ORIGINATOR
OFFICE OF NAVAL RESEARCH

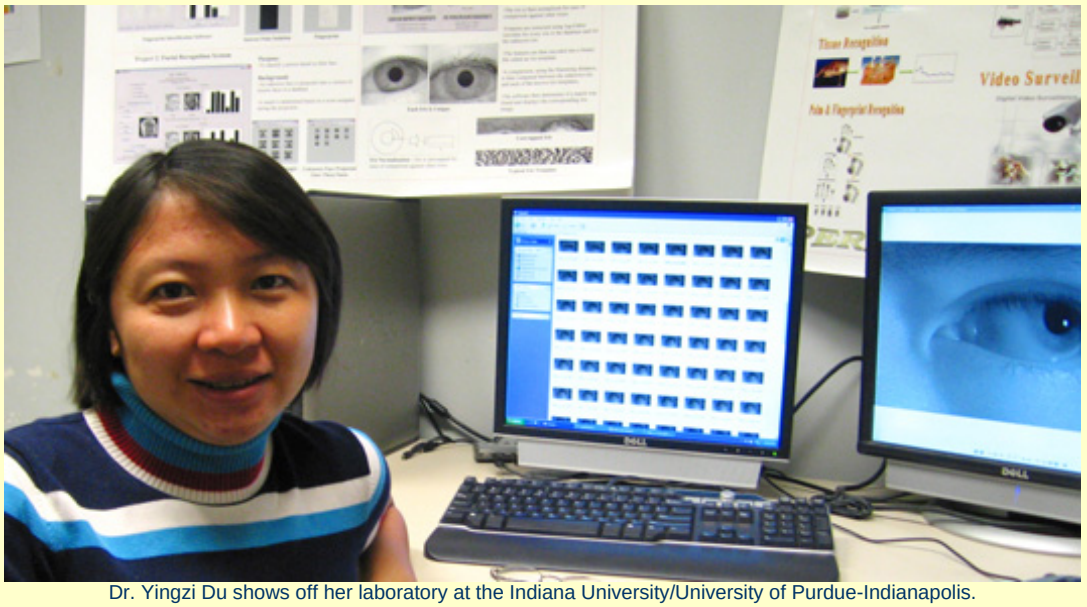
ONR's Mission | The mission of the Office of Naval Research is to: foster, plan, facilitate and transition scientific research in recognition of its paramount importance to enable future naval power and the preservation of national security.

July 26, 2007

Compiled by Colin Babb; Production Manager: Frank Cruz; Art: Larry Behunek

For additional information about any of these items, and other press coverage of ONR, contact the Office of Naval Research, Corporate Communications Office at ONRPAO@onr.navy.mil.

Searching for the Iris of Evil



Dr. Yingzi Du shows off her laboratory at the Indiana University/University of Purdue-Indianapolis.

Science fiction is at its best when it asks questions about how technological change affects human beings, how our mechanical, manufactured creations can end up changing our environment in profound and often unexpected ways. In the movie Minority Report, based on a short story by Philip K. Dick, the Washington, D.C., of the near future benefits from a lack of premeditated homicide (due to the abilities of three future-reading “pre-cogs” and the efforts of a special police force) as well as nearly constant public surveillance derived from countless iris scanners that can simultaneously identify the location of anyone in the city or activate personal advertisements for you as you enter a store. It is a world where “vision”—both physical (in the case of the iris scanners) and metaphysical (in the case of the pre-cogs)—is ubiquitous.

In an example of life imitating art, scientists are already at work on the technology that could make such scanners or something similar to them a reality (pre-cognition, however, likely will remain science fiction). Iris scanning has been around since the early 1990s, but like most identification systems—retina, fingerprints, DNA—the subject has to be a willing participant in the scanning process or there has to be laborious, time-consuming lab work to produce usable data. The automatic, and nearly instantaneous, scanners in Minority Report don’t exist—yet.

“Those kinds of systems are not available nowadays,” said Dr. Yingzi Du, a researcher at the Indiana University/University of Purdue-Indianapolis who is working on creating the very first automatic iris recognition system that can scan and identify “uncooperative” subjects. Du recently received a 2007 Young Investigator Award to pursue her research (Thomas McKenna, Code 342, program manager). Before coming to IU/PU-Indianapolis, Du worked on iris recognition research at the U.S. Naval Academy under Dr. Delores Etter, now the Assistant Secretary of the Navy for Research, Development and Acquisition.

“It is not our goal to have those kinds of systems set up all over the place, monitoring regular people, and trying to erase people’s privacy,” Du said. “But I hope we have an iris recognition system that can do some functions like they had in Minority Report, where you don’t need to

cooperate."

By uncooperative, she's thinking of terrorists and criminals. In both the 9/11 and the July 5, 2005 London attacks, it was discovered subsequently that the perpetrators were caught on airport and Underground surveillance cameras. But because such surveillance systems—which can consist of hundreds or even thousands of cameras—currently cannot be effectively monitored in real time by human eyes or by artificially intelligent networking capabilities, such identifications are useful only in providing the faces of terrorists in the aftermath of attacks and can do little if anything to prevent such events from happening.

What if you had a system that was virtually invisible to the average person—with small cameras or scanners hidden inside everyday objects, such as arrival/departure screens at an airport or a billboard or poster with an eye-catching image on it—that could scan irises in a fraction of a second and then automatically and instantaneously match the scan to a database of "bad guys," alerting authorities immediately to the presence of a wanted criminal or terrorist?

That's the kind of vision Du is working to create.

To capture the iris, cameras use the near-infrared part of the light spectrum, which is not visible to the human eye. Because they wouldn't know that they're being observed, Du said, criminals could "look around, and the camera can capture your eyes and recognize you. We don't want to compare it to everybody, but just want to compare that to a database that contains the FBI's most wanted people or the terrorist watch list, for instance."

Iris recognition, when done properly, is widely considered by experts to be the most accurate method of identification currently available—and it's also considered the most difficult to foil. "It's not very difficult to fake a fingerprint, but it's really hard to fake an iris pattern," said Du. Tom Cruise's character in Minority Report tries to avoid iris scanners by having new eyes surgically implanting with the help of a back alley quack. Although the ruse works in the movie, in the real world such a procedure would be a waste of time and effort, since iris patterns change once eyeballs are removed and blood flow stops. Contact lenses and sunglasses also would not work, since lenses would only provide an extra layer of filtering and would not block near-infrared light.

Du admits that one of the main drawbacks to an automatic iris recognition system is the current lack of any kind of significant database of iris scans—of criminals or of anyone else. Because Iris scanning is so new, it is not a standard procedure carried out during police bookings in the way fingerprinting is today, for instance.

"If we haven't scanned Osama bin Laden before, if you do not have that, you cannot do it," said Du. To catch someone like Osama bin Laden, authorities would have to build a database of iris scans from scratch—but it could be as easy as incorporating scanning technology into local police departments. Even the Osama bin Ladens of the world have to start out small.

"In addition to capturing his face and fingerprints, we also can scan a criminal's iris into a database," said Du. "A lot of times when they find a crack in a big network or find one of the top 100 most wanted criminals, it's not the first time they have been captured. We do assume we have been able to capture them before when they were not that huge or when we did not recognize that would be that damaging to society." There's also the possibility, said Du, of catching criminals in the midst of their crimes—in situations where there's a significant time span between their first act and their final one, such as in the Virginia Tech tragedy.

Once a solid database of iris scans has been built, the biggest technical challenge to an automatic scanning system designed to catch someone who is moving around randomly is dealing with the fact that with many scans you simply may never get a perfect image. Du's system will assume from the beginning that only a portion of an iris will ever be available, and will be built around the premise that each scan will result in a variable degree of confidence.

Instead of determining that the scanned person is definitively this person or that person, Du's system will essentially provide a best guess. "The future question is can we give them some confidence level, say 'I think this person probably is Osama bin Laden, and I'm not 100% sure—maybe I'm 50% sure,'" said Du. "Even though it's only 50%, I don't think the TSA [Transportation Security Administration] people would mind stopping this person to ask him some questions, because they'd have a 50% chance to capture bin Laden."

The project will involve new hardware, new software, and new ways of using existing technology and programs. Camera technology in this area already is quite advanced, so Du's

research will be focused mostly on software, creating the algorithms that will process and combine the partial bits of iris images that are likely to be the only data available from uncooperative subjects. Most existing software used for iris recognition depends on high-quality images of the front of the iris—the key for identifying uncooperative subjects will be processing images of the iris in profile or at odd angles.

The goal, Du said, is to create a system that eventually will be able to identify subjects in real time—as in seconds or even nanoseconds of time in between scanning, matching, identification, and alerting.

“If we can prevent tragedies” like Virginia Tech, the London bombings, and 9/11 from happening, said Du, “that would be great.”