Video Surveillance Technology Wins Engineering Design Competition

Engineering students Ajay Bangla and Stephen Chao won the 2009 Entrepreneur Design Contest in April with their business idea based on a technology that greatly improves the efficiency of video surveillance.

The annual Entrepreneur Design Contest encourages entrepreneurship in the College of Engineering by offering engineering students the opportunity to explore the conversion of technologies and ideas into business opportunities. The contest also facilitates collaboration between engineering and School of Management students.

The winning team receives a $2,000 cash prize, expedited review by BU's New Ventures Division at the Office of Technology Development, and 20 hours of free legal consulting from Foley and Lardner, LLP, one of the contest's sponsors. Bangla and Chao's project was selected from among four finalists by a panel of academic, industry and venture capital judges.

"We were thinking of getting into a business contest because it would be a new experience for us, but since we're engineers, we were looking for a cool idea," says Bangla, a doctoral student studying optimization theory.

Bangla and Chao based their business plan on technology developed by Assistant Professor Prakash Ishwar and Professor Janusz Konrad (both ECE).

Today, video surveillance is typically done by watching tape in real-time—which is time consuming—or in fast-forward, in which the viewer could miss key details. Bangla and Chao's start-up, VCon, uses Ishwar and Konrad's video editing technology that seamlessly edits video of parking lots, shopping malls or highways to cut out time when nothing happens. This can

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reduce the duration of a long surveillance video by three to four times.

If the viewer needs to see a specific event and the minutes surrounding it, one click of the mouse switches back to the full-length video.

"The really nice thing about the technology is that the way they built it, it's a really simple system. It's very intuitive, it's easy to understand, and at the same time, it does a very good job," Bangla says.

Throughout the competition, the technical proposals and explanations came easily to engineers Bangla and Chao; the business side presented more of a challenge because they had never before done market research.

"We didn't even know where to search—we started with Google," says Bangla. "A lot of things we learned that went toward this business competition we picked up along the way, so it's been a good learning experience."

"The [BU] Office of Technology Transfer was a big help," adds Chao, who just finished a master's degree in computer systems engineering. The OTT provided research reports and other market information the students could not access on their own.

Winning the competition opens up opportunities for the team's fledgling business idea. They will move to protect the technology by patenting it through BU, and may take it to a larger business competition or talk to venture capital firms to raise more money.

"I think that with what we have here, there's so many things you can do," says Chao. "The technology is open-ended, in a way. It's clear what it does, but the applications are so wide that I think we have many opportunities."

—Kate Fink

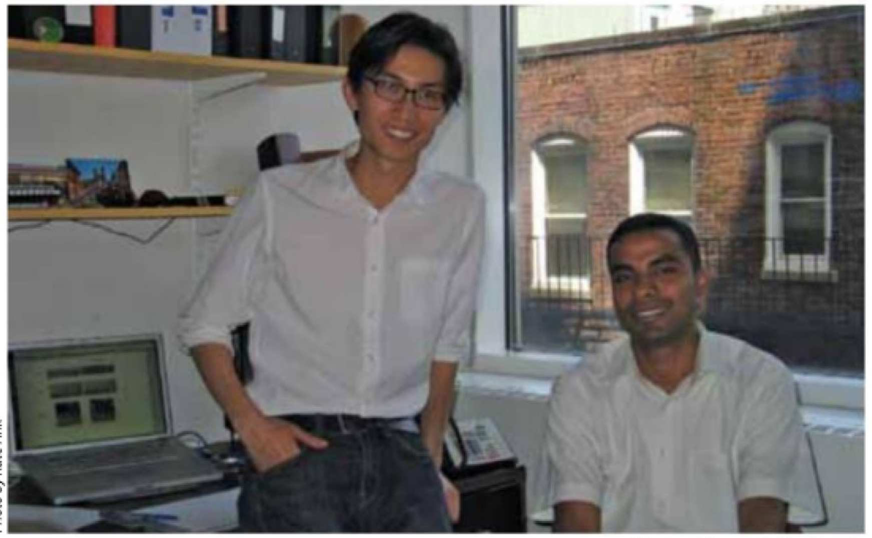


Photo by Kate Fink

Stephen Chao and Ajay Bangla

ENG Lab Makes Metamaterial Advances

Metamaterials, synthetic materials crafted in the laboratory and not available in nature, are providing the building blocks for future technologies, from detectors of dangerous chemicals to invisibility cloaks. With their expertise in complex, highly technical fabrication techniques, Associate Professor Xin Zhang (ME) and doctoral student Hu "Tiger" Tao are leading the way in creating metamaterials that can absorb, bend and detect electromagnetic radiation.

"We are gaining capability in building these flexible multilayered metamaterials that have so many possible applications," says Tao, whose recent advances in the field include a detector combining several different metamaterials to absorb multiple wavelengths of radiation simultaneously and creating a metamaterial that is plastic-like and flexible.

The potential applications of any metamaterial depend on the properties researchers design metamaterials to have, including which wavelengths of radiation the metamaterial can slurp up or push around. Zhang and Tao, collaborating with Assistant Professor Richard Averitt (Physics), focus on inventing metamaterials that manipulate electromagnetic waves in the terahertz range.

In a past publication, they created a specialized metamaterial that absorbs terahertz radiation, a previously hard-to-detect range of wavelengths longer than visible light but shorter than microwaves. The group's recent article in *Optics Express* builds on this work, constructing detectors of hexagonal metamaterial tiles rather than the usual square cells. Each hexagon is 30 microns wide with a pattern of two-micron-wide gold lines printed on it. The spacious interior of a hexagonal-shaped cell—roomier than the square's—gives the researchers room to make variations of the gold pattern in the cells; each different pattern can detect a specific terahertz frequency.

"Our metamaterial combines multiple designs into one sample—that has never been done before," says Tao. "Here, we've matched the performance of the metamaterials to a target."

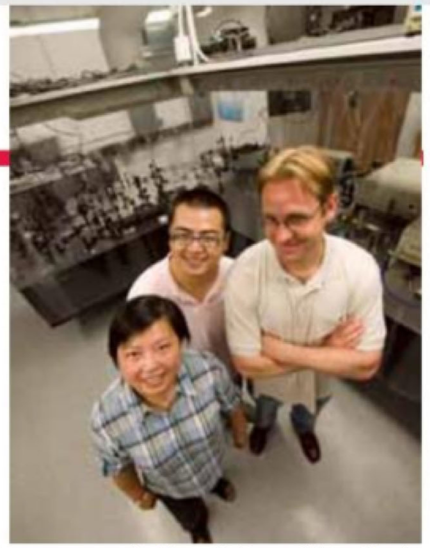
By putting together three differently patterned hexagonal cells, the team created an array that detects three terahertz wavelengths at once. The three designs can be tailored to match the signature set of wavelengths radiated by any specific molecule. This mosaic detection method minimizes the chances of a false positive reading because it matches not just one, but three characteristic wavelengths.

"In the future, we can detect any biological molecule or other things such as dangerous chemicals, as long as we find their frequency spectrum features, then we can use metamaterials to match and search for those," explains Tao.

Tao, Zhang and Averitt continue to tinker with metamaterial fabrication techniques to make them flexible and better absorbers of incoming electromagnetic radiation.

Tao changed the way he builds metamaterials to make them absorb nearly 100 percent of incoming light from all angles, not just light headed straight for the detector. This puts a metamaterial detector one step closer to commercial viability, since in real-world scenarios, radiation will likely hit the detector at many different angles.

Tao also made a switch from using stiff wafers of gallium arsenide to polyimide, a flexible plastic-like material, so his metamaterials are flexible and can wrap around any surface—a nice feature for his terahertz



Xin Zhang, Hu Tao, and Richard Averitt

detectors and absorbers and an essential property for invisibility cloaks.

Building metamaterial devices in the terahertz range has its own applications, and helps bring the field closer to bending visible light around objects. This task—creating invisibility—continues to intrigue researchers and has been the subject of many theoretical papers, says Tao, but, as yet, there have been no real-world demonstrations with visible light waves. One research group built a device that shunts microwaves around an object. Microwaves are very long compared to light waves, however, and the job gets increasingly difficult the shorter the wavelengths involved. Metamaterials that can wrangle visible light like this don't yet exist, but as researchers create metamaterials to work with shorter and shorter wavelengths, they step closer to manipulating visible light wavelengths, and possibly, someday achieving invisibility.

"We can't make an invisibility cloak yet, but this is a really big step. We've demonstrated the potential toward a functional invisibility cloak," says Tao. "It's kind of funny that on one hand, I am trying to build an invisibility cloak to hide objects, while, on the other hand, I am trying to build a terahertz detector to make any hidden object visible to terahertz frequencies."

—Kate Fink