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SPECIAL REPORT: TECH'S YOUNG ENTREPRENEURS

Bringing MEMS and Motes to Life

In creating micro-electro-mechanical systems that talk to each other, Mike Horton started a whole industry, which his Crossbow now leads

It was 1991, and Mike Horton was a freshman at the University of California, at Berkeley. Thinking him an astute young man, a professor asked him to solve an engineering problem that had stumped a slew of graduate and undergraduate students for months: Could he devise a tiny device that would notify a computer when wearers of virtual-reality goggles, say, turn their head to the right, so the PC would change the view?

The professor promptly forgot all about Horton -- until the student showed up at his office with an outline of not only how to build such a device but a list of $10,000 worth of equipment he would need to make it. "Never before in my career had anyone come to me with such a thorough sketch of a major project," says Richard Newton, the professor who's now the dean of the College of Engineering at UC Berkeley. Newton was even more flabbergasted when Horton built a crude prototype of the device that summer while also doing a full-time internship.

LIFE-SHAPING BREAKTHROUGH. The device was among the first crop of so-called micro-electro-mechanical systems (MEMS), tiny machines combining electrical and mechanical components and typically made on silicon. Today, such machines can be combined with wireless technology to create so-called active radio frequency identification (RFID) tags or smart tags, which can not only sense, say, a movement, but also tell another machine wirelessly about it.

The idea is to use MEMS to wirelessly "sense" -- smell, feel, measure -- the world around us and create, perhaps, the smartest, most immersive computing environment. Think of the computer on board *Star Trek*'s Enterprise. Now, take that concept a step further.

Back then, Horton's rough prototype could, essentially, only "feel" actions like a tilt of a head. But this was a breakthrough, and it has shaped Horton's life. As a sophomore, he began leading a group of senior undergraduates in MEMS research that would produce a flurry of dissertations. That year, Horton & Co. also licensed the technology to software giant Microsoft (MSFT), which used it in a joystick.

Most important, that project led Horton to found Crossbow Technology in 1995 at the ripe age of 22. Since then, Crossbow has become one of Silicon Valley's hottest companies.

"TECHNICAL DEPTHS." Crossbow's backers and supporters believe they have a winner, and they should be able to separate fact from fiction. Newton is Crossbow's chairman. The largest investor is Morgenthaler Ventures, which has backed such stars as Apple (AAPL), wireless service provider Nextel (NXTL), and chip software maker Synopsys (SNPS). Another investor, Intel (INTC), the world's largest semiconductor company, has bet billions on wireless computing over the past several years. Crossbow has raised $13 million, and it has been profitable for more than a year.

Investors say more than Horton's shy smile bewitched them. "Mike is young, and he has a lot of passion, but that's not what's unusual," says Michael Dierks, a director of strategic investments at Intel Capital in Santa Clara. "He has technical depths that are beyond my own, and most CEOs don't have that."

Horton has, essentially, pioneered a whole new industry of wireless sensor networks, a market that's projected to grow from $347 million worldwide this year to $7 billion by 2010, according to wireless consultancy ON World. While a slew of startups and industry heavyweights like General Electric (GE) and Honeywell (HON) are eyeing this market, most of them have gotten only as far as pilot deployments, says analyst Mareca Hatler of ON World. Crossbow has more than 1,000 customers.

MIGHTY MOTES. Since the early days of MEMS, Horton has worked hard to marry his tiny sensors with communications technology. The result is a device called a wireless mote. These little gizmos, for now the size of a quarter, should eventually become no bigger than a grain of rice. Spread out, they pass information to one another wirelessly the way a soccer team passes the ball until it reaches its destination.

Already, scientists place Crossbow's motes throughout buildings to determine various structures' response to earthquakes. Cosmetics companies spread them through their warehouses to keep track of temperature and humidity.

But that's just the start for wireless motes' applications, Horton says. Since late 2003, Intel, which has installed two Crossbow staffers in its own lab, has been using 240 motes to monitor more than 60 pieces of equipment in one of its Oregon chip factories. The devices detect irregular vibrations, indicative of abnormal operation, and alert technicians, so they can fix the gear before it breaks down. The idea is to avert costly line stoppages.

"STANDARD OPTION." Crossbow's systems also are being tested by oil-and-gas powerhouse BP (BP) for monitoring oil tanker engines, and they could, in the future, be used to prevent leaks on oil and gas lines.

In the past few months, Intel has also installed Crossbow's wireless sensor networks in the homes of a handful of Oregon and Nevada elderly. Placed under a mattress, the sensors collect information on weight shifts to help a computer deduce whether the old folks have

had a good night's sleep. Wireless sensor networks could, potentially, be used in future "smart homes," which might call a set phone number if a person being observed hasn't been sleeping well.

Horton believes Crossbow, the market leader in wireless sensor networks, can make plenty of money. "We are only a few percentage points penetrated into the available market," he says. "More and more of the stuff is going to have this as a standard option."

THE DEER FEEDER. While competition is increasing daily, "Crossbow definitely has staying power," says Marlene Bourne, senior analyst for tech consultancy In-Stat in Scottsdale, Ariz. "They're the pioneers in this emerging market, and they're doing everything right at this point." Horton sure has big dreams for his beloved MEMS and motes, perhaps because he grew up tinkering with electronics. His father and his grandfather were physicists. So it was only natural that as he was growing up, Horton was assembling all sorts of radios and tape recorders. At 14, he launched his first business, selling plans for making a deer feeder he developed out of standard parts found at Radio Shack.

Sold through the classifieds of magazines like *Guns & Ammo*, the plans for the device, which automatically dispenses food, became an instant hit with hunters in his native Texas. The battery-operated gadget won its owner a college scholarship from Duracell (G). And so, after finishing high school in three years, Horton arrived in Silicon Valley to finish his bachelor's degree in three years, too. He then hurried to complete his master's, also from UC Berkeley, before setting out to realize his big dream.

ANOTHER MICA. The first few years in Crossbow's life, Horton worked crazy hours. Now, he says he's back to "normal" 12-hour days. He even occasionally has time for his beloved golf or for the occasional company outing to a *Star Wars* movie. This August, Horton and his Vietnamese-born wife, Melissa, had their first baby, a girl.

Horton's all-consuming passion for MEMS came through in naming his daughter Mica. That's the same as one of Crossbow's product lines, which got the name first. It's a pretty name, Horton insists. Perhaps he figures that if the second Mica does as well in life as this product, she won't do too badly.

By Olga Kharif in Portland, Ore.