



Advanced Liquid Logic



Founded in 2004 by:

- **Richard Fair**, ECE PhD '69, Lord-Chandran Professor of Electrical and Computer Engineering
- **Vamsee Pamula**, ECE PhD '00
- **Michael Pollack**, ECE PhD '01

What it does: Develops and manufactures digital microfluidics-based research and diagnostic products

Employees: 80

Acquired by Illumina in 2013

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LAB-ON-A-CHIP TECHNOLOGY, A MODEL OF DUKE START-UP INNOVATION

When ECE graduate students Vamsee Pamula, Michael Pollack and Vijay Srinivasan* won Duke's first Duke Start-Up Challenge in 2000 for developing a prototype computer mouse that could be used in three dimensions, they planned to use the \$30K in prize money to start a consumer-product company that would integrate wireless technologies with microelectromechanical systems (MEMS) sensors.

But because Pamula and Pollack were interested in biological applications, they went in a very different direction: digital microfluidics.

SHARING KNOWLEDGE ACROSS DISCIPLINES

Although microfluidics is historically the domain of chemical and mechanical engineering, says Pratt ECE Professor Richard Fair, his lab got involved in 1997 because the Defense Advanced Research Projects Agency (DARPA) was trying to apply lessons learned from the design of computer chips to microfluidic chips.



therefore control) drops of liquid—requires much less fluid and much smaller processing and testing equipment.

After completing his PhD, Pollack was joined by Pamula as post-doctoral researchers in Dr. Fair's lab. The pair made plans to execute the technology as a business and, with two Small Business Innovation Research (SBIR) grants, founded Advanced Liquid Logic in 2004.

Nine years later, the company is going strong—in fact, it was recently acquired by Illumina, Inc., which develops life science tools and integrated systems for analyzing genes.

"We had built relationships with a number of companies to commercialize the technology over the years," said ALL CEO Richard West (BSME'79). "But the ultimate validation of the technology, and of the progress that the team has made, occurred on July 23, 2013, when Illumina announced that they had acquired the company. Illumina's market power and resources will ensure the technology's commercial success."

THE VALUE OF PARTNERSHIPS AND OTHER WORDS OF WISDOM FOR FUTURE ENTREPRENEURS

Prior to its acquisition, ALL formed partnerships to develop and market research and diagnostic products with companies that include Luminex Corporation, which develops, manufactures and markets biological-testing technologies and GenMark Diagnostics, which provides molecular diagnostic-testing systems.

The company also launched a product in collaboration with NuGEN Technologies, a developer and seller of reagents for genetic analysis. In 2011, ALL and NuGEN started selling the Mondrian SP Workstation, which uses disposable microfluidic cartridges to automate genomic-sample preparation for next-generation DNA sequencing.

Another collaboration, with physicians at Duke's Jean and George Brumley Jr. Neonatal Perinatal Research Institute (NPRI), began when Pamula and Pollack were Pratt graduate students—and led to one of ALL's first products.

"Since its beginnings, ALL has had a continuous and productive collaboration with Duke's [Jean and George Brumley Jr.] Neonatal/Perinatal Research Institute [NPRI]," Pamula says. "Dr. Ron Goldberg had the vision to see this technology's potential for addressing the needs of neonates and provided critical seed funding in the company's early days."

Since then, the company has worked with NPRI neonatologists on several grant-funded projects, including one for newborn screening (NBS) that has led to a product now on the market. The product, which identifies lysosomal storage disorders (LSDs) in newborns, is currently being used in a pilot study to screen all newborns in Missouri. Several babies with LSDs have been identified and are being treated.

Illumina plans to use ALL's digital microfluidics technology to improve its next-generation gene sequencing workflow. Electrowetting allows for precise manipulation of small droplets within a sealed disposable cartridge to perform complex laboratory protocols. This will streamline Illumina's next-generation sequencing workflow and make it more consistent, Illumina said in its announcement of the acquisition.

From helping Pamula and Pollack identify potential uses for their ideas to helping them license patents and develop prototypes, collaborations like these have been very valuable to ALL, Fair says, and can be critical to the success of new companies.

Fair, Pamula and Pollack have good insights to share with engineering students who hope to someday start their own businesses.

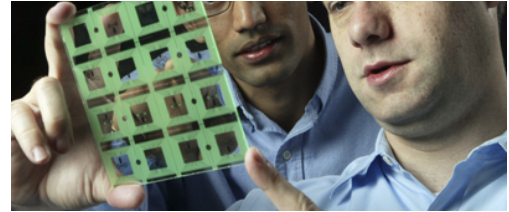


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Pollack says the time he and Pamula spent in Fair's lab as ECE graduate students helped them do just that.

"Our work in Dr. Fair's lab enabled us to prove our technology's feasibility and to begin to explore some potential applications," says Pollack. "It also allowed us to interact with other labs, particularly some in Duke University Medical Center, to better understand some of the problems that our technology could potentially solve."



Vamsee Pamula and Michael Pollack

"A big challenge for any device-oriented start-up is finding that application that will drive the bread-and-butter revenues," Fair says. "So partnering with these folks, seeing what they want to do with the technology, lowering the barriers to innovation and transferring the technology to the people who actually use it has been key in helping them do that."

That said, success doesn't come simply from how good an idea is.

"Success comes from executing a good idea well and having the right people in place; it comes from the management, the business plan and recognizing one's own areas of expertise and letting employees skilled in other areas handle those areas," says Fair. "The most valuable advice I gave to Michael and Vamsee was probably to get an experienced CEO," which the company found in West. West joined the company in 2005.

Pamula thinks that engineering students who dream of entrepreneurship should strive for a range of experiences.

"Business revolves around people, not just things, so try to get broad exposure to a variety of areas outside of engineering, particularly in business, humanities and law," he says. "Try to get an internship in an early-stage company to get a feel for the start-up environment."

Pollack, who says a big technical challenge for ALL has been to translate early research findings into a reliable and inexpensive technology platform, stresses that "there's a world of difference between making something work once in an academic lab and the level of technical maturity required for a commercial product."

As for the ideal time to strike out on one's own, "there's no better time to take a risk in starting a company than when you're just out of school," Pamula says. "You have nothing to lose and your naiveté may be an advantage in looking at problems in a novel way."

--by Jeni Baker

**Srinivasan, who later became ALL's first full-time employee, now leads the company's engineering activities.*

Company or Story Subtitle:

lab on a chip technology