Researchers have developed a system that can tell if patients — or subjects in a drug trial — have taken their medications as prescribed. Based on magnetic detection, the system can also send out an alert if required medications aren’t taken on schedule.

A sensor necklace designed by Maysam Ghovanloo, an assistant professor in the School of Electrical and Computer Engineering, wirelessly sends the date and time a magnet-containing pill is swallowed.

Forget Your Meds?

Sensor Necklace Aims to Increase Drug Compliance among Elderly and Clinical Trial Participants

By Abby Vogel

Researchers now have a possible solution for the one in three adults who fail to take their medicines as prescribed, as well as for everyone else who occasionally forgets: a sensor necklace that records the exact time and date when specially designed pills are swallowed, and reminds the user if any doses are being missed.

“Forgetfulness is a huge problem, especially among the elderly, but so is taking the medication at the wrong time, stopping too early or taking the wrong dose,” says Maysam Ghovanloo, an assistant professor in Georgia Tech’s School of Electrical and Computer Engineering. “Studies show that drug noncompliance costs the country billions of dollars each year as a result of re-hospitalization, complications, disease progression and even death.”

Ghovanloo and graduate student Xueliang Huo have designed a sensor necklace that records the date and time a pill is swallowed, which they hope will increase drug compliance and decrease unnecessary health care costs. The device could also be used to ensure that subjects in clinical drug trials take the study medications as directed by the research team. The details of the proof-of-concept device were published in the December 2007 issue of IEEE Sensors Journal.

The necklace, called MagneTrace, contains an array of magnetic sensors that detects when specially designed medication containing a tiny magnet passes through a person’s esophagus. And for persons who may not want to wear a necklace, MagneTrace sensors can be incorporated into a patch attached to the chest.

The date and time the user swallowed the pill can be recorded on a wireless device carried on the user’s body. The information can then be sent to the patient’s doctor, caregiver or family member over the Internet. The device can notify both the patient and the patient’s doctor if the prescribed dosage is not taken at the proper time.

According to a 2005 Wall Street Journal Online/Harris Interactive Health Care Poll, one in three U.S. adults who had been prescribed drugs to take on a regular basis reported that they did not follow the doctor-recommended course of treatment, with two-thirds reporting that they simply forgot to take their medication.

This technology can also help researchers and pharmaceutical companies conduct more accurate clinical trials of new drugs. Currently, compliance is determined by medication diaries kept by the patients. Inaccurate data from clinical trials can affect decisions made about new drugs, potentially impacting millions of people.

“If each drug trial volunteer had to wear a MagneTrace necklace, the exact date, time and dose would be recorded, rather than relying on the patient’s memory and honesty,” says Ghovanloo.

This technology also has the potential to reduce the size of clinical trials and reduce the need to repeat them.

“A patient cannot cheat the system by passing the pill past the necklace sensors on the outside of the neck because the signal processing algorithm is smart enough to only look for the pill’s
magnetic signature while it passes through the esophagus,” says Ghovanloo, who started working on this project about two years ago at North Carolina State University.

To test their system, the researchers have designed an artificial neck built from a PVC pipe filled with plastic straws. They place a necklace containing an array of sensitive magneto-inductive sensors around the artificial neck to study detection of a pill passing through it.

The magnetic sensors are distributed in different orientations, allowing the pill to be detected regardless of its orientation when it passes through the patient’s esophagus. The sensors are driven by a control unit on the necklace that consists of a battery, power management circuitry, low-power microcontroller and radio-frequency wireless transceiver. The prototype MagneTrace necklace with six sensors weighs less than one ounce.

“Preliminary results testing the artificial neck have shown 94.4 percent correct detections when the magnetic tracer passed through the esophagus detection zone and about 6 percent false positives when it passed through areas not in the detection zone,” says Ghovanloo.

Multiple strong magnets in the gastrointestinal tract can potentially result in a blockage. However, the magnet used in the pill or capsule is very small – three millimeters in diameter and about one millimeter thick – and coated with a thick indigestible, insoluble polymer coating that prevents absorption of the magnet and prevents magnets from aggregating.

“The magnet should simply pass through a patient’s gastrointestinal tract with no interactions and be excreted from the body in about 24 hours without any effects,” notes Ghovanloo.

Assistant professor Maysam Ghovanloo, left, and graduate student Xueliang Huo, both of Georgia Tech’s School of Electrical and Computer Engineering, test their drug compliance monitoring system on an artificial neck.

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