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Tongue Image Analysis with Color and Gist Features for Diabetes Diagnosis.

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Abstract - *The tongue is an important part of human body to taste, speak and swallow the food. It reflect the inner working of body. Any kind of unusual behavior of body is reflected through tongue like problem in stomach, pancreas, liver and intestines etc. So in Ayurveda and modern science, doctors initially inspect the tongue based on its color, texture and geometry to diagnose the disease. Changes in various features of tongue easily predict the misbehavior in human body. So in this paper, we are proposing automatic computer based technique to analyze the changes in tongue, which will be latter useful in diabetes diagnosis in patients. So initially we take the images of tongue and apply the image processing based feature extraction technique to extract the two types of features named as, Color features and Gist features. Latter on these quantifies features will be classify by using ANN based SOM Kohonen Classifier. To examine the performance of system, we are using tongue image dataset. Experimental results will prove that the color and gist features provides more accuracy in classification results than color and texture features .*

Key Words: SOM kohonen, tongue image analysis, color features, gist features, diabetes diagnosis

1.INTRODUCTION

The tongue can be used for the diagnosis of disease by using its various features such as color, texture, geometry etc. Figure 1 represent the various sides of tongue reflecting the behaviors of various part of human body. Tip of the tongue is related to lungs, heart, chest and neck. The central part is related to liver, spleen, stomach and pancreas. The rear one reflects the lower abdominal organs – small intestine and the colon(lagre Intestine). So to detect the diseases, system has to inspect the particular area of tongue. That is the infected area of tongue reflects the misbehavior in particular respected part of body.

This paper concentrate on the diagnosis of Diabetes. For this purpose we are extracting the features form all tongue image specifically from middle region. Because middle region is related to the pancreas. We extract the two features from region like color and gist feature. Most attributes are considers for diagnosis such as color, moisture, size, shape, and coating. These attributes reveals the actual functionality of organs. For example, dark red color indicate the inflammation or ulceration, a white color indicates cold attacker a weakness in the blood. This attributes leads to conditions of anemia. On the other side, a yellow tongue presents the diseases related to liver and gallbladder, and blue or purple related to difficulties in blood circulation or a weakness in digestive system. In healthy tongue, color is a nice, robust, sanguine(reddish) pink [2].

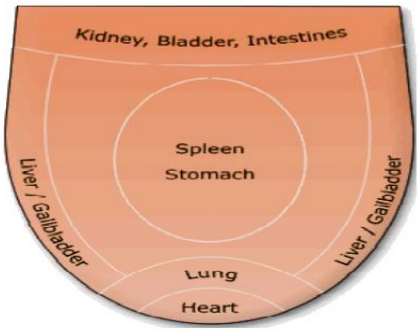

Fig- 1. Structure of Tongue

Changes in various features of tongue easily predict the misbehavior in human body. So in this proposed paper, we are developing automatic computer based technique to analyze the changes in tongue, which will be latter useful in diabetes diagnosis in patients. Here, computer based tongue analysis method is proposed. This method extracts the quantitative color and gist features (low dimensional representation of the scene, which does not require any form of segmentation) of images of tongue. Then system apply the SOM Kohonen classifier on these extracted quantitative features to classify the diagnosis of diabetes. SOM Kohonen [1] is one the popular type of Artificial Neural Network classifier and two types of features namely color and gist measures are extracted from images by using digital image processing technique. Finally classifier maps the relationship between features and disease.

2.LITERATURE SURVEY

Paper [3] studies and analyzes the tongue shape to establish a kind of tongue diagnosis method based on tongue images. CCD devices were employed to acquire the front and lateral images of tongue, and then measure the tongue's length (L), width (K) and height (H). Furthermore, in 500

tests with possible disorders, the coefficient of variation(CV) was corrected and adjusted to establish an optimum formula between the body surface area (Mt) and the sum of the width of the tongue (K) and height (H).

Traditional Chinese Medicine (TCM) has a long history and has been recognized as a popular alternative medicine in western countries. In [4], author proposed a fully automatic tongue detection and tongue segmentation framework, which is an essential step in computer-aided tongue image analysis. Comparing with other existing methods, this method is fully automatic without any need of adjusting parameters for different images and do not need any initialization.

CBIR is adopted in [5] to perform automatic tongue color analysis of Traditional Chinese Medicine (TCM). Firstly, extract the visual features of tongue images to be analyzed, especially the color features; and then retrieve the similar tongue images from the database, which have been labeled by TCM doctors in advance. Finally, statistical decision method is exploited based on the retrieval results to classify the tongue color.

The statistical distribution characteristics of human tongue color is analyzed in [6] that aims to propose a mathematically described tongue color space for diagnostic feature extraction is presented. Three characteristics of tongue color space, i.e., tongue color gamut that defines the range of colors, color centers of 12 tongue color categories, and color distribution of typical image features in the tongue color gamut, are elaborately investigated in this paper.

An effective color processing algorithm is proposed in [7] to analyze the hyper spectral image of the tongue and its application to preventive medicine by the concept of Japanese traditional herbal medicine (Campo medicine). Hyper spectral images of the tongue were taken with the system with an integrating sphere, and tongue area without coating was eliminated automatically. Then, spectral information of the tongue area without coating was analyzed by principal component analysis, and the component vector best representing the clinical symptom was found by rotating the vector on a plane spanned by two arbitrary principal component vectors.

Tongue diagnosis is important in the Traditional Chinese Medicine (TCM). When doctors analyze the diseases, they usually observe the patient health base on the shape, color and size of tongue. In order to decrease the mistake of subjective judgment, system aim to develop an automatic tongue feature detection system that can help the doctor diagnosis in more scientific way [8]. In this work, a novel region-based hierarchical filtering framework is proposed to robustly detect tongue features.

3. IMPLEMENTATION DETAILS

3.1 System Achitecture

The system proposes a tongue image capture, image preprocessing, feature extraction and feature analysis and final Self Organizing map (SOM) classification. This process is depicted in Figure 1. For SOM classification, system takes images of tongue and divide the image in 6 areas. For each area number of color and gist features are extracted. From these n number of features, SOM identify the 5 levels of severity of pancreatic such as, health, acute, sub a cute, chronic and regenerative. Gist and SOM features are been taken to improve the accuracy of the system.

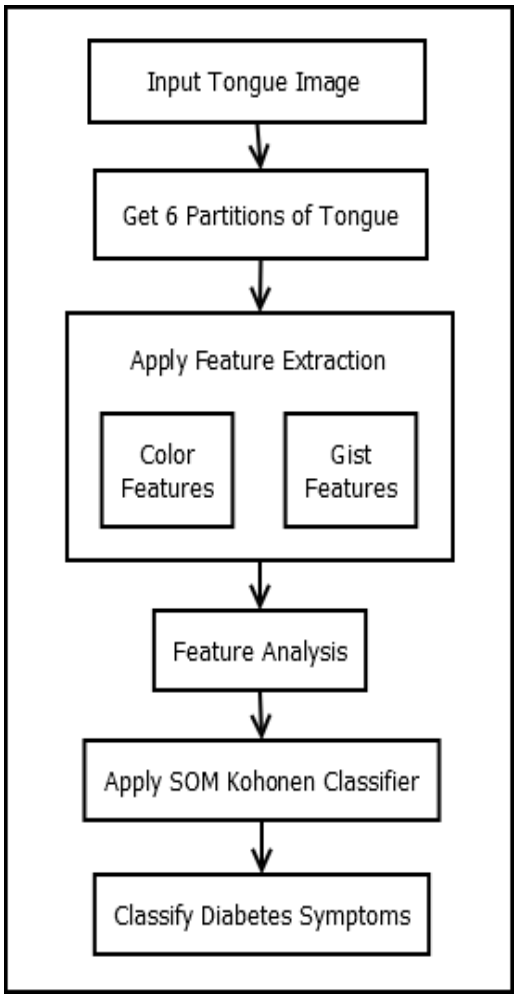

Fig-2 System Achitecture

3.2 Mathematical Model

Input: Tongue Images

Output: Tongue Diabetic or not.

Process:

1. Take Input Images
   I = {i1, i2, ..., in}
   Where,
   I is the set of different tongue images captured from camera.

2. Image Preprocessing
   In this step, we get 6 partitions from images
   P = {p1, p2, p3, p4, p5, p6}
   Where,
   P1 =Top Right edge of the tongue
   P2 = Center of the tongue
   P3 =Top Left edge of the tongue
   P4 =Bottom Left of the tongue
   P5 = Bottom Right of the tongue
   P6 =Tip of the tongue

3. Feature Extraction and Analysis
   In this step, we get 2 set of features.
   F = {f1, f2}
   Where,
   F1 = Color Features
   F2 = Gist Features

4. SOM Classification
   SOM identify the 5 levels of severity of S = {s1, s2, s3, s4, s5}

   Where,
   S1 = Health
   S2 = Acute
   S3 = Subacute
   S4 = Cronic
   S5 = Degenerative.

3.3 Algorithm

1. Initialize weights *wij*
   Set topological neighborhood parameters
   Set learning rate parameters
   While stopping condition is false
2. For each input vector x, do step 3-5.
3. For each *j*, compute:
   $D(j) = \sum_i w_{ij} - x_i$
4. Find index *J* such that *D(J)* is a minimum.
5. For all units *j* within a specified neighborhood of *J* and for all i:
   $w_{ij}(new)=w_{ij}(old) + \propto[x_i - w_{ij}(old)]$

4.CONCLUSION

In this paper, we proposed a new computer based tongue image analysis problem. This analysis is useful for diagnosis of diabetes based on the visible changes on the tongue surface. Both color and gist feature sets are used. These features maps the tongue image to corresponding diseases statistically. To perform the experiment, dataset of 100 images of tongue is used, which is consisting of maximum number of tongue images. Experimental results will prove that the color and gist features are more proper and beneficial to classify the tongue image into appropriate disease, than existing color and texture feature set.

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