Using CCTV for Human Temperature Detection

Abstract

As countries emerge from Lockdown as a result of the global COVID-19 virus outbreak, various plans for returning to some form of normal activity are being explored, whilst also seeking to minimize the transmission rate of the virus. One potential technical tool that is being considered is the use of Closed Circuit Television (CCTV) cameras to monitor the body temperature of people entering specific locations to assess whether they represent an enhanced risk of infection which merits further investigation.

This ASC Advisory Paper aims to assist independent security consultants, their clients and potential end-users understand the nature of this potential technical solution.

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1 Introduction

To better understand the use and application of enhanced CCTV technologies for the detection of temperature in people, the author chaired an online debate between four primary providers of this capability and members of the Association of Security Consultants. This is an informative paper aimed at enhancing understanding of the technology and its potential application. It does not seek to promote specific products or manufacturers. As each potential application is likely to require a bespoke solution, potential users are referred to seek the advice of a Registered Independent Security Consultant (RISC). Details can be found on the website of the Association of Security Consultants. www.securityconsultants.org.uk

2 Background

At the time of writing the UK and many other countries are just starting to emerge from Lockdown as a result of the Covid-19 virus outbreak. All sporting, hospitality and entertainment venues are closed. Transport is operating on a severley reduced basis and many businesses are in suspension. As part of plans to return to some form of normal activity, ways are being explored to open up activity whilst seeking to keep transmission rates ('R' value) of the virus, to a minimum (below one). The principal strategies being physical distancing, use of personal protective equipment (PPE) and testing.

One potential technical tool that has gained much ground recently has been to use Closed Circuit Television (CCTV) cameras to monitor the temperature of people entering a specific location to assess whether they have a raised temperature and potentially have a fever, which is one of the symptoms of the Covid-19 virus. Thus enabling operators to prevent individuals that are potentially infected from spreading the virus whilst allowing the venue to operate. This is acknowledged by the World Health Organisation as in Fig 1.

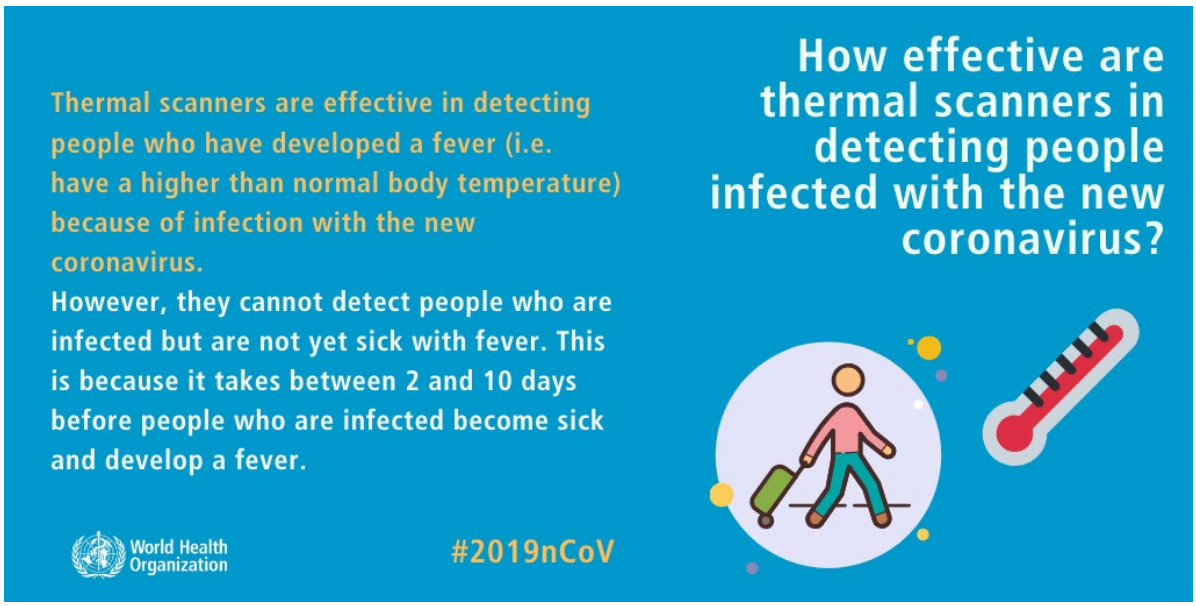

Fig 1. WHO advice

Thermal Imaging cameras which detect raised temperatures have been around for many years and are used in applications such as; industrial environments to monitor plant for potential points of failure, security to detect unlawful presence, Search and Rescue and fire detection. So the technology is available and many manufacturers are now offering thermal imaging products to detect raised temperatures in individuals.

At this point it should be made clear that thermal imaging cameras cannot identify that someone has Covid-19. Fever is only one potential symptom of Covid-19. Not all people infected with the virus will have a fever and fever can be a symptom of many other illnesses. Further, a raised temperature in an individual can be as a result of many other causes not related to illness. Therefore, using thermal imaging to detect a raised temperature in an individual can only be used as an indication that prompts further enquiry or action.

3 The Technology

As previously mentioned, thermal imaging technology has been around for many years in a variety of applications. The SARS outbreak in 2003 saw the first real use of the technology to detect temperature in individuals. However, the worldwide nature of the Covid-19 outbreak has seen its use in this feid increase substantially. As the UK and other nations start to emerge from total lockdown the demand for testing and screening of indivuals at venues or transport hubs is increasing. In 2017 the International Standards Organisation (ISO) published "ISO Technical Report 13154 (Medical electrical equipment - Deployment, implementation and operational guidelines for identifying febrile humans using a screening thermograph)" which sets out the specific guidelines for using technical devices such as cameras for medical screening. Most companies selling thermal imaging cameras for temperature detection do not describe their devices as medical equipment and therefore do not necessarily comply with specific requirements, but do tend to take reports such as this into account.

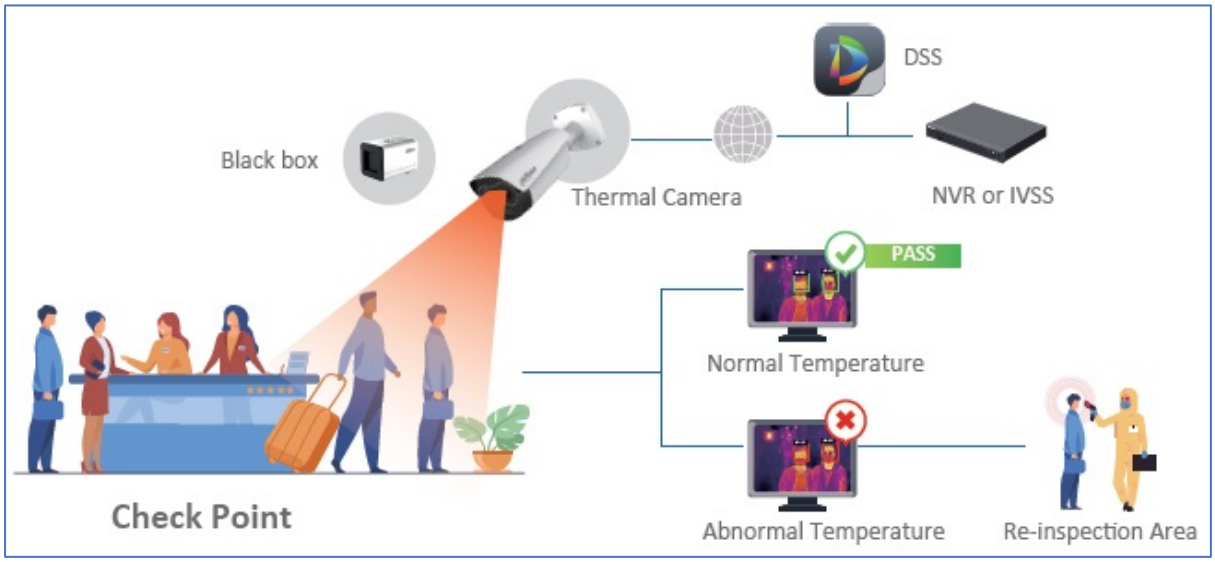

Fig 2. The screening process

Thermal imaging cameras detect temperature through an algorithm that compares the temperature of the pixels in a view, to the surrounding area and/or a reference source. For accurate measurement the area being measured should include at least 9 pixels (3x3). Most commercial thermal imaging devices can detect temperature to +/- 0.3° which is acurate enough to detect a raised temperature potentially caused by a fever.

Manufactures of thermal imaging systems make various claims about their performance. Some will claim that their system can detect temperature in 20 or 30 individuals simultaneously and can demonstrate this ability. However, this is of little practical use in this application as the more people in the scene, the harder it becomes to isolate a specific individual. To ensure that enough pixels are on the target area of an individual, measurement should take place at no more than three metres away, reducing the number of people that can be detected simultaneously to one or two.

When it comes to what part of the body to measure there are two competing methodologies. Each of which has advantages and disadvantages; these are forehead/face temperature, and tear duct temperature.

Skin temperature varies depending on the ambient temperature, but can be compensated for in all but the most extreme environments. Typically, it will be 1.6°/1.7° lower than core body temperature. The temperature at the tear duct in the corner of the eye is closer to the core body temperature so can provide a more accurate measurement.

Measuring forehead temperature provides a relatively large target area and can potentially be carried out while people are moving. It does not require individuals to remove their glasses. However, it can be affected by hair covering, hats, scarves or veils. Measuring the tear duct temperature will provide a result closer to core body temperature, but as thermal imaging cameras do not work through glass, will require the individuals to remove their glasses. It also normally requires the indivudual to be stationary.

Providing accurate detection to +/- 0.3° requires that the camera is accurately calibrated. This is normally carried out by having a “Black body source” within the scene. This radiates a known temperature, typically 36° - 38°, against which to measure. Another calibration method is to use the temperature of a number of the most recent measurements of individuals as a reference.

Recording of the imaging is not necessarily required. However, it may be a useful addition for training and future reference purposes. In some systems, the analytics are embedded within a recording device and therefore this forms an integral part of the system. If you are recording the images, you will need to comply with General Data Protection Regulations (GDPR) and the system will need to form part of the registration with the Information Commissioner.

4 What is Required?

There are two potential formats for setting up a screening process; temporary or rapid deployment and permanent or integrated. In a rapid deployment set-up the camera and black

body device, if used, are mounted on tripods in the screening area to monitor personnel passing through a temporary channel. In an integrated set-up the camera(s) can be part of the overall CCTV installation and monitored from a security desk or pedestal.

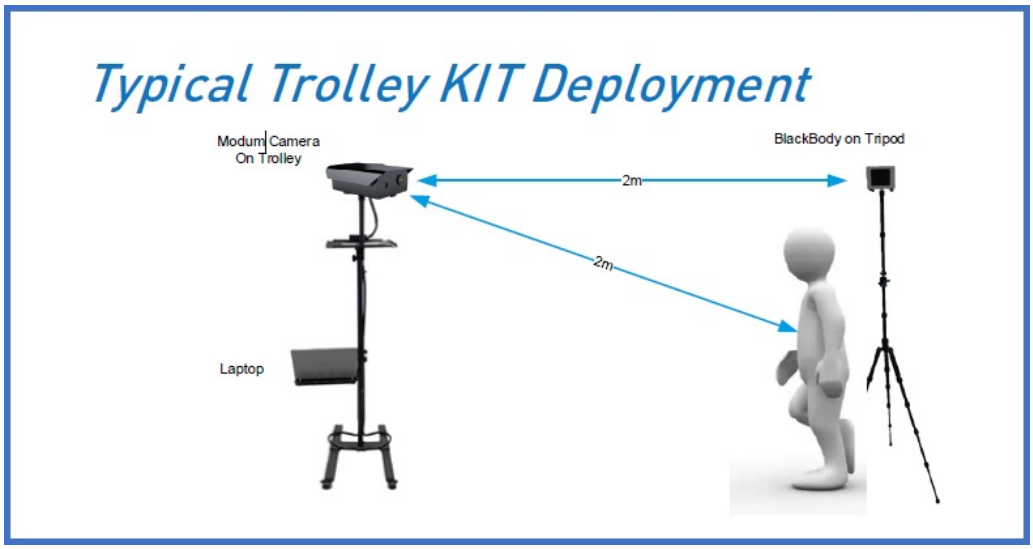

Fig. 3. Temporary set up

To implement a reliable screening process there are some principles that should apply, regardless of which manufacturers products are deployed.

1. The designated detection point should be within a building (either temporary or permanent) with a stable environment.
2. Personnel should be channelled through cordons to pass the detection device at the correct speed and distance for optimum performance.
3. Thermal imaging cameras should be positioned no more than 3m from the target individual, face on (or as close as possible), at normal head height (between 1.2m – 2.0m).
4. A calibrated thermal Blackbody device should be positioned within the scene as a reference.
5. The thermal image should be supported by a visible colour image (as in Fig 4. below) of the same scene to allow correct identification. This may be within the same camera housing or as a separate device.
6. The cameras should be monitored locally to the detection point to allow swift notification and identification.
7. The system should include a visual or audible warning locally.
8. All images should be recorded for later review, retrieval, and possible use in evidence.
9. The detection point should be positioned so that there is adequate opportunity to intervene safely and prevent anyone identified by the system from passing into the venue.
10. A second, medical means of temperature verification is likely to be required.

11. A robust strategy will be required for dealing with any indication of raised temperature.

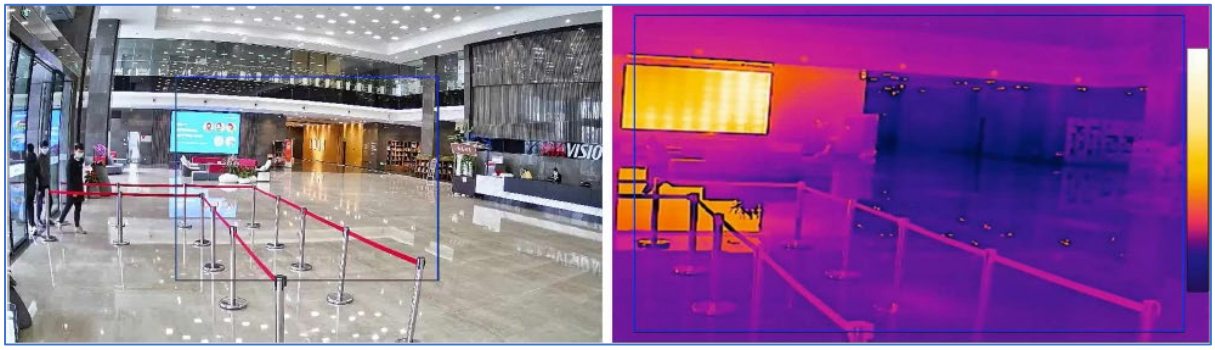

Fig 4. Images from a bi-spectrum camera

5 Managing the Process

In many ways, detecting personnel with a raised body temperature is the easiest part of the process. The next phase in the process i.e. what to do with the information and individual, can be more complex. Therefore, a detailed strategy will be required and staff dealing with the process will need to be trained not only to use the equipment but on how to deal with the information. They will also require the correct PPE for the task.

As stated previously, the camera is not a medical device and cannot detect Covid-19. Therefore, if the equipment indicates a raised temperature it is likely to be necessary to confirm that the individual indeed does have a raised temperature due to a fever. This may require allowing the person to rest and then taking their temperature again using a medical thermometer. Who should carry this out? Can an organisations customer service team, security staff or security contractor carry this out, or does it require a nurse? If it is decided to ask people to submit to a second test where will you do this? It may be necessary to provide a private room or cubicle for this (as in Fig 5).

If a person is detected with an apparent raised temperature and this is subsequently confirmed, what if any advice and support should be provided? Should entry or access simply be denied and turn the person around or should further support be provided? This will of course depend on the relationship with the person being tested (employee, customer). If the person arrived by public transport should they be sent back the same way risking them spreading the virus further in the community?

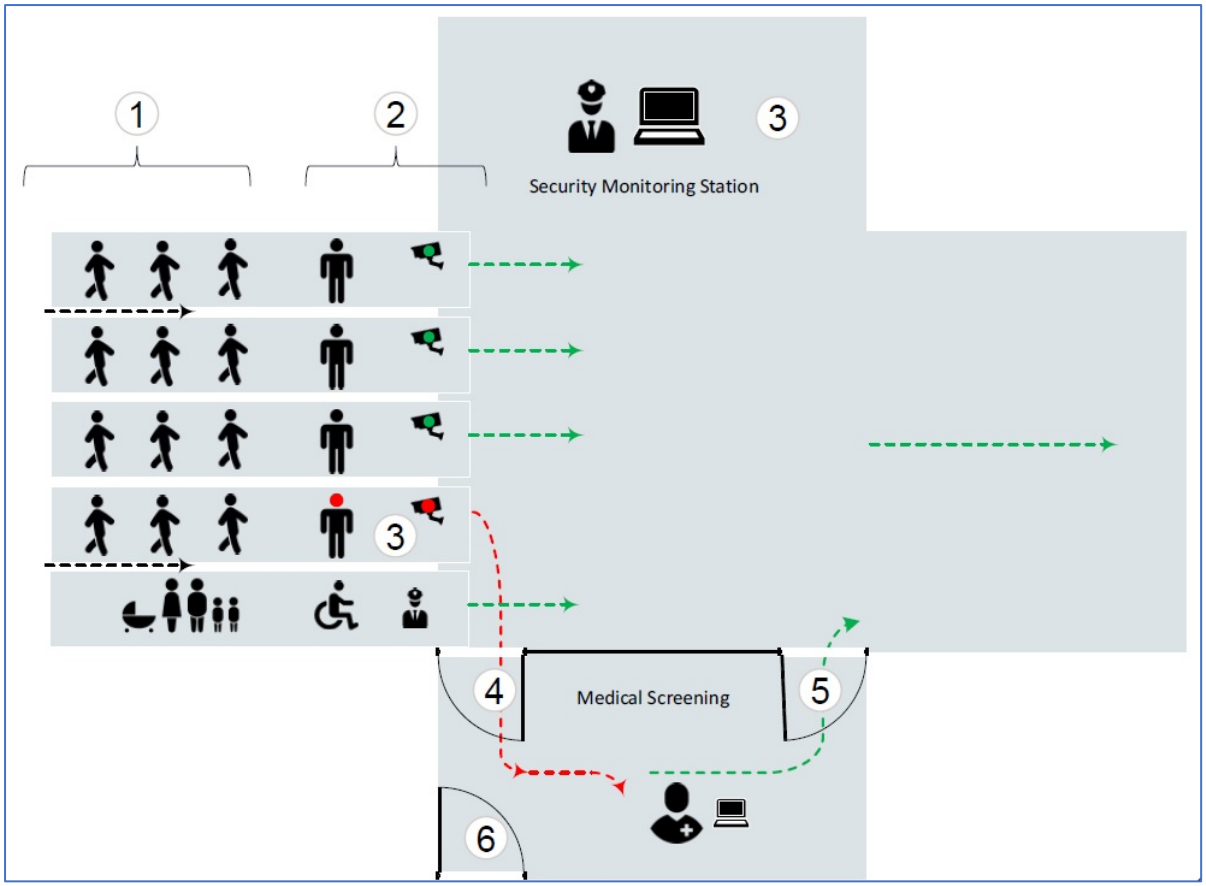

Fig 5. Typical screening layout for a large venue

If employees are being tested on entry to their workplace, the testing process and any actions in response to the test will need to comply with employment law and their terms of employment. If an employee displays symptoms of Covid-19 they should self-isolate for 7 days and anyone they live with should self-isolate for 14 days. Anyone who displays symptoms should also apply for a test , details of which are available at the UK government website. Additionally, it may be necessary for colleagues who have come into close contact with the individual to self-isolate.

If customers who have paid for travel or entry to a venue or function are being tested, any actions will need to comply with consumer law and the organisations terms of business. If entry is denied because it is suspected that an individual has Covid-19, will a refund or compensation be provided because access to the venue has been denied?

6 Applications

There are a wide range of potential applications for temperature screening. Some of these are better suited to implementing a temperature screening process than others. Large transport hubs such as airports and major stations already have barriers or security positions where temperature can relatively easily be added to the existing checking process. Large

sports or entertainment venues and large employment places may have space where a screening process can be set up relatively easily.

Where space allows, temporary facilities can be established. These may include marquees, containers or other temporary buildings. In other locations where buildings or facilities open directly onto public streets or walkways it may be necessary to establish a smaller set up. In such situations, consideration will need to be given to providing safe queuing taking into account physical distancing.

7 Summary

As the above has demonstrated, implementing a screening process will require a detailed strategy guidance and training. Key points to consider are:

- Is there adequate space to establish a screening process within the premises. Will a temporary facility be required?
- Providing a channel to direct personnel past the screening device.
- Selecting a supplier whose technology suits the specific situation.
- Establish clear performance criteria for the system and carry out trials of prospective systems.
- Providing signage or adequate information to personnel being screened about the use of the technology.
- Preparing a strategy for the screening process.
- Planning and documenting how a positive indication will be followed up.
- Training staff on the equipment and follow up process.
- Provide staff with the correct PPE equipment.
- Consulting with unions and/or employee representatives.
- Reviewing relevant legislation.
- Taking legal advice on how to implement actions from positive indications.
- Providing support or advice for individuals with positive indications.

8 Final Thought

As this is a relatively new application for an existing technology, several trials of thermal imaging systems are currently planned, underway and recently concluded. The results of these have been mixed, with some inconclusive and some failing to achieve the manufacturers quoted performance criteria. Anyone considering implementing the use of thermal imaging cameras for temperature detection should carry out their own trials to establish if the prospective suppliers' systems deliver the performance required from the technology.

We will be monitoring the outcomes of as many of the trials as possible and report what we can on the ASC website.

9 Further information sources

https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/myth-busters

https://www.gov.uk/coronavirus

https://www.nhs.uk/conditions/coronavirus-covid-19/

10 About the Author

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11 Acknowledgements

Association of Security Consultants http://securityconsultants.org.uk

Gary Thomas (gary@elite-sc.com) for additional content.

WHO - myth busting poster

https://www.dahuasecurity.com/uk - Fig 2. Screening graphic

https://www.flir.co.uk/ - Fig. 5. Typical screening layout for a large venue graphic

https://www.hikvision.com/uk - Fig 4. Images from a bi-spectrum camera graphic

https://silentsentinel.com - Fig 3. Temporary set up graphic