DIGITAL VIDEO MOTION DETECTION (DVMD) SYSTEM

Digital Video Motion Detection (DVMD) Sensor

Functional Description:

The DVMD is intended to be used in a wide variety of security systems that are installed internationally. To support these diverse applications, the DVMD shall provide flexibility in all attributes of the product. The DVMD sensor should incorporate adaptive signal processing technology to achieve highly sensitive detection in a wide range of operating environments with a low nuisance alarm rate and should work with a wide range of camera types allowing it to be applied in the broadest range of interior and exterior environmental conditions. The DVMD shall be capable of monitoring both fixed cameras and with PTZ cameras that operate with presets and tours. The DVMD should digitize video input and process to detect significant changes in the field of view. If the DVMD video processor determines conditions meet user-defined conditions that justify an alarm, the processor will turn on an alarm relay and show the alarm location(s) on the video overlay. The conditions that determine if an alarm is triggered shall depend on attributes such as the location of the target in the field of view, the length of time the target has appeared, and the size, speed, direction and aspect ratio of the potential target. The DVMD signal processing routines must rapidly learn new scenes and detect multiple targets. The DVMD shall allow the user to define multiple, arbitrarily shaped masked regions within the field of view of the camera.

User Interface:

The DVMD shall provide a Graphical User Interface (GUI) that allows an operator to define the settings and masks for each DVMD channel. The user interface shall provide a method to save and recall these settings and masks to and from disk. At a minimum, the sensitivity, target size, target direction and target speed shall be user definable. Additional discriminators may include luminance value, target age and minimum distance the target has moved. The DVMD shall be a modular system that provides a completely consistent user interface for systems that contain as few as one single-channel DVMD mounted at the camera pole or hundreds of video channels processed in 2U chassis mounted DVMDs at a central location.

Connectivity:

The user interface shall allow the settings, masks, firmware upgrades and PTZ controls to be executed over variable time-delay links (up to 5 seconds) for remote facilities linked via satellite. Using appropriate software all DVMD functions (control of settings/masks/and manual PTZ moves) shall work seamlessly through firewalls and Virtual Private Networks (VPNs).

Physical Mounting:

For single camera applications, the product shall be housed in a self-contained box that provides a method for physically securing the DVMD. For multiple camera installations the DVMD shall be mounted in racks with mounting holes that conform to the 19" rack standard per EIA-310-D, IEEE1101.1X, IEC60297-1 or IEC297.

Connectors:

The DVMD shall provide all connectors, components, cables, power supplies, and other items needed for a complete installation of a Digital Video Motion Detector.

Video Inputs:

The system shall act as a 75 ohm terminator to each video channel. The DVMD shall accept composite video in NTSC or PAL formats. At a minimum, the DVMD shall accept video from any EIA-170A source, including Black and White, Color, Image Intensified, Infrared or other EIA RS-170A video sources (E.G. VCR, DVR). The DVMD shall provide at least +/- 3dB of Automatic Gain Control (AGC) to compensate for variations in the received video amplitude. The DVMD shall not require external sync for operation.

Video Processing (Learn):

The DVMD shall learn the scene within 1 to 3 seconds (depending on settings) after moving to a new preset or after detection of excessive pan if in Auto-Detect Pan mode.

Video Processing (Pd):

The DVMD shall provide graphical feedback to the user to select appropriate sensitivity settings for a specific camera and field of view. The sensitivity range shall provide for high Probability of Detection (Pd) for the lowest contrast intermittent targets in the far Field-Of-View (FOV). The DVMD shall support high-alert sensitivity settings that shall detect targets that differ from the background by ten luminance levels or less (on a scale of 0 to 255). The DVMD shall allow detection of slow (.15 m/s) targets and ultra-slow (.015 m/s) targets by user control of the background learn rate. The DVMD shall have the ability to detect motion in any direction. The DVMD shall have the ability to quickly load the Factory Default settings.

Video Processing (NAR):

The DVMD shall allow a multitude of user set discriminators to reduce the Nuisance Alarm Rate (NAR) of an arbitrary scene. The discriminators shall include target qualifiers such as the Minimum Age, Minimum Size, Maximum Size, Direction Discriminators (Up/Down/Left/Right), Luma Discriminators (for calibrated thermal cameras), target aspect ratios (vertical and horizontal) and Minimum Move distance.

PTZ Control:

The DVMD shall be able to control Pan Tilt Zoom cameras and provide Video Motion Detection up to 12 presets. It shall provide a sequencer for automatically moving the PTZ through user defined presets for user defined dwell times. The DVMD shall offer the option of executing up to 4 sequences or tours each comprising up to 12 presets. Additionally the DVMD shall provide an option to modify the PTZ sequence with Random moves and Random dwells to reduce the vulnerability of a two-man attack using observer and intruder techniques. The DVMD shall provide at least 10 scheduled start times for the sequences accurate to one minute. The DVMD shall support all common PTZ protocols with the ability to add new protocols in a timely manner.

The DVMD shall also provide a method to over-ride the sequencer when a manual Joystick takes control of the camera. The sequencer shall be stopped for a user-set number of seconds after the last Joystick command is heard. The DVMD must not interfere with the user who wishes to maintain control of the camera for some period of time after the camera is manually positioned.

During unusual weather events (hurricane, snowstorms, sandstorms) the DVMD shall provide a fast and simple way to GOTOPRESET 12 that contains settings and masks that are appropriate for the extreme conditions.

Target Coordinates:

The DVMD shall track multiple targets (up to 32) and, when polled, provide the target coordinates for each of up to eight (8) targets for target tracking applications. In PTZ camera applications the preset number shall be reported in addition to the target coordinates so the central control software knows what the camera was looking at when an alarm occurs.

Mask:

Each DVMD hardware module, through software configuration shall mask over 4,000 cell areas within the field-of-view using a simple graphic editing tool. The arbitrarily shaped masked areas shall be ignored for motion analysis. A low resolution image of the field of view shall be provided during masking operation to allow the user to determine the best placement of the masked area.

On Screen Display (OSD):

The DVMD shall provide an OSD overlaid on the video image to provide information to the user. This may (optionally) include the Channel ID (up to 6 characters), Alarm Status, and Date/Time. The DVMD shall provide an optional method to overlay the time in high resolution (Tenths/Hundredths) and generate sequentially numbered frames satisfying the requirements of video to be submitted as evidence in courts of law. The user shall be able to see the alarm area by means of a bounding box that surrounds each target. All overlays may optionally be disabled.

Video Outputs:

The DVMD shall provide a buffered video output that will drive an external 75 ohm load. It is intended that the buffered video output will drive multiplexers, digital video recorders, video streamers or other site-specific video management hardware. In the power off condition the DVMD shall pass the unprocessed video from the input BNC connector to the output BNC connector. The video output shall be "Full-Motion" video at 30 f/s (NTSC) and 25 f/s (PAL) in color or black and white.

Alarm Reporting:

The DVMD shall provide a 1,500 Volt isolated Form-C dry-contact relay alarm (NO, COM, NC) for each video source. In multiple channel applications the COMMONS shall not be internally chained together to accommodate systems that use differential analog input cards for monitoring Alarms. The alarm status shall also be available through polling either by serial or Ethernet connections. The DVMD will cause the alarm condition to occur due to the loss of input power or the loss of input video.

Hot Swap

The DVMD shall support applications that require continuous monitoring of all channels. The DVMD hardware chassis version shall provide hot-swap capability to remove and install video processing modules in a "powered on" mode without any detrimental effects on the other DVMD video processing channels.

Power:

The single-channel DVMDs shall operate from a DC supply range from 8V to 40V DC or 24VAC. The 2U chassis mount DVMDs shall operate from universal AC voltage (100 -240 VAC, 50/60 Hz) and provide redundant power supplies in the standard product configuration. In the event of a loss of primary power, each DVMD channel shall retain all set-up parameters in non-volatile memory. Upon power being restored the DVMD shall automatically reactivate all normal system functions within 100 milliseconds. In the event of lightning or power surge sufficient to cause the DVMD video processer to abort the DVMD application a hardware watchdog time shall reset the DVMD processor within 2 seconds. The DVMD shall require low power and generate the least waste heat per channel (<1 watt per channel) to reduce the load on air conditioned central stations and the demands of backup power systems.

Environmental:

The DVMD hardware (single-channel or 2U chassis) shall operate from. Temperatures between 0º and +60C and at relative humidity levels between 20 and 80%, non-condensing.

Agency Approvals:

The DVMD shall meet all applicable international approvals for radiated emissions and immunity in accord with both FCC and CE testing. Copies of the test reports must be made available upon request.

MTBF:

The DVMD shall have a calculated MTBF of over 150,000 hours at 60 deg C and provide record of systems in full-time operation for over 10 years of continuous use with a total failure rate of <0.5% and an infant mortality rate of <0.4%. In the event of a failure the provider shall maintain a stock of replacement units for next-day-air shipment.

DVMD Performance Testing:

The DVMD shall provide (on request) the results of both Intrusion Detection and environmentally induced Nuisance Alarm Testing per the Sandia National Labs VMD test tapes.

The contractor shall use DVMDs that have been tested and independently verified against the 12 pre-recorded test tapes from Sandia National Laboratories[1]. These tapes provide standardized sources for Intrusion Testing and tests for 23 types of environmentally induced Nuisance Alarms. For high security applications the DVMD will have a documented Pd of 95% or greater for targets that are 2% or greater of the field of view, with <2 nuisance alarms per day (equivalent).

Intrusion Testing:

The DVMD Intrusion Detection Tests shall include:

- Crawling intruders or simulated crawls using a dummy providing a profile of 1 square foot moving at 0.15 meters per second.
- Walking intruders
- Running intruders (maximum speed of 5 meters per second)

The Intrusion Tests shall be conducted at the 50, 60, 70, 80, 90 and 100 foot FOV. These tests shall also be accomplished at different times of the day to include scenes during day, night, dusk and dawn. Intruders shall cross through the detection zone in any manner (run, walk, and crawl) as long as they stayed within the speed parameters noted above. Also intruders shall be dressed in a manner that allowed them to blend into the background as closely as possible.[1]

Nuisance Alarm Testing:

The DVMD Nuisance Alarm Test shall be concerned with the following environmentally induced Nuisance alarms:

- Cloud movement through the detection zone.
- Camera motion caused by the movement of the camera and/or the camera pole due to winds.
- Dawn shadows resulting from the sun rising over the horizon in the mornings generating fence or building shadows to appear suddenly or from reflections off shiny objects in the detection zone.

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[1] Sandia Report SAND94-2875 – UC-706

- Dusk shadows resulting from the sun setting, generating fence or building shadows to appear in the test zone.
- Plane shadows are caused by an airplane or helicopter flying between the sun and the test zone resulting in a moving shadow to briefly appear in the test zone.
- Flying birds that move through the detection zone.
- Bugs flying near the camera lens and appear as large objects.
- Lightning flashes or video signal noise from lightning.
- Rain falling in front of the camera lens, water puddles in the detection zone or water running through the detection zone.
- Snow falling in front of the camera lens or blowing across the detection zone.
- Fog, moving or stationary, in the detection zone.
- Small animals moving on the ground through the detection zone such as rabbits, walking birds or squirrels.
- Blowing debris carried by the wind through the detection zone.
- Tumbleweeds blowing through the detection zone.
- Vehicle headlights that move through the detection zone when the vehicle is operated adjacent to the detection zone.
- Camera signal that may generate noise that results in an alarm.
- Interference that results from a low contrast in the picture, which usually occurs at dusk, after a snowfall, during fog or after a heavy cloud moves over the detection zone.

Nuisance Alarm Rate (NAR):

The NAR shall not be more than 2 per day (equivalent) for each DVMD channel, as tested above.

Lighting Requirements for Exterior Cameras:

This section deals with lighting for near infrared sensitive, black and white and color cameras. Thermal and Image Intensified cameras do not apply to this section.

The performance of exterior DVMDs is directly related to the contrast (target to background) ratio of the targets to be detected. To obtain even detection levels for day and night operation, adequate and even lighting is required. The lighting levels, lens selection and camera sensitivity shall be matched to provide 100 IRE video levels (1 Vpp) to the DVMD sensor.

Sufficient lighting shall be supplied so that the combination of the sensitivity of the camera (LUX level), the speed of the lens (F-stop) and the actual video level (IRE) produced by the camera delivers 100 IRE video to the DVMD on a moon-less cloudy night.

Lighting shall not be co-sited within 15 feet of the cameras. Lights shall be positioned in such a way as to reduce the level of nuisance alarm from bugs that are attracted to the light.

As a general rule the light to dark ratio along a detection zone should not exceed a 1 to 4 ratio and the lighting should be at least 2 foot candles reflected light measured at a distance of 2 feet off the ground.