

Eyes may be the window to your soul, but the tongue mirrors your health

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A 2,000-year-old practice by Chinese herbalists—examining the human tongue for signs of disease—is now being embraced by computer scientists using machine learning and artificial intelligence.

Tongue diagnostic systems are fast gaining traction due to an increase in remote health monitoring worldwide, and a study by Iraqi and Australian researchers provides more evidence of the increasing accuracy of this technology to detect disease.

Engineers from Middle Technical University (MTU) in Baghdad and the University of South Australia (UniSA) used a USB web camera and computer to capture tongue images from 50 patients with diabetes, [renal failure](#) and anemia, comparing colors with a data base of 9,000 tongue images.

Using image processing techniques, they correctly diagnosed the diseases in 94 percent of cases, compared to laboratory results. A voicemail specifying the tongue color and disease was also sent via a [text message](#) to the patient or nominated health provider.

MTU and UniSA Adjunct Associate Professor Ali Al-Naji and his colleagues have reviewed the worldwide advances in computer-aided disease diagnosis, based on tongue color, in a new paper published as part of the *The Fourth Scientific Conference For Electrical Engineering Techniques Research (EETR2022)*.

"Thousands of years ago, Chinese medicine pioneered the practice of examining the tongue to detect illness," Assoc Prof Al-Naji says.

"Conventional medicine has long endorsed this method, demonstrating that the color, shape, and thickness of the tongue can reveal signs of diabetes, liver issues, circulatory and digestive problems, as well as blood and heart diseases.

"Taking this a step further, new methods for diagnosing disease from the tongue's appearance are now being done remotely using artificial intelligence and a camera—even a smartphone.

"Computerized tongue analysis is highly accurate and could help diagnose diseases remotely in a safe, effective, easy, painless, and cost-effective way. This is especially relevant in the wake of a global pandemic like COVID, where access to health centers can be compromised."

Diabetes patients typically have a yellow tongue, [cancer patients](#) a purple tongue with a thick greasy coating, and acute stroke patients present with a red tongue that is often crooked.

A [2022 study in Ukraine](#) analyzing tongue images of 135 COVID patients via a smartphone showed that 64% of patients with a mild infection had a pale pink tongue, 62% of patients with a moderate infection had a red tongue, and 99% of patients with a severe COVID infection had a dark red tongue.

Previous studies using tongue diagnostic systems have accurately diagnosed appendicitis, diabetes, and thyroid disease.

"It is possible to diagnose with 80% accuracy more than 10 diseases that cause a visible change in [tongue](#) color. In our study we achieved a 94% accuracy with three diseases, so the potential is there to fine tune this research even further," Assoc Prof Al-Naji says.

More information: Abdulghafor Khudhaer Abdullah et al, Computer-aided diseases diagnosis system based on tongue color analysis: A review, *The Fourth Scientific Conference For Electrical Engineering Techniques Research (EETR2022)* (2023). [DOI: 10.1063/5.0154231](https://doi.org/10.1063/5.0154231)

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