Digital Video Analytics and Intelligent Event Based Surveillance



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What are Video Analytics?

- Video Analytics are computer vision algorithms monitoring live or recorded video to:
 - Identify immediately "interesting" events
 - Record information about the video
 - What people or vehicles enter a space
 - Activities taking place in a space
 - Summarization
 - Search

What Video Analytics Can Do?

Analytics can assist security personnel by...

- Identifying "interesting" activity or events for closer examination
 - Help them monitor more video feeds effectively
 - People need not watch every video feed continuously
 - Changes role of human from monitor to overseer
- Record people and activity in a space
 - "Metadata"

Enables forensic search for unanticipated events

Analytics are NOT:

- Fully autonomous
 - A human must remain in the loop
- Perfect
 - There will always be questionable situations, false alarms and missed events



Outline

Challenges

- Video Analytic Technologies
 - Moving Object Detection
 - Moving Object Tracking
 - Face Detection and Tracking
 - Real-time Alerts
 - Behavior Analysis
- Privacy
- Applications

Challenges of Intelligent Video Surveillance

Complex events

Large System Deployment

Robust Event Detection

- System should work for 24/7
- Night and different lights
- Different weather conditions
- Different environments
- Identification (Face, fingerprint, License Plate recognition)
- Multi-scale multi-sensor data inputs

Large Scale Data Management

Fusion of Different Sensors (event, GPS, badge reader, LPR, fingerprints, faces, Tlog, etc.)

Privacy



Sources: New York Civil Liberties Union; New York Surveillance Camera Players

Basic Technologies of Intelligent Video Surveillance -- 1

- Camera Stabilization: Ability to tolerate typical movement of camera due to vibrations and wind.
- Adaptive Object Detection: Detecting moving objects while adapting to changes in lighting and environmental movement (swaying trees).
- Occlusion Resistant Tracking: Ability to track multiple objects thru occlusions.
- **Object Classification:** Ability to classify objects into vehicles, people and groups
- **Object Color Classification:** Ability to classify object's color
- **Face Capture:** Ability to detect both frontal and profile faces from video.
- Real-time Alerts: trigger real-time alert when events meet users' requirements.
- **Indexing:** Shape, Size, Color and Position indexing technologies.
 - **Search:** Ability to perform attribute based search on 30 days of data with response time of seconds.
 - **Integration Framework:** Ability to integrate the multiple analytics, sensors, transaction logs and other time based events.

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Basic Technologies of Intelligent Video Surveillance -- 2

- License Plate Recognition: This technology has been licensed from a partner and integrated.
- Face Recognition: This technology is being currently integrated into the S3 platform from a partner.
- Video Capture and Management: There are several partners who provide, DVRs, NVR's, Video Management Software. S3 provides a framework for this integration.
- Automatic PTZ Control
- Camera Handoff
- Advanced Object Classification
- Automatic Anomaly detection.

Video Analytics Technology





- **Object Detection**
- Motion / Change
- Challenge: ignore irrelevant motion/change
- **Object Classification**
- Size / Speed / Color / Rough Shape
- Challenge: identify a wider range of objects

Object Tracking

- Location/Speech/Duration
- Challenge: Occlusion, Merge, Split
- Behavior Analysis
- Motion Track
 - Location / Direction / Speed
- Challenge: identify more complex behavior
- Act on the Information Gathered
- Real Time Alerts, Store Summary, Feedback
- Challenge: Use information effectively

Background Subtraction and Foreground Analysis



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Moving Object Detection with Lighting Changes



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Improved BGS Results









Example of Real-time Alerts



Directional Motion Detection – right turn



MxM sub-window in the image

Cascade of classifiers for face detection

Reject the sun-window

Stage Classifier

Face Detection Results











Faces of People Exiting CVS Pharmacy



Face Tracking and Capture



Face Tracker and Capture

IBM Smart Surveillance Solution

License Plate Detection



Click on yellow box to play video

LPR SEARCHES FOR PLATES WITH 52 IN THEM



Behavior Analysis

Click on yellow box to play video

COLOR SEARCH - RED



2006-05-13 11:33:43.14[6.156 sec:] Get Temporally Related Tracks <u>Archive</u> <u>Unarchive</u> Color: 67.32226 %



2006-09-12 10:31:22.781 [1.172 secs] <u>Get Temporally Related Tracks</u> <u>Archive</u> <u>Unarchive</u> Color: 70.25317 %



2006-09-13 09-44:17.656(3.327 secs] <u>Get Temporally Related Tracks</u> <u>Archive</u> <u>UnArchive</u> Color: 65.37337 %



2005-09-13 09:15 41.342[1.0 secs] <u>Get Temporally Related Tracks</u> <u>Archive</u> <u>UnArchive</u> Color: 67.61364 %



2006-09-13 08:59:29.957[1.844



2006-09-12 08:34:45.796[4:328]



2006-09-12 08:11:35.592]0.986



2006-09-12 08:09:43 592[4.158

Results from Color search on the meta-data -- looking for red objects.

COMPOSITE COLOR & SIZE -- FINDING DHL TRUCKS?

Click on yellow box to play video



Results from combined (object color = yellow + object size > 1500 pixels), locates DHL delivery trucks delivering mail at the IBM Hawthorne Facility

Click on yellow box to play video

EVENT DURATION -- LOITERING



Results from (event duration > 30 secs), finds people loitering in front of the IBM Hawthorne Building

OBJECT TYPE (VEHICLE) + EVENT DURATION - ILLEGAL LOADING

Click on yellow box to play video





Results from (event duration > 40 secs + object type = person), locates vehicles loading in front a building around 3AM in the morning on Sept 14 2006

Privacy



Application for ATM

- Provide real time alerts on the following human behaviors patterns
 - a new device was fixed at the ATM's card reader
 - A client stands for more than a specific period of time in front of the ATM
 - A fake advertisement was fixed around the ATM
 - Two people goes to the ATM at the same time
 - The time that clients are spending on a line
 - How many clients are in a line
- Evolve these alerts as new threats and fraud behaviors are recognized.
- Use the S3 index to preemptively discover fraud behavior.
- Integrate video events with transactions at ATM



Facial Mask Detection





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