# Virtual hyperspectral images could determine plant health, assist in crop management, grocery shopping

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Purdue researchers are developing technology that could allow users to quickly determine the health of plants in the field and of fruits and vegetables in groceries through the translation of digital images on smartphones into virtual hyperspectral images.

Hyperspectral imaging collects and processes information from across the electromagnetic spectrum to obtain the spectrum for each pixel in an image to help find objects, identify materials or detect processes. Virtual hyperspectral images take the process one step further.

"We're working on technology that allows for nondestructive and quantitative chlorophyll imaging using image capturing techniques similar to those found in traditional digital cameras," said Young Kim, associate professor of biomedical engineering in Purdue's Weldon School of Biomedical Engineering. "The combination of a simple imaging system and a hyperspectral reconstruction algorithm for images from such a device could offer simple instrumentation and operation while avoiding the use of bulky equipment."

Stresses such as drought, temperature or pathogen attack can impact the growth of plants and affect crop yield. Loss of chlorophyll, which provides plants with their green color, is one measurable symptom of stress.

By effectively monitoring the chlorophyll content, experts can determine if plants that look fine to the naked eye are actually experiencing stress that can be minimized through changes in fertilization, watering or other efforts.

Current approaches of measuring chlorophyll content in plants involves fluorescent imaging, hyperspectral imaging, or biochemical analysis. Conventional imaging involves the use of bulky and expensive equipment, while biochemical analysis can damage plants.

The Purdue team is working to solve those problems through the use of technology that can translate digital color images into virtual hyperspectral images.

The team developed a working prototype utilizing a color digital camera, a telecentric lens and a white light source all attached to a computer. The prototype gathered color images of plant leaves that were translated into virtual hyperspectral images using an algorithm.

Kim's group is the first to utilize the technology for an agricultural application. The group is now beginning research on types of applications for the technology and on how to move the technology to smaller cameras such as those found in smartphones.

While the technology is still in its early stages, Kim envisions it being useful in a host of applications, from being able to use drone cameras to monitor stresses on entire fields to using a smartphone camera to determine the freshness of produce in the store.

"We believe that eventually any camera could be used to do this," he said.

The technology could also be utilized in non-agricultural applications,

such as determining hemoglobin content in blood to help diagnose anemia, a condition characterized by lower amounts of red blood cells or a lower ability of those cells to carry oxygen. Hemoglobin provides blood with its red color.

"There are several pigments this technology can detect," Kim said. "As long as they have a very unique color, we're able to do it."

The group is currently seeking funding sources and collaborators to assist in forwarding the research.

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