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# AVERAGE GABOR – WAVELET FILTER FEATURE EXTRACTION TECHNIQUE FOR FACIAL EXPRESSION RECOGNITION

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**ABSTRACT**

*Facial Expression Recognition has been a very essential area for research in pattern acknowledgement and presently, there is no method of a facial expression recognition structure that has a 100% recognition rate or say a 100% efficiency. So find the problems are to increase recognition rate by improving the preprocessing of datasets, and also refining the feature extraction method with using the best classifier for facial expression recognition. Feature extraction is the significant step on which recognition rate totally depends on facial gesture recognition. High dimension and high redundancy are a problem for Gabor while it has an extreme variance of features. Dimension and redundancy should be compact using the filtering practice. In the proposed Gabor feature extraction method, the Gabor features are clarified using wavelet change and obtained optimum features on the facial Gabor matrices.*

***KEYWORDS****: DWT, Facial Expression Recognition, Gabor Filter, Gesture.*

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## Introduction

The facial languages or say expressions have been calculated by intellectual psychologists, societal psychologists, neurophysiologists, cognitive scientists, and computer scientists [1]. Facial expression recognition also tracks the investigation framework of outdated pattern recognition, which is collected of three main characteristics: facial expression acquisition, feature extraction, and expression classification. Between of them, feature extraction is the maximum life-threatening, which can transmute the unique space into a smaller dimension space, translate the lattice into pictures expression at an advanced level and polish data mapping [2].

Feature selection is a worldwide optimization issue in machine learning, which decreases the number of features, unrelated data, earsplitting data, and redundant data, and results in suitable recognition correctness [3].

For the notice of facial feature, there are three types of methodologies that help in the analysis process:

- Geometric or Local feature-based approach
- Non-Geometric or Appearance or holistic feature-based approach
- Hybrid approach. In the hybrid approach

The altered feature analysis approaches such as Geometric, Non-Geometric are combined and may thus give better recognition results than the specific techniques [4] [5].

## Related Work

- **Gabor Filter Feature Extraction Technique**

Gabor filters can be useful to images extract structures, which are aligned at specific angles. The most significant parameters of a Gabor filter are angle and frequency. Definite features that share a similar angle and frequency, they can be selected and used to individualize between different facial reactions depicted in pictures. A Gabor filter can be characterized by the following equation [6].

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

(x, y), the pixel position in the spatial domain.

λ, Wavelength or a Reciprocal of frequency of pixels.

$\theta$, 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 largeness and phases of the Gabor filter panel both contribute valued cues about specific outlines present in pictures. The largeness consists of steering frequency spectrum statistics and a phase contains information about the location of edges and appearance details. The feature extraction technique converts the pixel data into a higher-level symbol of the structure, movement, intensity, characteristic of superficial, and spatial arrangement of the face or its constituents. The Gabor features are figured by convolution of an input image with the Gabor filter store. I(x, y) is a gray-scale face appearance of size M*N pixels. The feature extraction method can then be well-defined as a filtering action of the given face appearance(x, y) with the Gabor filter u,v(x, y) of size u and angle v are specified as equation [7].

$G_{u,v}(x,y) = I(x,y) * \Psi(x,y)$  (3)

- **Discrete Wavelet Transform Feature Selection Technique**

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

**Proposed Work**

In the Gabor Filter Feature Extraction method, the dimension and redundancy are too large for execution feature extraction. To overcome this drawback of huge feature vector dimension, decrease the size of the feature vector, so that the down sampling is executed without losing any kind of data. 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 that encode the related data 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 the most prominent information or characteristics features and HH sub band represent most redundancy. Using wavelet transform at one level filtering of a factor of 4 is accepted on an average Gabor feature matrix.

**Experiments & Results**

The recreation of the projected work is implemented in MATLAB and the IAFFE dataset is used for the calculation of the proposed algorithm for facial expression recognition. The IAFFE dataset (Lyons et al., 1998; Zhang et al., 1998) used in the experiment covers 214pictures posed by 10 women. Amongst 214 pictures 160 (75 %) are training pictures and 64 (30%) are testing pictures. The pictures were taken from 10 Indian feminine models. Each copy has a resolution of 256 x 256 pixels. The number of pictures corresponding to each of the 7 categories of appearance like neutral, happiness, sadness, surprise, anger, disgust, and fear is nearly the same 3 or 4. The multiclass AdaBoost classifier is applied for the organization of facial expressions. Facial expression recognition based Gabor Filter is executed as cited in section result of facial expression recognition gained from above feature extraction methods on IAFFE dataset are shown in Table I. Proportional Graph of correct classification of each expression based on proposed method and proposed method are shown in Figure 4.

**Results & Analysis**

**Table 1: Comparison of Recognition Rate for Different Techniques on IAFEE Dataset using Adaboost Classifier**

| S.No. | Expression | Recognition rate (%) |
|---|---|---|
| 1 | Gabor Filter | 63% |
| 3 | Proposed Gabor Method | 75% |

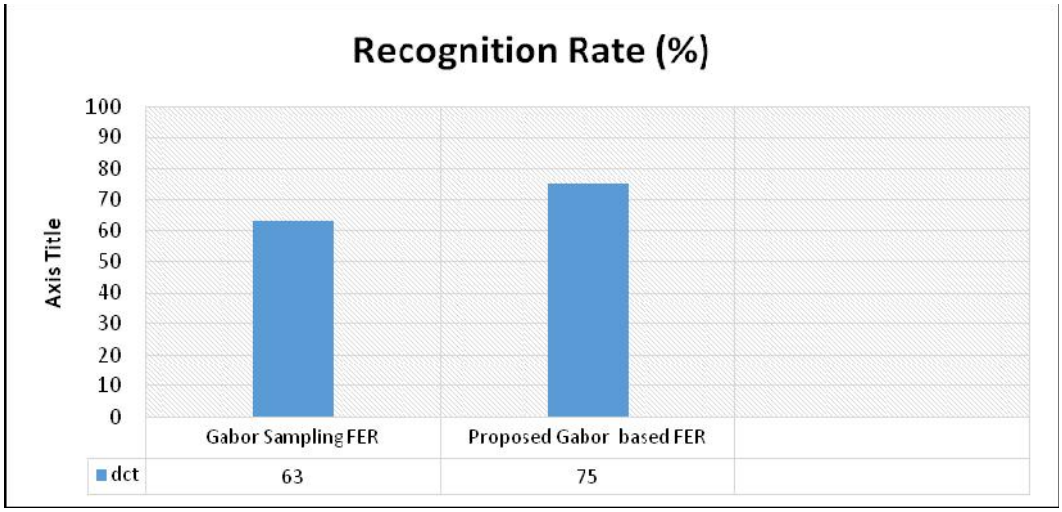


**Figure 3: Comparative recognition rate of the proposed technique with Gabor sampling Filter feature extraction technique for facial expression recognition**

**Conclusion**

This high Dimension and redundancy should be reduced using filtering method. The dimension and redundancy reduction technique for Gabor is called filtering so this whole method is called Gabor filter. In the proposed Gabor feature extraction system, the Gabor features are clarified using discrete wavelet renovation and obtained optimal features from the facial dataset. The proposed algorithms are applied in MATLAB and IAFEE dataset are used for experimentation with ratio of 75/35 training/testing with AdaBoost classifiers for seven altered facial expressions:

- Anger
- Disgust
- Fear
- Happy
- Natural
- Sad
- Surprise

The results show that the recognition structure based on Gabor filter feature extraction gives a 63% recognition rate while the proposed feature extraction method based on facial expression recognition structure achieved a 75%, an average recognition rate which shows that the projected method extracts better feature extraction compared to the overhead methods and also reduced generalized error.

**Future Scope**

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

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