Implementation of Neural Network for Face Recognition Using Gabor Feature Extraction

Miss.Prachi Vetal[1], Dr.R.S.Pawase[2]
PG Student Department of E&TC Microwave Enginerring,AVCOE Sangamner,Savitribai Phule Pune University, Maharashtra, India
Assistant Professor, Department of E&TC AVCOE Sangamner, Savitribai Phule Pune University, Maharashtra, India

***Abstract*- Face recognition is a process of identifying and recognizing a person based on facial features. It is one of the more accepted and widely used biometric techniques today. However there are challenges regarding robustness, rotation-invariant, real-time face recognition technique. Few challenges such as changes in illumination, rotation of the face, different head positions etc. This study mainly consists of feature extraction, training the neural network and face recognition. The most convenient and unique features of the face are extracted in the feature extraction phase. Face recognition is done by trained neural network. The system is trained and tested on Olivetti Research Laboratory (ORL) database.**

Index terms- Face Recognition, Global facial features, Neural Network, ORL database

1. INTRODUCTION

Recently with the rapidly development of computer science, face recognition technology has been widely explored and researched, which has been used in security human-computer intelligent interaction. A Facial Recognition System is a computer application able to identifying an individual from a digital image or video frame. Human being sees and remembers so many peoples face repeatedly in his life. Whenever he meets someone, he remembers someone's peculiar facial features through feature extraction process rather than whole face. So he can recognize face image naturally. Of course this feature extraction process is unconscious activity and is unknown process too us. Therefore we meet difficult barrier in the first step to recognize face using computer. These extracted features are still important information in spite of large changes due to aging, wearing glasses, changes in hairstyles. Thus most researchers on face recognition have concentrated on how to get a good feature vector. In this paper first we extract global Gabor features of human face The first step of face recognition is detection of face location in the given photo. A method that detects faces in every condition is very difficult task. Finding the location of the face in the image is the first step in the system. The Global Facial Features are extracted using a Gabor wavelet filter bank, by applying it on the image. The face registration is don with the help of Feed Forward Neural Network to solve the classification problem. The classifier compares the features vector of the input image with the facial models that are stored in the database and selects the model with the maximum likelihood value.

In order to cope with complication in the task of face recognition variations and find out the true invariant for recognition, researchers have developed various recognition algorithms. There are numerous methods and technologies which have been used for face recognition includes PCA [1], LDA [2], EBGM [3]. In the experiment stage we compare our face recognition algorithm with other technique including PCA, ICA. There are the several methods used for face recognition are Eigen faces, Fisher faces, Independent Component analysis. PCA method reduces dimensionality but disadvantage is that class repeatability remains same and is applicable only in low dimensional subspace. In LDA method reduce dimensionality and increase class repeatability but it needs large training set complex as there is a lot of within-class variation. Another most popular method for face recognition is EBGM. EBGM offers greater accuracy in identifying individuals but disadvantage is that the recognition rate is low. With the reference to above method we conclude that and our

experimental result shows that our proposed method for face recognition is effective and competitive.

This paper is organized as follows: In the next section, we briefly describe Gabor wavelet used for feature extraction. Section 3 introduces the theory of Feed Forward Neural Network. Experimental results are summarized in section 4 followed by discussion and conclusion in section 5.

2. FACE DETECTION

Face detection is the first step in face recognition system. The main aim of face detection is to locate and extract the face region and ignores anything else such as buildings, trees, and background. It has many applications such as content-based image retrieval, intelligent human-computer interfaces, crowed surveillance, video conferencing and video streaming. The man purpose of face detection is to determine where these faces are located at and to determine whether human faces appear in a given image. Face detection deals with many challenges and are usually present in images captured in uncontrolled environments, such as video coding, crowed surveillance, video systems. These challenges can be attributed to several factors such as:

- Pose variation: It's happens due to subject's movements or camera's angle.
- Imaging conditions: Different cameras and conditions can highly affect the quality of an image, and also affecting the appearance of a face.

There are different methods are used for face detection such as Knowledge based method, Template matching method, Appearance based method.

3. FEATURE EXTRACTION

After the face detection, facial features of the faces are extracted from the image. Directly using faces for face recognition have some disadvantages such as large and small pixel size due to which the system becomes robust and some other problems occurs such as pose variation, feature occlusion and imaging conditions. After this step we extract Global facial features by using Gabor filter by applying it on the whole image. There are two types of feature extraction.

- Local features: Extract only Mouth, Nose, and eyes information
- Global features: Extracts features from whole image

Gabor filter introduce in 1946 by Hungarian engineer Denis Gabor. By using Gabor filter for feature extraction we extract features based on transformations or combinations of the original data. It transforms data to select a proper subspace in the original function space. Gabor wavelet filters are constructed to serve as a basis for Fourier transform in information theory application. In image processing a Gabor wavelet filter used as a band-pass linear filter whose impulse response is defined by a harmonic function multiplied by a Gaussian function. Gabor filter presenting optimal localization properties in both spatial and frequency domain. Spatial domain means in which we deal with images as it is. The value of the pixel of the image changes with respect to scene. Whereas, in Frequency domain we deal with the rate at which the pixel are changing in spatial domain. Gabor filter are suited for texture segmentation, edge detection and image representation. Gabor filter can optically capture both local orientation as well as frequency information from an image means the image is filters at various orientations and frequency and standard deviation. Real part of the Gabor representation is used for feature extraction. In which we consider 8 spatial frequencies f at 5 orientations θ. Therefore the 2D Gabor filter bank is composed of 40 channels in total 40 filters is used.

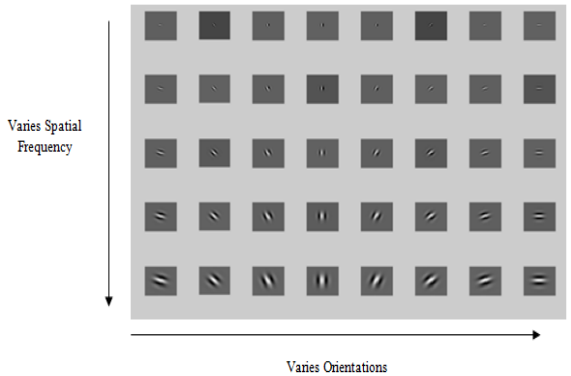

Figure 1: Gabor filter used real part of the input image

Gabor wavelet is a plate wave with decreasing range. After introducing Gabor wavelets the method of feature extraction from human face image is discussed.

$$G_{f,\theta}(x,y) = e^{-[\frac{x_{\theta_n}^2}{\sigma_x^2} + \frac{y_{\theta_n}^2}{\sigma_y^2}]} e^{t(2\pi f x_{\theta_n} + \varphi)} \quad (1)$$

The filter has two components real component and imaginary component. These are representing orthogonal directions. In this work we are using the real part of the Gabor representation.

$$RE_{F,\theta}(x,y) = e^{\cdot -[\frac{x_{\theta_n}^2}{\sigma_x^2} + \frac{y_{\theta_\pi}^2}{\sigma_y^2}]} cos(2\pi f x_{\theta n} + \varphi) \quad (2)$$

Here if input window is a rectangular with dimensions of 18 * 27, then matrix of characteristics will be 144*135. The dimensions of the images are 18*27 given to the database for training. The dimension of the image is directly proportional to the time taken to the database for training. Thus we have chosen smaller value as the dimensions so as to reduce the training time.

Feature extraction involves several following steps:

3. NEURAL NETWORK STRUCTURE

The neural network used here is feed forward neural network which includes input layer, hidden layer, and output layer. While designing the neural network various factors should be considered such as calculation time, responding time, and Generalization capability. To improve network response, the network structure, training data and extracted features plays significant role. As it was observed, after extracting features from face images, data will be transformed into the form of vector with 2160 elements. For better contrast it will adjust the histogram of the image. Then in frequency domain image will be convolved with Gabor filters by multiplying the image with Gabor filter. In order to save the time they have been saved in frequency domain

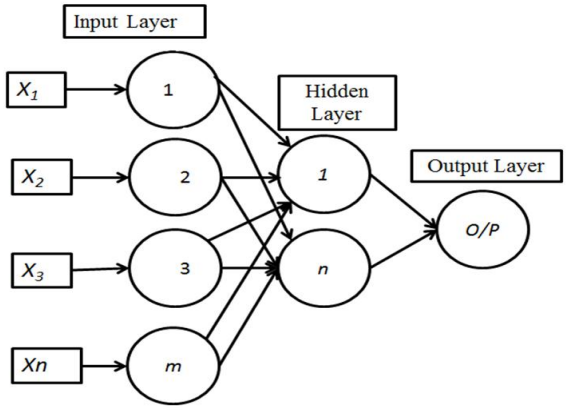

Figure 2: Structure of Pattern -Net

Training the neural network for its face i.e. Employment is difficult from the difficulty in characterizing prototypical "non-face" images. Unlike face recognition, which the classes in order to be discriminated are various other faces, you're a couple of classes in order to end up being discriminated throughout face recognition usually are "images containing faces" in addition to "images not containing faces". The idea is simple to obtain a representative sample of images that contain faces, but much harder for getting a great representative sample of the person which do not. In this work 70 faces and 60 non faces are used in training phase. For reducing network sensitivity every human face image with the angle of 5, 10, 15 degrees in positive and negative directions Are placed in training set.

5. PROPOSED ALGORITHM

The important and very first step in face recognition is the face detection. Face detection localize the face in an image. In this work our system detects the faces in the image.

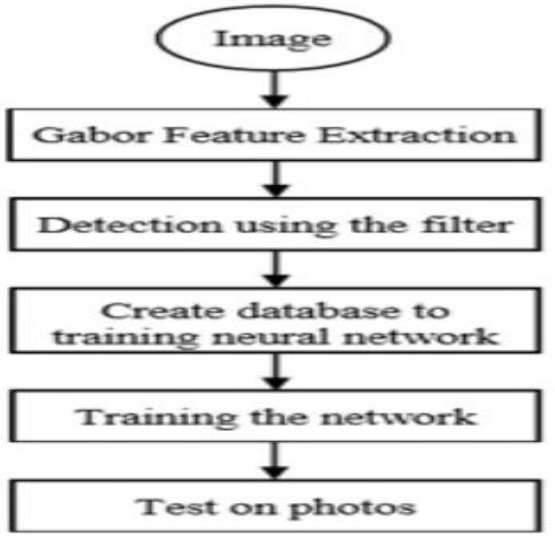

Figure 3: Flowchart for the face recognition

The algorithm for the proposed scheme as follows:

Step 1: Extraction of Feature.

Step 2: Face detection in the image using the output vectors.

Step 3: Create image database for training the feed forward neural network.

Step 4: Initialize the neural network.

Step 5: Train the neural network using the feature vectors.

Step 6: Result is Test on images.

5. EXPERIMENTAL RESULTS AND DISCUSSION

In this paper the detection algorithm result implementation based on neural network are studied. Experiments are conducted by using ORL dataset. The ORL databases consist of 140 frontal faces in which the size of each image is 18 × 27 pixels.

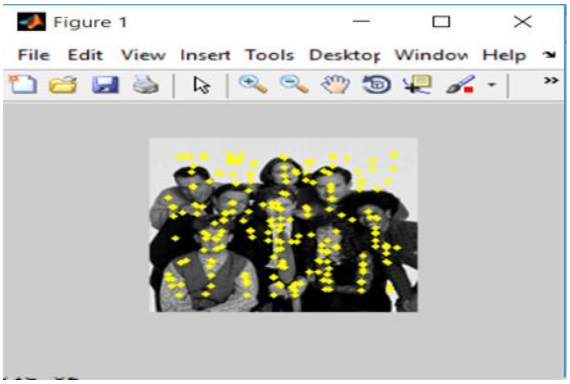

Figure 4: First Section

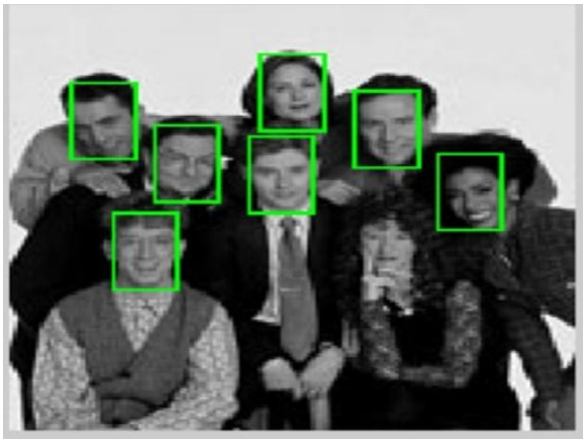

Figure 5: Finding face in test image

Here the faces are recognized by green rectangles and the yellow dots are used to indicate the scanning faces in the test image. In this image one face is not detected and this is the unrecognized face in the test image 1.

6. CONCLUSION

In this work we have proposed a new algorithm for face recognition by combining Gabor-based features with feed forward neural network. When analysing our system recognition rate we can observe that the new method outperforms the other methods. Gabor wavelet filter are used for feature extraction and feed forward neural network to solve classification problem are used. In which face recognition result from test images is fine. For this paper to generate the subject face model the number of neurons are used was determined by trial and error. In future this system can be develops in order to determine the optimal number of neurons contained in the network. In short in face recognition pre-processing of input image, feature extraction and at last comparision is done for matching.

REFERENCES

[1] Ceren Guzel Turhan.* and Hasan Sakir Bilg, ―A Novel Class-wise Two-dimensional Principal Component Analysis Method for Face Recognition

[2] YUAN Wei School of Information, Linyi University - Face Recognition Method Based on Improved LDA , 9th International Conference on Intelligent Human-Machine Systems and Cybernetics.2017

[3] Ridha Ejbali, Mourad Zaied and Chokri Ben Amar - Face recognition based on Beta 2D Elastic Bunch Graph Matching, 13th International Conference on Hybrid Intelligent Systems (HIS), 2013.

[4] Wiskott, L., Fellous, J.-M., Kuiger, N., & von der Malsburg, C. (1997). Face recognition by elastic bunch graph matching. IEEE Transactions on Pattern Analysis and Machine Intelligence

[5] Wang Gamg , DuanHui-Chuan ― a template extraction approach for image recognition‖, IEEE -International symposium on information technology in medicine and education,2012

[6] Amarapur, B., & Patil, N. (2006). The Facial Features Extraction for Face Recognition Based on Geometrical Approach. 2006 Canadian Conference on Electrical and Computer Engineering.,2006

[7] Al-Amin Bhuiyan, and Chang Hong Liu. On Face Recognition using Gabor Filters. World Academy of Science, Engineering and Technology International Journal of Computer and Information Engineering Vol:1, No:4, 2007

[8] Muthukannan K, Latha P and Manimaran . Implementation of artificial neural network for face recognition using gabor feature extraction., muthukannan k et.al. : implementation of

artificial neural network for face recognition using gabor feature extraction doi: 10.21917/ijivp.2013

[9] G. Yang and T. S. Huang, ―Human face detection in complex background,‖ Pattern Recognition Let-ter, vol. 27, no. 1, pp. 53-63, 1994.

[10] Ebrahim Parcham, Neda Mandami, A. Nicki Washington, Hamid R. Arabnia. Facial Expression Recognition based on Fuzzy Networks, 2016 International Conference on Computational Science and Computational Intelligenc.

[11] Ahmad Fadzil M. H., Lim Cheah Choon. Face Recognition Neural Networks System based on and Fuzzy Logic. 0-7803-4 122-8/97 $10.0001 997 IEEE

[12] Kyoung-Man Lim, Young-Chul Sim and Kyung-Wan Oh. A Face Recognition System Using Fuzzy Logic and Artificial Neural Network. 0-7803-02362 192 $3.00 Q 1992 IEEE.

[13] Swati Singh, Ranjeeta Singh. face recognition using gabor wavelet transform and feed forward neural network. International Journal of Advance Research In Science And Engineering IJARSE, Vol. No.3, Issue No.11, November 2014

[14] Omaima N. A. AL-Allaf. review of face detection systems based artificial neural networks algorithms. The International Journal of Multimedia & Its Applications (IJMA) Vol.6, No.1, February 2014.

[15] Eng. Catalin-Mircea Dumitrescu., & Acad. loan Dumitrache (2019). Combining Neural Networks and Global Gabor Features in a Hybrid Face Recognition System. 2019 22nd International Conference on Control Systems and Computer Science (CSCS)(2019)