Computational Measuring Approach for the Identification of Probable Intestinal System Pathologies through the Human Iris Parameters

Julián D. Miranda
Faculty of Systems and Informatics Engineering
Pontifical Bolivarian University
Bucaramanga, Colombia
julian.miranda@upb.edu.co

Sergio A. Salinas
Faculty of Electrical and Electronics Engineering
Pontifical Bolivarian University
Bucaramanga, Colombia
sergio.salinas@upb.edu.co

***Abstract*–Iridology is the science that aims to identify certain human pathologies through human iris by using manual visual methods. These methods, although they are less invasive, are cumbersome. In this paper, a detailed description of the results obtained by applying an algorithmic approach for the automatic identification, calculation, and computation measurements of the key internal parameters of the human eye iris and specific organic pathologies related to the intestinal system is presented. Results evidence that using composition and basic segmentation of human iris, it is possible to execute propitious computational procedures for the determination of organic anomalies in the intestinal system.**

I. Introduction

Determining the state of health through aspects that may be reflected in the eyes, dates to ancient times. A scientist called Salzer [1] wrote a book on eye diagnosis and occultism, which paraphrases a quote that says: *"...everything that happens in the cosmos is reflected in man. This reflex is carried throughout the body, and the iris is the most suitable part for this recognition…"* [2].

The discovery of Iridology is usually attributed to the Hungarian physician Ignatz Vom Peczely. Bernard Jensen, Doctor of Chiropractic, is the American author who has published on this subject and is the one known worldwide. Perhaps his greatest achievement has been to clarify the correspondence of many iris sector, as his chart is widely known and used by Iridologists from all over the world.

1.1 Iris Anatomy

The iris is a connective-muscle-vascular membrane that is positioned almost between the anterior and posterior chambers of the eye, which in part forms the partition wall [3]. The thickness of this membrane is about 0.3 mm, being thinner at its peripheral edge and having its maximum thickness in the area of the *Fuchs*[1] angle where the Autonomic Nervous Wreath (ANW) is located. In the pupillary margin, the iris has a moderate decrease in its thickness. The innermost part forms the pupil, and it is in contact, at its rear part, with the crystalline lens [4].

1.2 Iris Sector Map

It is necessary to consider any guidelines that facilitate the location of the elements to identify the human system's pathologies in the iris. Many references for carrying out this location have been proposed. The most widely used is to observe the iris like the face of a clock and locate the signs in the hypothetical time into where they lay. This location technique is the most used due to the simplicity of its application, being other complex techniques not used anymore.

Due to this, in pupil area, within the autonomous nervous wreath, for example, the digestive system section is located (which in this case is not represented in the ciliary zone, except for organs such as liver, pancreas and the end region rectum). In general terms, the outer half of the iris represents the front of the body while the inner half represents the back. This system, however, is reversed when referring to the area of the head: the front part is in the inner half, and the back, on the outside.

Sectors and areas traditionally incorporated in the study of Iridology are [4] (see Fig. 1):

1. Sector of the head (upper quadrant)
2. Broncho-cardiopulmonary Sector (external or parietal quadrant)
3. Sector of the upper limb
4. Sector of liver and spleen (Abdominal Sector)
5. Genital Sector (Abdominal Sector)
6. Kidney Sector (Abdominal Sector)
7. Zone if the intestinal system (Abdominal Sector)
8. Rectal Zone (Abdominal Sector)
9. Bladder Zone (Abdominal Sector)
10. Sector of the spine
11. Pharyngeal Sector
12. Sector of sinuses, nose, and eyes

[1] (*anatom*). (anatomy). Iris crown formed by a circle of arteries and veins surrounding the pupil, in one third of the pupil and two thirds of edge of the sclera [3].

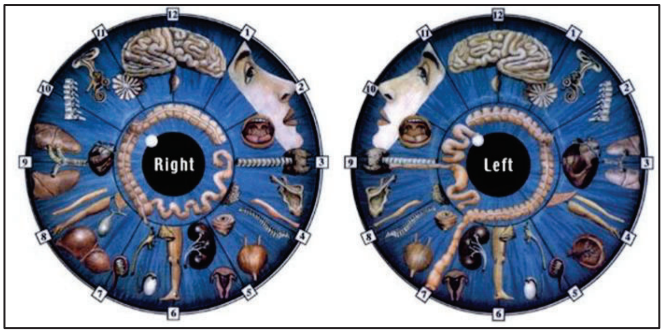

Fig. 1. Human iris chart [5].

Some scientific papers are about iris diseases, as [6] where is presented a recognition emphasized for patients with corneal edema, iridotomies, or conjunctivitis. It is made using pre-processing, template generation, feature extraction, pattern matching, and identification of the disease. They used a Gabor filter for feature extraction and pre-processing to improve images quality.

However, there are other articles that shown the usage of some computational processing algorithm to detect a pathology or disease through iris pictures. For example, in [7], [8], and [9] is mentioned how cholesterol could be detected in the blood, by simple, noninvasive computational methods. In [10], a pre-diagnostic tool to predict obstructive lung diseases using iris recognition system is assessed and an accuracy of 88% is obtained. By the other hand, diabetes classification has been also made using machine learning and iridology, obtaining a maximum average accuracy of 89.6%.

1.2.1 Zone of the Intestinal System

In the human iris chart, developed by Jensen [3], the third large circular area is called intestinal zone, which is located outside the ring of the stomach, and immediately within the Autonomic Nervous Wreath, within the pupillary area [4].

The intestinal tract has a similar striated structure as the ring of the stomach, but sometimes its density is usually a little more relaxed. It is rarely possible to distinguish a contracted or dilated stomach area, yet this is very often observed in the intestinal zone [4]. It should be borne in mind that it is not the intestinal zone that shrinks or expands, but it is the crown of the iris and the entire ciliated area which allows greater or lesser visibility of the lower layer of the iris stroma [2].

The intestinal zone must reach, at its peripheral edge, an imaginary circle located at a third of the pupil distance and two-thirds of the peripheral iris edge [2]. Any expansion on this standard will be an indication of intestinal dilation, and any contraction will match with an intestinal contraction, although it is necessary to bear in mind the pupil size.

Digestive system diseases are also detected using eye iris images. In [11], a backpropagation neural network is implemented to determine if a stomach disorder is presented or not. In [12], the author presents the development of a database of the iris related to colon diseases based on the charts of Jensen: 60 subjects were tested, obtaining 35-colon disorders confirmed. In [13], principal component analysis (PCA) and support vector machine (SVM) are used to detect colon pathologies, with an accuracy of 85%.

The major apparent pathologies studied for the intestinal system through Iridology are [14]:

- *Spastic Colon*: indicated by an excessive general closeness between the band of the autonomic nervous system and pupil.
- *Mega Colon (distended Colon)*: indicated by a band of the autonomic nervous system excessively separated from the pupil, that means a weak Colon with abnormal elongation.
- *Prolapse of transverse Colon*: partial excessive closeness of the band to the top edge of the pupil. This condition indicates a fallen transverse Colon with the possibility of abnormal pressure on pelvic organs.

Therefore, the study of detection and classification of human organs diseases, through processing and analysis of iris images, is a supporting non-invasive diagnostic tool.

II. Methodology

Human iris images sampled from consecutive relative diagonal measurements of the intestinal membrane were used to identify specific intestinal system's pathologies (healthy intestinal tract, distended Colon, prolapse of transverse Colon and spastic Colon). Fig. 2 shows a flowchart of the procedures applied.

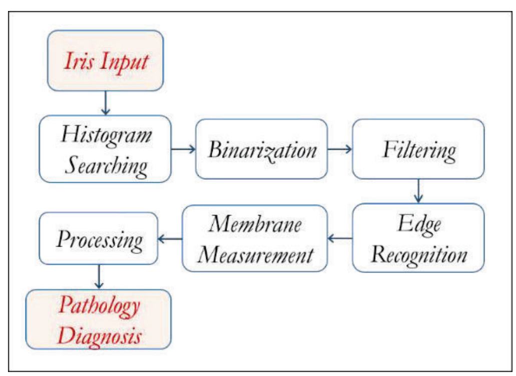

Fig. 2. The methodology proposed to identify pathologies in the intestinal tract from the observation and measurement of the intestinal membrane of the human iris.

First, the image import algorithm is run to bring images into the workspace. The images are stored as colored three-dimensional matrixes of pixels, which each dimension represents the numerical values RGB (Red, Green, and Blue). The chromatic coordinates in the axis of the red component were considered because it is the one that best represents the possible variations in the intestinal tract under diagnosis. The identification of the iris in the images is made through the highest color concentration specific areas. So, a color histogram search is used to define offset values of each scale. The histogram main peak is identified through a series of successive, autonomous cycles reviewing the whole arrangement of that histogram, looking for the greatest magnitude that did not correspond with nearby values of neutral colors (black and white). Then, quantities outside of the maximum section measured are subtracted, and the resulting sectioned image is binarized.

In order to identify the iris perimeter zone, repeated measurement procedures on the binary image are run. These measurement processes provide the radio that approaches the iris morphology. The same algorithm is executed to identify the pupil. Once both areas are sectioned, a filtering process is made to mitigate possible noise in the images. A logical AND operation between binarized images and original picture confirms and ensures that the only visible area will be within the iris and outside the pupil.

Considering that the representative area of the intestinal system in grayscale is evidenced as a darkened region, it is possible to see the impact of the comparison between a magnitude average and the standard color of the pixels of that region, using a high sensitivity *Canny* edges detector. At that time, it is possible to recognize what the most marked bordered area is, which in this case corresponds to the inside of the donut of the iris, where the intestinal membrane is located, the third irregular circle most evident in any Iridology image.

With possible sources of inaccuracy and noise attenuated, the measurement of the intestinal tract membrane is made using an algorithm which achieves 200 diagonal lines calculated starting from the center of the pupil, in an outward direction, like spokes going towards the outside. These diagonals are sloped to make them travel on the four quadrants of the image. Thus, it is possible to find out different magnitudes of distance for each of the spokes in the intestinal tract, and then an average radial distance of a possible irregular intestinal membrane.

III. Results

The input images came from a database of right iris images acquired using an iriscope, a camera designed to observe the iris. Iridology science professionals had carefully studied the pathology related to each of these images. Input images are depicted in Fig. 3.

Graphical results of the selection process and the sectioning process of the intestinal tract by circular approach for some sample images are shown in Fig. 4. The circular regions are superimposed on the original images to facilitate the visualization of the results about the segmentation process, and the images had been trimmed to remove all other eye regions different from the iris. Some of the shines located un the pupil zone of the original input images were suppressed.

An algorithmic process with all the features that represented the identified pathologies has been run to obtain a tabulated file. This procedure allows to shed an identification supported by the respective measurement of the variables in each area of relevance, as well as to observe some other related pathologies that the tool cannot display.

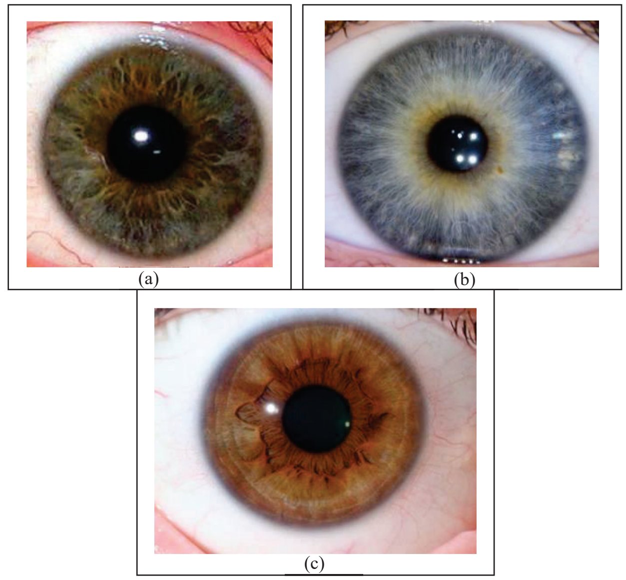

Fig. 3. Input Iris Images are taken from a database of Iridology: (a) relaxed and spastic ascending Colon; (b) Prolapse of transverse Colon (c) healthy intestinal tract.

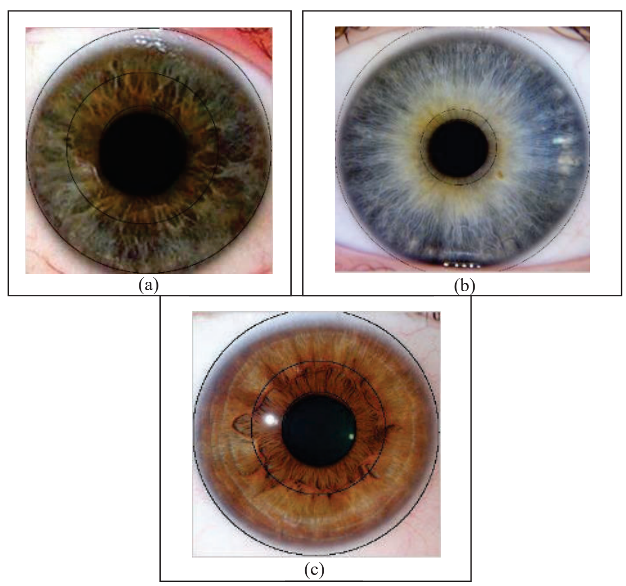

Fig. 4. Output Iris Images: (a) relaxed and spastic ascending Colon; (b) Prolapse of transverse Colon (c) healthy intestinal tract.

The results are presented in Tables I, II and III, where the parameters measured are shown in relative pixels to the size of each image for the specific pathology.

TABLE I. PARAMETERS MEASURED FOR A HEALTHY INTESTINAL TRACT.

Pupil Radius	Iris Radius	Intestinal Radius
47	154	85
Pupil Center	**Iris Center**	**Offset Pupil**
[160,147]	[156,154]	8
Intestinal Zone to Iris	**Intestinal Zone to Pupil**	
64%	36%	

TABLE II. PARAMETERS MEASURED FOR PROLAPSE OF TRANSVERSE COLON INTESTINAL TRACT PATHOLOGY.

Pupil Radius	Iris Radius	Intestinal Radius
121	531	165
Pupil Center	**Iris Center**	**Offset Pupil**
[538,524]	[554,531]	17
Intestinal Zone to Iris	**Intestinal Zone to Pupil**	
89%	11%	

TABLE III. PARAMETERS MEASURED FOR A DISTENDED COLON AND DIVERTICULA INTESTINAL TRACT PATHOLOGY.

Pupil Radius	Iris Radius	Intestinal Radius
91	259	160
Pupil Center	**Iris Center**	**Offset Pupil**
[247,255]	[259,259]	12
Intestinal Zone to Iris	**Intestinal Zone to Pupil**	
59%	41%	

IV. DISCUSSION

Table I denotes the percentage ratio measurements consistent with the specifications that identify a healthy intestinal tract. In this case, the radial distance from the intestinal tract into the pupil corresponds to 36% of the radial distance of the pupil to iris, which is in the 30% to 36% interval, which identifies a third of the radial distance proper to a healthy colon.

Table II shows a radial distance from the intestinal tract into the pupil equal to 11% of the radial distance of the pupil to iris. This value is below the lower range of health condition. In this case, the possible pathology found is the prolapse of the transverse Colon. In Table III, on the other hand, percentage ratio measurements consistent with theoretical specifications that identify the distended Colon pathology, since the radial distance from the intestinal tract into the pupil is 41% of the radial distance of the pupil to iris, which is significantly above the upper limit of the healthy interval.

Although algorithms and techniques for the identification of certain areas and patterns in image processing are already in force, the variability of the pictographic area in Iridology causes instability when running identification procedures due to a distinction that occurs in each processed image. This can be corrected if a generalization of the algorithms or other methods based on the input pictographic features is implemented.

In this sense, it is necessary to consider the feasibility of algorithms optimization, so that they can be executed, developed and used to the greatest possible number of processes involving processing images with high color variability. However, although many of the previously used algorithms were satisfactorily optimized, some shortcomings on the processing of light-colored iris or iris with too little delimited intestinal tracts were found. The correction of this problem requires a variation of the sensitivity of one of the methods that identify the required end region, such that the parameter can be varied when the input information varies its chromatic characteristics. The result of applying these corrections allows detecting the identification zone properly, with no significant noise and distracting components.

The application of computerized calculation tools for measuring the internal parameters in the iris of the human eye, through the development of algorithms, can be used to validate the diagnosis of pathologies of the intestinal system, giving the possibility of incorporating these tools in the validation of pathologies in other areas of the body, depending on the key parameters of the iris.

Iridology offers research opportunities and has grown very rapidly. The incorporation of image processing tools, supported by algorithms that facilitate the measurement of the characteristic parameters of the iris, becomes a very important alternative to help in the diagnostic process in an automated and efficient way.

V. CONCLUSIONS

The three objective pathologies: distended Colon, spastic Colon, and transverse Colon prolapse, in comparison with healthy Colon, were identified using the methodology developed. The results correspond to the implementation of an algorithmic approach for the identification of well-defined conditions in the intestinal tract.

The following improvements and future work are proposed: enlarge the images database to increase the diversity of cases and the fitting task of the pattern recognition algorithm, strengthen the biological and medical background to incorporate new iris features, and apply more robust algorithmic techniques to identify the human system pathologies through the iris. This would help in the improvement and implementation of more accurate diagnosis mechanisms used by iridologists.

REFERENCES

[1] J. Berdonces, «An Iridologic Study over hospitalized intestinal patients», 2 ed., Iridology Review (Natura Medicatrix), 1988, pp. 4-9.

[2] J. Berdonces, «El gran libro de la iriología: El iris de los ojos refleja la salud», 5 ed., Barcelona: Gayban Grafic S.L. (Barcelona), 2002, pp. 15-99.

[3] B. Jensen, «Iridology, the science and practice in the healing arts», vol. II, Jensen Publicher, 1982.

[4] D. Hall, «Iridology, personality, and Health analysis through the iris», Melbourne: Thomas Nelson Australia Editors, 1980.

[5] Mark medical instruments. “What it iris chart and how to read iris chart?”. Internet: http://www.iriscope.org/what-it-iris-chart-and-how-to-read-iris-chart.htm, [Mar. 16, 2019].

[6] G. DurgaDevi, «Disease Identification in Iris Using Gabor Filter», *International Journal Of Engineering And Computer Science,* p. 4, April 2014.

[7] Ridza Azri Ramlee, «Detecting Cholesterol Presence with Iris Recognition Algorithm», p. 21, 2013.

[8] S. G. Songire and M. S. Joshi. Automated Detection of Cholesterol Presence using Iris Recognition Algorithm. International Journal of Computer Applications (0975 – 8887) Volume 133 – No.6, January 2016.

[9] P. A. Reshma, K. V. Divya and T. B. Subair. Detection of Heart Abnormalities and High-Level Cholesterol Through Iris. Proceedings of the International Conference on ISMAC in Computational Vision and Bio-Engineering 2018 (ISMAC-CVB), Springer International Publishing, 2019.

[10] Atul Bansal, Ravinder Agarwal and R. K. Sharma. Pre-Diagnostic Tool to Predict Obstructive Lung Diseases Using Iris Recognition System. Smart Innovations in Communication and Computational Sciences, Advances in Intelligent Systems and Computing 669, Springer Nature Singapore Pte Ltd. 2019.

[11] A. K. Dewi, A. Novianty and T. W. Purboyo, "Stomach disorder detection through the Iris Image using Backpropagation Neural Network," 2016 International Conference on Informatics and Computing (ICIC), Mataram, 2016, pp. 192-197.

[12] R. Passarella, «Development of Iridology System Database for Colon Disorders Identification using Image Processing», *Universitas Sriwijaya,* p. 4, 2011.

[13] N. A. Rizanti, Arini and A. H. Setyaningrum, "Colon detection using Principal Component Analysis (PCA) and Support Vector Machine (SVM)," 2016 4th International Conference on Cyber and IT Service Management, Bandung, 2016, pp. 1-7.

[14] M. P. Popescu; D. A. Waniek, «Improved irido-diagnostic method: possibilities of computerized iridology», Bucarest: Revista de Chirugie, Oncologie, Radiologie, Oftalmologie, Stomatologie, 1986, pp. 29-33.