Computer vision may revolutionize structural inspection

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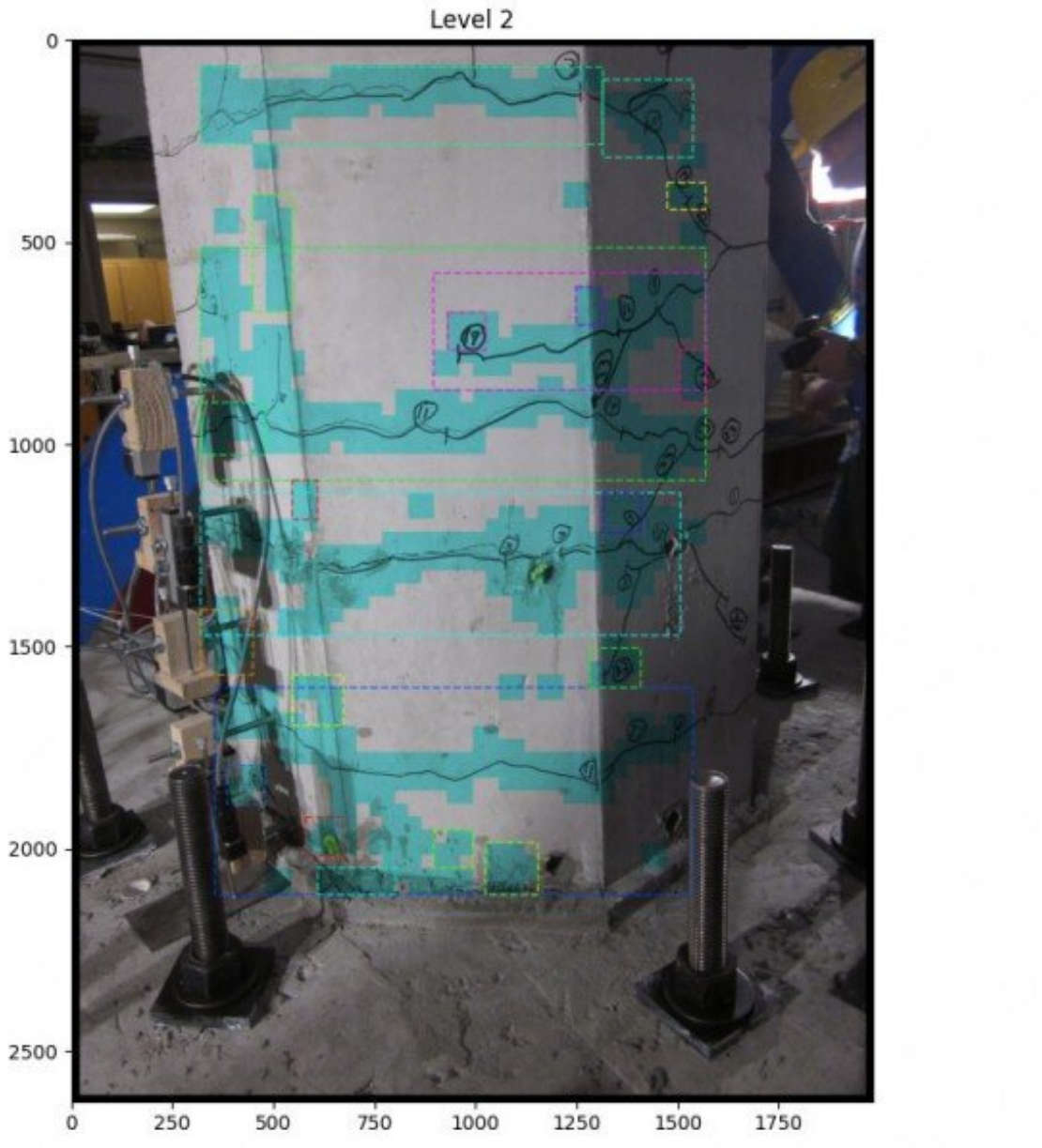

This image shows how the vision software automatically detects cracking in a reinforced concrete bridge column. Credit: South Dakota State University

Inspecting structures after an earthquake, hurricane or flood is essential to saving lives, but that can be difficult to accomplish in a timely manner.

"Trained inspectors need to decide whether to keep a bridge open, to restrict traffic to first responders only or to close it—and this must happen within a short time," explained associate professor Mostafa Tazarv of South Dakota State University's Department of Civil and Environmental Engineering. "After an earthquake, you need an army of structural engineers to quickly assess and comment on the serviceability of bridges and buildings in the affected area."

Tazarv, who is coordinator of the Jerome J. Lohr Structures Laboratory, does research on the structural behavior of buildings and bridges and how they behave during catastrophic events, specifically earthquakes. He also leads the Sustainable and Resilient Civil Infrastructure, or SARCI, research group.

Tazarv is working with another SARCI member, assistant professor Kwanghee Won of the Department of Electrical Engineering and Computer Science, to develop artificial intelligence software that scans and pinpoints cracks and other damages in support columns and other structural components. Won's expertise is in computer vision, neural networks, deep learning and intelligent systems.

The software has the potential to revolutionize how buildings and bridges are inspected—and save both time and money.

Developing vision capabilities

During Phase 1 of the project, the researchers have been developing the software's capability to visualize various types of damage in a concrete column. "Bridge columns are usually made with concrete," Tazarv pointed out. "From there, we can expand to different bridge components and maybe other types of structures."

This vision-based software can expedite the inspection process. "It can see concrete damage, including cracking, their angles, spalled area and exposed rebar," Tazarv said. "Once the program is refined, we can examine the structural components from all angles and even use color coding to categorize the severity of the damage and report that information to the inspector."

He envisions integrating the software in a mobile app, which would make it possible for an untrained individual to use the software to scan bridges and transmit the images to a central inspection office. Using that knowledge, trained personnel can then determine whether a bridge, for instance, can be opened or not, Tazarv explained.

Another possibility is to incorporate the software into a drone, for which Tazarv will rely on the expertise of another SARCI researcher, assistant mechanical engineering professor Marco Ciarcià, who specializes in controls, robotics and multirotor vehicles.

A software-equipped drone could fly around structures and send the information to the transportation office to expedite inspections. "We could send a fleet of drones to pinpoint cracks in structures," he said.

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