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Performance Evaluation of Iris Recognition System Using Fuzzy System

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Abstract- A biometric system provides automatic recognition of an individual based on some sort of unique feature or characteristic possessed by the individual. Biometric systems have been developed based on fingerprints, facial features, voice, hand geometry, handwriting, the retina and the one presented in this thesis, the iris. 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.

Keywords- Biometrics, Eye, Gabor filter, Iris recognition, Pattern, Possibilitic fuzzy matching (PFM).

I. INTRODUCTION

A biometric system provides automatic recognition of an individual based on some sort of unique feature or characteristic possessed by the individual. Biometric systems have been developed based on fingerprints, facial features, voice, hand geometry, handwriting, the retina and the one presented in this thesis, the iris. 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. A good biometric is characterized by use of a feature that is; highly unique – so that the chance of any two people having the same characteristic will be minimal, stable – so that the feature does not change over time, and be easily captured – in order to provide convenience to the user, and prevent misrepresentation of the feature. The computerized global control system requires the identification (ID) of every human being on earth. In today's information technology world, security for systems is becoming more and more important. The number of systems that have been compromised is ever increasing and authentication plays a major role as a first line of defense against intruders. One of the most dangerous security threats is the impersonation, in which somebody claims to be somebody else. The security services that counter this threat are identification and authentication. Identification is the service where an identity is assigned to a specific individual, and authentication the service designed to verify a user's identity.

II. LITERATURE SURVEY

Human verification has traditionally been carried out by using a password and/or ID cards. These methods can be easily breached, for password can be guessed and ID card can be stolen, thus rendering them unreliable. Biometrics refers to identifying a person based on his or her physiological or behavioral characteristics; it has the capability to reliably distinguish between an authorized person and an imposter. A biometrics system is a recognition system which operates by acquiring biometric data from an individual, extracting feature sets and comparing it with the template set in the database. Depending upon the application context, the identity of a person can be resolved in two ways: verification and identification. In the former, a person to be identified submits a claim; which is either accepted or rejected. In the latter, a person is identified without a person claiming to be identified. In literature, however, verification and identification are interchangeably used for biometrics recognition. There are many biometrics in use today and a range of biometrics that are still in the early stages of development. Biometrics can, therefore, be divided into two categories: those that are currently in use across a range of environments and those still in limited use or under development, or still in the research realm. Here we present literature survey for some of the biometrics of the two categories.

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A) Fingerprint

Fingerprint is the pattern of ridges and valleys on the tip of a finger and is used for personal verification of people. Fingerprint based recognition method because of its relatively outstanding features of universality, permanence, uniqueness, accuracy and low cost has made it most popular and a reliable technique and is currently the leading biometric technology. There is archaeological evidence that Assyrians and Chinese ancient civilizations have used fingerprints as a form of identification since 7000 to 6000 BC.Henry Fault in 1880 laid the scientific foundation of the modern fingerprint recognition by introducing minutiae feature for fingerprint matching . Current fingerprint recognition techniques can be broadly classified as Minutiae-based, Ridge feature-based, Correlation-based and gradient base.

B) Face

Face recognition for its easy use and non intrusion has made it one of the popular biometry. A summaries of the existing techniques for human face recognition can be found in. Further, a survey of existing face recognition technologies and challenges is given. A number of algorithms have been proposed for face recognition. Such algorithms can be divided into two categories: geometric feature-based and appearance-based. An inherent drawback of appearance-based methods is that the recognition of a face under a particular lighting and pose can be performed reliably when the face has been previously seen under similar circumstances. Further, in appearance-based methods the captured features are global features of the face images and facial occlusion is often difficult to handle in these approaches. Geometric feature-based methods are robust against variations in illumination and viewpoints but very sensitive to feature extraction process. The geometry feature-based methods analyze explicit local facial features, and their geometric relationships. The geometry feature-based methods include: Active Shape Elastic Bunch Graph matching and Local Feature Analysis (LFA)

C) **Hand geometry**

Hand geometry refers to the geometric structure of the hand that is composed of the lengths of fingers, the widths of fingers, and the width of a palm, etc. The advantages of a hand geometry system are that it is a relatively simple method that can use low resolution images and provides high efficiency with great users' acceptance. A brief survey of reported systems for hand-geometry verification can be found in . An elaborate survey on hand geometry verification. Geometrical features of the hand constitute the bulk of the hand features adopted in most of the hand recognition systems. One advantage is that geometrical features are more or less invariant to the global positioning of the hand and to the individual planar orientations of the fingers. Among numerous geometrical measures include lengths, widths, areas, and perimeters of the hand, fingers and the palm have shown that hand geometrical features solely are not sufficiently discriminative. Therefore, for more demanding applications one must revert to alternative features such as hand global shape, appearance and/or texture. Thus use 16 axes predetermined with the aid of five pegs use a similar set of geometric features, containing the widths of the four fingers measured at different latitude, the lengths of the three fingers and the palm, in addition to finger widths, lengths and interfinger baselines, employ the fingertip regions. Describe a peg-free system where 30 geometrical measures are extracted from the hand images. Addition to widths, perimeters and areas of the fingers, they also incorporate the radii of inscribing circles of the fingers.

D) **Palm print**

Palm print is the region between the wrist and fingers. Palm print features like ridges, singular points, minutia points, principal lines, wrinkles and texture can use for personal verification. There are two types of palm print verification systems: high resolution and low resolution. High resolution system employs high resolution images, while low resolution system employs low resolution images. In high resolution images, ridges, singular points and minutia points are used as features. In low resolution images, it is principal lines, wrinkles and texture that are used as features.

III. PROPOSED SYSTEM

A) Acquiring the Picture: Image is captured with the help of Web Camera. Image is captured at a distance of few inches from camera. To acquire more clear images through a web camera and minimize the effect of the reflected lights caused by the surrounding illumination, we arrange two halogen lamps as the surrounding lights.

B) Find the Pupil Region: The pupil is considered as blackest region in an eye. So to find center of Iris, pupil region has to be found. Using the box method pupil region is detected. Kong and Zhang present a method for eyelash detection, where eyelashes are treated as belonging to two types, separable eyelashes, which are isolated in the image, and multiple eyelashes, which are bunched together and overlap in the eye image. Separable eyelashes are detected using 1D Gabor filters, since the convolution of a separable eyelash with the Gaussian smoothing function results in a low output value. Thus, if a resultant point is smaller than a threshold, it is noted that this point belongs to an eyelash. Multiple eyelashes are detected using the variance of intensity. If the variance of intensity values in a small window is lower than a threshold, the centre of the window is considered as a point in an eyelash. The Kong and Zhang model also makes use of connective criterion, so that each point in an eyelash should connect to another point in an eyelash or to an eyelid. Specular reflections along the eye image are detected using thresholding, since the intensity values at these regions will be higher than at any other regions in the image. use circular Hough transform for detecting the iris and pupil boundaries. This involves first employing canny edge detection to generate an edge map. Gradients were biased in the vertical direction for the outer iris/sclera boundary, as suggested by Wildes et al. Vertical and horizontal gradients were weighted equally for the inner iris/pupil boundary. The range of radius values to search for was set manually, depending on the database used. For the CASIA database, values of the iris radius

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range from 90 to 150 pixels, while the pupil radius ranges from 28 to 75 pixels. In order to make the circle detection process more efficient and accurate, the Hough transform for the iris/sclera boundary was performed first, then the Hough transform for the iris/pupil boundary was performed within the iris region, instead of the whole eye region, since the pupil is always within the iris region. After this process was complete, six parameters are stored, the radius, and x and y centre coordinates for both circles.

Eyelids were isolated by first fitting a line to the upper and lower eyelid using the linear Hough transform. A second horizontal line is then drawn, which intersects with the first line at the iris edge that is closest to the pupil. This process is illustrated in Figure 2.2 and is done for both the top and bottom eyelids. The second horizontal line allows maximum isolation of eyelid regions. Canny edge detection is used to create an edge map, and only horizontal gradient information is taken. If the maximum in Hough space is lower than a set threshold, then no line is fitted, since this corresponds to non-occluding eyelids. Also, the lines are restricted to lie exterior to the pupil region, and interior to the iris region. A linear Hough transform has the advantage over its parabolic version, in that there are less parameters to deduce, making the process less computationally demanding. For isolating eyelashes in the CASIA database a simple thresholding technique was used, since analysis reveals that eyelashes are quite dark when compared with the rest of the eye image. Analysis of the LEI eye images shows that thresholding to detect eyelashes would not be successful. Although, the eyelashes are quite dark compared with the surrounding eyelid region, areas of the iris region are equally dark due to the imaging conditions. Therefore thresholding to isolate eyelashes would also remove important iris region features, making this technique infeasible. However, eyelash occlusion is not very prominent so no technique was implemented to isolate eyelashes in the LEI database. The LEI database also required isolation of specular reflections. This was implemented, again, using thresholding, since reflection areas are characterized by high pixel values close to 255. For the eyelid, eyelash, and reflection detection process, the coordinates of any of these noise areas are marked using the MATLAB® NaN type, so that intensity values at these points are not misrepresented as iris region data.

i) Acquiring the Picture:

Beginning with a 320x280 pixel photograph of the eye taken from 4 centimeters away using a near infrared camera. The near infrared spectrum emphasizes the texture patterns of the iris making the measurements taken during iris recognition more precise. All images tested in this program were taken from the Chinese Academy of Sciences Institute of Automation (CASIA) iris database.

j) Edge Detection

Since the picture was acquired using an infrared camera the pupil is a very distinct black circle. The pupil is in fact so black relative to everything else in the picture a simple edge detection should be able to find its outside edge very easily. Furthermore, the thresholding on the edge detection can be set very high as to ignore smaller less contrasting edges while still being able to retrieve the entire perimeter of the pupil. The best edge detection algorithm for outlining the pupil is canny edge detection.

This algorithm uses horizontal and vertical gradients in order to deduce edges in the image. After running the canny edge detection on the image a circle is clearly present along the pupil boundary.

k) Image Clean Up

A variety of other filters can be used in order decrease the extraneous data found in the edge detection stage. The first step in cleaning up the image is to dilate all the edge detected lines. By increasing the size of the lines nearby edge detected components are likely to coalesce into a larger line segment. In this way complete edges not fully linked by the edge detector can form. Thus the dilation will give us a higher probability that the perimeter of the pupil is a complete circle. Knowing that the pupil is well defined more filters can be used without fear of throwing out that important information. Assuming the image is centered a filter can be used to fill in the circle defined by the pupil's perimeter. In this way we clearly define the entire area of the pupil. After this, a filter which simply throws out sections of connected pixels with an area below a threshold can be used effectively to throw out smaller disconnected parts of the image the edge detector found. Finally, any holes in the pupil caused by reflections or other distortions can be filled, by looking for sections of blank pixels with an area below a threshold. After this processing we achieve a picture that highlights the pupil area while being fairly clean of extraneous data.

l) Pupil Information Extraction

Having pre-processed the image sufficiently the extraction of the pupil center and radius can begin. By computing the Euclidean distance from any non-zero point to the nearest zero valued point an overall spectrum can be found. This spectrum shows the largest filled circle that can be formed within a set of pixels. Since the pupil is the largest filled circle in the image the overall intensity of this spectrum will peak in it. In the pupil circle the exact center will have the highest value. This is due to the simple fact that the center is the one point inside the circle that is farthest from the edges of the circle. Thus the maximum value must correspond to the pupil center, and furthermore the value at that maximum (distance from that point to nearest non-zero) must be equal to the pupil radius.

C) Find the Edge points & center : Once pupil region is found ,detecedge points. At a distance above pupil region, scanning starts horizontal direction. RGB values of each point is calculated & there dramatic change in it, that point is

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considered as edge point

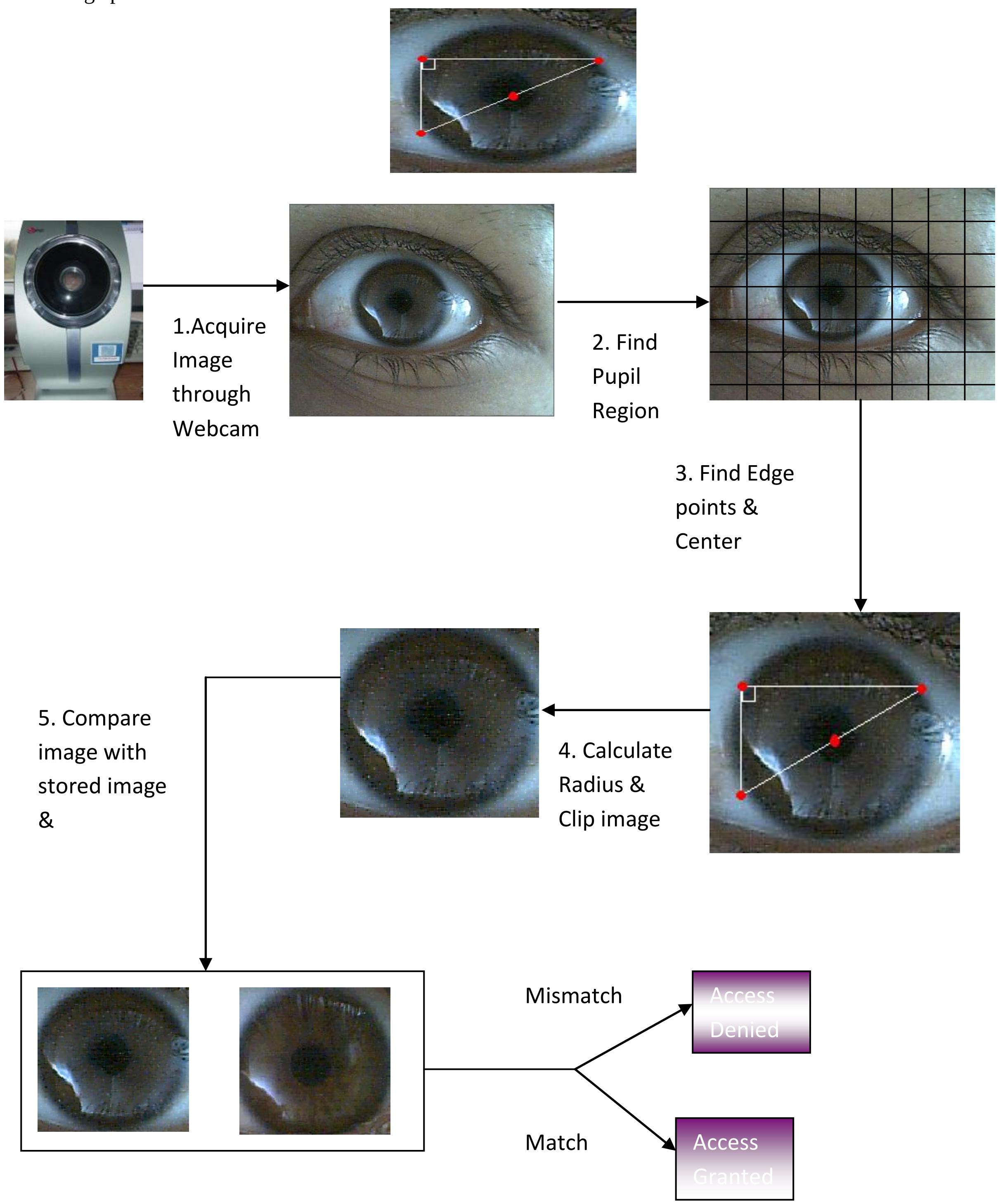

Figure3.2.System Diagram of Iris Recognition

IV. CONCLUSION

Highly accurate, positive personal recognition is feasible today using the iris of the human eye. This unique and complex organ, which has more dimensions (measures) of variation than any other biometric feature currently in use, remains stable throughout a lifetime and is readily available for sampling in a non-intrusive way. Recognitions can then be used to control access and entry, to provide recognition information to an existing entry control system, or for any other purpose where positive identification is needed. Recent testing, under U.S. Government controlled conditions, in three real-world environments, and in a variety of operational applications have proven the practicality and feasibility of the extremely accurate iris recognition for any function requiring positive recognition. Biometric solutions, including fingerprint, facial recognition, retina scan, and voice recognition do not provide the level of accuracy, speed, or cost-effectiveness found with iris recognition technology.

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