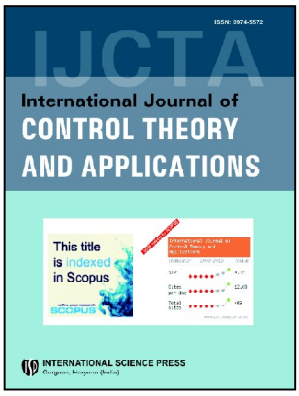

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Dual Feature based angular shift and binary analyzer algorithm with Artificial Neural Network for Face Databases

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Abstract: The face recognition is the process of recognizing the faces from the training database collected with the face images of various angles. The face recognition algorithms are utilized to recognize the persons from the database, which make it applicable in the people databases, criminal databases and social network databases. The primary focus of this paper is to accurately analyze the faces from the input samples with the faces rotated in the images. The training dataset contains the images captured between the -90° and +90° samples. In this paper, the dual feature method has been used over the artificial neural network (ANN) classification for the recognition of the persons from the given set of faces (74 samples) for each person. The angular rotation has been analyzed by using the angular shift mechanism along with the binary feature description based upon the fast retina key points algorithm and ANN classification model. The proposed model has undergone the variety of testing models by using the randomly selected samples. The experimental results have been proved the efficiency of the proposed model in the terms of accuracy and precision.

Keywords: Dual feature descriptor, artificial neural network, angular shift mechanism, angular rotation.

INTRODUCTION

The term 'BIOMETRICS' is a Greek word which is a combination of 'Bio' meaning life and 'Metrics' meaning measurement. Thus Biometrics refers to measurement of human characteristics. It is helpful to recognize the identity of individuals. In biometrics, physiological and behavioral characteristics of individuals are measured.

Physiological characteristics include fingerprints, face recognition, iris, retina etc. whereas behavioral characteristics are concerned with the behavior of an individual for example, gait, voice etc. Biometric characteristics being unique to individuals are more reliable than token or knowledge based more efficient and almost fully automated systems with the advent of computers.

Face recognition is the fundamental feature to recognize different individual's .When there was not any system for face recognition, it was done by humans because at that time, a person was introduced to limited

number of individuals .Now a days a person comes in contact with many more number of individuals due to increased mobility facilitated by new modes of transport. so it has become difficult to recognize all new faces. Hence there arose the need to find some system to recognize right individual. Early Chinese used fingerprints in business transactions to recognize humans.

Sir Francis Galton was of the pioneers on the fingerprint studies. He contributed very much to the field of the field of forensic science. His study of fingerprints is often called Galton details and is still in extent.

Aziz-Ul-Haque designed the fingerprint indexing System in India for the first time for Edward henry who General of police, Bengal, India. This system is known as Henry System and is still being put to use to classify fingerprints.

In 1883, Alphonse Bertillon developed a new system known as Bertllon System. This system was a French Criminologist. Measurements of various persons were written on cards which were then arranged according to age, arm length etc. for future use. This system proved to be a failure when same measurements were found in different persons.

In 1960, a first semi –automatic system for face recognition was developed by Woodrow .W.Bledsoe. This system requires an administrator to find features such as nose, month eyes etc from the photograph. A fully automatic face recognition System was developed in1977.In this system all measurements were taken confidentially. This distance of the eyes, chin width, nose width upper lip, lower lip and other local features were extracted from these measurements.

LITERATURE REVIEW

Tran Binh Long *et al.* [2012] proposed a brand new method for the classification of frontal face pictures. In this approach first of all Pseudo Zernike moment invariants (PZMI) are employed to extract features from the world wide information of the images. After that Radial Basis Function (RBF) Network is used for the classification of facial expressions on the basis of features extracted using PZMI. Preprocessing of the image was done to increase their gray –level that helps to enchance the accuracy of classification. The achieved rate of classification, using TAFFE database was found to be 98.33% which leads one to conclude classification. **Divyarajsinh N. parmer *et al.* [Jan, 2013]** present face recognition problem as a formidable problem in the field of image analysis. The security of information is increasingly becoming more and more difficult as well as significant .CCTV cameras are presently common in air ports, banks ,atm, offices and many other confidential locations .Face recognition is a biometric method employed to identify a person from an image .The best face recognition system should have the ability to detect a face from an features of the image and then recognizing it notwithstanding the lighting, illumination aging, expression, rotation of image or pose. Their paper firstly describes the common methods like holistic method, feature extraction method and hybrid methods. In the second part are described the applications with instances in the third is described the future research direction in the field.

Ma Christiva D.Fermandez *et al.* [2014] in their study presented a method that aims designed and build a face recognition system. In the proposed system, viola jones algorithm is employed for detecting faces from a given image. Artificial Neural Network is utilized to recognize faces that have been detected from the given input image. When implemented the system can recognize faces with 87.05% accuracy. The system yields the best results if the distance between the camera and the person is about 150 cm yielding 87.59% accurate rate. The optimum lighting for this system is 480 lumens with an accuracy rate of 88.64%.For best results, the person must be directly facing the camera.

Zahra Ahmadi *et al.* [July 2014] presented another algorithm for the face detection of identical twins that requires subtle differentiation. In this algorithm, local region pseudo Zernike Moments (PZM) are employed to extract features. Adaboost method is utilized to detect the facial area in the input image. This detected facial area

is broken down into local spaces or regions. Geometric moments in the end to extract features of identical twins to these local spaces .Local region PZM is utilized as feature extractor for identical twins.

Liao S.X *et al.* [Augest, 2014] In this paper an in-depth analysis of the accuracy of Zernike moments in phrases of their discretization mistakes besides the reconstruction power is provided It is discovered that there may be an innate problem in the precision of computing that ZMs because of the geometric nature of the circular domain. To explain it problem the accuracy issue is related to the celebrated/famous problem in analytic number Theory of locating the lathic points in a circle.

EXPERIMENTAL DESIGN

The angular shift mechanism has been included in the proposed to study the variation caused by the degree of rotation of the specific samples. Hence this has been observed that the normalization of degree of rotation can reduce the factors causing the false positive and false negative cases effectively. The face image database has been selected with the degree of rotation between the 0 and 180 degrees, where almost 74 samples of each subject has been stored in the database from the 90 subjects at all. The proposed model polynomial radial factor has been utilized for the reading of the degree of rotation. The data of 90 subjects with 74 samples each (from the Chinese people and with total 6660 images) contains the 2-D grayscale images. To compute the radial polynomial up to the N order to following equation is utilized

$$R_{nm}(\rho) = \sum_{s=0}^{(n-|m|)/2} c(n,m,s)\rho^{n-2s}, \tag{1}$$

Where the sample variance is defined with the variable c and the polynomial vectors are computed accordingly. The n factor represents the degree or radial, whereas the m factors given the angle of the rotation in the azimuth angle factorization. The variance c is evaluated using the following equation:

$$c(n,m,s) = (-1)^S \frac{(n-s)!}{s!((n+|m|)/2-s)!((n-|m|)/2-s)!}. \tag{2}$$

Where n represents the degree or radial and m factors gives the angle of the rotation in the azimuth angle factorization, which is utilized to determine the iteration count. The non-negative factor is computed over the input sample which can also inherit the zero value. The chi-square test is utilized to test the cases given in the form of (n-|m|) factor and (|m|<=n) factor, which are utilized to determine the radial polynomial based degree of rotation of the given sample.

FAST RETINA KEYPOINTS

There are several feature descriptors utilized for the feature description from the training and testing images. The primary feature descriptor class includes the color, texture and pattern based features. The popular color based features includes the histogram of gradients, color illumination, etc, whereas the low level texture features are obtained over the difference of Gaussians, difference of Hessians, laplacian of Gaussians, etc. The binary features returns the mask of the object feature, which is popularly obtained in the form of fast retina key points (FREAK), local binary features. In this research model, the combination of the SURF and FREAK has been used, which combines the low level feature descriptor for texture with the binary mask feature. The speeded up robust features (SURF) works over the difference of Gaussians, which is further processed using the FREAKS features. The visual properties of the input image are obtained using the following equation:

$$d^2_{f,t}(u,v) = \Sigma_{x,y}[f(x,y) - t(x-u, y-v)]^2 \tag{1}$$

Where the input image is represented with the ***f*** factor, and the obtained visual features are stored in the d matrix, which is a binary matrix. The object in the image is obtained using the u and v features along with the binary masking. The x and y shows the position of the object in the x and y coordinates. The proposed model has been designed by using the artificial neural network (ANN) based probabilistic classification model. The ANN model based proposed model algorithm design has elaborated in the following section:

Algorithm 1: ANN based face recognition model

Input: Training Database of Faces

Output: Matching subject index

- Perform the image acquisition
  - Provide the browse option to the user
  - User selects the desired testing sample
  - Acquire the image in the matrix form
- Check if the image is 3-D
  - If image is found 3-D convert to gray
- Apply the rotation shift evaluation algorithm over the image
  - Acquire the object mark
  - Analyze the image matrix against the object mask
  - Determine central point of the primary object
  - Calculate the degree of rotation
  - Calculate the distance from the central point
  - Calculate the visual depth in the terms of focal length
  - Return the feature vector
- Apply the SURF features over the input image
  - Acquire the image matrix
  - Obtain the difference of hessian over the image
  - Find the prominent pixel regions by applying the strong point algorithm
  - Return the strongest point matrix in each iteration
  - Validate the matrix size
  - Return the feature descriptor
- Load the training data build of face images
- Apply the pattern recognition model based the neural network.
  - Create the network using the neural network generation based upon the feed forwards with 10 layers
  - Initialize the neural network parameters
- Run the ANN
  - Acquire the training matrix
  - Prepare the group vector
  - Create the training model using the ANN back propagation training algorithm

- Select the support
- Run the ANN classification
  - Acquire the testing data
  - Pass the testing data to the ANN classification method
  - Return the determined class
  - Return the testing matrix class

RESULT ANALYSIS

Time complexity: The time complexity of the proposed model has been studied in order to study the time based complexity. The proposed model has attained very less time comparatively. The average time taken for the recognition of each subject is pretty much equal to one second while using the ANN for the face recognition.

$$\text{Elapsed Time} = \text{Final Finishing Time} - \text{Beginning Time} \quad (1)$$

Table 4.1
Time Complexity

S. No	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Elapsed Time	1.15	1.14	1.78	1.32	1.04	1.04	1.18	.0.86	1.45	1.05

Angular rotation based evaluation of proposed model

Table 4.2
Angular shift based sample evaluation for the proposed model performance evalaution

Person Angles	*1*	*2*	*3*	*4*	*5*	*6*	*7*
90	8	10	10	10	9	10	10
0	10	10	10	10	9	10	9
-90	10	9	10	10	10	9	10
Overall Accuracy	28	29	30	30	28	29	29

Figure 4.2: The graphical representation of the proposed model over the various degrees

The figure 4.2 declares the robust performance of the proposed model in comparison with the existing models. The proposed model has marked the overall accuracy of nearly 98% in all of the rotations performed over the final database, which have marked the better performance on the basis of the basic performance features. The proposed model has been tested under the extreme angles in the above figure 4.2, which includes the 0 degree and 90 degree samples.

CONCLUSION

The proposed model is based upon the angular shift features for the face recognition in the large face dataset. The face dataset contains the 6660 images from the 90 persons, which has been obtained in the various angles. The angular rotation has been studied after evaluating the face object in the image with the angular shift evaluation mechanism for the estimation of the angular shift features. The angular shift features are combined with quick

binary feature based upon the fast retina key points, which returns the pattern based binary features. The proposed model containing the 6660 images of faces has been evaluated for the performance using the randomly selected test sets. The overall accuracy of the proposed model has been recorded nearly 95% accuracy in comparison with the 87% accuracy in the existing model, where the existing model is based upon the Viola Jones algorithm with the artificial neural network algorithm.

REFERENCES

[1] Chandan Singh, Rahul Upneja, "Fast and accurate method for high order Zernike moments computation", ELSEVIER, Volume 218, Issue 15, 1 April 2012, pp. 7759–7773.

[2] Divyarajsinh N. Parmar1, Brijesh B. Mehta, "Face Recognition Methods & Applications", International Journal of Computer Applications (IJCA),Vol 4, Issue 1, Jan-Feb 2013, pp 84-86.

[3] Chandan Singh *et al.*, "Fusion of Zernike Moments and SIFT Features for Improved Face Recognition", International Journal of Computer Applications (IJCA), April,2012, pp. 26-31.

[4] Chong-Yaw Wee, RaveendranParamesran," On the computational aspects of Zernike moments", ELSEVIER, Volume 25, Issue 6, 1 June 2007, PP.967–980.

[5] Gholam Reza Amayeh, Ali Erol, George Bebis, and Mircea Nicolescu, "Accurate and Efficient Computation of High Order Zernike Moments", Lecture Notes in Computer Science, pp. 1-8.

[6] Hoda Marouf and Karim Faez ,"An Efficient feature extraction method With Pseudo-Zernike moment for facial Recognition of identical twins, International Journal of Computational Science and Information Technology (IJCSITY) Vol.2, No.1, February 2014.

[7] Evangelos Sarýyanidi, Volkan Da¢gl, Salih Cihan Tek, Birkan Tun, Muhittin G¨okmen, "Local Zernike Moments: A New Representation for Face Recognition", IEEE, 2012.

[8] Fernandez, Ma, D. Christina et.al," Simultaneous face detection and recognition using Viola-Jones Algorithms and Artificial Neural Networks for identity Verification", In Region 10 Symposium, 2014 IEEE, IEEE, 2014, pp 672-676.

[9] Nabatchian, A.,Abdel-Raheem, E and Ahmadi, M., "Human Face Recognition Using Different Moment Invariants: A Comparative Study", IEEE, Volume:3, May 2008, pp. 661 – 666.

[10] Naoyuki Nomoto, Yusuke Shinohara, Takayoshi Shiraki, Takumi Kobayashic and Nobuyuki Otsu, "A New Scheme for Image Recognition Using Higher-Order Local Autocorrelation and Factor Analysis", IAPR Conference on Machine VIsion Applications, Vol. 3, 2004, pp. 1-7.

[11] Hayet Boughrara, Mohamed Chtourou, Chokri Ben Amar, "MLP Neural Network Based Face Recognition System Using Constructive Training algorithm", IEEE, 2012, pp. 233-238.

[12] Javad Haddadnia, Majid Ahmadi, Karim Faez, "An Efficient Feature Extraction Method with Pseudo-Zernike Moment in RBF Neural Network-Based Human Face Recognition System", EURASIP Journal on Applied Signal Processing, April 2003, pp. 890-901.

[13] Reza Safabakhsh and Vida Movahedi , "Identification of human face profiles using autocorrelaton coefficients and geometric features", IJCA, 2006, PP. 113-118.

[14] Seyed Mehdi Lajevardi, Zahir M. Hussain, "Higher order orthogonal moments for invariant facial expression recognition", ELSEVIER, 2010, Volume 20, Issue 6, Dec 2010, PP. 1771–1779.

[15] Nurulhuda Ismail, Mas Idayu Md. Sabri, "Review Of Existing Algorithms For Face Detection and Recognition", Recent Advances in Computational Intelligence, Man-Machine Systems And Cybernetics, ISBN: 978-960-474-144-1.

[16] 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, pp-1-16.

[17] Sundus Y. Hasan,"Study of Zernike moments using analytical Zernike polynomials", Advances in Applied Science Research, Volume 3 issue1, 2012, pp. 583-590.

[18] Simon X. Liao and Miroslaw Pawlak, " On the Accuracy of Zernike Moments for Image Analysis", IEEE, VOL. 20, NO. 12, 1998, pp.1358-1364.

[19] Tran Binh Long, Le Hoang Thai, and Tran Hanh, "Facial Expression Classification Method Based on Pseudo Zernike Moment and Radial Basis Function Network", International Journal of Machine Learning and Computing, Vol. 2, No. 4, August 2012 pp. 402-405.

[20] Tolga Alasag and Muhittin Gokmen, "Face Recognition in Low-resolution Images by Using Local Zernike Moments", Proceedings of the International Conference on Machine Vision and Machine Learning Prague, Czech Republic, Aug14-15, 2014, pp 1251-1257.