Wireless camera network offers new possibilities for security systems

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Computer engineering graduate student Kevin Abas designed the SWEETcam prototype.

(Phys.org) —Advances in computer technology are opening up new possibilities for surveillance cameras and environmental video monitoring systems. Kevin Abas, a graduate student in computer engineering at UC Santa Cruz, used off-the-shelf components to build a prototype device for a solar-powered wireless network of smart cameras with potential applications in security systems and wildlife monitoring.

Abas described his system and reviewed similar designs developed by

other researchers in a paper published as a cover feature in the May issue of the journal Computer, published by the *IEEE Computer Society*.

"The on-board components are getting so much smaller and more computationally powerful, it's possible for a compact camera device to have a lot of data processing and other capabilities," Abas said.

Working with Katia Obraczka, professor of computer engineering at UC Santa Cruz, Abas is designing a "Solar Wi-Fi Energy Efficient Tracking camera (SWEETcam) system," in which the camera nodes can cooperate to form a wireless network for transmitting and processing data. Each camera node is powered by a solar panel and a rechargeable battery. Using computer vision software, the system is able to analyze the images as they are captured.

"It has a motion sensor, so the cameras wouldn't be on all the time. And if it gets activated by something that is not of interest, the computer vision software can identify that and put the system back into sleep mode so it's not recording things like vegetation moving in the wind, or raccoons and deer," Abas said.

The primary motivation for the project came from considering the challenges of monitoring for public safety purposes in remote areas where traditional wired security systems are impractical. The researchers acknowledged that, while security cameras in stores are now commonplace, some people might find the idea of a network of smart cameras monitoring public spaces a bit too Orwellian. "It's always a trade-off. There are certainly privacy concerns, but if their security is at risk people may be willing to live with some compromises," Obraczka said.

Abas noted that SWEETcam could also be used by biologists for monitoring wildlife. "Researchers deploy motion-activated cameras to study animals like mountain lions, and my device could be perfect for

that," he said.

A lot of effort went into power management to make the system as energy efficient as possible. "It has to be energy efficient to run on solar power, so making it smart in terms of how it uses power is one of the most interesting parts of the system," Obraczka said. "The balance between performance requirements and energy efficiency is what drives the design."

Based on the popular Raspberry Pi platform—a low-cost single-board computer the size of a credit card—the prototype device has the computational power required for complex networking, power management, and image processing tasks. The image analysis capabilities were not a primary focus of the project, but could potentially be a very powerful feature of the system. For example, it could identify and tag certain "behaviors" in the images, Abas said.

"With most security systems, you only go back and look at the data after a crime has been reported, and then someone has to look through hours of video," he said. "In theory, we could tag certain images so that, for example, in a bike theft scenario, you could search for all the video where there's a person at the bike rack. You could also program it to send an alert for certain types of suspicious activity when it's happening."

Currently, however, the SWEETcam system has fairly limited image analysis capabilities. Caio Porto, a visiting student from Brazil, worked on this aspect of the project as a summer intern in Obraczka's lab last year. The main focus was on recognizing people and animals to avoid "false alerts" from the motion sensor.

"For now, we are not doing any sophisticated visual processing, just using standard open-source libraries," Obraczka said. "We're mostly

interested in the networking and systems engineering aspect, but the computer vision part is certainly fascinating. The fact that you can do so much with so little is amazing, and a little scary at the same time."

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