SARS is very contagious and spreads rapidly at places where large crowds gather such as airports.

KEEPING THE SPREAD OF SARS UNDER CONTROL

Infrared thermography helps to reduce the spreading of SARS virus

Since the outbreak of the SARS virus, travelers are monitored with infrared cameras for signs of elevated body temperature. A fever is one of the first symptoms of a possible SARS contamination.

Severe acute respiratory syndrome (SARS) is a respiratory illness recently reported in Asia, North America, and Europe. A quickly developing fever greater than 38°C is an early warning sign of SARS. Other early symptoms may include headache, an overall feeling of discomfort, and body aches. Some people also experience mild respiratory symptoms. After 2 to 7 days, SARS patients may develop a dry cough and have trouble breathing.

Installation of an IR system at Hong Kong airport.

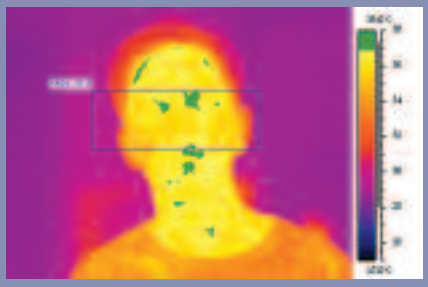
The primary way that SARS appears to spread is by close person-to-person contact. Potential ways in which SARS can be spread include touching the skin of other people or objects that are contaminated with infectious droplets and then touching your eye(s), nose, or mouth. This can happen when someone who is sick with SARS coughs (or sneezes) droplets onto themselves, other people, or nearby surfaces. It also is possible that SARS can be spread more broadly through the air or by other ways that are currently not known.

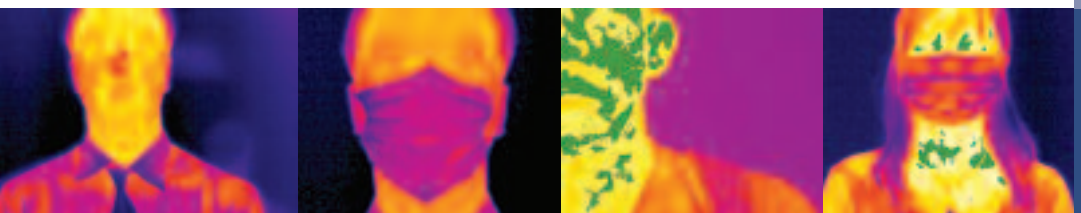
SARS is a very contagious disease and therefore spreads rapidly at places where large crowds gather such as airports, train stations, hospitals, schools, and factories. The aim is to detect possible SARS patients as early as possible to reduce the possibility of infecting others.

Infrared thermography: an effective tool to detect elevated body temperatures

An infrared camera is a simple and very effective tool to detect people infected with SARS at an early stage of the disease.

The ThermaCAM™ automatically detects the hottest temperature within an area, set by the operator. Furthermore a colour alarm makes it easy to decide whether a person needs futher examination or not.





An infrared camera produces thermal images, or heat pictures. Based on these thermal images, accurate temperature measurements can be made to detect even the smallest temperature differences when looking at human bodies.

Human body temperature is a complex phenomenon. Man is homeothermic, and produces heat, which must be lost to the environment. The interface between that heat production and the environment is the skin. This dynamic organ is constantly adjusting to balance the internal and external conditions, while meeting the physiologic demands of the body.

Numerous medical specialists have discovered that infrared is a reliable and quick non-invasive method to detect hot spots, as this technique provides a visual map of skin temperatures in real time. Infrared is widely accepted as an accurate and reliable tool for medical assessment and diagnosis.

Able to measure differences in the surface temperature of the skin as small as 0.08°C, one of the obvious applications of infrared thermography is to detect whether a person has an elevated body temperature (fever) or not. Since a rise in body temperature is one of the first symptoms of SARS, the infrared camera detects the potential SARS patient at a very early stage allowing for further examination.

Detecting possible patients easily

It is extremely easy to detect whether a person is a possible SARS patient or not. All that needs to be done is make an infrared image of the subject and see if their body temperature exceeds a certain value. Thanks to the infrared camera's built-in functions like colour and sound alarms, the operator can instantly decide whether the subject needs further examination or not. Since the infrared camera produces images in real-time (at a rate of 50 Hz), the total evaluation process takes less than a second. This makes infrared technology very useful for rapidly screening large numbers of people. However, a few things need to be taken into account.

Setting up the infrared camera for SARS detection

Infrared cameras are very sensitive devices. FLIR Systems ThermaCAM™ series cameras can measure temperature differences as small as 0.08°C. However, the absolute temperature readings have an accuracy of ± 2°C. This means that if we measure a body temperature in the corner of the eye of 36°C, the real temperature could be somewhere between 34°C and 38°C.

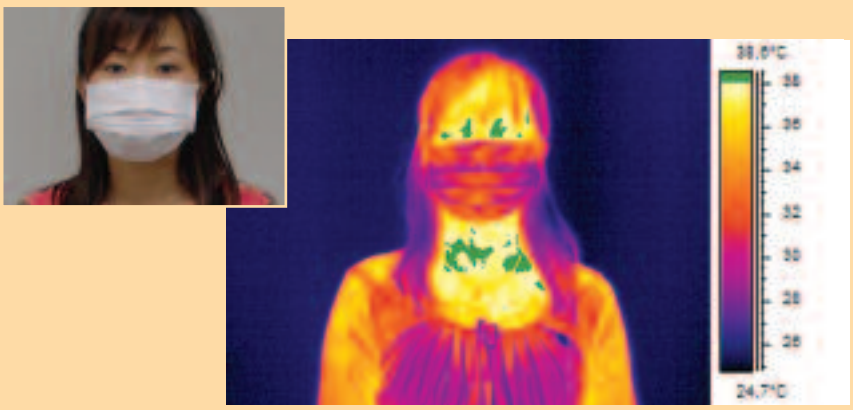
Fortunately, it is not necessary to measure absolute temperatures to determine whether a person has an elevated temperature or not. Since the normal body temperature varies very little between healthy people, a comparative method can be used. Here is the process:

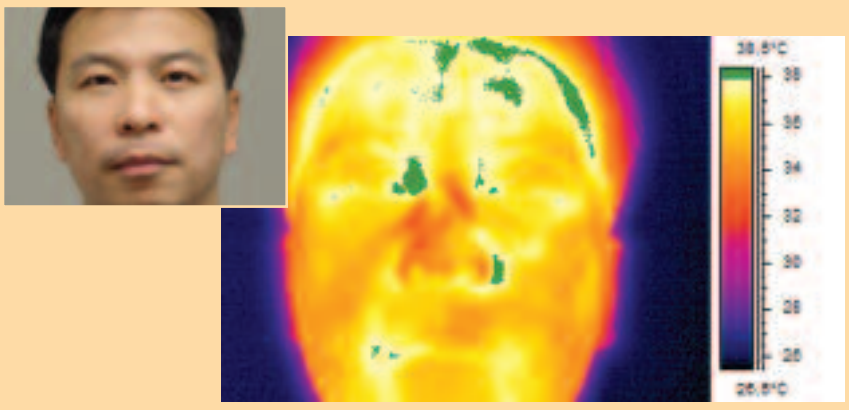
The true body temperature, of approximately 10 to 25 healthy people, is measured with a medical ear thermometer. The face temperature of these same people is measured with a ThermaCAM. Next, the average temperature difference is calculated. This means the true body temperature minus the face

Using a FLIR Systems ThermaCAM for detecting possible SARS patients:

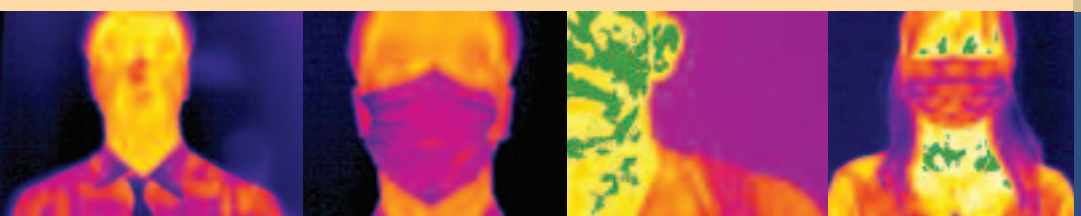
- Assure that there are no hot objects such as lamps in the field of view of the camera. The camera should be turned on at least 30 minutes before measurement starts and carefully focused.
- Set the emissivity value to 0.98.
- Determine the average temperature of a healthy person by using an ear thermometer and an infrared camera (or utilise the built-in ATC function).
- Add 1°C to the average temperature of a healthy person to obtain the critical temperature.
- Set an area in the infrared camera.
- Set the colour and sound alarms to signal if the temperature within the area is higher than the critical temperature.
- Bring the subjects to be tested, one by one, in front of the camera. Each for about 1 second.
- If the alarms signal, detour the subject for further examination.

Infrared and visual image of 2 subjects with an elevated body temperature. The colour alarm clearly shows the parts of the head with a temperature higher than 38°C.





The average temperature of a healthy person can be determined with an ear thermometer or with the Automatic Temperature Compensator in the FLIR ThermaCAM.



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First experimental set-up in the lab. The FLIR Systems IR camera is set to generate both a colour, visible and audible alarm.

temperature. Experience has shown that this average temperature difference is fairly constant and varies between 0.8 and 1.2°C depending on the environmental conditions where the test is done e.g. air conditioning, wind, cold weather etc. Using this method, the infrared camera will measure the face temperature of healthy people between 35-36°C.

Once the average temperature of healthy people has been determined by the infrared camera, a trigger can be set to generate an alarm whenever the measured temperature reaches the average plus 1°C. This corresponds to the recommendation that the body temperature of a feverish person is about 1°C higher than a healthy person.

Whether that average temperature turns out to be 32, 34, or 36°C makes no difference, as long as it can be correlated to the core temperature, and is stable. The purpose is to differentiate the people who are well from those that have a fever and not to measure absolute body temperatures. The absolute error measured on both the threshold values and the subjects tested will be the same, as long the camera is stable.

A unique FLIR Systems feature: the Automatic Temperature Compensator (ATC)

FLIR Systems has equipped its SARS detection cameras with an Automatic Temperature Compensator (ATC) to improve the reliability of this method and to avoid generating false alarms, or even worse, losing some real temperature rises.

The ATC constantly calculates a moving average of the body temperatures from the last 10 scanned people. The two highest and the two lowest values are not taken into account when making this calculation. Based on the outcome of this calculation the ATC will automatically adjust for the generation of visible and audible alarms.

Measuring the temperature of the human body

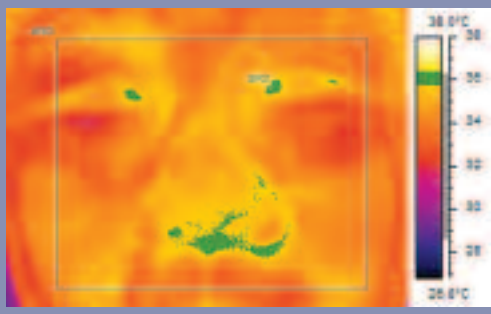
The general skin temperature of a person does not represent the core temperature so we have to identify those areas of the body that give us the most reliable result. Such areas are the auditory canal or the corner of the eyes. The most practical place where the skin temperature approaches the core temperature of the human body is in the corner of the eyes where the lachrymal duct comes to the surface.

It is therefore recommended that the people to be examined be directed to stop before the camera, at a predefined distance, so that their face will fill the entire image (in general at 1 to 1.6 meters away from the camera lens). This can be easily accomplished by putting a mark, such as a line, on the floor. The subject only needs to look into the camera for less than a second. Glass and plastic do not transmit infrared radiation, so people need to remove their glasses in order to be examined.

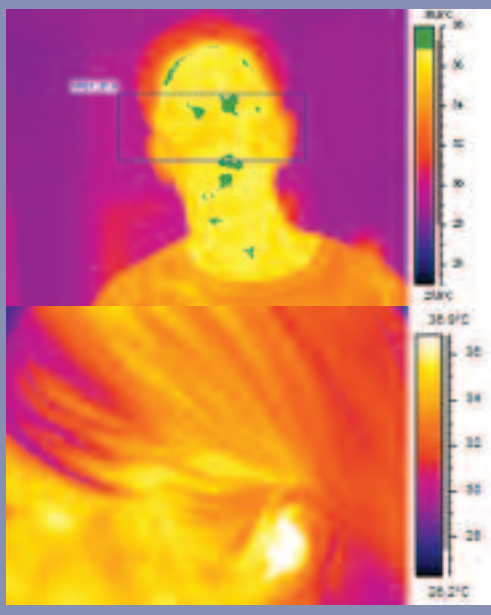
Since the highest temperature will be measured in the corner of the eyes, the subject can wear a mouth mask without influencing the measurement.

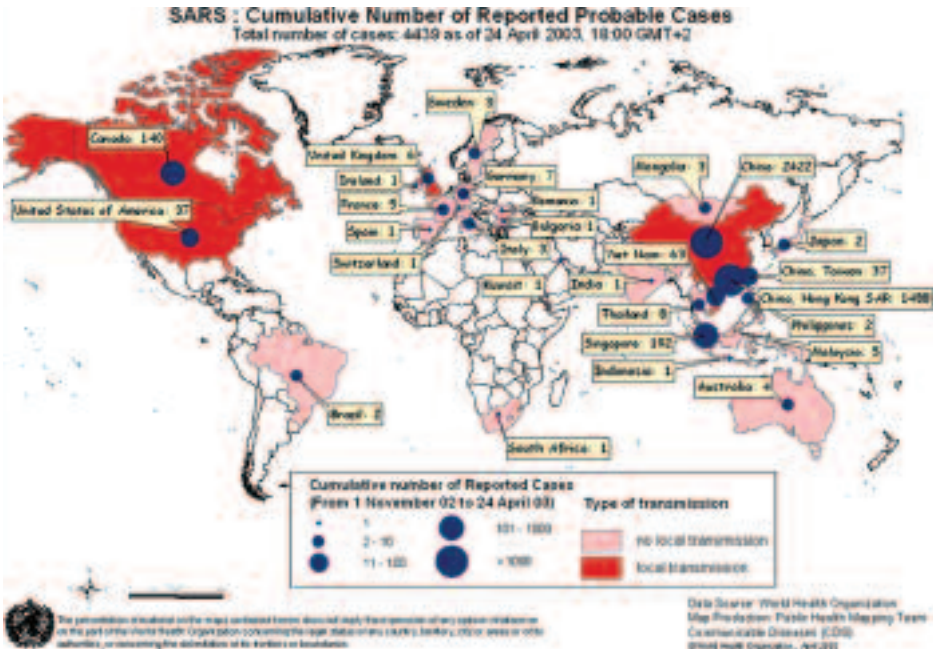
Note that persons need to be examined on an individual basis. It is not possible to scan a crowd with an infrared camera.

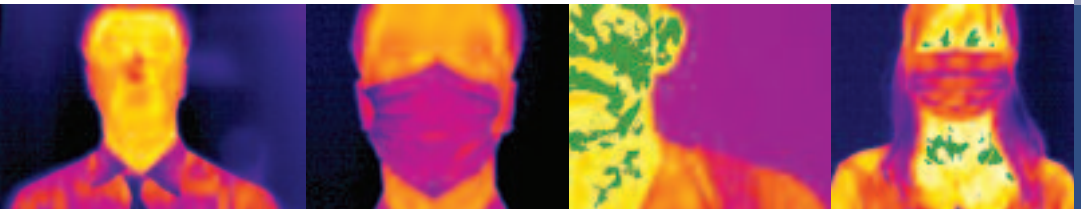
Setting up a ThermaCAM™ P60 with Automatic Temperature Compensator (ATC) at Singapore Cruse Centre.



The infrared image shows the hot spots in the corner of the eyes.







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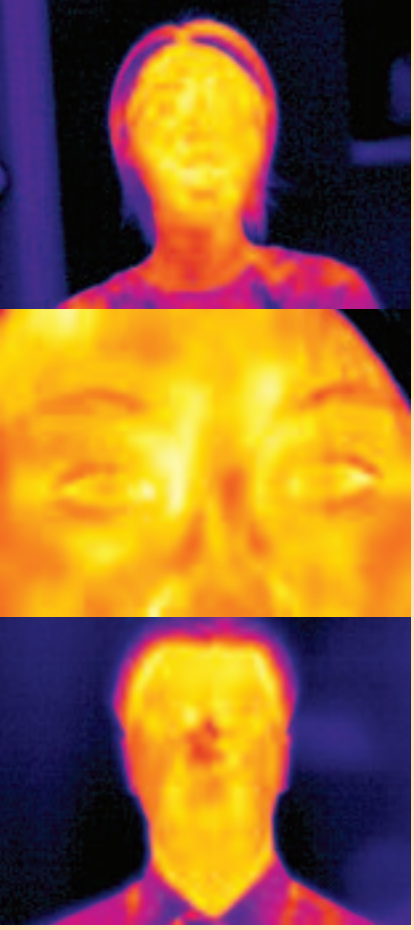

Quickly scanning a large number of people by using infrared cameras with colour AND sound alarms

In order to measure temperatures it is necessary to use a full radiometric camera, not an infrared imager. Recommended cameras to use are the FLIR Systems ThermaCAM™ P60 or ThermaCAM™ E2. Both systems can be battery operated for over 2 hours, or continuously by connecting to main power. The cameras are IP 54 rated so they can be used either indoors or outdoors.

Both cameras have built-in functions to measure the highest temperature inside a given area. In this case, the area is set to frame the face. The infrared camera will automatically detect the hottest spot within the area and its value can be immediately read on the built-in LCD of the camera or on a connected video monitor. Both cameras have also been optimised for fever detection as they will re-calibrate themselves more frequently to compensate for drift.

The cameras have a built-in colour alarm function in order to make an immediate decision if the subject requires further examination. This means that all areas, which are hotter than a predefined temperature value, can be immediately recognised on the infrared image. To make it even easier for the operator, FLIR Systems is the first to equip its cameras with a sound alarm. If the temperature exceeds a certain value, a buzzer alarm will go off.

A subject, activating the alarm, can easily be taken aside to determine his true body temperature more accurately with e.g. an ear thermometer. If necessary, he can be sent to a hospital for further examination.

Preferably the infrared camera will be installed at places where there is already a line of people such as just before passport or customs control. Although not necessary, it is recommended that the camera be installed on a tripod and connected to a video screen, to facilitate the working conditions of the camera operator.

A small investment to protect public health

Different airports in Asia are already using FLIR Systems cameras and have successfully applied this methodology to screen all people entering and leaving the country. It is a quick and non-invasive method, which is perfectly safe for both the camera operator and subject to be screened.

The results are extremely satisfactory. The FLIR Systems ThermaCAM™ has proven itself as a tool that can be operated by non-specialists after a few hours of training to quickly and accurately scan a large number of people for symptoms of SARS. As some officials have put it, it is a very small investment to protect public health worldwide.

Legal disclaimer: although infrared cameras are accurate temperature measurement devices, they have not been tested or qualified as diagnostics medical equipment. As such FLIR Systems cannot be hold liable for any error resulting from the use of these systems or errors in the interpretation of the results. The methodology as described has not been validated by clinical tests and should be used as a guideline only.

ThermaCAM P60 and ThermaCAM E2 both with colour and sound alarm and an Automatic Temperature Compensator (ATC). Both cameras are perfectly suited for SARS detection.

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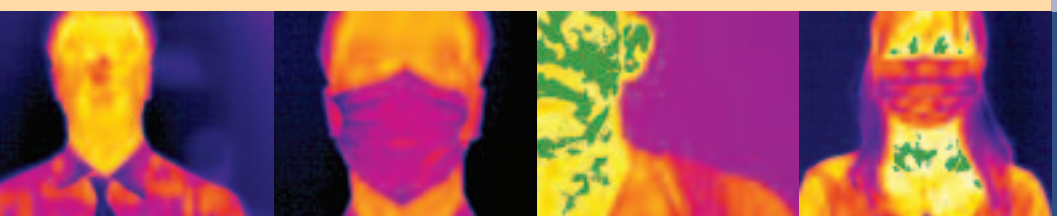

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