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IN THE LAB

New Technologies to Help Seniors Age in Place

Researchers test ways to prevent elderly people from injuring themselves at home

By SHIRLEY S. WANG



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James OBrien

How do you keep Grandma safe from falls without making her feel like someone's watching her every move?

As the population grows older in many parts of the world, engineers and health experts are searching for new ways to prevent elderly people from injuring themselves at home. In doing so, they hope to keep people in their homes longer, a concept known as aging in place.

The technology to help make this happen has improved. But researchers also must factor in whether seniors will be able to or willing to use the devices. Current methods include wearable alarms, which usually must be activated by the person after an injury, and optical devices, such as videocameras, that can be intrusive.

The technology "has to fit the cultural ethics of the aging population," says Cathy Bodine, a professor of bioengineering at the University of Colorado Denver. "We're not always taking that into consideration."

Falls are the leading cause of death by injury in those 65 and older. Now, health experts are using new methods, like radar technology and sensors, to prevent their falls. WSJ's Shirley Wang joins Tanya Rivero on Lunch Break with the details. Photo: Getty

Falling is the leading cause of death by injury in those aged 65 and older, with 1 in 3 seniors falling each year. Falls can cause hip fractures and head wounds, increasing risk of earlier death, and induce fear that can reduce mobility, according to the Centers for Disease Control and Prevention. More than 72 million Americans—nearly 1 in 5—will be 65 and older by 2030, up from 1 in 8 in 2009,

according to the government's Administration on Aging.

That has sparked scientists' quest to design better systems for getting help quickly to elderly people who have fallen. They're also working to find ways to prevent the falls in the first place.

Some researchers are studying how to adapt radar technology, which has been used for years to catch highway speeders and in weather forecasting, to applications for assisted living. Others are testing the 3-D sensors used in gaming systems like the Xbox to develop nonintrusive alert systems.

WSJ Radio

Shirley Wang discusses her story with WSJ This Morning's Gordon Deal.



Urban radar has been used by the military to find and observe people hidden in buildings from a distance. The goal with the elderly is to detect a fall without disturbing them unless they have just fallen. "The whole idea is you cannot have visual access to inside," says Moeness Amin, director of the Center for Advanced Communications at Villanova University.

The radar sends and receives electromagnetic waves that reflect off people and objects inside a building at different frequencies and strengths. The reflected waves, which vary depending on whether the object is moving or still and the density and type of material, then return through the wall to the radar device.





Dr. Moeness Amin with the radar device he is testing at Villanova University. *Villanova University*

By studying how the reflected waves differ, Dr. Amin's team aims to be able to tell if a person is simply sitting in a chair, tripping or collapsing from a heart attack. A big challenge is to figure out whether a person actually fell or whether it was a false alarm, like a pet jumping to the floor or a visiting grandchild flopping down in a chair.

To do that, scientists need to be able to program the system to distinguish between different actions. A first step is to model what a fall looks like. Simply gathering accurate information can be difficult, since researchers can't use real elderly people. Instead, they teach young, healthy people to walk and fall like seniors. Kelly Nestor, a colleague of Dr. Amin's and a clinical instructor in the Villanova adult geriatric nurse practitioner program, coached her college-student models by telling them to observe elderly people in a grocery store and instructing them not to pick up their feet while walking.

Marjorie Skubic, director of the Center for Eldercare and Rehabilitation Technology at the University of Missouri, and her colleague, nursing professor Marilyn Rantz, have created an alert system using a combination of motion sensors, radar and sensors that gather depth information to produce 3-D images of people.

The system is in use in a residential-care facility, TigerPlace in Columbia, Mo., and has demonstrated its effectiveness in detecting falls there. If a resident falls, staffers receive an email alert, along with a video clip that shows what's happened. (The image is a 3-D silhouette, which protects the patient's privacy.) Staffers can see whether the fall was serious and what happened leading up to it.

George Hage, a 90-year-old resident of TigerPlace, has had sensors set up throughout his apartment, including in the ceilings of each room, over the shower, in the refrigerator and kitchen cupboards and above the bed and under the mattress. Mounted sensors resemble residential fire alarms, while the bed sensors, filled with pressurized gas, sit in a strip under the mattress.

The bed sensors, some of which monitor his breathing and pulse rate in addition to motion, often pick up that he's a restless sleeper. So Mr. Hage will stop by the nursing station to tell them when he didn't sleep well and they shouldn't worry about him.

While many residents thought the sensors were intrusive, Mr. Hage, a retired postal inspector, says he's gotten used to them. "If [the research] is going to help somebody in the future, then I'm all for it."

Dr. Skubic and Dr. Rantz have also been using radar and 3-D sensors to measure speed, stride time and stride length among residents in TigerPlace apartments and using the information to calculate risk of falling. Studies have shown that people whose movement speed has slowed and whose strides are inconsistent, among other factors, are at greater risk of falling. The hope is that balance or strength training can be offered to these patients to prevent a serious fall. The researchers also plan to begin testing the feasibility of using the system in private homes.

The research team has also been testing mounted sensors that detect pulse, respiration and motion to predict health problems. A person making more trips to the bathroom than usual might be developing a urinary tract infection. Someone who spends longer sitting in a chair when they usually move from room to room might be getting depressed or struggling with mobility.

In another application under development, Dr. Bodine's team, at the University of Colorado Denver, has

been testing a prototype of a system that monitors actions, such as how people put items like pills in a case. If someone puts the wrong medicines in the box, the sensor shows a picture of the correct pill and says, "Take a look at this picture. Try again."

The visual component uses an inexpensive digital camera and special software that can follow the hand and see if it is moving in the right direction for the right object.

Dr. Bodine says such technologies must be simple to use. They also must have a built-in backup plan, or redundancy, in case at first they fail. "The trick is to make them affordable enough, robust enough and redundant enough to be useful," she says.

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