# Florida Guards Against Leaks in Hydrogen-powered Vehicles

Topics/Verticals: Innovation, Chemical, Aerospace

**In cooperation with the state's government, University of Florida researchers installed wireless sensors where the vehicles are stored. The system measures any hydrogen gas escaping from fuel cells, then transmits that data in real time.**

By Claire Swedberg

Jan. 15, 2008—The state of Florida, as part of a project to acquire and utilize fuel-cell vehicles, has been employing ZigBee-based wireless sensor tags in the city of Orlando, to ensure the state's 14 hydrogen-powered vehicles do not leak. Users can log onto a Web site and watch the sensor results in real time. The system was designed and developed by the University of Florida's department of chemical engineering.

This inexpensive system, says John Painter, manager of the state's hydrogen-powered fleet and project, could be utilized by dealerships throughout the country, as fuel-cell vehicles proliferate, in order to ensure that those vehicles can be safely stored and maintained. Such vehicles are powered by fuel cells that use hydrogen gas, in conjunction with oxygen from the air, to produce electricity. Because the nodes consist of off-the-shelf components, they cost very little. What's more, the nodes, a base station, a laptop and software would be all that would be required for a user to set up a remote sensing system.

*Fan Ren*

Painter first began investigating fuel-cell vehicles as a researcher at Ford Motor Co.. In about 2006, he was hired by the state of Florida to acquire and maintain fuel-cell vehicles. The state operates 14 Ford Focuses powered by a fuel-cell battery that consumes hydrogen gas. Some of the cars are used by the Florida State Department of Environmental Protection, and others by utility company Progress Energy, which operates two major utilities serving 3.1 million customers in the Carolinas and Florida.

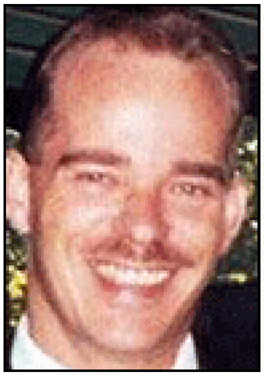
Hydrogen is a highly explosive gas, and although Painter says the safety precautions engineered into the vehicles make them safer than gas-fueled vehicles, the state sought an added layer of protection to ensure that no hydrogen leaks would go undetected. Initially, the vehicles were stored and serviced in a covered outdoor area at Progress Energy, because of the storms that often blow into the region, at times while the cars were being serviced. The state chose to move the cars to a covered work site, which better protects them but makes hydrogen leaks a greater hazard since any gas leak would collect in the enclosed space. The covered site is part of a garage at auto dealership Greenway Ford, located in Orlando.

Painter says he began speaking with local universities and companies about the problem two years ago, upon meeting University of Florida professors who had already developed a hydrogen sensor. One of those professors, chemical engineer Fan Ren, had worked  on a system known as AlGaN/GaN High Electron Mobility Transistors (HEMTs), four years ago for NASA—a project funded by a grant from that agency. The HEMT sensors for that project measured the presence of hydrogen around the space shuttle, but did not use any wireless transmission technology.

In August 2006, Ren says, the researchers installed six wireless sensor nodes at Greenway. A wired solution, such as that which had been installed for NASA, would have been unrealistic, he explains, noting, "It's a huge garage. It would be very difficult to put wires through there."

Each sensor node contains two hydrogen gas sensor chips and a ZigBee transceiver compliant with the IEEE 802.15.4 wireless standard. The nodes measure for the presence of hydrogen in the air at a rate of once every five seconds, then transmit those measurements directly to the base station, which is connected to a computer by USB cable. The software on the computer, written by students at the University of Florida, enables it to read the data, then transmit it over the Internet to be accessed by Orlando city officials, as well as by the public. The base station can also trigger an alarm if hydrogen is detected at a quantity higher than 1 percent—but to date, Painter says, no such leaks have occurred.

Installed throughout the 170- by130-foot area in which the 14 vehicles are stored, Ren says, the nodes are mounted on the ceiling above the vehicles, making it easy for them to detect the presence of hydrogen, since hydrogen gas is lighter than air and tends to rise. The nodes are plugged into AC power sources, but each node's built-in battery provides 30 days of power if an outage occurs. The base station and computer also have battery back-up power.



*John Painter*

Since installing six nodes two years ago, the research team has reduced that number to four. The researchers believe four nodes are sufficient for monitoring the hydrogen levels in the garage, and now use the other two nodes for further experiments at the university. The sensor nodes have a transmission range of up to 328 feet, according to professor Jenshan Lin, who, along with professor Steve Pearton, designed the wireless system, but are positioned within 50 feet of the base station that receives their transmission.

Although the nodes initially contained just one hydrogen sensor, the state found the results confusing because of the temperature fluctuations within the garage. Such fluctuations affect hydrogen readings since warmer temperatures result in higher electrical current readings from the sensor, and the current readings are pivotal to the hydrogen sensor system since the presence of the gas causes a change in current reading as well. To solve the problem, the team installed two identical chips—both providing temperature-sensing functionality, but one with the hydrogen readings deactivated, so that the software system could compare the two results against each other to provide a more accurate hydrogen reading.

The system, Ren says, could be a solution for other companies and organizations to address concerns related to the safety of hydrogen storage for fuel-cell vehicles and generators. The cost of the technology is low, he says, adding, "Our cost was less than $200—and if mass-production is adapted, the cost can be reduced significantly."

The solution also has medical applications, Lin says, in which data could be collected regarding a patient's health and transmitted wirelessly to a doctor's office. A female patient could use a sensor at home, for instance, to test her saliva for the presence of c-erb-2, an antibody present in individuals with breast cancer, thereby providing an alternative to mammograms for cancer screening. As with the hydrogen-sensing system, the results of a saliva test could be transmitted to a receiver with a USB connection to a computer, then sent to a doctor's office via the Internet.

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