Fully automated detection robot promotes efficient soil testing

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The equipment realized fully automated and unmanned detection of soil nutrients and heavy metals. Credit: HFIPS

A research team developed new equipment that achieved fully automatic and unmanned detection of soil nutrients (such as organic matter, available potassium, available phosphorus) and heavy metals (including Pb, Cd, Hg, As, Cr). They named it High Throughput Soil Composition

Intelligent Detection Robot Equipment. The team is led by Prof. Wang Rujing from the Hefei Institutes of Physical Science (HFIPS) of the Chinese Academy of Sciences.

Arable land is essential for food production. To overcome the challenges of long cycles, complicated procedures and high costs associated with large-scale manual soil testing, advanced technological solutions are required.

This equipment features three technological highlights: machine vision, multi-arm coordination, and optimized scheduling algorithms.

Machine vision identifies colors in chemical titration reactions. The researchers used a camera to capture images, digitized them, and matched red-green-blue color components to determine the threshold for color changes in the reactions.

Multi-arm coordination uses neural networks and distributed control to break down complex actions into precise mechanical arm movements. This enables efficient planning, decision-making, and coordinated control of multiple arms to ensure accurate and efficient pre-treatment actions.

The optimized scheduling algorithm uses a cloud-based lab management platform to coordinate sampling, weighing, pre-treatment, and testing for various indicators such as pH and available potassium. It ensures accuracy and prioritizes efficiency, enabling the efficient operation of the soil sample pre-treatment process.

By replacing complex manual labor with robotics, this equipment increases the efficiency and accuracy of soil testing, according to the researchers.