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How thermal cameras can help prevent the spread of COVID-19

Thermal body temperature solution applications

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Introduction

Thermal cameras can play an important role in helping organizations to prevent the spread of COVID-19.

Around the world, governments are responding to the unprecedented circumstances related to the coronavirus (COVID-19) epidemic. In many countries and regions, authorities have placed restrictions on their citizens movements and have increased guidance on the basic hygiene required to reduce the spread of the virus. The primary aim of this activity is to reduce the reproduction number (R_o) of COVID-19 by limiting contact between groups of people as much as possible.

Similarly, many government and healthcare authorities have provided guidance on the key symptoms associated with the disease. One of the key symptoms is an increased body temperature or fever.

Graphic 1. European government led advice on covid-19 symptoms and response

	United Kingdom (UK)	Germany	France
symptoms	• High temperature • New, continuous cough	• Flu-like symptoms such as dry cough, fever, a runny nose and fatigue • Difficulties breathing, an itchy throat, headaches, joint pains, nausea, diarrhea and shivering	• Respiratory infection (a fever or feverish feeling, a cough)
Action	• Stay at home / self-isolate • Contact GP/doctor or 111 online service • Do not attend doctor or pharmacy	• Stay at home / self-isolate • Contact doctor / health office	• Stay at home • Avoid contact (self-isolate) • Call doctor if symptoms get worse
Source	National Health Service website (www.nhs.uk)	Federal Ministry of Health website (www.bundesgesundheitsministerium.de)	French government website (www.gouvernement.fr)

How can thermal cameras help?

There are several activities and approaches being applied to help reduce the reproduction rate of COVID-19. These include self-isolation methods such as working from home, improved basic hygiene such as increased hand washing and the deployment of personal protective equipment (PPE) to reduce the prospect of infection.

Similarly, when symptoms appear there is clear guidance on what to do next. Primarily this involves limiting social contact through self-isolation for up to 14 days. Medical professionals should be contacted digitally if symptoms persist or deteriorate. Ultimately, prior to any vaccine being available, the fight against COVID-19 is being led by the ability to detect symptoms and isolate people suspected of an infection. This is a combined effort between different key workers and technology applications.

Thermal cameras can play a part in this coordinated approach. These cameras provide thermal imaging for body temperature solutions which can quickly and accurately identify people with elevated body temperatures, one of the key symptoms of COVID-19. These solutions can provide organizations with an additional layer of protection to their facility from increased exposure to the coronavirus.

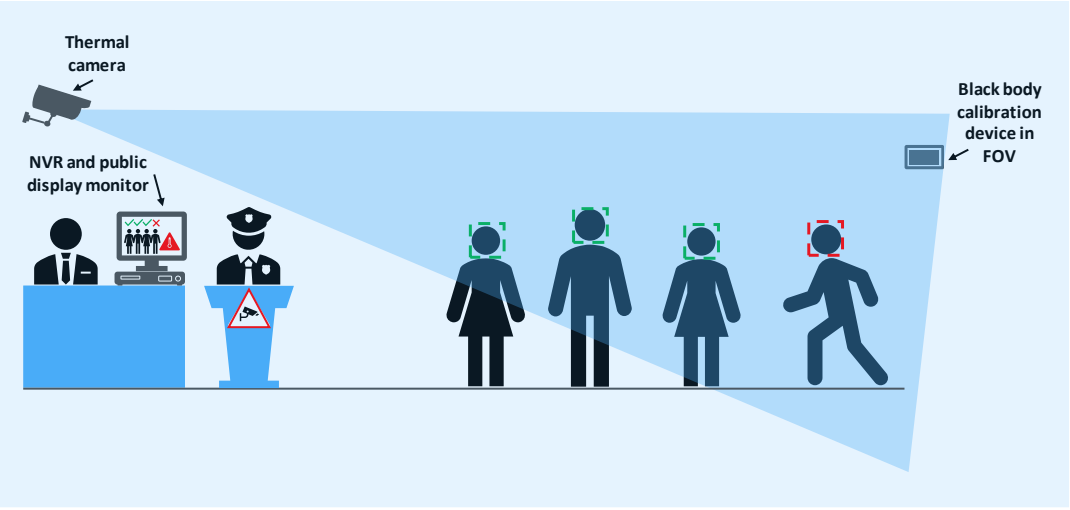
Organizations can then decide how best to deploy this information based on region, culture and the critical nature of the facility. In some circumstances a security officer may ask the person to scan their temperature using a medically approved sensor. In others, the person may be denied access to the facility. Ultimately, it is a decision for each organization on how best to deploy the solution.

Thermal body temperature solutions

An important distinction to make in the overall societal response to COVID-19 is that body temperature solutions are not a medical solution. They cannot identify the virus and they do not protect organizations or individuals from catching the virus.

Thermal body temperature solutions are a tool that can support the identification of a key symptom of the disease. They can help organizations identify people showing these symptoms, but they do not diagnose or treat COVID-19. However, this does not mean that thermal body temperature solutions do not add value in the overall response. In fact, they provide a non-invasive method to check body temperature, can do this at faster rates than hand-held scanners and at a greater (potentially safer) distance. The deployment of these solutions in a facility may even encourage positive behaviour with staff more likely to stay at home when they are unwell with a fever.

Graphic 2. Example of the components of a thermal body temperature solution



Thermal body temperature solutions require, at a minimum, a radiometric thermal camera to measure temperature differences in people entering the field of view. More advanced solutions will use blackbody devices to help calibrate the temperature measurement, especially in less controlled environments where the elements can influence the reading. AI (Artificial Intelligence) algorithms can also be integrated to help target the temperature reading on the most accurate part of the body, typically the forehead or near the eyes.

The blackbody calibration tool consists of a target object whose temperature is precisely known and controlled. Specifically, this is important in human temperature measurement where accuracy to +/- 0.3 degrees Celsius is advised by many international standards organizations. By deploying the blackbody calibration tool, it is easier to establish an accurate relationship between gray level and temperature. Essentially there is known,

fixed temperature object in the field of view which can be used to calibrate and measure all other objects' temperatures.

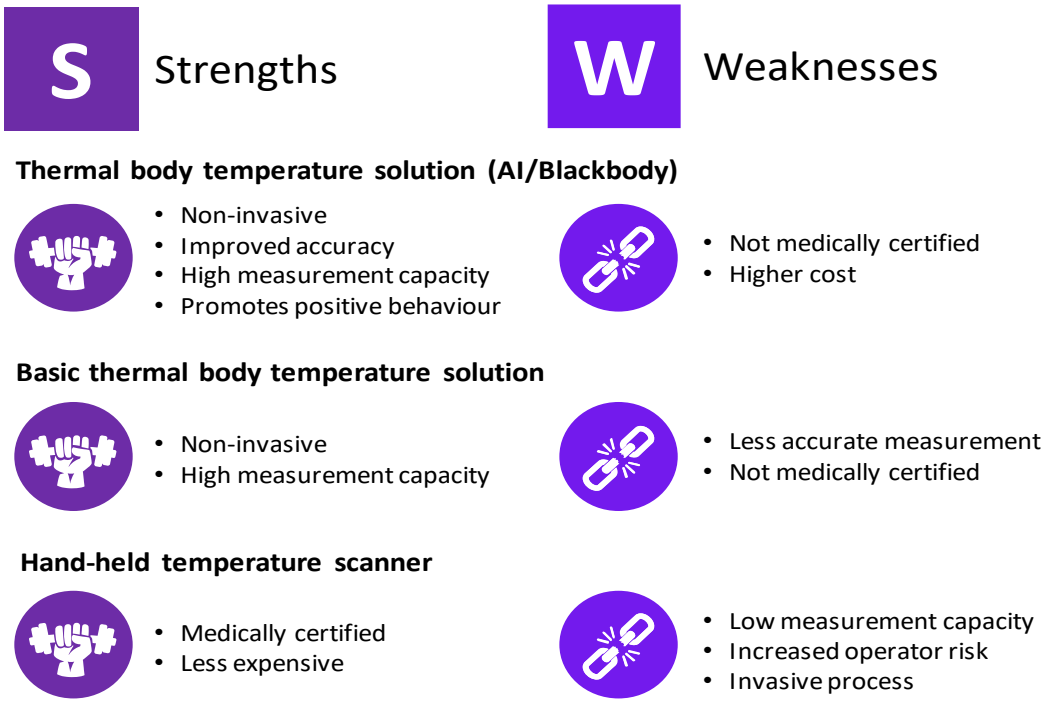
Using this method, false temperature alarms caused by environmental influence can be effectively reduced, and the accuracy of the thermal body temperature solution can be controlled to more precise parameters. However, monitoring accuracy does depend on the stability of the body temperature and it is recommended to install the system in a stable environmental condition to ensure that the skin temperature is stable.

The emergence of AI technology, and specifically face detection algorithms, will play an important role in the evolution of these solutions too. Algorithms can help complete more accurate temperature tests. Cameras can do this by locating specific areas of the face, such as the forehead or eyes, more accurately. This could be critical in the case of people wearing masks. Combining thermal cameras and facial detection can enable thermal body temperature solutions to combine accurate temperature scanning with the best face location to take the measurement from, improving the overall measurement accuracy.

It should also be noted that facial detection, as opposed to recognition, is used to improve the accuracy of the solution with better positioning of the measuring point on the face. It is not used to detect specific individuals and does not break privacy compliances (such as GDPR).

While there remain challenges to the effectiveness of thermal imaging cameras for measuring human body temperature in public areas, especially when face masks are commonplace, the introduction of facial detection and AI can improve the accuracy of temperature scanning.

Graphic 3. Strengths and weaknesses for different body temperature measurement solutions.



Managing expectations for use

Comparisons can be made between the current stage of the market for thermal body temperature solutions and another physical security technology: video analytics. Here, the expectation level for object detection or activity tracking algorithms was extremely high. The expectation was that video analytics would be near 100 percent accurate in spotting, identifying and tracking objects through the field of vision. However, analytics would sometimes mis-understand a scene, potentially alerting to the same object multiple times or mis-allocating an object – essentially false alerts.

The reality was that these solutions were often more accurate and reliable than the alternative – a human viewing the camera feeds. It is similar for thermal body temperature solutions. The alternative solution is to have someone manually take each person's temperature with a medically approved scanner as they enter a building or facility. This is slow, time intensive and places the person taking the temperature measurements at more risk. Manually measuring temperatures with handheld devices may also require greater amounts of PPE for the staff.

Thermal market applications are changing

The prevailing story for thermal cameras in recent years has been the growth of the market for uncooled thermal security cameras. These products have been created to sell at a fraction of the cost of cooled thermal cameras. Typically, high priced, long-range cooled thermal cameras are used in military or government border applications.

Uncooled thermal cameras have carved out a niche in the video surveillance market. Increasingly lower pricing has enabled the technology to move into new applications and end-user industries. In tandem, many traditional video surveillance camera companies have expanded their product lines to include thermal cameras. This is compounding the increased adoption and price declines.

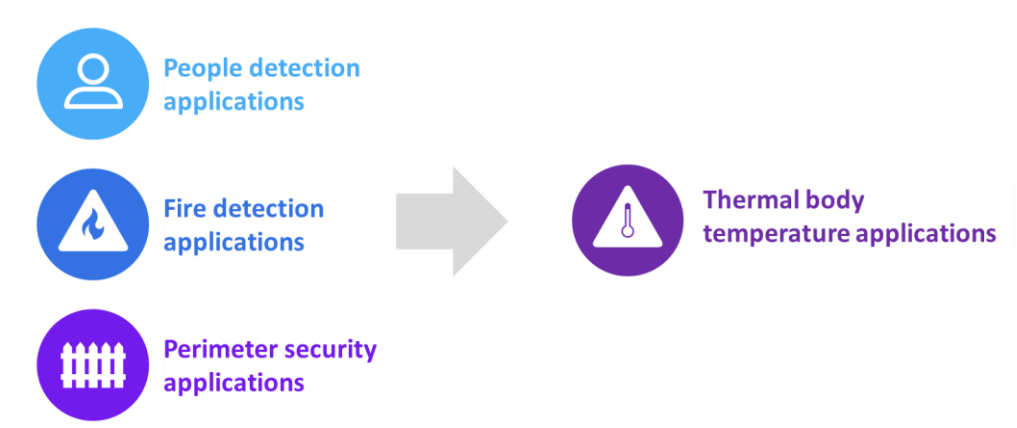
The uncooled thermal security camera market has started to commoditize. Cameras are comparatively affordable when compared to the options on the market five years ago which has increased their deployment. Thermal cameras are also being integrated into full perimeter security systems to bolster the existing system. These cameras are often being used in combination with both video analytics and visible light cameras. For this reason, dual head thermal cameras (with both a visible and thermal imaging sensor) will increase in popularity.

In the applications and end-user markets, the verticals that have been showing most opportunity are manufacturing, industrial, government and ports. These end-users have a need for perimeter security and fire detection applications where thermal cameras are well suited to support. An often-overlooked advantage of thermal cameras is that they can provide surveillance and detection without compromising the identity of those being surveilled. In markets with stringent data protection legislation, such as the General Data Protection Regulation (GDPR) in the EU, this is an important technology consideration.

Radiometric or thermographic cameras are a sub-set of thermal imaging which can measures the temperature of a surface by comparing different intensities of an infrared signal reaching the camera against a calibrated reference. Often this can be visualized via a coloured scale.

Typically, these cameras have been used for industrial inspection, such as checking the temperature in machinery to warn of overheating. The COVID-19 pandemic has enabled a new use for these thermal cameras. Now, thermal body temperature solutions represent a much larger percentage of the thermal camera application demand from integrators and end-users. Furthermore, end-users in commercial office buildings, transportation and government facilities are looking to deploy thermal camera solutions. The market for uncooled thermal cameras was forecast to hit nearly 200,000 units in 2020. These new solutions will likely add tens of thousands of unit shipments to the market opportunity.

Graphic 4. Thermal camera application evolution



This transition in application demand will support both short-term and longer-term requirements in the commercial market:

- Helping to identify people with high temperatures (fever) now.
- Helping to identify unwell people in the future to protect facilities.

Case studies: thermal cameras assisting with the coronavirus outbreak

As the number of Coronavirus (Covid-19) cases increases, so too does the demand for non-contact temperature measuring equipment. Especially in use cases that require mass scanning of the public such as in offices, airports, train stations and railway stations. Despite the challenges discussed there are already examples of thermal body temperature solutions deployed successfully in real world solutions:

- Thermal body temperature solutions have been deployed in large transport hubs where daily passenger flow is high, and it is not possible to manually check each person's temperature. In one project, more than 100 passengers have been detected with an abnormal temperature between deployment of the solution at the end of January and the 7th February 2020.

- Solutions have been deployed in multiple airport locations in different Latin American countries. In addition, these systems have deployed video analytics such as people counting and mask/face recognition to improve the accuracy rate.

- A large bus terminal in South East Asia has used body temperature solutions to identify people with fevers to better protect their passengers.

Future applications

While body temperature solutions have been available for some time, many of the solutions and applications related to COVID-19 have been created recently, in response to the pandemic. Consequently, many of the solutions available are designed for rapid and temporary deployments. There are many exciting potential opportunities for future technological and operational developments, some of which include:

Pedestrian access control gates

Physical access control is prevalent in most office buildings and transportation infrastructure. While the solution is primarily to prevent unauthorized access, there is potential to integrate body temperature solutions with these control gates. This could allow organizations to test the temperature of people looking to enter the building or transport hub. While there would be GDPR implications in storing the data alongside personal identifiable data, these types of solutions could make the entering and temperature reading process more integrated in many locations.

Blackbody location

In most of the recently deployed solutions, blackbody devices are located on tripods and not embedded aesthetically into the field of vision. If more permanent solutions were deployed in office lobbies or hotel reception areas, these devices could be integrated into the scene more covertly through different form factors.

Smart city dashboarding

City wide concepts have been described whereby citizens' temperatures would be taken as they enter a city through various transit locations. Smart city solutions, essentially big data applications, could use this information as another input to the system, helping the city to manage healthcare facilities and general citizen health. While there are clearly privacy concerns, the benefits of such a data set could help operationalize healthcare and assist with any necessary quarantining, particularly during epidemic or pandemic outbreaks.

Other video analytics

There is also potential to further integrate thermal body temperature solutions with other video analytics to provide greater health related functionality. Examples of video analytics which could be integrated include face mask and other PPE detection, social distancing (are people two meters apart) and handwash/anti-bacterial station use (ensuring everyone entering a facility uses a hand sanitizing station).

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www.omdia.com
askananalyst@omdia.com

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