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TONGUE ANALYSIS USING GEOMETRY FEATURES

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ABSTRACT

The tongue is considered to be the mirror of the body. It not only gives taste but also reflects the physical state of body. Since ancient times Ayurvedic as well as Chinese medical practitioners have diagnosed disease by observing the tongue. The tongue color, texture and geometry plays a very important role in diagnosis. The shape i.e. the geometry equally contributes in predicting the disease. The proposed method extracts the geometric features like length, area and their ratios for tongue analysis. A dataset of 300 tongue images is considered for classifing wherein 190 are healthy and 110 are of diabetic patients from which 10 are with NPDR.

KEYWORDS: Color features, Texture features, Geometry features, Tongue analysis

INTRODUCTION

The tongue is a vital organ in the human body. Its visible aspects like the color, coating, texture, shape determine the overall health of the body. Though these aspects are not considered in western medicine, they are of great importance in the traditional Ayurvedic and Chinese medicine.

In Ayurveda [5] different areas of the tongue are allocated for different organs in the body. The tip of the tongue relates to organs in the chest like heart, lungs, neck. The mid-area responds to the stomach, liver, pancreas and spleen. While the inner-most part corresponds to the small intestine and the colon. Any changes with the functioning is reflected on the tongue.

In Chinese [3] medicine the tongue is divided into its tip, margins, center and root. The tip reflect changes in the heart and lungs, 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.

Detecting the disease by mere observation is an art by itself and requires years of experience hence diagnosis based on tongue analysis is full of uncertainty. Automated methods based on the feature extraction are found out.

A lot of work has been done in extracting the color and the texture features of the tongue. In [2] Color features are extracted based on the colors commonly seen in the human tongue using the 12 color gamuts. Texture features [4] are analysed using gabor filtering.

The proposed method deals with the extraction of the geometry features [1]. Measurements are done based on the length, width, areas and their respective ratios. The tongue geometry or shape varies corresponding to the disease hence the measured parameters change accordingly.

MATERIALS AND METHODS

Firstly information about the tongue dataset is provided. It is then followed by the 11 geometric features which are extracted from the image.

Tongue Image Dataset

Dataset of total 300 tongue images is considered. The healthy amongst them are 190 while diabetic tongue images are 110 in munber. From the diabetic images 10 are with non-proliferative diabetic retinopathy (NPDR). The images were captured jointly from Diabetic Association of India, Pune, Kotnis Health Unit and Kamla Nehru Hospital.All the images are taken using 8 Megapixel camera with uniform illumination.

Geometry features

Here 11 geometric features are extracted based on measurement, area and ratio.

Width: The width of tongue (w) is measured as a horizontal distance along the x-axis from tongue's extreme right edge (x_{max}) to extreme left edge (x_{min}).

$$w = x_{max} - x_{min} \quad (1)$$

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Length: The length of tongue (l) is measured as the vertical distance along y-axis from tongue's extreme bottom egde (y_{max}) to its extreme top edge (y_{min}).

$$l = y_{max} - y_{min} \quad (2)$$

Length-Width Ratio: Length-width ratio (lw) is defined as the ratio of length of tongue to the width of the same tongue.

$$lw = \frac{l}{w} \quad (3)$$

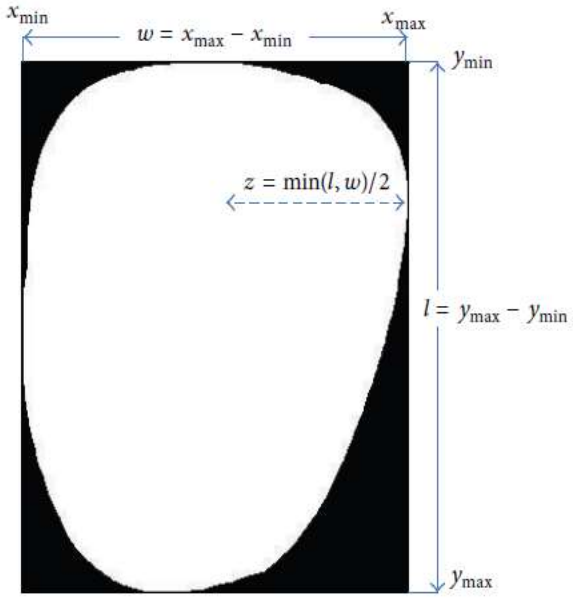

Fig.1. Image for features 1, 2 and 4. [1]

Smaller Half Distance: Smaller half distance (z) is the half distance of l or w depending on which is smaller.

$$z = \frac{\min(i,w)}{2} \quad (4)$$

Area: Area (a) is defined as the number of foreground pixels on the tongue.

Circle area: The circle area (ca) is the circle drawn on the foreground of the tongue having its radius equal to the smaller half distance (z) of the tongue.

$$ca = \pi z^2 \quad (5)$$

Circle area ratio: The circle area ratio (car) is defined as the ratio of circle area with the overall area of the tongue.

$$car = \frac{ca}{a} \quad (6)$$

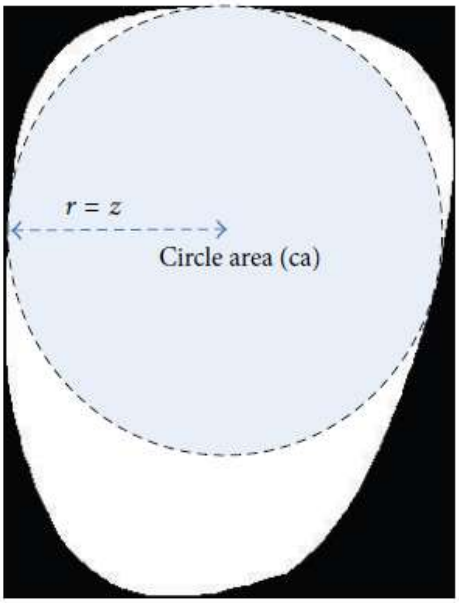

Fig.2. Image for feature 6. [1]

Square area: Square area (sa) is the area of the square in the foreground of the tongue drawn using the smaller half distance.

$$sa = 4z^2 \quad (7)$$

Square area ratio: Square area ratio (sar) is the ratio of square area to the overall area of the tongue.

$$sar = \frac{sa}{a} \quad (8)$$

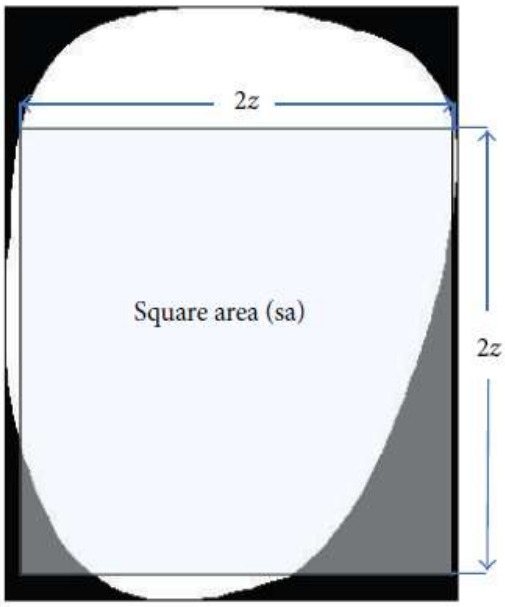

Fig.3. Image for feature 8. [1]

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Triangle area: Triangle area (ta) is the area within the foreground. The right point of triangle is x_{max}, left point is x_{min}, and the height is y_{max}.

Triangle area ratio: Triangle area ratio is the ratio of triangle area to the area.

$$\text{tar} = \frac{ta}{a} \quad (9)$$

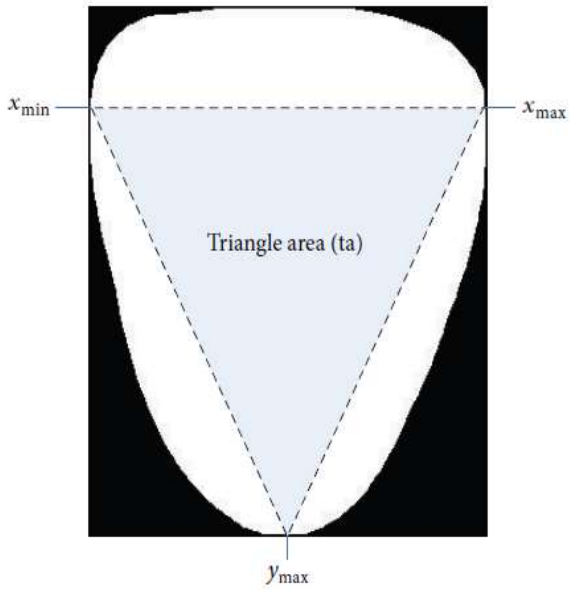

Fig.4. Image for feature 10. [1]

RESULTS AND DISCUSSION

All the images of the dataset are processed for the geometry features. A typical image from each set is considered for comparison. Values for each feature is calculated for the typical image of each case.

(a) (b) (c)

Fig.5.Typical images for (a) Healthy, (b) Diabetic, (c) Diabetes with NPDR

Table.1. Comparison of feature values in each case

Features	Healthy	Diabetic	NPDR
l	324	231	361
w	286	201	207
lw	1.1329	1.1493	1.7440
z	143	100.5	103.5
a	79531	43784	61372
ca	64242	31731	33654
car	0.8078	0.7247	0.5484
sa	81796	40401	42849
sar	1.0285	0.9227	0.6982
ta	12513	7236	10971
tar	0.1573	0.1653	0.1788

By observing the comparison table it is seen that the length to width ratio is maximum for NPDR and minimum for Healthy. Circle area ratio is seen to be maximum for healthy and minimum for NPDR i.e. with respect to foreground pixels area of circle in Healthy is greater than that in Diabetic and NPDR and lowest in NPDR.

Similarly square area ratio is maximum in Healthy, a little less in Diabetic and least in NPDR. Finally NPDR shows maximum triangle area ratio than the other two cases.

CONCLUSION

The comparison table gives information about the shape of the tongue for a specific disease. It is seen from the results that in Healthy case the tongue appears more square and then circular, in Diabetic it appears more circular and then square-like and NPDR tongue appears more triangular. Though one or more disease may relate to the same tongue shape. Mere observation of tongue geometry helps in shortlisting the diseases and makes diagnosis easy.

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REFERENCES

[1] Bob Zhang, Han Zhang, "Significant Geometry Features in Tongue Image Analysis," in Hindawi Publishing Corporation, Evidence-Based

Complementary and Alternative Medicine, Article ID 897580
[2] Bob Zhang *et. al.*, "Tongue Color Analysis for Medical Application", Research article, Hindawi Corporation, Vol. 2013, Article ID 264742, Mar 2013
[3] Ratchadaporn *et. al.*," Automated Tongue Feature Extraction for ZHENG Classification in Traditional Chinese Medicine", Research article, Hindawi Corporation, Vol. 2012, Article ID 912852, Mar 2012
[4] Bob Zhang, V. K. Vijaya Kumar, David Zhang," Detecting Diabetes Mellitus and Non-proliferative Diabetic Retinopathy using Tongue Color, Texture and Geometry Features", *IEEE Trans. On Biomedical Engg.* , Vol. 61, No. 2, Feb 2014
[5] www.ayurveda.com/online_resourse/tongue_analysis.html
[6] Lun-chien Lo,et., al., " Automatic Tongue Diagnosis System," IEEE, 2009.
[7] Bo Pang, David Zhang, Kuanquan Wang, " Tongue image analysis for appendicitis diagnosis," in Science Direct, 2005

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