FACE RECOGNITION TEMPERATURE MEASUREMENT TERMINAL

Based on available evidence up to 5 May 2020

INTRODUCTION

In the medical field, the usage of infrared thermography has shown to be a potential non-invasive and non-obstructive tool in assisting medical practitioner to detect and diagnose any illnesses or diseases which causes an increase in body temperature. A low-cost infrared thermometer is widely utilised in clinics, hospitals or even for personal use to simply detect the body temperature with minimal area coverage in a short distance range (≤ 15cm).[1] Today, high definition infrared thermal imaging (thermal scanner) with better processing capabilities and sensitivity have helped authorities to screen multiple individuals and automatically produce an alarming sound when the temperature screened is exceeding the normal body temperature. Both screening and detecting processes can be automatically done without any assistance from health personnel, in order to reduce the risk of transmitting the infection to others.[2]

Face recognition temperature measurement terminal is a terminal that combines contactless temperature measurement with mask detection and face recognition technology. It comprises of a tablet size device with camera on top and built-in deep learning algorithm for real-time facial recognition and automatic infrared thermal imaging (thermal scanner), even in the low light environment. The device has a binocular liveness detection feature to distinguish between a real person with or without a mask, or an object such as face on a mobile phone. It is also equipped with unified data management system (personnel management, attendance management and data storage). There are multiple installation methods provided, including tall stand, wall-mounted stand, desktop stand and stand for turnstile. This device can be used on various locations such as an office, condominium, pharmacy, public transportation, entertainment center, construction sites, or any sorts of buildings/area that acquires access control. For contactless temperature measurement, the infrared thermal imaging is able to detect and capture a person's forehead temperature in a very brief time within a range of 0.3-0.7 meters, with an accuracy of ±0.3-0.5^{o}C (values may vary between brand and model).(Figure 1) [3-5]

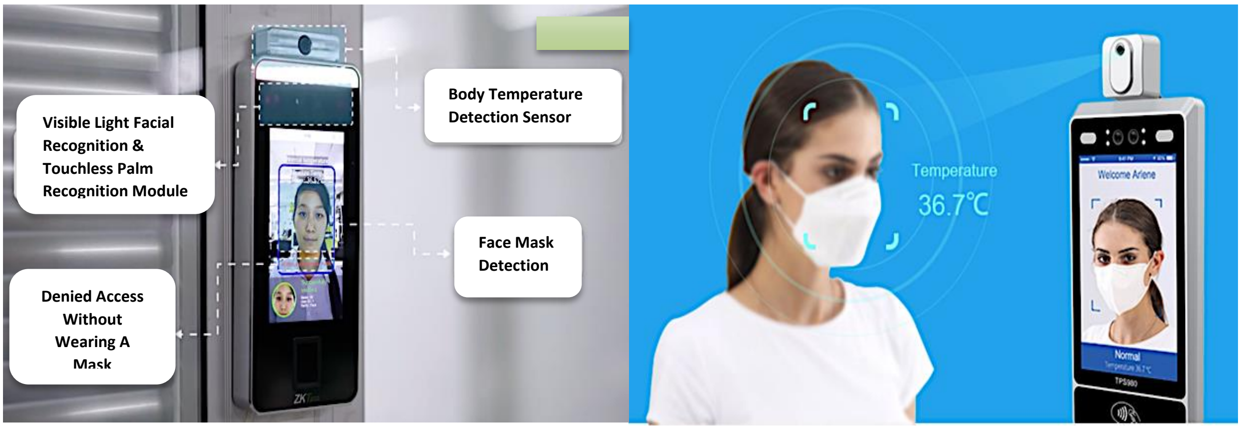

Figure 1: Face recognition temperature measurement device as a non-invasive and contactless screening tool for fever detection and access control

EVIDENCE ON EFFECTIVENESS AND SAFETY

Based on extensive search through available scientific databases (Ovid MEDLINE, Cochrane Database, PubMed) and Google search engine, one systematic review and two experimental studies were identified that evaluate the effectiveness of infrared thermal imaging for detecting febrile individuals. The systematic review included six studies (one systematic review, five non-randomised studies) originated from France, Korea, China, New Zealand and USA. The accuracy of infrared thermal imaging was compared with tympanic thermometers (four studies), with oral temperature (one study) and with a reference that could be either oral, rectal or axillary temperature (one study). Studies included inpatients or patients presenting at hospital (four studies) or travellers presenting at the borders (two studies). The reported sensitivities, specificities, Positive Predictive Value (PPV), Negative Predictive Value (NPV) and Area Under Receiver Operating Characteristic Curve (AUROC) values are as shown in Table 1.[6]

Table 1: The reported sensitivities, specificities, PPV, NPV and AUROC values of Infrared Thermal Scanner with different comparators

Comparator	**Infrared Thermal Scanner**				
	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	AUROC
Tympanic thermometers	86.0	71	1.5	-	0.86
Oral temperature	80.0-91.0	65.0-86.0	5.7-18.4	99.1-99.6	0.78-0.96
Rectal or axillary temperature	83.0-83.7	85.7-86.3	-	-	0.92-0.93

In second study, finding of an experimental study by Bach AJE et al. had shown poor agreement between conductive temperature devices and infrared temperature devices during static (resting) and dynamic thermoregulatory responses as a result of environmental extreme. The infrared thermal imaging significantly overestimated skin temperature, T_{sk} compared to the thermistor (conductive device), with a mean bias of 0.83 ± 0.77°C during rest, exercise and recovery periods in the heat. It was concluded that infrared devices may not be suitable for monitoring T_{sk} in the presence of, or following, metabolic and environmental induced heat stress.[7]

The third study, conducted by Sun G et al. using experimental design, reported a positive correlation between thermopile array used in infrared thermal imaging with the axillary temperature measured using the contact-type thermometer ($r = 0.71$, $p < 0.01$). Comparison of the maximum facial temperature and reference axillary temperature showed an average mean difference of 1.03°C with a standard deviation of 0.19°C. The sensitivity and specificity of the thermopile array in identifying the febrile subjects were 80.5% and 93.3%, respectively, for setting the threshold cut-off of maximum facial temperature at 36.5°C.[8]

There was no retrievable evidence on the safety. However, the use of infrared thermography is considered safe as it is non-invasive, contactless and non-radiant.[9]

Cost

The cost of the device ranges between USD499.00 to USD3000.00.[10-12]

CONCLUSION

Based on retrievable evidence, infrared thermal imaging/scanner had shown to have good performance in identifying elevated body temperature, comparable to oral, tympanic, axilla and rectal thermometers. However, it has a tendency to produce false positive result (low PPV) under certain circumstances associated with metabolic and environmental induced heat stress. In conclusion, infrared thermal imaging/scanner can be used for rapid, mass fever detection as part of infection prevention and control measure.

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