# The role of thermal and focused beam NIR technologies

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## Overview

The most often quoted reasons for using thermal cameras rather than traditional CCTV CCD colour or IR cameras include long distance covert detection of humans and vehicles in total darkness and up to several kilometers range in daylight. This is combined with the ability, depending on the type and wavelength of the detector used, to detect targets through a variety of obscurants, including smoke, fog, water vapour, and glare from the sun. These attributes have long been applied to the military and defence markets but are now finding serious application in the commercial security sectors for perimeter security.

A major contributor to this increasing take up of thermal imagers and cameras into the security market has been the ongoing reduction in manufacturing costs and the improvement in resolution and sensitivity of uncooled thermal sensors in the 8-14 micrometers infra red range. Cameras with a pixel pitch of 17 micrometers and 25 micrometers pitch are readily available with sensor sizes of 640 by 480 and 320 by 240 Noise Equivalent Temperature Difference (NETD) and sensitivities of better than 40 milliKelvin are achievable. This value describes the ability of the imager to distinguish between two temperatures. A wide range of silicon germanium lenses are available including fixed focus, dual field of view, and continuous electronic zoom.

The (still) comparatively high cost of thermal cameras is offset by their superior range performance, resulting in a lower total camera count and associated infrastructure costs. Also the ability to see (covertly) in complete darkness without the added power consumption of IR illuminators offers an additional infrastructure advantage. The addition of video encoders to what were formerly analogue only cameras allows complete integration into IP systems with the added possibility of POE (power over ethernet) solutions. Also, the ready addition of various analytics further enhances the usefulness of the thermal technology.

## Safety – a more complete solution

A unique advantage of thermal cameras in security situations is also the ability to combine both safety and security. An example of this is provided in the Fire Detection and Security range of at least two major manufacturers of thermal cameras. Available with a wide range of lens options these cameras combine the ability to detect human and vehicular intrusion into security sensitive sites with the further facility to protect areas at high risk of fire. These include premises with flammable materials, transportation tunnels, combustible storage areas, and plant machinery, as well as perimeter sites located near flammable forest and bush.

Typically these cameras use the long detection range inherent in thermal cameras to continuously monitor large areas looking for fires. The cameras' flame detection analytics identify the fire, establishing that a real fire threat exists, and then using multiple alarm mechanisms, communicate the level of risk and the fire's positional coordinates to the user who can also manually 'window in' on the area of interest. The algorithms in the analytics reduce false alarms to a minimum by scrutinising each hotspot in the observed area. The fire detection analytics can be used in combination with any other video analytics system.

A typical system tends to use a 640 by 480 resolution, 17 micrometer pitch thermal camera with either a fixed field of view optics or with a motorised dual FOV 45 to 135 millimeter lens, the latter enabling the user to 'zoom' in on the area of interest, and to subsequently autofocus on the scene.

In applications where the objective is to avoid an open flame situation, observing, say, a factory area with multiple machines, the EyeSec system can identify and alert the user when one of the machines reaches a pre-set temperature. The user can configure temperature thresholds and regions of interest (together with regions of non-interest using a masking algorithm if required). A similar scenario applies to any bulk storage area of hazardous materials with multiple possible sources of combustion. The analytics allow the operator to be alerted and intervene before materials held in these areas reach a critical temperature.

Long range flame detection and positioning is achieved within five seconds with multiple fires being detected up to an 11 kilometer distance, during the day, night, and in inclement weather.

Alerts are given when a preset temperature level is observed in the field of view. Temperature sampling with ambient temperature compensation improves detection accuracy. The image processing algorithms combined with a sensitive thermal imager provide high contrast thermal video enabling accurate analytics.

## Focused beam NIR

While thermal cameras can detect targets up to several kilometers away in both daylight and complete darkness, other technologies are available which provide other attributes or, in combination with thermal, can deliver an even more complete situational awareness solution.

One such technology is based on illuminating the scene with a focused beam of NIR (Near Infra-Red) illumination integrated with a CCD imager and a continuous pan-tilt system. Depending on the type of the NIR illuminator, either a single panel 850nm LED, or a CW laser, human threat assessment ranges up to 8km can be achieved in daylight and up to 3km in total darkness.

These systems are able to resolve alphanumeric markings in both bright light and total darkness conditions within their operating ranges. They can also see through glass, which thermal imagers cannot. They are also capable of recognition of a specific individual in total darkness.

Figure 1 EyeSec PTZ Camera.

Figure 2 Harbour Scene Thermal Wide Angle 320x240 pixel.

## Available systems

The Vumii Claritii™ 500 system which utilises a single panel 850nm LED, can, with no natural light available, provide up to 500m of night time threat assessment level surveillance of a human target, and up to 80m of night time identification level surveillance from which a human target can be identified as a specific known individual. This night time threat assessment range is considerably superior to conventional NIR systems which typically are limited to around 100m. During daylight, a human can be detected from the background at up to 5500m, with a threat assessment level surveillance of up to 1900m. Identification level is the same as at night, 80m. In practice these figures will be dependent on atmospheric conditions.

The Vumii Discoverii™ systems with a CW laser as illuminator provide the longer range threat assessment figures alluded to above.

## Conclusion

Thermal imaging provides for the ultimate long range detection and recognition of threats while Near-IR imaging allows critical assessment and identification capabilities which creates a powerful long range surveillance system in combination. In addition, as described, thermal cameras add an important and unique fire safety aspect to the surveillance feature set.

Figure 3 Claritii NIR Facial Identification 50 metres.

### ABOUT THE AUTHOR

**George Swanson** graduated from Glasgow University with a BSc (Eng) in Electronics and Electrical Engineering in1974. He has a background in micro-electronics R&D in telecommunications and electro-optics, and has occupied positions at the design, project management, and management levels during his career. In 2006 he joined Premier Electronics Ltd as Sales Engineer where he is responsible for technical support and sales.

### ABOUT THE COMPANY

**Premier Electronics** was founded in 1994 and is a supplier of a wide range of CCTV and security products including Thermal Imaging Cameras, Laser Ranging modules, CCTV and Board Cameras, Remote Building and Audio Control Systems and Biometric Access Control products. In addition to its security portfolio Premier also supplies cameras for machine vision applications as well as datacomms for factory automation. Premier Electronics provides technical support on all its sourced products backed up by its supply partners

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