OpenVSS
Open Source Video Surveillance System

Introduction

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Outline

• Overview – Surveillance System

• OpenVSS – Open Source Video Surveillance System
Introduction

• Applications
  – Transport Applications:
  – Airports, Border, Railways, Underground, and Roadway

• Places:
  – Banks, Supermarkets, Homes, Department Stores, Parking Lots
1st Evolution

- First Generation
  - Analog CCTV Cameras + Analog Video Tapes Recording
  - Complete Human Monitoring
2nd Evolution

- Second Generation
  - Analog CCTV Cameras + Digital Video Recording
  - Automatic Event Detection based on Motion Detection
3rd Evolution

- Third Generation
  - Complete Digital Solutions: IP Cameras + Network Video Recording
  - Multi-Camera Cooperated Object Detection, Tracking, and Event Analysis

(Image Source: MIT CSAIL)
4th Evolution

• Next Generation
  – Distributed Video Surveillance Networks
User problems

• Storage space consumption
  – Typical assignment:
  – 2-16 cameras, 7 or 30 days of recording, 2-10 Mb per min. 1.5 GB per day per camera / 20 -- 700 GB total!

• Data management and retrieval
  – Manual browsing of millions of hours of digitized video from thousands of cameras?
  – Impossible within time-sensed period
Research problems

• Low video quality
  - low resolution, blurring, out-of-focus, interlacing, due to wireless - just see the snapshots from real surveillance monitoring!

• Real-time constraint
  - Real-time: < 80 msec per frame (>12 fps) for Short-term & Short Range: objects close to camera (or captured at close zoom)
  - Quasi real-time: < 500msec (2 fps) for Long-term & Long-range: objects away from camera (or wide zoom)
System on the market!

IBM:S3 – Smart Surveillance System Architecture
BOSCH – Intelligent video Analysis System
AXIS – software
Milestone – The Open Platform IP Video Surveillance Software

VS

OpenVSS – Open Source Video Surveillance System
IBM:S3 – Smart Surveillance

System Architecture

IBM:SSE - Smart Surveillance Engine
IBM: MILS - Middleware for Large Scale Surveillance

Analytics Engines With DLL plug-ins

Behavior Analysis
IBM:SSE

License Plate Reco
IBM:SSE

Face Reco
IBM:SSE

Badge Reader
IBM:SSE

Radar Analytics
IBM:SSE

XML Event Metadata

Tables for Event Indexing

SQL-like search queries

Interpreted events

IBM: MILS (Meta-Data Ingestion Web Services)

Multi-Modal Event Database

IBM: MILS (Event Query Web Services)

Event Browsing
Event Search
Real Time Event Alert
Pattern Discovery
Event Interpretation
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Smart Security System

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OpenVSS - Smart Security System

Intelligent Motion Detection / Human Behavior

Real-time Video Analysis

Distributed & Scalability System

License Plate Detection

Face Tracking

Network

Hand detection

Bandwidth

multi-processors

Memory

multi-cores

Re-configurability

Support

Plug & Play

Support

Resource management

Plug & Play

Multiple-camera platform

CPU
OpenVSS – System Specification

• Real-time
  – QoS (Accuracy, Spatial & Temporal Resolution, Latency)

• Distributed & Scalability
  – Distributed processing nodes
  – Independent task execution

• Resource management
  – CPU, Memory, Bandwidth

• Re-configurability
  – Adapt simply for a specific application
  – Analyze on local, neighborhood, and global view
OpenVSS – System Support

• Support **multiple cameras platform**
  – HTTP/RTP protocol : JPEG, MJPEG, MPEG…
  – AXIS, BOSCH, D-Link, Panasonic, Sony, Stardot, Pixord, et etc

• Support **multi-cores and multi-processors** for parallel processing

• Support **standard functions of Network Video Recorder**
  – Viewing, Recording (FULL, MOTION), Playback
  – Intelligent Motion Detection

• Support **additional plug and play modules**
  – Provider : Camera drivers
  – Analyzer : Image Analysis Filters (**Intelligent features!!!**)
OpenVSS – Framework overview

- Video Management Framework (VMF)
  - Raw data
  - Meta data
- Video Analysis Framework (VAF)
- Video Processing Filter (VPF)
- Video Interactive Framework (VIF)
- Video Cognitive Framework (VCF)
- Video Control Framework (VCF)
OpenVSS – System Architecture

**Application Layer**
- Alert Server
- Database Server

**Viewer**

**Communication Layer**
- IP Cameras
- Video Acquisition Component
- Video Analysis Component
- Video Encoding Component

**Processing Layer**
- Application Interface
- Video Playback Component
- Event Alert Component
- Data Alert Component

**Offline Processes**

**Online Processes**

OpenVSS – System Architecture
SysA — Inter-Components Communication

Intra-Components Data-Dependency
Independent Components Execution

input

Acquisition Component

process_Frame()
{
  LOCK()
  RECEIVE (VsImage)
  UNLOCK()
  : Process...
  : 
  SEND(VsImage)
}

output

Video Analysis Component

process_Frame()
{
  LOCK()
  RECEIVE (VsImage)
  UNLOCK()
  : Process...
  : 
  SEND(VsImage)
}

Clock Activator

 WRITE

READ

input

output
**SysA — Inter-Components Synchronization**

**Multi-Threading**

```
process_Frame()
{
    LOCK()
    RECEIVE (VsImage)
    UNLOCK()
    : Process…
    : SEND(VsImage)
}
```

Thread#1

```
WRITE
```

Thread#2

```
READ
```

Thread#3

```
process_Frame()
{
    LOCK()
    RECEIVE (VsImage)
    UNLOCK()
    : Process…
    : SEND(VsImage)
}
```
Asynchronous Method Invocation : SEND(VsImage)

```
input
Clock
Activator

process_Frame()
{
  LOCK()
  RECEIVE (VsImage)
  UNLOCK()
  : Process…
  SEND(VsImage)
}
```
OpenVSS – Software Architecture

VsMonitor
VsService
VsPlayback
VsWebPlayback

VsCoreMonitor
VsCorePlayback

VsCore (VsCamera, VsChannel, VsPage)

VsProvider
VsAnalyzer
VsEncoder
VsData

VdDlink
VdPanasonic
VdAxis
VdBosch
VdStardot
VdPixord

VkMotionDetection
VkMediaEncoder
VkAviEncoder
VkMySQL

Open Source Video Surveillance System
OpenVSS – Quasi-distributed software

Client

VsAdmin

Network

TCP/IP

CommandClient

Server

VsServer

VsProxy

VsWeb

NVR

...
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Simple Smart Software

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OpenVSS Server

- **OpenVSS Server**: an online video processing system for analysing, recording and alerting.
  - **VsMonitor** – the video analyzer management.
  - **VsAdmin** – the remote connection tool for activating the analyzers, recorders, and alerters.
  - **VsConfig** – the system configuration tool.
  - **VsService** – the service configuration tool.
OpenVSS Client

- **OpenVSS Client**: client applications.
  - **VsLive** – the application for video live views.
  - **VsPlayback** – the application for video searching and playback.
  - **VsWeb** – the liveview and playback on web ...coming zoon...
  - **VsMobile** – the liveview and playback on mobile ...coming zoon...
OpenVSS SDK

- **OpenVSS SDK**: additional plug-ins.
  - VsAnalyzerSDK – the analyzer plug-in, source code generator integrated with OpenCV 2.0.
  - VsProviderSDK – the provider plug-in ...coming zoon...
  - VsAlerterSDK – the alerter plug-in ...coming zoon...
OpenVSS requirement

• OpenVSS Server requirement:
  – MySQL database server
  – IIS web server
  – Windows Media Encoder 9 Series.
  – .NET Framework 3.5.

• System is tested
  – Windows XP SP3
  – Windows 7, OK but problem with only IIS.
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What it look like!!

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VsMonitor (1)
VsMonitor (2)
VsMonitor (3)
VsLive

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http://code.google.com/p/openvss

Prince of Songkhla University
Department of Computer Engineering
VsLive – web
VsPlayback (1)
VsPlayback (2)
VsPlayback (3)
VsPlayback – web (1)
VsPlayback – web (2)
VsMap

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http://code.google.com/p/openvss
VsMap - web

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VsMap – Large

OpenVSS
Open Source Video Surveillance System
VsOperator (2)