UCLA GRAD DEVELOPING MEMS DEVICES TO TEST FOR COMMON DISEASES

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LOS ANGELES -- Forty years ago, few people would have believed that a woman with morning nausea could skip the visit to her gynecologist and instead go to the drug store and buy a home pregnancy test kit.

The day is coming when folks with a high fever, diarrhea or those suspecting sexually transmitted diseases can go to a pharmacy and buy a MEMS device that will identify pathogens and diagnose diseases. Vincent Gau and Genefluidics, Inc., a spin-off company from the University of California at Los Angeles, are at the forefront of this wonder technology.

The importance of quickly determining pathogens by using hand-held devices originated during the Gulf War in 1991 when the U.S. determined that Iraq had anthrax and botulism in its biological weapons arsenal. In a project funded by the Defense Advanced Research Project Agency (DARPA) in 1995, scientists at UCLA and the California Institute of Technology received more than $5 million to develop a MEMS sensor that could detect airborne pathogens. For starters they chose E. coli.

Gau, 31, who designed the DNA sensor chip for the DARPA project, has taken the integrated genetic analyzing system out of a university setting and into the business world. He formed Genefluidics in November to promote widespread application of the technology.

Gau was one of the first to graduate with a doctoral degree from UCLA's biomedical engineering program last month. He received UCLA's outstanding graduate student award and the chancellor's service award for the year 2001.

"Most biosensors need a computer to do the image processing -- most are based on optical detection," said Gau, president of the Los Angeles-based company. "Our sensor is on a silicon chip and does not require a computer. We can get data from a raw sensor. The whole system is automatic so you don't need a technician to run (it)."

The device includes a biofluidic system and a DNA microchip. The biofluidic part of the device can do simple sample preparation; it collects particles in the air and sends it from the air phase to the liquid phase needed for biochemistry. The DNA microchip does the genetic detection.

The research team for the government project included Chih-Ming Ho at UCLA and Yu Chong Tai at Cal Tech. After developing a prototype, they sampled airborne particles that had been coated with E. coli, transferred them into a liquid state and then identified them.

With research completed and a prototype device developed, officials at DARPA offered the scientists an additional project that would have required them to field test the device with real anthrax and small pox pathogens. No one was thrilled about working with the diseases, said Gau, and they decided to focus future work on clinical diagnostics in the U.S. and in Asia.

Although the U.S. government has the right to use the technology for military and other applications, Gau and Ho share the patent.

"In the future, it can be helpful in monitoring air quality in hospitals," Gau said. "Now there is no way to do that. People get sick when they go to the hospital."

Also, the device can be used for determining the presence of E. coli in food. Normally those tests take three to four days. Gau's device can spot lurking E. coli within 45 minutes. Other applications for the technology include identifying pathogens that live in the body fluids like saliva, blood and urine.

Checking for urinary tract infections is one of the most common tests requested by physicians. Utilizing the methodology that has been available for nearly 40 years, it takes technicians three days to culture urine samples and determine which of the 20-plus bacteria may be causing the infection. In the meantime, patients are usually given a broad-spectrum antibiotic intended to kill the five most common culprits.

In the future, the new technology would be able to determine the specific bacterium and corresponding treatment within 45 minutes.

"If you can make one of the most commonly prescribed tests better, then I think you will do a great service," said Dr. Joseph Liao, a urology resident at UCLA who is working with the device. "In theory, this is definitely better than what's available. But it takes a systematic effort to show that this will work across the board."

Liao is integrating a sample preparation device and a DNA sensor into one device, as part of year-long research with Genefluidic's technology. "Now we can do it, but it is not efficient," Gau said. "We need to make it more robust and consistent."

Estimating that the tissue box-sized device and subsequent smaller versions will decrease the need for lab space, Gau has targeted hospitals as potential customers. He is working on contracts with a hospital on the West Coast to diagnose sexually transmitted diseases and another one in Asia where the device will be used to detect highly prevalent hepatitis B and hepatitis C.

Business growth depends on where the technology is targeted, said Rachael Leheny, senior vice president and head of biotechnology research at Lehman Brothers in Menlo Park, Ca. In the developing MEMS market, growth will be more complex at the hospital level, she said. It will be driven by the value-added aspects of the medical tests, and then the likelihood of reimbursements from managed care companies.

"You're talking about a market that doesn't exist and a product that doesn't exist," said Leheny. "If the market is going to be big it will be from microfluid or chip technology. It's very difficult to predict. There are a lot of competing technologies in this area."

With five researchers working on a commercial level prototype, it is expected to reach completion by the end of this year.

"It's one of those things that's limited by manpower," said Liao. "If a company will become interested in this then it will be done faster."

Since private funding is expected to last for about seven months, Genefluidics is monitoring its expenses and spending money at a "very slow burn rate," Gau said. "We still need to find the right venture capital firm; we need money and their professional help to market the devices and make sure we can make the most profit."

In the future, Gau wants his hand-held devices to be stocked on drug store shelves. "We'll sell different chips for diseases or different symptoms. A high fever can be caused by many different infections. We could sell a high-fever chip or a diarrhea or sexually transmitted disease chip. That will take a few years to reach the final product, but we're working on it now."

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