details. Face recognition research provides the cutting edge technologies in commercial law enforcement and military applications. It has also drawn considerable interest and attention from many researchers for the last two decades because of its potential applications, such as in the areas of surveillance, secure trading terminals, closed circuit television control and user authentication.

Neural networks play an active role in pattern recognition and have also been applied in face recognition [5]. Multi layer perceptron, time delay neural networks, back propagation, radial basis function networks and fuzzy neural networks are some of them. With increased population size,

computational cost of running a system increases substantially. Hence, choosing the right type of classifier is the first problem to be solved. We chose Step Error Tolerance Back propagation neural networks because of their flexibility and straightforward design.

VII. Basic Definition

A. Image

The term monochrome image or simply image refers to a two-dimensional light intensity function f(x, y), where x and y denote coordinates and the value of f at any point (x, y) is proportional to the brightness (or gray level) of the image at that point. A digital image can be considered as a matrix whose row and column indices identify a point in the image and the corresponding matrix element value identifies the gray level at that point. The elements of such a digital array are called image elements, picture elements, pixels or pels. When an image is generated from a physical process, its values are proportional to energy radiated by a physical source (e.g., electromagnetic waves). As a consequence, f(x,y) must be nonzero and finite; that is $0 < f(x, y) < \infty$.

B. Image Processing

Many types of remote sensing images are routinely recorded in digital form and then processed by computers to produce images for interpreters to study. The simplest form of digital image processing employs a microprocessor that converts the digital data tape into a film image with minimal corrections and calibrations. At the other extreme, large mainframe computers are employed for sophisticated interactive manipulation of the data to produce images in which specific information has been extracted and highlighted. Many image-processing techniques were developed in the medical field to process X-ray images and images from sophisticated body-scanning devices.

C. Face Recognition

Face Recognition means matching the original face from a set of faces previously stored in the knowledge base. This system takes the scanned image of human face as its input and creates a knowledge base for future uses. Finally, when a face is given for verification, the recognition part of the verification system verifies the image with the help of the knowledgebase. The system that can recognize a known person's face is called the Face Recognition System (FRS). Mainly the system consists of various procedures through which the human faces are verified and recognized.

D. Artificial Neural Network

A neural network is a powerful data-modeling tool that is able to capture and represent complex in-put/output relationships. The motivation for the developments of neural network technology stemmed from the desire to develop an artificial system that could perform "intelligent" tasks similar to those performed by the human brain.

An ANN is composed of a number of units, connected by links. Each link has a numerical weight associated with it. These weights are the primary means of long-term storage in neural networks. Learning is a task of updating these weights in order to get the required results.

E. Back Propagation Neural Network

Back Propagation Network is a very popular ANN learning algorithm. It is a gradient descent algorithm, which learns the weights of the multilayer network. The gradient descent is employed to minimize the squared error between the network output values and the target output values for these outputs.

VIII. Techniques of Real Time Face Recognition using BPN

The process of real time face recognition system consists of two main phases. The first phase, the image processing, consists of face image acquisition through scanning, image enhancement, image clipping, filtering, edge detection and feature extraction. The second part consists of the artificial intelligence which is composed of Back Propagation Neural Network. . The existing standard Back propagation learning algorithm has been modified to reduce learning time [6]. The steps are discussed here:

Step 1: **(Face Image Acquisition):** The face image is acquired by web cam, digital camera or using scanner.

Step 2: **(Filtering and Clipping):** The input face of the system may contain noise and garbage data that must be removed. Filter is used for fixing these problems. For this purpose median filtering technique is used because median filter is the nonlinear filter more used to remove the impulsive noise from an image [7][8]. Furthermore, it is a more robust method than the traditional linear filtering, because it preserves the sharp edges. After filtering, the image is clipped to obtain the necessary data that is required for removing the unnecessary background that surrounded the image and it is performed using start-point and end-point detection algorithm. The algorithm for detecting the window co-ordinates (Xmin,Ymin) and (Xmax, Ymax) is:

```
START ALGORITHM
Step-1: Set X=image width
        Set Y=image height
Step-2: For loop i=0 to Y
        Sum=0;
        For loop j=0 to X
        Sum=Sum+Pixel[i][j];
        IF Sum>0
        Set Ymin=i
        Exit outer loop
Step-3: For loop i=Y to 0
        Sum=0;
        For loop j=0 to X
        Sum=Sum+Pixel[i][j];
        IF Sum>0
        Set Ymax=i
        Exit outer loop
Step-4: For loop i=0 to X
        Sum=0;
        For loop j=0 to Y
```

```
            Sum=Sum+Pixel[j][i];
            IF Sum>0
            Set Xmin=i
            Exit outer loop
Step-5: For loop i=X to 0
            Sum=0;
            For loop j=0 to Y
            Sum=Sum+Pixel[j][i];
            IF Sum>0
            Set Ymax=i
            Exit outer loop
Step-6: Set Window (Xmin, Ymin, Xmax, Ymax)
END ALGORITHM
```

Step 3: **(Edge detection):** Then edge of the face image is detected. There are several methods for edge detection. The procedure for determining the edge of an image is similar everywhere but the only difference is the use of the masks. Different types of masks can be applied such as Sobel, Prewitt, Kirsch, quick mask to obtain the edge of a face image. The performance of different masks has a negligible discrepancy. Here quick mask is used as this is smaller than any others. Another reason is that, it is applied in only one direction for an image, but others are applied in eight direction of an image. So, the quick mask is eight times faster than other masks.

Step 4: **(Features Extraction):** The facial features for recognition are extracted as the major analytical target because they compose the characteristics of a human face [9]. In the feature point extraction stage, the images are processed as two-dimensional (2-D) holistic patterns, to avoid difficulties associated with three-dimensional (3-D) modeling, and shape or landmark detection [11] and the desired facial features such as eyes, nose, and mouth are extracted in the face region by the method of template matching. By using the feature templates, all the candidate points within the face region are evaluated [10]. The candidate points that have the best matching values are extracted as feature points.

Step 5: **(Learning):** Back propagation Neural Networks are generally used in classification problems. Their advantage over other methods is flexibility and the straightforward design. Training time which increases substantially with increasing population size is not a disadvantage for our SET-BPN [6]. The major advantage of the BPN is that it is faster in recognition, because it performs only one iteration to produce the output based on its knowledge base (weights and threshold).The networks used in the system is shown in Fig. 2.

This model has three layers: input layer, hidden layer and output layer. Transfer function of the hidden and output layer is given as:

$$f(net(j)) = \frac{1}{\left(1 + e^{-net(j)}\right)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Training the Back Propagation depends on many parameters such as Learning Rate Alpha (α), Initial Weight, and Number of hidden layers. The results are tested by selecting a range of value for the parameters given below,
Learning Rate (α) = 0.05
Initial Weight = Random values between -1 to +1
Number of Input Layers=900
Number of Hidden Layers = 50
Number of Output Layers=4
Target error=1
Error reduction rate=0.0015

For learning or training, the extracted features of image are then fed into SET-BPN network .The weights and threshold are adjusted and saved into memory to create a knowledge base for recognition.

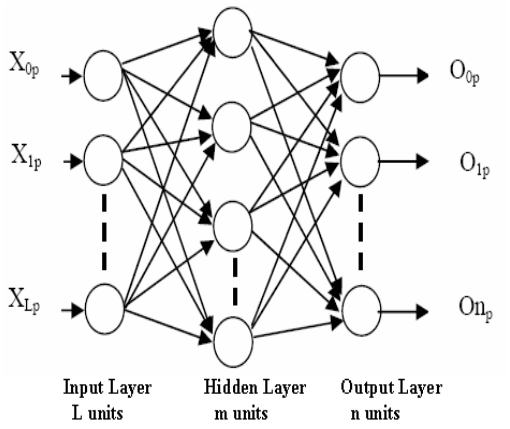

Fig. 2 Model of Multilayer Back propagation Neural

Step 6: **(Recognition):** BPN provides best matching face for each input vector. However, in order to increase the success rate, multiple input vectors from each sample are needed. In the recognition part the stored weights and thresholds are used by the networks. Comparing the output with some predefined output decision about the unknown pattern can be reached. Here the features from the face image that is to be identified is fed into the network without having any target output, the network found the closest matching output using the weights and thresholds stored before and provided the corresponding recognized face.

IX. EXPERIMENTAL RESULTS

Our system is realized in the MATLAB 7.0 environment with single Pentium 4 processor at 2.6 GHz and 512 MB RAM. The results for Classification/Recognition rate on Back Propagation networks are presented in table 1. The results are carried out for 115 samples and learning rate is 0.05. The results are validated for recognition rate against the training samples.

Table 1. The classification /recognition rate using BPN

No of Face Images	Successfully Recognized Face Images	Unrecognized Face Images	Efficiency (%)
5	3	2	60
13	12	1	92.31
20	19	1	95
22	19	3	86.36
25	24	1	96
30	28	2	93.33

The above tables describes that for first sample and for 5 face images of one person, 3 face images is recognized successfully and 2 is unrecognized. In such a way, all the samples are tested. The total efficiency is calculated in the following way:
Efficiency= (Number of correctly recognized faces / Total number of faces in the input)*100%
Here, Total number of faces in the input image=115
Number of correctly recognized faces=105
Efficiency=91.30%

Therefore the efficiency of the Face Recognition System by using Step Error Tolerance Back-propagation Algorithm is 91.30%.

A. Performance Analysis

Fig. 3 presents the efficiency of proposed algorithm with respect to increasing number of input face images and it is observed that the system can ensure almost 100% successful recognition albeit running amid several constraints-bound environment.

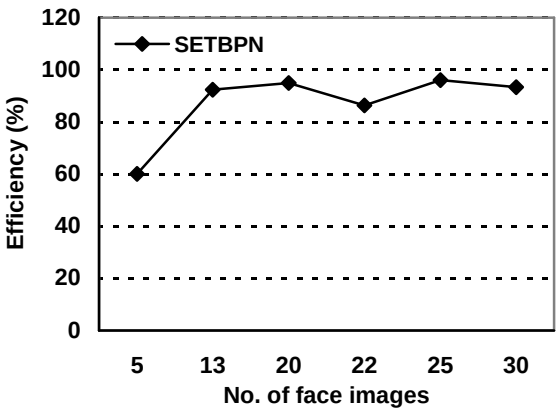

Fig. 3 Performance Analysis Chart

X. CONCLUSION

Face Recognition plays an important role in security services. In this paper we proposed a computational model of face recognition using the concept of Step Error Tolerance Back-propagation Neural Network and digital image processing, which is fast, reasonably simple, and accurate in constrained environments such as an office or a household. The system performs human face detection, eye localization and face recognition in close to real time speed. The proposed approaches have advantages over the other face recognition schemes in its speed and simplicity, learning capacity and relative insensitivity to small or gradual changes in the face image.

REFERENCES

[1] Juwei Lu, Kostantinos N. Platiniotis, Anastasios N.Venetsanopoulos, "Face Recognition Using LDA-Based Algorithms", IEEE Transactions on Neural Networks, vol. 14, no. 1, January 2003, pp 305-347.
[2] Olivier de Vel, Stefan Aeberhard, "Line-Based Face Recognition under Varying Pose", IEEE Transactions on Pattern Analysis Machine Intelligence, vol. 21, no. 10, October 1999, pp 134-156.
[3] Juwei Lu, Kostantinos N. Platiniotis, Anastasios N. Venetsanopoulos, "Face Recognition Using Kernel Direct Discriminant Analysis Algorithms", IEEE Transactions on Neural Networks, vol. 14, no. 1, January 2003, pp 230-259.
[4] Sham Kashyap, Nagini Indugula, "Face Recognition using Artificial Neural Networks", IEEE Transactions on Neural Networks, vol. 10, no.4, July 2003, pp. 234-267.
[5] Steve Lawrence, C.Lee Giles, Ah Chung Tsoi and Andrew D. Back (1997), "Face recognition: A convolutional neural network approach", IEEE Transactions on Neural Networks, vol.8.
[6] Md. Murad Hossain, Abu Sayeed Md. Sohail, Md. Shamsul Alam, Prof. Dr. M A Mottalib , "Step Error Tolerance BPN Learning Algorithm"- A Proposed Algorithm for Multi Layer BPN with Reduced Learning Time. ICCIT-2005.
[7] L. Yin, R. Yang, M. Gabbouj, Y. Neuvo. "Weighted Median Filters: A Tutorial", IEEE Trans. on Circuits and Systems, 43(3), pp. 157-192 (March 1996).
[8] G.A. Baxes. "Digital Image Processing. Principles & Applications", Wiley & Sons (1994).
[9] Anil Jain, Ruud Bolle, Ling Hong, "Online Fingerprint Verification", IEEE Transactions on Pattern Analysis and Machine Intelligence, 1997, vol. 19, no. 4, pp. 311-316.
[10] Umamaheswari, K.; Sumathi, S.; Sivanandam, S.N. "Neuro - Genetic approaches to classification of Face Images with effective feature selection using hybrid classifiers" Advanced Computing and Communications, 2006. ADCOM 2006. International Conference on Volume , Issue , 20-23 Dec. 2006 Page(s):286 - 291
[11] M. Turk, "A random walk through eigenspace," IEICE Trans. Inform. Syst., vol. E84-D, pp. 1586–1695, Dec. 2001.
[12] R. Chellappa, C.L. Wilson, S. Sirohey (1995): Human and machines recognition of faces: a survey. Proc. IEEE 83(5): 705-740.
[13] A.Samal and P.A.Iyengar (1992): Automatic recognition and analysis of human faces and facial expressions: A survey. Pattern Recognition 25(1): 65-77.
[14] Rafael C. Gonzalez and Richard E Woods, "Digital Image Processing", Person Education Asia.
[15] Rafael C. Gonzalez and Richard E Woods," Digital Image Processing Using MATLAB7", Person Education Asia.
[16] S. Rajasekaran & G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms" Prentice-Hall of India Private Limited, 2003.
[17] Md. Murad Hossain and Md. Shamsul Alam,"BD FINE READER: A Bangla Character Recognition System for Converting Printed Bangla Text Documents into Editable Electronics Documents", ICCIT-2006.

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Fuzzy Rule Based System and Metagraph for Risk Management in Electronic Banking Activities

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***Abstract*— Risk Management in Electronic Banking and electronic money is a comprehensive study of the concepts and best practices in electronic banking. Card Swap Machine may be used in very effective and safe manner for electronic banking purposes. It fills a badly needed global requirement for not only bankers but all users of electronic banking then delves into the risks inherent in e-banking including strategic, operational, compliance, reputational and others. This paper provides a broad overview of electronic banking and It also highlights the importance of risk management. Proposed research work in the rule based expert system would overcome the limitations of uncertain and imprecise knowledge representation by using fuzzy logic and fuzzy metagraph. Metagraph is a powerful tool used for visualizing data dependence. It allow one node to have multiple instances and these instances are automatically tracked.**

In the electronic banking sector the most commonly seen risk are primarily of our kinds – reputational, strategic, legal and operational. These are regarded as the most important risks in the global banking industry. The purpose of this paper is to provide

considerations for supervisory authorities and banking organisations as they develop methods for identifying, assessing, managing and controlling the risks associated with electronic banking and electronic money. While providing new opportunities for banks, electronic banking and electronic money activities carry risks as well as benefits and it is important that these risks are recognised and managed in a prudent manner.

***Keywords* — Electronic money, Electronic banking, Fuzzy metagraph**

I. INTRODUCTION

Electronic banking (finance definition) is a form of banking in which funds are transferred electronically between financial institutions instead of cash, checks, or other negotiable instruments being physically exchanged. The ownership of funds and transfers of funds between financial institutions are recorded on computer systems connected by telephone lines. Customers.

of the financial institutions can access their records using a password or personal identification number (PIN).Electronic money (also known as e-money, electronic

cash, electronic currency, digital money, digital cash or digital currency) refers to money or scrip which is exchanged only electronically. Technically electronic or digital money is a representation, or a system of debits and credits. The rapid development of e-banking capabilities carries risks as well as benefits.

It is already accepted that e-banking can be separated into two streams one is e-money products, mainly inthe form of stored value products, the other is electronic delivery channel products or access products. The latter are products that allow consumers to use electronic means of communication to access conventional payment services. As we know the e–money is money that moves electronically and it can be carried on the person to person in the form of a smart card or stored value card or electronic wallets. It can be used at the point of sale and can be moved around or spent through telephone lines to banks or other provides or issuers.

Fuzzy logic was initiated in 1965 by Lotfi A. Zadeh and it was first invented as a representation scheme and calculus for uncertain or vague notions [1]. It is basically a multi-valued logic that allows more human-like interpretation and reasoning in machines. It allows intermediate categories between notations such as true/false, hot/cold, black/white etc. as used in Boolean logic. In fuzzy system values are indicated by a number in the range of 0 to 1. Where 0 represents absolute falseness and 1 represents absolute true. Fuzzy rule based expert system[2] could be used in business, robotics, manufacturing, online servicing and many other field of decision making with imprecise and uncertain knowledge. I use this fuzzy rule based system for risk management.

2. RISK MANAGEMENT

In businesses, risk management entails organized activity to manage uncertainty and threats and involves people following procedures and using tools in order to ensure conformance with risk-management policies.

Risk Management is the area of project management that "identifies as many risk events as possible, minimizes their impact, manages responses to those events that do materialize (contingency plans), and provides contingency funds to cover risk events that actually materialize."

Another source defines risk management as "the act or practice of dealing with risk. It includes planning for risk, assessing (identifying and analyzing) risk issues, developing risk handling strategies and monitoring risks to determine how they have changed."

Types of operational risks

1.People risk: Incompetence, Fraud

2.Process risk:.

Model risk - Model/methodology error,

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