

## Disease Analysis Using Tongue Image

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**Abstract**— Tongue diagnosis is one of the important area in diagnosing most of the diseases, thus tongue diagnosing has received more significance among the experts. Tongue diagnosing is usually carried out by processing the tongue images, But it is not practiced in western medicine the main aim of this paper is to bridge the gap between Chinese medicine and western medicine and also improve the quality of segmentation for that we proposed a sequential method for processing the tongue image. The method consists of mainly three phases, first two kinds of quantitative features, chromatic and textural measures, are extracted from tongue images by using popular image processing techniques. Second shape detection phase, and edge detector with the aid of region growing algorithm is used for extracting the shape of the tongue. Third, pimple detection and crack detection are done with help of color intensity extraction method. Level set Algorithm gives better segmentation results. Then Mean and Entropy value of normal and abnormal tongue was compared. The goal of providing an automated system for tongue analysis is not to replace conventional diagnostic methods, but to assist doctors with their decision-making by giving an early alert signal that can lead to further diagnosis by other methods such as MRI, CT, X-Ray and colonoscopy.

**Keywords:** *Tongue Diagnosis(TCM),Diabetes,Tongue Segmentation*

### I. INTRODUCTION

TCM believes that the tongue has many relationships and connections in the human body, both to the meridians and the internal organs. It is, therefore, very useful and important during inspection for confirming TCM diagnosis as it can present strong visual indicators of a person's overall physical and mental harmony or disharmony. In TCM, the tongue is divided into tongue tip, tongue margins, tongue center, and tongue root. Figure 1 shows each part of the tongue and its correspondence to different internal organs according to TCM while. The tongue tip reflects the pathological changes in the heart and lungs, while the bilateral sides of the tongue reflect that of the liver and gallbladders. The pathological changes in the spleen and stomach are mirrored by the center of

tongue, while changes in the kidneys, intestines, and bladder section correspond to the tongue root.

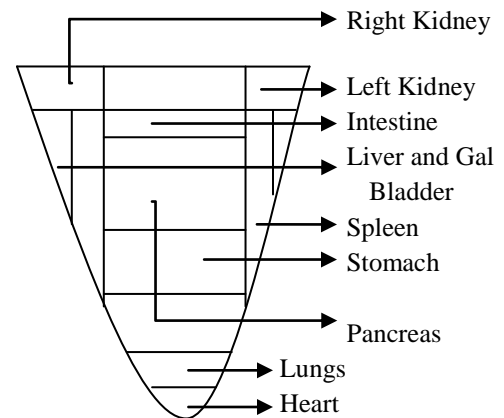


Fig 1: Reflex Zones of Tongue

In this paper, we focus on the patients with Diabetes. Hence, we are interested in extracting features not only from entire tongue image but also specifically from the above the middle region, as this corresponds to the pancreas organ, according to TCM. We extract the middle rectangular region. The practitioner examines the general and local shape as well as the color of the tongue and its coating. Some signs of imbalance or pathology are red body, yellow coating, or thick coating like mozzarella cheese, and so forth. Some characteristic changes occur in the tongue in some particular diseases. Most tongue attributes are on the tongue surface. TCM doctor looks at several attributes of tongue body: color, moisture, size, shape, and coating. These signs not only reveal overall states of health but they also correlate to specific organ functions and disharmonies, especially in the digestive system. The two main characteristics of the tongue diagnosis are the color and the coating. The color of the patient's tongue color provides information about his/her health status. For example, dark red color can indicate inflammation or ulceration, while a white tongue indicates cold attack, mucus deposits, or a weakness in the blood leading to such conditions as anemia. Moreover, a yellow tongue points out a disorder of the liver and gallbladder,

and blue or purple implies stagnation of blood circulation and a serious weakening of the part of the digestive system that corresponds to the area of the tongue where the color, appears. The coating on the tongue is discriminated by not only its presence but also its color. The color could be yellow, white, and other colors. The normal color of a healthy tongue is a nice, robust, Sanguine pink - a perfectly balanced blend of red and white. Any deviation from this perfect Sanguine pink denotes a deviation from this ideal state of health and balance; the greater the deviation, the more severe the imbalance. In order to get a true reading of tongue body color, it's important that inspection of the tongue body be done in a natural, full-spectrum light, free from any undue tinting or shading

## II. RELATED WORK

Tongue images can be captured by using a specific set of image acquisition devices, including an advanced kernel camera and its corresponding lighting system. The reason for this failure is that those methods do not take the shape property into account, which is an essential feature in such a task. A model-based segmentation scheme, used in concert with image preprocessing, can overcome many of these limitations. Recently, researchers have been developing serious methods and systems to circumvent these problems. At present, there are many ways to segment objects, in which active contour model, or snake has been developed as useful tools for segmenting rigid or non-rigid (i.e. deformable) objects during the past decade. A snake is an elastic curve placed on an image that deforms from an initial shape to adjust to certain image features, e.g., the boundary of an object. Supatman and M. H. Purnomo suggested identifying the dirtiness tongue texture's image using a texel (texture element) as a basic element in image processing to identify the typhoid fever in 2007. 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 1/100(84.61%), 1/200(92.85%), 1/400(90.00%) and 1/800(75.00%). In 2004 Bo Pang, David Zhang Energy Engineering & Systems375 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. Then, Bayesian networks are employed to model the relationship between these quantitative features and diseases. The effectiveness of the method is tested on a group of 455 patients affected by 13 common diseases as well as other 70 healthy volunteers, and the diagnostic results predicted by the previously trained Bayesian network classifiers are reported. application.

The segmentation result will directly affect the accuracy of image analysis.

- Color mixture between tongue body and complexion(especially lip color).
- Different shooting angle, circumstance and certain patient, his/her tongue shape,all these subjective factors affect the segmentation.
- As a soft tissue, tongue body edges do not show a distinctive gradient descend compared with hard objects.
- From the perspective of pathology, features such as tongue color, texture, coating etc.add additive difficulties to image segmentation.

## III. EXPERIMENTAL PROCESS FOR DIABETES ANALYSIS

Fig 5:Represents the Overall flow of the proposed Method

In this paper, we used Canon PowerShot SX20 IS camera, used super macro mode, ISO 100, additional lighting with ring flash camera covered by paper to get soft lighting. To ensure the distance between camera and object fixed 5 cm was used tools as buffer chin. Before image acquisition is done, the patient is done, the patient should be fasting and temporarily stop the use of diabetes medication or insulin injections within 2x24 hours to ensure no effect of the drug on the condition of the pancreas. The system framework consists of image capture, image preprocessing, texture feature extraction and symptomatic analysis.

Tongue images are the elementary features for diagnosis various diseases. For the ease of the diagnosis, the tongue images should be processed clearly and properly. As we discussed earlier, tongue image processing is quite a tough task due to the tongues particular features like, its irregular shape, interference with the lip etc. So it's difficult to get an effective diagnosis of diseases without an effective tongue image processing methods. The main features that are used for diagnosing the tongue include shape, color, pimples, cracks and texture of the tongue. Fig. 2. Two tongue images with different characteristics. Normal healthy tongue image is represented in the Fig 3(a).The symptoms of any of the body problem such as heart associated problems, kidney related problems, etc. will be reflected as abnormalities in any of the features. So, most of the diseases can be detected easily by the examination of the tongue. For detailed analysis of the tongue, we use the tongue images, with the help of the clear tongue images a detailed diagnosis of tongue can be possible. Now, let us consider some tongue images and the disease analysis. The main features that we consider for tongue diagnosis are shape, color and tongue body cracks

and pimples. Here, the Fig 3(b) Patient with Diabetes. Diseases caused by the virus and bacteria result in the difference in color. Thus tongue can be characterized with different measures. The common measures of the tongue can be detailed as follows.



Fig 2: Tongue with different shape characteristics'

**Width:** A wide tongue on the whole shows a composed physical and mental character. A lack of physical flexibility with noticeable strengths and weaknesses is depicted by a narrow tongue. They may be sharp thinkers but generally have a narrow view. A generally loose and expanded physical condition and a tendency to have more psychological concerns are related to a wide tongue.

**Tip:** A flexible yet firm physical and mental condition is mirrored by a rounded tip. A pointed tip reveals a tight, perhaps even rigid physical condition and an antagonistic or even unpleasant mentality. A very wide tip shows an overall weakness of the physical body and a limp or even "spaced out" mental situation. A tendency toward physical and mental imbalances with the likelihood of sharp variations in thinking and mood is mirrored by a divided tip.

**Thickness:** A flat tongue echoes a composed condition and the competence to docilely adapt to situations. A calmer and easy going trend is depicted by a thin tongue. It also reflects a more mental orientation. A more bodily orientation is reflected by a thick tongue, they tends to be self-confident or even forceful.

**Color:** Inflammation lesions or ulceration and sometimes a deterioration of the associated body part are pointed out by dark red. White designates stagnation of blood; fat and mucus deposits or feebleness in the blood leading to such disorders as anemia. A disorder of the liver and gallbladder is specified by yellow. This results in a surplus secretion of bile, deposits of animal fats, particularly in the middle organs of the body, and likely inflammation. Blue or purple shows the stagnation of blood circulation and a grave fading of the part of the digestive system that is connected to the zone of the tongue. Internal conditions can be understood by analyzing the color on the underneath of the tongue. As a summary, the colors and

their symptoms given above are the same, with the subsequent exceptions. Surplus of blue or Green shows maladies in the blood vessels and in blood quality and circulation. Surplus purple color mirrors ailments of the lymphatic and circulatory system. It designates a fading of the immune capacity of the blood vessels.



Fig3:(a)Normal Tongue,(b) Diseased Tongue

#### IMAGE SEGMENTATION

The usual approach is to find a point near the center of the target image, which is used as the center of image, and then to give an initial two-dimensional curve and make it astringe to the edge of the target according to dynamics mechanism. This approach is appropriate when the general form of the target is fixed. But human tongue is not always flat when extended out of the mouth. Some forms will be changed and therefore it is not suitable for this algorithm. We adopt the component H (Hue) and V (Value) of HSV space to decide the initial position of tongue.

Then level set algorithm is used to obtain the better segmentation

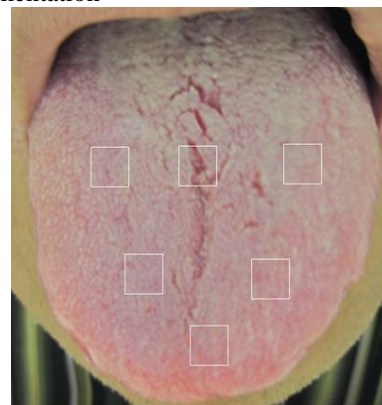


Fig 4 : Region of interest to diagnose the Diabetes

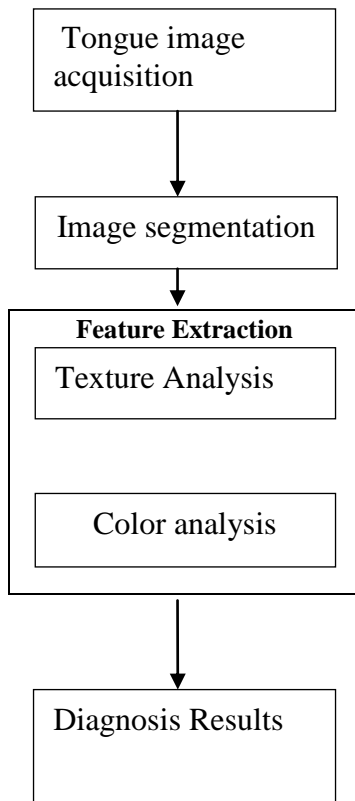
#### Quantitative Texture Features

Methods for extracting the features of the texture can be categorized roughly as follows: feature based, model-based, and structural. In feature based methods, some characteristic or characteristics of the textures are chosen and regions are sought in which these characteristics are relatively constant (or the boundaries between the regions). In this paper, two feature-based texture operators, which are derived from the co-occurrence matrix, are implemented to extract different textural features from images of the tongue. These two descriptors are the second moment and the contrast metrics based on a co occurrence matrix, which are shown respectively as follows:

$$W_M = \sum_{g_1} \sum_{g_2} P^2(g_1, g_2)$$

$$W_C = \sum_{g_1} \sum_{g_2} |g_1 - g_2| P(g_1, g_2)$$

Where  $P(g_1, g_2)$  is a co-occurrence matrix and  $g_1$  and  $g_2$  are two values of the gray level.  $W_M$  measures the smoothness or homogeneity of an image and it will reach its minimum value when all of the  $P(g_1, g_2)$  have the same value.  $W_C$  is the first moment of the differences in the values of the gray level between the entries in the co-occurrence matrix. Both of the two textural descriptors are calculated quantitatively and they have little correlation with the sensation of the human vision system.



**Fig 5:Proposed Methodology**

## Colour features

The color always has to be given relative to a specific color space. The extraction of the features of the color can be performed in different color spaces, which usually include RGB, HSV, CIEYxy, CIELUV and CIELAB. Different from the other color spaces, the HSV color space is an intuitive system in which a specific color is described by its hue, saturation and brightness values. This color space is often used in software systems to aid in interactive selection and manipulation of color. However, the HSV space has discontinuities in the value of the hue arounded, which make this approach sensitive to noise. Therefore, in our system we use the remaining four color spaces (RGB, CIEYxy, CIELUV and CIELAB) for the extraction of quantitative features of the color.

Color Partition	Mean	Standard deviation
R	170.5219	10.9794
G	138.7956	24.3665
B	135.3916	20.6999
X	0.3091	170.5665
Y	0.2964	140.6263
Z	0.2789	136.6892
L	60.5963	110.4725
U	20.3011	120.9738
V	6.9111	130.1374
A	11.6642	129.4454
B	6.5518	130.4921

**Fig 6:Mean and standard Deviation values**

## IV. RESULTS AND DISCUSSION

### Performance on metrics for color

The objective of this section is to discover which metrics do not perform well for diagnosis of diabetes mellitus. Figure 7 shows the results for the GODs of different metrics (means) in four color spaces (as defined in Section 2.2). For the measurement of the mean, the metric that gives the best performance is CM11 (the B chromatic plane in the CIELAB space), whereas the metric that gives the worst performance is CM2 (the B plane in the RGB space). Moreover, all of the metrics that are related to lightness or brightness (CM4 and CM7) exhibit poor performance. However, the four chromatic metrics in the two CIE perceptual uniform color spaces (CM8–CM11) perform exceptionally well. Figure 6 illustrates the results of the GODs of different metrics (standard



deviation) in the four color spaces. The best performing metrics are CM12 (deviation of R in the RGB space) and CM18 (deviation of L in the CIELUV/AB space), whereas the worst performing metric is CM15 (deviation of Y in the CIEYxy space)

This section evaluates the suitability of different textural metrics for diagnosing diabetes mellitus. Two kinds of textural features (WM and WC) are implemented for five Partitions of the tongue, providing a total of 10 different metrics whose GODs are shown in Figure 7. It can be seen that all of the metrics of WM provide a much better performance than those of WC. TM5 (WM measurement of the root of the tongue) provides the best performance. Such a difference might be the result of the different degrees to which WM and WC correspond to the perception of the human vision system to a specific texture, especially in an image of the tongue. A problematic result is the relatively low value of GOD for the WM measurement at the tip of the tongue, as shown in Figure 7. Actually, because of the existence of hyperplastic filiform papillae, the picture of the tip of a tongue affected by diabetes mellitus is very different from other diseases. However, all of the textural metrics that were introduced in this paper fail to report such a difference.



Fig 7 (a) Abnormal tongue, (b) segmented portion of Abnormal Tongue.

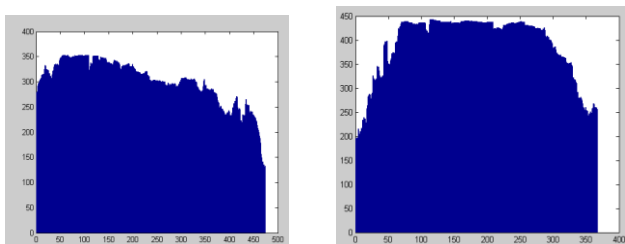


Fig 8(a) Histogram of normal tongue, (b) segmented portion of Abnormal Tongue.

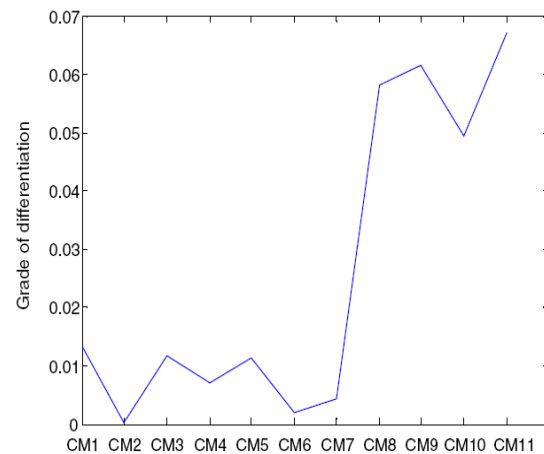


Fig 8 performance curve Using God's Algorithm

## V. CONCLUSION

In this paper, we proposed a distinct computerized tongue diagnosis approach for the diagnosis of diabetes mellitus based on a quantitative analysis of the pathological changes on the surface of a tongue. Both chromatic and textural features are used to build the mapping from a tongue image to corresponding diseases by a statistical way. Experiments are implemented on a large tongue image database, and the results are promising. The main contribution of this research is that computerized tongue image analysis approach is proposed for the building of the mapping from tongue signs to Western medicine defined diseases. This will undoubtedly boost the modernization process of the traditional tongue diagnosis and, more importantly, shorten the gap between the tongue diagnosis and clinical application.

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