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Coss Spectral Iris Recognition Using Artifitial Neural Network

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Abstract: Biometric is defined as study of various methods for measurement of physiological and behavioral characteristics that can be considered to identify a person. Biometric identification of a person gained major importance in the world from its application such as access control and security. The iris recognition is the process of recognition of individual by analyzing random pattern of iris. As compared to several other biometrics, iris recognition system is believed to be more reliable, accurate and scalable for person identification. Iris recognition is one of the booming biometric modalities due to its unique characteristics. The iris structure from human eye can be used for biometric authentication and identification at reduced resolution, iris under uncontrolled illumination, iris at a distance, iris off axis, presence of eyelashes, low accuracy. These type of visible wavelength based iris recognition system eliminate the limitation of iris recognition system that require close range iris imaging under infrared illumination which can be hazardous. I prefer image processing technique for overcoming these difficulties. The challenges emerge when the iris images acquired in one domain is matched against the images acquired in different domain. Such cross-domain iris recognition problem includes the cases when the images in one domain represent the sensor-specific iris images or wavelength-specific iris images. Here a new class of bi-spectral iris recognition system that can simultaneously acquire visible and near infra-red images with pixel-to-pixel correspondences is proposed and evaluated. This paper describes the approaches used by other research group around the world in related area. It also presents a brief overview of digital image processing techniques such as image segmentation, normalization, feature extraction, image restoration and image enhancement.

Keywords— Iris Recognition, Artificial Neural Network, Feed forward Artificial Neural Network, Cross Spectral Matching

I. INTRODUCTION

Biometric characteristic have highly reliable and unique features that make it best suited for security systems over a conventional security systems. Jain et al (1999) identified seven factors that would be used to identify a person's physical or behavioral characteristics. A biometric trait to be used in biometric security systems. The biometric iris recognition is consider to be best identifier for biometric identification. These property makes the biometric as best identifier that are universality, uniqueness, performance, performance quality for being efficient. Sometimes though a biometric trait cannot satisfy all above property, some of them must be satisfied to make a characteristic a biometric trait.

Iris satisfies almost all the factors hence used as a popular biometric trait in biometric recognition systems among various other identifiers. Iris is a well-protected muscle present inside the eye with unique and rich patterns like rings, freckles and crypts. It has a distinguishable color which is immutable and invariant over time. It has been proved that for an individuals. There are differences in iris patterns even between right and left eye. Even iris patterns differ for twins who are identical. Thus recognition techniques developed using iris patterns could be considered as a best suited identification and authentication technique especially in areas like personal authentication systems, time and attendance maintenance systems, law enforcement systems and banking application.

Iris recognition biometrics system are usually taking advantage of image collected using near infrared illuminations. This is due to certain light absorption properties of melanin. While the absorption is significant for light from the visible spectrum, it is almost negligible for higher wavelengths. Higher reflectance enable good visibility of iris texture details even for highly pigmented iris. For this reason most commercial iris cameras collect images under illuminations from the 700-900 nanometer wavelength range. However with thier recent shift in consumer computing towards mobile devices. Visible light cross spectral iris recognition has received considerable attention.

This study aim at analyzing cross spectral performance of the state of the art iris recognition methods when applied with visible spectrum and near infrared images. To our best knowledge this is the first analyze of such kind incorporating high quality, flash illuminated visible light iris images obtained using a mobile phone, which are then matched against NIR illuminated enrollment samples. If good performance of the recognition methods can be achieved, it could pave the way for low effort, real world applications such as user authentication on a mobile device, which would serve as a remote verification terminal complementing typical enrollment setup employing an NIR camera we envisage a scenario in which enrollment stage is performed using a professional NIR setup for purposes such as government issued IDs, travel documents. Then mobile authentication could be performed using a phone or a tablet whenever user deems it necessary.

Basic principles of operations of an iris recognition technique are image acquisition, pre-processing iris segmentation, normalization, feature extraction and comparison of templates against enrolled data for recognition or authentication purpose.

All the algorithms developed so far could be considered advantageous or disadvantageous based on considering the domain area in which it will be applied to work.

In this above system thee feature extraction and the iris template matching stage. Normally, a single iris is said to have more than 266 distinct information in its patterns, where approximately 173 are used in creating templates. This information must be extracted from the normalized iris and should be used for comparison purposes for either personal authentication or identification based on the application area. Thus at the end of the feature extraction stage, a biometric template is created, which is then used for template matching. A biometric template could be an iris code, or an iris signature or a decision tree. These templates are then matched with the help of several available matching techniques, which helps in identifying the similarity levels of two different iris templates. When the two different templates belonging to same eye are matched, it results in a range of values called "intra class variations. Similarly if the templates are from different eyes, range of values is called "inter class variations". Based on these two variation a decision can be made whether the templates belong to sane or two different iris or irises respectively.

II.RELATED WORK

Move on to iris recognition history in the ancient civilizations Egypt to Chaldea in Babylonia, China and Greece believed in a divination concept called Iridology which deals with iris patterns of the eye to predict the health status of an organ in the body. They used to compare the iris of the subject with Iris charts and predict the nature of the behavior of the body organs. In (1885) a French police official, Alphonse Bertillon suggested the use of iris for personal identification based on its texture and color. Later in (1949), James Doggart, examined iris pattern complexity and suggested that it can be used instead of finger print. In (1987) two ophthalmologists Leonard Flom and Aran Safir thorough study they patented Doggart's concept. Variation in iris patterns were observed and was suggested to be used for personal identification for the past one century. A practical or commercial iris recognition algorithm was developed and patented by John Daugman who is a computer scientist only in (1988). After which there is a sudden growth for the past two decades in developing several automated iris recognition systems. But still John Daugman's algorithm forms the basis for all the commercially available iris recognition systems.

In [1], [2] Daugman (1993) design an iris recognition system which is a basis for most developmental activities in this area. Here he acquires human eye with the help of camera and identifies it. It localize two boundary before segmenting an iris, inner pupillary boundary and outer boundary with the help of integro differential operation. In most eyes pupil is not in the center of the iris so pseudo polar coordinates system is bring down to a homogenous rubber sheet model by analyzing the annular rings of the iris and assigning a doubly dimensionless real coordinates. A 2D Gabber filter is used to extract the features from this doubly dimensionless polar coordinates system resulting in a 256 bite iris codes. Main problem arises here is the problem of recognizing a given code as belonging to particular subject or not. Here forms a normalized Hamming distance matrix which uses a fraction of bits that disagree and helps in finding similarity between two codes. The iris code generated by normalized hamming distance matrix helps in easy handling of the iris bit and its matching. This approach provides a noise detection model at the segmentation stage thus resulting with better performance rate. The main challenges in this approaches are presence of noises in image processing technique effects the identification system and eyelid eyelashes occlusion also effect here.

In [3] Wilde (1997) propose an approach which a LED point source was used while acquiring the eye image of the subject along with a video camera. Inner and outer iris boundary is computed with the help of a gradient based binary edge map followed by circular Hough transform. Wilde approaches an isotropic band pass decomposition. This decomposition derived from Laplacian of Gaussian at multiple scales to develop an iris template. Here through this method, this template is used for finding similarity through normalized correlation of the appropriate match. Wildes done his experiments through 60 irises acquired from 40 subjects. Comparing with this work Daugman's approach is simple. The segmentation process done by Wilde is more stable pertaining to noise disturbances. This segmentation approach is the main advantage of this system. Wilde's approaches mainly emphasis toward it's segmentation technique and normalized correlation matching techniques. One of the limitation for this approach is that there is a presence of noise due to specular reflection.

In [4] Kong and Zhang (2001) developed a system. This method mainly concentrated on the noise disturbances, occlusion of eye lashes and specular reflections, involved while segmenting an iris image. Hough transform was use to isolate an iris. 1 D Gabor filters in spatial domain and thresholding functions are to detect eyelid occlusion and specular reflection respectively. Multiple eyelashes were detected with the help of variance of intensity values. 2D Gabor filters were used to extract features and then to design a binary feature vector. A matching score is obtained to find the dissimilarity between any two irises. This approach provides a noise detection model at the segmentation stage thus resulting with better performance rates. The main limitation in this field are accuracy is less comparing with other approaches. Uncontrolled illumination cannot overcome through this above mentioned algorithm.

In [11] MahaSharkas (2016) developed an approach for neural network based approach for iris recognition based on both eyes. In this method use canny edge detection and Hough transform to detect and enhance the image. 2D DWT and fourier transform techniques are used for feature extraction. Here ANN is used as a classifier. The limitation in this field are arises due to poor resolution problem. In this method they do not prefer a method for overcoming uncontrolled illumination.

In [12] Aparna Gale, Suresh Salankar (2016) introduce evolution of analysis of iris recognition system by using hybrid method of feature extraction and matching by hybrid classifier for iris recognition system. In this approach they use Gaussian filter to enhance quality of iris images. Combination of HAAR transform and block sum algorithm descriptors are used to extract final features. Here they uses ANN classifier. The main limitation of this approaches are poor resolution condition and uncontrolled illumination.

In [13] Suchitra Patil , Ujwala Bhangale, Nilkamal More (2017) develop a performance evaluation approach in terms of accuracy and execution time is performed for iris recognition process. Different feature extraction techniques such as DCT , LBG and KFCG algorithm are applied. Efficiency of two color spaces like RGB and HSV are evaluated. This proposed approach does not require iris localization on input images. Iris matching using any feature extraction technique give better result in HSV color space. Vector quantization method is more efficient than transformation method Algorithm gives about 95% accuracy in HSV color space.

A. Structure of Iris Recognition System

The structure of iris recognition system is shown in given figure1.The image recognition system include iris image acquisitions iris recognition. The image recognition system includes preprocessing and neural network. In image acquisition the iris image in the image sequence must be clear and sharp. At that time iris recognition is done through visible camera. When there is low light or uncontrolled illumination at that time NIR image is capture. This is due to the reason that iris not visible at low intensity. Also it form reflection at high intensity of light. Through which during iris acquisition, the iris image in the input sequence must be clear and sharp. Clarity of the iris minute characteristics and sharpness of boundary between pupil and the iris and boundary between iris and sclera affects the quality of the image. When image is in low quality then image become capture through NIR camera. A high quality image must be selected for iris recognition. In preprocessing the iris is detected and extracted from the eye image and normalized. Normalized image after enhancements represent by a matrix that represent gray scale values of the image. This matrix become gray level values of the neural network. If there any image with low intensity or un controlled light the NIR imaging is happen. In neural network iris recognition includes two mode training and testing mode. In training mode of recognition system is carried out using gray values of iris images. After training testing is happen. Neural network is trained with all iris

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images. After training process neural network performs classification and recognition

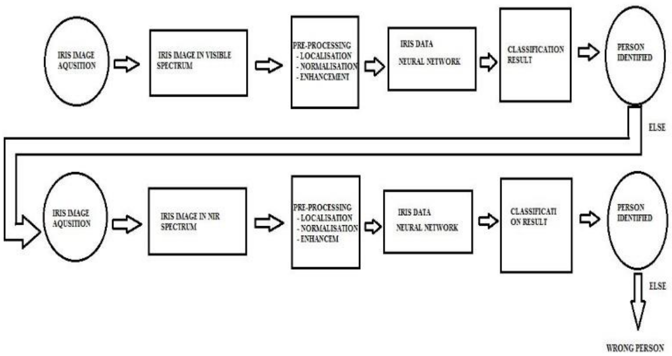

Fig. 1. Structure of iris recognition system.

.B. Iris Localization

When we capture an eye image it contain irrelevant parts such as eye lashes, eyelids, sclera and so on. In localization first step segmentation is done to extract the region from eye image. Iris localization detect iris area between pupil and sclera. Here the main process is to detect inner and outer boundaries of iris. Detection of inner boundary is quite simple but outer boundary is more difficult. We need to determine a circle need to determine a circle. A number of algorithm developed for iris localization. Some of them are based on the Hough transform. An iris segmentation algorithm based on the circular Hough transform is applied. A number of algorithms has been developed for iris localization. Some of them are based on the Hough transform. An iris segmentation algorithm based on the circular Hough transform is applied. In this research canny edge detection algorithm with circular Hough transform is applied to detect the inner and outer boundaries of the iris. The circular Hough transform is employed to reduce the radius and the center coordinates of the pupil and its regions. In this operation starting from the upper left corner of the iris circular Hough transform[6] is applied. This algorithm is used for each inner and outer circle separately.

In this paper a fast algorithm for detecting the boundary between pupil and iris and also sclera and iris has been used. To find the boundary between pupil and iris , we must detect location of the pupil, The rectangular area technique is applied in order to localize pupil and detect thr inner circle of iris. The pupil is a dark circular area in an eye image. Besides the pupil eyelids and eyelashes are also characterized by black color. In some cases the pupil is not located in the middle of the eye image and this causes difficulties finding the exact location of the pupil using point by point comparison on the bastes of threshold technique. Choosing the size of the black rectangular area is important and this effects the accurate determination of the pupils position. If we choose a small size then this area can be found in the eyelash region. In this paper rectangular area is used to accurately detect the location of the pupil .Searching starts from the vertical middle point of the iris image and continue to the right side of the image. A threshold value is used to detect the black rectangular area. Starting from the middle vertical point of the iris image gray scale value of each point is compared with the threshold value as it proven by many experiments gray scale values it in the pupil are very small. So a threshold value can be easily chosen. If gray scale value in each point of iris image are less than the threshold value then the rectangular are will be found. If this condition is not satisfactory for the selected position then the search is continued from the next position. This process starts from the left side of the iris and bit continues until the end of the right side of the iris. In case the black rectangular area is not detected the new position in the upper side of the vertical middle point of the image is selected and the search for the black rectangular area is resumed. If the black rectangular area is not found in the upper side of the eye image then the search is continued in the down side of the image. After finding the black rectangular area is start to detect the boundary of the pupil and iris. At first step the points located in the boundary of pupil and the iris in horizontal direction then the point in the vertical direction are detected. The border of pupil and the iris has a much larger gray scale change value. Using a threshold value on the iris image the algorithm detects the coordinates of the horizontal boundary points of (X1,Y1) and (X1,Y2) . The procedure is applied to find the coordinates of the vertical boundary points (X3,Y3) (X4,Y3). After finding the horizontal and vertical boundary point between the pupil and the iris the following formula is used to find the central coordinates (Xp,Yp) of the pupil.

The same procedure is applied for two different rectangular areas. In case of small difference between coordinates the same procedure is applied for four and more different rectangular areas in order to detect a more accurate position of the pupil center after determining the center points the radius otf the pupil is computed using equation. Because of the change of the gray scale values in the outer boundaries of iris is very soft the current edge detection methods are difficult to implement for detection of outer boundaries. In this research another algorithm is applied in order to detect the outer boundaries of the iris. When starts from the outer boundaries of the pupil and determine the difference of sum of gray scale values between the first ten elements and second ten elements in horizontal direction. This process is continued in the left and right sector of the iris. The difference corresponding to the matrix in minimum value is selected as boundary point. This procedure implemented a formula.

C. Normalization

The iris captured from the different people have different size. The sizes of iris from the same eye may change due to illumination variations, distance from the camera or other factors. At the same time iris and pupil are nonconcentric. These factors may effects recognition the normalization of iris image is implements. In normalization the iris circular region is transform to a rectangular region with a fixed size. With the boundary detected the iris region is normalized from Cartesian [8]coordinates to polar representation.

Normalized iris provides important texture information. This spatial patterns of the iris is characters by the frequency and orientation information that contain freckles, coronas strips ,furrows, crypts and so on

IV. NEURAL NETWORK FOR IRIS RECOGNITION

The normalized and enhanced iris image is represented by a two-dimensional array. This array contains the greyscale values of the texture of the iris pattern. These values are input signals for the neural network. Two hidden layers are used in the NN. In this structure, x1,x2,…,xm are greyscale values of input array that characterizes the iris texture information, P1,P2,…,Pn are output patterns that characterize the irises. The k-th output of neural network is determined by the formula

where vjk are weights between the output and second hidden layers of network, uıj are weights between the hidden layers, wil are weights between the input and first hidden layers, f is the activation function that is used in neurons, xl is input signal.

m is number of neurons in input layer, n is number of neurons in output layer, h1 and h2 are number of neurons in first and second hidden layers, correspondingly. Here yi and yj are output signals of first and second hidden layers[9] , respectively. After activation of neural network, the training of the parameters of NN starts. The trained network is then used for the iris recognition in online regime. 3.2. Parameter learning In this paper, a gradient based learning algorithm with adaptive learning rate is adopted. This allows to guarantee convergence and speed up learning processes. In addition a momentum is used to speed up learning processes. At the beginning, the parameters of NN are generated randomly. The parameters vjk, uij, and wli of NN are weight coefficients of second, third and last layers, respectively. Here k=1,..,n, j=1,..,h2, i=1,..,h1, l=1,..,m. To generate NN recognition model, the training of the weight coefficients of vjk, uij, and wli. s has been carried out. During training the value of the following cost function is calculated.

V. RESULT

In order to evaluate the iris recognition algorithms, the PolyU cross spectral iris iris image database is used. Currently this is largest iris database available in the public domain. This image database contains both visible and NIR data base Experiments are performed in two stages: iris segmentation and iris recognition. At first stage the above described rectangular area algorithm is applied for the localization of irises. The experiments were performed by using Matlab . The average time for the detection of inner and outer circles of the iris images was 0.14s. The accuracy rate was 90%. Also using the same conditions, the computer modelling of the iris localization is carried out by means of Hough transform and Canny edge detection and integrodifferential operator realized by Daugman [1]. The results of Daugman method are difficult for comparison. If we use the algorithm which is given in [16] then the segmentation represents 57.7% of precision. If we take into account the improvements that were done by author then Daugman method presents 100% of precision. The experimental results have shown that the proposed iris localization rectangular area algorithm has better performance. In second stage the iris pattern classification using NN is performed. 50 person's irises are selected from iris database for classification. The detected irises after normalization and enhancement are scaled by using averaging. This help to reduce the size of neural network. Then the images are represented by matrices. These matrices are the input signal for the neural network. The outputs of the neural network are classes of iris patterns. Two hidden layers are used in neural network. The numbers of neurons in first and second hidden layer. Neural learning algorithm is applied in order to solve iris classification. After training the remaining images are used for testing. The recognition rate of NN system was 90 percentage.

V. CONCLUSION

This review discusses a detailed history of how iris has been started to be treated as a biometric trait and a general framework of iris recognition system which are currently being used. The main aim of this work is to provide a timeline view of various iris recognition techniques. Based on this view it is concluded that most of the works carried on iris recognition is more or less similar but the focus was mainly made into 4 major areas namely iris segmentation, normalization which includes noise removal, feature extraction and classification of iris templates. During 1993 - 2002, researchers focused on developing algorithms for all the 4 major areas and were interested in developing their own systems. During 2003 - 2009, major research works had taken place on segmentation stage which involves segmenting the iris and reducing the noises present in it. During 2007 - 2012, majority of the research works were done on developing new feature extraction algorithms and classification of iris further. Until 2006 most of the research works were done on developing new filters and image processing algorithms to enhance the accuracy of the system. But after 2006, this field had seen a tremendous change in which researchers started implementing machine learning algorithms to improve the system accuracy. Recently the focus has moved towards multimodal biometric techniques. A detailed study on various publicly available iris databases is also included after the time-line review. Based on this work it is concluded that though this area has seen a tremendous growth in the past two decades, there are still more possible domain areas available in which this technology can be used by modifying few approaches. The next decade will be more interesting since many robust spontaneous iris recognition systems will be developed and will be deployed in various domain areas like border security systems, immigration checking systems, access control systems both to premises and devices, time and attendance maintenance system

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