

System harnesses thousands of network cameras for public safety

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Purdue researchers have developed a prototype system that could allow law enforcement and public safety agencies to tap into thousands of cameras located in numerous venues including parking garages, college campuses, national parks and highways.

In addition to applications in law enforcement, the [system](#) can be used to quickly find damage, plan rescues and other operations during natural disasters such as tornadoes, hurricanes and blizzards, said David Ebert, Purdue University's Silicon Valley Professor of Electrical and Computer Engineering and director of Visual Analytics for Command, Control and Interoperability Environments, or [VACCINE](#), a U.S. Department of Homeland Security center based at Purdue.

Surveillance cameras usually are operated in closed circuits commonly called CCTV and are available only to authorized personnel.

"However, in recent years many organizations have deployed cameras for a wide range of purposes, and these are accessible to the public without the need for a password," said Yung-Hsiang Lu, an associate professor of electrical and computer engineering. "Although the cameras are not deployed for surveillance purposes, they can be utilized to increase public safety by properly integrating with current surveillance systems."

Purdue researchers previously demonstrated a system that can allow law enforcement to see the locations and viewing angles of CCTVs. The new work extends the previous study by including real-time streams of public network cameras. A research paper about the system will be presented this week during the IEEE International Symposium on Technologies for Homeland Security in Waltham, Massachusetts. The paper was authored by graduate students Youngsol Koh, Anup Mohan, Guizhen Wang and Hanye Xu; research scientist Abish Malik; Lu; and Ebert.

The cameras are deployed by city and state governments along highways and at intersections, national parks, construction sites and other public venues.

"We expect the number of network cameras and their coverage to grow substantially in the near future," Lu said.

The new system is a combination of two existing systems called Visual Analytics Law Enforcement Toolkit (VALET) and Continuous Analysis of Many CAMeras (CAM2). VALET can visualize multiple sets of data, including crime locations, emergency medical services runs, gang graffiti locations, calendar events and weather. CAM2 is an interactive visualization and analysis tool showing the locations and orientations of public network cameras.

"The new system integrates the public and CCTV cameras," Ebert said. "We had developed a system to quickly find which area is covered by which camera. This can be helpful when a crime occurs. This function can also help to guide the public to use safer routes and to optimize locations of new cameras based on crime patterns."

Lu said, "We have demonstrated the proof-of-concept prototype using network cameras for public safety. CAM2 is an open system, allowing all interested researchers to register as users. The integrated system is based on VALET and its value can be demonstrated with two case studies. One uses crime data for investigative analysis, and the second enhances situational awareness using social media content. As part of future work, we plan to extend our system to more cities."

CAM2 is originally built for research using cloud computing and image processing.

"It is a research tool, although public safety and [homeland security](#) would be a great application," Lu

said. "The system can produce very large amounts of data. CAM2 has thousands of public cameras. If we retrieve one image from each [camera](#) every minute, we will get millions of images in a single day."

Some experiments in the CAM2 project require dozens of computer processors to retrieve and analyze the data.

CAM2 locates public-network cameras, identifies certain properties such as location, orientation, whether it is indoors or outdoors, the frame size and frame rate. Information is displayed on a map so that law enforcement, as well as the general public, can visualize which locations are monitored by the public network cameras.

"Adding public cameras substantially improves the coverage of surveillance systems," Ebert said. "The tool can provide data to improve [public safety](#) by allowing [law enforcement](#) to evaluate whether the coverage is satisfactory. The locations of past crimes can also be superimposed in VALET for references. CCTV, by definition, has restricted access. However, when the data come from publicly available cameras, the information can be accessed by the general public."

Researchers at VACCINE are developing interactive software algorithms that create visualizations, graphics and maps with essential information to help emergency personnel who use a variety of devices, from office desktop computers to mobile phones in the field.

Provided by Purdue University

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