Analyze That

The rapid evolution of video analytics indicate a bright future for the technology

By Randall R. Nason, PE, CPP

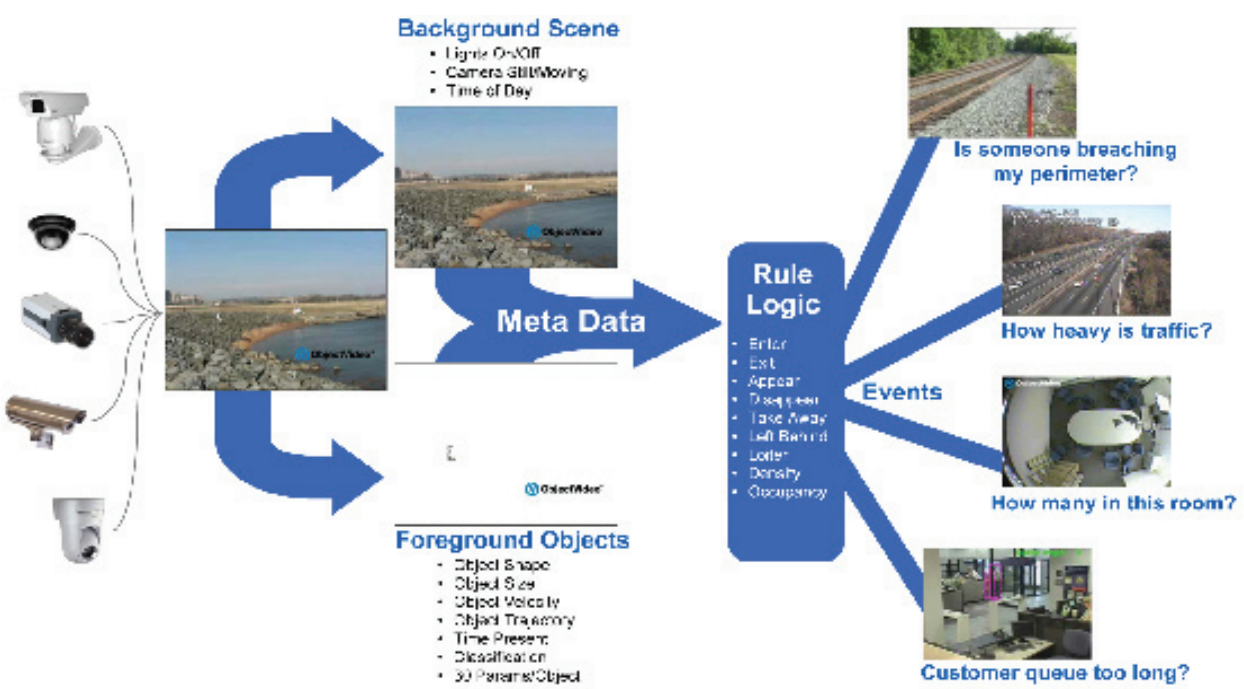
One of the most prevalent topics among security industry practitioners today is video analytics (VA). The combination of CCTV data and rules-based algorithms hit the market hard in the 2002-2003 timeframe with the potential to solve perimeter security problems at ports and airports.

The attempt to use CCTV data as a primary security sensor is long standing and well founded — industry best practices rely heavily on a CCTV system to determine the cause of alarms, record the passage of an individual or vehicle through a controlled portal, or simply provide a record of activity in a general area of interest. The most directed use is to determine the cause of an alarm generated by any number of available intrusion sensors, ranging from a passive infrared sensor monitoring an interior area to a fence-mounted acoustic detection sensor around a Class A storage site. If properly deployed, the sensors will provide acceptably high probabilities of detection with equally acceptable nuisance alarm rates. The CCTV system is a necessary adjunct to these sensors in order to provide the necessary information for the monitoring entity initiate a proper response.

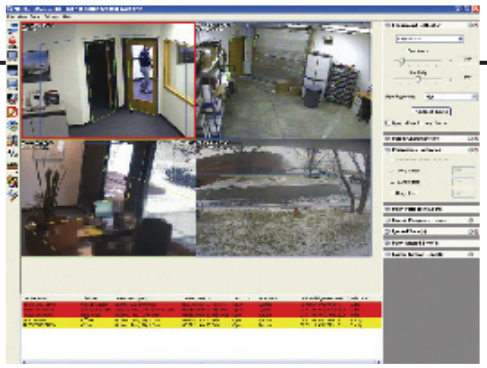
Therefore, it makes sense both from a design and implementation standpoint to somehow do away with the sensor and use the CCTV system to provide the necessary data to both detect unauthorized activity and provide the necessary data to the monitoring entity to initiate a proper response to that activity.

The allure of video analytics, however, goes far beyond just eliminating intrusion sensors. The real value is in the ability to solve once-unsolvable problems. Seaports are a clear example of sites that did not lend themselves to traditional security measures. There was no tool or technique available to provide a robust means to secure the waterside perimeter. With the heightened concern over the security of seaports, analytics offered a means to monitor a virtual perimeter, thus allowing continued waterside operations.

Industry leaders are careful to define VA as essentially different from legacy video motion detection — which simply provides an alarm based on changes in pixel grayscale levels. VA takes it one step further and



This outline of the video analytics process from ObjectVideo starts with the software continually scanning the video scene and detecting changes. If the analysis determines that the changes represent a previously defined unauthorized activity, an alarm is generated.



Arteco software can be charaterized as an advanced trip-wire application.

attempts to determine if these pixel changes represent unauthorized activity. "Simple changes in pixels do not necessarily indicate activities of interest," says Alan Tipton, chief technology officer for ObjectVideo. "Our software analyzes the entire video scene and creates meta data about what it sees. User-defined rules are run against the meta data to see if any activities that have been detected by the software are in violation of any rule — if so, an alert is generated."

The Basics: The VA Process

As shown in the diagram on the previous page, the VA process can be described in three steps. First, the software continually scans the video scene looking for changes. Once a change has been detected, the second process — analyzing the changes — takes place. If the analysis determines that the changes represent a previously defined unauthorized activity, an alarm is generated.

The heart, and ultimate potential, of VA lies within this analysis process and the ability — without human intervention — to take raw video data and extract not just motion but motion that represents activity of interest based on predefined algorithmic rules. VA software and hardware manufacturers are consistent in describing their filters as examining size, shape, speed and type of movement. Simple ratios such as height-to-width are found to be surprisingly strong differentiators of people from large mammals. Another filter looks at differential motion. When a vehicle moves, all parts of the vehicle move as a unit; however, people move differently — the main portion of the body moves together, but the arms tend to move with and then against the main body movement. While a single filter cannot be relied on as definitive, multiple filters or rules can be used to increase the confidence in the classification of the video scene changes.

Information content in the video stream is also cited as a key factor in VA performance. Current cameras generally provide data streams in MPEG-4 format as a means to conserve bandwidth. The reduced information content in this compressed stream affects the precision at which the VA algorithms can operate. The information content in the video is often further reduced by dropping the frame rate and resolution, again as a means to conserve bandwidth. This is one of the reasons for the continued push toward edge processing. With the VA software onboard at the camera, the potential exists for the software to operate on the full, uncompressed data stream. Bandwidth conservation activities can then take place downstream of the VA package without impacting the efficacy of the VA analysis.

Even though VA is somewhat of a newcomer to the security field, market segregation is already occurring. Arteco Vision Systems is an example of a firm that has targeted a specific portion of the VA environment. Steve Birkmeier, vice president of Arteco, characterized its products as focused on highly refined and advanced trip-wire applications. Arteco has also introduced a mobile notification device that provides real-time video based on a VA alarm. "False alarms can be reduced by providing personnel in the field access to live real-time video from the same handheld, Web-enabled device that notified them of the security event taking place," Birkmeier says.

Lessons Learned

With 3 to 4 years of aggressive implementation of VA systems in a variety of environments, end-users and specifiers are reporting mixed results. While VA has enabled the industry to tackle problems that could not previously be addressed, room for improvement remains. A number of lessons have been learned to date. First, setup and calibration of the multi-camera exterior site systems is an extensive effort — often requiring accurate surveys of specific camera positions. ioimage has attempted to address this item with a simpler set-up procedure. Its current software offering "can be set up and calibrated in minutes, with one person in the field and one person at the console," says Dvir Doron, ioimage vice president of marketing.

A second lesson learned has been the amount of time required of the system administrator to routinely "adjust" the system to account for daily and seasonal changes that produce nuisance alarms. Again, ioimage has attempted to address this concern in its latest package.

A third lesson has been the tendency to push the fields of view past optimum limits. Tipton emphasizes that the "minimum information necessary to detect, identify and classify is a function of basic physics." Thus, camera locations and fields of view must be conservatively designed to ensure adequate information processing.

Irene Lam, director of product management for American Dynamics/Tyco, suggests that one key to the success of VA is to critically evaluate the real capabilities of current VA offerings and accurately communicate these capabilities to the end-user. "VA prod-

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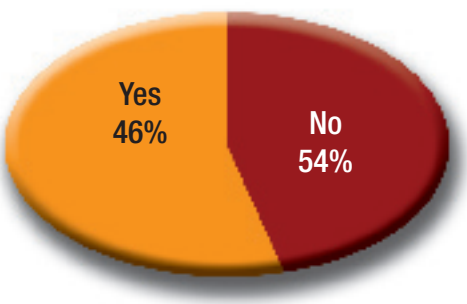
ucts came on the market with the promise of eliminating the human from the decision-making process. While VA is a powerful tool that can effectively address pressing security issues by filtering the video requiring human review, it is not ready to replace the human element. Skillfully and responsibly applying VA in appropriate environments will provide real value today while the capabilities continue to improve for future applications."

There is little doubt that VA is poised to radically change the industry. Significant penetration has already occurred in the museum and cultural property sector, where the necessity to attach sensors to priceless objects has always been a concern. Dedicated cameras focused on single pieces or collections of artifacts can reliably detect object disturbance or removal without sensors on or near the collection. "This straightforward application of the basic VA algorithms could change our whole approach to museum video security," says Stevan Layne of Layne Consultants Intl. Similarly, VA installations at large perimeter sites such as ports, power plants and electric substations continue increasing degrees of confidence.

Have you incorporated video analytics into your security program?



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The Next Level

The key question is: What will it take for VA to reach the next level of performance — where high probabilities of detection and low nuisance alarm rates routinely occur without day-to-day management? George West, vice president and division head of Security Systems for Siemens, sees the future development of VA as dependent on more robust algorithms and faster chips. As the algorithms become more complex, faster chips are needed to provide the processing power to analyze the data in near-real-time. Thus, the second area of development is geared toward faster chips that can operate reliably in a field environment. West says Siemens "is currently fielding VA applications focused in security, package handling, and medical imaging. Experience gained in these specific areas will result in enhanced performance in security applications."

One application worth watching is perimeter security for high-value federal government sites. Traditional designs call for multiple sensor perimeters with CCTV assessment. The augmentation or even replacement of some of the perimeter intrusion detection sensors with a VA application could result in considerable cost savings. While not currently allowed by regulation or policy, continued improvements in VA capabilities may lead to expanded use in this critical environment.

It is not difficult to envision VA eventually eliminating the use of discrete motion sensors both in the interior and exterior environment. Meaningful leave-behind and loitering detection may also become an available VA feature. Continued development will also provide the ability to perform behavioral analysis, a feature especially coveted in the retail environment. Continued research on VA algorithms, faster chips, edge processing, gigabit networks and high-definition CCTV will all contribute to continued improvements in VA capabilities and an increased use in security applications. Development of industry standards is also needed to facilitate integration and communication of meta data between VA platforms.

Finally, the end-user community would benefit from a standardized testing process and a competitive product analysis. Pull all of these together and VA will become a foundational capability for enhanced facility and site security. **ST&D**

Randall R. Nason, PE, CPP is a corporate vice president and manager of the Security Consulting Group at C.H. Guernsey and Co. His experience spans a broad spectrum of the security profession including threat assessment, vulnerability analysis and master plan development through complete system design, construction management and design-led build projects. He has also designed and conducted full-scale emergency response exercises for a federal agency.