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NEED OF BLACKBODY FOR THERMAL TEMPERATURE SCANNING

Purpose

To cite validated information sources which can be used for calibrating the accuracy of temperature detection by thermal scanner systems, and the need for using blackbody radiation sources for these systems.

Context

We are in the middle of a deadly COVID-19 pandemic. All over the world, people are struggling to cope up with the problems of searching, tracing and isolating the probable candidates who may have had some exposure to this deadly virus. One effective way of assisting health care workers and administrators in doing this is by providing easy to use human temperature/fever detection solutions. Many players in the market have come out with such febrile systems, which are also called tele-thermographic systems (or thermal temperature scanner systems).

Although the need may be urgent, in due course of time, the need of a standardized reference point for such systems will be immense, as the market is getting flooded by different options and varied claims. Diseases like COVID 19, SARS, EBOLA, MERS and others keep on cropping up intermittently, and there has been an established need for such thermal temperature scanner systems which can cater to the problem of human surface temperature monitoring and detection. Although primarily such systems are meant for both medical and non-medical systems; many manufacturers lay claim to being accurate up to the order of ±0.3 degrees Celsius , without any validated calibrating source (blackbody) or any authentic technology which can certify the accuracy of such claims. Triaging of suspected cases with probable fever could be an effective way by which medical and administrative agencies can stop the spread of the virus well in advance. Such applications in both medical and non-medical environments are defined and mandated (non-binding) as per the norms laid out by international agencies like FDA, ISO/IEC and others.

A big dark area in this whole scenario is the need of using a blackbody radiation source.

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Blackbody

A black body is an idealized body that fully absorbs impinging electromagnetic radiation of any wavelength. Neither reflection nor transmission occurs on it. A black body radiates at every wavelength the maximum possible energy for all potential emitters. The radiation density is independent of angles here. The black body forms the basis for understanding the physical principles of non-contact temperature measurement technology and for calibrating infrared measuring devices. This is as per the principles of Plank's Law.

Any body (including the human body) emits IR radiation. For an IR thermographic system to detect the radiation being emitted by the body and measure its temperature, a benchmark calibration is needed for the ambient environment. All thermographic temperature scanning systems work on the principle of comparison of the benchmark temperature with the source body under observation. For the mass movement of humans in public places (where multiple bodies are moving around at any given point of time and where the reference point of the system for comparing the absolute temperature of those bodies with the ambient temperature source keeps on changing), a blackbody is essential for accurate temperature measurement. Any thermal camera-based system which claims that a blackbody is not needed for accurate detection of body temperature may be doing the calibration on the basis of an estimation model, where the position and field of view of the camera are fixed and may have limited mobility. Also, any system with a blackbody can give repeated measurements with the same level of accuracy (as claimed by many solution providers: ±0.3 Degree Celsius accuracy) while scientifically speaking (as per the available literature on this developing subject), any AI-driven system which claims this level of accuracy (±0.3 Degree Celsius) without a blackbody may be doing so based on heuristic methods for estimating an average ambient calibrated temperature for comparison with the body under study, and hence the repeatability and accuracy of the method and system may be questionable.

As per Plank's Law of Thermodynamics, if a blackbody source of an IR detection system is removed from the setup, then each independent body under observation may start behaving as a temperature benchmark, thereby changing the minimum-maximum temperature range of the ambient (which is part of the environment being measured). This is not possible thermodynamically as the temperature calibration may not be possible for such a system.

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An AI system without a blackbody may be doing so based on mathematical projections of the average temperature (within the maximum and minimum temperature limits fixed for the system) of all the bodies under study, moving in front of the camera and hence, the accuracy and repeatability of such a system may be questionable.

FDA Recommendations for Thermal Temperature Scanning Systems

1) The system be tested and labeled consistent as per the guidelines set by IEC 80601-2-59:2017 or

2) Is tested as per some other credible international standard and matches the performance specifications given below:

a) The laboratory temperature accuracy of a screening tele-thermographic system, including the measurement uncertainty, is less than or equal to ±0.5°C (±0.9°F) over the temperature range of at least 34-39°C (93.2-102.2°F);

b) The system includes an accurate blackbody temperature reference source; which can compensate for the thermal temperature drift;

c) Both stability and drift are less than 0.2°C (0.36°F) within a timeframe specified by the manufacturer; and

d) The device risk assessment addresses all potential safety issues, including:

i) Electrical safety;

ii) Mechanical safety;

iii) Excessive temperatures and other hazards;

iv) Accuracy of controls, instruments, and information display;

v) Considerations for software associated with Programmable Electrical Medical Systems including network connections;

and

vi) Usability.

In light of these developments, it is important to keep in mind that any claim regarding the accuracy of measurement of such systems is validated with lab results or test data from credible sources. Fever detection is serious business, as human lives are at risk.

References

1) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6145558/

2) https://patents.google.com/patent/US20070153871

3) https://ipvm.com/reports/faked-corona?code=allow

4) FDA

5) ISO/IEC

6) Multiple sources publically available on the internet

Note: *All the facts given in this white paper are indicative and subject to revision as per the changes and developments that may take place from time to time on this topic. These are non-binding, and only for the information and perusal of the reader.*