Turning up the heat

Safeguarding infrastructure and individuals, thermal camera technology is fast becoming an essential solution for those organisations looking towards highly effective visual imaging and threat detection. Tony Holloway outlines how thermal imaging allows security personnel to monitor extensive areas efficiently, identify potential threats promptly and respond accordingly

FOR MANY years, it seems, debates have surrounded the cost versus value of thermal imaging. Historically, thermal cameras were expensive and only used in high-risk, high-budget security applications. However, recent advancements have rendered the technology significantly more affordable, with some thermal imaging cameras now available at prices comparable to professional video surveillance models.

The reduction in costs can be attributed to advancements in manufacturing, sensor technology and increased competition among manufacturers. This affordability has expanded thermal imaging technology's accessibility across a broader range of sites and applications, from Critical National Infrastructure-centred projects through to both commercial and residential security set-ups.

As the cost of these devices has come down, more organisations are considering thermal imaging to supplement their traditional security measures. Businesses, airports, prisons, border security, transport hubs, Government and construction sites as well as utility sector businesses are among the many operations that have now embraced the technology to enhance their surveillance and threat detection capabilities.

Under the bonnet

Supporting the growth in thermal imaging applications, manufacturers are constantly innovating thermal technology in a determined bid to improve camera performance, resolution and, what's more, the capabilities of analytics.

Thermal cameras operate in the lower infrared spectrum, detecting differences in thermal radiation or 'heat signatures' emitted or otherwise reflected by objects within a field of view. Unlike conventional cameras that rely on visible light, thermal imaging cameras capture heat variations, making them effective in complete darkness or adverse conditions such as those created due to the presence of fog, smoke or dust. This ability allows security personnel to identify targets such as people and vehicles and take early action for intervention.

Since all objects emit some level of infrared radiation, thermal cameras don't need external illumination, unlike traditional optical surveillance systems that rely on street lighting or infrared LEDs. This makes them highly effective in remote locations where there may be little or no ambient light.

Further, today's thermal cameras incorporate advanced software that enhances image clarity, providing sharper visuals and distinguishing between human, animal and vehicular movement.

Cooled and uncooled

There are two main types of thermal imaging camera: cooled and uncooled. Each has distinct advantages and will be suitable for different applications. Cooled thermal cameras contain a cryogenically cooled sensor that enhances sensitivity and detection accuracy. These cameras provide the highest performance with superior signal-to-noise ratios, rendering them ideal for applications requiring extremely long-range detection.

Cooled sensors can detect minuscule temperature variations, which is particularly useful for high-end security applications such as Government, military and border control installations and specialised industrial applications. However, the high cost and maintenance requirements of these systems somewhat limits their practical use in most commercial security applications.

Uncooled thermal cameras, on the other hand, are more commonly used for commercial security and industrial regimes. These cameras operate without the need for cryogenic cooling, in turn reducing their maintenance costs and increasing reliability.

Although uncooled thermal cameras are less sensitive than their cooled counterparts, they're still highly effective for security surveillance, perimeter protection and process monitoring. The affordability of uncooled thermal cameras has allowed businesses and public sector organisations alike to consider their deployment for broad applications.

Detection and recognition

The process of detection, recognition and identification is of paramount importance in security applications. Detection refers to the initial spotting of a potential threat, while recognition involves determining whether the detected object is a person, vehicle or another entity. Identification is the most detailed stage whereby specific characteristics, such as facial features or clothing, are discerned.

Understanding the capabilities and limitations of thermal imaging technology will be essential for successful deployment. While thermal imaging cameras detect potential threats by analysing heat differentials, the addition of integrated surveillance technologies can be extremely beneficial, particularly so when considering visual confirmation.

Since thermal cameras don't capture colour or fine visual details, they're often used in conjunction with high-definition optical cameras as an integrated 'hybrid' dual camera head solution. For example, a thermal camera might detect an object at a long range and trigger an alert, prompting an integrated HD surveillance camera to provide a clearer view for the purposes of identification.

This hybrid approach ensures that security teams receive accurate and actionable intelligence, reducing false alarms and enhancing response times. It's important to note that the use of thermal imaging cameras alone is unlikely to yield images of use for evidential purposes.

To optimise this process, there are highly effective hybrid solutions available

that integrate thermal and optical HD surveillance within a single housing. These dual-camera head solutions provide high-resolution images even in challenging conditions, such as those involving haze and darkness.

In addition, ONVIF compatibility ensures seamless integration with leading third party video management software platforms and advanced analytics, allowing for automated tracking and the identification of detected threats.

The combination of thermal and optical imaging is particularly beneficial for perimeter security. When a thermal camera detects an anomaly, an optical PTZ camera can automatically zoom in and provide a detailed view of the subject, including a colour identification for clothing. This allows trained security operators to make informed decisions about whether a threat is genuine and how best to respond.

Some advanced systems also incorporate Artificial Intelligence (AI) and machine learning algorithms to further enhance detection accuracy and reduce false positives caused by animals or various environmental factors.

Core applications

Thermal imaging cameras can be used to great effect in airport security scenarios where the monitoring of vast perimeters and high-traffic areas is essential. These cameras provide clear imaging regardless of lighting conditions, helping to identify suspicious movements and prevent security breaches. In addition, they can play a role in thermal screening for potential health threats (such as fever detection, for example).

Other transport hubs, including railway stations and ports, can use thermal imaging to monitor passenger movements and detect suspicious activities. Construction sites employ thermal cameras to prevent unauthorised access and detect potential safety hazards.

In addition, ONVIF compatibility ensures seamless integration with leading third party video management software platforms and advanced analytics, allowing for automated tracking and the identification of detected threats

Prisons and border security require 24-7 monitoring to prevent escapes and unauthorised crossings. Here, thermal cameras are being deployed to provide an effective solution for detecting movement in restricted or sterile areas, notably so in low-light conditions where conventional surveillance cameras may fail. They enable the authorities to respond swiftly to any detected anomalies.

Utility plants and Critical National Infrastructure sites rely on thermal imaging for both security and operational monitoring. In this type of application, the cameras are used to detect trespassers and unauthorised vehicles, while also identifying equipment malfunctions that could lead to costly downtime or the realisation of safety issues.

Surveillance challenges

As a business, 360 Vision Technology specialises in adapting and innovating technical surveillance solutions to meet the most rigorous of end user demands. This has been demonstrated by a recent project at a major power station.

Challenged with securing the expansive perimeter of this Critical National Infrastructure, the company faced a unique obstacle: the site's security video infrastructure could only accommodate analogue technology, thereby posing a potential limitation in today's digital era.

Drawing on over 20 years' worth of manufacturing expertise, the company engineered three Predator dual-view cameras. Each camera unit combines an optical video and thermal head delivering a high-performance analogue output perfectly suited to the site's infrastructure. This solution now supplies the system operator with comprehensive monitoring capabilities without compromising system compatibility or performance.

360 Vision Technology also implemented an innovative solution at the historic Clifton Suspension Bridge in Bristol, which faced significant security challenges due to its unique lighting conditions. At night, the structural illumination – itself designed for aesthetic appeal and visibility – posed a major challenge for traditional optical HD cameras, causing glare and reducing the effectiveness of standard surveillance.

In order to overcome these limitations, 360 Vision Technology proposed deploying a camera option from its advanced thermal camera range. The available camera configurations include dual-view analogue and thermal, HD and thermal, thermal with zoom and

PoE-powered. These cameras operate effectively regardless of lighting conditions (including complete darkness) and are resilient to varying weather conditions such as those experienced at the Clifton Suspension Bridge.

The integration of the thermal cameras with sophisticated video analytics enables real-time alerts for security personnel. Virtual tripwires are used to detect any unauthorised activity and swiftly notify the team of potential security breaches, in turn facilitating prompt response measures to mitigate risks effectively.

These enhanced surveillance capabilities ensure continuous monitoring and protection of this iconic landmark structure, safeguarding it against potential security threats both in the daytime and in the hours of darkness.

Going beyond security

In industrial settings, thermal imaging is widely used for monitoring equipment performance, checking for overheating components and preventing failures before they lead to costly downtime. Power plants, oil refineries and manufacturing facilities use thermal cameras to inspect electrical systems, detect leaks and identify structural weaknesses in machinery. This predictive maintenance approach increases efficiency and safety, helping organisations avoid catastrophic failures.

Fire and Rescue Services and emergency response personnel rely on thermal imaging cameras to locate fire 'hotspots' and detect trapped individuals in smoke-filled environments. Unlike standard cameras that struggle in low-visibility conditions, thermal imaging provides clear visuals, making rescue operations faster and more efficient.

Fire detection systems also use thermal cameras to identify potential fire hazards at industrial sites, in warehouses and at recycling plants where the spontaneous combustion of materials like paper and chemicals can occur.

Thermal imaging is also used in the medical field for detecting fever and monitoring body temperature. Airports, hospitals and public spaces implemented thermal screening during the COVID-19 pandemic in order to identify individuals with elevated body temperatures.

Beyond pandemic-related applications, medical professionals use thermal imaging to diagnose circulatory disorders, inflammation and other types of health conditions.

In wildlife conservation, thermal cameras are helping researchers to monitor nocturnal animals, track endangered species and detect poachers.

The agricultural sector also benefits from thermal imaging by using the technology to monitor crop health, assess irrigation effectiveness and spot pest infestations before they're able to spread.

On the road ahead

As AI and machine learning continue to advance, the role of thermal imaging in the security space and beyond will expand further. AI-powered analytics will improve object recognition, enabling thermal cameras to differentiate between humans, animals and environmental elements more accurately.

Additionally, improvements in sensor technology will undoubtedly enhance the resolution and clarity of thermal images, subsequently making them even more useful for critical applications.

Given ongoing innovations and decreasing costs, thermal imaging is becoming an indispensable tool in modern security surveillance and operational monitoring. Organisations looking to bolster their security and efficiency should strongly consider integrating thermal imaging into their technology mix to stay ahead of potential threats and challenges.

Ultimately, the integration of thermal and optical surveillance yields a versatile solution for modern security challenges, ensuring reliable detection, identification and situational awareness. It's a compelling combination.

Tony Holloway is Technical Solutions Manager at 360 Vision Technology
www.360visiontechnology.com

Ultimately, the integration of thermal and optical surveillance yields a versatile solution for modern security challenges, ensuring reliable detection and identification