Measuring and saving saliva alcohol levels with a smartphone attachment

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A researcher team from Purdue University, Indiana have developed a smartphone device and an app that together quantitatively analyzes and store the results of strip-based saliva alcohol tests—which is helpful, since the current method consists of matching up the strip against a color scale on its packaging. The dipsticks used are sensitive to the saliva alcohol range of 0.02% to 0.30%, which is sufficient to determine if someone should be operating a motor vehicle. Additionally, the app allows for storage and recall of this data.

"It depends on your subjective interpretation of colors," said Euiwon Bae, senior research scientist, Purdue University School of Mechanical Engineering, Indiana, "we try to avoid that, so we made a system that can be easily integrated in a smartphone."

Bae's previous work has involved using lasers and optical methods to provide quantitative measurements of samples, such as bacterial colonies. He and his colleagues, working in collaboration with Novilytic for alcohol sample preparation— a local startup company in West Lafayette, Indiana—describe their device this week in Applied Optics, a journal of The Optical Society.

The attachment itself is small, measuring 25 x 12 x 12 millimeters, and consists of a plano-complex lens, mirror reflector, and plastic diffuser that allow for consistent illumination conditions via the phone's LED. The strips fit into a small chamber above the camera lens, and the device attaches to a metal strip in the smartphone's case by way of a weak

magnetic strip. Because the device is manufactured in a laboratory setting, the device's plastic casing and lens are relatively low in cost.

The dipstick tests work by using a reaction between ethyl alcohol and alcohol oxidase to produce hydrogen peroxide, which then mixes with the enzyme ABTS and is converted by peroxidase, another enzyme, into a green-colored complex. Darker hues correspond to higher ethanol contents.

This change is colorimetrically analyzed by an in-house MATLAB program within the app that imports the images, crops them to a 120 x 120 pixel center area and examines them with Red-Green-Blue and Hue-Saturation-Value color schemes.

"With the app, you can record the digital image of your dipstick, calculate the concentration, date and time of the recording, and also geographical locations—everything is stored in the database of your phone," said Bae. "Practically speaking, if you are in the middle of a legal dispute, you have proof at your fingertips—when it was taken, where it was taken, what your concentration was, everything."

Future work for Bae and his colleagues involves expanding the device's analytic applications in food safety. "When you have outbreak situations, or even before you have them, one quick way to see whether you have salmonella present is by using these assays," Bae said.

More information: Youngkee Jung et al. Smartphone-based colorimetric analysis for detection of saliva alcohol concentration, *Applied Optics* (2015). DOI: 10.1364/AO.54.009183

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