

# INTELLIGENT VIDEO ANALYTICS

The field of electronic surveillance has matured significantly over the past 2 decades, fuelled by the growth of safety and security concerns around the world. Surveillance cameras are being used for a wide variety of applications from homeland security to securing the home.

A report entitled "Global CCTV Market Analysis (2008-2012)" estimates the global CCTV market to exceed US \$13 billion in 2009 and the Compounded Annual Growth Rate (CAGR) to be more than 27% during 2009-2012.

## Challenges of Video Surveillance

The challenges of effective video surveillance continue to grow with massive amounts of video being generated (both live and recorded).

- ◆ In a large number of cases recorded video is only watched or reviewed after the event (theft, vandalism, etc) has already occurred.
- ◆ In many instances, manual monitoring of live or recorded video misses key events or suspicious behavior due to operator oversight, error, or fatigue.
- ◆ As cameras get added and the area under surveillance increases, human operators find it a challenge to keep up with the scaled environment.
- ◆ The advent of mega pixel cameras makes further demands on the storage and management of recorded video. In the absence of quick decisions, massive amounts of recorded video have to be retained and reviewed, before deletion.

Since computers do not suffer from human frailties like fatigue and distraction, computers can be used to extract meaningful information from video data and alert human operators, thereby giving early warnings of potential risks, even in the case of unmonitored cameras.

## What is Video Analytics?

A number of terms like Smart CCTV, Intelligent Video (IV), Video Content Analysis (VCA) and Video Analytics (VA) have been used to describe the use of computers in analyzing captured video.

The field of video analytics deals primarily with

1. **Extraction of useful information:**  
Based on certain predefined requirements, the video is analyzed to extract specific information such as events of threat/risk, or events of interest to the user. This information is used in assisting the human operator in making quick and proactive decisions.

2. **Detection of motion/ activity in a video sequence:** By discarding sequences that do not possess relevant activity, redundant information and storage space is greatly reduced. In certain applications, moving objects such as humans or vehicles are tracked over time.
3. **Management of the stored data:** Enhanced indexing of stored video frames and richer metadata generation significantly speeds up and improves the search and retrieval of stored video. Video analytics can be used to search and retrieve a particular video sequence in minutes compared to a manual search and retrieval process, which could be significantly longer.

With the widespread use of video analytics and rapid strides in the technology, the next generation of video analytic software offer sophisticated features including integration with other security and information systems. This has led to a large number of new applications in the retail and traffic monitoring environments, which are outside the traditional security environment.

## Markets for Video Analytics

Video analytics is used in a variety of security applications and increasingly in other areas not related directly to security. Some major areas include

- Homeland security and protection of critical infrastructure like airports, ports, train, bus stations, and water supply infrastructure.
- Traffic monitoring/enforcement.
- Security at correctional facilities.

- Campus security, educational institutions.
- Enterprise.
- Banking.
- Parking monitoring and management.
- Construction projects, storage (warehouse), and museums.
- Home protection, child monitoring.
- Retail.

## Basic Video Analytics Applications

Video analytics software supports customizable applications such as

- **Virtual tripwires/intrusion detection** – Alarms are generated when an object violates a virtual tripwire. This is used to secure entrances, perimeters, etc.
- **Motion detection** – Motion detection alerts the operator to potential suspicious activity. Motion detection can also be used to save storage space by discarding video sequences in the absence of relevant activity.
- **Camera tampering** – Cameras that have been intentionally been tampered with (painted, covered, damaged) can be detected when their operation is disrupted, and alarms are generated to notify the operator/user.
- **Shape based object detection and tracking** – Shape based object detection (example – humans, vehicles) are used to detect, label and track the pre-designated objects. The labels generated can be used for search and retrieval of recorded video.

- **Theft detection/object removal detection** - When an object under surveillance is removed, an alarm is immediately generated.
- **Loitering detection** – Alerts are generated when humans/objects in a pre-designated zone exceed a certain time limit. This can be used to detect suspicious activity (example - loitering near an ATM machine), trespassing or soliciting.
- **Unattended object detection** – An alarm is generated when an object is detected to be abandoned in a particular area.
- **Traffic/People counter** – This is used to provide traffic statistics or footfall in retail outlets.
- **Density detection** – An alert can be generated if the number of objects/people in a certain area exceeds a certain limit. In the retail environment this tool can be used to gauge the interest in a product. The tool can also be used to open a new retail counter if the number of people in a queue exceeds a certain limit.
- **Illegal parking violation** – Generates an alert if a vehicle is parked in a “No Parking Zone”.
- **Stop light violation** – The tool can be used to detect a stop light violation at a traffic light.
- **Lane violation** – If a vehicle enters an unauthorized lane, an alert can be generated.
- **License plate recognition** – The tool can be used to read number/license plates of vehicles for a variety of security or traffic monitoring/enforcement applications.
- **Human face detection** – Once an object has been identified to be a human, the face of the human object can be captured and stored for other applications.

## Challenges for Video Analytics

1. **False alarms** – Similar to burglar alarm systems, false alarms can prove to be a major irritant to the user. Since each alert has to be reviewed by a human, every false alert decreases confidence and increases frustration with the system. Typically, false alarms occur more frequently compared with burglar alarms. The frequency of false alarms also increases with changes in light and weather conditions.
2. **Environment** – The system needs to be immune to harsh weather and environmental conditions, but typically this is not the case. In case of sudden changes in lighting or a rainstorm, there may be false alarms generated and the system may have to be re-configured. Additionally, the cameras should be protected from harsh weather and environment.
3. **Technology** – There is a lot of hype about what video analytics can do. Some solutions claim to detect “*suspicious*” behavior. Others claim to recognize faces in a crowd. The bottom line is that there are certain applications that video analytics can do with a fair degree of reliability like virtual tripwires, density detection, and counting. However, even the best software will depend on factors

like camera position, lighting, and lens quality. The picture quality may depend on the quality of the compression used and the bandwidth available to transmit the video stream.

4. **Customization/support** – In case of problems that stem from changing lighting/environment or when additional features need to be added system maintenance and upgrades become necessary. In some cases support can be an expensive proposition, when support engineers need to be on site for extended periods.
5. **Economics** – Cost can range from \$200 to over \$1000-\$2000 per camera. To eliminate problems like false alarms, substantial customization may be required. With the current pace in technology, it may be necessary to upgrade the system every few years to reap the benefits of the new technology.
6. **Geography** – No two geographical locations are alike. A system that may have produced good results in one country, may not work well in another country having a different population density and infrastructure.

## Comparison of Distributed vs. Centralized Video Analytics

With the migration to IP cameras underway, more and more camera vendors are pushing analytics to the edge. The advantages of having smart cameras are

1. Processing video at the edge reduces the cost of servers.

2. Since video analytics can be used to transmit only specific scenes of interest, bandwidth requirements can be significantly reduced.

However, the advocates of processing the video streams centrally at the server strongly challenge this view.

1. There is a substantial cost factor in choosing smart cameras over analog cameras. Centralized video processing is less expensive.
2. It does not make sense to throw away perfectly good analog cameras or add expensive encoders with built in analytics.
3. Installation, maintenance, bandwidth and security management of IP networks raises a host of new problems.
4. With the current pace in technology, the smart cameras may be required to be replaced every few years. It is cost efficient to replace a server that processes hundreds of cameras instead.
5. In certain cases video is analyzed at the edge in real time. To save bandwidth sequences are discarded in the absence of useful information. If there is an error in analyzing the video, critical information can potentially be lost.

## Characteristics of a Good Video Analytics Solution

A good video analytics solution should address the issues listed earlier under “Challenges for video analytics

- ◆ **Low rate of false alarms** - The solution should be fairly robust and not generate false alarms frequently.
- ◆ **Ability to work in harsh environments** – The solution should continue to work reliably under adverse conditions like rain and sudden changes in light.

In addition the solution should possess the following desired qualities

- ◆ **Ease of setup** – The video analytics software should be fairly easy to setup, maintain and upgrade when new features are to be added or existing features enhanced.
- ◆ **Ease of integration** – The solution should be easy to integrate with the existing system and support 3<sup>rd</sup> party applications.
- ◆ **Scalability** – The solution should be scalable, when extra channels are added and additional features are required to be turned on.
- ◆ **Support multiple platforms and vendors** – The software should be easy to install on multiple platforms and should support inputs from cameras of multiple vendors.
- ◆ **Ease of use and customization** – The user interface should be fairly easy to use and the tools should be easy to configure in order to customize the solution for the user's application. Users should require minimal training and support.

## The Videonetics Intelligent Video Analytics Solution

Videonetics Technology has developed a 3<sup>rd</sup> generation intelligent video solution, called the Videonetics Intelligent Video Analytics (V<sub>2</sub>A) processing engine.

The Videonetics solution, V<sub>2</sub>A, offers unique differentiators from the competition and provides remarkable benefits and cost savings to the user.

1. **Single framework core** - V<sub>2</sub>A's innovative Single Camera Multiple Application (SCMA) enables *multiple* intelligent video applications from a single video channel. The present generation of solutions available in the market provides only one or at the most two applications simultaneously. In some cases users have to pay for dedicated software and hardware based on the application of choice.
2. **Unprecedented scalability and flexibility** - Advanced multi-threading processing provides the ability to support Multiple Camera Multiple Applications (MCMA) in which multiple video channels support multiple applications available in the suite.
3. **Human detection (HD)** – V<sub>2</sub>A's unique algorithm is able to analyze a video sequence, detect moving objects in the sequence and identify and classify humans and inanimate/non-human moving objects in the scene online.
4. **Automated, adaptive modeling** – V<sub>2</sub>A's sophisticated video analytics algorithms are uniquely tailored to work with different cameras and sensors, and lighting conditions.

5. **Flexible automatic alert generation** – V<sub>2</sub>A's automatic dispatch system is able to alert operators and users instantly by different tools including email and SMS.
6. **Robust, field tested** – V<sub>2</sub>A's suite of algorithms are field tested under a wide range of environmental, lighting conditions. They have been proven to work more reliably in high population density conditions, compared to other competing solutions. Field trials conducted by the Kolkata Police using V<sub>2</sub>A's traffic management and modeling suite have demonstrated V<sub>2</sub>A's robust and superior and performance under adverse conditions.
7. **Cost effective** - The solution is configurable, scalable, integrable, customizable, easy to use, and supports a wide range of cameras and platforms.
8. **Affordable** – The Videonetics solution is an affordable solution with a cost that is orders of magnitude less compared to some of the existing solutions.