Iris Recognition Technology: Implementation, Application, and Security Consideration.

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ABSTRACT

Biometrics can be described as the technology used in identifying or authenticating an individual based on their unique biological features such as iris, signature, and voice. This paper discussed in details the real life implementation, and also the application of iris recognition security system to understand their strength and weakness. It also discussed its security considerations. Iris recognition is regarded as the most reliable and accurate biometric identification system available.

(Keywords: biometrics, biometric identification system, iris recognition)

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, hand geometry, voice, facial features, handwriting, the retina [1], and the one presented in this paper, the iris. The aim of this paper is to study the real life application of iris recognition security system to understand their strengths and weaknesses. It also focuses on the steps that should be followed for real life implementation of iris recognition security system.

This study is useful in enhancing security and access control. It is also useful in organizations where access to specific resources is strictly controlled. For instance, in boarding areas in Airports, biometric iris recognition can be used to control access to the boarding area. When a passenger registers his/her body pass, an iris recognition security scheme can prevent his identity from being compromised in the boarding area. Other areas of application of the study include thwarting identity falsification in examination halls, access to secure areas in banking institutions, building and other organizations, access and log on restrictions in mobile phones and computers to mention but a few [2].

IRIS RECOGNITION TECHNOLOGY

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 repository database [2].

The biometric template contains an objective mathematical representation of the unique information stored in the iris, and it allows comparisons to be made between templates. When a subject wishes to be identified by iris recognition system, their eye is first photographed, and then a template created for their iris region. This template is then compared with the other templates stored in a database until either a matching template is found and the subject is identified, or no match is found and the subject remains unidentified. Although prototype systems had been proposed earlier, it was not until the early nineties that Cambridge researcher, John Daugman, implemented a

working automated iris recognition systems [1][3]. The Daugman system is patented [4] and the rights are now owned by the company Iridian Technologies. The Daugman system is the most successful and most well-known, and also many other systems have been developed. Other notable ones include the systems of Wildes [5][6].

IMPLEMENTATION OF IRIS RECOGNITION SECURITY SYSTEM

This explains the steps that should be followed for the real life implementation of iris recognition security system.

Stages Involved in Iris Recognition

The stages involved in iris recognition techniques were discussed below:

1. **Image Capturing / Data collection:** The first phase of our method is to collect a large database consisting of several iris images from various individuals. Images in the database are stored in bitmap format on the hard drive of the computer that will be used to analyze them. The database needs to be dynamic. The images can be captured using a CCD camera, which should have a resolution of at least 512 dpi to create a meaningful detailed image. However, to capture the rich details of the iris patterns, a camera at a minimum image resolution of 70 pixels should be used. Special cameras with an illumination of 70mm to 90mm wavelengths are required for imaging. Imaging must also be done with light reflecting at special angles depending on the wavelength so as to capture the rich patterns and striations. The camera can be a still camera or a video camera. A video camera is highly preferable so that iris aliveness can be tested [2].

2. **Quality Testing:** The second phase is to check images for noise and distortion. If an image satisfies a given requirement of quality, then the next phase is skipped, that is image pre-processing.

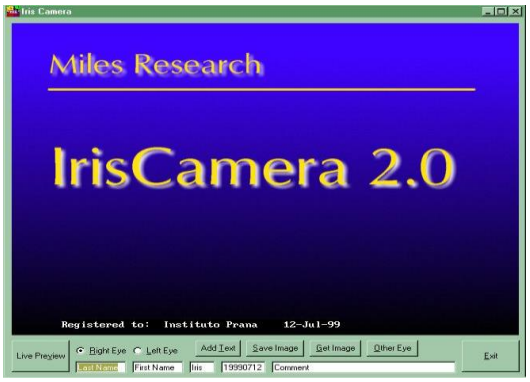

Figure 1: Startup Screen for Iris Camera v.2.0 [9].

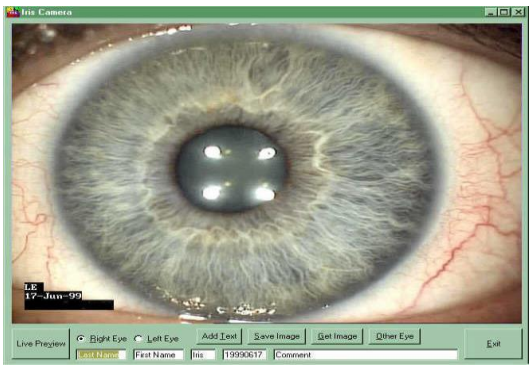

Figure 2: Captured Image Screen for IrisCamera v.2.0 [9].

3. **Image Pre-Processing:** If an image does not satisfy the requirements in phase two (quality testing), it is pre-processed to reduce noise as much as possible to simply improve the quality of the image. This can be achieved by various methods.

4. **Segmentation:** Image segmentation simply has to do with the isolation of the actual iris region in a digital eye image. The iris region can be approximated by two circles, one for iris/sclera boundary and another, interior to the first, for the iris/pupil boundary. The eyelids and eyelashes normally obstruct the upper and lower parts of the iris region. Also, specular reflections can occur within the iris region corrupting the iris pattern. Furthermore, variations in distances at which the image is taken may result in different image sizes of the same under some conditions and the brightness may not be uniformly distributed. A technique is required

to isolate and exclude these artifacts as well as locating the circular iris region. There exists number of techniques used for segmentation, namely: Hough transform, Daugman's integro-differntial operator, Active contour models, and Eyelash and noise detection. The circular Hough transform can be used to detect the iris and pupil boundaries. The algorithm was chosen because it is less computationally complex than other segmentation techniques and it is also less prone to specular reflections.

5. **Normalization:** The size of the pupil may change due to the variation of the illumination and the hippos, and the associated elastic deformations in the iris texture may interfere with the results of pattern matching. For accurate texture analysis, it is necessary to compensate this deformation. Since both the inner and outer boundaries of the iris have been detected, it is easy to map the iris ring to a rectangular block of texture of a fixed size. For normalization of iris regions a technique based on Daugman's rubber sheet model can be employed. The centre of the pupil can be considered as the reference point, and radical vectors pass through the iris region. Virtual circles technique can also be employed.

6. **Feature Extraction (Digitization):** The iris contains important unique features, such as stripes, coronas, freckles to mention but few. These features are collectively referred to as the texture of the iris. These features are extracted using a variety of algorithms. Any of these techniques can be employed: Wavelet encoding, Gabor filters, Log-Gabor filters, Haar Wavelet, Laplacian of Gaussian filters.

7. **Matching:** This phase consists of two steps, namely matching and identification. In the matching process, the extracted features of the iris are compared with the iris images in the database. Matching can be done using Hamming distance. Other techniques are Weighted Euclidean distance, Normalized correlation.

APPLICATIONS OF IRIS RECOGNITION TECHNOLOGY

This section discussed deployed applications of the iris recognition security systems:

- Pakistan Iris recognition technology has been successfully implemented by BioID Technologies SA in Pakistan for UNHCR repatriation project to control aid distribution for Afghan refugees.

- Used to verify the recognition of the "Afghan Girl" [Sharbat Gula] by National Geographic photographer Steve McCurry.

- At Schiphol Airport, Netherlands, iris recognition has permitted passport free immigration since 2001. A U.S Marine Corps Sergeant uses an iris scanner to positively identify a number of the Baghdaddi city council prior to a meeting with local tribal figureheads, sheiks, and U.S. service members [2].

- United Arab Emirates Homeland Security Border Control has been operating an expellee tracking system in the United Arab Emirate [UAE, 2001]. Today all of the UAE's Land, Air and Sea ports of entry are equipped with systems.

- In a number of US and Canadian airports, as part of the NEXUS program that facilitates entry into the US and Canada for pre-approved, low-risk travelers [2].

Advantages

- One third of the world's leading airport operators have already incorporated biometric (iris recognition systems) into their access control solutions.

- The iris of the eye has been described as the ideal part of the human body for biometric recognition has been one of the most effectively deployed biometrics to ensure secure, efficient, and expedited airport operations for both landside and airside applications. Iris recognition's unique capabilities are proven to increase security, speed, and user identification for several reasons.

- The iris is an internal organ that is well protected against damage and wear by a highly transparent and sensitive membrane (the cornea). This distinguishes it from fingerprints, which can be difficult to recognize after years of certain types of manual labor.

- The iris has a fine texture that, like fingerprints is determined randomly during embryonic gestation. Even genetically identical individuals have completely independent iris textures, whereas DNA is not unique.

- The iris is mostly flat and its geometric configuration is only controlled by two complementary muscles, which control the diameter of the pupil. This makes the iris shape far more predictable than, for instance, that of the face.

Disadvantages

- Iris scanning is a relatively new technology and is incompatible with the very substantial investment that the law enforcement and immigration authorities of some countries have already made into fingerprint recognition.

- Iris recognition is very difficult to perform at a distance larger than a few meters and if the person to be identified is not cooperating by holding the head still and looking into the camera.

- As with other photographic biometric technologies, iris recognition is susceptible to poor image quality, with associated failure to enroll rates.

SECURITY CONSIDERATIONS

Like with other biometric identification technology, a still not satisfactorily solved problem with iris recognition is the problem of "live tissue verification". The reliability of any biometric identification depends on ensuring that the signal acquired and compared has actually been recorded from a live body part of the person to be identified, and is not a manufactured template. Many commercially available iris recognition systems are easily fooled by presenting a high-quality photograph of a face instead of a real face, which makes such devices unsuitable for unsupervised applications, such as door access-control systems. The problem of live tissue verification is less of a concern in supervised applications such as immigration control, where a human operator supervises the process of taking the picture. Methods that have been suggested to provide some defense against the use of fake eyes and irises include:

- Changing ambient lighting during the identification such that the papillary reflex can be verified and the iris image can be recorded at several different pupil diameters.

- Analyzing the 2D spatial frequency spectrum of the iris image for the peaks caused by the printer dither patterns found on commercially available fake-iris contact lenses.

- Analyzing the temporal frequency spectrum of the image for the peaks caused by computer displays using spectral analysis instead of merely monochromatic cameras to distinguish iris tissue from other material.

A 2004 report by the German Federal Office for Information Security noted that none of the iris recognition systems commercially available at the time implemented any live-tissue verification technology. Like any pattern-recognition technology, live-tissue verifiers will have their own false-rejected probability and will therefore further reduce the overall probability that a legitimate user is accepted by the sensor.

WHY THE IRIS?

- **Accurate and Reliable:** More accurate than other security alternatives biometric or otherwise. A distinctive pattern is not susceptible to theft, loss or compromise.

- **Fast and Stable:** Unique iris pattern is formed by 10 months of age, and remains stable throughout one's life. Full enrollment with instruction can take less than 2 minutes. Authentication takes less than 2 seconds.

- **Expandable, Scalable, and Flexible:** Data templates require only 512 bytes of storage per iris and even very large databases do not compromise search speed or degrade performance accuracy. Operates in

standalone mode and easily integrates into existing security systems.

IRIS RECOGNITION ACCEPTANCE TO THE PUBLIC

Public acceptance of iris authentication technology and iris authentication products is determined by its ease of use. Another factor that contributes not only to lowering the initial threshold but also the recurring ease of use is the user feedback interface. One factor involved in getting high quality images is ensuring that the subject is looking directly into the camera. Previous approaches usually forced the individual to redirect their gaze away from the iris camera to get necessary feedback information.

IRIS RECOGNITION TECHNOLOGY LIMITATIONS

- A person must have an eye, with an iris. According to the US National Eye Institute [7], the condition of aniridia (lack of an iris) occurs in 1.8 of 100,000 births. Because it is genetically linked the condition usually affects both eyes according to the UK's Royal Institute for the Blind [8], but its incidence covers a wide spectrum of partial conditions such as just chronically enlarged pupils. Iris recognition requires the pupil to have a diameter less than about 75 percentage of the iris.

- Blind persons may have difficulty in getting themselves aligned with the iris camera at arm's length, because some systems rely on visual feedback through a mirror or LCD display to guide the user into alignment with the camera.

CONCLUSION

The use of iris recognition system has been seen in various areas of life such as airport, crime detection, business application, various research firm and industries, experts anticipate the growth of iris recognition system. The study showed that the use of iris recognition system is expanding worldwide as the public has been oriented about the necessity of iris recognition system. For instance, iris recognition system is used in banks where it is incorporated into the Automated Teller Machines (ATMs).

RECOMMENDATION

In view of the aforementioned in this paper, the use of iris recognition is hereby recommended for all firms and industries where security and personal identification is desired. However, to improve on iris recognition, the use of sharp iris camera is recommended to take the picture of an iris, and the user must be within a capture zone which is approximately 50cm away from the camera because the technology cannot work without the cooperation of the end user.

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