

Comparative Analysis of Iris Segmentation and Iris Feature Extraction Techniques

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Abstract—Iris recognition is identification and verification of an individual based on their respective unique iris patterns. This system is preferred because it is stable: Iris of an individual does not change by the passing of time; Unique: Each person has a different Iris pattern; Flexible: it can easily be incorporated into security systems; Reliable: No theft because people can't create an iris of another person; In our survey project the processes of Iris segmentation and Feature Extraction have been studied in depth. In this survey paper the various techniques that are used in Iris segmentation and Feature extraction processes are compared and analysed and a conclusion is drawn from them.

I. INTRODUCTION

Today Iris Recognition has gained global acclaim and its use is widespread all across the globe. Iris Scanners are now being used in banks for ATM Machines, Smartphones are coming out in the market with Inbuilt Iris Scanner.

In India for making Aadhar card, people have to go through an Iris Scanner and then the database registers the users eyes thus the person can be uniquely identified by the Indian government.

To identify a person there are also various biometric techniques available like DNA Matching, (Analysis using segments of DNA strand of a person), Ear Biometric (Analysis by the ear shape of a person), Iris Recognition (Analysis by features of eye), Retina Recognition (Analysis by patterns of veins in eye), Face Recognition (Analysis of features of face of a person), Fingerprint Recognition (Analysis by the pattern present on finger tips of a person), Finger Geometry Recognition (Analysis by 3D geometry), Gait (Analysis by how a person walks), Signature Recognition (Analysis by handwriting style of a person), Voice Recognition (Analysis by voice pattern), Hand Geometry Recognition (Analysis by hand geometry like lengths of fingers and width of hand). Out of all these biometric techniques available, this project uses the Iris Recognition technique.

II. STEPS PRESENT IN IRIS RECOGNITION SYSTEM

A. Image Acquisition

It is defined as the process of getting an image through any source [15], which can be a hardware-based source, so that it can be processed through the methods done afterwards.

B. Image Pre-processing

1) *Iris localization*: An iris [13] has inner and outer boundaries which are considered as circles [14]. However, the usual shape of the two circles are not in the way such that they have the same center. The two steps in iris localisation are as follows:

a) In an image by horizontal and vertical direction projection of an iris image the approximate region of iris can be found.

b) In Detecting outline to get the exact parameters of two circles..

2) *Iris normalization*: Many people have variation in iris measurements and sometimes they have different iris size, the modification in size of an iris is due to variation in illumination and other factors also. The results of iris matching are affected by elastic deformations [14] of iris texture. These deformations are need to be compensated in order to achieve more precise outcome. The anti-clockwise unwinding is done to the circle of iris and we obtain a block of texture rectangular in shape and of a fixed size (64x512) through the means of piecewise linear mapping.

3) *Image Enhancement and denoising*: The low contrast and maybe the illumination which is non-uniform [14] can be caused by the light sources position even after normalization of an iris image. Well-distributed texture image [22] is obtained by using low-pass Gaussian filter. This filter filters out the high frequency noises from iris picture and enhances the pic by using local histogram equalization.

C. Iris Segmentation:

For image processing, we partition digital image of iris in various segments. A unified framework approach [16] for iris recognition is the one which provides the localised eye images automatically from face images. Here is a comparison table for different methods used in iris segmentation:

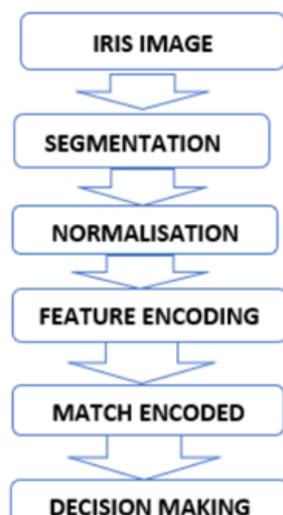


Fig. 1. Flowchart representing the steps of Iris Recognition system

TABLE I. COMPARATIVE ANALYSIS OF DIFFERENT IRIS SEGMENTATION TECHNIQUES

S.NO.	Proposed by	Method and Description	Advantages	Disadvantages
1.	Daugman et.al [1]	Integrodifferential operator -Most cited approach, it helps locating curved interior and exterior bound of iris.	Very high performance	Very high computational time
2.	Wildes et.al [2]	Hough Transform -Automated, it works in three phases which involves creating images, locating iris in that and comparing pattern so that uniqueness can be preserved.	Accurate	No attention to EL, reflection etc
3.	Masek et.al [3]	Masek Method -Open and automated iris segmentation method, iris region is localized from iris image and lashes, blepharon and area of reflections are isolated.	Localizes effectively	Low speed
4.	Proenca et.al [4]	Fuzzy clustering algorithm -Robust performance, extracts image features, applies the k-means clustering algorithm	Better segmentation	Determining of the curve specification of iris as well as the hole in its center.
5.	Qiu et.al [5]	Pulling and Pushing (PP) Method -Perfect, rapid five major contributions include-a reflection removal method, a PP procedure, a cubic smoothing spline, an efficient method for iris localisation, statistically learned prediction model	High accuracy and speed	Segmentation error arises
6.	T. Tan et.al [6]	Eight-neighbourconnection-based clustering - Efficient and robust, major contributions include - a novel region growing scheme, integrodifferential constellation, 1-D horizontal rank filter, prediction model	Iris Segmentation accuracy is attained	Does not give good results with noisy images.
7.	Puhan et.al [7]	Partitioning based on Fourier spectral density - Fourier spectral density is computed then row-wise adaptive thresholding is performed and then the image which is binary can be used to calculate various curve specific partitions.	Lower Computations as compared to other methods	Limbic boundary detection needs improvement.
8.	Radmanet.al [8]	Circular Gabor Filter -Less time consumption, localizes the initial pupil center, robust, develops a new iris segmentation framework.	Accurate for the pupil and the iris boundaries.	Over all segmentation accuracy is less.

D. Feature Extraction:

TABLE II. COMPARATIVE ANALYSIS OF DIFFERENT IRIS FEATURE EXTRACTION TECHNIQUES

S.NO.	Proposed by	Method and Description	Advantages	Disadvantages
1.	Mehrotra et.al [9]	Corner Detection based Iris encoding- Its purpose is to discover indexed polynomial which can be formulated like straight line, polynomial etc.	Have good efficiency	Performs poorly because lot of requirements, focus on corner of eye no info used from rest of the image, not well localized and during detection large amount of noise present
2.	Singh et.al [10]	Feature Extraction using Haar Wavelet- Binary coding is obtained from feature vector.	Binary code is easy to read than a vector	Suitable for applications only if image matrix has rows columns in multiples of 2
3.	Tuama et.al [11]	Feature Extraction using Gabor Filter- Convolution is used to sunder out the information from normalized filter for iris.	Helps to extract and store the information about noise position	Computational time is high and limited bandwidth
4.	Daugmanet.al [1]	Statistical Pattern Recognition- Uses fast fourier transformation to extract the information.	Mid-to-higher freq. is useful to extract the result	Difficult to extract result because of unwanted frequency range
5	Nechyha et.al [12]	Multichannel Gabor Filter- Analyse any specific freq. in the image in specific direction.	Texture analysis	Time taken for execution high, memory usage not effective, during image decomposition dimensions of image matrix gives error, openCL environment required

E. Matching

Images which are present in the database are compared [17], [18] with the individual’s eye image that is produced and on the basis of that a decision is formed whether the user is an authorized user or not.

- Eyelashes and lenses serves as a problem.
- Iris serves as a moving target which sometimes creates problem.
- Iris is located behind a curved wet reflective layer so focus issue arises.

III. CONCLUSION

This paper shows comparison between the various methods that exist for iris segmentation and feature extraction. Their advantages and disadvantages are studied along with their performance and efficiency.

IV. ADVANTAGES OF IRIS RECOGNITION SYSTEM

- Iris has very unique pattern which is formed at the age of 10 months and remain unchanged for rest of life.
- So, recognition of iris for security is itself a very stable concept [25].
- Two irises never produce same code. So, they are very unique.
- Iris recognition is such a technique which can be easily integrated into existing security systems easily.
- Iris pattern has very distinct characteristics, so, it can not be stolen or compromised anyway. Nobody can anyhow duplicate or steal it.
- It gives unmatched accuracy percentage when it comes to other security alternatives.
- This is a fast technique.

V. DISADVANTAGES OF IRIS RECOGNITION SYSTEM

- For PC and network access, fingerprint is suitable than Iris recognition.
- Iris serves as a small target which needs to be acquired from a distance. Sometimes clarity issue arises.
- Luminosity should be accurate.

VI. APPLICATIONS

A. Aadhar card

The motive of Aadhar card is to generate a unique identification number to all the citizens of India and through this number people can claim various benefits. In the process for registering for Aadhar card people have to go through an Iris Scanner [24] and register their eyes into the database of the Indian government.

B. MORIS

MORIS is specially designed system which reveals whether the person is a criminal or not by instantly identifying the suspect from his iris pattern and revealing all of his criminal history if present. This system is used by police forces all across America and New York Police department (NYPD) was the first to install this system.

C. Smartphones

Many mobile companies are now launching Smartphones with this technique [23] to identify the original user.

D. Banks

IrisGuard at Cairo Amman Bank deployed world’s first ATM machine that uses iris scanning [21] and with this ATM machine, customers can withdraw cash without entering any pin and they don’t have to use their bank card. They just have to show their eye to the camera that is installed on the ATM.

E. Airports, seaports

In UAE entry points of all airports, seaports or in general all of UAE’s land has iris recognition system. Foreign nationals who

have a visa, whenever they enter they have to pass via an iris scanner installed from security point of view [20] at different checking arena.

F. RAIC (Restricted Area Identity card)

Canada employed RAIC across 29 airports. It is first program in the world which does double biometric identification. It is being implemented [19] on airport. In this airport workers like pilots, flight attendants ground crew, maintenance workers and caterers are given a RAIC card and they have to swipe the card and pass through an Iris or a fingerprint scanner. After their identity is confirmed they are allowed access to the Restricted Area.

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