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Wavelet Based Feature Extraction Technique for Face Recognition and Retrieval: A Review

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Abstract:*With enormous growth in video applications, a huge amount of video data is being generated every day. The proposed work is inspired from the same issuein concern face recognition and retrieval. The features are always plays an important role. Meanwhile, most of the features are directly proportional to the accuracy and inversely proportional to the speed.Wavelets have finds third way to find eminent solution to such problems.*

The goal of proposed work is to systematically address the recent work of face recognition and retrieval with Wavelet, through evaluation that permits a meaningful objective comparison of techniques, provides the research community with sufficient data for the exploration of automatic modeling techniques. The outcome of the paper which fulfilled the three objectives-i) study the recent of recent techniques based on Wavelets ii) analyzed the status recent techniques with respect to results and performance with respect to Wavelet iii)various applications based on wavelet based feature extraction Finally, iv) identification of most feasible and optimized technique along with discussion for betterment. Mean while, objective evaluation would be extremely useful to the computer vision research community for years to come.

Keywords:-Wavelets, DWT, Gabor,

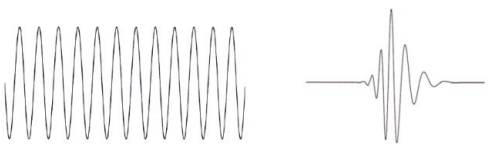
I. INTRODUCTION

With enormous growth in Surveillance and security systems, a huge amount of video data is being generated every day. It would be the future demand for searching, browsing, recognizing and retrieving human face of interest from video database for several applications.

The feature extraction is a special form of dimensionality reduction process. Transforming the input data into the set of features is called feature extraction. If the features extracted are carefully chosen it is expected that the features set will extract the relevant information from the input data in order to perform the desired task using this reduced representation instead of the full size input. Various popular techniques suchas Principal Component Analysis (PCA), Kernel PCA, Linear Discriminate Analysis (LDA), SVM are pixel based feature extraction techniques having good results. The major limitation of these techniques is, features are directly proportional to the accuracy and inversely proportional to the speed. It means if the selected features are more the probability of accuracy also more and rate of speed is less because the selected features are more, it required more time for computation of more features. Wavelets have finds third way to find eminent solution to such problems.

The transform of a signal is just another form of representing the signal. It does not change the information content present in the signal. The Wavelet Transform provides a time-frequency representation of the signal. It was developed to overcome the short coming of the Short Time Fourier Transform (STFT), which can also be used to analyze non-stationary signals. While STFT gives a constant resolution at all frequencies, the Wavelet Transform uses multi-resolution technique by which different frequencies are analyzed with different resolutions.

A wave is an oscillating function of time or space and is periodic. In contrast, wavelets are localized waves. They have their energy concentrated in time or space and are suited to analysis of transient signals. While Fourier Transform and STFT use waves to analyze signals, the Wavelet Transform uses wavelets of finite energy.



(a) (b)

Fig 1: Demonstration of (a)a Wave and (b) a Wavelet

The Wavelet Series is just a sampled version of CWT and its computation may consume significant amount of time and resources, depending on the resolution required. The Discrete Wavelet Transform (DWT), which is based on sub-band coding is found to yield a fast computation of Wavelet Transform. It is easy to implement and reduces the computation time and resources required.

The foundations of DWT go back to 1976 when techniques to decompose discrete time signals were devised. Similar work was done in speech signal coding which was named as sub-band coding. In 1983, a technique similar to sub-band coding was developed which was named pyramidal coding. Later many improvements were made to these coding schemes which resulted in efficient multi-resolution analysis schemes.

The DWT is computed by successive lowpass and highpass filtering of the discrete time-domain signal as shown in figure 2. This is called the Mallat algorithm or Mallat-tree decomposition. Its significance is in the manner it connects the continuous-time mutiresolution to discrete-time filters. In the figure, the signal is denoted by the sequence x[n], where n is an integer. The low pass filter is denoted by G_0 while the high pass filter is denoted by H_0. At each level, the high pass filter produces detail information, d[n], while the low pass filter associated with scaling function produces coarse approximations, a[n].

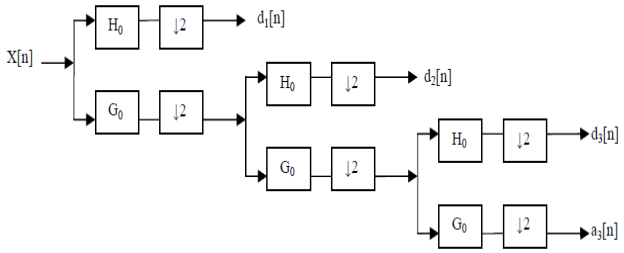


Fig 2: Three-level Wavelet Decomposition tree

At each decomposition level, the half band filters produce signals spanning only half the frequency band. This doubles the frequency resolution as the uncertainity in frequency is reduced by half. In accordance with Nyquist's rule if the original signal has a highest frequency of ω, which requires a sampling frequency of 2ω radians, then it now has a highest frequency of ω/2 radians. It can now be sampled at a frequency of ω radians thus discarding half the samples with no loss of information. This decimation by 2 halves the time resolution as the entire signal is now represented by only half the number of samples. Thus, while the half band low pass filtering removes half of the frequencies and thus halves the resolution, the decimation by 2 doubles the scale.

The outcome of the paper which fulfilled the three objectives-i) study the recent of recent techniques based on Wavelets ii) analyzed the status recent techniques with respect to results and performance with respect to Wavelet iii)various applications based on wavelet based feature extraction finally, iv) identification of most feasible and optimized technique along with discussion for betterment.

The paper is organized as follows- Section II described classification of face tracking. Section III contained important tabular analysis of different approaches significant analysis, performance evaluation and discussion has discussed in Section IV. The paper ends with conclusion in Section V.

II. WAVELET FAMILIES

There are a number of basis functions that can be used as the mother wavelet for Wavelet Transformation. Since the mother wavelet produces all wavelet functions used in the transformation through translation and scaling, it determines the characteristics of the resulting Wavelet Transform. Therefore, the details of the particular application should be taken into account and the appropriate mother wavelet should be chosen in order to use the Wavelet Transform effectively.

Figure 3 illustrates some of the commonly used wavelet functions. Haar wavelet is one of the oldest and simplest wavelet. Therefore, any discussion of wavelets starts with the Haar wavelet. Daubechies wavelets are the most popular wavelets. They represent the foundations of wavelet signal processing and are used in numerous applications.

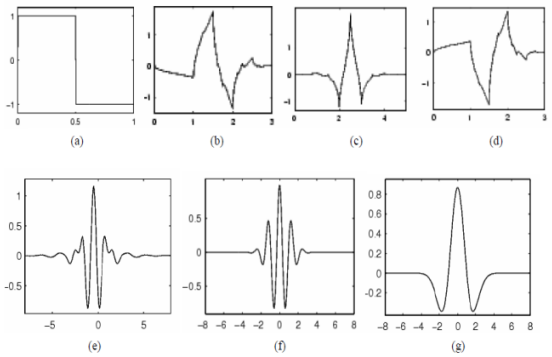


Fig 3: Wavelet families (a) Haar (b) Daubechies4 (c) Coiflet1 (d) Symlet2 (e) Meyer (f) Morlet (g) Mexican Hat.

These are also called Maxflat wavelets as their frequency responses have maximum flatness at frequencies 0 and π. This is a very desirable property in some applications. The Haar, Daubechies, Symlets and Coiflets are compactly supported orthogonal wavelets. These wavelets along with Meyer wavelets are capable of perfect reconstruction. The Meyer, Morlet and Mexican Hat wavelets are symmetric in shape. The wavelets are chosen based on their shape and their ability to analyze the signal in a particular application.

III. LITERATURE REVIEW

In the last decade, a new *mathematical microscope* has allowed scientists and engineers to view the details of time varying and transient phenomena,**in**a manner hitherto not possible through conventional *tools.* This invention, which goes by the name of wavelet.transform, has created revolutionary changes **in** the areas of signal processing, image compression, not to speak about the basic sciences. This novel procedure enables one to achieve the so called *time-frequency* localization and *multi-scale resolution,* by suitably focussing and zooming around the neighborhood of one's choice. Wavelets are of very recent origin; their construction, properties and applications are subjects of intense current research. **In** this article, we explain with illustrations the working of this transform and its advantages vis-a-vis the Fourier transform. [1]propose a Wavelet Transform based analysis method for Face Recognition. This algorithm has been used to extract the features of the FERET face database. Results indicate that the proposed methodology is able to achieve excellent performance with only a very small set of features being used, and its error r ate is calculated using FAR and FRR. The choice of the Wavelet transform in this setting is motivated by its insensitivity to large variation in light direction, face pose, and facial expression. In the experiments we used Correlation and Threshold values to assure high consistency of the produced classification out comes.[2]

Survey of feature extraction techniques[3] has divided into four basic techniques are Knowledge based, Mathematical Transform based, Neural Network or fuzzy extraction and Others. [4] Geometrical ,colour, appearance and template based techniques. A Comparative Study of Feature Extraction Using PCA and LDA for Face Recognition [5].Semisupervised Local Discriminant Analysis for Feature Extraction in HyperspectralImages[6].Local invariant features detector a survey[7]

IV. VARIOUS APPLICATIONS USING WAVELET

There is a wide range of applications for Wavelet Transforms. They are applied in different fields ranging from signal processing to biometrics, and the list is still growing. One of the prominent applications is in the FBI fingerprint compression standard. Wavelet Transforms are used to compress the fingerprint pictures for storage in their data bank. The previously chosen Discrete Cosine Transform (DCT) did not perform well at high compression ratios. It produced severe blocking effects which made it impossible to follow the ridge lines in the fingerprints after reconstruction. This did not happen with Wavelet Transform due to its property of retaining the details present in the data.

In DWT, the most prominent information in the signal appears in high amplitudes and the less prominent information appears in very low amplitudes. Data compression can be achieved by discarding these low amplitudes. The wavelet transforms enables high compression ratios with good quality of reconstruction. At present, the application of wavelets for image compression is one the hottest areas of research. Recently, the Wavelet Transforms have been chosen for the JPEG 2000 compression standard.

Wavelets also find application in speech compression, which reduces transmission time in mobile applications. They are used in denoising, edge detection, feature extraction, speech recognition, echo cancellation and others.

They are very promising for real time audio and video compression applications. Wavelets also have numerous applications in digital communications. Orthogonal Frequency Division Multiplexing (OFDM) is one of them. Wavelets are used in biomedical imaging. For example, the ECG signals, measured from the heart, are analyzed using wavelets or compressed for storage. The popularity of Wavelet Transform is growing because of its ability to reduce distortion in the reconstructed signal while retaining all the significant features present in the signal.
The feature extraction with Discrete Wavelet Transform also used for Speech Recognition [8]
The fine-scale and large-scale information in the original signal is separated into the wavelet detail and approximation coefficients, respectively, and 2) the wavelet decomposition coefficients include all information in the original signal. Thus, multiscale features of the original hyperspectral signal can be extracted directly from the wavelet decomposition coefficients. Infinitely many choices of features could be extracted, including the coefficients themselves or any combination of the coefficients. However, for comparison purposes, other methods of feature extraction were also investigated. The wavelet-based feature extraction is quite a departure from traditional hyperspectral dimensionality reduction methods. It allows the user to extract features related to scale (or frequency) from the hyperspectral signal. Furthermore, hen individual coefficients are used, it allows the user to extract features related to very localized activity in the hyperspectralsignal[9].

The construction of feature vectors is then conducted by thresholding and counting of wavelet coefficients. The proposed feature extraction method can be applied to classifying any kind of bank note. However, in this paper we examine Korean won bills of 1000, 5000 and 10000 won types [10]. Discrete Wavelet Transform for Image Classification[11].

This paper presents a method of features extraction in Speaker Recognition. This methoddivides voice signal into two parts based on the MPEG Psychological Model I, and processesthem respectively. And then we analyze the extracted MFCC parameters, and compare thepartition of frequency-band between Mel-spaced filter group and wavelet packet decomposition. We extract the coefficients by Wavelet Package Transform (called "WPTC") as diagnostic parameters used in the Speaker Recognition. The results of experiments indicated that it perform well than MFCC while using the WPTC based on MPEG-1. [12]

This research proposes feature extraction and classification method using Wavelet. The DWT is used to generate the feature images from individual wavelet sub bands. The feature imagesconstructed from Wavelet Coefficients are used as a feature vector for the further process.[13]

V. USES OF RECOGNITION AND RETRIEVAL

Haar, 9/7 wavelet filters have been implemented as a part of the proposed algorithms due to their simplicity, suitability and regularity for face recognition using multiresolution approaches[14].

According to the fact that the basic features of a palmprint, including principal lines, wrinkles and ridges, have different resolutions, in this paper we analyze palmprints using a multi-resolution method and define a novel palmprint feature, which called wavelet energy feature (WEF), based on the wavelet transform. WEF can reflect the wavelet energy distribution of the principal lines, wrinkles and ridges in different directions at different resolutions (scales), thus it can efficiently characterize palmprints. This paper also analyses the discriminabilities of each level WEF and, according to these discriminabilities, chooses a suitable weight for each level to compute the weighted city block distance for recognition. The experimental results show that the order of the discriminabilities of each level WEF, from strong to weak, is the 4th, 3rd, 5th, 2nd and 1st level. It also shows that WEF is robust to some extent in rotation and translation of the images. Accuracies of 99.24% and 99.45% have been obtained in palmprint verification and palmprint identification, respectively. These results demonstrate the power of the proposed approach[15].

A new face recognition system based on Haar wavelet transform (HWT) and Principal Component Analysis (PCA) using Levenberg-Marquardt backpropagation (LMBP) neural network is presented. The image face is preprocessed and detected. The Haar wavelet is used to form the coefficient matrix for the detected face. The image feature vector is obtained by computing PCA for the coefficient matrix of DWT. A comparison between the proposed recognition system using DWT, PCA and Discrete Cosine Transform (DCT) is also made[16].

Image Retrieval system is an effective and efficient tool for managing large image databases. A content based image retrieval system allows the user to present a query image in order to retrieve images stored in the database according to their similarity to the query image. In this paper content based image retrieval method is used as diagnosis aid in medical fields. The main objective of this paper is to evaluate the retrieval system based on

Texture features. The texture features are extracted by using pyramidal wavelet transform. The major advantage of such an approach is that little human intervention is required. The method is evaluated on Diabetic Retinopathy Database (DRD). Here the precision rate obtained is about 60% for DRD images[17].
In this study we reviewed four important techniques of the face recognition in the feature extraction phase. With regard to the results obtained from several studies and also comparison made on the performance of four techniques of the feature extraction methods in the face recognition, it is concluded that weighted-LBP has the highest recognition rate compared to the rest of the techniques. Non-weighted LBP has the highest performance in the feature extraction among three techniques EBGM, 10-Gabor filter and the 15-Gabor filter. Although the vector length in 10-Gabor and 15-Gabor filters is long, the extracted recognition rates in these two techniques are higher compared to the EBGM and Optimal-EBGM methods[18].

A new method for texture feature extraction and description is proposed. The method starts from whole scale space and whole direction space, and extracts time-frequency coefficients from each scale and each direction using Gabor wavelet. The energy is computed according to the coefficients, and dominant multi-scale and multi-direction fuzzy set is computed based on all energy computed. The standardized energy is used to measure the dominance of each element. Texture feature vector is computed according to the fuzzy set. The similarity measure is carried out between the fuzzy sets. When two images are of the same kind, their similarity measure is carried out between the texture feature vectors of two images[19].

Multiresolution representations and Subspace analysis have been widely accepted in the face recognition systems. This research paper combines the benefits and presents the featureextraction method using Discrete Wavelet Transform (DWT) and Independent Component Analysis (ICA). The DWT provides multiresolution representations and are effective in analyzing the information content of the image and generates the feature sets for images from individual wavelet sub bands. The feature images constructed from Wavelet Coefficients (Cohen DaubechiesFeauveau (CDF-9/7)) are used as a feature vector for ICA based subspace analysis. ICA is an unsupervised statistical method reduces the dimensionality of the feature vector and extracts the information in the higher-order relationship of pixels. ICA method has been used to find statistically independent basis images or coefficients for the face images to deal with the sensitivity to higher order image statistics. Reduced feature vector are used for further classification using Euclidean Distance (ED) classifier. The proposed scheme has been tested on the standard and real-time Database and the results have been reported. It was observed that the proposed method classifies the images with better accuracy and outperforms the existing methods[20]

Wavelet packet analysis (WPA) and gray model (GM) are investigated for nonlinear unsupervised feature extraction of hyperspectral remote sensing data. This letter has addressed the problem of feature extraction for hyperspectral image classification by combining WPA with GM. There are two generic indices to reveal spectral profiles, which are not limited to individual applications. Our proposed feature extraction method is unsupervised and has no need for training samples, which is an advantage over other supervised techniques. Experimental results show that WGFE cannot only largely reduce the dimension of data space but also keep reliable information for classification.[21]

VI. CONCLUSION AND FUTURE SCOPE

The study and analysis would help to identify problems in current techniques and improved by eliminating it. Study assists to use and impact of face recognition and retrieval using wavelet. The proposed work provides review and analysis of recent different available techniques on wavelet. The study leads towards development of improved approach or method which has reduced the existing limitation of system. The categorization and classification has been performed on the available and studied.
Meaningful objective comparison of techniques would provide the research community with sufficient data for the exploration of automatic modeling techniques. We explored the study and analysis for any other available and latest relevant approaches with suitable classification. This work would be extended with using scientific tools and data for evaluation and performance analysis.

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