IMPACT SPOTLIGHT

Using IoT to Monitor Infrastructural Integrity

IoT | Machine Learning | Infrastructure | Transportation | Sensors

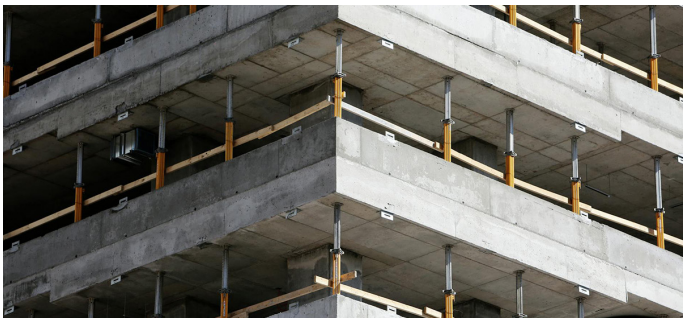

Photo by Pixabay

Who did it

Wavelogix, a startup selling sensors that detect concrete strength.

What they did

Created connected, internet of things (IoT) sensors that measure the strength of concrete, in real time, as it cures.

Wavelogix's REBEL sensors are embedded in concrete as it's poured. Data collected from the sensors is run through a machine learning[1] algorithm that measures the concrete's "compressive strength," the ability of a material to withstand pressure without losing its structural integrity. That information is plotted on a user-interface dashboard to show strength over time as the concrete cures.

Concrete "is an interesting little animal," Wavelogix president Joe Turek tells MIT Horizon. Once poured, it can take up to a month to fully cure to maximum strengths, which is usually 5,000 pounds per square inch for the heavy-duty concrete used to construct buildings, roads, and bridges. But many of these applications don't require a full cure to reach adequate strength; they may require as little as 2,500 pounds per square inch, Turek says, before you can move onto the next step in construction. "Strength in real time is really critical to a contractor who's pouring concrete," he says. "If you're building a road, you want to let traffic start to roll. If you are building a vertical building, you want to remove scaffolding and structures that are holding floors in places, bridges in place."

How it helped

Wavelogix's connected sensors offer significant improvements over standard methods, which are low-tech or cumbersome. The technology currently used to test the strength of a concrete cure is over a century old, according to Turek. When a contractor pours concrete, they also pour separate "companion cylinders" that can be several inches in diameter and nearly a foot in height. To test the strength of a project, those cylinders are mechanically crushed at different intervals to determine their compressive strength. That leaves a lot of room for error, and it's a bit of a guessing game when concrete reaches the correct pounds per square inch. "It's pretty inefficient," Turek says.

Another more recently developed method, called "maturity sensing," uses sensors and calculations in a lab to determine cure strength. Maturity sensing can show results in real time, but it also has drawbacks, according to Turek, because it requires precise measurements and the sensors need to be recalibrated for each individual concrete mix. "It's somewhat cumbersome, expensive, and time consuming," Turek says.

[1] A subfield of artificial intelligence involving systems that can be trained to interpret or extrapolate from data without depending on explicit, preprogrammed rules.

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Wavelogix sensors, on the other hand, emit sonic waves, which can then measure the concrete's resonance, or vibrational frequency, as it cures. Wavelogix then crunches those numbers to calculate compressive strength. "It's done in real time. It's done very quickly, and it's agnostic to the mix design, so you don't have to calibrate the system between different types of concrete mixes," Turek says. "Having a tool that actually tells you the real-time strength is a much safer alternative than guessing."

Such sensors are not only adding safety, according to Wavelogix, but also reducing costs by increasing the efficiency of the construction process.

So far, Wavelogix has installed about 1,000 sensors on bridges, multistory buildings, pavement, and more, and the company is working with more than 20 state transportation departments.

Why IoT

IoT sensors allow for the collection and processing of data across a network. Sensors make data delivery more accessible and faster, so users can analyze the information more quickly and efficiently. For industrial sectors steeped in conventional processes, like construction and infrastructure, it can be a challenge to introduce new technology. But IoT sensors can be small, inexpensive, and deliver data right to a computer or phone. "There has not been, to this date, any other efficient technology that was small, low-cost, and easy to deploy," Turek says. "An IoT device is a very, very elegant solution to an age-old problem."

For more on how IoT can help with industry's age-old problems, see How Organizations Use IoT.