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IEEE Communications Society

Architectures and Applications of Video Surveillance/ Video Analytics Systems

April 14 2010

Basant Khaitan
Videonetics Technology Pvt Ltd.
basant@videonetics.com




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Video Analytics?

- **Real Time Detection, Classification and Tracking of Objects** in Video Streams
- **Actionable Information to add value, e.g.,**
Real Time Alerts upon Violation; Forensics and Statistical Processing
- **Intelligence in Video surveillance leads to a More Productive, More Responsive, More Reliable System**
- **Video Analytics is a proven tool; solutions exist even in mission-critical systems**

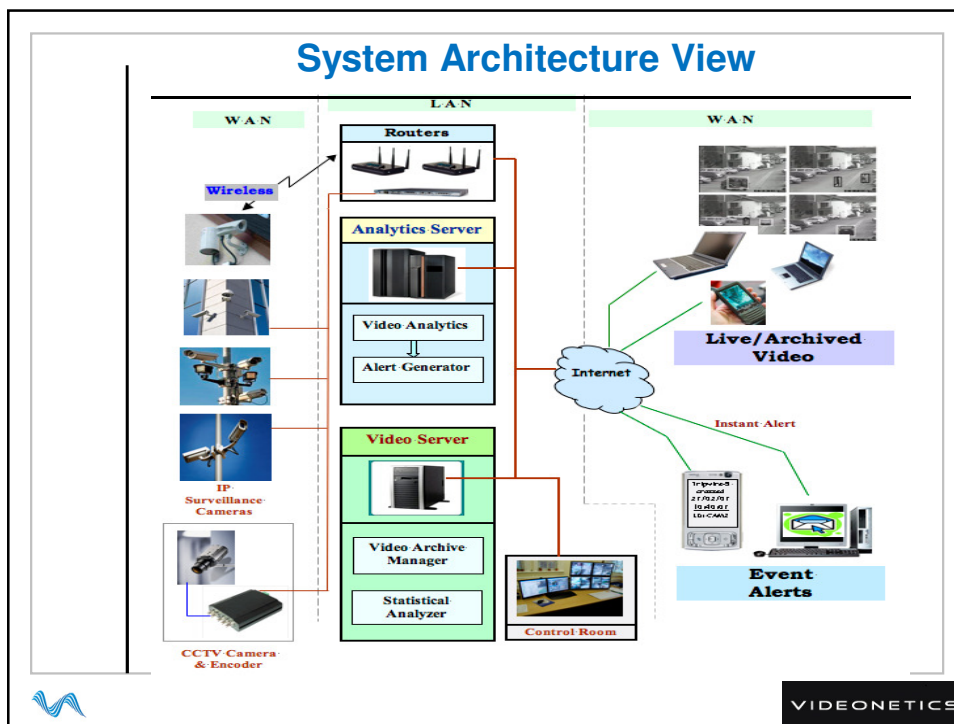
However, not a Panacea!



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2

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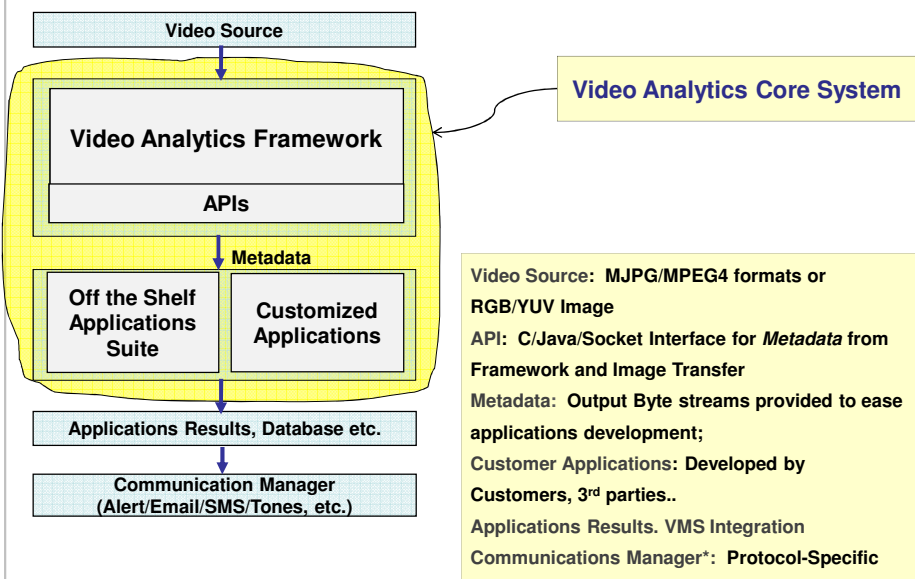
- ### Video Analytics Deployment @
- **Central Server-Remote Local**
 - **Network Edge-Lower Density Server Within the Camera**
 - **Other Configurations May Be Desirable Due To System Reliability and Bandwidth Considerations**
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Video Analytics @ the Edge



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Advanced And Open Video Analytics Architecture



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A Sensible Video Analytics System Provides..

- **Single Framework Unifies All Core Video Analytics Requirements; Delivers a Versatile Video Analytics Platform**
- **Architecture Drives Flexibility and Scalability @ Central Server, Network Edge including Camera-embedded**
 - ▶ **Single Camera, Multiple Applications**
- **Framework/APIs**
 - ▶ Designed to Integrate With Any System
 - ▶ Pre-Specified *Metadata* Eases New Customer Specific Applications
- **Automated Modeling** for Sensors, Light Conditions & Cameras
- **Compatible with most video formats:** MJPG, MPEG4, RGB,YUV,....
- **Efficient Environment For integration of 3rd Party Video Management System**
- **OS Platform independent** – Windows, Linux/Unix, Embedded Systems, etc.



7

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Need for Standards is Critical!

- **Almost all OEM and Software Companies, today, use Proprietary and Manufacturer Specific Specifications and APIs to Interface to Their Product Offerings**
 - IP Cameras (including PTZ...) or Encoders**
 - DVRs/NVRs/Servers**
 - Video Analytics Products**
 -
- **Many Larger Vendors Require Use of Proprietary SDKs!**
- **Growth in Business and Products in Recent Years Has Led to a Unsustainable Present-Day State For For Both End-Customers and Product Vendors**



8

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Emerging Standards for Video Surveillance

- **Two Standards Organizations Since 2008**
ONVIF: Open Network Video Interface Form, and
PSIA: Physical Security Interoperability Alliance
 Have Proposed or Released Compliance Specifications
- **Considerable Overlap Between the Competing Bodies**
- **Scope, Applicable to Any Networked Device, Includes:**
 - Discovery of Device (via a VMS)
 - Device Management/Settings (PTZ, IP addresses..)
 - Image Configuration (Frame, Resolution..)
 - Streaming (Video, Audio, Metadata..)
 - Events (Video analytics..)



9

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Unique Characteristics of Video Analytics Software

- **Pixel Level Processing**
 (FG/BG modeling, 2-D filtering, morphological operations)
 - Locality; smaller data memory
 - Similar operations
 - Suitable for parallel processing at macro-block level
- **Object Level Processing**
 (Segmentation, tracking, histograms)
 - Computationally less demanding
 - Random access to bigger memory
 - Suitable for scalar processing
- **Much Less MAC Intensive Algorithms** Relative to Voice, Broadband Modems, etc.



10

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Video Analytics: Application Examples

People Detection and Tracking

- People Detection and count: Number of people entering and exiting a zone; Foot-fall mode (overhead camera)
- People approaching a restricted area
- Intrusion detection or zone monitoring; Multiple zones
- Persons in unauthorized zones
- Single or multiple tripwires
- Loitering in designated locations
- People/Object tracking
- Automated face detection and capture for access control or security log; multiple camera views
- Tailgating through secure access area
- Crowd and Queue Monitoring, Statistical Counting



11

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Video Analytics: Application Examples

Vehicle Detection and Tracking

- Presence of vehicles via *vloops*, Example: automated traffic signal control
- Illegal or unauthorized parking
- Vehicle moving in wrong direction
- Traffic congestion
- Traffic statistics data collection
- Vehicle approaching unauthorized area
- Stop-line violation
- Other traffic applications

License Plate Reader and Verification:

- Residential or enterprise access



12

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Video Analytics: Application Examples

Objects Detection and Tracking

- Object, left unattended in designated area
- Artifact protection- theft or disturbance
- Obstructions in designated rail or traffic areas
- Smoke and fire detection

General

- Security camera tampering
- Network tampering



13

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Video Analytics Management Server System

- **Video Analytics Enabled Video Server & Management Event Triggered Indexing, Viewing, Archiving and Retrieval; Higher Productivity and Responsiveness**
- **Logical Grouping of Cameras**
Image Stitching; Saves BW
- Access to **Live or Recorded Video- Anytime, Anywhere**
via Internet/Intranet; Browser Interface
- **Event Based Alert:** Via communications manager- SMS, Email, Phone
- **Database:** Statistical Analysis, Forensics, etc.
- **Access/Administrative** Controls



14

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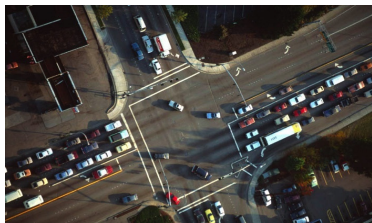


Video Analytics for Indian Traffic Signal and Management



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Traffic Management



US and European Roads

Moulali Junction, Kolkata



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Indian Traffic Conditions



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Indian Traffic Conditions Are Challenging

- **Challenges**
 - Dusty air, Unstable power....**
 - Reduced Visibility, Image clarity, Flickering
 - Scattering of Light is Random
 - High information contents are also highly noisy
 - Disciplined Driving, Strict Lane Rules/Concept Rare**
- Traditional Traffic Offerings, suitable for Western roads, are **Ineffective**
- **Innovation and Customization Required For A Zero or Low Error Tolerance System**



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Video Analytics Example: A Solution in Demanding & Mission Critical Applications

Ingredients for A Sustainable Solution

- ✓ **First Hand Awareness of the Environment/ Challenges**

- ✓ **Accessibility & Focus; Development & Operational Teams**

- +
- ✓ **Technology Provisions for Customized and Adaptable Solutions**



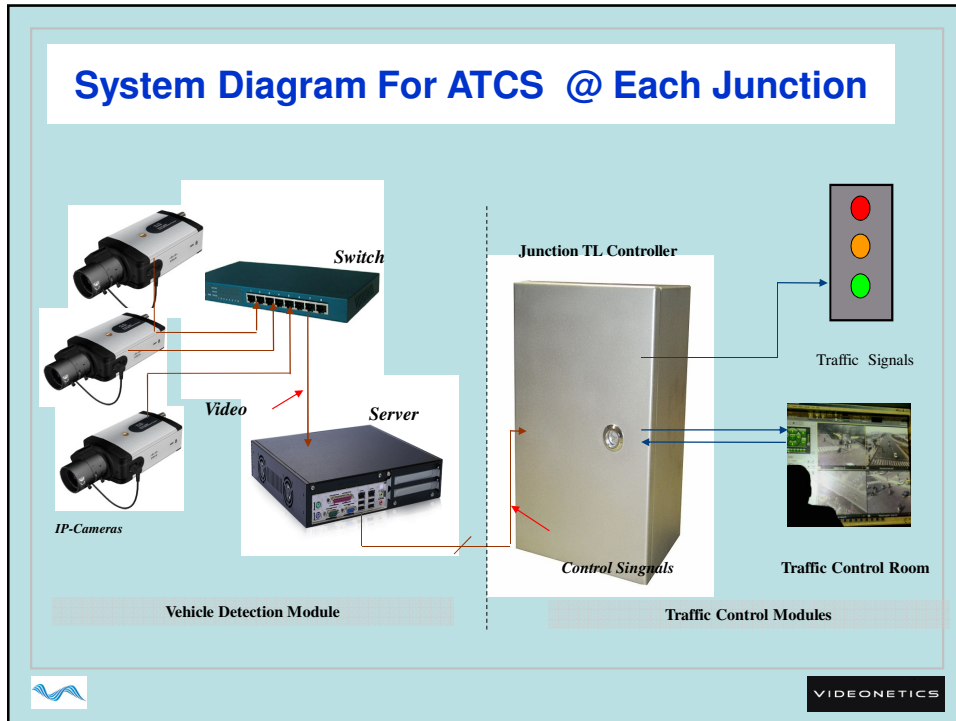
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Innovations That Led To A 24X7 Automated Traffic Control Solution

- **Customizations in Background Modeling**
- **Customizations in Edge Segmentation & Object extraction**



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R₂A Vehicle Authentication DEMO

The screenshot shows a software interface for vehicle authentication. On the left is a live video feed of a road with a barrier. On the right is a control panel with the following elements:

- Event List:** A large empty box for displaying detected events.
- Clear List:** A button to reset the event list.
- Video Player:** A black area for playing back recorded events, with playback controls (stop, play, previous, next) below it.
- Event Details:** A box for viewing information about a selected event.

License Plate No.

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Summary

- **Video Content Processing is in its infancy**

Applications Have Only Been Deployed Since ~ 2005

- **This Technology Has An Enormous Strategic Value, as Applications Proliferate in Diverse Areas**

Transportation, Robotics, Medical, etc.

- **Off the Shelf Analytics Was Over-Hyped In Early Years Leading to Disappointments**

There Is A Better Alignment Today Due To Improved Products from the Industry and End Users Expectations

- **High Value Applications Require Focused Execution**



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Thank you

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