Tongue Diagnosing with Sequential Image Enhancement Methods

M. Dhanalakshmi, P. Premchand, A. Govardhan

Abstract— Tongue diagnosis is one of the important area in traditional diagnosing techniques and it has more significance among the experts. Tongue diagnosing is usually carried out by visually understanding the tongue, but the processing of tongue image is not an easy task to carry out. The difficulty strikes because of the irregular shape of the tongue, overlapping of colours, dominance of saliva on cracks and buds etc. In this paper, we proposed image enhancement methods for processing the tongue image to get the required features of the tongue. The method mainly consists of two techniques; first, contrast enhancement with edge detection in grey scale for highlighting the shape, cracks, buds and pimples,; second, colour enhancement for identifying the true nature of colours and coating on different parts of the tongue. The aim of our method is to reduce the complexity in tongue understanding. The experimental results revealed that our methods produced significant result for the tongue diagnosis.

Index Terms— Tongue diagnosis, Image Processing, Image enhancement.

I. INTRODUCTION

'Tongue analysis' is one of the diagnosis processes in the patient management. In all traditional methods of diagnosis, tongue is an essential part for understanding the condition of the patient. Doctors ask the patient to open the mouth and show the tongue to extract the visual information. Some of the areas of Doctor's interest are – 1)size and shape of the tongue, 2)tip, 3)width, 4)thickness, 5)colour, 6)texture, 7) projections, 8) fissures and cuts, 9) coating or fur, 10) swelling, 11)bleeding, 12) above conditions in different parts of the tongue, etc.. Based on this information and their knowledge and experience, Doctors try to understand the condition of the patient. But the problems faced by the Doctors are: 1) While the visual information that can be extracted from the patient's tongue is same, all Doctors do not have same level of knowledge and experience to analyze it.2) As the Doctors have to depend on their eye's perceivability to understand the tongue of patient, either because of old age or because of problem in their visual capability or due to any other reason, Doctors can also make mistakes; it is false negative results that are likely to be more

dangerous than false positive results because they usually lead to failure to provide appropriate treatment.
3) Even though some instruments are there like MRI, CT scan etc., they are very costly for procuring as well as diagnosing and as their main purpose is different, no Doctor advises his patient to diagnose the tongue with these costly equipments. In view of the above, there is a scope for the computer engineers to develop new model for the 'Tongue image analysis'.

Tongue image processing needs some special attention in the field of image processing and disease analysis, due to the irregular shape, color, texture, etc. of the tongue. However, one significant aspect in tongue diagnosis is that, its practice is subjective, qualitative and complicated in automated diagnosis. The tongue characteristics are mainly concentrated in its edges, texture and colour and they should be given an important attention for processing the image. Hence, for the analysis of tongue image, we have to extract the shape feature, color feature and texture feature of the tongue image separately. Texture identification provides a clear processing of the tongue image. A number of algorithms have been proposed for the processing of tongue images. The processing of tongue image navigates through different steps like, enhancement of image, identifying the color and texture of the tongue, highlighting the irregularities and etc.

At present, there are two major concerns in automated tongue analysis. The first is the objective illustration of tongue's color, texture and coating with the support of image analysis technology Second one is the enhancement of tongue image. A number of methods have been developed to efficiently process the tongue image. Since the need of an accurate and well equipped tongue processing method comes more frequently; several methods have been proposed for the analysis of tongue image segmentation and every method performs good by its own algorithms and functions. Though researchers have made significant advancement in the standardization and quantification of tongue diagnosis, there are still significant problems with the existing approaches. First, some methods are only concerned with the detection of syndromes in tongue. Second, the original validity of these methods and systems is usually derived from a comparison between the diagnostic results that are acquired from the methods or systems and the judgments made by skillful practitioners of tongue diagnosis. That is, they cannot hope to keep away from subjectivity, using such an approach.

Third, only very few samples are used in the experiments and this is far from meeting the requirements of obtaining a reasonable result in statistical pattern recognition.

Earlier approaches such as gradient operator methods are applied to detect the boundary of the tongue. Another approach is an edge detector with contour model to crop the tongue area. The irregular shape of the tongue badly affects the gradient on parts of the boundary that result in bad segmentation result. Therefore, it is required to put up an objective and quantitative diagnostic standard for tongue diagnosis. So, for an effective diagnostic standard for tongue diagnosis, we proposed a new method, which is a gradual, step by step diagnosis of the tongue image. The system consists of mainly; extracting the true colour and finding coating by filtering and enhancement and the detection of pimples and cracks of the tongue with the help of intensity measures. Since our proposed method is sequential process, result entirely depends on the input and output of different spaces. The evaluation of the result showed that our proposed method provided expected results in diagnosing the tongue image.

II. REVIEW OF RELATED WORKS

Recently, new approaches for segmenting the tongue images have received a great deal of interest among researchers. A brief review of some of the recent researches is presented here.

Wangmeng Zuo et al. [1] have presented a technique for automated tongue segmentation by merging polar edge detector and active contour model. Experimental results revealed that the tongue segmentation can segment the tongue precisely. A measurable assessment on 50 images shows that the mean DCP (the distance to the closest point) of the proposed technique is 5.86 pixels, and the average true positive (TP) percent is 97.2%.

Bo Pang et al. [2] have presented a tongue-computing model (TCoM) for the diagnosis of appendicitis based on quantitative measurements that comprise chromatic and textural metrics. customary tongue diagnosis is always dedicated to the identification of syndromes other than ailments. Applying their method to clinical tongue images, the tentative results are promising.

Yang Ben Sheng et al. [3] proposed an image segmentation algorithm centered on the shortest path. The algorithm is superior to the conventional region growing algorithm , it lacking of certain disadvantages experienced by old-fashioned region growing built on competing seeds. algorithm depicts the contours of the object area precisely, particularly when it is used to segment the local object of the image, the segmentation outcomes is useful to sequence image analysis and patter recognition.

Wang X and Zhang D [4] proposed an optimized correction scheme that amends the tongue images captured in various device-dependent color spaces to the target device-independent color space. while the tentative results on real tongue images illustrate that the distorted tongue images (taken in different device-dependent color spaces) become more steady with each other. In actual fact, the average color difference amid them is significantly abridged by more than 95%.

The segmentation of the body of tongue plays a significant part in automatic tongue diagnosis in Traditional Chinese Medicine. If there are comparable grayscales near the boundaries of the body of tongue, it is tough to excerpt the

body of tongue suitably with some standard methods directly. In order to overcome this effort, Wenshu Li et al. [5] have offered a technique that joins prior knowledge with improved level set method. First, the contour of tongue is initialized in the HSV color space and a technique which improves the contrast between tongue and other parts of the tongue image is presented. Then, a region-based signed pressure force function is suggested, which can proficiently stop the contour at weak edges. To finish with, a Gaussian filtering process was used to further regularize the level set function as an alternative of reinitializing signed distance function. Experiments by abundant real tongue images showed desirable performances of our method.

III. TONGUE IMAGE ANALYSIS

Tongue images are the elementary features for diagnosis of 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, overlapping of colours, dominance of one colour, etc. So it's difficult to get an effective diagnosis of diseases without an effective tongue image processing. The main features that are used for diagnosing the tongue include shape, color, pimples, cracks and texture of the tongue.

Fig. 1. Two tongue images with different characteristics

The figure 1 shows images of the two tongues that shows different shapes and characteristics. In the first image one colour is dominating entire image and in the second image texture like cracks and buds are not properly visible.When we consider a tongue, we should be aware about the diagnosing factors of the tongue. The shape, size, color, etc. describes special features of the tongue. Normal healthy tongue image is represented in the figure 2.
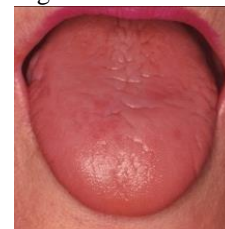

Fig. 2. Normal healthy tongue image

The ayurveda says that 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. With the help of the clear understable tongue images, a detailed diagonosis of tongue can be possible.

Fig. 3. Tongue images with different colors and textures

Here, the figure 3 shows the tongue images with different colors and textures. Ayurveda says that diseases caused by different pathogens result in the difference in blood characteristics resulting in difference in color of the tongue.

Tongue color varies widely from person to person, but is a good indicator of the overall nature of what is going on in the body. A red tongue indicates that there is heat present in the body, and the redder the tongue, the greater amount of heat present. A tongue that is pale indicates a deficiency of blood or the presence of cold. A purple tongue tells your practitioner that there is stagnation somewhere in the body. Tongue color may also vary on different parts of the tongue. Tongue color may also vary on different parts of the tongue. For example, a tongue that is red at the very tip indicates heat in the Heart, as the tip of the tongue correlates with conditions of the Heart. Just behind the tip corresponds to the Lungs; the sides of the tongue are associated with the Liver; the center of the tongue with the Spleen/Stomach or digestion; and the back of the tongue is associated with the condition of the Kidney.

A coating on the tongue can also give information about your health. The thickness of a coating is an indicator of the severity of the condition being treated. A thin coating, one in which you can see the tongue through the coating, indicates that any pathogen present is mild or on the exterior. A thick coating that obscures the tongue tells that the condition is deeper and more serious. The condition of the coating also speaks to the condition of fluids in the body.

The condition of the tongue will change as the health changes, but in general those changes appear on the tongue slowly. Thus tongue can be characterized with different measures.

IV. TONGUE IMAGE PROCESSING

We have introduced a sequential approach for the tongue analysis. The sequential process consists of extraction of the color feature, texture feature and so on. We have developed a systematic approach for the efficient processing of the tongue image taken by a normal digital camera. The illustrated block diagram in figure 4 and 5 represents the step by step process we have undergone in our proposed method. There are two different methods followed in the processing of the image. First block diagram represents the process followed to derive the True colour and the white coating of the tongue image. Second block diagram describes the method followed to extract the cracks, pimples and buds in the tongue.
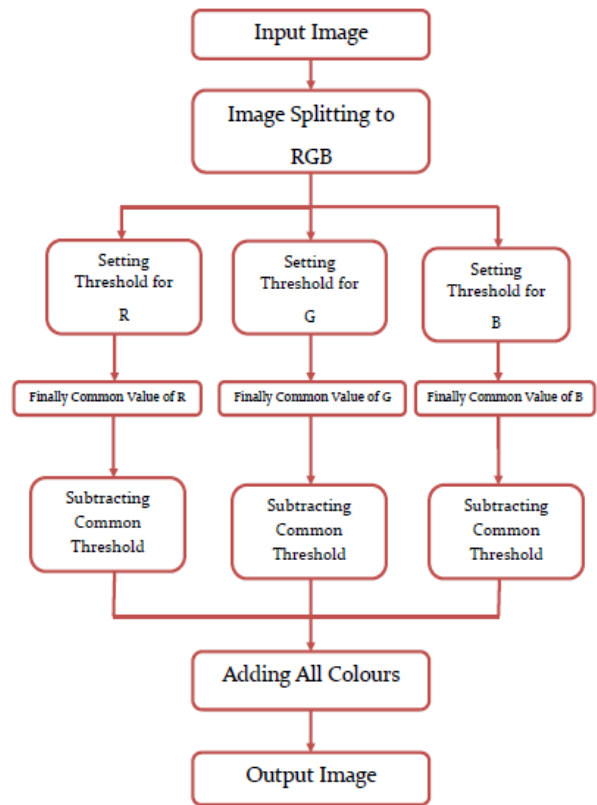
Fig. 4. Block diagram to detect true colour and coating
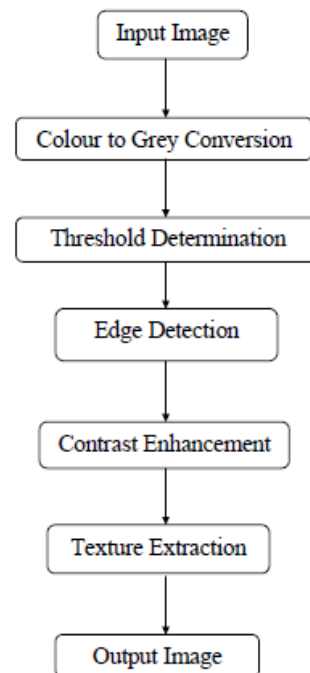

Fig. 5. Block diagram to detect cracks, pimples and buds

a) Colour and coating extraction

The color feature is extracted with help of intensity filtering methods. We extract the color of the tongue on the basis of the intensities presented in the different areas of the tongue. We apply this feature because intensity levels of different colours will be different for different areas of the tongue. So with help of this intensity method, we can extract the color feature, the coating and true colour of the tongue. We identify the white coating, true colour and dominant color of the tongue through this approach. The white coating may dominantly present in some tongues and in some others it will be less dominant.. The figure 7 shows the detection of white coating in the tongue. In the un processed image the coating is not pronounced and it got mixed up in the normal red colour of the tongue. In the procedcced image , the white coating can be clearly seen. In fig-7, the coating and the true colour of the tongue is seen in the processed image .
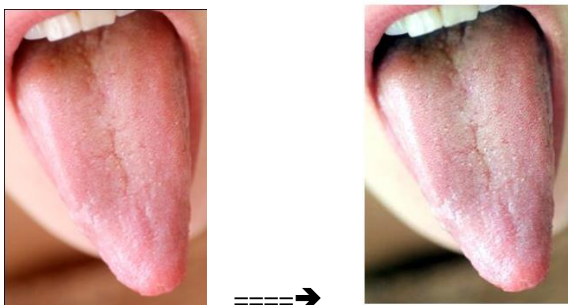

Fig. 6.

Fig. 7. Detection of coating

b) Crack and Pimple Detection

For the detection of pimples in the tongue,. We considered area in the tongue through some arithmetic calculation. Initially, we convert the color image in the gray scale image. Then, we find the different intensity in different areas of the tongue through the histogram method. After selecting the particular area we assign a threshold for detecting the pimples and cracks. According to the value of threshold, the areas are selected on accordance with the intensities. The areas with similar intensities are segmented So, those values that come below the threshold value are selected and after the complete process the pimples are highlighted. After plotting the histogram, the difference in intensity is identified then a threshold is applied.
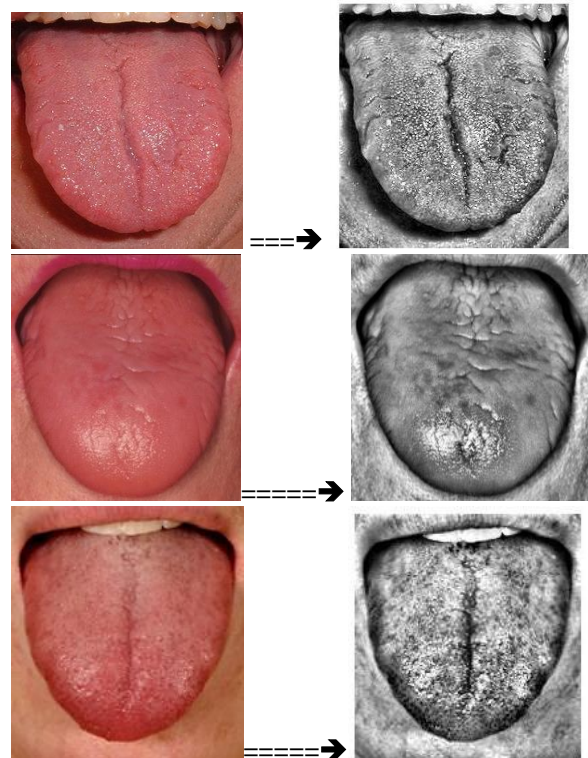

Fig. 8. Detection of cracks and buds

The fig-8 shows the unprocessed and processed images of three tongue using above mentioned approach. The processed images clearly highlight the cracks, buds and pimples. The secong figure is remarkable as we can see in the unprocessed image, the cracks almost invisible due to thin in nature and also due to dominance of red colour. But in the processed image , we can clearly identify the cracks of the tongue. Similarly in the third image buds are highlighted which are not properly visible in original image

V. RESULTS AND DISCUSSION

We have implemented our proposed approach using MATLAB and the results showed that the approach produce better results in tongue image enhancement methods

From the figures, we can identify that our methods provide feasible results. The occurrence of white coating is very low in tongue images, even though our method out performs other methods in the case white coating detection. When we consider the pimples and cracks in the tongue, our method performs better with the help of the grey image enhancement algorithm. The intensity method we adopt is providing good result in finding the color feature of the tongue. The dominant color also can be easily identified with the help of our method. The color dominancy is shown with high precision with help of the intensity extraction method. The intensity of tongue tissue can be easily differentiated from the other that is the reason behind intensity method in our proposed method. But when we consider the other tongue extraction methods, it was found that their color extraction was disturbed with the lip color. In our method we have assigned parameter values to effectively extract the tongue color, which was not affected by any disturbances from the color of the lip.

From our experimental analysis it is shown that our proposed method detects almost 90% of the cracks in the tongue. Thus from the qualitative evaluation our methods provides satisfactory results.

VI. CONCLUSION

The tongue image enhancement is one of the important research methods in the tongue image processing and hence there are different methods introduced for the effective processing of tongue images. But with the one or more disadvantages in the processing, new techniques are become necessary. Thus, in our method we have introduces a method in which every process is occurring in a step by step manner. In our proposed method, we have provided methods to detect the white coating, true color, cracks, pimples and buds of the tongue. From the evaluation of the results it is showed that the methods we proposed gives the appropriate results and is well suited for the tongue image processing. Further enhancement to the system can be done by improving the localized intensity methods and calculation of the features and giving an empirical table to identify the disease.

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