Biometric Solution for Person Identification Using Iris Recognition System

Kishori B. Jagtap, M.P.Satone

Department of E&TC Engineering, K.K.Wagh College of Engineering & Research Centre, Nasik, India

Abstract—The features extracted from the human iris can identify individuals even among genetically identical twins. A human iris is fully formed six months after birth and is invariant to physical changes, such as illness or pregnancy, as is the retina (e.g., diabetic retinopathy). As a central component of the Iris recognition system, we present an iris analysis technique that aims to extract and compress the unique features of a given iris with a discrimination criterion using limited storage. The compressed features should be at maximal distance with respect to a reference iris image database. The iris analysis algorithm performs several steps such as the algorithm detects the human iris by using a new model which is able to compensate for the noise introduced by the surrounding eyelashes and eyelids, it converts the isolated iris using a wavelet transform into a standard domain where the common radial patterns of the human iris are concisely represented, and It optimally selects, aligns, and near-optimally compresses the most distinctive transform coefficients for each individual user.

*Index Terms —***Iris Analysis, Support vector machine(SVM), Wavelet coefficients, Feature extraction, Principal Component Analysis (PCA), Discrete Wavelet transform (DWT).**

I. INTRODUCTION

Biometric systems: work by first capturing a sample of the feature, such as recording a digital sound signal for voice recognition, or taking a digital color image for face recognition. The sample is then transformed using some sort of mathematical function into a biometric template. The biometric template will provide a normalized, efficient and highly discriminating representation of the feature, which can then be objectively compared with other templates in order to determine identity. Most biometric systems allow two modes of operation. An enrolment mode for adding templates to a database, and an identification mode, where a template is created for an individual and then a match is searched for in the database of pre-enrolled templates. The iris analysis algorithm consist of: 1) Detection of human iris using new model which is able to compensate noise introduced by the surrounding eyelashes and eyelids 2) Conversion of isolated iris using a Discrete Wavelet transform into standard domain where common radial patterns of the human iris are concisely represented, and 3) it optimally selects, aligns, and compresses most distinctive transform coefficients for each individual user. The purpose of 'Iris Recognition', a biometrical based technology for personal identification and verification, is to recognize a person from his/her iris prints. In fact, iris patterns are characterized by high level of stability and distinctiveness. Each individual has a unique iris the difference even exists between identical twins and between the left and right eye of the same person. The iris is a thin circular diaphragm, which lies between the cornea and the lens of the human eye. The iris is perforated close to its centre by a circular aperture known as the pupil. The function of the iris is to control the amount of light entering through the pupil, and this is done by the sphincter and the dilator muscles, which adjust the size of the pupil. The average diameter of the iris is 12 mm, and the pupil size can vary from 10% to 80% of the iris diameter. The iris is an externally visible, yet protected organ whose unique epigenetic pattern remains stable throughout adult life. These characteristics make it very attractive for use as a biometric for identifying individuals. Image processing techniques can be employed to extract the unique iris pattern from a digitized image of the eye, and encode it into a biometric template, which can be stored in a database. This biometric template contains an objective mathematical representation of the unique information stored in the iris, and allows comparisons to be made between templates.
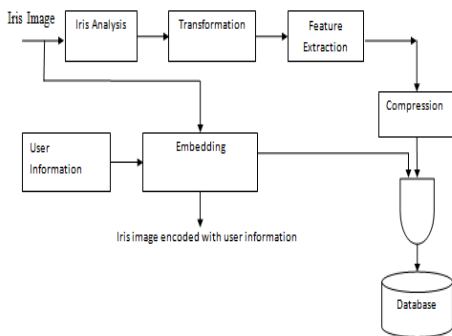
II. RELEVANCE

Today, biometric recognition is a common and reliable way to authenticate the identity of a living person based on physiological or behavioral characteristics. A physiological characteristic is relatively stable physical characteristics, such as fingerprint, iris pattern, facial feature, hand silhouette, etc. This kind of measurement is basically unchanging and unalterable without significant duress. A behavioral characteristic is more a reflection of an individual's psychological makeup as signature, speech pattern, or how one types at a keyboard. The French ophthalmologist Alphonse Bertillon seems to be the first to propose the use of iris pattern (color) as a basis for personal identification. In 1981, after reading many scientific reports describing the iris great variation, Flom and San Francisco ophthalmologist Aran Safir suggested also using the iris as the basis for a biometric. In 1987, they began collaborating with computer scientist John Daugman of Cambridge University in England to develop iris identification software who published his first promising results in 1992. Later on a little similar works have been investigated, such as R.Wildes' W.Boles' and R.Sanchez Reillo's systems, which differ both in the iris features representation (iris signature) and pattern matching algorithms. R.Wildes' solution includes (i) a Hough transform for iris localization, (ii) Laplacian pyramid (multi -scale decomposition) to represent distinctive spatial characteristics of the human iris, and (iii) modified normalized correlation for matching process. W.Boles' prototype operates in building (i) a one dimensional representation of the gray level profiles of the iris followed by obtaining the wavelet transform zero-
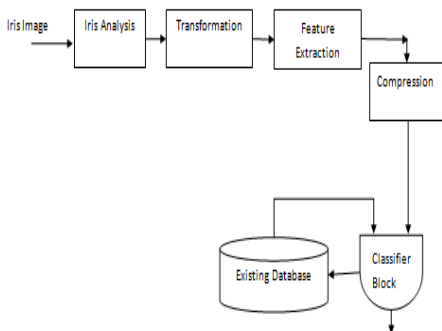
crossings of the resulting representation, and (ii) original dissimilarity functions that enable pertinent information selection for efficient matching computation. To finish J.Daugman's and R.Sanchez-Reillo's systems are implemented exploiting (i) integro differential operators to detect iris inner and outer boundaries, (ii) Gabor filters to extract unique binary vectors constituting iriscode TM, and (iii) a statistical matcher (logical exclusive OR operator) that analyses basically the average Hamming distance between two codes (bit to bit test agreement). Because of unified reference database of iris images does not exist, a classic performance comparison of the described systems is not trivial. However in terms of recognition rates (FAR, FRR), the commercial success of the patented Daugman's system speak in his favor. Indeed Daugman's mathematical algorithms have been contributing to a commercial solution patented by IriScan. This biometric identification platform processes iris recognition through (i) a specific optical unit that enables noninvasive acquisition of iris images, and (ii) a data processing unit. Although capturing a well-defined image of the iris while not interacting actively with the device seems to be one the major challenge we encountered for iris recognition system design, our research focus on the second block both in charge of (i) the enrolment process, and (ii) the matching which quantifies the similarities between two biometric templates.

IV. BLOCK DIAGRAM OF PROPOSED SYSTEM

"Fig 1. Issuer Side Block Diagram"

"Fig 2. Verifier Side Block Diagram"

Iris recognition is the biometric system used for identification of person which achieves offline verification. Iris images from CASIA database are taken to form database for the system. This database of implemented system also consists of user information like name, date of birth, address & PANS number. The complete system operation is divided in two parts, issuer & verifier. Issuer side performs the operation of iris analysis. At the verifier side the authentication is being done. The block diagram of the issuer side of the system is as shown in fig.1. Iris image from the database is given as input for iris analysis. Iris analysis perform pupil detection, edge detection & noise removal on the given iris image. The separated portion of iris from the input image is then transformed using 1 level wavelet transform. The wavelet transform performs the scaling operation which resizes & reshapes the iris image. Then feature extraction is done using PCA (Principal Component Analysis) technique. This features are then compressed using DWT compression technique & it is then stored in database of the system. The user information is then embedded into the iris image, this will generate the iris image encoded with user information. This is also stored in a database. Now, at the verifier side of the system as shown in fig 2. if you will give the same image to the classifier block, it will generate its information by comparing with the existing database. This information further can be used to identify whether the user is authentic or not & accordingly it can be used for the application.

A. Iris Analysis

Image preprocessing is that act of taking an input image I[n,m] of an eye and separating the iris from the surrounding noise, resulting in the output image R[n,m] . Such noise includes the pupil, the cornea, the eyelids, the eyelashes, the eyebrows, and the surrounding skin. Isolating relevant data is of great importance for system performance as the noise factors have a strong and profound effect on the compression and pattern recognition process; in particular, in the presence of a limited storage space. The approach we take is unique to that found in the related literature in that it considers all of these potential noise sources and takes measures to mitigate their effects [13]. Frequently, the presence of eyelashes, difficult to model, is not taken into account in related works. In this work, the philosophy taken is to first eliminate as much noise as possible while secondarily retaining as much of the iris as is possible The iris detection proceeds in three phases. The phases are: 1) detecting the iris center and the pupil; 2) detecting the outer edge of the iris; and 3) removing the surrounding noise from the recovered iris. Each successive step further refines the image removing noise. In the end, the result is an image whose size equals that of the image but where the pixels for non-iris regions have been masked [1].

B. Transformation

Once the iris is detected, it must be transformed into a common domain. The iris width and scale can vary due to dilation and camera positioning, as well as the location of the iris within the image. The annular shape of the iris suggests a transformation of this donut into a rectangle. Further, the dilation of the pupil and its effect on the iris suggests the use of a normalized scale invariant transform.

This would effectively eliminate the effects of pupil dilation and illumination. 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. In DWT, the signal to be analyzed is passed through filters with different cut-off frequencies at different scales.

C. Principal Component Analysis

PCA is a useful statistical technique that has found application in field such as face recognition and image compression, and is a common technique for finding patterns in data of high dimension.

We take this method to extract the iris regions features, and use these steps.

Step 1: Get the data from the iris regions.

Step 2: Subtract the mean. For PCA to work properly, we have to subtract the mean from each of the data dimensions. The mean subtracted is the average across each dimension.

Step 3: Calculate the covariance matrix.

Step 4: Calculate the eigenvectors and eigenvalues of the covariance matrix.

Since the covariance matrix is square, we can calculate the eigenvectors and Eigen values for this matrix. These are rather important, as they tell us useful information about our data.

Step 5: Choosing components and forming a feature vector

Step 6: Deriving the new data set this is the final step in PCA, and is also the easiest. Once we have chosen the components (eigenvectors) that we wish to keep in our data and formed a feature vector, we simply take the transpose of the vector and multiply it on the left of the original data set, transposed. Final Data=Row Feature Vector × Row Data Adjust, Where Row Feature Vector is the matrix with the eigenvectors in the columns transposed so that the eigenvectors are now in the rows, with the most significant eigenvector at the top, and Row Data Adjust is the mean adjusted data transposed, i.e. The data items are in each column, with each row holding a separate dimension.

D. Image Steganography

Steganography is the art of hiding the fact that communication is taking place, by hiding information in other information. The most widely used technique to hide data is the usage of the LSB- Least Significant Bit technique. Least Significant Bit insertion method is a simple approach to embed information in a cover file. The LSB is the lowest order bit in a binary value. This is an important concept in computer data storage and programming that applies to the order in which data are organized, stored or transmitted. Usually, three bits from each pixel can be stored to hide an image in the LSBs of each byte of a 24-bit image [5]. Consequently, LSB requires that only half of the bits in an image be changed when data can be hidden in least and second least significant bits and yet the resulting stegoimage which will be displayed is indistinguishable to the cover image to the human visual system. When using a 24-bit image, a bit of each of the red,
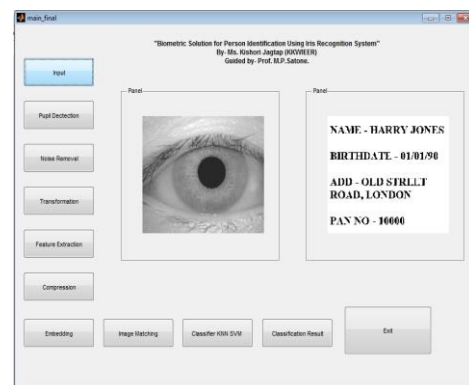
green and blue color components can be used, since they are each represented by a byte. In other words, one can store 3 bits in each pixel. An 800×600 pixel image, can thus store a total amount of 1,440,000 bits or 180,000 bytes of embedded data.

E. Classifier

In this proposed method classifier is used classify the users and then to show their corresponding information so as to authenticate them. We have used two classifiers Support Vector Machine and k-Nearest Neighbor to do the comparative study. k-NN stands for "k-Nearest Neighbor algorithm", it is one of the most simplest and widely used method of machine learning algorithm. It classifying objects based on closest training examples in the feature space. Training process for this algorithm only consists of storing features vectors and labels of the training samples. It utilizes a similarity or distance measure method between training and testing samples. Support vector machine constructs a hyper plane or set of hyper planes in a high- or infinite-dimensional space, which can be used for classification, regression, or other tasks. Intuitively, a good separation is achieved by the hyper plane that has the largest distance to the nearest training data point of any class (so-called functional margin), since in general the larger the margin the lower the generalization error of the classifier.

V. SIMULATION RESULTS

Here the GUI shows all the steps for iris analysis- pupil detection, noise removal. Transformation gives result in popup window which is shown next. The results for Feature extraction & compression are displayed on command window of MATLAB. Embedding performs the embedding operation on iris image. From image matching pushbutton operation of verifier side of the system starts. Using image matching pushbutton image to verify is browsed after that for classification using KNN & SVM classifier, KNN & SVM pushbutton used. To display the result of classification another pushbutton is provided, which displays result in command window of MATLAB. Table I gives the results for average accuracy for both the classification method KNN & SVM.
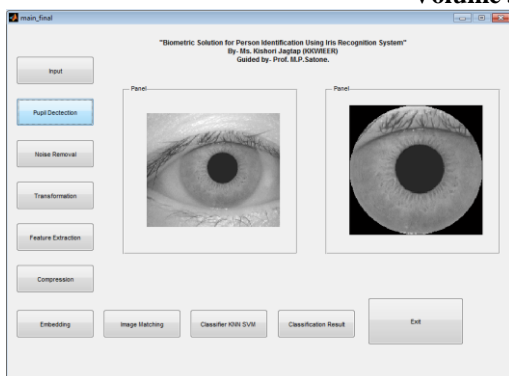

"Fig 3. GUI of Iris Recognition System"

"Fig 4. Result of Pupil Detection with Iris Recognition"

"Fig 5. Result of Noise removal Step"

"Fig 6. Result of Transformation Step"

"Table I: Classification average accuracy with all features"

FOR TRAINING NO. OF INPUT IMAGES CONSIDERED	FOR TEST NO. OF INPUT IMAGES CONSIDERED	CLASSIFICATION ACCURACY FOR CLASSIFIER (%)	
		K-NN	SVM
15	15	60	80

VI. APPLICATIONS

Access control is currently the principal focus of Iris ID's business; it is widely deployed in both public and private sectors around the world, providing state-of-the-art access control to organizations valuing human and physical assets. One area in which Iris ID is gaining considerable attention and acceptance for Iris Access is in data center access control. The repositories of information regarding business, employees, customers and competitors contain a company's most valuable asset - information compiled over time at considerable expense. Iris recognition technology is finding its way into the education sector - not just for security but for other applications as well. It's being used in daycare and schools to restrict access and establish the identity of school employees, as well as parents or other adults who come to school to pick up particular children.
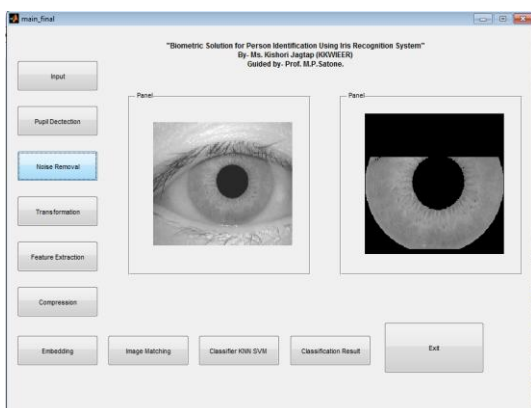
VII. CONCLUSION

The iris recognition algorithms are best suited for applications where subjects are willing to go through enrollment and verification. This method can be used in banking applications to authenticate users who wish to carry out some online transactions. In proposed system iris analysis step performs pupil detection, ring detection & noise removal. For the pupil & iris boundary detection canny edge detection method is used. As canny edge detection holds good results than prewitt's & sobel edge detection as it can identify the weak & strong edges for the image. For noise due to eyelids & eyelashes thresholding technique is used. The separated portion of iris is then resized & shaped using 1 level 2D wavelet transform. Then the approximation sub band image i.e. image from LL sub band is used to extract the features. These features are then compressed using DWT. For feature extraction PCA method is used. Then LSB algorithm is used to embed the user information into iris image. For the creation of database for proposed system CASIA database iris images are used. Now, for the verification of the user we have used classifier such as KNN & SVM. Out of the two classifiers SVM has better results almost around 80%. The accuracy of the system can be improved by using genetic algorithms. The iris biometric method is already being used in identification and authentication in many UK airports and the UAE. The effectiveness of the iris biometric method can be much higher if used in combination with other biometrics (to be multimodal), or used in combination with a password/PIN, or token. This can also address the limitation of the iris method for users who are blind, or whose irises are affected some eye disease (drooping eyelids, cataracts etc.).
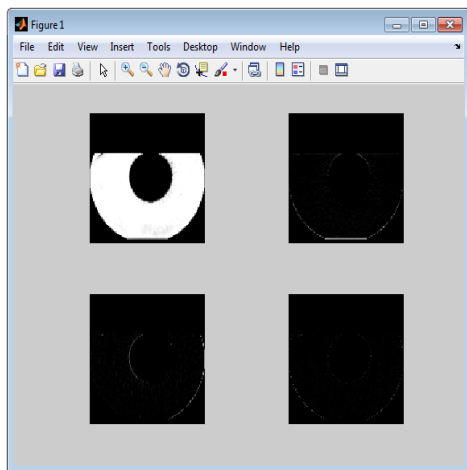
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