Converting Cameras Into Real-Time Environmental Detectors

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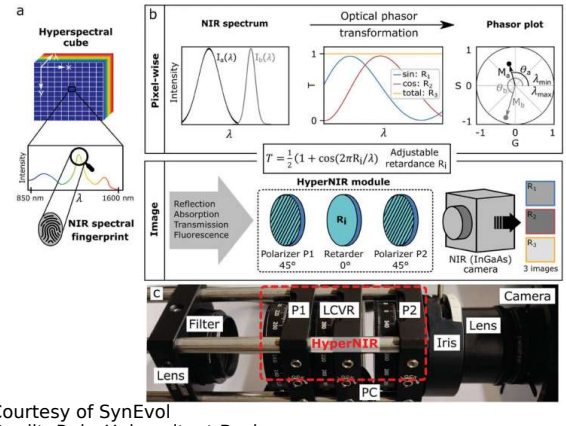

Courtesy of SynEvol
Credit: Ruhr Universitaet Bochum

Identifying plant stress early and detecting microplastics—this and additional tasks can now be accomplished through a new technique that utilizes near-infrared light measurements. It is affordable and operates in real time.

Scientists from Bochum, Duisburg, Karlsruhe, and Münster have created a novel approach for monitoring the environment. It relies on near-infrared (NIR) light and allows users to acquire detailed spectral data from different materials and biological specimens.

The group led by Jan Stegemann and Professor Sebastian Kruss from the Fraunhofer Institute for Microelectronic Circuits and Systems IMS and Ruhr University Bochum in Germany demonstrated that HyperNIR technology is applicable for the non-contact identification of various kinds of plastic, which is beneficial for recycling processes and identifying microplastics. The research appears in Advanced Science.

Near-infrared light, imperceptible to humans, holds crucial information regarding the chemical makeup of a sample. Earlier techniques represented it either as a grayscale image or as a spectrum, meaning as an intensity distribution for various wavelengths. The novel technique relies on hyperspectral imaging, integrating both spectral and spatial data.

By utilizing low-cost and readily accessible parts, the researchers can modify any conventional camera into a HyperNIR camera to change spectral data into visual images. For this purpose, they utilize optics with controllable polarization. External indicators, like dyes, can also be recorded, but they are not mandatory.

The system captures three images of every sample, offering comprehensive spectral data. In contrast to traditional methods that necessitate lengthy scanning of a sample, the HyperNIR camera operates much more quickly. "The capability to assess various materials and their characteristics in real time can significantly enhance the effectiveness of procedures in environmental monitoring," forecasts Kruss.

The researchers demonstrated, for instance, that the HyperNIR technology allowed them to monitor in real time the water absorption of a bell pepper plant—non-invasively and without utilizing dyes. "According to Stegemann, this type of hyperspectral imaging could possibly be applied to different molecules." "It may serve to assess the nutrient levels in a plant or to identify pest invasions and plant stress early on."

The HyperNIR technique can additionally be integrated with fluorescence microscopy to distinguish among different fluorescent molecules utilized as markers. This indicates that the system may be relevant for biomedical research. The group led by Stegemann and Kruss aims to investigate this application area further in the future.

"According to Kruss, incorporating the process into drones may also address urgent environmental challenges in agriculture by creating a new avenue for data gathering and assessment."