Iris Recognition using Color Models with Artificial Neural Network

S. B. Kulkarni, U. P. Kulkarni, Siddu Tushara M. S.

Abstract*—Biometrics plays a vital role for an extensive array of highly secure identification and personal verification systems. Iris Recognition is the recognition of an individual based on iris features. It is regarded as the most promising biometric identification system available. In this paper, the iris recognition is applied on UBIRIS database. Image is segmented using circular Hough transform, then converted into a fixed sized rectangular block using Daugman's Rubber sheet model. Iris features are extracted using CMYK color model and a feature vector is created using 2D Walsh Hadamard transform, finally these are classified based on Artificial Neural Network(ANN) using MLP. Based on the database size ROC(Receiver Operating Characteristic) curve is plotted using true positive rate and false positive rate in order to analyze for what size efficiency may be good.

Index Terms- Artificial neural network, Biometrics, Receiver operating characteristic curve.

I. INTRODUCTION

Biometric patterns include physiological or behavioral characteristics of a person. Different biometrics includes face, fingerprint, palm print, palm veins, knuckles, hand geometry, iris, retina, signature, voice etc. Biometric technologies are crucial for an extensive array of highly secure identification and personal verification systems. As the level of security breaches and transaction fraud increases, the need for highly secure identification and personal verification technologies is becoming apparent. Biometric-based solutions are able to provide confidential financial transactions and personal data privacy. Biometric authentication is increasingly being used in areas like banking, retailing, defence, manufacturing, health industry, stock exchange, public sector, airport security, internet security etc. Iris is the most promising amongst various other biometric patterns because of its stability, uniqueness and no invasiveness. Moreover, the left and right eye's iris patterns never match for any individual. As it is impossible to alter the iris images for anybody, it is indeed the most secure and robust biometric pattern that is used in biometric identification system. Iris is comprised of many distinctive features such as arching ligaments, furrows, ridges, crypts, corona and freckles. What is more, iris is protected from the external environment behind the cornea and eyelids. The small scale radial features of the iris remain stable and fixed from about one year of age throughout the life

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All these advantages justify the iris recognition to be a promising field of biometrics.

II. LITERATURE REVIEW

Randy P Broussard et al.[1]. Using Artificial Neural Networks and Feature Saliency Techniques for Improved Iris Segmentation they proposed Feature saliency technique to determine which combination of features contains the greatest discriminatory information. The set of salient features is used as the input to a multi-layer percepton feed-forward artificial neural network trained for classification. Rahib H Abiyev et al.[2] Personal Iris Recognition using Neural Network , Fast algorithm is proposed for the localization of the inner and outer boundaries of the iris region. Located iris is extracted from an eye image, and, after normalization and enhancement, it is represented by a data set. Using this data set a Neural Network (NN) is used for the classification of iris patterns. The adaptive learning strategy is applied for training of the NN. Ruggero Donida Labati et al.[3] Neural based Iterative Approach for Iris Detection in Iris recognition systems Iterative approach to the detection of the iris center and boundaries by using neural networks. Algorithm starts by an initial random point in the input image, then it processes a set of local image properties in a circular region of interest searching for the peculiar transition patterns of the iris boundaries. A trained neural network processes the parameters associated to the extracted boundaries and it estimates the offsets in the vertical and horizontal axis with respect to the estimated center. The coordinates of the starting point are then updated with the processed offsets. The steps are then iterated for a fixed number of epochs, producing iterative refinements of the coordinates of the pupil's center and its boundaries. R M Farouk et al. [4] Iris matching using multi-dimensional artificial neural network, The proposed technique has the distinct advantage of using the entire resized iris as an input at once. It is capable of excellent pattern recognition properties as the iris texture is unique for every person used for recognition. The system is trained and tested using two publicly available databases (CASIA and UBIRIS). The proposed approach shows significant promise and potential for improvements, compared with the other conventional matching techniques with regard to time and efficiency of results. Mrunal M. Khedkar et al. [5] Robust human Iris Pattern Recognition System Using Neural Network Approach Feature extraction algorithms are developed and an optimal feature vector comprising of features in relation to image statistics, texture and 2-D transform domain is formed. It is observed that 2D Walsh Hadamard Transform (WHT) entails the best performance as compared to other image transforms. Different neural network configurations, such as, Multi Layer Perceptron (MLP), Radial Basis Function (RBF) and Support Vector

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Machine (SVM) are implemented after systematically varying the concerned parameters of the respective networks and MLP with single hidden layer is seen to outperform all others with respect to performance on cross validation dataset derived from CASIA iris image database. Tom Fawcett HP Laboratories, MS 1143, 1501 Page Mill Road, Palo Alto, CA 94304[6] ROC Graphs: Notes and Practical Considerations for Researchers Receiver Operating Characteristics (ROC) graphs are a useful technique for organizing classifiers and visualizing their performance. ROC graphs are commonly used in medical decision making, and in recent years have been increasingly adopted in the machine learning and data mining research communities. Although ROC graphs are apparently simple, there are some common misconceptions and pitfalls when using them in practice. This article serves both as a tutorial introduction to ROC graphs and as a practical guide for using them in research.

III. IMPLEMENTATION

Iris reorganization could be implemented in five steps image acquisition, segmentation of an eye, normalization of iris, feature extraction and matching. Initially image acquisition involves the process of acquiring the image of an eye. Further, the eye image needs to be normalized which is done by converting to rectangular block of a fixed size may be of 32 x 256. Next step is to create the person's feature vectors that are extracted, further the features are tested in the classification phase which is performed by the ANN's Multi Layer Perception (MLP) classifier. MLP is one of the most common neural network architectures. It consists an input layer, a hidden layer, and an output layer. Each layer has a certain number of neurons. The number of neurons in the input and output layer depends on number of inputs and outputs of the network. In order to accomplish the work, MATLAB R2012a with Statistics Toolbox, Image Processing Toolbox and Neural network Toolbox are used.

The procedure of the implementation is as shown in the figure.1.

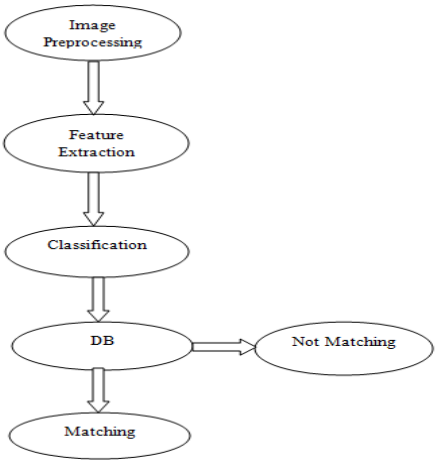

Fig. 1 Flow of the Procedure

IV. EXPERIMENTAL RESULTS

In UBIRS db, there are 241 folders in S1 and S2 respectively. Further tp rate and fp rate are calculated by considering the size of database 20, 40, 60….241 respectively by using LM algorithm of ANN which is used for training the data set. The observations are tabulated in table.1. These observations are used to plot the ROC curve. From these observations the database with 241 size and 20 size has good tp rate. True Positive Rate is calculated using the formula

$$TPR = TP / (TP+FP) \ldots\ldots (1)$$

False Positive Rate is calculated using the formula

$$FPR = FP / (TN+FN) \ldots\ldots (2)$$

Table 1. Observations

UBIRIS Data Base Size	TPR	FPR
20	0.79	0
40	0.66	0
60	0.63	0
80	0.59	0
100	0.517	0
120	0.61	0
140	0.23	0
160	0.196	0
180	0.017	0
200	0.249	0
220	0.171	0
241	0.871	0

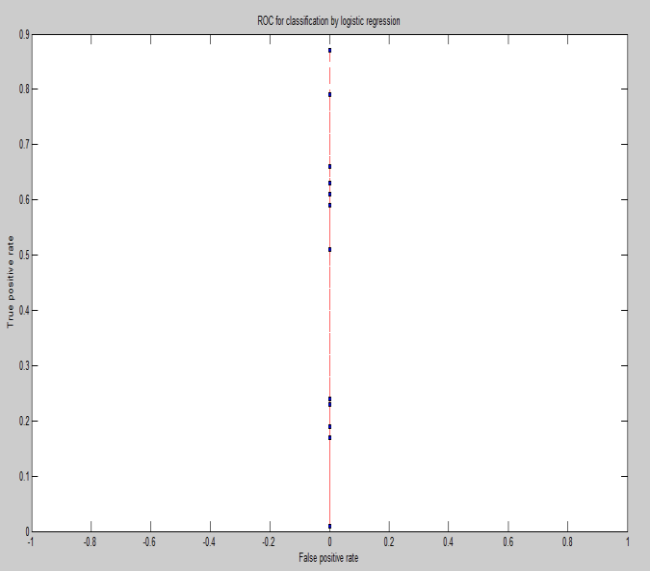

Fig.2. ROC Curve

V. CONCLUSION

Image is segmented using circular Hough transform, then Converted into a fixed sized rectangular block using Daugman's Rubber sheet model. Iris features are extracted using CMYK color model and a feature vector is created using 2D Walsh Hadamard transform, finally these are classified based on Artificial neural Network using MLP. UBIRIS session 1 is trained with the Levenberg Marquardt training algorithm of ANN. The session2 images of the same database is considered for testing. After testing, the TPR is calculated and found that the classification rate is 87.1%.This is the better performance when compared with the AdaBoost algorithm which has the classification rate of 85.7% which was proposed by Xianchao qiu. By using Walsh Hadmard technique for feature extraction and Levenberg Marquardt algorithm of ANN approach got good results for UBRIS large database.

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