

SENSOR-INDEPENDENT FRAMEWORK FOR TONGUE COLOR CLASSIFICATION SYSTEM

Thesis

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ABSTRACT

Tongue diagnosis is one of noninvasive methods to diagnose the condition of a patient's internal organs in Traditional Chinese Medicine (TCM). Since this way is noninvasive, it encourages self-diagnosis at home. One of the essential aspects of this diagnosis is the tongue color which is prone to being influenced by the lighting environment and different sensor sensitivity. It brings ambiguity and problems to get a consistent diagnosis result in self-diagnosis. In facing this problem, many researchers have found great solutions to make a reliable automated tongue diagnosis (ATD) system which potentially can solve the problem for a smartphone. However, the system can still be improved to minimize the error which is caused by the different sensor sensitivity and unoptimized parameters. For improving it, this paper suggests an alternative framework for tongue color classification system (TCCS) as the part of ATD system in getting more consistent color before going to the disease prediction in ATD system. The improvisation is done by implementing the kernel partial least square regression (K-PLSR) optimized algorithm in color correction of framework and other reliable algorithms. After doing an experiment by implementing this framework in several smartphones, this framework can show an improvement and can be used in more than one sensor and environment. As a result, it gets a more consistent and objective tongue color classification result.

Keywords: *Tongue color classification system, image processing, machine learning, sensor-independent, self-service healthcare, K-PLSR*

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CHAPTER 1

INTRODUCTION

1.1 Background and Motivation

TCM has a long history that was around 3000 years ago. Many researchers had done researches to see how effective TCM in the medical field. As a result, it had been proved that TCM is adequate for handling many diseases and improving quality of life [1, 2]. In the process of development, TCM found four specific methods in diagnosing its patients. Those are inspection which is using visual inspection for observing abnormalities in the tongue and another vital body, listening and smelling which is detecting abnormalities inpatient voice and odor, inquiring which is inquiring about observable symptoms and relevant medical history, and palpation which is palpating corresponding body parts to predict pathological changed.

In the inspection method, the tongue becomes one of the things that is being observed because the tongue becomes a link between the internal organs and the outside world. Therefore, the tongue becomes an indicator to judge whether it's abnormal or not. If there is an abnormality, it means there is something wrong with the internal organs. There are several aspects to consider whether tongue can be said as abnormal or not, such as a body of tongue and coating of the tongue. In Joyce et al. [3], I found that when judging body and coating, also there are some aspects, such as the shape of the body, the color of coating and body, the thickness of the coating, moisture, movement, etc. However, color is easy to get influence by the light environment, age of the doctor, experience, etc. Thus, researchers researched to make a system to get a consistent result, that is ATD. ATD system is needed to make a consistent result in TCM treatment which can handle the subjectivity of doctors in judging color [4].

In nowadays, the self-diagnosis and health monitoring demands have been increased. It encourages the implementation of ATD in the smartphone for a public online used case. So that, it provides a media to doctor and patient for diagnosing tongue. But in the public online case, the diversity of sources will make a higher chance to get a bias in the result such as different sensor sensitivity and lighting conditions. In Hu et al. [5], their framework implements SVM to estimate lighting conditions and polynomial color correction (PCC) to do color correction. The result shows it can be implemented well in one smartphone under a controlled condition in the black box. However, the actual implementation will require more various conditions. So that, the framework that can be adapted in the various condition is needed to support ATD in the smartphone used, especially in public used condition.