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Robo Bird-Watcher

An intelligent video system in an Arkansas bayou searches for an elusive bird.

By Rachel Ross

Researchers from the University of California, Berkeley and from Texas A&M University have developed a new kind of bird-watching system that automatically identifies birds in flight and records their movements in high-resolution video. Preliminary results and video clips from the ongoing project were presented on Saturday at the annual meeting of the American Association for the Advancement of Science, in San Francisco.

Ultimately, the researchers hope the cameras catch a glimpse of the ivory-billed woodpecker. The search for the woodpecker, long thought to be extinct, was revitalized in 2004 when a bird resembling the species was caught on video in the Cache River National Wildlife Refuge of eastern Arkansas. The video was too blurry, however, to allow a definitive identification. Field biologists sat in canoes for hours, waiting for an ivory-billed woodpecker to fly by so they'd have more-conclusive evidence.

"It's incredibly difficult and tedious," says Ken Goldberg (http://goldberg.berkeley.edu/) , one of the lead researchers on the project and a professor of engineering at the University of California, Berkeley. "Even if they see something, getting the camera focused [quickly] is very tricky." Some birders were using motion sensors to trigger video cameras, but Goldberg says the equipment wasn't sensitive enough to detect the relatively small creatures.

Intrigued by the problem, Goldberg and colleague Dezhen Song (http://faculty.cs.tamu.edu/dzsong/) , an assistant professor of computer science at Texas A&M University, designed a special system to aid in the search. Known as the Automated Collaborative Observatory for Natural Environments (http://www.c-o-n-e.org/acone/) (ACONE), the two-camera system scans a patch of sky (measuring roughly 300 feet by 900 feet) above the Cache River refuge. Goldberg says it's an ideal location because it's a high-traffic area for birds and clear of treetops, so the cameras get a relatively unobstructed view. The cameras are mounted on a power-line pole, along with a computer, in the middle of a bayou.

As the cameras scan the sky, each one captures images at 11 frames per second. Those frames are temporarily stored in a buffer. Software on the computer analyzes each

frame immediately, looking for things that roughly match the speed and size of an ivory-billed woodpecker. When a bird is detected, Goldberg explains, the system permanently records and stores the previous seven frames and the next seven frames of video on the hard drive. Each frame has a resolution of 1,600 by 1,200 pixels. To save storage space, frames that the software deems irrelevant are automatically deleted.

The software also saves time. The fewer images collected, the fewer canoe trips are required to replace the hard drive in the middle of the bayou. More important, the automatic identification system means that human eyes are spared from watching endless hours of empty sky.

The system is also designed to detect rain because birds typically don't fly in a downpour. Goldberg says that when the software identifies the "avalanche of motion" caused by raindrops, the system shuts down for a few hours. "It's not perfect yet, but we're getting pretty good data," says Song. "It's much more complicated than we thought at the beginning." Falling leaves or fast-moving clouds can confuse the camera, causing it to record birdless scenes. Song says the ACONE team will continue working on the image-analysis software to minimize these issues.

Natural lighting conditions can also make it difficult to capture a detailed image. But David Luneau (http://www.ualr.edu/mdluneau/) , the birder who captured the controversial 2004 video of what he believes was an ivory-billed woodpecker, notes that the lighting problem isn't unique to automated systems. "Even if it's a human taking the picture, if it's a generally dark bird against a hazy sky, it's almost impossible to get a good picture," he says.

Gaurav Sukhatme (http://robotics.usc.edu/%7Egaurav/) , director of the robotic embedded systems laboratory (http://robotics.usc.edu/%7Eembedded) at the University of Southern California, says he's pleased to see that the team has deployed a functional system in a natural environment. He has been involved in several projects in which sensor systems were used in the field. "The environment is pretty harsh at times, and systems tend to go down," Sukhatme says.

Goldberg says ACONE has been very stable, despite its exposure to the elements. It's been running around the clock since it was first installed four months ago.

The system hasn't yet captured an image of the ivory-billed woodpecker, but it has won over some ornithologists. "I was somewhat skeptical about the use of a robotic camera system like this to detect birds whizzing across [the sky]," says Ron Rohrbaugh, director of Cornell Lab of Ornithology's ivory-billed-woodpecker recovery project. He thought it would take many more cameras to capture quality clips and properly cover the prime search area. But Rohrbaugh says that now that he has seen the video, he's pleasantly surprised by the results. "The [ACONE] system could have a

lot of applications monitoring other wildlife species too, particularly other birds," he says.

While some of the video clips are too blurry to use to determine species, Rohrbaugh says others are quite clear. Using the video captured by the system, the team has already identified a blue heron, a red-tailed hawk, and Canadian geese.

Ultimately, Goldberg says, the researchers would like the software to automatically identify each species. For now, human eyes still have to review the selected footage to determine whether the bird is, indeed, an ivory-billed woodpecker. "It's not capturing as many pictures as we hoped it would capture," says Luneau. "But it holds a lot of promise." Goldberg says the team plans on studying the rate of false negatives in March, by comparing the number of birds recorded by the robo watcher to the number of birds spotted by a field biologist.
