

# SECURITY FOCUS



## Going Thermal: Hot Technology in Today's Security Market

Thermal imaging cameras are just one of the newer technological tools that the increasing emphasis on homeland security has brought to fruition.

I recently wrote an article for Security Technology Executive ([www.securityinfowatch.com](http://www.securityinfowatch.com)), looking at the technology of thermal imaging cameras and their expanding role in current security solutions.

Thermal imaging cameras stand out as a particular class of technology that allows a new and effective approach to intrusion detection, assessment and surveillance. Those of us familiar with traditional CCTV cameras that operate in the visible light spectrum expect the thermal imaging cameras (often referred to as infrared or IR cameras) to simply be an extension of the infrared sensitivity of these cameras.

However, the deviation from this expectation are anything but subtle.

**Light Source:** Thermal imaging devices are often described as cameras that operate in low light conditions. To most people that means visible light. However, the essential characteristic of these devices is that they do not respond to visible light; they are designed to respond to light in the infrared portion of the electromagnetic radiation spectrum. Figure 1 shows the electromagnetic spectrum as a function of wavelength. Most thermal imaging cameras used in security applications are designed to be sensitive to radiation in the long infrared portion of the spectrum. This generally corresponds to the radiation emitted by everyday objects in the form of heat. This object could be a human body or a car whose engine is or has been running. The infrared radiation emitted by an object can be attenuated but normally not

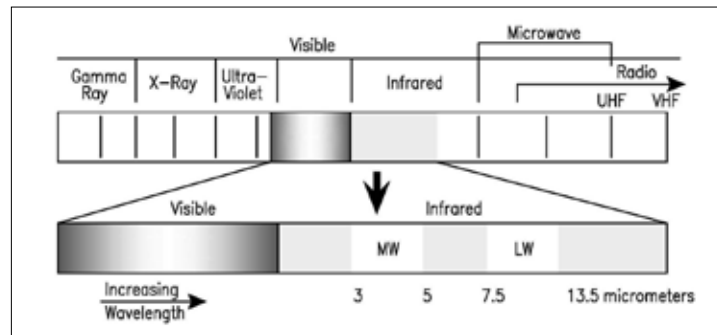


Figure 1

completely eliminated by fog, smoke, rain, or other obscurants. This allows the thermal imaging devices to be effective even in inclement conditions. Examples of this are illustrated in Figures 2 and 3 where the visible and thermal images are compared side by side.

**Lenses:** Typical lenses for cameras operating in the visible light range of the spectrum are made either of glass or some plastics. However, glass is essentially opaque to infrared radiation; many formulations of plastic used in CCTV lenses also



Figure 2

offer poor thermal transmissivity in the infrared portion of the spectrum. Therefore, lenses on thermal imaging cameras are usually made either of germanium or zinc selenide which are interestingly enough opaque to visible light but highly transmissive to infrared wavelength radiation.

**Detector:** The CCD and CMOS sensors typically used in visible light cameras are sensitive to what is referred to as the near infrared (NIR, 0.8 to 2.5 micrometers) portion of the infrared spectrum. This explains the nighttime

performance of many current technology cameras in low light (not no light) conditions with the IR cut filter removed. Thermal imaging cameras operate in a different portion of the spectrum using a chip called a microbolometer. Infrared radiation strikes the detector material in the microbolometer causing its temperature to rise thus changing its electrical resistance. This change in electrical resistance can be correlated to the temperature of the object initially emitting the radiation and is therefore used to create a visual image.

**Cooled vs Uncooled:** Thermal imaging cameras operating in the long infrared wavelength portion of the spectrum using microbolometers do not require cooling. Thermal imaging cameras operating in the medium mid-wavelength spectrum employ a different technology that does

require the chip to be cooled to increase the signal to noise ratio.

**Purpose:** Thermal imaging cameras are primarily used in applications where detection, not identification, of an intruder is the goal. This is illustrated in Figures 2

**Continued on page 2.**



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## Going Thermal (cont.)

and 3 where the thermal pattern clearly represents a human; however the lack of facial or body structure in the image precludes any further analysis leading to the identification as a specific individual.

**Bandwidth:** While resolutions of 4 CIF and higher are available, most thermal imaging cameras deployed today for security applications have typical resolutions in the CIF range. Coupled with the fact that the image is in black and white, the resulting digital image file is much smaller than what we are accustomed to handling. As a result, the bandwidth requirements for a thermal imaging camera are miniscule by current security standards.

**Video Analytics:** Current thermal imaging product offerings by FLIR and others offer many features that the industry has demanded of visible light cameras. Power over Ethernet (POE) enabled IP addressable devices are appearing on many of the newer models allowing ease of integration of similarly equipped visible light systems. Thermal imaging systems are also excellent platforms for video analytics. With visible light cameras, video analytic applications have




**Figure 3**

to deal with a broad range of color variations both in the background and the object to be detected. With a thermal image, the object of interest normally displays a high level of contrast to the background making it video analytic detection relatively straightforward.

**Price:** Perhaps the most significant development is the price points on some of the newer models. Uncooled thermal imaging cameras are now available with a manufacturer's suggested retail price on the order of \$3,000. While more expensive than a comparable visible light camera, these devices provide an ability to covertly monitor movement without the expense and environmental considerations associated with providing lighting for a visible light system.

Borders and ports have represented surveillance and detection applications that were out of reach prior to the availability of thermal imaging CCTV systems. These devices provide the ability to view large fields of view at ranges that would make it nearly impossible for the human eye to detect even large scale movement. Some of the cooled medium wavelength devices are often coupled with a ground based

radar system. The radar system detects movement; the thermal imaging camera then focuses on that location to provide the security monitoring personnel a visible (thermal) picture of the detected object. These devices, often priced well above \$50,000, address the previously unaddressable problems efficiently, and considering the alternatives, cost-effectively.

However the bulk of the CCTV cameras implemented address the security concerns of more modestly sized facilities, campuses, residential estates, and infrastructure sites. As the price of thermal imaging systems continue to decline, and video detection, not identification, is an acceptable intermediate outcome, these systems will see expanded use where visible lighting is either not an option or is excluded as a consideration. While not providing the high resolution color images that we have come to rely on for the majority of our CCTV applications, thermal imaging CCTV provides the ability to obtain video images in no light situations that are well suited for video analytic applications. As their prices continue to decline, thermal imaging cameras will find wider application. 

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