ISSN No. 0976-5697
Volume 8, No. 3, March – April 2017
International Journal of Advanced Research in Computer Science
RESEARCH PAPER
Available Online at www.ijarcs.info

Analysis of Iridology using Zhang- Suen's Algorithm

J. Sahaya Sheeba Mangalam
M.Phil Research Scholar,
Mother Teresa University,
Kodaikanal, India

Dr. S. T. Deepa
Assistant Professor, Department of Computer Science,
Shri Shankarlal Sundarbai Shasun Jain College for Women,
Chennai, India

Abstract: Biometrics is the measurement and statistical analysis of people's physical and behavioural characteristics. The technology is mainly used for identification and access control, or for identifying individuals that are under surveillance. The biometric features can be used for authentication. There are many biometric modalities like the fingerprint, iris, face recognition, signature and gait. Iris found in an eye image forms the important biometric feature in a human body. This paper proposes new methodology for iris segmentation and accurate measures for post processing using Thinning algorithm. The pre-processing steps involving binarization and thinning of the iris is done. The Zhang- Suen's algorithm is the most effective thinning algorithm. Simulations are done using MATLAB. The final result helped in concluding that thinning algorithm is an indispensable process which needs to be done for precise calculations.

Keywords: Segmentation; Morphological; skeletonization; topology; Medial Axis Transform

I. INTRODUCTION

Pictures are the most common and convenient means of conveying or transmitting information. A picture is worth a thousand words. Pictures concisely convey information about positions, sizes and inter-relationships between objects. They portray spatial information that we can recognize as objects. Human beings are good at deriving information from such images, because of our innate visual and mental abilities. Image processing [3] is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing [10] in which the input is an image and output may be image or characteristics/features associated with that image. Nowadays, image processing is among rapidly growing technologies. There are different techniques within this category and the techniques include contrast enhancement, hue, intensity, and saturation, edge enhancement, and Gray level slicing.

The basic premise of biometric authentication is that everyone is unique and an individual can be identified by his or her intrinsic physical or behavioural traits. There are two main types of biometric identifiers:

Physiological characteristics**:** The shape or composition of the body.

Behavioural characteristics**:** The behaviour of a person.

Examples of physiological characteristics used for biometric authentication include fingerprints, DNA, face, hand, retina or ear features and odour. A biometric [4] system is essentially a pattern recognition system that operates by acquiring biometric data from an individual, extracting a feature set from the acquired data, and comparing this feature set against the template set in the database. Depending on the application context, a biometric system may operate either in verification mode or identification mode. Nowadays, there are a number of biometric [4] systems available and they are being used more and more for almost everything that needs security or identification and verification.

Using image processing [3] and biometric [4] modality, the accuracy and identification is increased. In this paper, the methodology applied helps in finding the accurate canny edge points. Segmentation is a process which usually involves resizing, colour to grey conversion or to binary conversion and thinning of the image. Thinning of an iris [8] image refers to converting a thick image signal to thin image signal. Thinning also referred to as skeletonization. Segmentation forms the major part, as eye image contains abundant information which is not required. Iris is the annular region of the eye bounded by the pupil and the sclera (white of the eye) on either side. The visual texture of the iris is formed during foetal development and stabilizes during the first two years of life. The complex iris texture carries very distinctive information useful for personal recognition. The accuracy and speed of currently deployed iris-based recognition systems is promising and point to the feasibility of large-scale identification systems based on iris information. Each iris is distinctive and, like fingerprints, even the irises of identical twins are different. It is extremely difficult to surgically tamper the texture of the iris. Further, it is rather easy to detect artificial irises (e.g., designer contact lenses). Although, the early iris-based recognition systems required considerable user participation and were expensive, the newer systems have become more user-friendly and cost effective.

Iris recognition is one of the rare personal identification and security. Iris recognition helps in authentication which refers to the automated method of verifying a match between two human irises. Like fingerprint recognition system, iris recognition system is also becoming the most matured and accepted biometric system. Irises are one of many forms of biometrics used to identify individuals and verify their identity.

Many algorithms have been published in recent years and the accuracy rates showed varied results. Thinning algorithm is a morphological operation that is used to remove selected foreground pixels from binary images. It preserves the topology (extent and connectivity) of the original region while throwing away most of the original foreground pixels. It can be used for several applications, but is particularly useful for skeletonization and Medial Axis Transform. In this mode it is commonly used to tidy up the output of edge detectors by reducing all lines to single pixel thickness. Thinning algorithms can be divided into two broad classes namely iterative and non-iterative. Although non-iterative algorithms can be faster than iterative algorithms they do not always produce accurate results. The most popular thinning algorithms are Zhang-Suen's algorithm [1], Guo-Hall's algorithm[1],[2], Abdulla et al algorithm [1],[3] and Stentiford's Algorithm [1],[4]. This paper is organized as follows: Section 1 discusses the introduction and the purpose of the recognition of iris. Section II elaborates the methodology used for recognition and thinning of the iris. Section III discusses the Zhang- Suen's algorithm and section IV and V enumerates the results and the conclusion respectively.

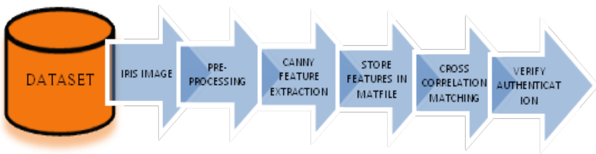


Fig 1.1

II. METHODOLOGY

REQUIREMENTS FOR THINNING *ALGORITHMS*

There are various skeletonization methods [9] which can be used to create skeleton. There are few basic requirements that skeletonization methods should fulfill:

1. Skeleton should be one pixel thick.
2. Connectivity should be preserved.
3. Shape and position of the junction points should be preserved.
4. Skeleton should lie in the middle of a shape.
5. Skeleton should be immune to the noise (especially to boundary noise).
6. Excessive erosion should be prevented (length of lines and curves should be preserved).

1. *Pre-Processing:*

1.1 Remove noise

The selected image is de noising using median filter. The median filter is a nonlinear digital filtering technique, which often used to remove noise. Such noise reduction is typical pre-processing step to improve the results of later processing. Median filtering is very widely used in DIP because, under certain conditions, it preserves edges while removing noise. [2]

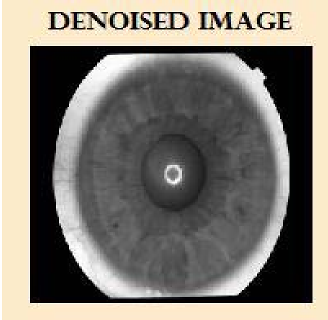


Fig 2.1

Fig 2.2

1.2 Histogram Equalization

Histogram equalization is to expand the pixel value distribution of an image so as to increase the perceptional information. The original histogram of a fingerprint image has the bimodal type, the histogram after the histogram equalization occupies all the range from 0 to 255 and the visualization effect is enhanced [2].

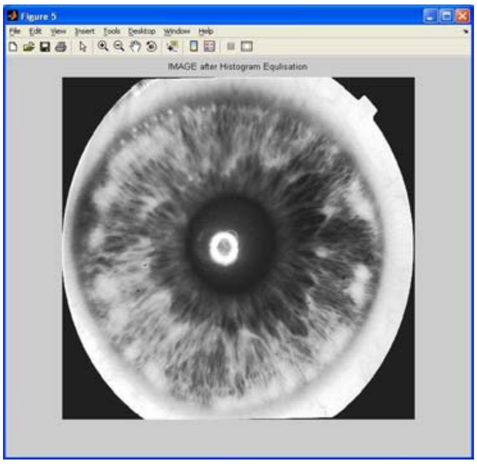


Fig 2.3

2. *Canny Edge Features*

Edge detection takes a grayscale or a binary image I as its input, and returns a binary image BW of the same size as I, with 1's where the function finds the edges in I and 0's elsewhere.

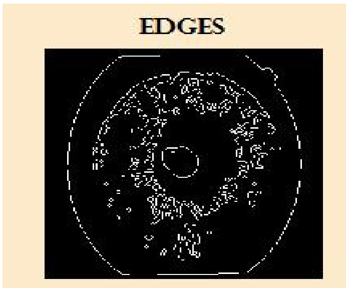


Fig 2.4

3. *Post Processing*

The post-processing algorithm is applied on the extracted minutiae and results are generated. The goal of post-processing is to minimise the number of false minutiae and to increase the probability of iris matching. Percentage reduction in average number of minutiae shows the efficiency of proposed technique. [7]

Fig 2.5

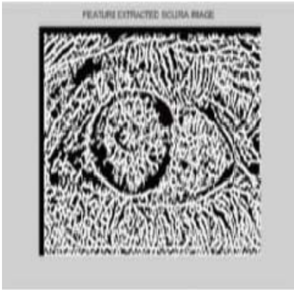


Fig 2.6

III. THINNING ALGORITHM:

It is fast and simple to be implemented. This algorithm is made by two sub-iterations. This algorithm is a parallel method that means the new value obtained only depend on the previous iteration value.

In the first one, a pixel I(i , j) is deleted if the following conditions are satisfied:

1. Its connectivity number is one.
2. It has at least two black neighbours and not more than six.
3. At least one of I(i,j+1), I(i-1,j), and I(i,j-1) are white.
4. At least one of I(i-1,j), I(i+1,j), and I(i,j-1) are white.

In the second sub-iteration, the conditions in steps 3 and 4 change.

1. Its connectivity number is one.
2. It has at least two black neighbours and not more than six.
3. At least one of I(i-1,j), I(i,j+1), and I(i+1,j) are white.
4. At least one of I(i,j+1), I(i+1,j), and I(i,j-1) are white.

A 3x3 window is move down throughout the image and calculations are carried out on each pixel to decide whether it needs to stay in the image or not. To the right is a description of the window and the classification given to the pixels that surround the centre pixel. The algorithm runs two sub iterations continuously until the image reaches a stable state.

[1] P_9 [2] (i-1. j-1)	[3] P_2 [4] (i-1, j)	[5] P_3 [6] (i-1, j+1)
[7] P_8 [8] (i, j-1)	[9] P_1 [10] (i, j)	[11] P_4 [12] (i, j+1)
[13] P_7 [14] (i+1, j-1)	[15] P_6 [16] (i+1, j)	[17] P_5 [18] (i+1, j+1)

Table 3.1

PSEUDO CODE ZHANG-SUEN THINNING:

Let A(P) be the number of 01 patters in the order set P2 … P9.
Let B(P) be the number of non-zero neighbors of P.

Do until image is stable (i.e. no changes made)

Sub-iteration 1:

Delete P from image if:
a) 2 ≤ B(P) ≤ 6
b) A(P) = 1
c) P2 * P4 * P6 = 1
d) P4 * P6 * P8 = 1

Sub-iteration 2:

Delete P from image if:
a) and b) from above
c') P2 * P4 * P8 = 1
d') P2 * P6 * P8 = 1

Our method for extracting the skeleton of a picture consists of removing all the contour points of the picture except those points that belong to the skeleton. In order to preserve the connectivity of the skeleton, we divide each iteration into two sub iterations.

In the first sub iteration, the contour point P_1 is deleted from the digital pattern if it satisfies the following conditions:

(a) $2 \leq B(P_1) \leq 6$
(b) $A(P_1) = 1$
(c) $P_2*P_4*P_6 = 0$
(d) $P_4*P_6*P_8 = 0$

where $A(P_1)$ is the number of 01 patterns in the ordered set P_2, P_3, P_4, ... P_8, P_9 that are the eight neighbours of P_1 (Figure 1), and B(Pi) is the number of nonzero neighbours of P_1, that is, $B(P_1) = P_2 + P_3 + P_4 + ... + P_8 + P_9$. If any condition is not satisfied, e.g., the values of P_2, P_3, P_4,... P9 as shown in Table 3.2, then $A(P_i) = 2$ Therefore, P~ is not deleted from the picture.

1

[19] 0	[20] 0	[21] 1
[22] 1	[23] P_1	[24] 0
[25] 1	[26] 0	[27] 0

2

Table 3.2

In the second sub iteration, only conditions (c) and (d) are changed (Table 3.3) as follows:
(c') $P_2*P_4*P_8 = 0$
(d') $P_2*P_6*P_8 = 0$
and the rest remain the same.
By conditions (c) and (d) of the first sub iteration, it will be shown that the first sub iteration removes only the south-east boundary points and the north-west corner points which do not belong to an ideal skeleton.

NORTH

WEST

[28]	[29] P_2	[30]
[31] P_3	[32] P_1	[33] P_4
[34]	[35] P_5	[36]

EAST

SOUTH

Table 3.3

Assume black pixels are one and white pixels zero, and that the input image is a rectangular N by M array of ones and zeroes.

The algorithm [6] operates on all black pixels P1 that can have eight neighbours. The neighbours are, in order, arranged as:

P_9	P_2	P_3
P_8	P_1	P_4
P_7	P_6	P_5

Fig 3.1

Obviously the boundary pixels of the image cannot have the full eight neighbours.

Define = the number of transitions from white to black, (0 → 1) in the sequence P_2, P_3, P_4, P_5, P_6, P_7, P_8, P_9, P_2. (Note the extra P_2 at the end - it is circular).

Define = the number of black pixel neighbours of P_1. (= sum ($P_{2....}$ P_9)).

Step 1

All pixels are tested and pixels satisfying all the following conditions (simultaneously) are just noted at this stage.

(0) The pixel is black and has eight neighbours

(1) $2 \leq B(P_1) \leq 6$

(2) $A(P_1) = 1$

(3) At least one of P_2 and P_4 and P_6 is white

(4) At least one of P_4 and P_6 and P_8 is white

After iterating [4] over the image and collecting all the pixels satisfying all step 1 conditions, all these condition satisfying pixels are set to white.

Step 2

All pixels are again tested and pixels satisfying all the following conditions are just noted at this stage.

(0) The pixel is black and has eight neighbours

(1) $2 \leq B(P_1) \leq 6$

(2) $A(P_1) = 1$

(3) At least one of P_2 and P_4 and $\mathbf{P_8}$ is white

(4) At least one of $\mathbf{P_2}$ and P_6 and P_8 is white

After iterating [4] over the image and collecting all the pixels satisfying all step 2 conditions, all these condition satisfying pixels are again set to white.

At the end, pixels satisfying these conditions will be deleted. If at the end of either sub-iteration there are no pixels to be deleted, then the algorithm stops. This processes effectively thins the image, however, it sometimes creates undesirably artefacts.

Iteration

If any pixels were set in either step 1 or step 2 then all steps are repeated until no image pixels is changed.

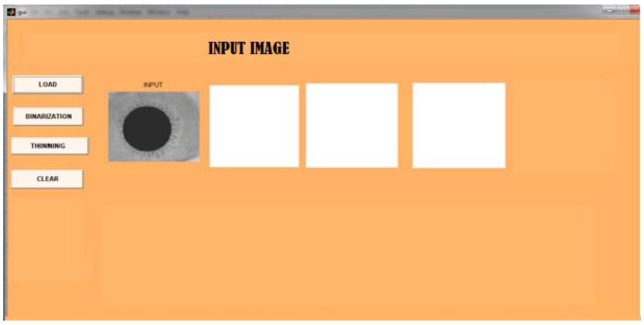
IV. RESULTS:

Thinning is the main pre processing stage in the iris recognition process. The algorithm is implemented and tested in MATLAB.

STEP 1:

It is a truecolor image.

An RGB image, sometimes referred to as a *truecolor* image, is stored as an *m*-by-*n*-by-3 data array that defines red, green, and blue color components for each individual pixel. RGB images do not use a palette. The color of each pixel is determined by the combination of the red, green, and blue intensities stored in each color plane at the pixel's location. Graphics file formats store RGB images as 24-bit images, where the red, green, and blue components are 8 bits each. This yields a potential of 16 million colors. The precision with which a real-life image can be replicated has led to the nickname "truecolor image".

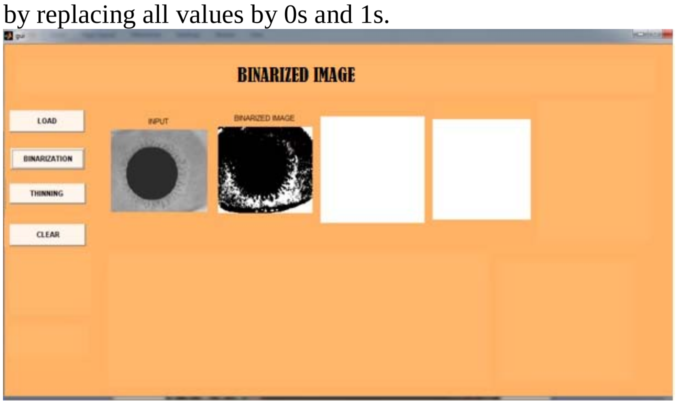


TRUECOLOR IMAGE
Fig 4.1

STEP 2

It involves binarization. Convert truecolor image to binarized image.

Binarization is the process of converting a pixel image to a binary image. It creates a binary image from truecolor image by replacing all values by 0s and 1s.

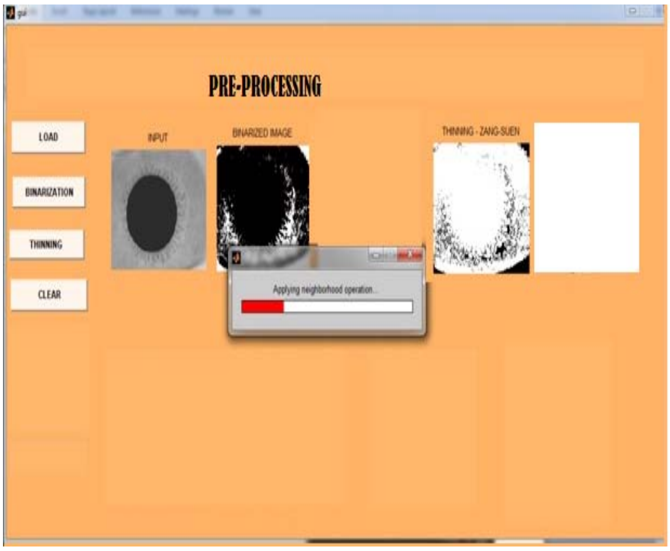


BINARIZED IMAGE
Fig 4.2

STEP 3

Thinning process

It iterates the image and converts the thick image into reduced skeletal image using Zhang - Suen's algorithm.

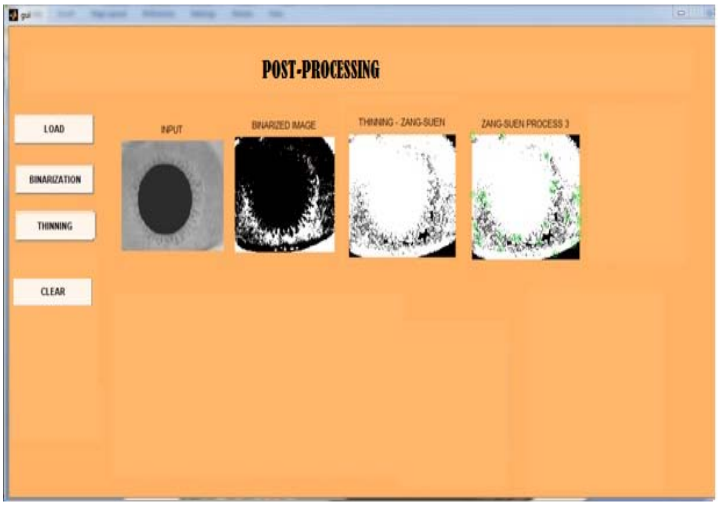


AFTER THINNING
Fig 4.3

STEP 4

Post Processing

The post processing is improved image and gives accurate result because thinning has been implemented. For medical purposes, canning edge filtrate can be implemented in the post processing.



POST PROCESSING
Fig 4.4

V. CONCLUSION:

In this paper, an improved fast thinning algorithm is proposed for thinning iris images. The algorithm is implemented in MATLAB. Experimental results show that this algorithm is more efficient than any other algorithm.

Iris recognition process consists of series of image enhancement and minutiae extraction processes. Out of many algorithms only one algorithm is being presented. Binarization and noise removal method can be enhanced further to improve the quality of the image.

VI. REFERENCES

[1] Romulo Ferrer L. Carneiro, Jessyca Almeida Bessa, Jermana Lopes de Moraes, Edson Cavalcanti Neto and Auzuir Ripardo de Alexandria, "Techniques of Binarization, Thinning and Feature Extraction Applied to a Fingerprint System", International Journal of Computer Applications (0975 8887), Volume 103 - No. 10, October 2014.

[2] Uday A.R and G.Sreelakshmi, "Fingerprint And Iris Recognition Using Cross Correlation ", International Journal of Advanced Research in Computer and Communication Engineering Vol. 3, Issue 9, September 2014.

[3] Mahmud S. Alkoffash, Mohammed J. Bawaneh, Hasan Muaidi, Shihadeh and Muath alzghool, "A Survey of Digital Image Processing Techniques in Character Recognition", IJCSNS International Journal of Computer Science and Network Security, VOL.14 No.3, March 2014.

[4] Anil K. Jain, Arun Ross and Salil Prabhakar, "An Introduction to Biometric Recognition", IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, VOL. 14, NO. 1, JANUARY 2004.

[5] T. Y. ZHANG and C. Y. SUEN, "A Fast Parallel Algorithm for Thinning Digital Patterns", Communications of the ACM, Volume 27 Number 3, March 1984.

[6] Rupal K. Snehkunj, "A Comparative Research of Thinning Algorithms", National Technical Symposium on Advancements in Computing Technologies (NTSACT) 2011 Proceedings published by International Journal of Computer Applications® (IJCA).

[7] M. Usman Akram, Anam Tariq and Shoab A. Khan, "Fingerprint image: pre- and post-processing", Int. J. Biometrics, Vol. 1, No. 1, 2008.

[8] Dr.S.T.Deepa and M.Sharmila, "Uncertain object's survey for optimal results in spatial database for users query", International Journal of Innovations & Advancement in Computer Science IJIACS, Volume 4, Special Issue March 2015.

[9] Dr. S. T. Deepa and Praneetha.V, "Iris Pattern Recognition", IOSR Journal of Computer Engineering (IOSR-JCE), Volume 18, Issue 4, Ver. II (Jul.-Aug. 2016).

[10] Dr.S.T.Deepa and Navaneetham.L, "TEMPORAL ANALYSIS AND REMOTE MONITORING OF ECG SIGNALS", International Research Journal of Engineering and Technology (IRJET), Volume: 03 Issue: 07, July-2016.