IBM Smart Surveillance System

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http://www.research.ibm.com/peoplevision
IBM Smart Surveillance System (S3-R1)

The world's first, event based, distributed smart surveillance system
www.research.ibm.com/peoplevision

IBM Smart Surveillance System (S3-R1)

Video camera based surveillance systems are key to acquiring intelligence in urban combat zones. Current systems provide raw image data leaving the intelligence gathering task to humans. Human monitoring of video is known to be ineffectual from an intelligence gathering perspective. The first generation of smart surveillance systems were limited to providing real time alarms to “pre-programmed” events. While real-time alarms are useful, the ability to search through event data and understand patterns of activity enables the adoption of new “security strategies & postures” in challenging urban environments. The IBM S3-R1 system is a platform for event-based surveillance. S3-R1 provides the following capabilities

- **Real Time Alerts** including Motion Detection, Directional Motion, Abandoned Object, Object Removal & Camera Move/Blind:
- **Event Search** using Object Type, Size, Speed, Location, Color
- **Automatic Face Capture** & **Statistical Event Tracking**:

**Application Scenarios**

While being able to provide real time alarms to “pre-programmed” events is useful, the ability to search through event data and understand patterns enables new “security strategies”.

**Force Protection:** Understanding long term patterns of activity and the ability to search through events can help identify potential vulnerabilities.

**Border Monitoring:** While real-time alarms are useful, reacting to a large number of real time alarms is infeasible. Understanding patterns of violations for effective deployment of patrols is critical.

**Large Scale Investigations:** In large scale investigations like the Washington Sniper incident, the ability to sift through large numbers of surveillance video tapes to identify commonality is essential.
S3-R1 Pilot at IBM Research Facility in Hawthorne, NY

Event Search Capabilities
Find last 100 events  
Find events between 1PM & 2PM  
Find all “people – events”  
Find all “vehicle events”  
Find “vehicle-speeding events”  
Find “loitering events”  
Find “events at-this-position in camera”  
Find “objects by size”  
Find “objects by color”

Camera used for demo queries
Real-Time Alerts

- Person / vehicle in area
- Wrong direction motion
- Crowd / loiter detection
- Abandoned object
- Vehicle arrival / departure
- High speed objects
- Camera move / blind
- Removed object
- Virtual Perimeter Monitoring
S3-R1 Query Result: Find People Events
S3-R1 Query Result: Find Car Events

The last 100 moving Objects/Events.
S3-R1 Query Result with linked Video Player
Face Images Captured by SSE Face Engine
Long Term Monitoring Results – for 24 hours

Hawthorne 1 Deployment Scenario for Camera #2

Tracks of all objects over a 24 hours
Depression Peak: ~ 3.30 pm & 5.30 pm
Arrival Peak: ~ 8.30 am

Paths of Large Objects over a 24 hour period

Arrival & Departure Distribution of people into Hawthorne 1
Applications of Smart Surveillance

- Security Applications
  - Airports/Critical Facility
  - Borders
  - Embassies & Bases
  - Enterprise Security
  - Schools
- Retail Applications
  - Banking
  - Loss Prevention
  - CRM – people counting, demographics, shopping patterns
- Manufacturing
  - Safety Applications
  - Operations – Time & Motion

- Transportation
  - Safety – railways
  - Congestion monitoring
- Health Care
  - Elder Care facilities
  - Home Monitoring
- Sports
  - Player tracking
- Gaming
  - Casinos
Smart Surveillance Middleware

Homeland Security

Critical Facility Protection

Business Intelligence

Casino Gaming

Facility Protection Application
Biz Intelligence Application
Casino Gaming Application
Homeland Security Application

Smart Surveillance System-Release 1 (S3-R1) Middleware/Framework

SSE
Ingest
Alert
Archive
Retrieval
Intg. Mgr

Core Video Analytics
(Detection, Tracking, Classifications, Activity Analysis)

DB2-CM, Websphere
GPFS, IBM Blade Servers

IBM Research

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Open Architecture for Smart Surveillance

- Camera
- Video Encoder
  - MPEG 4
  - Windows Media
  - Verint Encoder
- SSE
  - Object Detection
  - Object Tracking
  - Object Classification
  - Activity Analysis
  - start/stop
- Database Server (IBM DB2)
- Video Manager (IBM DB2 CM)
  - Speeding Alert
  - Vehicle Alert
  - Loitering Alert
  - Other Alerts
- Application Server (Websphere)
- MILS

IBM Smart Surveillance System

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Distributed Smart Surveillance

New York Ports

LA Ports

Network

Metadata

Video Server

Application Server

Web

Centralized Management

Monitoring & Queries
Open Architecture for Sensor Analytics

- Open Platform for Sensor Analytics
- Open Sensor-Event Data Ingest Middleware
- COTS Data Management Technology (IBM's RAMMP)
- Open Command and Control Middleware
- Search and Retrieval Services
- Real-time Alert Services
- Command and Control Services
- Open Interfaces: XML / Webservices

- Analytics #1
- Analytics #2
- Analytics #N

- Proprietary Analytics Application
- Proprietary Control Application
- Proprietary User Application #1
- Proprietary User Application #2
System Requirements for S3-R1

- **Analytics Server**– handles 4 video streams (320x240)
  - Single Processor 2.8Ghz+ Intel Pentium
  - 1 GB Ram, 160GB Hard disk
  - 4 Channel Frame Grabber Card—Osprey
- **Database / Analytics Server** – handles up to 24 cameras
  - Dual Processor System 2.8GHz+ Pentium
  - 2GB Ram, 160GB Hard disk
- **Video Encoding and Storage.**
  - Partner Systems.
- **Ongoing Scalability Work**
  - Re-architect SSE and port to DSP’s
  - Backend scalability testing
## Competitive Analysis

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<thead>
<tr>
<th>Dimension</th>
<th>IBM Research</th>
<th>Other Vendors</th>
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<tbody>
<tr>
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<tr>
<td>Advanced Analytics</td>
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<td>-</td>
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<tr>
<td>Event Data Management</td>
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<tr>
<td>User Interfaces</td>
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<tr>
<td>System Architecture</td>
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<tr>
<td>Accuracy</td>
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<td>Performance (Speed)</td>
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<tr>
<td>Backend Scalability</td>
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+ **Advantage**

= **Similar Capabilities**

- **Behind**