

A system developed by researchers at the University of South Florida wanted to determine if an RFID-based system could be used as a diagnosis tool by tracking and analyzing a patient's movements.

By Mary Catherine O'Connor

Jan. 14, 2009—In Greek mythology, Hermes acted as a messenger, relaying information between humans and the gods, while also protecting boundaries. That makes him an apt namesake for the Health Research Management and Evaluation System, or HERMES—a preventative health-care system developed at the [University of South Florida](#) that has already been tested at one assisted-living facility and is currently being evaluated at another. The system uses radio frequency identification to track residents' movements. These movement patterns are then mined for clues that could indicate early stages of dementia.

A large body of research links wandering behaviors with dementia. In fact, the tendency of individuals suffering from various forms of the disease to wander from their homes is one major reason their families place them in assisted-living facilities or nursing homes, where they can be closely monitored. RFID is already being employed increasingly within these facilities, where the technology can be combined with an alarm system designed to prevent residents from leaving the facilities unaccompanied.



At the Shady Palms assisted-living facility, participating residents wore a battery-powered RFID tag on their wrists.

However, [William Kearns](#), an assistant professor in the University of South Florida's department of aging and mental health, wanted to determine if RFID could also be utilized as a tool for the early diagnosis of dementia. The result of this research is HERMES, for which Kearns—along with an USF colleague, James Fozard, and Ted Kostis, an RFID entrepreneur and the president of [Silent Partner Technologies](#), which develops RFID tracking solutions—has filed a patent. The system, which uses a combination of RFID hardware and software, has been tested at the Shady Palms assisted-living facility in Tampa, Fla., and is currently being evaluated at a second facility in that city.

"The human [body] is a marvelously expressive organism," Kearns says. "It produces sounds, it moves, it emotes." The professor's work, therefore, is focused on studying how our bodies communicate changes in our aging minds. "It's reasonable to assume that variations in patterns of movement are indicative to pathological changes in the mind."

At the heart of the HERMES system is a computer program that scans patterns in a person's movements, over time, within a monitored area. The RFID system then feeds that location data into the

program. The goal is to identify patterns showing that an individual is beginning to wander when moving through the monitored area. "Basically, we're looking at the tendency for individuals to walk in other than a straight line," Kearns explains. "We use higher-order mathematics to identify and analyze the walking patterns."

Armed with information regarding which residents exhibit a tendency to wander, caregivers can then conduct cognitive tests and possibly establish an early diagnosis of dementia. Early detection is vital, Kearns explains, because some drugs are effective in treating dementia only if a patient begins taking them before brain function reaches a specified level of decay.

From March to October 2008, a group of Shady Palms' residents began to participate in a test of the HERMES system. For 30 days, each wore a wristband containing a battery-powered RFID tag manufactured by [Ubisense](#). A total of 14 residents have participated at different times throughout the seven-month period.

Ubisense's real-time location systems (RTLS) employ ultra-wideband (UWB) RFID technology. The tags emit short bursts of radio pulses over multiple bands of frequencies (6 GHz to 8 GHz) simultaneously. This is different than conventional RFID systems, which operate on narrow bands of the radio spectrum. UWB signals are also transmitted for a much shorter duration than those used in conventional RFID, though Ubisense claims this improves the read rate by making the signals easier to filter from multipath reflections—that is, RF signals reflected from surfaces—than conventional RF signals.

At Shady Palm, four receivers were mounted in the corners of a 25- by 9-meter (82- by 30-foot) room with five entry and exit points. "Persons wearing the tags passed through the room on the way to the dining area," Kearns states, "and provided us a sample of their locomotion in the process."

According to Kearns, Ubisense's tags and receivers were selected because they provided accurate location data to within 6 to 10 inches, and because they maintain accurate calibration for intervals of at least six months. When the RFID-based RTLS system is initially installed, he says, the system needs to be checked and possibly adjusted to make sure it provides accurate location information. Over time, this accuracy can deteriorate, so the system must be rechecked and, if necessary, recalibrated. Kearns and his team checked the tags and receivers at the six-month mark, and found that they still provided accurate location information.

After wearing the tag for 30 days, each Shady Palms participant was given a short test known as the Mini-Mental State Examination. Kearns and his team then compared the movement data collected from a particular RFID tag with the corresponding participant's exam results. What the researchers found is that residents whose exam indicated mild cognitive impairment, consistent with early dementia, also showed patterns of wandering. To ensure that the study was blind, the test was administered by a gerontology graduate student who was independent of Kearns' team and who, therefore, had no knowledge of whether the residents' movement patterns indicated wandering.

HERMES is now being tested at a second assisted-living facility in Tampa. Kearns hopes the results at that location will reinforce the findings from Shady Palms. He has also submitted a report on the Shady Palms test to a medical journal.

The university, Kearns notes, hopes to license HERMES to a third party that will market the system to assisted-living facilities. He envisions that the facilities would purchase the system and then offer the tags and tracking service, for a fee, to any residents who wished to have their movements monitored.

Robert Bennett, the administrator of Shady Palms, says the test did result in one resident who participated in the study being placed on a drug regimen designed to stave off dementia. Still, he says he's not sure that using the HERMES system on an ongoing basis could compete in price with having a counselor periodically visit the site and offer the Mini-Mental State Exam to all residents. Thus, he says, HERMES would need to offer Shady Palms more than just alerts regarding residents exhibiting early signs of dementia.

A system based on HERMES could provide location tracking for residents deemed likely to try to leave the facility—something dementia patients often attempt. This would issue alerts to staff members if a resident suffering from dementia were to attempt to leave. Shady Palms, however, is already using a different RFID-based system to monitor its residents' locations.