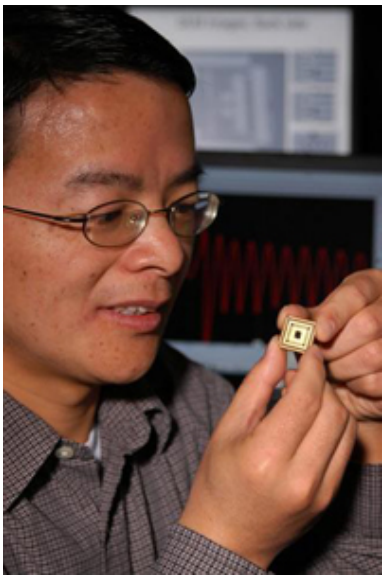
UF engineer develops tiny, easily mass-produced motion sensor



Huikai Xie, a University of Florida assistant professor of electrical and computer engineering, examines a tiny motion sensor that he and two graduate students recently designed. (Kristen Bartlett/University of Florida)

A University of Florida engineer is the latest researcher to design a tiny, easy-to-manufacture motion sensor, a development that could help popularize the sensors as standard equipment in personal electronics, medical devices and other applications.

The sensor, which measures about 3 square millimeters or one-tenth of an inch, is not the smallest motion sensor ever invented. But it is extremely sensitive, draws only a tiny amount of electrical power and -- most important – is one of a new generation of sensors that can be made using the computer chip manufacturing industry's standard techniques and equipment.

That means that in the near future "the application range can be expanded a lot," said Huikai Xie, a UF assistant professor of electrical and computer engineering.

Xie is one of five authors of a paper describing the sensor that appeared in the December issue of the journal Institute of Electrical and Electronics Engineers Transactions on Circuits and Systems.

Motion sensors are hardly new, but they were large, heavy and typically used in airplanes and ships for navigational purposes in recent decades. Miniaturization techniques developed as part of a relatively new field called Micro Electrical Mechanical Systems, or MEMS, have steadily reduced their size and cost.

The result is that the sensors are steadily becoming commonplace in commercial products. Today's cars, for example, contain tiny accelerometers that deploy airbags after sensing the sudden stops or changes in motion that occur during collisions. A small number of cell phones, personal digital assistants and laptops also now carry motion sensors, said Dave Monk, the manager for sensor operations at Freescale Semiconductor, the nation's third-largest chip manufacturer.

They have several functions, he said. In PDAs, they may allow users who are reading a book to "turn the page" by simply turning the PDA over in their palm and then turning it back again, he said. And in cell phones, the motion sensors may sense when the phone has been dropped and shelter the hard drive to prevent memory loss.

"UF engineer develops tiny, easily mass-produced motion sensor." PHYSorg.com. 9 Feb 2006.
http://www.physorg.com/news10706.html

Xie believes these sorts of applications are only the beginning. Cheap, tiny, easily made and paired with wireless technology, motion sensors could be easily worn or even sewn into clothes, he said. That could help coaches zero in on the movements of athletes, or nurses working at a distance monitor elderly people in their homes.

"This can be used to monitor an athlete's physical activities, determining maximum shock during a football game, with the sensor placed inside the pads or helmet," Xie said.

It's even possible that the sensors could be implanted in bones during surgeries, giving orthopedic surgeons a unique way to monitor the progress of repairs, he said.

These developments have been stalled by high costs because many of the tiniest sensors developed so far require new or nonstandard manufacturing technology. Xie and other UF team members, including doctoral students Hongwei Qu and Deyou Fang, sought to solve this problem in their new research.

In a three-year-old project originally funded with a $170,000 grant from NASA, they developed a single-chip sensor that can be manufactured using Complementary Metal Oxide Semiconductor technology, the industry standard for silicon chip manufacturing.

The chip uses about one-thousandth of a watt of power, meaning it has the potential to operate for as long as a year on a standard watch battery. It is also extremely sensitive, so much so that it can register sound as well as motion.

Monk, of Freescale Semiconductor, said Xie's research is important because its applied nature makes it highly useful to industry. "I see these engineers going all the way to putting it into a package, showing why it could be manufactured, showing all the critical components – that's a whole lot closer to where we would pick it up," he said.

Although developing the first few sensors was expensive, Xie estimated it could cost $10 or less if mass produced. He and his graduate students have installed several sensors in a cigarette pack-sized board of electronics to test their capabilities. UF also is pursuing a patent on the sensor.

"Eventually, you can wear all kinds of sensors with you to monitor everything you want to know - your heartbeat, your blood pressure or even something like your glucose concentration," Xie said. "I think this is a very interesting, exciting field that will eventually help people live much higher quality of life."

Source: University of Florida