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Sensors to avert 'carmaggedons'

By John Roach
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The much-hyped 'carmageddon' predicted last month for Los Angeles never materialized when a stretch of highway was closed to allow a bridge demolition, but commuters may not be so lucky if one of the nation's thousands of deteriorating spans suddenly collapses.

University of Maryland

Mehdi Kalantari tends his sensor network under the Capital Beltway's Northwest Branch Bridge. The wireless sensors communicate with this box that sends data via the cellular network to a central server.

That's the sort of scenario that Mehdi Kalantari hopes to avoid with the deployment of wireless sensors on the nation's — and world's — aging bridges. One in four U.S. highway bridges is either structurally deficient or functionally obsolete, according to a 2009 estimate by the U.S. Society of Civil Engineers.

"That does not necessarily mean that the bridges will collapse or that they are unsafe to use," said Kalantari, an electrical engineer at the University of Maryland, today. Rather, he said, they are like old cars: unreliable, costly to maintain, and potentially problematic.

The idea is to monitor the aging bridges and identify problems that need to be fixed so that cash-strapped federal and state agencies can prioritize their infrastructure spending to keep traffic flowing and roads safe.

The playing-card size wireless sensors harvest and store energy from ambient light and radio waves. They are designed for easy attachment to various points of bridges and networked together via a central data hub on the bridge that communicates with an offsite server.

This system constantly collects data on structural integrity issues such as strain, vibration, flexibility, and development of cracks.

Strain, for example, is a reflection of load. If a bridge has a loose bolt or a newly developed crack, "you are going to see an active shift in the amount of load that is carried. ... When you see the pattern of load is different from what you expect it to be, that starts generating alerts," Kalantari explained.

Those alerts, in turn, are coded so engineers know the severity of the problem and can plan their maintenance accordingly. Sensors currently cost about $50 each. An average interstate bridge – say 200 to 300 yards long – might require several hundred for monitoring.

This averages to about $10,000 per bridge. The cost of repairing and rebuilding the nation's aging bridges runs into the billions .

Kalantari is testing the technology with the Maryland Department of Transportation on the Capital Beltway Nortwest Branch Bridge, which is similar to, though smaller, than the span that collapsed in Minneapolis in August 2007. So far no problems have been detected, but the system is operating as predicted.

"We are confident if a problem happens, the sensors are going to pick them up," he said. That's important, since it could give planners time to make arrangements for repairs and give the public time to schedule a vacation.

After all, the Los Angeles traffic nightmare was averted at least in part due to the massive media campaign preparing drivers to take alternative routes or simply stay off the roads. Without advanced warning, carmageddon may have looked something more like the 60-mile traffic jam in China this April.