



Optotherm Thermoscreen

Thermal Imaging System for Human Fever Screening



Optotherm's fever screening technology provides the most accurate method of mass screening for elevated facial skin temperatures that may indicate a fever. Because it is both fast and noninvasive, Thermoscreen is the best way to safeguard areas with high pedestrian flow.

Thermoscreen was originally developed in response to the need to screen large numbers of individuals for potential fever during the SARS outbreak in 2003. Thermoscreen scans subjects without contact from a distance, providing a discreet and safe method of detecting potentially feverish individuals.

Over 1,000 individuals can be screened per hour so as not to restrict pedestrian flow. Thermoscreen is sold as a complete, fully tested system including a computer with preinstalled hardware and software.



Advantages

Highest Sensitivity and Specificity

The effectiveness of Thermoscreen has been studied and confirmed by the U.S. Center of Disease Control.

Lowest Rate of Missed Detections and False Positives

Thermoscreen's sophisticated measurement process involves precision calibration, face and movement detection, ambient temperature compensation, and subject group compensation. Together, these unique features provide unparalleled ability to reduce the number of missed detections and false violations. A low false violation rate allows Thermoscreen to be employed in applications where a high number of false positives are unable to be effectively processed.

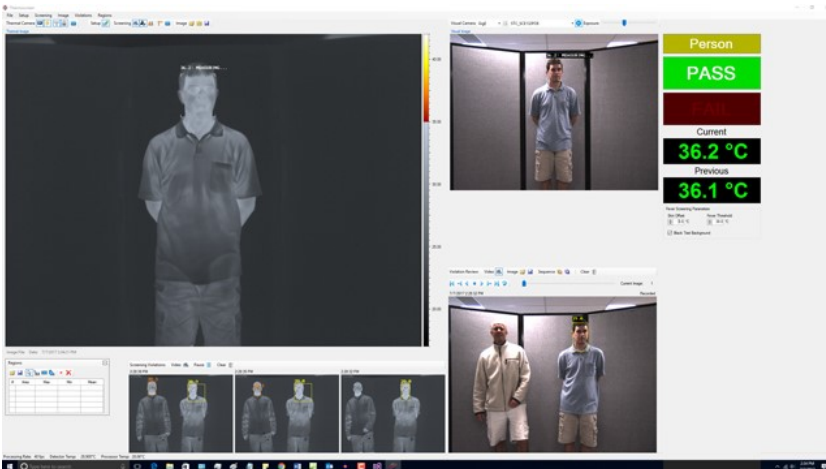
Overview

A primary symptom of many infectious diseases is fever. This has led to monitoring the temperature of pedestrians in hospitals, airports, corporate building companies, schools, and other public areas. Thermoscreen provides a non-invasive, non-contact method of screening large groups of people for elevated facial skin temperature quickly and easily. Potentially febrile individuals can be detected with minimal inconvenience and disruption to pedestrian flow.

Thermoscreen is best utilized as the first of a two-point fever detection process. At the entrance to crowded areas, Thermoscreen is used to detect individuals whose facial skin temperature is higher than normal. Fever is then confirmed using a medical thermometer. This two-point system enables large groups of people to be screened quickly and accurately to effectively prevent febrile individuals from entering areas where contagious diseases can spread easily.

System Hardware

- Easy to setup and operate
- 0.05°C sensitivity; 0.3°C accuracy
- Integrated visual camera
- All-inclusive turnkey system
- Mobile platform
- No external calibration source required



Fever Screening Software

- Simple user interface
- Operator-free automated screening
- Verbal commands and audible alarms
- Ambient temperature compensation
- Verifies subject is standing still
- Verifies subject is facing camera
- Violation image and movie display
- Automatic data and image logging
- Historical data display and graphing

How It Works

Thermoscreen's high-accuracy Infrasight infrared camera, manufactured by Optotherm, measures skin temperature by detecting and quantifying the infrared energy that is continuously being emitted from the face. As individuals walk up to the screening station, skin temperatures above a predefined threshold are detected and displayed in bright colors on the computer screen. Verbal instructions and screening results are announced through the computer's speakers and an audible alarm is activated to notify personnel that a temperature violation has occurred.

Integrated Visual Camera

A visual camera is mounted inside the camera enclosure next to the infrared camera to provide continuous visual images of subjects as they pass through the screening zone. Real-time video enables operators to quickly identify subjects as they are being screened. Highlighted areas and temperature values on the thermal image are transferred to the visual image so that operators can quickly process screening results.

Automated Screening Mode

Our patent-pending automated screening process simplifies the screening process, reduces the demands on operators, and improves screening measurement accuracy. Thermoscreen detects when a subject's face is in view and then issues audible instructions through the computer speakers to "please stand still and look directly at the camera." A large TESTING button illuminates on the computer screen to indicate that an individual is currently being evaluated.

After verifying that the subject is facing the camera and standing still, Thermoscreen performs the screening measurement and then audibly issues the results. Subjects with elevated skin temperature are instructed to "please wait here for an attendant" and passing subjects are instructed "thank you, you may proceed." You can even create custom messages for your specific screening application and language.

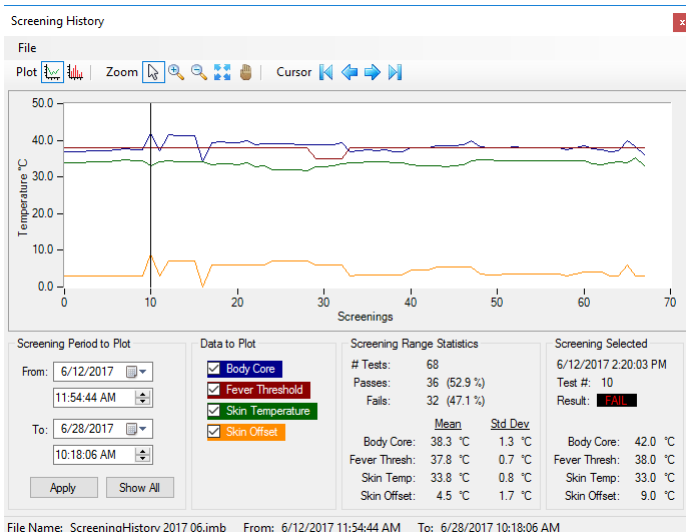
Fever Violation Images and Movies

To allow continued screening after a fever violation has occurred, the thermal images that were captured during the three most recent violations are displayed at the bottom of the screen. The top violation image displays the most recent violation. The time that each violation occurred is displayed above the image along with the screening measurement. Without stopping the screening process, operators are able to review and address previous violations.

To enable a more detailed review, the violation movie that was recorded during the selected violation can be replayed. Violation images, both thermal and visual, can be automatically or manually saved to hard disk for historical documentation.

Screening History

All screening measurements are recorded to hard disk to provide a historical archive that can be reviewed at a later time. Screening data can be displayed in a number of useful ways for trend analysis.

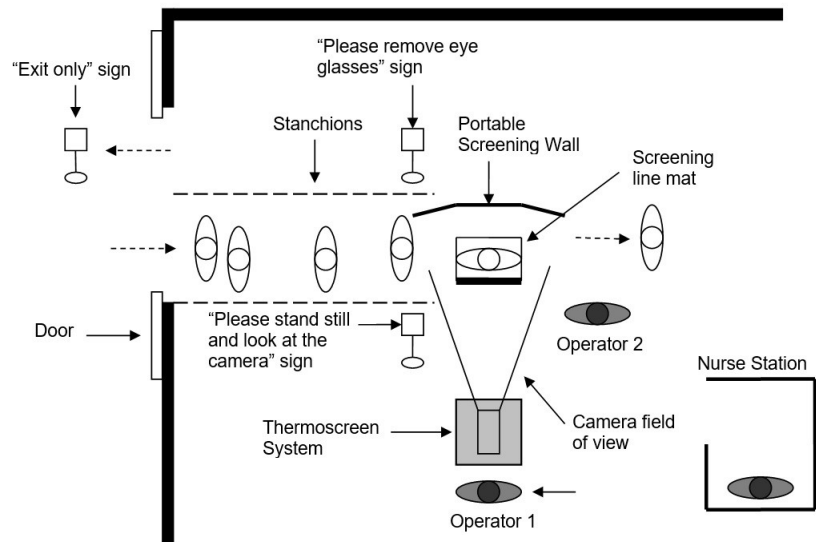


Screening Site Example

A Thermoscreen system is placed at the entrance of a hospital to screen patients and visitors upon entering the building (see figure). When operating in Automated Screening Mode that requires each individual to stop briefly to be screened, a single Thermoscreen station can effectively screen up to 1,200 subjects per hour.

Screening Area Setup

The screening area is climate controlled; the temperature varies from 20 to 24°C (68 to 75.2°F), and the relative humidity is approximately 70%. The screening area has diffuse ambient daylight and fluorescent lighting. The screening area is located far enough interior to minimize outside air striking the camera or screening alone that enters the building through the entrance doors.



As subjects enter the building, waist-high stanchions are setup to channel and direct them into a single file line. The screening line mat is placed 2m (6' 6" feet) away from the camera for subjects to stand on while being screened. At this screening distance, the screening zone is 195cm (6' 5") horizontally. The camera is aimed and focused in order to screen subjects with height from 61 to 207cm (2' to 6' 9"). Any individuals taller than 6' 9" are instructed to bend down so that their faces are in the camera's field-of-view.

Operator Training

A hands-on training session should be conducted by the purchaser to properly train all operators. Operators are trained to operate the Thermalyze software and to adjust the camera's aim. The Thermoscreen User Manual is kept on hand at the screening station for operator reference. The screening station logbook (not provided) is used by operators to record Thermoscreen usage and personnel on duty.

The Screening Process

Each subject is screened individually. Subjects are notified to "remove eyeglasses" (contact lenses do not need to be removed) and to "stand still and look at the camera." Subjects can be notified verbally by the operator or by using signs positioned along the line.

The Thermoscreen System detects each subject's face as they enter the screening zone and issues a verbal command through the computer speakers to "please stand still and look directly at the camera." After verifying that the subject is standing still and facing the camera, the screening measurement is automatically conducted and the screening result is displayed. In the case of a fever threshold violation, the audible command to "please wait here for an attendant" is issued. If screening result = Pass, "thank you, you may proceed" is issued.

Operator 1 operates the Thermoscreen system, examines the Thermal and Visual Images of subjects, and confirms Fever threshold violations. Operator 2 directs subjects into and out of the screening zone and also directs subjects whose facial skin temperature exceeds the skin threshold to the nurse station for further evaluation. If subjects are queued in line properly, screening each subject requires approximately three seconds.

Note: When screening throughput is low, a single operator can perform the tasks of both operator 1 and 2.

Competitive Advantages

Highest Accuracy

Thermoscreen is designed to be intrinsically accurate; a reference calibration source is not required during operation. Each Thermoscreen system undergoes an extensive calibration process. During operation, software algorithms provide real-time compensation for environmental variables that can affect screening results. Furthermore, Thermoscreen hardware is designed to prevent unwanted radiant energy from affecting screening measurements.

Many competing fever screening systems require a reference calibration source to be placed within view of the camera during operation to correct for camera inaccuracy. The use of an external reference source adds complexity, increases setup time, decreases portability, and places restrictions on the areas in which the system can be operated. In addition, the use of a reference source can lead to significant instability and measurement errors if misalignment occurs between the camera and source or if environmental factors cause the source temperature to drift during operation.

Integrated Visual Camera

A visual camera is mounted inside the camera enclosure next to the infrared camera to provide continuous visual images of subjects as they pass through the screening zone. Real-time video enables operators to quickly identify subjects as they are being screened. Highlighted areas and temperature values on the thermal image are transferred to the visual image so that operators can quickly process screening results.

Automated Screening Mode

Automated screening mode provides the most accurate and effective method of mass fever screening. Thermoscreen guides subjects through the screening process by issuing verbal commands, thus reducing the demands on operators, allowing them to focus their attention on processing fever violations. During the screening process, individuals are required to stand still to prevent image blur from degrading measurement accuracy. Important: Subject movement can reduce a subject's measured temperature by more than 3°C (5.4°F), resulting in ineffective screening measurements.

Because the facial skin temperature that indicates a fever can vary depending on time of day and other factors affecting specific subject groups, individuals are evaluated based on the screening measurements of previously screened subjects, not on a fixed temperature threshold. Evaluating subjects in this manner results in a screening process that minimizes missed detections and false violations.

Complete System

Thermoscreen is a complete system including radiometric infrared Camera, integrated Visual Camera, fever screening Software, computer, and Mobile Computer Stand. All software is pre-installed and each system is fully tested prior to shipment.

Product Technology Comparison

A number of different technologies have been evaluated and used in the past decade for mass fever screening. Below is a comparison of Thermoscreen operation and effectiveness with several of the most common mass fever screening tools.

Fixed-Mount Infrared Cameras

Thermoscreen is included in this category but is distinct from its competition by its unique method of fever screening called Automated Screening. Automated screening is a sophisticated measurement process involving precision calibration, face and movement detection, verbal commands, ambient temperature compensation, and subject group compensation. Together, these unique features provide unparalleled ability to reduce the number of missed detections and false violations. A low false violation rate allows Thermoscreen to be employed in applications where operators cannot attend to a high number of false positives. Furthermore, automated screening significantly reduces the demands on system operators, enabling them to focus their attention on addressing fever violations.

Hand-Held Infrared Cameras

Thermoscreen has the same advantages over hand-held infrared cameras as over fixed-mount cameras. Hand-held camera however, have other important disadvantages including the following:

- Holding the camera continuously leads to operator fatigue.
- Camera movement (even slight movement) leads to image blur, resulting in inaccurate measurements.
- Inconsistent screening distance between the camera and subject leads to inconsistent screening results.
- Cameras can be easily dropped and damaged.

Infrared Spot Pyrometers

Spot pyrometers are infrared measurement devices that measure the temperature of a single area. In the case of fever screening, this area is typically the forehead. Most spot pyrometers are designed to be used in industrial applications where their accuracy is not sufficient for effective fever screening. Because temperature is measured at a single spot, cooler areas of the skin are averaged with warmer areas, making it difficult to obtain consistent temperature measurements that correlate well with internal core temperature.

Infrared Temporal Scanners

These devices require operator contact with subjects and measure temperature by swiping a hand-held probe over the temporal artery. In order to screen a different subject, a new disposable cap cover must be installed on the probe. Operation of a temporal scanner requires practice and therefore measurement accuracy is influenced by operator skill. Thermoscreen can screen over 1000 subjects per hour, more than 10 times the screening rate of temporal scanners. Additionally, all subjects can usually be screened using a single Thermoscreen system. Studies confirm the importance of using the same instrument when screening subject groups in order to obtain consistent results.

Infrasight IS640 Testing and Certifications

EMC Specifications

The IS640 has been subjected to, and been shown to comply with, the EMC (Electromagnetic Compatibility) tests listed below in accordance with the requirements of the following specifications:

- IEC 60601-1-2 (4th Edition 2014 07): Medical electrical equipment – Part 1-2: General requirements for basic safety and essential performance – Collateral Standard: Electromagnetic disturbances – Requirements and tests
- EN 61000-6-1:2007: Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity standard for residential, commercial and light-industrial environments
- EN 61000-6-3:2007/A1:2011: Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments
- EN 61326-1:2013: Electrical equipment for measurement, control and laboratory use - EMC requirements Part 1: General requirements

EMC Tests Performed

- EN 55011:2009 - Radiated Emissions - Class B 30MHz - 1GHz
- EN 61000-4-2:2008 - Electrostatic Discharge Immunity - 2kV, 4kV, 8kV, 15kV (Air), 8kV (contact)
- EN 61000-4-3:2010 - Radiated Electromagnetic Field Immunity - 80MHz to 2.7GHz @ 10V/m 80% AM @ 1kHz
- EN 61000-4-3:2010 - Proximity Fields from RF Wireless - 80MHz to 2.7GHz @ 10V/m 80% AM @ 1kHz
- EN 61000-4-4:2012 - Fast Transient/Burst Immunity - I/O Lines (1kV)
- EN 61000-4-6:2013 - Conducted RF Immunity - 3Vrms (150kHz - 80MHz)
- EN 61000-4-8:2009 - Magnetic Field Immunity - 30A/m @ 50Hz & 60Hz

Thermoscreen Specifications

System Component List

- Optotherm IS640 thermal imaging camera (see specs below)
- Camera macroscopic lens (see specs below)
- Camera Link video board (Matrox eCI PCIe)
- Camera Link cable (3m)
- Optotherm Thermalalyze fever screening software (multithreading application)
- Lens cleaning kit
- Dell computer (see specs below)
- Visual camera (see specs below)
- PoE cable (3m)
- Dual camera enclosure
- Mobile stand (see specs below)
- Screening floor mat
- Thermoscreen assembly toolkit
- Thermoscreen user manual

Thermoscreen Specifications

System

Ambient Operating	15 to 35°C
Ambient Storage	-20 to 60°C
Power Requirements	100/240 VAC 50/60 Hz

IS640 Thermal Imaging Camera

Detector	Uncooled amorphous silicon
Array Size	640 x 480
Pixel Pitch	17 µm
Wavelength Range	7 – 14 µm
Frame Rate	60 Hz
Data Interface	Base Camera Link
Communication Interface	Serial over Camera Link
Power	12 V PoCL (Power over Camera Link)

Lens

Field of View	48 x 38°
Screening Area	181 x 136 cm
Screening Distance	2 meters
Focus	Manual
Working Distance	100 mm to infinity
Focal Length	12 mm
Working F/#	1.02

Measurement

Calibration Range	0 to 80°C
Sensitivity (NETD) *	< 40 mK
Accuracy	+/-0.3°C between 30 to 40°C +/-1°C otherwise

* Noise Equivalent Temperature Difference (NETD) specifies the smallest temperature difference that can be detected.

Visual Camera

Array Size	1280 x 1024 (color)
Frame Rate	60 Hz
Lens	Vari-focal lens
Communication Protocol	GigE
Power	PoE (Power over Ethernet)

Dell PC

Model	Dell Optiplex 7070
Form Factor	Mini Tower
RAM	16 GB
Hard Drive	1 TB
Monitor	Dell Ultrasharp 25"
Speaker	Dell USB sound bar
Graphics board	PCIe
Keyboard	Dell standard
Mouse	Dell standard

Dual Camera Enclosure

Material	Aluminum (Anodized)
Dimensions	355 L x 180 W x 125 H [mm]
Weight	5 kg

Mobile Stand

Material	Aluminum (Anodized)
Dimensions	185 height x 70 cm base
Weight	13 kg
Wheels	5 (locking)

Optotherm, Inc.

2591 Wexford-Bayne Rd.
Suite 304
Sewickley, PA 15143 USA
+1-724-940-7600
www.optotherm.com