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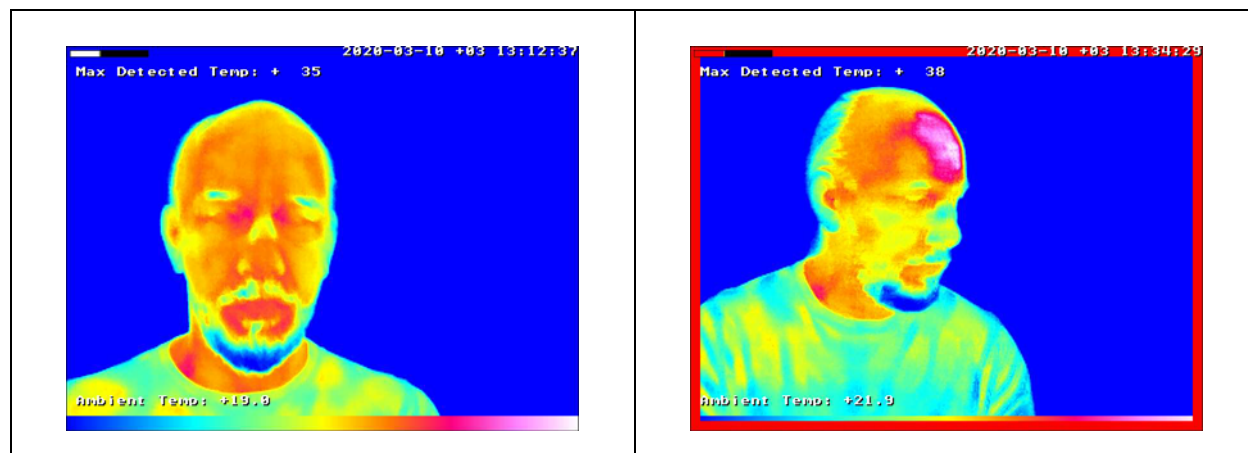
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THERMAL CAMERA SOLUTIONS FOR DETECTION OF FEBRILE INDIVIDUALS

BRT offers a custom-configured, calibrated, radiometric thermal security camera solutions configured for high volume, real-time detection of individuals presenting skin surface temperatures indicative of fever, such as may be caused by symptomatic COVID-19, SARS, MERS and other infections. The fully customizable system is configured to alarm on observation of temperatures greater than 38°C.



CRITICAL TEMPERATURE DETECTED ALARM

Temperature thresholds are adjustable, can be automatically re-calibrated to compensate for ambient temperature changes. A variety of alarm modes can be programmed including audio, visual, remote, and control of external devices such as horns or lights.

BRT solutions include a range of camera options which can be integrated into existing technical security systems as well as stand-alone, turn-key systems for indoor use and fully ruggedized and battery-operated outdoor systems suitable for field deployment.

1.0 TECHNICAL DETAILS

BRT configures a solution for detection of high temperature conditions based on calibrated Mobotix thermal radiometric cameras and can be configured consistent with ISO/TR 13154:2015¹. The thermal imager is rated for 50mK (0.05°C) thermal resolution, periodically self-calibrates, and has been validated for detection of febrile individuals by a [French study published in the Journal of Infection](#)².

The study, using a mobotix M15 series camera,³ achieved an [Area Under the Receiver Operating Characteristic \(AUROC\)](#) of 0.963; this is substantially better discrimination of fever conditions than a different study found for [infrared thermometers reading from the forehead](#), reaching only 0.873⁴. AUROC is a standard measure of the discrimination capability of a diagnostic test; an AUROC of 1.0 is a perfect discriminator, an AUROC of 0.5 is no better than chance.

Thermal cameras tend to be far more accurate than commonly used infrared spot meters for reasons intrinsic to the measurement process, despite using similar technology and spot meters typically reporting more “resolution”—typically reading to 0.01°C which would seem “more accurate”. The first issue is that, as the thermograph above clearly shows, forehead temperature varies significantly and so spot measurements might read cold if a cold spot is targeted while thermal cameras measure all locations simultaneously and report the highest temperature, usually from the artery just behind the inner canthi, the inner corners of the eyes, rather than the forehead. Another reason for spot meter error is that forehead temperature varies with breeze, sweat, and ambient temperature while the inner canthi far less, making thermal camera measurements much less dependent on subject conditioning.

Previous studies have found that the discrimination accuracy of a thermal camera measurement system is dependent on the ambient temperature and generally works better at lower ambient temperatures, with optimal discrimination between febrile and non-febrile individuals at an ambient temperature of 20-24°C and RH of 10%-50%. According to Bardou M, et al., the system becomes noticeably less accurate with ambient temperatures in excess of 30°C.

On detection, secondary screening should be performed with a clinical thermometer compliant with ISO 80601-2-56 according to ISO/TR 13154:2015. This would typically be either a tympanic IR measurement or a rectal thermometer.

The BRT standard system is a hybrid thermal/color camera with dual sensors configured to observe individuals or a flow of pedestrian traffic and to provide real-time display to a nearby operator. The system is typically configured to indicate temperatures over 36°C with a color thermal overlay on top of the high-resolution video image with an on-screen display of maximum temperature observed and an alert for detected temperatures over 38°C. The specific parameters can be adjusted to meet screening requirements.

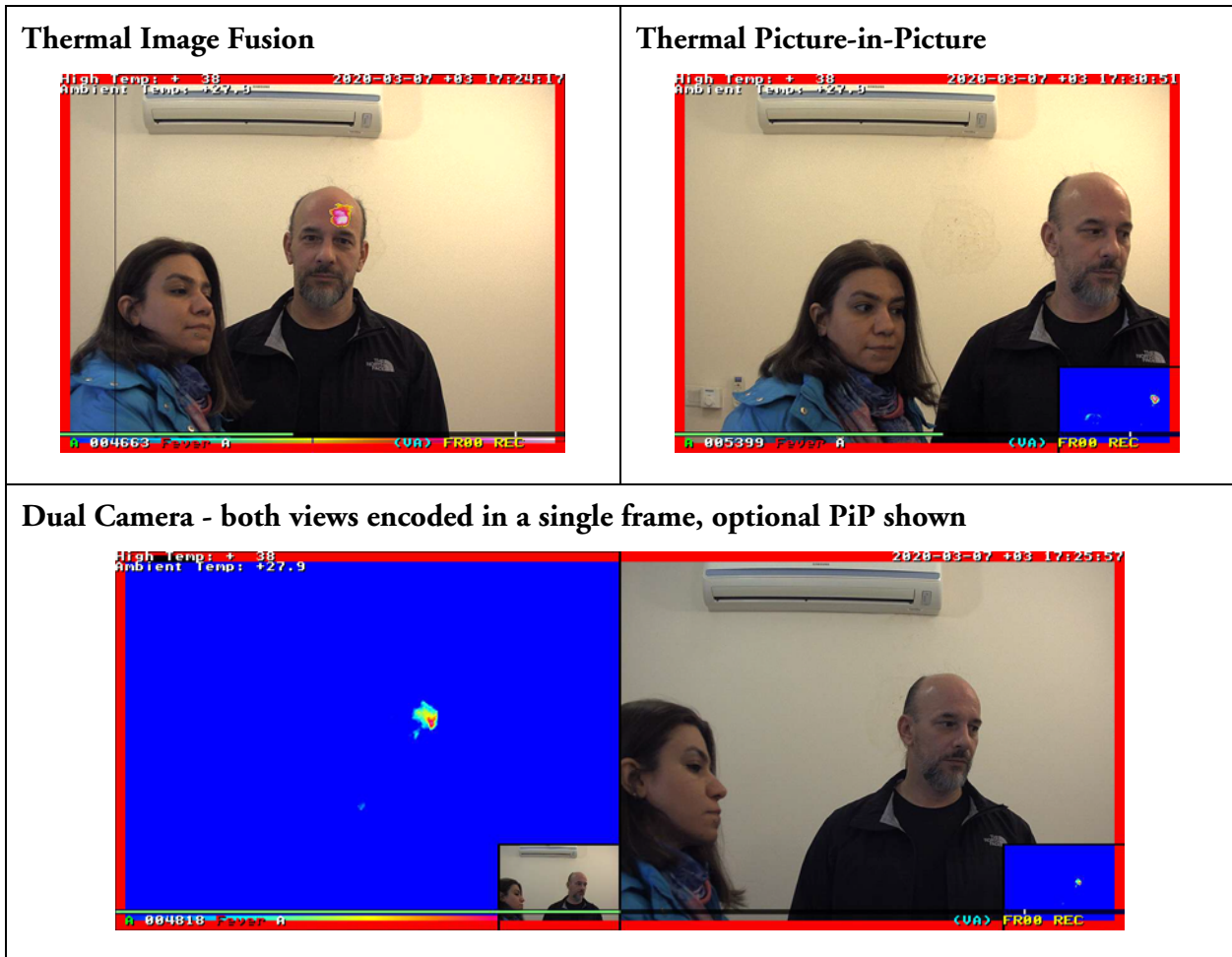
Black Rose Technology can provide engineering services to optimize placement of the sensor and advise on the condition of the screening site, the design of the screening operation, the screening protocol, and operator training.

1. International Organization for Standardization. (2009) Medical electrical equipment — Deployment, implementation and operational guidelines for indentifying febrile humans using a screening thermograph (ISO technical report no. 13154:2015)
2. Bardou M, et al., Modern approach to infectious disease management using infrared thermal camera scanning for fever in healthcare settings, *J Infect* (2016), <http://dx.doi.org/10.1016/j.jinf.2016.08.017>
3. The M15 is EOL, the current series is the M16, which provides higher CPU performance and uses the same sensors as in the study.
4. Hausfater P, Zhao Y, Defrenne S, Bonnet P, Riou B. Cutaneous infrared thermometry for detecting febrile patients. *Emerg Infect Dis* [serial on the Internet]. 2008 Aug [date cited]. Available from <http://www.cdc.gov/EID/content/14/8/1255.htm>

1.1 DATA DISPLAY

The standard configuration integrates an optical view with an overlaid thermal image (hybrid fused image). BRT programs the thermal image overlay to highlight any area above normal, healthy temperature and providing a graphical and an optional acoustic alert, either from the camera itself or at the workstation, on detection of temperature greater than 38°C within the field of view, the standard diagnostic criterion for a febrile condition.

Data can be presented in a variety of ways, in addition to a standard thermal image, to maximize operator capability and ensure easy identification of any suspected febrile individual within a pedestrian traffic flow.



DISPLAY OPTIONS

Note: fever condition was simulated by the application of a hot cloth to demonstrate the alarm function when temperature exceeds 38°C. Typically a febrile subject's maximum temperature reading will be read from the inner canthi, the inside corners of the eyes just beside the nose rather than the forehead.

2.0 SYSTEM CONFIGURATION

BRT provides equipment, installation, and custom configurations. We have specific, tested configurations available as components or as complete turnkey systems for indoor use in locations such as airports, public venues, or hospitals and for outdoor use in locations such as checkpoints, borders, outdoor events, or for portable field operations.

The minimum configuration requires, in addition to the camera, only an available Class 3 PoE switch port and at least one networked device capable of running a standard browser. BRT can integrate the system with most VMS systems and can provide complete, turnkey systems from stand-alone detection stations to city-scale fully integrated security systems.

Integrated, stand-alone camera with simultaneous thermal and optical capture and recording capability on an internal 128GB high-reliability uSD card. The optical sensor may be omitted without impact to thermal detection capability though doing so makes identification of a detected target more difficult and the additional sensor imposes only a small incremental cost of approximately 4% per camera.

Discreet system with sensors integrated into existing structures as individual modules where a less visually intrusive detection capability is preferred. Note this configuration cannot be easily configured to support Thermal Image Fusion display mode as the two sensors are not mechanically aligned by the factory-made housing.

Bidirectional audio capability: record audio or permanently disable audio if necessary to comply with privacy requirements. The integrated camera contains a built-in speaker which can be configured to provide an automatic alert sound or recorded message if a high-temperature condition is detected and can be used to give remote instructions. Discrete cameras can be supplied with integrated stand-alone speakers if needed.

Ruggedized, Rapid Deployment Options: BRT can supply a pre-configured, tested, complete system ready for deployment in a variety of environments from semi-rugged for high-traffic protected applications to fully-ruggedized outdoor systems capable of long-duration battery operation.

2.1 END USE STATEMENT

BRT will support applications for End Use Statements required for non-military use of thermal cameras.

2.2 WARRANTIES

Manufacturer warranties are passed through to customers; BRT provides local technical support and supports management of any warranty claims.

3.0 SYSTEM PRICING

List prices are provided for standard configuration options attached below. Final quotations can be provided on request and depend on system size and customization or integration services required. Detailed specifications, full data sheets, and project-specific quotes provided on request.

Any import duties are the responsibility of the final customer and are not included in the price.

3.1 BASIC SCREENING CAMERA: \$5,806.00

A calibrated, thermal radiometric camera suitable for integration into an existing video surveillance system configured to alert operators on observation of temperatures 38°C or higher. The system tolerates wide environmental temperature ranges from -40 to 60°C, and is suitable for indoor or outdoor installations. Price includes:

- Choice of stand-alone or discreetly mountable configuration, both rated IP66/IK06, -40°C to 60°C operating range,
- Calibrated thermal radiometry sensor with 50mK/0.05°C thermal resolution, 336×252 pixel spatial resolution, and automatic periodic recalibration,
- Color optical sensor with 6MP, 3072×2048 resolution and 0.005 lux sensitivity,
- 128GB in-camera high endurance μSD card for recording,
- Shipping
- Standard installation, and on-site configuration.



Minimum system requirement: PoE switch with at least one available port and suitable, networked workstation for viewing or existing PoE VMS/DVR system. Discreet integration of sensors into existing structures may incur additional costs.

All systems can be supplied with a calibrated black-body temperature reference target for periodic or continuous calibration per ISO/TR 13154:2017.

3.2 INDOOR SCREENING STATION: \$8,903

A complete, turnkey system suitable for rapid, stand-alone installation in indoor or covered locations to alert operators on observation of temperatures 38°C or higher on high volume flows of pedestrian traffic such as at airports, malls, and government facilities.

The system combines one screening camera and:

- a semi-rugged laptop with sunlight readable display, backlit keyboard, core i5 processor, complaint with MIL-STD-810H/IP53, -29°C to 60°C operating range,
- Mobotix PoE injector.



The system can be configured to support multiple cameras and to integrate with existing video facilities or new VMS systems. The supplied laptop is suited to high traffic areas and is protected from dust ingress and liquid spray, as may be necessary for periodic disinfection. The display is bright enough for easy viewing in indirect sunlight.

All systems can be supplied with a calibrated black-body temperature reference target for periodic or continuous calibration per ISO/TR 13154:2017.

3.3 OUTDOOR SCREENING STATION \$13,124

A complete, turnkey system suitable for rapid, stand-alone installation in outdoor or exposed locations to alert operators on observation of temperatures 38°C or higher on high volume flows of traffic such as at checkpoints, border crossings, refugee facilities, outdoor events, and field locations; supports extended operation with only battery power.

The system combines one screening camera and:

- a fully-rugged laptop with sunlight readable display, backlit keyboard, core i7 processor, compliant with MIL-STD-810G/MIL-STD-461G/IP65, -29°C to 60°C operating range,
- a ruggedized, battery-backed PoE injector.



The system can be configured to support multiple cameras and to integrate with existing video facilities or new VMS systems. The supplied laptop is “dust tight” for outdoor use and can be washed down with water jets as may be needed for disinfection. The display is bright enough to be clearly visible in direct sunlight. The laptop is configured with hot swap dual batteries for continuous battery operation.

We can also provide a military-grade PoE injector that is fully outdoor rated, configured with military connectors, and operates selectively from AC mains, vehicle power, or internal battery which can be sized to provide 3 days run time.

All systems can be supplied with a calibrated black-body temperature reference target for periodic or continuous calibration per ISO/TR 13154:2017.