



Security & Surveillance Solutions

March 2004

Prepared By:

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And its products subsidiary

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1. Overview

The following information provides an overview of the solutions offered by Sarnoff Corporation and its subsidiary, Pyramid Vision Technologies (www.pyramidvision.com) relevant to the security & surveillance market. Our pursuits are primarily in the Homeland Security, Transportation Security, and Force Protection space with an application focus that includes Perimeter Security & Defense, Airport and Seaport Security, Critical Industrial Site Security, Border Surveillance, and Unmanned Aerial Vehicle (UAV) Tactical Reconnaissance.

Our solution set, which includes VisionAlert™, Hawk and Video Flashlight™, enhance the ability of security operators and military forces to understand and respond to physical security threats. Our customer approach is to team with prime contractors and system integrators in order to provide solutions, service and support that can satisfy procurement requirements related to intelligent video surveillance and/or sensor visualization.

2. Background: Sarnoff and Pyramid Vision

Sarnoff has been providing innovative solutions to industry and government needs for over 60 years. Established in 1942 as RCA Laboratories, Sarnoff Corporation has been an independent firm since 1986. With over \$100M in annual sales, Sarnoff delivers innovations in: ICs, lasers and imagers; digital TV and video for security, surveillance, and entertainment; high-performance networking; and wireless communications. Sarnoff's history includes the development of color TV, the liquid-crystal display, and a leadership role in creating the US digital/HDTV standard. We have won eleven Emmy awards for technical achievement in television, video processing and broadcasting. Since 1986, Sarnoff has been a wholly owned subsidiary of SRI International.

Sarnoff markets its commercial security and surveillance products through its wholly owned subsidiary, Pyramid Vision. Established in 1997 to manufacture and market commercial products incorporating Sarnoff's vision technology, Pyramid Vision's products are known for their ability to handle difficult, real-world video. Pyramid Vision offers an unmatched breadth of commercial products based upon years of privately funded research and development as well as research and development on behalf of U.S. Government agencies such as the Defense Advanced Research Projects Agency (DARPA), the Technical Support Working Group, the Office of National Drug Control Policy, and the Department of Defense.

3. Product Descriptions

VisionAlert™ Suite

VisionAlert provides real-time, 24/7 monitoring and analysis of activity in video surveillance systems, and automatically detects, displays, and tracks security violations such as intruders, moving objects, and suspicious packages. The product runs in a standard PC platform and works with most commercial surveillance cameras.

“Hawk” (Version 1.0 to be released 2Q 2004)

Our 2Q 2004 product release of the Hawk platform leverages years of work in developing capabilities for visualization and decision support for the Department of Defense. Hawk performs integrated sensor visualization and management in a network-centric environment. It will enable decision makers to evaluate threats in real-time and collaborate using the same data. The system provides next-generation capabilities such as:

- × Wide area geo-spatial visualization on PC-class platforms. It can handle centimeter-resolution images over vast areas spanning several hundred square miles and interactively pan and zoom to any location instantly. It can process and display both 2D and 3D representations of areas and facilities, such as building models. Critical assets, sensor position and alarm locations can be viewed in a command display with zoom-in on demand.
- × Visualization of the outputs of multiple real-time video sensors over the geo-spatial data for in-context evaluation of video and other alarms. Hawk is plug-compatible with VisionAlert.
- × High-level rule-based alarm functions such as simultaneous event triggers or dissimilar sensor inputs (e.g. radar plus video)
- × Dynamic track display of thousands of units to high precision and filtering of such tracks based on a variety of attributes.
- × Network-based operation enabling the portrayal of the Common Operating Picture across distributed nodes to arbitrary wired and wireless users with a range of computing platforms and display media.

Video Flashlight™

Video Flashlight enhances situational awareness for security personnel by creating a 3D visual context that seamlessly merges “live” video streams from security cameras with a three-dimensional representation of the monitored facility. It shifts the paradigm from one of scouring a bank of video monitors to one where the operator can select a viewpoint in space and “see what’s there”. It does so in two ways:

- × Intelligently selects the best images from multiple video feeds to create virtual cameras and a unified view of the area under surveillance.
- × Enables operators to actively view and move through monitored areas. With intuitive controls, security personnel can move in any direction to look around corners, fly through space from sky to street level, and even use video recorded earlier to review events of interest from a different perspective.

Video Flashlight is currently in Beta release at 3 sites with three more installations scheduled for 2004. The first commercial release will be available in 3Q 2004. Video Flashlight is offered as a standalone “immersive” video surveillance capability or as an add-on feature of Hawk.

4. Competitive Advantages

VisionAlert

Integrated Stabilization. With integrated video stabilization, VisionAlert has the ability to work with really long-distance or shaky optics; integrated stabilization also helps the security operators by making the image easier to look at.

Robust in Outdoor Environments against Background Noise. A key challenge for video-based alarm detection is to achieve reliable detection of objects of interest in real-world scenes without obtaining false detects from motion artifacts caused by, for example, camera vibration or pan, snow, imager noise or vegetation blowing in the wind. VisionAlert is founded on a robust set of algorithms, where actual and artifactual motions in the scene are modeled and recovered. This modeling process discriminates the artifactual motion (due to snow, camera sway, vegetation etc.) from actual motion due to an alert. This approach dramatically reduces the false alarm rate while maintaining sensitivity of detection of alert events.

Alarm Functionality with PTZ Cameras. VisionAlert can detect motion and trigger various alarms from a moving platform. This unique capability, developed for advanced military applications and proven in wartime environments like the Kosovo campaign, reduces the cost and increases the operational flexibility of systems employing PTZ cameras. Because the camera no longer has to stop and stare for detection to be enabled, it is possible to cover wider fields of view from the same PTZ platform (or achieve the same degree of coverage as less capable systems while using fewer cameras, a major benefit when infrastructure costs are factored into the total cost of ownership). With PTZ tracking (currently in beta testing) enabled, Sarnoff's patented video-enabled closed loop control for PTZ cameras permits automatic following of detected objects. It also eliminates the need for separate fixed cameras for detection and handoff to PTZ cameras covering the same zone, simplifying system design and again reducing overall costs.

Company

Operational Experience. Our operational experience is unmatched - we've been doing advanced video systems for more than a decade. 15 years+ experience went into building our product lines. The same functionality that drives VisionAlert (sold for traffic monitoring) is installed in 500+ sites in all imaging situations around the world (snow, low-altitude sun, heavy rain, day/night) giving us extensive and proven field-experience in detecting and tracking reliably.

Upgrade Path, Rich R & D Pipeline. We provide an upgrade path from all current and future Sarnoff R&D programs for advanced and complementary capabilities. Our 40-person-plus R&D team at Sarnoff (Computer Vision and Decision Support Systems groups) is funded yearly to a level of more than \$10M to improve our technology.

Track Record, Financial Stability. We are not a venture-funded startup. We're a division of a 60-year-old, \$100M+/yr company with a reputation for integrity to maintain. When you need help or are ready for the next big thing, we will still be here year after year.

5. Customers

Installations of our products include previous and ongoing installations at US Marine Corps Base Quantico, systems for the Air Force at Eglin Air Force Base and in Western Europe, a major facility of a European ally, a pilot installation on the southern US border for the US Border Patrol, and an installation at the Virginia Port Authority (Norfolk International Terminal, Portsmouth Marine Terminal, and Newport News Marine Terminal). New installations in 2004 will include a commercial campus in suburban Washington, DC, and a major airport.

6. Product Cut Sheets & Media

Attached

VISIONALERT™ SUITE

INTELLIGENT VIDEO SURVEILLANCE

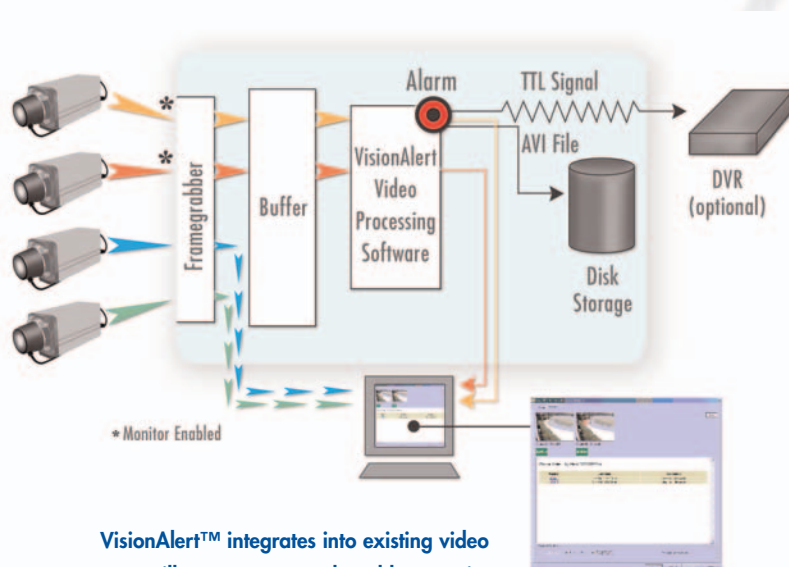
VisionAlert™ Suite transforms conventional security video tools into vision-based, intelligent tools that enhance the awareness of security personnel and enable more effective responses to security threats. VisionAlert delivers real-time, 24/7 vigilance for the most common behaviors that can indicate a security breach: moving target detection, perimeter/zone violation, and suspicious object detection. For long-distance applications, a tower surveillance module combines solid stabilization with motion detection and tracking. VisionAlert can eliminate false alarms from scene activity due to camera sway, snow, rain, vegetation or sensor noise.

These capabilities are grounded in patented, world leading computational methods for video stabilization, enhancement and analysis, the result of more than a decade of research and more than \$60 million of government and private investment. They have been proven in wartime environments such as UAV video exploitation in the Kosovo conflict, and adapted to security applications at military and civil sites both domestically and abroad.

PRODUCT CAPABILITIES

Moving Object Detection: Protects inside or outside a perimeter, either close-up or at a distance. Performs highly reliable, low false-alarm-rate detection of moving objects, even against clutter caused by camera sway, moving leaves on a tree, snow, rain, or small waves on water. Provides for storage and playback of imagery of the target.

Virtual Perimeter Breach: Protects fence-lines, virtual perimeter boundaries, and secure entry/exit points. Typically used when the presence of a moving object is not sufficient by itself to indicate an alarm condition. Allows users to designate authorized and unauthorized zones, object sizes and monitoring times to create virtual perimeters in a scene. Alerts on objects or individuals that move from authorized to unauthorized zones.



VisionAlert™ integrates into existing video surveillance systems and enables security personnel to immediately act on security breaches by providing instant access to the video clips that trigger alerts.

Left-Object Detection: Performs robust detection of objects that are left behind in a zone of interest. Allows users to define zones of interest, object sizes and detection time intervals to suit the operational environment.

Tower Surveillance (optional): Used to protect inside or outside a perimeter, either close-up or at a distance. Performs continuous analysis of one or more Pan/tilt/Zoom (PTZ) cameras to monitor multiple locations automatically. Compensates for camera sway and displays high quality stabilized video on a monitor. Available for PTZ cameras only.

Specifications

HARDWARE COMPONENTS	2.8 GHz Intel Xeon Dual Processor 512MB Memory 10GB System Disk 180GB Data Hard Drive 10/100/1000 Ethernet Euresys™ Picolo Tetra II Video Frame Grabber and MIO Card (<i>except network configuration</i>) Keyboard and Mouse
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SYSTEM INFORMATION	Windows® XP Professional IIS (Internet Information Server) Web Server Version 5.1 Internet Explorer, Version 6.0 Windows Media Player, Version 8.0 Microsoft® SQL Server 2000 Desktop Edition
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INPUTS	
Per Unit	1-4 PAL or NTSC Analog Video
Physical Connector	1-4 Composite Video Cables with BNC Connectors BNC, 75 Ohm
Max Video Inputs	4 Per Unit
Max Frame Rate	30 fps NTSC, 25fps PAL
Max Image Resolution	640x480 NTSC, 786x576 PAL

PHYSICAL INFORMATION	
Dimensions	1.75"(H) x 17"(W) x 23"(D) for 1U, 3.5"(H) x 17"(W) x 14" (D) for 2U
Weight	28lbs (1U), 25lbs (2U)
Shipping Weight	42lb (1U), 40 lbs (2U)
Mounting	19" Rack Mount

OPERATING PARAMETERS	
Temperature Range	10 - 35 °C (1U), 0 - 50° C (2U)
Humidity (Non-Condensing)	8% - 80% at 40 °C (1U), 5% - 95% at 40 °C (2U)
Shock	6 Shock Pulses of 41g for up to 2ms (1U), 2.5g at 15-20ms (2U)
Vibration	0.25g at 3-200Hz (1U), 5g at 2-200 Hz (2U)
Cooling	2x10cm Heavy Duty Processor Turbo Blower Fans (1U), 3x 80mm 35 CFM Front-Intake, 3x40mm 25 CFM Rear Exhaust (2U)

NON-OPERATING PARAMETERS	
Temperature Range	-30 - 65 °C (1U), -20 - 65 °C (2U)
Operating Humidity (Non-Condensing)	5% - 95% at 40 °C (1U), 5% - 95% at 40 °C (2U)
Shock	35g at 15-20ms (1U), 35g at 15 - 20ms (2U)
Vibration	5g at 2-200 Hz (1U), 5g at 2-200 Hz (2U)

STORAGE	
Minimum RAM	512MB
Maximum RAM	8GB
Minimum HD	60GB @ 7200 rpm
Maximum HD	2x250GB (1U), 250GB (2U) @ 7200rpm

POWER SOURCE	
Voltage	120-240VAC
Power	47-63Hz Single Phase

POWER CONSUMPTION	
Peak AC watts	350W (1U), 400W (2U)

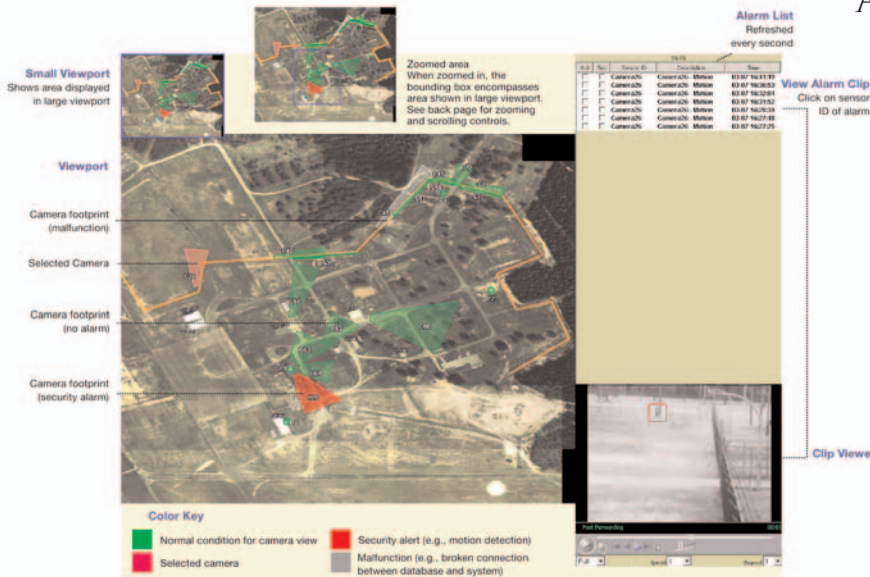
NETWORK	
Interface	One 10/100/1000 Ethernet on RJ45 Connector
I/O: Serial	One Port Four Input and Four Output Dry Contact Terminals

VIDEO OUTPUT	Video Loop-Out in the 2U Box
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VIDEO EVENT TRIGGERS	Video Motion Detection Virtual Perimeter Breach Object Introduction or Removal
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HAWK

INTEGRATED SECURITY SENSOR VISUALIZATION AND MANAGEMENT PLATFORM



Hawk Concept Display

Hawk is the next step in situational awareness for security at medium-to-large-scale facilities. As tactical situations become more complex and the number of sensors grows, security forces are increasingly challenged to quickly interpret and respond to emerging threats. Hawk simplifies the task by creating an intuitive visual context that permits the rapid assessment of the type, location and output of multiple alarms, as well as integrated monitoring for video-equipped facilities.

The capabilities in Hawk are derived from technology developed for the US

military for seamless visualization of wide operational areas and small site details, as well as the status and properties of large numbers of sensors. They have been tailored to the operational environment for site security and optimized for sites with large numbers of video cameras.

Hawk is designed to integrate a variety of sensors and alarm hardware and provide a single platform for complete situational awareness of a site. It is intended to operate as the electronic sensor management and display component of a larger security and surveillance system. Major elements include:

Visualization: Multiple-perspective geographic view of a site(s), along with visual display of information about sensor locations, coverage and alarm conditions

Control: Ability to set or modify the operational characteristics of various components, including:

Alarms: Alarm parameters, monitoring times and options including alarm on/off

Devices: Configuration and on-line control for pan/tilt/zoom (PTZ) cameras, sensors, matrix-switcher, etc.

Storage: Recording and retrieving streaming video with a DVR

Rules: Logic for multiple alarm events that enables users to define a control or visualization function in response to an external event such as an alarm, a screen event such as a mouse click, or an internal system event, such as an operation completion

Hawk is scalable and capable of supporting hundreds (and eventually thousands) of sensors. The system is easily expandable and able to plug and play new components without disruption to system operation. It accepts video-generated alarms from Pyramid Vision's VisionAlert™ Suite. Optional integration with the Video Flashlight™ 3D "immersive" security visualization system is also available.



HAWK

Features

-
- ▲ Integrated alarm, visualization, rule and device control displays in either single or double monitor format
-
- ▲ Multiple sub-meter, geo-registered map or imagery overlays (CAD, Landsat, GIS, etc.) for large areas
-
- ▲ Alarm-generated "fly-to" capability
-
- ▲ Alarm query and pop-up
-
- ▲ Video alarm location and trigger event playback
-
- ▲ Pan/tilt/zoom camera control
-
- ▲ DVR control
-

Configuration

-
- ▲ Single PC workstation
-
- ▲ Windows XP operating system
-
- ▲ Supports up to two display devices
-
- ▲ Network connectivity
-
- ▲ Direct sensor input capacity (e.g., TTL and analog video)
-

Hawk is scheduled for availability in Summer 2004.

VIDEO FLASHLIGHT™

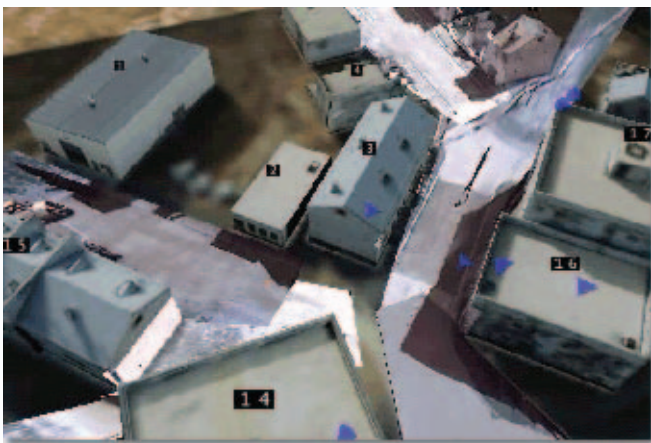
IMMERSIVE VIDEO SURVEILLANCE

Video Flashlight™ redefines the concept of traditional video surveillance by expanding both the camera view and the operator's investigative capabilities to truly immerse an observer within a monitored area. While conventional video security systems are comprised of closed-circuit TVs viewed on banks of video

monitors, Video Flashlight combines multiple video feeds into a unified view that an operator can actually travel through. Rather than looking at fixed or limited views, operators can use Video Flashlight to proactively monitor areas of interest. Move in any direction to look around corners, fly through space from rooftop to street level, even use video recorded earlier to review events of interest from different perspectives. Whether for security or complex training operations, Video Flashlight provides unmatched tactical and situated awareness.

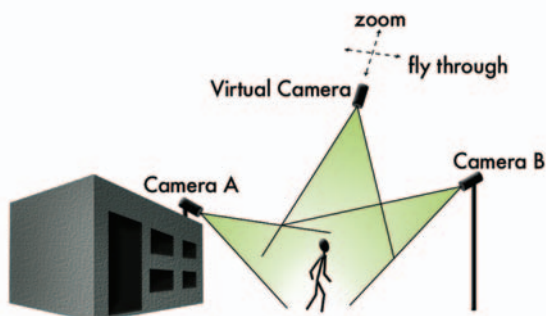


Traditional view — standard bank of monitors



Video Flashlight view

A bank of video monitors often contains gaps in the overall view of the monitored area. Video Flashlight fills those gaps by combining multiple video streams into a single 2D/3D image with complete contextual information.



Applications

- ▲ Facility security and surveillance operations
- ▲ Advanced training exercises
- ▲ Facility security planning
- ▲ Forensic investigations

Capabilities

- ▲ Integrates hundreds of sensors in a unified, contextual view
- ▲ Improves coverage and identifies blind spots to provide a complete, contextual view of any location
- ▲ Allows users to “fly through space”, move seamlessly from sky to street levels and even look around corners
- ▲ Allows users to move seamlessly in time — instant replay — to see where an individual or vehicle has been
- ▲ Enables action-centric surveillance navigation, independent of specific camera controls
- ▲ Disseminates actionable information to multiple locations
- ▲ Optimizes camera placement
- ▲ Lets users run the system with little or no training

VIDEO FLASHLIGHT™

PRODUCT OPTIONS

The Video Flashlight System is comprised of four components

Video Flashlight Core: Provides core video capture, streaming and rendering architecture to support a multi-machine networked infrastructure for a 16-camera system. Includes timing, buffering and synchronization of video. Includes graphical pipeline capable of overlaying video information on a 3D model.

Video Flashlight GUI: Provides graphical user interface for the Video Flashlight system. Permits navigation controls including joystick, mouse and keyboard interfaces. Provides preset viewpoint controls, Picture-In-Picture displays, Video Matrix Displays and Integrated Map displays.

Instant Review: Provides integrated control and access to a DVR system that can store video for up to 16-camera units. Provides master control panel to the Video Flashlight GUI that allows the user to navigate through the video in time.

Video Expansion: Provides controls to expand the base 16-camera system to a greater number of video feeds. Each module can support an additional 16-camera inputs to the system.

Additional modules are available for advanced requirements

Map-Based Alarm Display: Provides Video Flashlight 16-camera core alarm display, including core capability to display a site model with alarm icons from any given viewpoint, with alarm location API.

Map-Based Alarm Integration Module: Provides for integrating time codes, metadata storage with alarm display, joysticks, and keyboard/mouse.

External Alarm Input Module: Alarm input to Alarm Display Module (32 channel) from 3rd Party Alarm Module, including TTL input, and XML input via Ethernet port. Requires geo-coordinates provided by the integrator.

Camera Installation & Positioning Tool: Collection of utility software that support Video Flashlight installation. Includes video calibration module, camera positioning tool, camera lens parameter adjustment tool, camera footprint analysis, automatic view creation, automatic object insertion (people, vehicles), 3D fly-through view of placement, generic site models (fence, building), VisionAlert™ alarm zone display, geo-location table output and camera specification output log.

Technical Features

Standard COTS hardware,
purchased separately

Multi-machine PC based system
installed on 19" racks

Custom-configured based on
system requirements

Backup power provided by UPS
system

Input: NTSC/PAL composite video

Output: XVGA output with
keyboard/mouse/joystick controls

Pyramid Vision™ to Provide Intelligent Video Security System for Virginia Port Authority Contract

VisionAlert™ Suite Will Give Norfolk, Portsmouth, Newport News Terminals 24/7 Automated Video Surveillance in Project Headed by L-3 Communications

ARLINGTON, VA (November 17, 2003) — Pyramid Vision™, a leader in security, surveillance, and reconnaissance solutions, will provide its VisionAlert™ Suite of intelligent video surveillance products to detect and report on unauthorized vehicle and personnel activity around the commercial seaports of the Hampton Roads area of Virginia. Pyramid Vision, along with prime contractor L-3 Communications and others, will provide technology and equipment for critical security improvements to the Virginia Port Authority (VPA).

VisionAlert will be installed at Norfolk International Terminal, Portsmouth Marine Terminal, and Newport News Marine Terminal. The state-of-the-art digital system will combine VisionAlert with ultra-low-light cameras and a wireless communications network to provide electronic detection, alarm assessment, communications, command and control, and display capabilities, allowing for effective response to an intrusion.

The contract is the result of a Transportation Security Administration (TSA) grant to the Virginia Port Authority for the installation of Closed Circuit Television (CCTV) cameras, advanced video motion detection, supplemental lighting, and other security measures.

“We are pleased to be a participant in this important project,” said Craig Chambers, President & COO of Pyramid Vision. “Hampton Roads is home to a number of critical maritime facilities, and we look forward to providing state-of-the art capabilities that can help protect them more effectively.

VisionAlert Suite is a PC-compatible solution that transforms CCTV surveillance installations into “smart” video alert systems. It monitors activity on all cameras, and automatically detects, displays, and tracks security violations such as intruders, moving objects, and suspicious packages. By alerting personnel to potential infractions it multiplies the effectiveness of an existing security force. The product runs in a standard PC platform and works with most commercial surveillance cameras.

VisionAlert is the latest product from Pyramid Vision, developer of the VideoDetective™ platform for enhancement of video from counter-drug and counter-terror operations; Acadia™ I, the PC-compatible accelerator for real-time video processing; and Jam™, the aerial image analyst workstation.

###

About Pyramid Vision

Founded in 1997 as a venture of the Sarnoff Corporation, Pyramid Vision (www.pyramidvision.com) is dedicated to the application of video and related technologies to strategic and tactical decision-making. Our products have been deployed in a variety of military, security, law enforcement and commercial applications that require the highest image quality and automated video intelligence. Pyramid Vision’s customers include the Department of Defense, leading defense system integrators, agencies of the Department of Homeland Security, drug enforcement agencies, UAV producers, and state and federal law enforcement organizations. Pyramid Vision manufactures, sells, and services a family of hardware and software products that includes complete systems as well as customizable modules. Many of our products are based on Sarnoff’s proprietary Acadia™ I vision chip, which provides the real-time speed and processing power required of critical, video-intensive applications. Pyramid Vision serves agencies of the Federal Government and its suppliers from its Washington, D.C. area offices.

About Sarnoff

Sarnoff Corporation (www.sarnoff.com) produces innovations in electronic, biomedical and information technology that generate successful new products and services for clients worldwide. Founded in 1942 as RCA Laboratories, it develops breakthroughs in ICs, lasers, and imagers; drug discovery, manufacture and delivery; digital TV and video for security, surveillance, and entertainment; high-performance networking; and wireless communications. Its history includes the development of color TV, the liquid-crystal display, and the disposable hearing aid, and a leadership role in creating the U.S. digital television standard. Sarnoff also founds new companies to bring its technologies to market. It is a subsidiary of SRI International.



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Sarnoff software helps guards monitor security cameras

WEST WINDSOR, N.J. (AP) — Ever wonder how security guards watching banks of video monitors for hours on end can be sure of spotting suspicious activity?

Sometimes, they can't — because viewing too many images at once simply numbs the human brain.

Sarnoff (www.sarnoff.com) believes it has the solution: a computer software system that analyzes images from security cameras. The VisionAlert System removes much of the drudgery from watching video and makes the process a bit more like playing a video game.

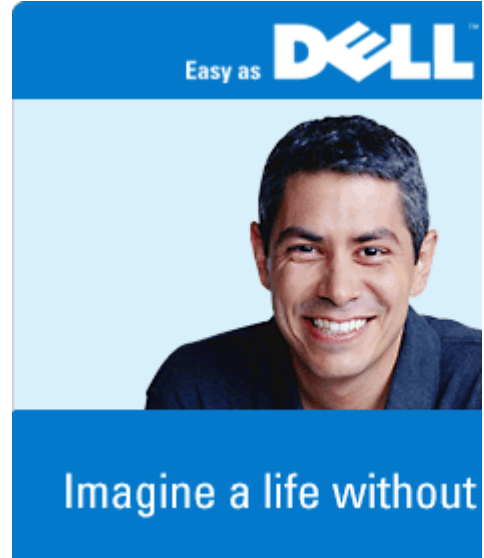
The software analyzes data from up to several dozen security cameras, distinguishes normal and abnormal activity, and highlights anything unusual with colored boxes on a computer screen. Guards can then use a joystick to zoom in on that picture, zoom out to see an entire property or jump from one part of the building to another as if taking a virtual tour.

"Study after study has demonstrated that humans cannot effectively monitor large numbers of video feeds for hours," Manoj Aggarwal of Sarnoff's technical staff told The Times of Trenton for Monday's editions.

"Our system gives fewer false positives than any other we've seen," Aggarwal said. "Plus, it makes all alerts easy to check. Guards don't have to walk across the building if they get an alarm. They can check it out over the system in a couple seconds."

The system can distinguish movement where there should be none, such as strangers walking on a property, from normal motion, like rain or tree branches swaying in the wind.

It can point out someone walking in an unexpected direction, such as a person in an airport heading the opposite way from a crowd going to baggage claim. It can alert guards when someone puts a package down, walks away and doesn't return.



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The system works with most cameras and computers on the market, linking them into one network, and can function nearly anywhere, according to the company.

Security cameras have been used since the 1960s by businesses, government agencies and other groups. Many bought more and more cameras as they became cheaper, eventually overwhelming guards with too much visual data.

"Once you get beyond 16 monitors, you completely surpass a person's ability to see what's going on," Supun Samarasekera, another technical staff member, told the newspaper. "Any more screens certainly doesn't help the situation, and in some cases it might actually make things worse."

Sarnoff is selling the systems, at tens of thousands of dollars each, through a subsidiary, Pyramid Vision of Washington, D.C. Launched in September, it was tested first by the U.S. Air Force, Navy, Marine Corps and Border Patrol.

Sarnoff said it has sold several systems, but most clients don't want to be identified. However, officials at the Virginia Port Authority said they bought a system to improve efforts to fight terrorists, smugglers and thieves in the busy harbor they monitor.

Initial marketing has been focused on airports, banks and other entities with big security budgets, but Sarnoff and Pyramid Vision also plan to target locations such as shopping centers and public garages.

The two companies already are working on improvements, such as simplifying installation of VisionAlert, enabling it to network hundreds and eventually thousands of security cameras, and allowing guards on patrol to access the system with a handheld computer.

Sarnoff, best known as a high-tech R&D incubator, normally partners with outside investors on product development costs and then splits any profits. This time the company is going it alone.

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SEAMLESS SURVEILLANCE

What if monitoring an airport or city was as easy as joysticking through a video game? Rakesh Kumar's team at Sarnoff is creating big-picture views from myriad individual video feeds. **PHOTOGRAPHS BY BETH PERKINS**

VIDEO CAMERAS ARE proliferating; they're everywhere at airports, urban centers, and government buildings. But how do you tackle the tedious job of actually watching all these boring, narrowly focused video feeds? Sarnoff, the former RCA Labs now owned by SRI International, is building a solution—a system that combines video from many cameras into a 3-D model of an area. “Instead of watching the world through a soda straw, this is essentially taking video and putting it into context,” says Rakesh Kumar, a computer scientist who developed the technology as director of Sarnoff's 14-member media vision lab. The result is called Video Flashlight: it's like playing a video game, except the scene is of real events in real time; grab a joystick and you can swoop down hallways and fly around buildings, immersing yourself in a scene. The technology has a rich legacy: RCA was a pioneer in television technology, and its laboratory was a key source of World War II-era electronics innovations. Today, Video Flashlight is getting tested as a security tool at government buildings. At Sarnoff's labs in Princeton, NJ, Kumar showed *TR* senior editor David Talbot the latest in surveillance.





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1. The critical first step: creating a 3-D computer model of the area to be monitored. This forms the background on which live video feeds are superimposed. Kumar introduces the modeling-project leader on his team, computer scientist Steve Hsu.

Hsu taps a few keys and shows a current work in progress, a 3-D model of downtown Baton Rouge, LA. This model was made using an established technology: airplane-mounted laser scanners that record topographical features. Models can also be made using video images—and even ordinary 2-D digital photographs—that are rendered by software into 3-D.

Once the data is gathered, the raw 3-D shapes get a more realistic look from software that “paints” features like windows and doors, using information gathered from photographs. It takes days to build a model, but “it used to take a skilled artist weeks,” Hsu says. “Our goal is to get to where I can model a small town in six hours.” Such speed is critical for jobs like rapidly installing video surveillance on urban battlefields.



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2 - 3. Camera placement is the next step. A computer analysis of the 3-D model suggests ideal placements on building facades or in hallways to optimize coverage; “Any old camera will do,” Kumar says. As part of the system deployed at the Sarnoff site itself, cameras (2) are installed on an exterior wall. The enormous amounts of data gathered by these cameras are stored inside the Sarnoff facility in banks of digital video recorders (3). With this information, the monitoring system allows security guards to instantly review old events.



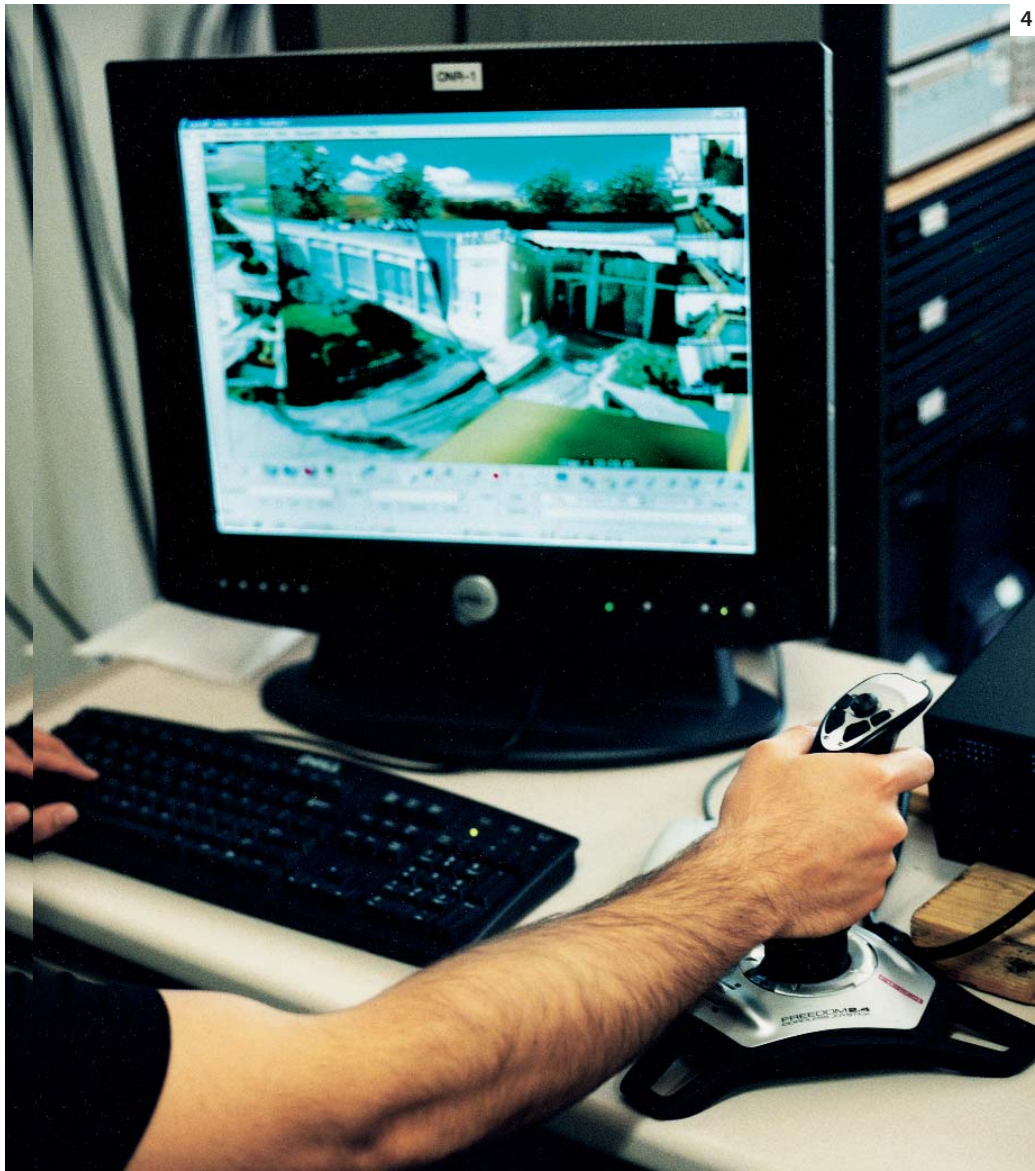
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4. It's game time. Demonstrating how the system works with 12 fixed cameras around a Sarnoff building, Kumar hands the controls to Aydin Arpa, whom he calls the "graphics guru" of his group. Arpa grabs the joystick for a view of Sarnoff's main entrance (4). On the display, data from each of the cameras is superimposed on the model. "The cameras act like a flashlight, illuminating the static model with live video," Kumar says. As Arpa swoops around and zooms in and out of the scene, software keeps video images seamlessly aligned with each other and with the 3-D model. This allows Arpa to "fly" around an object and even view it from different angles. When the video cameras pick up new or moving objects, a Sarnoff technology called "pyramid processing" enables automatic detection and tracking of new people or other elements



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in a scene. The Sarnoff system also merges interior and exterior models; this provides a way, for example, to follow a person as he or she enters a building. Sarnoff is working on software that will transform 2-D video images of people and new objects into rough 3-D versions to make them look realistic as a guard "flies" around them.

5 - 6. The current technology requires fixed cameras. Kumar has bigger ambitions: handling video from cameras in motion, and linking video surveillance across the globe. In an experimental system, a Sarnoff chip (5) processes video feeds from cameras in motion, even those attached to airplanes. The chip also aligns moving video feeds with digital maps using both Global Positioning System information and software that "matches features the camera sees on the ground with features in a database," Kumar says. The results are visible on a wall screen (6), where the field of view of a plane-mounted camera shows up as a pyramid shape on a map of the New Jersey coastline. The result is Video Flashlight writ large: a joystick sweep can pull you back from the Sarnoff campus and then transport you clear across New Jersey—and eventually, the world. 