Thermal imagers: the new mainstream choice of security camera?

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Thermal imaging is a sophisticated technology which has many industrial and engineering applications, and which has in recent years also been deployed in specialist security installations for intruder detection.

The capability of thermal imaging has always been attractive to security professionals: the infra-red (IR) signature of a human being is very hard to mask, and so thermal cameras provide highly reliable detection of intruders, in daylight and at night. Nevertheless, the sheer unit cost of a thermal imaging camera – several multiples of that of a conventional, visible CCTV camera – for many years made it an unaffordable choice for mainstream security installations.

Technology never stands still, however. The same technical and economic forces which mean that a pin-sharp Full HD television is the same price today as an equivalent low-resolution analogue screen would have been ten years ago also apply to thermal imaging cameras. Today, a thermal security camera with pan, tilt and electronic zoom capabilities may cost as little as £1,500, a sharp decline from the higher than £10,000 price tag on the same technology soon after its introduction.

But does this steep price decline mean that the thermal imaging camera is now ready to become the mainstream choice for security installations in place of the visible CCTV camera?

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Integration with video analytics

Surprisingly, perhaps the biggest factor influencing the answer to this question is not the fall in the unit price, important though this is. In fact, the widespread adoption of sophisticated video analytics, supporting a more effective and efficient use of security personnel, has had a stronger effect on the thermal vs CCTV choice.

This is because thermal imaging offers both performance and cost benefits over CCTV cameras in any installation using analytics. The performance benefits arise from the basic operational characteristics of a thermal camera. The thermal camera detects the IR emissions of everything within its field of view (see Figure 1). It is a narrowband device: it is insensitive to other types of electro-magnetic radiation apart from IR. It is, for instance, blind to the light that a sighted human can see.

Interestingly, this means that the thermal camera 'sees' better than a visible camera, while suffering from less distortion and interference. It captures the outline of a potential intruder better because its view is not obscured by phenomena that blind a visible camera: the thermal camera 'sees' through any density of fog, smoke, rain or haze. Its view is also not obscured by objects such as leaves on trees that break up the outline of an intruder when viewed by a visible camera – and of course, it can 'see' in the dark as well.

Fig 1: imagery from a thermal camera showing alleged drug traffickers being arrested by Colombian naval forces. (Source: Official U.S. Navy imagery on Flickr)

For the same reason, the camera's image is stable and consistent at all times of day and night, and in all weather conditions, whereas the image rendered by a visible camera shows dramatic variations depending on whether the scene is bathed in bright sunlight, for instance, or covered by thick, dark cloud cover.

For video analytics software, the consistency of the image captured by a thermal camera is crucial. This intelligent software relies on the ability to detect outlines that may be recognised as a potential intruder. If the nature of the image is consistent at all times of day and night and in all weather conditions, the software's detection algorithms operate far more effectively.

Naturally this has a beneficial effect on the performance of the security system: it ensures that a greater proportion of potential intrusion events are detected. They should also be detected earlier, because of the ability of the thermal camera to 'see' through obscurants such as leaves or smoke, which an intruder might use as cover. A thermal imaging camera, then, enables a more prompt and effective response by security personnel on the ground.

A thermal camera system also reduces operating expenses, because video analytics using thermal images will tend to produce fewer false alarms than the same software using visible images. An installation can therefore potentially be secured with a smaller squad of security personnel, or with fewer wasted (and expensive) call-outs.

Taking value as well as cost into account

The adoption of video security analytics, then, has fundamentally changed the terms of the cost-benefit analysis of thermal and video cameras. And the improved performance that analytics offer when supported by thermal cameras shows that the choice of visible or thermal cameras is not a simple mathematical exercise, comparing the cost of one type of installation versus the cost of the other.

Superior performance, and its value to the user, also come into the equation. Every user now needs to decide the value to them of the additional and quicker detection of intruders that a thermal camera can provide. Put another way, users must decide how much they can afford to lose from an intrusion event taking place with a visible camera system that might have been prevented had they used thermal cameras.

Nevertheless, the unit cost of a thermal camera still makes up a considerable proportion of the total installation cost. New thermal imagers, such as the CCTi series from Acal BFi, benefit from the latest technology and from advanced manufacturing techniques, resulting in record-low prices starting at around £1,500 for a full-function Pan, Tilt and electronic Zoom (PTZ) model with resolution of 384 x 288 pixels. For comparison, an equivalent visible CCTV camera would have a typical unit price of around £300.

The comparison of interest to potential users, however, is not the unit price comparison of different camera types, but the total cost over the lifetime of the installation. And a thermal system's costs are quite different from those of a system based on visible cameras. This is because:

- a thermal camera typically has a longer range than a visible camera. This means that any given surveillance footprint may be covered by fewer thermal cameras than visible cameras. This results in lower materials and installation costs.
- a visible camera system requires floodlighting if it is to support night-time surveillance (see Figure 2). This carries an additional unit and installation cost, of course. But it also adds operating costs over the whole lifetime of the installation: not only electricity costs, but also maintenance costs for the replacement of failed lamps. (It is also important to note the potential cost of the downtime in the interval between the failure of a lamp and its replacement. The dark space created by a failed lamp will be a haven for intruders.)

Fig. 2: a security fence at Frankfurt airport, supported by artificial lighting. (Photo credit: Norbert Nagel)

A full lifetime calculation, then, can often reveal that a thermal camera-based system is similar in cost to a visible camera-based system, while offering superior effectiveness and value.

Into the mainstream?

Overall, then, the assumption that thermal imaging is an exotic technology out of reach of ordinary installations because of the high unit price of thermal cameras is not borne out by a detailed cost-benefit analysis.

It is important to recognise that thermal cameras are effective as part of a security monitoring and intruder detection system: a thermal camera cannot provide identification of an intruder, while the picture of an intruder's face captured by a visible CCTV camera may be used for identification. If identification is required, users might consider the use of a dual thermal/visible camera such as the CCTi-300P-02 from Acal BFi (see Figure 3).

Fig. 3: the CCTi-300P-02 from Acal BFi, a dual visible/thermal security camera

In all new security installations considering the use of visible CCTV, however, consideration should be given to whether a thermal camera system would deliver both better performance and lower system cost over its lifetime.