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AN EXPERIMENTAL STUDY OF FACE RECOGNITION METHOD

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ABSTRACT

The increased use of face recognition techniques leads to the development of improved methods with higher accuracy and efficiency. Currently, there are various face recognition techniques based on different algorithm. In this study, a new method of face recognition is proposed based on the idea of wavelet operators for creating spectral graph wavelet transformation. The proposed idea relies on the spectral graph wavelet kernel procedure. In this proposed method, feature extraction is based on transformation into SGWT by means of spatial domain. For recognition purpose, the feature vectors are used for computation of selected training samples which makes the classification. The decomposition of face image is done using the SGWT. The system identifies the test image by calculating the Euclidean distance. Finally, the study conducted an experiment using the ORL face database. The result states that the recognition accuracy is higher in the proposed system which can be further improved using the number of training images. Overall, the result shows that the proposed method has good performance in terms of accuracy of the face recognition.

Keywords: Face Recognition, Wavelet Theory.

INTRODUCTION

There is increased usage of face recognition in modern life especially in civil security, human resource management, office administration, customer relationship management, and so on. The technology of face recognition is new and going through its infancy stage towards its maturity stage. Generally, in face recognition technology, comparison is made between an image captured

and the database of images to identify a person. In this regard, different algorithms are proposed to make face recognition successful by improving its performance. For example, ZhileRen (2013) proposed a hierarchical segmentation algorithm which initiate the process based on fine over segmentation and subsequently utilize cascades of boundary classifiers for merging regions. Adaption to the segmentation scale by the weights of the region and boundary features is possible using this approach. For maximizing boundary recall, stages of the cascade are trained sequentially with asymmetric loss. The algorithm achieves optimum performance based on data segmentation sets and worked with fewer segments and under most region quality measures. The algorithm is also found to be highly efficient in dense over segmentation regime under boundary-based measures. Another proposed model is by Riaz (2012). The proposed model algorithm overcome the problem of deep face shape models. The proposed model addresses the issue by proposing a discriminative deep face shape model which makes use of augmented factorized three-way restricted Boltzmann machines model. The proposed model is based on the combination of local point detectors in unified framework for bottom up measurement; and embedded face shape patterns for the top down information. For inferring the actual facial point locations and relevant measurements and for important model learning, a suitable algorithm is also proposed. The model shows promising results in both the experimental as well as non-experimental settings.

A unified framework having capability of extracting multiple information from the human faces and effective in facial deformation is proposed by Wu & Ji (2015). The framework by function of single feature vector based on a given image which is representative of an individual identity, age estimation, gender, and facial expressions. It is extracted from image sequence and labelled as spatio-temporal multi feature. the STMF is based on three different features which goes through rigorous testing for establishing their validity. The proposed framework is tested using experimental method and found that it has good success rate for its designed function.

Zhang, Qu, Yang, and Wang (2012) proposed another face recognition system based on uncontrolled settings. The system is based on overcoming illumination and pose variations using the normalization strategies. The system is found to be providing better results compare to the modern system in settings which were not optimal such as outdoor with very bright daylight or rainy days.

Passalis (2011) propose a new system based photometric stereo using the both 2D and 3D for real time face recognition. The system is based on minimum interactions from subjects and constructed using four-source PC devices designed for data capturing.

Face recognition system proposed by Wagner, Wright, Ganesh, Zhou, Mobahi, and Ma (2012) is based on gradient information consist of pixel wise interaction qualities based on small scale neighborhoods. The information is used for incorporation into larger region scale and subsequent encoding for extendable image patches based on their relationships. The final outcome possesses several desirable qualities including accuracy and efficiency in face recognition.

The proposed system also overcome the problems of blurred pictures and poorly illuminated faces.

Most of the algorithms discussed above are based on nearest neighbor classification and generative models for query image and the gallery space. Cao, Wei, Wen, & Sun (2012) proposed a sparse representation scheme based on sparse representation approach. The proposed system is based on large-scale database and utilizes the technique by decomposition of the face recognition procedure into recognition and outlier detection stages. The first stage consists of learning robust metric for general multi subspace framework where outliers and noise are identified. The second stage is based on collaborative representation and learned metric for efficient nonnegative sparse code algorithm.

Manfredi, Grana, Calderara, & Cucchiara (2013) proposed a classification algorithm which works on the basis of linear discriminate regression classification. The proposed algorithm is used for improving the performance of face recognition by using the linear regression classification. The system obtains optimum projection matrix by using the classification algorithm in such a manner that subspace possesses higher discriminatory abilities for classification purpose.

Ahonen, Hadid, Pietikainen (2004) reviewed the probabilistic distribution and intrinsic structure of the error incurred from occlusion using morphological features. Structured sparse error coding model for face recognition is implemented using these two methods. The model is highly efficient and seems to be overcoming the problem of occlusion.

Another model is proposed by Phillips (2003). The model utilizes the cost sensitive subspace analysis approach. The model is based on different types of misclassifications by utilizing a cost matrix.

Guo (2000) proposed a novel face recognition scheme labelled as robust kernel representation model. The technique is based on kernel representation which is a multipartition max pooling technique used for improving the image invariance of local features and reducing registration errors. The kernel representation also integrates with robust regression function for improving the occlusion handling in image recognitions.

Manfredi, et al., (2013) propose a unitary regression classification algorithm which is claimed to enhance the face recognition system robustness by achieving minimum projection error. The system works by reducing intra-class reconstruction errors from all classes to establishes an optimal projection for linear regression. The system utilizes the projection error on the unitary rotation subspace for reducing the errors in recognition stage. In matching stage, automatic approach for matching images with high-resolution images in the frontal pose is conducted.

Tan (2007) propose a Bayesian network based multicamera face recognition system. The system is tailored towards the security cameras-based settings. For achieving robust recognition results, the method utilizes videos from several cameras. Yang (2015) also proposed a cross-model data association approach.

Investigation is made about two different rule-based data. The result shows that along with the facial input, the input from the audio also significantly improves the system accuracy and efficiency. In this paper, a facial recognition method is proposed which utilizes the Spectral Graph wavelet Theory.

PROPOSED PROCEDURE

Wavelet operators is used for creating spectral graph wavelet transformation Leonardi (2013). According to 18, by making use of endless functional calculus, the quantifiable function of flourished self-ad joint rectilinear operator on Hilbert space is proposed. The end is achieved by utilizing the spectral representation of an operator. The following equations represent this idea.

Spectral graph wavelet kernel is represented by g

The wavelet operator is calculated $Tg=g(L)$ and represented by modification of modes as

$Tg f \Delta$

$$tfg \nabla (l) = g(\forall l) f \Delta (I) - 1.1$$

the following equation is obtained by making use of the inverse Fourier transforms yields.

$$(Tg f) (m) = \sum_{N-1} g(\forall) f > (I) X_1 (m) - 1.2$$

$Tg t = g (tL)$ is used for describing the wavelet operators at scale t . the nature of spatial domain graph is discreet, however, the kernel g is continuous in nature. Therefore, any positive real number t scaling is possible. Standardization of SGWT is done using the operators and application for compulsion on single vertex.

$$xt, n(f) = N \sum_{-1} g(t \forall I) X_1 8 * (n) X * (n) X_1 (m) - 1.4$$

the wavelet coefficients given functions can be obtained by obtaining internal product of the wavelets.

By making use of orthonormality of $\{X_1\}$, wavelet coefficients can be obtained using the wavelet operators

By design, the spectral graph wavelets $\forall t, n$ is fully orthogonal for 0 eigenvector X_0 and almost orthogonal for X_1 for $\forall 1$ to 0. The content of f is denoted in smaller frequency for steadily characterization. Its denotation is based on vertices of the graph such that it is convenient to acquaint with next class waveforms which is equal for lowering pass remaining classical wavelet analysis. These spectral graph scaling functions possess equal construction to the SGW. Only one real valued function is used for explaining this i.e. $R \geq +R$. the function of low pass filter is conducted by spectral graph wavelet by

$$h(0) > 0 \text{ and } h(x) \geq 0 \text{ as } x \geq 0$$

$h_n = (n)$ is used for scaling function and for $S_f(n) = \tilde{a}_n$, f is used for coefficient function

Proposed Methodology

For face recognition, feature extraction is main step in our proposed methodology. Transformation in to SGWT is done using the input face image by means of spatial domain. According to this module, wavelet transformation and frequency domain is considered identical. The key reason we are using the SGWT is that it provides synchronized localization in frequency and time domain. The proposed methodology is mainly based on spectral graph wavelet theory which is considered as a filtration technique. It uses response energies which are calculated by taking decomposed sample and respective SWGT coefficient and making it squared. Response energies are calculated by making use of squaring spectral graph wavelet theory which is decomposed coefficient at sub-bands are made. Feature vector is calculated by combining all sub-bands. For recognition purpose, the feature vector consists of energies of sub-bands.

Proposed feature vector is used for computation of selected training samples which makes the classification. The face image is decomposed using the SWGT. In future, a corresponding image is proposed which is unknown for experiment purpose. By making use of Euclidean distance, the feature vector is compared with the feature vector in the database. Recognition is made based on the minimum Euclidean distance.

EXPERIMENTAL RESULTS

The face images which are used in experiment are based on different varieties including changes in pose and facial details and variability in expressions. This end is achieved using the ORL face database. The database consists of 35 individual and corresponding 350 images. All images in the ORL database is considered for experiment purpose. The performance measure is based on accuracy of face recognition. By making use of SGWT, the features are decomposed and then performance is observed.

Table 1: Recognition Accuracy

Decay Level	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	sample 6	Sample 7	Sample 8	Sample 9	Sample 10
1	85.78	83.23	81.23	85.44	88.55	90.12	92.04	91.23	88.54	88.34
2	88.91	82.67	82.35	86.52	88.43	90.34	92.45	93.21	88.32	88.35
3	89.23	84.34	82.56	87.65	88.65	92.23	92.34	91.23	88.91	84.33
4	90.21	85.43	83.45	89.01	88.43	92.13	92.36	93.5	86.54	83.28
5	90.45	84.32	83.43	88.43	87.66	94.32	92.36	90.23	87.34	83.51
6	86.32	82.31	86.71	88.32	88.43	91.26	92.56	90.26	87.31	85.49
7	84.57	85.43	87.54	88.49	89.43	94.31	92.31	91.26	85.43	86.41



Figure 1: Results

The above table present the findings of recognition accuracy which were calculated using the SGWT. For SGWT image decay, the polynomial of laplacian applied to the input vector is 11 and images of maximum 75% are used for neighbor classifier for training purpose. The result

states that the recognition accuracy is increased as the number of training images is increases. However, decomposition level is not much influencing the recognition accuracy. Based on training images of 71%, the 99% accuracy is achieved. Out of 325 images tested, only 8 images were wrongly recognized. The results for the comparison of SGWT and transform of wavelet method, based on changing polynomial order, we found that accuracy of the SGWT was better than the transform of wavelet. Overall, our result shows that the proposed method can be successfully used for facial recognition.

CONCLUSION

The proposed face recognition method in this experimental study is based on the spectral graph wavelet theory. The theory is equivalent to the wavelet transformation. Accordingly, the performance is assessed at each level and computed accuracy is tabulated for the face recognition. The face recognition proposed is based on nearest neighbor classifier and Euclidean distance measure. The experiment result indicate that the system has higher efficiency and accuracy in terms of face recognition.

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