

Allocation of thermal imaging camera: Promoting efficient movement in entrepreneur workplace

Arra Chang Kien Guan, Mohd Jaki Bin Mamat* 

School of Housing, Building and Planning, Universiti Sains Malaysia
11800 Gelugor, Penang Malaysia



ARTICLE INFO	ABSTRACT
<p><i>Article history:</i> Received July 10, 2021 Received in revised form July 12, 2021 Accepted September 31, 2021 Available online April 01, 2022</p> <p><i>Keywords:</i> Efficient movement Thermal imaging camera (TIC) Workplace zoning</p> <p>*Corresponding author: Mohd Jaki Bin Mamat School of Housing, Building and Planning, Universiti Sains Malaysia Email: mjakim76@gmail.com ORCID: https://orcid.org/0000-0002-1358-8208</p>	<p><i>The pandemic COVID-19 has been a disaster for all over the world. The significant changes caused by the pandemic has left a huge impact on every sector especially on business environment and caused a major economic shock. In this paper, the role of technology- Thermal Imaging Camera (TIC) has been explore and discuss in achieving a proposed studies to preventing and decreases the spreading of virus in efficient way. From this point of view, the proposed study has contributed to working environment – entrepreneur workplace. The working environment has been a high risk in virus spreading since it involved in people interaction's place. Thus, TIC is important to prevent the virus spreading in workplace and community. The study of efficient movement and the issue regarded appropriate location of TIC in entrepreneur workplace has been carried in this paper. The objectives of this study are to identify the requirement of Thermal Imaging Camera (TIC) in entrepreneur workplace zoning, to determine the best location for Thermal Imaging Camera (TIC) in entrepreneur workplace zoning and to study the Thermal Imaging Camera (TIC) location in promoting efficient workplace movement. The literature review is carried out to determined the related issues: TIC, workplace zoning and efficient movement I entrepreneur workplace. the qualitative method by John Creswell is used in collecting data to identify the best position of TIC in entrepreneur workplace by using observation method. As conclusion, the study for practice of allocate the TIC in the best location in entrepreneur workplace promotes the efficient of movement which it gives a direct and indirect impact on workplace performance.</i></p>

Introduction

COVID-19 has left a huge impact all over the world, especially on business environment. The post COVID-19 has totally changed the landscape significantly (Bartik et al. 2020). As in the age of COVID-19 and the nation has reopened, the negative issues addressed to business area by resolving and handling the legal and safety aspects. The impacts left the business fields explored on technological solutions as in the application of temperature scanning of people,

social distancing camera practice and QR Code scanning before entering the building or any places (Siddiqui et al. 2021). To ensure the business can be safely reopens, many employers have practicing the social distancing among the staffs and visitors, hygiene protocols and the capacity limitations in one area to accommodate the regulations executed by government. From this point of view, the technologies have played a pivotal role in helping the employers in detecting and identify the person who might be have the virus before the person entering the premise.



Hence, the implement of Thermal Imaging Camera system (TIC) in entrepreneur workplace is important to solve the issues of viral the virus spreading in the workplace and community.

However, before implementing the technology in entrepreneur workplace, the employers must take consideration on the potential legal risk associated with their use.

Thermal imaging camera (TIC) is one of the applications based on the proven technology - infrared thermography, it provides effective real-life temperature monitoring of an objects in contactless way (Bagavathiappan et al. 2013). It also provides a better throughput of people for temperature scanning. On the other hand, the limitation of TIC has become the concerned issue of enterprise. A limitation on mass temperature scanning of TIC may lead to the increasing risk of virus spreading while in the high traffic areas or overcrowded people especially in the morning rush hour. It is necessary to assign and distributed the application of TIC into different zoning based on the requirement and function of the certain space. To achieving the high effective movement and prevent the spreading of virus in entrepreneur workplace, the issue regarded appropriate location of TIC that effect the efficient movement in entrepreneur workplace has been study.

From this point of view, the questions have raised:

RQ1: What are the requirements to allocate Thermal Imaging Camera (TIC) in entrepreneur workplace?

RQ2: Which is the best location to allocate Thermal Imaging Camera (TIC) in entrepreneur workplace?

RQ3: What role does the location of Thermal Imaging Camera (TIC) play in promoting efficient movement in entrepreneur workplace?

The research objectives for this study are as following:

RO1: To determine the requirements to allocate Thermal Imaging Camera (TIC) in entrepreneur workplace.

RO2: To determine the best location to allocate Thermal Imaging Camera (TIC) in entrepreneur workplace.

RO3: To study the role of location of Thermal Imaging Camera (TIC) play in promoting efficient movement in entrepreneur workplace.

In this part, the past research on application of thermal scanning system in building is reviewed. Moreover, the components regarding the topic

such as Thermal Imaging Camera, workplace zoning and effective movement are discussed accordingly.

1. Thermal imaging camera (TIC)

In response to COVID-19, World Health Organization (WHO) published a range of public health and social measures, to prevent the transmission risk of COVID-19 in terms of social distancing, thermal monitoring, hand hygiene awareness etc. (WHO 2020). In view of this, employers should have taken appropriate steps to assure the protection of their employees and business.

The action taken by employers in the workplace such as ensure the staff to take temperature regularly before entering any space in workplace area (Ministry of Health Malaysia 2020). Basically, the employee's temperature is detected and recorded by using body temperature scanners.

There are many different types of body temperature scanners in the market such as digital thermometer, digital ear thermometer, forehead thermometer, thermal camera, mercury thermometer etc. (Mah et al. 2021). Thermal imaging camera (TIC) is one of the applications based on the proven technology - infrared thermography, it provides effective real-life temperature monitoring of an objects in contactless way (Bagavathiappan et al. 2013). As scientific studies support that thermal imaging systems also known as TIC is used to detect and measure the surface skin temperature (Priest et al. 2011). However, the study has been revealed the TIC for its advantages and limitation in terms of the applications throughout the pandemic COVID-19 (Whitelaw et al. 2020). The benefits of TIC are people during the measurement of temperature is not required to physically contact to each other.

The studies have showed that TIC measure the surface skin accurately and faster than the other thermometer such as forehead or oral thermometer which both of this application required physical contact between the people who doing the measurement and being evaluated. Although TIC may be used in several high throughput areas such as airports, shopping mall, institutions etc, but this system does not support "mass temperature screening" as in the system not effective in screening temperature of multiple people at the same time (FDA 2021). In consequences, it may cause crowded situation

while employees are standing in line without social distancing for temperature measure which this situation does not follow the Standard Operating Procedure (SOP) may cause the increases risk of virus spreading. To prevent the widespread of influenza in workplace environment, employers have to ensure the right environment and location installed for TIC and to set up the devices according to instructions and correctly.

2. Workplace zoning

A workplace must provide the employees a flexible, safe, comfortable, inspire and accessible working environment (Davidescu et al. 2020; Bushiri 2014). A good design of workplace or design of layout has a huge impact on the efficiency and performance in workplace environment. Under the Occupational Safety and Health Act 1994, employers and employees are required to meet the standard on safety, health and welfare for protecting each one against the risk of safety in the workplace (ILO-OSH 2001). Therefore, employers have to defined the zoning for the location of thermal imaging system in consideration of accessibility and safety in entrepreneur workplace. Identification of each zoning in terms of the activities carry or frequency of use, direction of movement, time of use and the capacity of the space is essential to clarify the criteria of allocating the TIC.

Based on (G. Miller 2014; Harris 2015), there are different types of space in workplace which are included as following:

- i. Offices: Private or semi-private office and conference room
- ii. Employee or visitor support spaces: Lobby, social space, cafeteria, toilets, vending machines, child care center, physical fitness area and interior parking areas.
- iii. Administrative support spaces: Private of semi-private offices
- iv. Operation and maintenance spaces: Storage, kitchen, maintenance closet and information technology closet.

Standard operating procedure (SOP) in entrepreneur workplace

The ILO-OSH (2001) (Act 514) requires employers to execute with safety and health standards and regulation published by DOSH. Furthermore, employer and self-employed person also required to ensure the practicable, the safety, health and welfare at work in the Act's Part IV.

Directions for compliance with the Occupational Safety and Health Deed (AKKP) 1994 concerning Prevention of the 2019 Coronavirus Disease Outbreak (COVID-19) in the Workplace has provided a number of provisions and its recommendation prevention and protection measure. The following are the provisions provided (Malaysia Government 2013):

- All employers are required to provide suitable PPE to their workers based on the risk assessment.
- Employer and the employees are required to practice high level of personal hygiene such as frequently hand washing or hand sanitizing in workplace.
- Employers and employees are required to wearing mask of face shield when necessary.
- Employers and employees are required to avoid a mass gathering or mass meeting and to be in close contact with others.

The Minister of Health Malaysia, 2021 has provided guideline that aims to prevent and control measure that should be taken in the workplace in order to ensure the continuity of operation in the workplace. Employers are required to take action under the prevention and control measures sections (ANNEX 25) To encourage employees to take temperature regularly and monitor for respiratory symptoms. The temperature screening should be taken by all employees before entering the workplace. Those with temperature above 37.5°C should taking action and ask for seeking assessment at a medical facility.

In addition, European Data Protection Authorities have highlighted that the employees are having their temperature scanning at the workplaces entrance, such training is necessary for staffs and reluctant employees will be refused entry (Liguori and Culliton 2020).

3. Efficient movement

Efficiency in a movement, technically can be defined as the way less consuming in amount of energy during the execution, the more efficient in movement can be achieved (Yessis 2006). From the design perspective, efficient movement in a space achieved when the design is taking consideration in accessibility and circulation according to the types of space, size, layout and the user requirement (Mahmoud 2017). Circulation in a design workplace space is a necessary feature that should be take into account

while designing. To ensure the circulation in workplace is well designed, there is some components of circulation need to identify and determined : horizontal circulation (entrance foyer, corridors, lobbies, doors), vertical circulation (staircase, ramps, elevators and escalators) The efficiency of movement in the workplace can promote and accelerating the performance of employees. However, the inadequate circulation design might cause a lot of problems in workplace especially in this COVID-19 era, such as overcrowding while waiting or line up for temperature measurement which it has against the Standard Operation Procedure (SOP) by Malaysian Government which implemented social distancing and as a consequence, the overcrowd situation might cause the high risk of COVID-19 virus spreading.

Method

In this study, the qualitative method by John Creswell is used in collecting data to identify the best position of TIC in entrepreneur workplace by using. A literature review was conducted on the concept and theories of TIC, the entrance of workplace design requirement and the efficient movement. In addition, a preliminary study undertaken observing the flow of the circulation in the entrance of the workplace.

The result will be analyzed by the criteria that meet the requirement of the element in efficient circulation such as the approach, configuration the path and the form of the circulation space. The data will be analyzed in table form and proposed guideline location for TIC in entrepreneur workplace.

The breakdown of the proposing TIC location in entrances area of the entrepreneur workplace as follow:

- i. Analysis of new characteristic of entrance area design in pandemic era
- ii. Analysis of design criteria and requirements of entrance area design
- iii. Evaluation of tic location based on the criteria of tic requirements and workplace entrance area design guideline
- iv. Layout design guideline of TIC location in entrance of entrepreneur workplace.

Case studies

Case study 1

A proposed Class-A office building in Manhattan's Hudson Yards was used by the researcher to create a 'Pandemic-Resilient Office Tower'. The paper aims to examined architectural design strategies by incorporating the measures to decrease the spread of disease where the design has to speak in this new era and has the ability to switch between normal and health-crisis modes. The study proposed the design approach to apply in the design of building entrance, lobby layout, vertical circulation in considerations of people wellness and productivity in workplace.

Table 1. Design consideration factors

Design consideration factors	Description
Circulation	1. One-way circulation systems 2. Pinch point free circulation
Interior space	Required adequate occupant spacing
Screening area	Required adequate space away from entrances doors
Entrance door	1. Automatic door 2. Touch-free entrance door

Case study 2

A case study on the Workplace Requirement in New Normal Era due to COVID-19 Pandemic: Design Criteria and Health Environment Perspectives by Cita Sari and Budiyaniti (2020). The aims of the study is to identification workplace requirements in new normal era. The study method was evaluated the workplace requirements and analyzed based on their suitability with this new normal era. The method of evaluation also takes consideration of ergonomics point of view. The results showed that there are many requirements need to be fulfilled to provide a safety zone in the workplace environment such as workspace layout, ventilation, lighting, establishment of the equipment, and also the thermal comfort. As a conclusion, by fulfilled the requirement in workspace area, it can help to minimize the probability of spreading illness and provide workers a safe and healthy place to work with.

Table 2. Design consideration factors

Design consideration factors	Description
Circulation	One-way walking path to avoid cross passing between people
Interior space	1. Required available space that has to be easy access to doors, window, and radiators, workstation and

Design consideration factors	Description
	every space in office (Cita Sari and Budiyaniti 2020); 2. The minimum volume per person is 11 m ³ ; minimum area is 2.3 m ² per person. The standard is for general conditions (Ministry of Health Malaysia 2020).
Position of equipment	1. Furniture positions such as chair, sofas, cabinets, etc should not be obstacle and disturb the free space of workers; 2. The placement of cabinets and sofas should place in the corners of the room, and it can be given a divider to restrict it if the room is large enough to ensure that the furniture does not interfere with people walking or movement in the space.

Case study 3

The study of the telethermographic systems as known as Thermal Imaging Systems has been carried out and revealed. TIC has been showed the accurately measures of temperature in the medical fields. Based on (FDA 2021), there is some requirements that should be fulfilled before the use of TIC. The table below list out the requirements of the proper use of TIC based on FDA (2021).

Table 3. Requirements of preparing TIC for temperature measurement

Subjects	Requirements
Preparing the area	1. Room temperature between 68 to 76°F (20-24 °C); relative humidity between 10-50 percent; 2. Avoid any reflective backgrounds such as glass, mirrors, metallic surfaces to reduce the reflection of infrared radiation; 3. The environment of the area and room should avoid the direct sunlight, the movement of air and away from radiant heat such as portable heaters and electric sources.
Preparing the ITC	1. There is a tool – calibrated blackbody which is function as checking the calibration of an infrared temperature sensor during an evaluation to ensure the accuracy of the measurement;

Subjects	Requirements
	2. The entire system has to turn on 30 minutes early before the use to warm in up.
Preparing the person (being evaluated)	1. Ensure the person who being evaluated does not have face obstruction such as hiding by the hat, wearing a scarf, glasses or a face shield; 2. However, FDA believes that under the COVID-19 situation, the benefits of wearing a mask when using a TIC outweigh any risk of inaccurate measurements.

Result and discussion

This section presents the analysis of case study by divided into 3 parts which are analysis of characteristic of entrance area design, analysis of criteria and requirements of entrance area design and analysis of requirements of TIC placement in entrepreneur workplace.

Analysis of characteristic of entrance area design in entrepreneur workplace

In this pandemic era, workplace design should rethink the design principle for flexibility and adaptability in response of dealing with the health issue in this business environment. The office building should have the ability in switching between normal model and physical distancing mode (Kaplan and Davis 2020). The covid-free workplace entrance design required touchless principle among employers and employees in a space. An adequate space in entrance area design is the priority aspect among the characteristics which directly implementing the social distancing practices in workplace which promote healthy work environment by avoiding direct people contact.

In addition, the entrance space required less obstacle such as equipment or furniture which is one of the principles to maximize the space area to create a safe zone as known as physical distancing. Speaking of the characteristic of entrance area design in workspace, pinch point free design principle is one of the keys to access to the goal of government in preventing the spreading diseases in work environment. A one-way circulation design of workspace has to be implemented in order to promoting adequate occupant spacing and orderly flow from the entrance of the building to the temperature

screening area where the TIC will be located. Moreover, a large entrance area or lobby in the building encourage pinch-point free circulation by preventing narrow intersections of cross traffic.

Analysis of design criteria of entrance area in entrepreneur workplace

Based on the analysis of case study, in order to create efficient movement of staffs in entrepreneur workplace there is several criteria and requirements that need to be fulfilled when designing the space for this new normal era of COVID-19. The study revealed the workspace layout determined by the available space that has to be easily access, also defined that no complex or two ways of circulation in workplace that against the guideline of SOP by government in preventing collisions or physical contact between people in workplace. Besides, the arrangement of the furniture or equipment should take consideration in provide good circulation in the space with blocking people from move from a place to another place. The furniture should be place at the corner of the space and it recommended to set the furniture with minimum distance of 6 feet or 1.8 meters far away. The study also showed the use of divider or partition to guide the way access from the entrance to

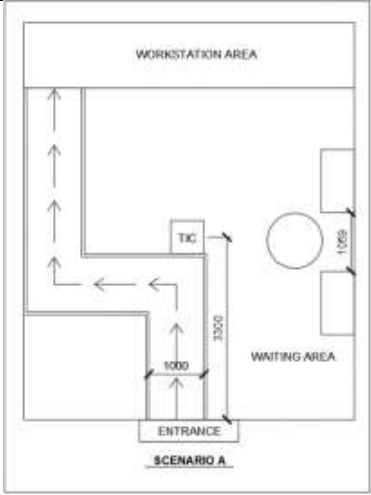
workstation helps in efficient movement and time without any confusion and keep maintaining healthy and safety of the users in workplace. A signage is one of the best solutions to easy guide people and promote efficient circulation.

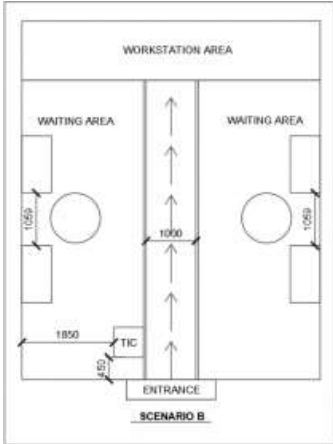
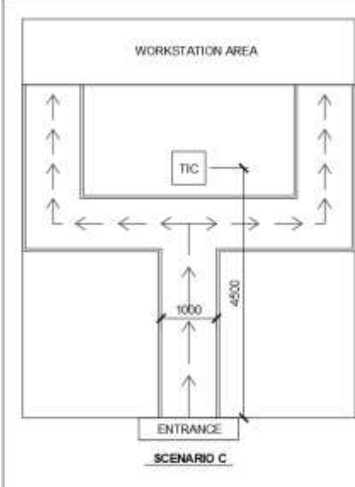
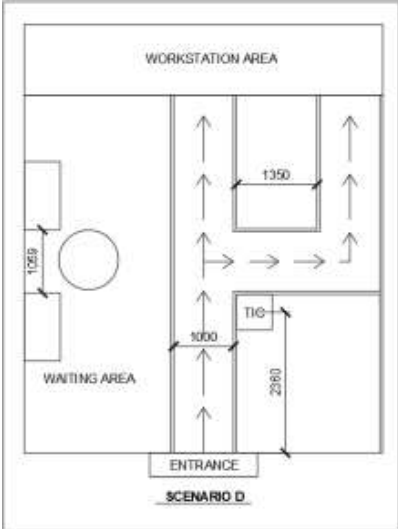
Analysis of requirements of TIC placement in entrance of entrepreneur workplace

From the data collecting based on the case study, the TIC should be place before the people entry the premise where the person being evaluated on the body temperature. The position of the person being evaluated should at a fixed distance from TIC as in the image area should take the person's whole face. Before the process of evaluation of the person, it has to be clear that is no any obstacle that blocking the person. On the other hand, the temperature measurement of the person may affect by some aspects such as direct sunlight or heat from the outside through the window or the entrance door. It summarized that while in consideration of TIC location, the TIC should be place at the location where it is easy to access by workers in the workplace before entry to workstation.

Evaluation of TIC location based on the criteria of TIC requirements and workplace entrance area design guideline

Table 4. Evaluation of TIC location based on the criteria of TIC requirement and workplace entrance area design guideline

Scenarios	Criteria				
	Easy access path (one-way circulation)	Adequate space (spacious)	Efficient distance of TIC from entrance	Position of TIC (avoiding direct sunlight)	Arrangement and distance between furniture
 <p>SCENARIO A</p>	√	√	×	√	√

Scenarios	Criteria				
	Easy access path (one-way circulation)	Adequate space (spacious)	Efficient distance of TIC from entrance	Position of TIC (avoiding direct sunlight)	Arrangement and distance between furniture
 <p>SCENARIO B</p>	√	√	×	×	√
 <p>SCENARIO C</p>	×	√	×	√	×
 <p>SCENARIO D</p>	√	√	√	√	√

Based on the table above, there is 4 scenarios convey the different positions of TIC and design of interior element in workplace entrance and it has been evaluated based on the criteria given. It showed that Scenario D has fulfilled all the criteria and requirements. The estimated plan given with the entrance at the middle of the building allowed the direct access to the premise. The direction of TIC from entrances is 2360mm which is within the requirement and specification of the TIC model which the temperature detection distance within 2 meters to 3 meters. The circulation showed the efficient way of movement by providing 2 paths after the temperature screening and it allowed collisions and practicing social distancing among staffs. Moreover, the arrangement of furniture in waiting area placed with 1-meter distance from each other and it is expected not interfere with the staff movement. The overall design has showed the spacious space which meet the new principle design in this pandemic era. The best location of TIC has been revealed in this study and contributes the application for entrepreneur workplace in the future.

Conclusion

The COVID-19 pandemic has brought changes in the basic life as it shifts people normal life to another new normal. People have to deal with the transformation by apply new strategies or new principle in terms of design in basic activities besides applying health protocols. In business environment, connection between people in terms of physical contact is crucial especially in this outbreak, designer have to consider and rethink new strategies of design in battling and impede the spreading of virus in working environment. As this study draws to its conclusion, the aim of identify the best location for TIC in entrepreneur workplace has been revealed. At the time this paper was written, the requirement of TIC in entrepreneur workplace zoning has been determined. The study for practice of allocate the TIC in the best location in entrepreneur workplace promotes the efficient of movement which it gives a direct and indirect impact on workplace performance.

References

- Bagavathiappan, S., B.B. Lahiri, T. Saravanan, John Philip, and T. Jayakumar. 2013. 'Infrared Thermography for Condition Monitoring – A Review'. *Infrared Physics & Technology* 60 (September): 35–55. <https://doi.org/10.1016/j.infrared.2013.03.006>.
- Bartik, Alexander W., Marianne Bertrand, Zoe Cullen, Edward L. Glaeser, Michael Luca, and Christopher Stanton. 2020. 'The Impact of COVID-19 on Small Business Outcomes and Expectations'. *Proceedings of the National Academy of Sciences* 117 (30): 17656–66. <https://doi.org/10.1073/pnas.2006991117>.
- Bushiri, Christabella P. 2014. 'The Impact of Working Environment on Employees' Performance: The Case of Institute of Finance Management in Dar Es Salaam Region'. University of Tanzania. <https://core.ac.uk/download/pdf/33424874.pdf>.
- Cita Sari, Undayani, and Rani Tiyas Budiyaniti. 2020. 'Workplace Requirements in New Normal Era Due to COVID-19 Pandemic: Design Criteria and Health Environment Perspectives'. *Journal of Public Health for Tropical and Coastal Region* 3 (2): 8–14. <https://doi.org/10.14710/jphtcr.v3i2.8628>.
- Davidescu, Adriana Ana Maria, Simona Andreea Apostu, Andreea Paul, and Ionut Casuneanu. 2020. 'Work Flexibility, Job Satisfaction, and Job Performance among Romanian Employees-Implications for Sustainable Human Resource Management'. *Sustainability (Switzerland)* 12 (15). <https://doi.org/10.3390/su12156086>.
- FDA. 2021. 'Thermal Imaging Systems (Infrared Thermographic Systems/Thermal Imaging Cameras)'. FDA U.S. Food and Drug Administration. 2021. <https://www.fda.gov/medical-devices/general-hospital-devices-and-supplies/thermal-imaging-systems-infrared-thermographic-systems-thermal-imaging-cameras>.
- G. Miller, Norm. 2014. 'Workplace Trends in Office Space: Implications for Future Office Demand'. *Journal of Corporate Real Estate*

- 16 (3): 159–81. <https://doi.org/10.1108/JCRE-07-2013-0016>.
- Harris, Rob. 2015. 'The Changing Nature of the Workplace and the Future of Office Space'. *Journal of Property Investment & Finance* 33 (5): 424–35. <https://doi.org/10.1108/JPIF-05-2015-0029>.
- ILO-OSH. 2001. *Guidelines on Occupational Safety and Health Management Systems*. Geneva: International Labour Office. https://www.ilo.org/wcmsp5/groups/public/@dgreports/@dcomm/@publ/documents/publication/wcms_publ_9221116344_en.pdf.
- Kaplan, Dan, and Sara Davis. 2020. 'The Pandemic-Resilient Office Tower'. *CTBUH Journal*, no. 4: 32–39.
- Liguori, Jacopo, and Nicola Culliton. 2020. 'Temperature Measurement at the Workplace: The European Overview'. Withersworldwide. 2020. <https://www.withersworldwide.com/en-gb/insight/temperature-measurement-at-the-workplace-the-european-overview>.
- Mah, Aaron James, Leili Ghazi Zadeh, Mahta Khoshnam Tehrani, Shahbaz Askari, Amir H. Gandjibakhche, and Babak Shadgan. 2021. 'Studying the Accuracy and Function of Different Thermometry Techniques for Measuring Body Temperature'. *Biology* 10 (12): 1327. <https://doi.org/10.3390/biology10121327>.
- Mahmoud, Heba-Talla Hamdy. 2017. 'Interior Architectural Elements That Affect Human Psychology and Behavior'. *The Academic Research Community Publication* 1 (1): 10. <https://doi.org/10.21625/archive.v1i1.112>.
- Malaysia Government. 2013. *Akta Keselamatan Dan Kesihatan Pekerjaan 1994*. Malaysia. <https://www.dosh.gov.my/index.php/ms/perundangan/acts-legislation/3773-akta-keselamatan-dan-kesihatan-pekerjaan-1994-akta-514/file>.
- Ministry of Health Malaysia. 2020. *Guidelines on COVID-19 Management in Malaysia No. 04/2020*. Malaysia. https://www.moh.gov.my/moh/resources/Penerbitan/GarisPanduan/COVID19/Annex_25_COVID_guide_for_workplaces_22032020.pdf.
- Priest, Patricia C., Alasdair R. Duncan, Lance C. Jennings, and Michael G. Baker. 2011. 'Thermal Image Scanning for Influenza Border Screening: Results of an Airport Screening Study'. Edited by Benjamin J. Cowling. *PLoS ONE* 6 (1): e14490. <https://doi.org/10.1371/journal.pone.0014490>.
- Siddiqui, Shama, Muhammad Zeeshan Shakir, Anwar Ahmed Khan, and Indrakshi Dey. 2021. 'Internet of Things (IoT) Enabled Architecture for Social Distancing During Pandemic'. *Frontiers in Communications and Networks* 2 (April). <https://doi.org/10.3389/frcmn.2021.614166>.
- Whitelaw, Sera, Mamas A Mamas, Eric Topol, and Harriette G C Van Spall. 2020. 'Applications of Digital Technology in COVID-19 Pandemic Planning and Response'. *The Lancet Digital Health* 2 (8): e435–40. [https://doi.org/10.1016/S2589-7500\(20\)30142-4](https://doi.org/10.1016/S2589-7500(20)30142-4).
- WHO. 2020. 'Considerations for Public Health and Social Measures in the Workplace in the Context of COVID-19'. World Health Organization. 2020. <https://www.who.int/publications/i/item/considerations-for-public-health-and-social-measures-in-the-workplace-in-the-context-of-covid-19>.
- Yessis, Michael. 2006. *Build a Better Athlete: What's Wrong with American Sports and How To Fix It*. Mount Vernon Avenue Alexandria, Virginia: AGA Press.

Author(s) contribution

Arran Chang Kien Guan contributed to the research concepts preparation, methodologies, investigations, data analysis, visualization, articles drafting and revisions.

Mohd Jaki Bin Mamat contribute to the research concepts preparation and literature reviews, data analysis, of article drafts preparation and validation.

