Automated Technology for Video Surveillance

Vast numbers of surveillance cameras monitor public spaces. Far more video is recorded than people have time to watch, and the quality of the images is often poor. For example, in London, security cameras captured footage of some of the July 2005 subway bombers before the explosions, but the information did not help prevent the attacks. Engineers and computer scientists at the University of Maryland are developing practical systems for recording and rapidly transmitting high quality images, and they are developing algorithms to detect important events that might otherwise be buried in the recordings. New methods of analyzing human movement will be able to recognize a large range of suspicious behaviors. The goal is to create cost-effective, automated systems that quickly and reliably alert authorities to suspicious activities.

Stuart Milner and Chris Davis have developed a test system on campus that transmits high quality images over wireless networks, automatically analyzes the images to detect suspicious events, and can immediately follow up by zooming in and tracking specific objects while a main camera continues to survey the larger scene.

Rama Chellappa and Larry Davis are developing sophisticated algorithms to recognize complex patterns caught on videotape. They specialize in analyzing human gait to track people.

A Total Solution for Rapid, High-Resolution Analysis

Engineers Stuart Milner and Chris Davis are working together to develop a complete system for analyzing events recorded on video in real time. Taking advantage of the university's high-performance wireless communication networks, Milner and Davis are using the campus as a testing ground. Their goal is a comprehensive video surveillance system that combines high-definition cameras, broadband data transmission, and real-time analysis. A key component of the system is a secondary "smart" camera that can be programmed to track or zoom in on suspicious things. In combination, real-time detection and intelligent zooming capabilities could immediately alert authorities to potential problems.

Davis and Milner's system benefits from having a robust wireless network to transport high volumes of data. Image transmission through the air is a thousand times faster than transmission through cable wires, and images need not be compressed, so details are not lost. Setting up a wireless network is often less expensive and takes much less time than laying down cables. A wireless network could be deployed quickly where it's needed, for example, at a temporary gathering, a disaster site, or even a war zone.

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Pattern Recognition in Video

Rama Chellappa, an engineer, and Larry Davis, a computer scientist, work in close partnership in the university's Computer Vision Lab. They work on a wide range of problems in image analysis, including face recognition and gait recognition. In research funded by the Department of Defense, the National Science Foundation, and others, the professors' research teams are developing algorithms for recognizing patterns in video data. Chellappa and Davis model normal patterns observed by video cameras, assess what sorts of data are revealing and what can safely be ignored and home in on informative anomalies.

Chellappa and Davis have made particular progress in analyzing human movement. They are working to develop algorithms that can detect all kinds of atypical movements, such as loitering, physical confrontations, thefts in a bank, or dropping off a package in an airport. The researchers are working to track individual people through large settings that are monitored by many cameras. To follow individuals, they analyze human gait—individuals' appearance, dimensions, and walking style. By studying human gait, Chellappa and Davis are also developing ways to detect people who are carrying objects and to detect when people drop off what they're carrying, even if the dropping off isn't observed directly on camera.. In collaboration with companies such as Honeywell and Siemens, the researchers have taken sample videos in airports as raw material for interpretation. With these videos, they are working to track people and work out methods to detect unattended baggage.

Chellappa and Davis are also working on using videos for face recognition, for example at restricted entrances. By placing a virtual grid on each face and modeling light distribution, the researchers can match videos of faces in a set of about 30 people. With funding from the Defense Advanced Research Projects Agency, they are working to recognize faces among larger sets of people and to try to recognize faces from a distance.

While Chellappa, Davis, and the other researchers in the Computer Vision Lab apply pattern recognition in videos and human motion modeling mainly to surveillance work, their work has other applications as well, such as following where a computer user is looking to design more intuitive user interfaces, and assessing how patients with movement disorders respond to therapy by closely measuring how they move.

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