



VA-SCT Embedded Video Analytics for Sterile Zone CCTV

Overview

Synesis' VA-SCT is an intelligent video motion detection and object tracking video analytics for sterile zone surveillance. Our video analytics software is embedded in high definition CCTV cameras and video encoders. The software generates video metadata and automatically invokes alerts to personnel, which significantly improves their productivity both in responding to real-time events and in performing retrospective analysis of the video archive.

Applications

- Automated CCTV surveillance of building infrastructure, secured perimeters and borders
- i-LIDS sterile zone scenarios (both operational alert and event recording roles) developed by UK's Home Office Scientific Development Branch
- Automatic PTZ camera targeting
- Statistical data collection (object counting, trajectory registration)

Unique selling proposition (USP)

- Superb object tracking accuracy under significant environment changes such as moving trees and lighting changes
- High tolerance to small animals, birds and insects
- High scalability thanks to the embedded implementation
- Industry standard compliance including ONVIF and PSIA
- Full resolution image processing up to 1080p (Full HD) – suitable for long range cameras
- 3D object position and speed measurement in real world units
- Built-in digital image stabilizer (antishaker) with subpixel accuracy
- Turn-key hardware and software reference designs

Behavior recognition

The following types of object behavior are automatically categorized:

- Entering (intrusion) or leaving zone
- Staying over a certain period of time
- Crossing a tripwire in given direction
- Moving in given direction
- Running or stopping inside zone

Service detectors

Synesis' service detectors automatically generate alerts in case of a visible degradation of the image quality or a sudden change of the scene under surveillance. Possible causes include a technical failure of the sensor, iris or lighter; lens dusting or, in worse case, camera sabotage by an intruder. The following detectors are parts of the VA-SCT package:

- Blackout detector (underexposure)
- Overexposure detector
- Camera displacement detector
- Out-of-focus (blurring) detector
- Obstruction (scene change) detector
- Illuminator failure detector

Algorithm highlights

- Multi-scale multi-feature image analysis at full resolution and full frame rate resulting
- Dynamic texture modeling of the background scene
- Up to 255 object simultaneous tracking
- Trajectories are not broken in case of global lighting changes

Interoperability

- ONVIF and PSIA standards
- xDAIS 6.10 for TI' DaVinci DSP
- SSE 2 for the x86 platform

Detailed specification

Intelligent motion detector and tracker	<ul style="list-style-type: none"> • One common tracking region • Unlimited number of rules regions • The following rules can be configured independently for each rule region <ul style="list-style-type: none"> ○ Entering (intrusion) or leaving zone ○ Staying over a certain period of time ○ Crossing a tripwire in given direction ○ Moving in given direction ○ Running or stopping inside zone • Each region is defined with a convex polygon with unlimited number of vertices
Tamper detectors (active antitampering system)	<ul style="list-style-type: none"> • Loss of signal • Autoexposure/iris failure • Illuminator failure • Camera tampering (moving, defocusing, covering, spraying)
Object types	<ul style="list-style-type: none"> • People (walking, running, crawling etc) • Vehicles
F_1 measure for the Sterile Zone scenario*	<ul style="list-style-type: none"> • Operating alert role $F_1 = 0.99$ • Event recording $F_1 = 0.99$
Response time	<ul style="list-style-type: none"> • Less than 2 seconds under normal viewing conditions • Up to 10 seconds under difficult viewing conditions
Algorithm features	<ul style="list-style-type: none"> • Object detection and tracking under slow and fast illumination changes • Dynamic texture modeling on different scales • Multiscale multifeature image analysis based on 3D calibration • Intelligent false alarm suppression caused by shadows • Simultaneous tracking up to 10 targets
Calibration	<ul style="list-style-type: none"> • One minute calibration using two height markers • Default profile (no calibration) • Local and remote calibration using ONVIF • Live video or static image calibration
Control parameters	<ul style="list-style-type: none"> • Contrast sensitivity (16 steps) • Spatial sensitivity (16 steps) • Minimum stabilisation time • Minimum and maximum object dimensions • Maximum object speed
Digital antishaker	<ul style="list-style-type: none"> • Built-in in the main pipeline • Subpixel accuracy • Compensation with a bilinear interpolation • Moving object masking for robust stabilization on busy scenes



Target platforms	<ul style="list-style-type: none">• Synesis HW-6467-CORE• Texas Instruments DaVinci DSP with xDAIS 6.10 support• x86 with SSE 2 support
Input frame dimensions	<ul style="list-style-type: none">• standard definition, SD (240p, 480i, 576i)• high definition, HD (720p, 1080p)
Performance	<ul style="list-style-type: none">• up to 2 SD or 1 HD on TI's DaVinci DM6467• up to 10 SD streams on Intel Core 2 Duo 2.5 GHz
RAM requirements	<ul style="list-style-type: none">• 64 Mb for SD resolutions• 256 Mb for HD resolutions
Operating system requirements	<ul style="list-style-type: none">• DSP BIOS, xDAIS 6.10 on TI's DaVinci• Windows or Unix-type OS on x86
Output metadata	<ul style="list-style-type: none">• Event type, date and time• Rule zone number or tripware number• 2D object features: position (px), dimensions (px), area (px²), speed (px/s), contract (0..255)• Real 3D object features (estimated from 2D features using the 3D calibration): position (m), dimensions (m), area (m²) and speed (m/s)• JPEG frame snapshot with object dimensions and trajectory annotation

Sterilize zone performance*

Video set specification

- 432 true perimeter security violations (running, walking, rolling, crawling camouflaged, single or in groups);
- Over 500 events for potential false alarms (fast illumination changes, shadow movements, camera vibrations, animals, birds, insects, snow, rain, fog).
- Over 38 hours of PAL video (720 x 576 x 25 fps)
- High quality M-JPEG video compression at 40 Mbps.

Test rules

- All algorithm parameters remain unchanged during the test, no tuning is allowed.
- Maximum detection time is 10 seconds. Any delay is counted as false negative (*c*).
- Second detection after 10 seconds is counted as false positive (*b*).

Test results

- Number of true positive alarms: $a = 432$
- False positives alarms (type I error): $b = 3$
- False negatives alarms (type II error): $c = 0$

	Recall bias	Recall	Precision	Weighted average
Formula	α	$r = a/(a + c)$	$p = a/(a + b)$	$F_1 = \frac{(\alpha + 1)rp}{r + \alpha p}$
Operating alert role	0.65	1.00	0.99	0.99
Event recording role	75.00	1.00	0.99	0.99