

Analysis and Diagnosis of Tongue Color for Medical Applications

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Description

The human tongue is one of the body's major organs, and it contains a wealth of information about one's health. Even though every person's tongue may appear a little bit differently, a "normal, healthy" tongue has some similarities. It should be pink, with a thin layer of whitish colour covering the surface. A healthy tongue also has a lot of papillae. We are able to eat and taste the food more easily only because of these tiny nodules along the surface. If the tongue colour is unusual, then there might be a health problem. Other tongue colours and their potential meanings are listed below [1].

Colors of an Unhealthy Tongue

Red: A basic B vitamin deficiency, which can be treated by supplementing, may be indicated by a red (not dark pink) tongue. Tongue may also turn red if they have Kawasaki illness, eczema, or scarlet fever. Geographic tongue is a rare but harmless condition that causes red patches with white borders along the tongue. **Purple:** Tongue may turn purple if they have cardiovascular issues or poor blood circulation in general. Kawasaki disease may also cause a purple tongue. **Blue:** A blue tongue might be a sign that the blood is not getting enough oxygen. Lung or kidney issues can be a reason for this. **Yellow:** Tongue can be yellow among people who smoke or chew tobacco. Sometimes Psoriasis and jaundice also causes the yellow tongue. **Gray:** Tongue may rarely turn into grey due to digestive problems. Eczema or peptic ulcers might also be a reason. **White:** White patches that develop on the tongue's surface are typically the cause of a white tongue. These are typically brought on by fungi, like oral thrush. Antifungal drugs help get rid of these patches. The appearance of white lines on the tongue can also be brought on by benign illnesses like leukoplakia or oral lichen planus. Leukoplakia can occasionally develop into cancer. **Brown:** This is usually harmless and is brought on by the diet and beverage intake. Tobacco use, a bad habit that may result in oral cancer symptoms like sores in the tongue, is another cause of brown tongue. **Black:** The most typical explanation for a dark brown to black tongue is germs from bad dental hygiene practices. Another potential reason for a black tongue is diabetes [2]. Papillae may occasionally grow in number and appear hairy, which is a sign of the benign condition known as "hairy black tongue."

Areas of the Tongue Observed in TCM

Practitioners of Traditional Chinese Medicine (TCM) have used tongue readings to make health diagnosis. According to TCM beliefs, tongue itself is the symbol of a person's overall health. The tongue can be observed in four primary areas [3]. **Color:** Long-term abnormal colour changes may be

a sign of problems with vital body organs like the heart, liver, or kidneys. **Coating:** According to TCM, a thicker covering can represent a serious problem with our bladder, stomach, or intestines. **Moisture:** A tongue that is too dry signifies the opposite of "dampness," which is a state of being in our body. **Shape:** A thin tongue could be a sign of fluid loss. The most crucial aspect of the tongue's information is its color. The majority of current approaches classify a tongue image taken with a colour CCD camera pixel-by-pixel or in the RGB colour space. The lack of information in these types of photographs, however, prevents accurate analysis of tongue surfaces using these conversional methods. It is possible to more precisely extract the colours of an organism using its spectrum. This new colour analysis method outperforms the conventional one, especially when it comes to identifying significant areas of substances and tongue coatings [4].

Color picture analysis can be a helpful tool for standardisation and automation in the field of computer-assisted medical diagnosis. Color image analysis has been used to diagnose tongue illnesses, identify the border of skin tumours, evaluate and monitor wound severity, determine the effectiveness of new medications on the spread of skin erythema, and more. These studies demonstrate a link between an organism's colour and its physiological changes and functions. As a result, automatic and quantitative colour recovery from images is critical for determining the severity and prognosis of illness. The quick development of information technology nowadays encourages the automation of tongue disease diagnosis using cutting-edge image processing and pattern recognition techniques. The limitations of images captured by conventional CCD cameras continue to pose challenges for computerised tongue diagnosis, despite the fact that many standardisation and quantification issues have been resolved [5].

Conclusion

First, when using these images, it is challenging to tell the tongue from nearby tissues with a similar colour in RGB colour space. Second, it is challenging to tell the tongue's coating from its substance. Third, automatic and quantitative colour discrimination is difficult. These are the three main challenges. Due to these factors, current methods of tongue colour calibration or recognition only work well on tongue images obtained under specific circumstances and frequently fall short when the image quality is subpar. Due to the frequent digital photos' low information, different lighting conditions, etc., tongue colour analysis becomes challenging. Physics dictates that an object's surface colour and its spectrum have a close relationship. Since an organism's spectra in the visible light spectrum (about between 400 nm and 700 nm) fully encompass the RGB colour space, spectra can be

used to more precisely extract an organism's colours. Using hyperspectral medical images, we created a Pushbroom Hyperspectral Tongue Imager (PHTI) and suggested a brand-new automatic tongue colour calibration and discriminating approach in this study.

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