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TONGUE DIAGNOSIS USING TEXTURE ANALYSIS

Shivai A. Aher[1], Dr. V. V. Dixit[2]

[1]Asst. Professor, Department of IT, RMD Sinhgad School of Engineering, Pune, Maharashtra)shivai.aher@gmail.com

[2]Director/Principal, RMD Sinhgad School of Engineering, Pune, Maharashtra) vvdixit73@gmail.com

Abstract

Tongue is an important organ in the human body mainly known as an organ of speech and taste. It is also used as a diagnostic tool in ancient medicine. In Ayurveda, Jivha Parikshan (Tongue examination) is one of the important parameters considered by the physician for the diagnosis of any disease. Similarly in Chinese and Korean medicine also tongue based diagnosis has been prevalent since ancient times. Various features of the tongue are considered fordetection of diseases. Features such as tongue color, texture, geometry, coating, teeth marks, etc are mainly examined. Amongst these features the texture of the tongue plays a key role in detecting the disease and correlating with the symptoms seen. The proposed method extracts the texture features of the tongue using the Gabor filter in which 8 textures of different areas of the tongue are considered.

Keywords: Texture feature, Gabor filter.

I. INTRODUCTION

The tongue is commonly known as the mirror of the body, as it gives an overview of the health of the body. It is used as one of the tools for the diagnosis of diseases. Ancient Indian medicine- Ayurveda considers tongue examination [1] as an important means for detection of diseases. Traditional Chinese medicine also includes disease detection based on the visual aspects of the tongue.

Practitioners examine various features of the tongue based on its color, coating, texture and shape. Diagnosing and detecting a disease based on the external aspects of the tongue can be at times tricky and misleading. Correct disease detection requires years of experience of examination of the tongue and consider all its features.

In accordance with Ayurveda [6], different areas of the tongue relate to different organs in the body. The front portion i.e. the tip one-third of the tongue relates to lungs, heart, chest and neck. The central area relates to the liver, spleen, stomach and pancreas. The rear or the innermost one-third portion of the tongue i.e. the base relates to the lower abdominal organs – small intestine and the colon. Any disorder in the organs corresponding to that area is reflected by reddening, discoloration or sensitivity in that area.

In Chinese medicine [2], the tongue is divided into parts i.e. tip, margins, center and root. The tip of the tongue corresponds to the changes in the heart and lungs, tongue margins reflect changes in the liver and the gallbladder. Spleen and stomach are related by the center of tongue while kidneys, intestines and bladder correspond to the tongue root.

Hence the tongue depicts the overall health of an individual and texture feature of the tongue plays a very important role in determining it. The proposed method therefore extracts the texture features of the tongue.

II. RELATED WORK

Supatman and M. H. Purnomo [3] have mentioned about identifying the dirtiness tongue texture's image using a texel (texture element) as a basic element in image processing to identify the typhoid fever. From the experiments using 89 data (40 data of learning and 49 data of recognition), the system can identify the four models of the differences of tongue's dirtiness from the image tongue according to the titer typhoid.

Bo Pang, David Zhang, [4] suggested that a novel computerized tongue inspection method to identification of syndromes rather than with the connection between tongue abnormal appearances and diseases. First, two kinds of quantitative features, chromatic and textural measures, are extracted from tongue images by using popular digital image processing techniques.

Muh. Fuad Al Haris, I Ketut Eddy Purnama [5], propose that tongue diagnosis is an important

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diagnostic method for evaluating the condition of the internal organ by looking at the image of the tongue. Two kinds of quantitative features have been considered, chromatic and textural measures. The textural measures are found using feature based texture operators derived from co-occurrence matrix.

In the proposed method the foreground pixel of the tongue are extracted and then further subjected to Gabor filter for extraction of texture features. It gives a better representation of the tongue texture features with human health which is described as follows.

III. PROPOSED METHOD

The tongue region is cropped from the background to Smaller block sizes would prevent overlapping, but separate foreground pixels from the background pixels. Foreground pixel image is then used for further feature extraction.

Texture feature extraction [7] from tongue images is presented in this section. To better represent the texture of tongue images, eight blocks of size 64 × 64 strategically located on the tongue surface are used. A block size of 64 × 64 was chosen due to the fact that it covers all eight surface areas very well, while achieving minimum overlap.

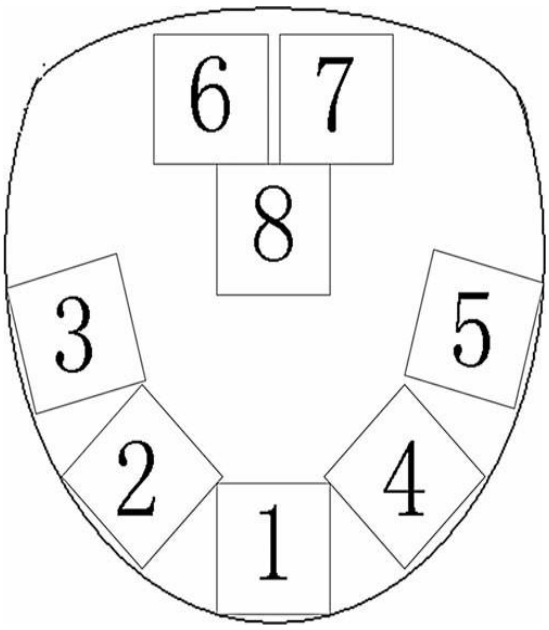

Figure 1: Position of 8 blocks for texture extraction.[7]

Larger blocks would cover areas outside the tongue boundary, and overlap more with other blocks. not cover the eight areas as efficiently. The blocks are calculated automatically by first locating the center of the tongue using a segmented binary tongue foreground image.

Following this, the edges of the tongue are established and equal parts are measured from its center to position the eight blocks. Block 1 is located at the tip; Blocks 2 and 3, and Blocks 4 and 5 are on either side; Blocks 6 and 7 are at the root, and Block 8 is at the center.

The Gabor filter is a linear filter used in image processing, and is commonly used in texture representation. To compute the texture value of each block, the 2-D Gabor filter is applied and defined as

$$G(x,y) = \exp\left(\frac{(x'^2+\gamma^2.y'^2)}{-2\sigma^2}\right).\cos\frac{2\pi x'}{\lambda} \quad \ldots (1)$$

Where,

$x' = x.cos\theta + y.sin\theta$, $y' = -x.sin\theta + y.cos\theta$ and σ is the variance, λ is the wavelength, γ is the aspect ratio of the sinusoidal function, and θ is the orientation. Each filter is convolved with a texture block to produce a response $R(x,y)$:

$$R(x,y) = G_k(x,y) * im(x,y) \quad \ldots (2)$$

where $im(x,y)$ is the texture block and $*$ represents 2-D convolution. Responses of a block are combined to form FR_i and its final response evaluated as follows:

$$FR(x,y) = \max(R_1(x,y), R_2(x,y), .., R_n(x,y)) \quad \ldots (3)$$

which selects the maximum pixel intensities, and represents the texture of a block by averaging the pixel values of FR_i.

IV. EXPERIMENT AND DISCUSSION

The texture features are extracted using the Gabor filter which is a linear filter specially used for representation. Frequency and orientation representations are found to be similar with the human visual system. Image analysis using Gabor filters is also considered to be similar to the perception of the human visual system. Hence it is more compatible for texture feature extraction. It is as good as being observed by physician.

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Table 1. Values of Gabor filter component

Components	Values
σ (Variance)	**1**
λ (Wavelength)	**4**
γ (Aspect ratio)	**0.1768**
θ (Orientation)	**30, 60, 130, 160**

The values of the components in the above table no 1 are optimized values for extracting the texture of the tongue.

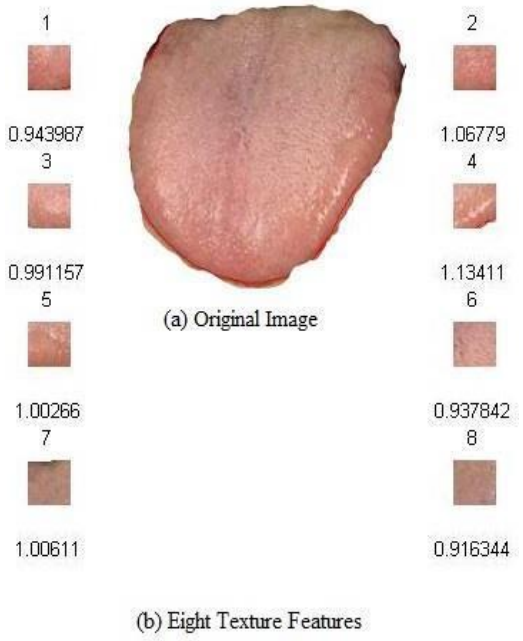

Figure 2: (a) Original image, (b) Eight extracted texture features with texture values

The above image shows the original tongue image along with the eight texture features extracted from the original tongue image.

V. CONCLUSION

The proposed method extracts the texture features of tongue which further can be used for detection of diseases such as Diabetes, kidney disorders, nephritis etc. It is easy to understand and efficient method with significantly lesser computations. All the 8 texture features of the tongue have been extracted here successfully.

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