Average Gabor – Wavelet Filter Feature Extraction Technique for Facial Expression Recognition

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Abstract
Facial Expression Recognition has been a very important topic for research in pattern recognition and currently there is no method of facial Expression recognition system that have 100% recognition rate. So research issues are to improve recognition rate by improving the preprocessing of datasets, improving the feature extraction method and using the best classifier for facial expression recognition. Feature extraction is the key step on which recognition rate depends for facial gesture recognition. High dimension and high redundancy is a problem issue for Gabor while it has maximum variance of features. Dimension and redundancy should be reduced using filtering technique. In the proposed Gabor feature extraction technique the Gabor features are filtered using wavelet transformation and obtained optimum features from facial Gabor matrices.

Keywords
Facial Expression Recognition, Gesture, DWT, Gabor Filter.

I. Introduction

Facial expressions have been studied by cognitive psychologists, social psychologist, neurophysiologists, cognitive scientist and computer scientists [1]. Facial expression recognition also follows the research framework of the traditional pattern recognition, which is composed of three main aspects: facial expression acquisition, feature extraction, and expression classification. Among them, feature extraction is the most critical, which can transform the original space as a smaller dimension space, translate the lattice into images expression in the higher level and finish data mapping [2]. Feature selection (FS) is a global optimization problem in machine learning, which reduces the number of features, removes irrelevant, noisy and redundant data, and results in acceptable recognition accuracy [3]. To detect the facial feature there are three different types of approaches which help in the analysis process [4]: Geometric or Local feature-based approach, Non-Geometric or Appearance or holistic feature based approach and Hybrid approach. In hybrid approach, different feature analysis methods such as Geometric, Non-Geometric are combined and may thus give better recognition results than the individual methods [5].

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II. RELATED WORK

2.1 Gabor Filter Feature Extraction Technique

Gabor filters can be applied to images to extract features aligned at particular angles. The most considerable parameters of a Gabor filter are angle and frequency. Certain features that share similar angle or frequency can be chosen and used to individualize between different facial emotions depicted in images. A Gabor filter can be represented by the following equation [6].

$$\psi(x,y,\lambda,\theta) = \frac{1}{2\pi s_x s_y} e^{-\frac{1}{2}\left(\frac{x_1^2}{s_x^2}+\frac{y_1^2}{s_y^2}\right)} e^{j\frac{2\pi x_1}{\lambda}} \quad (1)$$

(x, y), the pixel position in the spatial domain.
λ, Wavelength or a Reciprocal of frequency of pixels.
θ, Orientation of a gabor filter.
S_x, S_y, Standard deviation of the x & y directions.
The parameters x' and y' are given as equation
x'=xcosθ + ysinθ y'= -xcosθ + ysinθ (2)
The amplitude and phases of Gabor filter bank both contribute valuable cues about specific pattern present in images. The amplitude consists of directional frequency spectrum information and a phase contains information about the location of edges and image details. The feature extraction method converts the pixel data into a higher-level representation of structure, movement, intensity, characteristic of surface, and spatial configuration of the face or its components. The Gabor features are computed by convolution of input image with Gabor filter bank. I(x, y) is a gray-scale face image of size M*N pixels. The feature extraction method can then be defined as a filtering operation of the given face image I(x, y) with the Gabor filter u,v(x, y) of size u and angle v are given as equation [7].
$G_{u,v}(x,y) = I(x,y) * \Psi(x,y)$ (3)

2.2 Discrete Wavelet transform Feature Selection Technique

In the Wavelet transformation the signal is decomposed into different sub-band which has high frequencies called detailed components. The sub-band which has low frequency coefficient is named Approximate Components. Approximate coefficient contains dominant information about gesture and detailed coefficient represents disruption and noise in a signal. So we have to extract low frequency coefficient or approximate components from transformed wavelet coefficient matrix [8].

III. PROPOSED WORK

In the Gabor Filter Feature Extraction technique, the dimension and redundancy is too large for performing feature extraction. To overcome this disadvantage of huge feature vector dimension decrease the size of feature vector So that the down sampling is performed without losing any kind of information. In the Gabor filter feature extraction technique, the problem of feature extraction can be viewed as a dimensionality reduction problem. It refers to transforming the input data into a reduced representation set of features which encode the relevant information from the input data. In my proposed average Gabor wavelet filtering the wavelet transform is applied on each average Gabor matrix which converts it into four equal sub bands LL, LH, HL and HH in which LL sub band have most prominent information or characteristics features and HH sub band represent most redundancy. Using wavelet transform at one level a filtering of a factor of 4 is carried out on average Gabor feature matrix.

IV. EXPERIMENTS & RESULTS

The simulation of proposed work is implemented in MATLAB and JAFFE dataset is used for evaluation of proposed algorithm for facial expression recognition. The JAFFE dataset (Lyons et al., 1998; Zhang et al., 1998) used in experiment contains 213 images posed by 10 female. Among 213 images 150 (70 %) are training image and 63 (30%) are testing image. The images were taken from 10 Japanese female models. Each image has a resolution of 256 x 256 pixels. The number of images corresponding to each of the 7 categories of expression (neutral, happiness, sadness, surprise, anger, disgust and fear) is almost the same 3 or 4. The multiclass AdaBoost classifier is applied for classification of facial expressions. Facial expression recognition based Gabor Filter is implemented as mentioned in section 2.1 Result of facial expression recognition obtained from above feature extraction techniques on JAFFE dataset are shown in Table I. Comparative Graph of correct classification of each expression based on proposed technique and Gabor Filter method proposed method are shown in Figure 4.

V. RESULTS & ANALYSIS

Table 1. Comparison of recognition rate for different technique on JAFEE dataset using Adaboost Classifier

Sno	Expression	Recognition rate (%)
1	Gabor Filter	63%
3	Proposed Gabor Method	75%

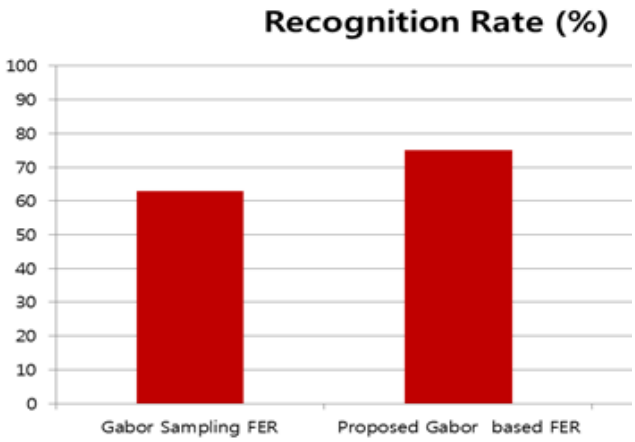

Figure 3: Comparative recognition rate of proposed technique with Gabor sampling Filter feature extraction technique for facial expression recognition

VI. CONCLUSION

High dimension and high redundancy is a problem issue for Gabor while it has maximum variance of features. This high Dimension and redundancy should be reduced using some filtering technique. The dimension and redundancy reduction technique for gabor is called filtering so this whole technique is called gabor filter. In the proposed gabor feature extraction technique the gabor features are filtered using discrete wavelet transformation and obtained optimum features from facial dataset. Proposed algorithms is implemented in Matlab and JAFEE dataset are used for experiment with ratio 70/30 of training/testing with adaboost classifiers for seven different facial expressions: Anger, Disgust, fear, happy, natural, sad, surprise. The results shows that recognition system based on Gabor filter

feature extraction gives 63% recognition rate while Proposed feature extraction technique based facial expression recognition system achieved 75% average recognition rate which shows that proposed technique extracts better feature extraction compared to above technique and reduced generalized error.

VII. FUTURE SCOPE

There is wide future scope in facial expression recognition such as to introduce new feature space in facial expression and improvement of existing techniques reducing their drawback. The proposed concept of combined feature vector can be implemented with more techniques and feature reduction can be done using principle component analysis feature extraction.

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