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Iris Identification Method of Biometric Authentication

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Abstract:

The iris is the colored, donut-shaped portion of the eye behind the cornea and surrounds the pupil. A person's iris pattern is unique and remains unchanged throughout life. Also, covered by the cornea, the iris is well protected from damage, making it a suitable body part for biometric BIOMETRICS is the measurement of humans physiological characteristics for security reasons. There are so many types of biometrics existed including finger print, iris recognition, voice recognition. From the above mentioned biometric techniques Iris recognition gives better security and it has more advantages over other types of biometric authentication methods

Iris biometric authentication as it has low error rates compared to other biometric authentication methods. The iris is the colored ring in our eyes, a muscle that expands and contracts the eye based on the amount of light entering the eye itself. On the surface, we don't see the complexity of the iris—we see the melanin-colored ring but not much else. These scans function as verification methods because each human iris has unique patterns and color circles that can be used to identify them. Basic idea of the method is as follows: First of all, it locates the image of iris and then it fits the contour of lower eyelid, after that normalization to the iris image is done and gets 512 columns x 64 rows rectangular iris image. Next thing is that it makes segmentation according to the filter parameters and then it adopts optimized multi directional filter so that it gives filter for each sub-block in the effective iris image area, and also gets edge response of iris image in different directions. Biometric scanning uses a user's physical features (a fingerprint, facial scan, voice authentication, or iris scan) as part of an identity verification process. The idea behind this approach to authentication is that these physical features should be almost 100% unique to the user, and as such, can serve as an un-spoofable way to verify them when they try to access their accounts. Some forms of biometrics are more common than others in the consumer and enterprise space. Fingerprint and facial scanners are more and more common on mobile devices like smartphones, tablets, and laptops. These biometrics are used to grant access to devices or to support biometric password setups for applications installed on the device

Like other forms of biometric authentication, there are two primary steps in using eye scans as verification. First, patterns in the iris must be scanned and enrolled in a system and associated with a digital identity. Following that, the system can scan your iris as a form of verification against the data provided during enrollment.

To conduct an eye scan, the technology used for the scan directs infrared light into the eye at wavelengths smaller than visible light. These wavelengths allow the scanner to see

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more delicate patterns in the iris consisting of approximately 240 different features that, together, comprise a unique digital representation of the user. The scanned data is encoded into a machine-readable form for future reference. This information is usually stored in an identity database, and subsequent scans used for authentication compare scanning information against the data in the database.

Keywords: Iris recognition, Biometric authentication, Normalization, Segmentation.

Features of iris recognition

Highly accurate and fast, iris recognition boasts of having top-class precision among different types of biometric authentication technologies.

Remains unchanged throughout life. (This does not constitute a guarantee.)

Since the iris is different between the left and right eye, recognition can be performed separately by each eye.

Possible to distinguish twins.

As long as the eyes are exposed, iris recognition can be used even when the subject is wearing a hat, mask, eyeglasses or gloves.

Because of using an infrared camera, recognition is available even at night or in the dark.

Without the need to touch the device, contactless authentication is possible, making it hygienic to use.

Biometric Technology

Now a days in many applications, the identity of a person is necessary. For the secure access of anything personal identification is needed. There are some conventional methods for the recognition of individual. The methods include the use of cards or passwords which are not always reliable or accurate, because these cards or passwords can be stolen or forgotten. But in Biometric technology, it uses Artificial Intelligence, for the identification of particular features for the particular human body. By using the particular feature, the biometric authentication system identifies the specific user. The physical structure of the some part of human body like hand geometry, DNA, retina, iris and palm is unique. A biometric system gives automatic recognition of an individual based on unique feature possessed by the individual. Biometric systems have been developed based on fingerprints, facial features, voice, palm recognition, handwriting, and the retina.

Advantages of Using Biometrics:

Easier fraud detection

Better than password/PIN or smart cards

No need to memorize passwords

Requires physical presence of the person to be identify

Unique physical or behavioural characteristic

Cannot be borrowed, stolen, or forgotten.

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Segmentation

The first step of iris recognition is to differentiate iris region in a digital eye image which can be taken from CASIA iris database. The iris region, can be divided in two circles, one for the iris /sclera boundary and another, interior for the iris/pupil boundary. The eyelids and eyelashes present at the upper and lower parts of the iris region. Spectacular reflections can present in the iris region in some of the images which corrupts the iris pattern. A technique is required to isolate and exclude these artefacts. Also, locating the circular iris region is required. The success of segmentation depends on the quality of images. Images in the CASIA iris database do not contain spectacular reflections due to the use of near infra-red light for illumination. Circular Hough transform is most of the time used for differentiating the iris and pupil boundaries. First it applies Canny edge detection to create an edge map. Vertical and horizontal gradients were weighted equally for the inner iris/pupil boundary. A modified version of Kovesis Canny edge detection was implemented, which allowed for weighting of the gradients. The range of radius values to search for was set manually and that can be depending on the database used. For the CASIA database, values of the iris radius range from 90 to 150 pixels, while the pupil radius ranges from 28 to 75 pixels. For the making the circle detection process more accurate, the Hough transform for the iris/sclera boundary was performed first, then the Hough transform for the iris/pupil boundary was performed second within the iris region, instead of the whole eye region. After this process was complete, six parameters are stored, the radius, and x and y centre coordinates for both circles. The centre of the pupil was considered as the reference point, and radial vectors pass through the iris region. A number of data points are selected along each radial line and this is defined as the radial resolution. The number of radial lines going around the iris region is defined as the angular resolution. Since the pupil can be non-concentric to the iris, a remapping formula is needed to rescale points depending on the angle around the circle. The normalisation process is able to rescale the iris region so that it has constant dimension.

The iris has a particularly interesting structure and provides abundant texture information. For the accurate recognition of individuals, the most discriminating information present in an iris pattern must be extracted. Only the significant features of the iris must be encoded so that comparisons between templates can be made.

Feature Encoding Algorithms

Feature encoding was implemented by convolving the normalised iris pattern with 1D Log-Gabor wavelets. The 2D normalised pattern is broken up into a number of 1D signals, and then these 1D signals are convolved with 1D Gabor wavelets. The rows of the 2D normalised pattern are taken as the 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 the normalised pattern, since maximum independence occurs in the angular direction. The intensity values at known noise areas in the normalised pattern are set to the average intensity of surrounding pixels to prevent influence of noise in the output of the filtering. The output of filtering is then phase quantised to four levels using the Daugman

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method, with each filter producing two bits of data for each phasor. The output of phase quantisation is chosen to be a grey code, so that when going from one quadrant to another, only 1 bit changes. This will minimise the number of bits disagreeing, if say two intra-class patterns are slightly misaligned and thus will provide more accurate recognition. The encoding process produces a bitwise template containing a number of bits of information, and a corresponding noise mask which corresponds to corrupt areas within the iris pattern, and marks bits in the template as corrupt. Since the phase information will be meaningless at regions where the amplitude is zero, these regions are also marked in the noise mask.

Matching Algorithms

Hamming distance

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. If two bit patterns are completely independent, such as iris templates generated from different irises, the Hamming distance between the two patterns should equal 0.5. This occurs because independence implies the two bit patterns will be totally random, so there is 0.5 chance of setting any bit to 1, and vice versa. Therefore, half of the bits will agree and half will disagree between the two patterns. If two patterns are derived from the same iris, the Hamming distance between them will be close to 0.0, since they are highly correlated and the bits should agree between the two iris codes.

What Are the Four Steps for Iris Recognition Enrollment?

The enrollment and verification process is rather seamless for users: the system scans the eye and uses it to verify identity. However, to actually use information from the iris as a form of identification, a four-step enrollment process takes the information and makes it a form of biometric ID:

Image Capture: The scanner takes high-quality images of the left and right eye using near-infrared light for a more accurate and fine-grained image of the iris and its unique features. Near-infrared light also doesn't cause contractions in the iris the same way natural light would, providing a more realistic image from which to draw information.

Quality Checks and Controls: Now that the system has an image to draw information from, it performs quality checks to ensure that the image is enough to serve as a biometric template. Different image qualities are tested during this step, including analysis of the sharpness, iris sclera contrast, iris pupil contrast, pupillary dilation and the presence of any artifacts like eyelashes and eyelid occlusions. During this analysis, the scan segments of the recognizable iris from the rest of the eye in the image.

Compression: The remaining, high-quality image is compressed using JPEG 2000 algorithms. This helps remove image distortions and other artifacts.
Template Creation: The remaining image information is then translated into a biometric template that can be used in

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future verification scans. Once the template is in place, it is difficult to spoof using fake biometrics. Likewise, this information can be used across multiple authentication events so long as you use the same or similar quality NIR scanners.

What Are the Advantages of Iris Biometrics?

While not as common as other biometric verification methods, eye scans have several advantages:

Difficulty of Spoofing: Since iris information is unique to everyone and requires special technology to collect, it can be hard to spoof this information for unauthorized access.

Persistence: Iris dimensions and conditions don't vary much as we age, meaning that scans have significant longevity as verification methods. Likewise, barring trauma to the eyes, they are not typically vulnerable to physical disfigurement.

Distance and Flexibility: It might seem like it would be hard to scan an iris, but advances in cameras and light technology have made it possible to scan a human iris from up to 40 feet away.

With these advantages in mind, eye scanners are often more accurate and reliable than fingerprint or facial scanners. Fingerprint scanners are touch-based, meaning that dirt, grease, or other artifacts can hinder fingerprint scans. Likewise, individuals who do hard work that damages the fingers might be unable to use the technology or find it doesn't work for them as they get older. On the other hand, eye scanners don't degrade in functionality unless there is trauma to the eyes, and eyes are self-cleaning by nature. Because of this, iris scanners can serve a broader population than a fingerprint verification system, particularly populations from poor or working-class backgrounds.

A method of biometric authentication that uses pattern recognition techniques based on high-resolution images of the irises of an individual's eye. Iris recognition utilizes the same technology as cameras coupled with subtle infrared illumination to reduce the specular reflection from the convex cornea. This creates detail-rich images of the intricate structures of the iris. When these images are converted and stored as digital templates, they provide mathematical representation of the iris that enables unambiguous positive identification of individuals.

Accuracy

Iris is formed in the early stages of an individual's life and once it is fully formed its texture remains stable throughout a person's life. The iris of the eye has a distinct pattern and iris recognition has been found to be a highly accurate biometric system. Its efficiency is rarely impeded by the presence of glasses or contact lenses. Moreover, it has a small template size that allows speedy comparisons making iris recognition technology particularly well suited for one-to-many identifications. Even genetically identical individuals have distinct iris textures which further confirm that it is a highly accurate and reliable technique.

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FAR/FRR

National institute of standards technology conducts many evaluation tests to determine accuracy of biometric devices and the accuracy proven by NIST tests is considered to be the international recognition for the these devices and superior technology provided by vendors. The test for iris recognition systems conducted by NIST where FAR and FRR are the evaluation metrics is known as Iris Exchange or IREX test.

The error rates as per the ICE 2006 are

FRR=1% and FAR=0.1%

Verdict

Iris recognition is a very stable technique with high template longevity where a single enrollment can last a lifetime. Since iris is an internal organ, it is very well-protected against damage and wear by a transparent and sensitive membrane known as the cornea. This feature distinguishes irises from fingerprints which can be quite difficult to recognize after certain years of manual labour. Also, the geometric configuration of the iris is only controlled by two complementary muscles. This makes the shape of the iris far more predictable than that of the face. However, iris scanners are relatively expensive as compared to other modalities and require user-cooperation. Iris recognition systems have been implemented in all of the UAE's air, land and sea ports of entry. Google too uses this technology to regulate access to its datacenters. The FBI has also incorporated it into its next-generation biometric identification system.

Usability

Although iris recognition is the most accurate biometric system and works very well for positive identification against a large database, there are some usability concerns. It is a new technology that requires substantial investment and hence may not be suitable for small organizations. It is quite difficult to perform iris recognition from a distance larger than a few metres and moreover the subject to be identified needs to be co-operative. The subject should hold his or her head still and look into the camera. Iris recognition is also susceptible to poor quality of images as well as associated failure to enroll rates. However, iris has a fine texture similar to that of fingerprints and is formed randomly during embryonic gestation. This fine texture remains stable for many decades and attributes iris recognition to be the most accurate modality. Some iris identification schemes have succeeded over a period of almost 30 years.

CONCLUSION

The recognition of person through this iris authentication system is simple and requires few components. This system is effective enough to be integrated within security systems that require an identity check. There are negligible errors that occurred when this system used and that can be easily overcome by the use of proper and stable equipment. Iris recognition is a recent technique in the area of the personal identification and it is considered as one of the most reliable ways of biometrics.

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