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Literature Review on Segmentation in IRIS Recognition

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Abstract: IRIS recognition is one of the most accurate identify verification system. A Biometric System identifies a human being based on the unique feature like finger prints, facial features, plam print etc. Generally algorithm is divided into four steps like localization, normalization, feature extraction and matching. The performance of IRIS recognition systems depends heavily on segmentation and normalization techniques. Segmentation involves various techniques in IRIS reorganization. No single method has been proposed to detect all four kinds of noises viz., eyelashes, eyelids, reflections, and pupil in a single algorithm. The Iris recognition is not widely accepted because of its high cost. The various segmentation methods are included in this paper.

Keywords: Normalization, Segmentation, pattern recognition, Biometric, Threshold Method, Watersheds.

I. INTRODUCTION

Biometrics is automated methods of recognizing a person based on a physiological or behavioral characteristic. Among the features measured are ; face , finger print, hand geometry, iris , retinal , signature, and voice. Biometric technologies are becoming the foundation of an extensive array of highly secure identification and personal verification solutions. As the level of security breaches and transaction fraud increases, the need for highly secure identification and personal verification technologies is becoming apparent.

Biometric-based solutions are able to provide for confidential financial transactions and personal data privacy. The need for biometrics can be found in federal, state and local governments, in the military, and in commercial applications. Enterprise-wide network security infrastructures, government IDs, secure electronic banking, investing and other financial transactions, retail sales, law enforcement, and health and social services are already benefiting from these technologies.

Biometric-based authentication applications include workstation, network, and domain access, single sign-on, application logon, data protection, remote access to resources, transaction security and Web security. Trust in these electronic transactions is essential to the healthy growth of the global economy. Utilized alone or integrated with other technologies such as smart cards, encryption keys and digital signatures, biometrics are set to pervade nearly all aspects of the economy and our daily lives. Utilizing biometrics for personal authentication is becoming convenient and considerably more accurate than current methods (such as the utilization of passwords or PINs). This is because biometrics links the event to a particular individual (a password or token may be used by someone other than the authorized user), is convenient (nothing to carry or remember), accurate (it provides for positive authentication), can provide an audit trail and is becoming socially acceptable and inexpensive. The security field uses three different types of authentication:

- Something you know - a password, PIN, or piece of personal information (such as your mother's maiden name)
- Something you have - a card key, smart card, or token (like a Secure ID card)
- Something you are - a biometric.

Of these, a biometric is the most secure and convenient authentication tool. It can't be borrowed, stolen, or forgotten, and forging one is practically impossible. (Replacement part surgery, by the way, is outside the scope of this introduction.)

1.1 Characteristics:

Face recognition analyzes facial characteristics. It requires a digital camera to develop a facial image of the user for authentication. This technique has attracted considerable interest, although many people don't completely understand its capabilities. Some vendors have made extravagant claims - which are very difficult, if not impossible, to substantiate in practice - for facial recognition devices. Because facial scanning needs an extra peripheral not customarily included with basic PCs, it is more of a niche market for network authentication. However, the casino industry has capitalized on this technology to create a facial database of scam artists for quick detection by security personnel.

Fingerprint looks at the patterns found on a fingertip. There are a variety of approaches to fingerprint verification. Some emulate the traditional method of matching; others use straight pattern-matching devices; and still others are a bit more unique, including things like ultrasonic's. Some verification approaches can detect when a live finger is presented; some cannot.

A greater variety of fingerprint devices is available than for any other biometric. As the prices of these devices and processing costs fall, using fingerprints for user verification is gaining acceptance despite the common criminal stigma. Fingerprint verification may be a good choice for in-house systems, where you can give users adequate explanation and training, and where the system operates in a controlled environment. It is not surprising that the workstation access application area seems to be based almost exclusively on fingerprints, due to the relatively low cost, small size, and ease of integration of fingerprint authentication devices.

Hand Geometry involves analyzing and measuring the shape of the hand. This biometric offer a good balances of performance characteristics and is relatively easy to use. It might be suitable where there are more users or where users access the system infrequently and are perhaps less disciplined in their approach to the system.

Accuracy can be very high if desired and flexible performance tuning and configuration can accommodate a wide range of applications. Organizations are using hand geometry readers in various scenarios, including time and attendance recording, where they have proved extremely popular. Ease of integration into other systems and processes, coupled with ease of use, and makes hand geometry an obvious first step for many biometric projects.

Iris based biometric, on the other hand, involves analyzing features found in the colored ring of tissue that surrounds the pupil. Iris scanning, undoubtedly the less intrusive of the eye-related biometrics, uses a fairly conventional camera element and requires no close contact between the user and the reader. In addition, it has the potential for higher than average template-matching performance. Iris biometrics work with glasses in place and is one of the few devices that can work well in identification mode. Ease of use and system integration has not traditionally been strong points with iris scanning devices, but you can expect improvements in these areas as new products emerge.

Retina based biometric involves analyzing the layer of blood vessels situated at the back of the eye. An established technology, this technique involves using a low-intensity light source through an optical coupler to scan the unique patterns of the retina. Retinal scanning can be quite accurate but does require the user to look into a receptacle and focus on a given point. This is not particularly convenient if you wear glasses or are concerned about having close contact with the reading device. For these reasons, retinal scanning is not warmly accepted by all users, even though the technology itself can work well.

Signature verification analyzes the way a user signs her name. Signing features such as speed, velocity, and pressure are as important as the finished signature's static shape. Signature verification enjoys a synergy with existing processes that other biometrics do not. People are used to signatures as a means of transaction-related identity verification, and most would see nothing unusual in extending this to encompass biometrics. Signature verification devices are reasonably accurate in operation and obviously lend themselves to applications where a signature is an accepted identifier. Surprisingly, relatively few significant signature applications have emerged compared with other biometric methodologies. But if your application fits, it is a technology worth considering. Voice authentication is not based on voice recognition but on voice-to-print authentication, where complex technology transforms voice into text. Voice biometrics has the most potential for growth; because it requires no new hardware most PCs already contain a microphone. However, poor quality and ambient noise can affect verification. In addition, the enrollment procedure has often been more complicated than with other biometrics, leading to the perception that voice verification is not user friendly. Therefore, voice authentication software needs improvement. One day, voice may become an additive technology to finger-scan technology.

Biometric Technology	Accuracy	Cost	Devices required	Social acceptability
ADN	High	High	Test equipment	Low
Iris recognition	High	High	Camera	Medium-low
Retinal Scan	High	High	Camera	Low
Facial recognition	Medium-low	Medium	Camera	High
Voice recognition	Medium	Medium	Microphone, telephone	High
Hand Geometry	Medium-low	Low	Scanner	High
Fingerprint	High	Medium	Scanner	Medium
Signature recognition	Low	Medium	Optic pen, touch panel	High

Fig: Characteristics

The iris of the eye has been described as the ideal part of the human body for biometric identification for several reasons:

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

- An iris scan is similar to taking a photograph and can be performed from about 10 cm to a few meters away. There is no need for the person being identified to touch any equipment that has recently been touched by a stranger, thereby eliminating an objection that has been raised in some cultures against fingerprint scanners, where a finger has to touch a surface, or retinal scanning, where the eye must be brought very close to an eyepiece (like looking into a microscope).

1.2 Current and Future Applications of Iris Recognition:

1.2.1 National border controls: At national border controls the iris recognition technique can be exclusively used as a living passport where much of the efforts of humans can be reduced no need to spend much time in the queue, and much of the time can be saved.

1.2.2 Computer login: The major application of this is for login to the computer present passwords are used to prevent the unauthorized access to our data. Whereas the password will not produce much security as the password can be known in any one or other cases. The iris can be used as a living password for computer login.

1.2.3 Cell phone and other wireless-device-based authentication: For mobile applications also the Iris can be used as password which means only the authorized person can operate his cell phone.

1.2.4 Secure access to bank accounts at cash machines: The other major application is at cash machines the iris can be used to withdraw amount.

1.2.5 Premises access control (home, office, laboratory, etc): For highly secured areas where security is the primary concern iris can be used for entry password in to the premises to security. Etc.,

Steps in IRIS Recognition:

The following are the steps involved in iris recognition.

- Image acquisition: In this stage, a photo is taken from camera.
- Pre-processing: Involving edge detection, contrast adjustment and multiplier.
- Segmentation: Including localization of iris inner and outer boundaries and localization of boundary between iris and eyelids.
- Normalization: Involving transformation from polar to Cartesian coordinates and normalization of iris image.
- Feature extraction: Including noise removal from iris image and generating iris code.
- Classification and matching: Involving comparing and matching of iris code with the codes already saved in database.

II. SEGMENTATION

Digital media image is widely used in the society, such as education, advertisement, video, film, and so on. Processing algorithm for the digital media image is also quite important for us to get vivid image. So, many treatment methods have been emerged. Although its history is not long, it attracts concern of various researchers. Image segmentation is the foundation of object recognition and computer vision. Image segmentation is the process of subdividing a digital image into multiple regions of objects consisting of set of pixels sharing same properties or characteristics which are assigned different labels for representing different regions or objects. The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is used to locate objects and boundaries in images. Segmentation is done on basis of similarity and discontinuity of the pixel values. There are two types of segmentations- soft segmentations and hard segmentation. Segmentation that allows regions or classes to overlap is called soft segmentation. Hard segmentation forces a decision of whether a pixel is inside or outside the object.

Precise iris image segmentation plays an important role in an iris recognition system since success of the system in upcoming stages is directly dependent on the precision of this stage. The main purpose of segmentation stage is to localize the two iris boundaries namely, inner boundary of iris-pupil and outer one of iris-sclera and to localize eyelids. As it could be seen in this figure, segmentation stage includes three following steps:

i. Localization of iris inner boundary
ii. Localization of iris outer boundary
iii. Localization of boundary between eyelids and iris.

2.1 Digital Image Segmentation Methods:

2.1.1 Inversion technique: The principle of the inversion is to continuously update the muscle activity to produce a face movement following a given face trajectory. When the inversion had been carried out for all frames, the inverted activity was used to generate an animation. A conventional nonlinear optimizer minimizing a cost function was selected to implement the inversion. The cost function *E* was the sum of the squares of the Euclidean distances between the markers and the corresponding face model nodes.

2.1.2. Pattern Recognition Techniques: Pattern Recognition Techniques is a non-linear modeling tool and we can be used to model the inputs and outputs relationships. Weights in the classifier are selected through optimizing energy functional defined by the features of structures and are updated through processing each sample in the training set. The extracted information from the training set provides important cues of the structures such as intensity, position and shape, which can be valuable complementary information for the segmentation of test images. Active appearance models (AAM) are statistical models of the shape of structures. Training samples are used to extract the mean shape, mean appearance and define ranges of shape parameters. Restrictions on shape parameters guarantee the similarity between the segmentation result and the training samples. The segmentation procedure is to find the better positions of the shape points according to the appearance information. To guarantee the correctness of the results, the training set must contain enough samples and the samples should be representative and segmented accurately.

2.1.3. Active contour models: Contour models (snakes) goal is to apply segmentation process to an image by doing deformation to the initial contour towards the boundary of the object of interest. We do that by deforming an initial contour to minimizing the energy function which defined on contours there are two components in this energy: the potential energy, which is small when the contour is aligned to edges of the image, and the internal deformation energy, which is small when the contour is smooth. Both components are contour integrals with respect to a parameter of the contour. An Active contour can be parametrically represented by $v(s) = (x(s), y(s))$. Active contour models (Snakes) can be represented by two models: region based models and edge-based models. The characteristics of the image determine the model we should choose. The main advantage of snakes models is the ability of snakes to give a linear description of the object shape during the time of convergence without adding extra processing. But what scientifically limits the use of snakes is the need of the method to have strong image gradients to be able to drive the contour.

2.1.4. Threshold Method: Thresholds in these algorithms can be selected manually according to a priori knowledge or automatically through image information. Algorithms can be further divided to edge-based ones, region-based ones and hybrid ones Thresholds in the edge-based algorithms are related with the edge information. Structures are depicted by edge points. Common edge detection algorithms such as canny edge detector and Laplacian edge detector can be classified to this type. Algorithms try to find edge pixels while eliminate the noise influence. For example, Canny edge detector uses the threshold of gradient magnitude to find the potential edge pixels and suppresses them through the procedures of the non maximal suppression and hysterics shareholding. Hence, it is necessary to apply post- processing like morphological operation to connect the breaks or eliminate the holes. The method has the ability to segment 3D image with good accuracy, but the disadvantage of this method is the difficulty of the method to process the images of textured blob objects.

2.1.5. Topological Alignments Method: Topological Alignments Method depends on formalize the problem of aligning two consecutive frames as a generalized assignment problem. The algorithm links the segmentation of two frames from the video sequence. The process starts from the output of the segmentation procedure, the algorithm work by finding the maximum weighted solutions to a generalized matching between two segments, and derive weights from relative sets of segments. In this method we identify the segmentation of the first image into m segments with an index set $P = \{1,..., m\}$, and the second image segmentation into n segments with an index set $Q = \{1,..., n\}$. Then, alignments between these sets can be introduced through partitioning P and Q into an equal number of subsets. The method can deal with low contrast images and shape cells and improves the filtration efficiency. The advantage of the method is the ability of topological alignments to mitigate the image noise and cell deformation.

2.1.6. Watersheds Method: Watershed image segmentation is based on the theory of Mathematical morphology. Numerous techniques have been proposed to compute watersheds. The classical idea for building the watershed is using a geographical analogy, begin by piercing the regional minima of the surface. Then slowly immerse the image into a lake. The water progressively floods the basins corresponding to the various minima. To prevent the merging of two different waters originating from two different minima, we erect a dam between both lines. Once the surface is totally immersed, the set of the dams thus built is the watershed of the image. In one dimension, the location of the watershed is straightforward: it corresponds to the regional maxima of the function. In two dimensions, one can say in an informal way that the watershed is the set of crest lines of the image, emanating from the saddle points. Watershed contour discriminate to initial contour. A watershed contour is also a closed contour, but it is exactly along the watershed edges, i.e., it is composed of watersheds. When we input an initial manually delineated contour, we need to push (or expend) it to the nearby watershed edge to facilitate the later calculation. The method helps to improve the capture range but it has disadvantage of over segmentation.

2.2 Comparative Analysis of Segmentation Methods:

Method	Advantages	Disadvantages
Inverse Dynamics method	Data are very good. Animations are of high quality. Using a non linear optimizer.	Many different EMG patterns can produce the same kinematic output.
Active contour Method	Use active contour models. Preserves global line shapes efficiently.	Should find strong image gradients to drive the contour. Lacking accuracy with weak image

		boundaries and image noise.
Watersheds method	Based on mathematical morphology. Helps to improve the capture range.	Over segmentation.
Novel edge-based method	Algorithm based on an energy minimization procedure.	Depends on assumption that the deformation and movement of the tracked object is small between the frames.
Topological alignments method Pattern Recognition Method	Improve the filtration efficiency using linkage clustering. Pattern recognition fields used to perform the segmentation. The method used to model relationships between inputs and outputs.	Complicated Restrictions on shape parameters. Complicated.
Threshold method	Try to find edge pixels while eliminating the noise influence. Use gradient magnitude to fine the potential edge pixels.	The detected edges are consisted of discrete pixels and may be incomplete or discontinuous. Computationally expensive.

III. CONCLUSION

In this paper the importance of Iris recognition is introduced. The different types of authentication methods used in Biometrics are included among which Iris is providing high security in today's concern. The different Biometric methodologies are included along with their characteristics. The segmentation importance is included as well as the various segmentation methods along with their advantages and disadvantages are presented.

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