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IRIS RECOGNITION BASED LEARNING `VECTOR QUANTIZATION AND LOCAL BINARY PATTERNS ON IRIS MATCHING

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***Abstract*— Iris recognition is a biometric system for access control that uses the most unique characteristic of the human body, the iris employed in automated border crossings. This is Local binary pattern (LBP) is used for feature vectors extraction and Learning Vector Quantization (LVQ) performs classification. Here, matching is performed using the hamming distance of iris detections of matching. Iris images are selected from the CASIA Database, then the iris and pupil boundary are detected from rest of the eye image. It has been found that several accurate iris recognition algorithms use multiscale techniques, which provide a well-suited representation for iris recognition. Also we create Lab information of the users. All the images used in this paper were collected from the Chinese Academy Automation (CASIA) iris database VI.0 with 20 subjects in it.**

***Index Terms*— Gabor filter, local binary pattern (LBP), learning vector quantization (LVQ).**

I. INTRODUCTION

Biometrics system has the potential for application to identification and verification of individuals for controlling access to secured areas, many countries support biometrics research after 9 11. There are iris matching in learning vector quantization and local binary patterns on iris matching based research. Iris recognition has become an active research since the concept of an iris recognition system was first proposed by Flam and Safi in 1987. Iris recognition is a rapidly expanding method of biometric authentication that uses pattern-recognition techniques on images of irises to uniquely identify an individual been extensively deployed in commercial iris recognition systems for various security applications and more than 50 million persons have been enrolled using Iris Code recognition is the most promising for high environments among various biometric techniques (face, fingerprint, palm vein, signature, palm print, iris, etc.) because of its unique, stable, and noninvasive characteristics code is a set of bits, each one of which indicates whether a given band pass texture filter applied at a given point on the iris image has a negative or nonnegative result3. Unlike other biometrics such as fingerprints and face, the distinct aspect of iris comes from randomly distributed features. Iris recognition is one of the most reliable noninvasive methods of personal identification owing to the stability of the iris over one's lifetime. In the year 1994, John Daugman patented his "biometrics personal identification system based on iris analysis"[1][2][3].

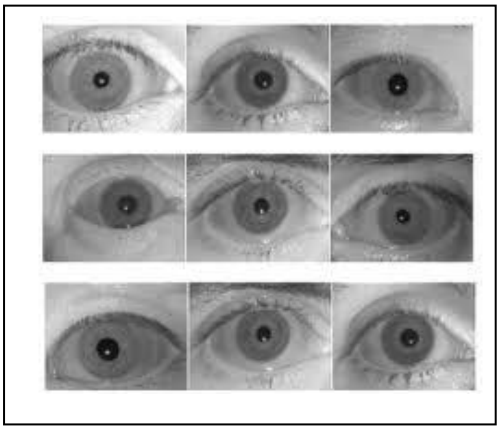


Fig.1. Sample of Iris Images

The iris patterns of the two eyes of an individual or those of identical twins are completely independent and uncorrelated [4]. Iris recognition system can be used to either prevent unauthorized access or identity individuals using a facility. Biometric authentication has been receiving extensive attention over the past decade with increasing demands in automated personal identification. Among many biometrics techniques, iris recognition is one of the most promising approaches due to its high reliability for personal identification [5–14]. the above problem, as one of the algorithms which compares iris images directly without encoding [13, 14], this paper presents an efficient algorithm using phase-based image matching – an image matching technique using only the phase components in 2D DFTs (Two-Dimensional Discrete Fourier Transforms) of given images. The technique has been successfully applied to high accuracy image registration tasks for computer vision applications [9–11], where estimation of sub-pixel image translation is a major concern. In our previous work [15], on the other hand, we have proposed an efficient fingerprint recognition algorithm using phase-based image matching, and have developed commercial fingerprint verification units [16].

The identification based on iris pattern has some advantages, which are:

1) Iris is a highly protected, internal organ of the eye.

2) Iris is visible from a distance.

3) Iris patterns possess a high degree of randomness.

4) Changing the size of the pupil confirms natural physiology.

5) Limited genetic pen trance.

6) Iris is stable throughout life.

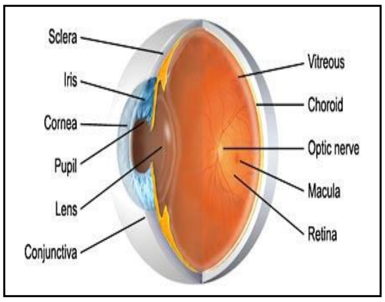


Fig. 2. Anatomy of human eye

Human iris identification process is basically divided into four steps:

- **Localization -** The inner and the outer boundaries of the iris are calculated.
- **Normalization -** Iris of different people may be captured in different size, for the same person also size may vary because of the variation in illumination and other factors.
- **Feature extraction -** Iris provides abundant texture information. a feature vector is formed which consists of the ordered sequence of features extracted from the various representation of the iris images.
- **Matching -** The feature vectors are classified through different thresholding techniques like Hamming Distance, weight vector and winner selection, dissimilarity function, etc the process of iris recognition system consists of:-

(i) Image acquisition

(ii) Preprocessing the iris image including iris localization, image normalization and polar transformation,

(iii) Iris Feature extraction and

(iv) Iris matching.

Iris patterns are formed by combined layers of pigmented epithelial cells, muscles for controlling the pupil, a stromal layer consisting of connective tissue, blood vessels and an anterior border layer [18, 17]. Iris recognition analyzes the

Iris pattern. Iris pattern is a combination of specific racteristics

such as cornea, filaments, crypts, freckles, pits, radial furrows and striations. Iris patterns are more unique, table and reliable

with agein comparison with other biometric features such as

Fingerprints and faces [3]

The physiological complexity of the organ results in the random patterns of the iris, which are statistically unique and suitable for biometric measurements [19]. In addition, iris patterns are stable over time and only minor changes happen to them throughout an individual's life [20]. It is also an internal organ, located behind the cornea and aqueous humor and is well protected from the external environment. This characteristics such as being protected from the environment and having more reliable stability over time, compared to other popular biometrics, have well justified the ongoing research and investments on iris recognition by various researchers and industries around the world. Compared to other biometric systems, iris recognition has been in the limelight for high-security biometric applications.

A. FEATURES OF IRIS

It is the colored portion (brown or blue) of the eye that regulates the size of the pupil. The coloration and structure of two irises is genetically linked but the details of patterns are not. They have stable and distinctive features for personal identification. They are stable with age. Extremely data rich physical structure having large number of features. Its inherent isolation and protection from the external environment. The impossibility of surgically modifying it without unacceptable risk to vision.

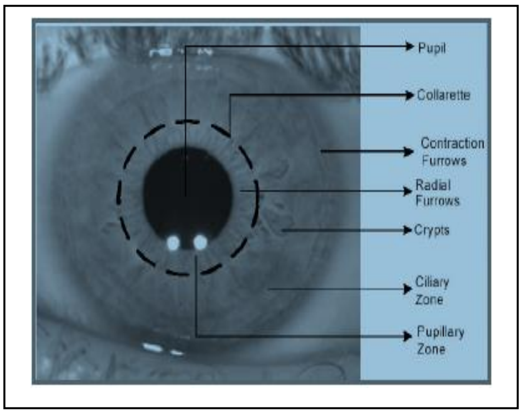


Fig. 3.Front View of the Eye.

B. Related Work in iris

Daugman made use of multistage Gabor filters to demodulate texture phase structure information of the iris [21-22]. The resulting 2048 component iris code was used to describe an iris. The difference between a pair of iris codes was measured by their Hamming distance. Similar to the matching scheme of Daugman, they sampled binary emergent frequency functions to form a feature vector and used Hamming distance for matching. The correlation filter of each class was designed using the two-dimensional (2-D) Fourier transforms of training images. If the correlation output (the inverse Fourier transform and correlation filter) exhibited a sharp peak the input image was determined to be from an authorized subject otherwise an imposter. The localization algorithm makes use of the first derivative of the image to the find the boundaries of the iris. The normalization process produces iris regions, which have the same constant dimensions, so that two photographs of the same iris under different conditions will have characteristic features at the same spatial location. Research in the area of iris recognition has been receiving considerable attention and a number of techniques and algorithms have been proposed over the last few years. Flom and Safir first proposed the concept of automated iris recognition in 1987 [23]. Since then, a number of researchers have worked on iris representation and matching and have achieved great progress [22]. Daugman made use of multiscale Gabor filters to demodulate texture phase structure information of the iris. Filtering an iris image with a family of filters resulted in 1024 complex-valued phasors which denote the phase structure of the iris at different scales. Each phasor was then quantized to one of the four quadrants in the complex plane. The resulting 2048-component iris code was used to describe an iris. The difference between a pair of iris codes was measured by their Hamming distance. Sanchez-Reillo and Sanchez-Avila [23].

II. Iris recognition system

A. Image Acquisition

It deals with capturing of a high quality image of the iris. Concerns on the image acquisition rigs, Obtain images with sufficient resolution and sharpness. Good contrast in the iris pattern with proper illumination. Well centered without unduly constraining the operator**.** It deals with capturing of a high quality image of the iris. Concerns on the image acquisition rigs, Obtain images with sufficient resolution and sharpness. Good contrast in the iris pattern with proper illumination.

B. Iris Localization

Iris localization is a process to isolate the iris region from the rest of the acquired image. Iris can be approximated by two circles, one for iris/sclera boundary and another for iris/pupil boundary. The iris is an annular part between the pupil (inner boundary) and the sclera (outer boundary). Both the inner boundary and the outer boundary of a typical iris can approximately be considered as circles. Iris localization by definition means to isolate the actual iris region in a digital eye image by detecting the inner and outer boundary of the iris.

C. Feature Extraction with iris

Feature encoding was implemented by convolving the normalized iris pattern with 1D Log-Gaber wavelet.2D normalized patterns are broken up into a number of 1D signal. Each row corresponds to a circular ring on the iris region. The angular direction is taken rather than the radial one, which corresponds to columns of normalized pattern. The features are extracted in codes of 0 and 1.

D. Template Matching

For matching, the Hamming distance was chosen as a metric for recognition. The result of this computation is then used as the goodness of match, with smaller values indicating better matches. If two patterns are derived from same iris, the hamming distance between them will be close to 0 due to high correlation.

III. Methodology

Iris recognition systems can be explained as follows:-

1. Input image
2. Preprocessing
3. Normalization.
4. Matching image.
5. Feature extraction.
6. Enhancement.

Normalization of Iris Using Gabor Filter: In normalization the obtained iris region is transformed in order to have fixed dimensions for the purpose of comparison.

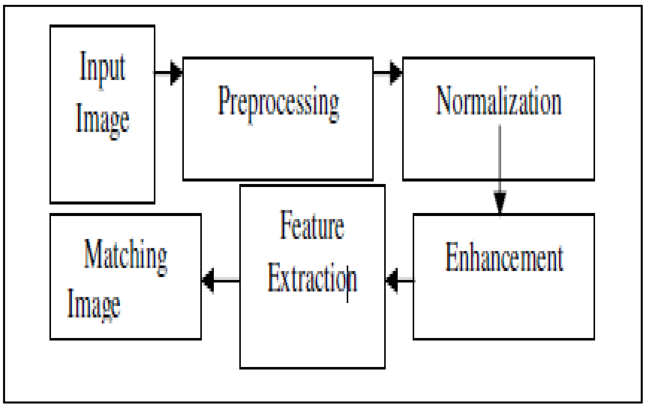


Fig.4. Block Diagram of Proposed System

Gabor filter is used for the purpose of normalization. It is a linear filter used for edge detection. The one dimensional Gabor filter is defined as the multiplication of cosine wave with a Gaussian window as follows.

$$g_e(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{\frac{-x^2}{2\sigma^2}} \cos(2\pi\omega_0 x)$$
(1)

$$g_o(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{\frac{-x^2}{2\sigma^2}} \sin(2\pi\omega_0 x)$$
(2)

Where, ω0-centre frequency and σ - the spread of the Gaussian window.

Daugman extended the Gabor filter to two dimensions

$$g_e(x) = \frac{1}{2\pi\sigma_x\sigma_y} e^{\frac{-1}{2}\left(\frac{x^2}{\sigma_x}+\frac{y^2}{\sigma_y}\right)} \cos(2\pi\omega_0 x + 2\pi\omega_0 y)$$
(3)

$$g_o(x) = \frac{1}{2\pi\sigma_x\sigma_y} e^{\frac{-1}{2}\left(\frac{x^2}{\sigma_x}+\frac{y^2}{\sigma_y}\right)} \sin(2\pi\omega_0 x + 2\pi\omega_0 y)$$
(4)

Feature Extraction with Local Binary Pattern: Local binary patterns are a type of feature used for classification in computer vision. LBP was first described in 1994. It has since been found to be a powerful feature for texture classification. It has further been determined that when LBP is combined with the histogram of oriented gradients (HOS) classifier, it improves the detection performance considerable on some datasets.

A. Concept of LBP

The local binary pattern (LBP) operator is defined as a gray-scale invariant texture measure, derived from a general definition of texture in a local neighborhood. Through its recent extensions, the LBP operator has been made into a really powerful measure of image texture, showing excellent results in many empirical studies. The LBP operator can be seen as a unifying approach to the traditionally divergent statistical and structural models of texture analysis. Perhaps the most important property of the LBP operator in real-world applications is its invariance against monotonic gray level changes. Another equally important is its computational simplicity, which makes it possible to analyze images in challenging real-time settings. The LBP method and its variants have already been used in a large number of applications all over the world. The LBP feature vector, in its simplest form, is created in the following manner: i. Divide the examined window to cells ii. For each pixel in a cell, compare the pixel to each of its 8 neighbors (on its left-top, left-middle, left-bottom, right-top, etc.). Follow the pixels along a circle, i.e. clockwise or counter- lock wise. iii. Where the center pixel's value is greater than the neighbor, write "1". Otherwise, write "0" The feature vector now can be processed using the Support vector machine or some other machine-learning algorithm, to produce a classifier. Here, features of iris textures are extracted using Local Binary Patterns (LBP). LBP operator forms labels for the image pixels by thresholding the neighborhood of each pixel and considering the result as a binary number.

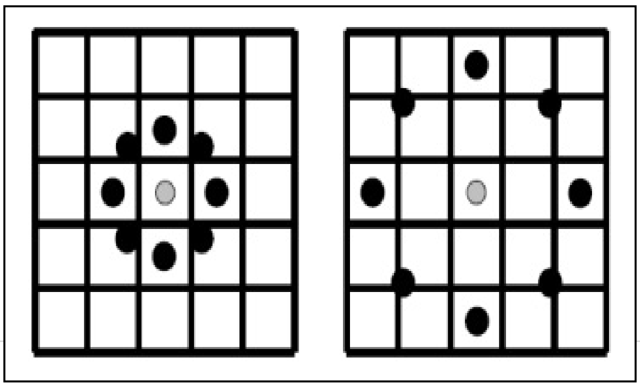


Fig.5. Three neighborhood examples used to define a texture

LBP provides fast feature extraction and texture classification. Due to its discriminative power and computational simplicity, the LBP texture operator has become a popular approach in various applications like image retrieval, remote sensing, biomedical image analysis, motion analysis etc…. to extract the entire iris template features. Here, LBP is used to extract the features of the normalized iris image. And so, the output of LBP is feature vectors with dimension. Finally this feature vectors are given as input to the LVQ Classifiers.

B. Classification with Learning Vector Quantization

A competitive layer automatically learns to classify input vectors. However, the classes that the competitive layer finds are dependent only on the distance between input vectors. If two input vectors are very similar, the competitive layer probably will put them in the same class. There is no mechanism in a strictly competitive layer design to say whether or not any two input vectors are in the same class or different classes. LVQ networks, on the other hand, learn to classify input vectors into target classes chosen by the user. An LVQ network has a first competitive layer and a second linear layer. The competitive layer learns to classify input vectors in much the same way as the competitive layers of Self-Organizing Feature Maps. The linear layer transforms the competitive layer's classes into target classifications defined by the user. The classes learned by the competitive layer are referred to as subclasses and that classes of the linear layer as target classes. In the training process of LVQ different computational paradigms were used. It is a pattern classification method, in which here each output node is represented as a class. The weight vector of an output node is called a reference or codebook vector. LVQ will classify one main class and neglects the others.

C. Matching

Iris matching The Hamming distance gives a measure of how many bits are the same between two bit patterns. Using the Hamming distance of two bit patterns, a decision can be made as to whether the two patterns were generated from different irises or from the same one. In comparing the bit patterns *X* and *Y*, the Hamming distance, *HD*, is defined as the sum of disagreeing bits (sum of the exclusive-OR between *X* and *Y*) over *N*, the total number of bits in the bit pattern…………………

hat Hamming distance was chosen as a metric for recognition. The result of this computation is then used as the goodness of match, with smaller values indicating better matches. If two patterns are derived from same iris, the hamming distance between them will be close to 0 due to high correlation.

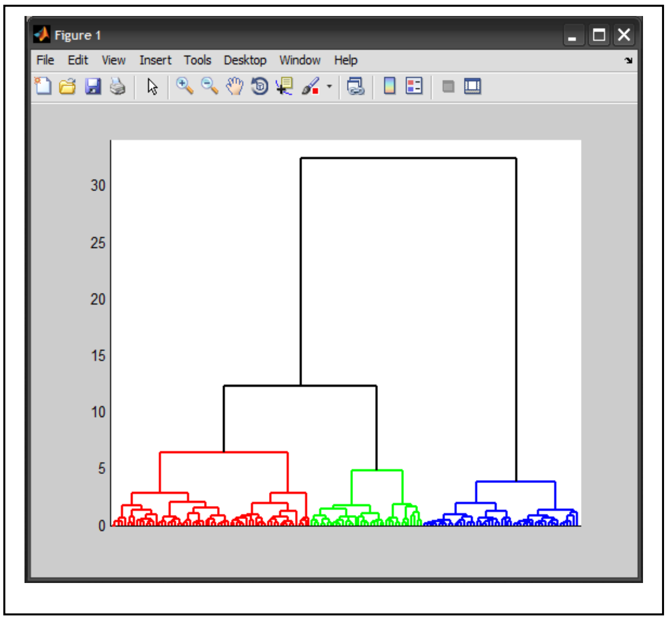


Fig.6.. Iris matching graph

IV. Result

that are used normal data base is used to CASIA recognitions matching result in 100% .The CASIA V1.0 iris database is a classic iris set which contains (10-20) iris images from 20 subjects, in which iris textures are clear and there are seldom noises. K is a CASIA data base of fully perfects data matching in eye.

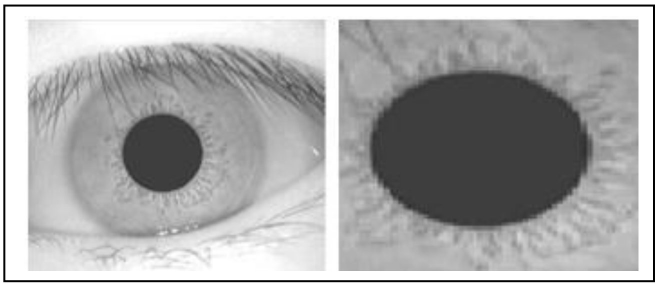


Fig.7. Iris Recognition Process:

(a) The original eye image taken from CASIA iris database
(b) Region of interest extracted image

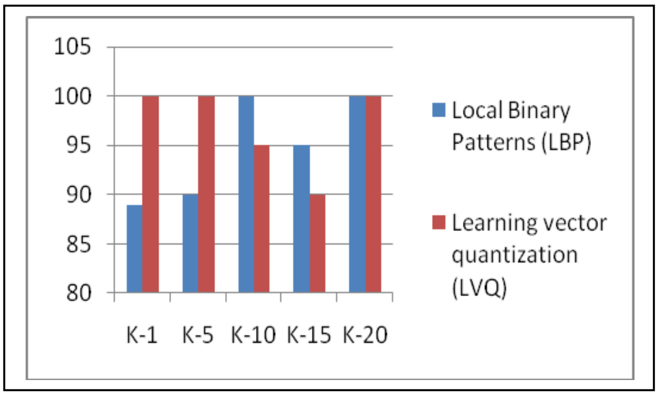
R-1That is concert local binary patterns and learning vector quantization this graph position of iris matching k-1 local binary patterns result in89% and learning vector quantization result 100%. That is k-1 form learning vector quantization form is best.

Table: 1

S.No.	Table LBP and LVQ over all matching		
	Number of data base of iris	*Local Binary patterns*	*Learning vector quantization*
1.	K-1	89	100
2.	K-5	90	100
3.	K-10	100	95
4.	K-15	95	90
5.	K-20	100	100

R-5That is concert local binary patterns and learning vector quantization this graph position of iris matching k-5 local binary patterns result in90% and learning vector quantization result 100%. That is k-5 form learning vector quantization form is best.

That are overall result k-1, k-5, k-10, k-15, k-20 eye data base of learning vector quantization is best result in100% and k-20 is over all frame in best recognition rate.



Graph 1 LBP and LVQ matching Graph

VI. **Conclusion**

The iris recognition is discussed by using the NI Lab VIEW (VISION MODULE) software. Here, initially input eye images are uploaded from database and region of interest segmentation and localization of iris using canny edge detection is performed. Use of Canny edge detection provides good localization and detection which in turn provides time consumption. Also normalization of iris is performed using the Gabor filter and feature vectors are extracted using Local Binary Pattern (LBP) and classification is performed using Learning Vector Quantization (LVQ). That are 100% iris matching using of local binary pattern method is using through data.

I. Future Work

we planned to enhance these iris recognition systems for real-time images using NI Lab view that modules. The real-time capturing images are possible by use fully of digital cameras compatible with USB. Then which the resolution of camera must be at least 3 mega pixel images and it must be able to process depends on (20-25) frames/sec for clear capture of images.

II. Copyright Forms

You must submit the IEEE Electronic Copyright Form (ECF) as described in your author-kit message. THIS FORM MUST BE SUBMITTED IN ORDER TO PUBLISH YOUR PAPER.

Acknowledgement

Portions of the research in this paper use the CASIA data base iris image database collected by internet website, Chinese Academy of Sciences Institute of Automation (CASIA) iris database VI.0 with 108 subjects.

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