Semantic Object Generation in Tongue Image Analysis

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Abstract: A method of computerized tongue image analysis based on image processing for the purpose of digitizing the tongue properties in traditional Chinese medical diagnosis is presented. A hybrid method which uses Support Vector Machine to extract the semantic object, and a combination kernal function is selection after many compare. Finite Mixture Model and many image process methods is applied into diagnosis system. The experiment of the system shows that methods proposed are effective. The following results are presented in the article:

1) A multiply semantic image model is built our literature, which contributes abundant character to determine disease.

2) The SVM classifications are applied to transaction from the lower level to the top ones. The complex of the SVM classifications depends on the sample number rather than the characteristic dimension, which can satisfy the requirement of the system.

3) An application implements the approaches mentioned by the literature is introduced, through which the effect of the model are proved.

Keywords: Tongue image; Support Vector Machine; Finite Mixture Model; Image Semantic Model; Chinese medical diagnosis

I. INTRODUCTION

The main information sources for Chinese traditional medicine consist of "look", "smell", "inquiry" and "feel". As the important part of "look" means, tongue diagnosis is significant to catch the patient's status. Tongue diagnosis depends on the tongue image basically and scientific classification for Chinese traditional tongue diagnosis approaches is crucial for modernization of Chinese traditional medicine.

The existing methods always infer by rule, such as, ZHOU Yue, et al [18] partition some characters and set the threshold as condition to identify the result. The traditional approaches have the following defects:

1) The rule only can represent a little of Chinese traditional medicine knowledge. As we all know, the modernization for Chinese traditional medicine is still on process and therefore the work to import all the diagnosis knowledge into the reasoning rules completely is impossible.

2) A case can be seen as a complex object that contains some problems cannot be represented by simple conditions. The partitions and the thresholds are somewhere dogmatic.

3) The rule knowledge can hardly be transformed to other form, which is required by modern medicine. Maturity system concludes the disease by combination of many techniques. Hence, the knowledge in analysis system need to be extensive.

The problems mentioned aforementioned can be solved successfully by the extraction the semantic object from image. Firstly, semantic information is some description for tongue image and has much more detail than the rule. Furthermore, semantic reasoning is similarity to human being knowledge, which are recorded on books, paper and other documents. Lastly, semantic information can be transformed into other form easily.

In a nutshell, the procedure of tongue diagnosis can be simplified as a kind of image process which extracts the disease feature from the picture of tongue. In the paper, a hybrid method will be introduced and the experiments will show its good consequence.

II. IMAGE SEMANTIC MODEL OVERVIEW

A. Introduction of the Model

In order to make clear the process how to transfer the image into the illness information, author establish the model composed of four levels: feature level, object

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level, conception level and diagnosis level. The feature level always handles the content-based character, such as color, shape, texture and area. The object level mainly concerns the problems of objects and the relationship between objects. The conception level will synthesize the object level and present the meanings, behaves of the images. The highest level, diagnosis level will purify the conception level and show the information which the doctors need.

Definition (Image Semantic Model) Image Semantic Model M is the description for advantage image knowledge structure, which extracts the image feature $\mathrm{A}(f_1, f_2, \cdots f_{\mathrm{n}})$ and uses a structure method to represent the relationship between the property. Hence,

$$M : D(\overline{f_1, f_2, \cdots f_{\mathrm{n}}}, KD, OP) \Rightarrow knowlege\_chains$$

Where KD is the knowledge base and OP is the operations and rules to reason. The knowledge chains are what we need. In this paper, it stands for the some notations in Chinese traditional medicine.

To work out a computerized model, the article use the FMM(Finite Mixture Model)[1] to evaluate the classification distribution of the conception objects. The conception C_j classification probability is:

$$P(X, C_j, k, \omega_{C_j}, \theta_{C_j}) = \sum_{i=1}^{k} P(X \mid S_i, \theta_{S_i}) \varpi_{S_i}$$

Where: C is the conception, S is the semantic and $P(X \mid S_i, \theta_{S_i})$ is the probability of i-th multi-dimensions mix component，k is the selected component ， $\theta_{C_j} = \{\theta_{S_j}, i = 1,2, \cdots k\}$ is the multi-dimensions parameter of model 。 $\varpi_{\mathrm{C}_i} = \{\varpi_{S_i}, i = 1,2, \cdots k\}$ is the weight vector for multi-dimensions mix component ， X is a multi-dimensions object vector.

B. Image Semantic Classification by Using SVM

Image classification and clustering include supervised and unsupervised classification of images[1]. In the supervised classification supervised classification, we are given a collection of labeled images (or priori knowledge), and the problem is to label a newly encountered, yet unlabeled image. On the other hand, for unsupervised classification (or image clustering), the problem is to group a given collection of unlabeled images into meaningful clusters according to the image visual feature without a prior knowledge[2].

We have tried to cluster images into semantic categories using SOFM (Self-organism Feature Mapping) and C-Means. The experiment results show that the error rates are very high. The reason perhaps is that the low-level visual features are not related to the human perception about image content. The clustering algorithm couldn't automatically bridge the enormous gap between low-level visual feature and high-level semantic content without priori knowledge.

We believe supervised classification is a promising method, and there have been many achievements in this field. Smith[3] proposed a multi-stage image classification algorithm based on visual features and related text. Bruzzone and Prieto[4] developed a variety of classifiers to label the pixels in a landset multi-spectral scanner image. MM-classifier developed by Zaiane et al.[5] classifies multimedia images based on some provided class labels. Vailaya et al.[6] used a binary Bayesian classifier for the hierarchical classification of vacation images into indoor/outdoor classes. Outdoor images are further classified into city/landscape classes. Li and Wang[7] classified textured and non-textured images using region segmentation. Experiments performed by Chapelle[8] have shown that SVM could generalize well to image classification, however the only features are high-dimension color histogram, which simply quantizes RGB color space into 4096 color bins. In fact, image content cannot be represented effectively by only color feature. For example, lawn and trees may have the same color histogram, while lawns in spring and autumn have different color histograms whilst they have the same shape or semantic feature.