

Design of a graphic interface for tongue tissue image processing and classification employing neural networks

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Abstract— In this work, we introduce a graphical interface for detection and classification of different tissue, focusing on tongue soft tissue, based on ADALINE neural networks to provide tools for a highly accurate diagnosis. The interface is capable to identify an affected area or even by exploration of an image of the same sample, to identify normal and pathological conditions. The Adaptive Linear Element (ADALINE) neural network successfully achieved a correct classification of 95% of total study cases, identifying either healthy or abnormal tissue, presented from a set of 70% of images for validations and 30% for training out of the total images.

Key words— **graphical interface, tongue tissue, image processing, neuronal networks**

I. INTRODUCTION

The digital medical imaging is a consequence of a set of techniques and processes used to create images of the whole human body, or parts of it, for clinical purposes or for medical science (including the study of normal anatomy and function). It is important to identify human tissue belonging to different organs, including the tongue, since this provides us with relevant information that can allow its identification and even detect anomalies. [1][2][3][4].

Human body tissue consists of groups of cells with a similar structure working to perform a specific function. There are four main types of tissue in the body: muscle, epithelial, nervous and connective tissues. The technique in medicine for the examination of biological tissue using a microscope, is consider a milestone on diagnostic technique for many diseases in histology [5].

An important trend is the digitalization of tissue samples, letting them to be viewed on a computer rather than through a microscope. Despite these changes, much of the routine analysis of tissue sections remains to be a meticulous, manual task that can only be completed by highly trained pathologists at a high cost per hour.

The emerging techniques for imaging analysis can automate some aspects of this analysis. In the clinical field, these methods could improve the accuracy and consistency of diagnoses and to the pathologists to focus on specific cases. Research enables a reduction on the time-consuming discovery of new disease markers from hundreds of whole-

slide images or precisely delineating tissue within a tumor, allowing for quantitative comparison of tumors grown under different conditions. It will be possible to solve problems by using an automated process of the histology image analysis [6].

The tongue is a mobile organ located inside the mouth odd, medium and symmetrical, which fulfills many functions such as allowing the articulation of phonemes and speech modulator, swallowing during food intake, intervenes in taste, amongst others [7]. The knowledge of the anatomy of the tongue allows differentiating variations of normal and pathological conditions, many of the lingual affections are benign, while others can mean systemic disorders.

For that reason, in this work we have focused on the design an of graphical user interface (GUI) to allow the user to visualize, compare and classify tongue tissue for its identifications and detection of abnormalities with reduction on time and resources, provide more tools to have a more accurate diagnosis.

II. METHODOLOGY

The extraction of relevant image information is characterized by the computation of attributes from the input image that represent the structures of interest. These attributes are commonly used as input data to a classifier which automatically identifies the structures or related characteristics, like shape or condition. The tissue processing consists on stabilizing the tissue chemically and physically, the process is mentioned by Mccann [6], applying one of several methods (freeze, drying, microwave, chemical) with the ultimate goal of preserving the cellular morphology. The most commonly employed method involves the use of alcohols and xylene.

The samples observed in the microscopes were small intestine, large intestine, stomach, connective tissue, trachea and epidermis. The samples were focused on weak dry lense (10x), strong dry (40x) and immersion (100x). Finally, the image processing was focused primarily on the images of tongue obtained with the strong dry lense (40x)

The images from the microscope were digitalized by a 12 megapixels smartphone camera, placing the smartphone camera on the microscope ocular. For the interface in

MATLAB, it was considered that the indexed image is an M-by-N array of integers. The color map is a three-column array of values in the range [0,1]. Each row of the color map is a three-element RGB triplet that specifies the red, green, and blue components of a single color obtained from the color map, the process is presented in the Fig. 1 [8].

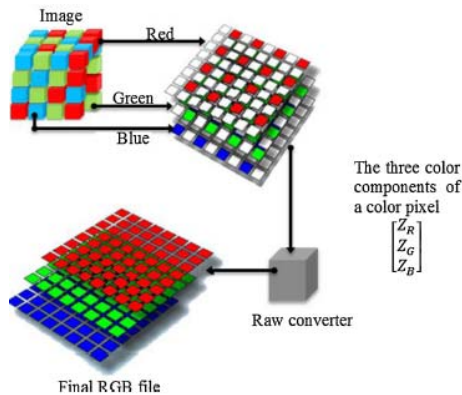


Fig. 1 Schematic of the implementation of RGB color model to process images.

The interface is presented in Fig. 2. consists of four buttons and their functions are listed below:



Fig. 2. Interface designed to process the images.

- 1) Load Image. By clicking this button, the user can “Load” an image where it is possible to select the tissue you want to search or analyze.
- 2) Filter. The image is filter and placed in the side window. The filter applied was HSV (Hue, Saturation, Value).
- 3) Select. By clicking this button, it allows you to select a region of the tissue, the selected region appears in the top window of the “Select button”.
- 4) Search. This button allows you to search the selected region and compare it with the rest of the images saved in a file, in order to show the image with which you found similarity.

Although it was only made with tissue samples, this interface allows to look for abnormalities among all the images from a pattern.

2.1 Neural Network

ADALINE is a basic ANN (Artificial Neural Network) which has an activation function given by equation 1.

$$a = \sum_{i=1}^n X_i W_i + \Theta, \quad (1)$$

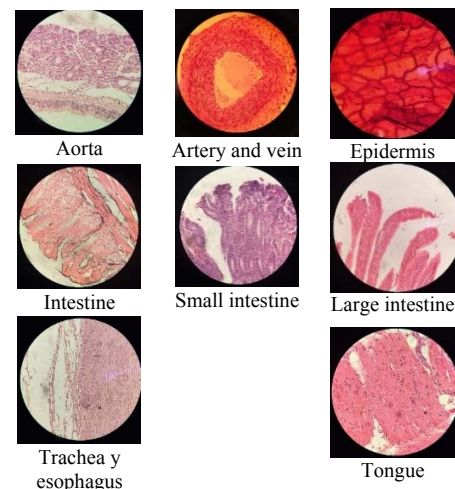
where X_i is the input, in this case the image tissues, W_i is the synaptic weight, and Θ is called polarization or bias, the response of the neuron is denoted by a and t , which is the expected solution that is needed at the output when it is trained, the mathematic model was developed by Widrow and Lehr [9].

ADALINE neuronal network was used to do a lineal classification and for training the network was occupied Widrow Hoff because esteem the medium quadratic error using the squared error in every iteration of the process. After the ANN was training, its learning optimizes the response with high reliability and it allows to work with security, the matrix size will be determined by the different parameters.

III. RESULTS

Several images were captured and processed of the tissues previously mentioned. The table 1 shows the image of some tissues gotten with the 40X lens.

TABLE I
IMAGE OF DIFFERENT TISSUES



A colorimetric analysis was made by using the different model's color such as RGB (Red, Green and Blue), HSV (High Saturation Value), HSI (High Saturation Intensity), the graphic and the value was used to identify each image. Although the images for the human eye looked the same, the values of their components changed allowing to differentiate them. However, in this case, the staining, the light and the position are reflected in the color components, some examples of the tissue samples for model's color are presented in the Fig. 3.

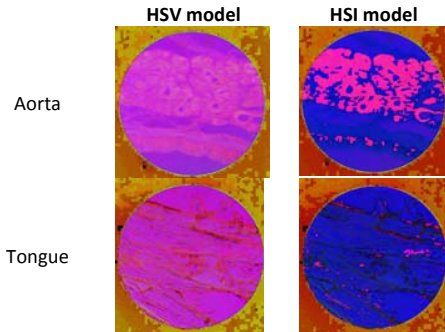


Fig. 3. Representation of the samples for HSV and HSI model color.

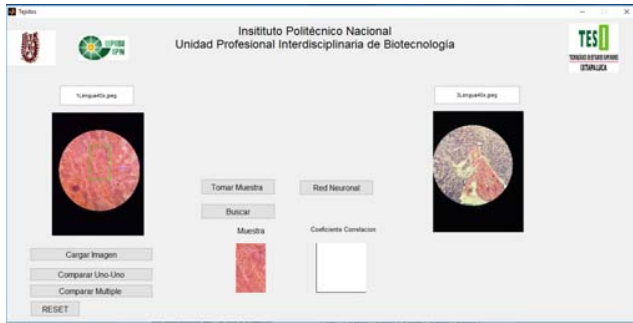


Fig. 4. Area selected compared with others tongue images.

Once the image was selected as the Fig. 4 presented, the results of the neural network application were obtained, given equation 1, input X is given by the image in pixels, and the weights are given by a 3 by 3 matrix that is shown in Fig. 5 as model A and B, for experimental cases θ we take it as 0. The activation function is a sigmoid, given by equation 2.

$$f(x) = \frac{1}{1+e^{-gx'}} \quad (2)$$

where g is the class of the image to be classified. The neural network was tested with 5 different classes: Aorta (A), Tongue (T), Small intestine (S), Epidermis (E) and Intestine (I).

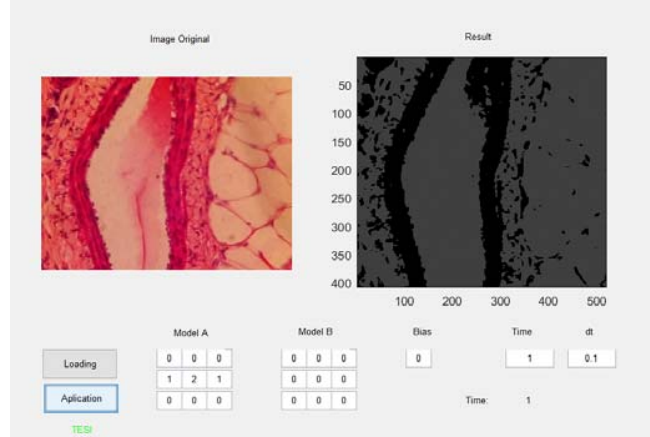


Fig. 5. Another Image classification with neural network.

70% of the images were chosen for validation and 30% for training out of the total pool. The results gotten with the neural network are presented in the table 2.

TABLE II
RESULTS OF THE NEURAL NETWORK TRAINED

	A70%- T30%	T70%- S30%	S70%- E30%	E70%- I30%	I70%- A30%
NPV	0.9511	0.9234	0.9279	0.9336	0.9186
PPV	0.0488	0.0766	0.0720	0.0663	0.0813
TPR	0.9661	0.9613	0.9648	0.9504	0.9675
SPC	0.3859	0.5738	0.4383	0.5357	0.5441

Negative Prediction Value (NPV), Positive Prediction Value (PPV), True Positive Rate (TPR), and Specificity (SPC). These values are calculated according to the equations 3 to 6, as follow:

$$NPV = \frac{TruePositives}{(TruePositives + TrueNegatives)} \quad (3)$$

$$PPV = \frac{TrueNegatives}{(TrueNegatives + TruePositives)} \quad (4)$$

$$TPR = \frac{TruePositives}{(TruePositives + FalseNegative)} \quad (5)$$

$$SPC = \frac{TrueNegatives}{(TrueNegatives + FalsePositive)} \quad (6)$$

IV. DISCUSION

The GUI designed has been capable of identify the selected area in the same image or other images belonging to the same tissue, thus avoiding comparing different tissues. Unlike the color models where the light or position influences the values of the same, the interface can search the selected area regardless of the position of the image as the Fig. 3 presented, thus allowing to compare patterns with the corresponding tissues.

In the Fig. 5, it can be seen that the image is correctly classified, the matrices of the weights are represented by the Matrix A and B. In order to be classified, the images must be in gray scale, the ADELIN type neural network only accepts linearly separable data, as they are color images, and they present linearly inseparable pixels. It was observed that the NPV data gives us good results; 95% of the cases the neural network classified correctly.

V. CONCLUSION

Tissue imaging is highly valuable to classify in order to know the pathology that associates it. The ADELIN type neural network has good results, with a 95% rate of classification, however the image must be converted to grayscale. In the future, a dynamic neural network must be design to reduce the inconvenience.

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