Infrared Thermal Imaging: A dataset definition towards decision making and intelligence

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Abstract

Infrared imaging is being used every day for monitoring and diagnostic purposes, although it is poorly documented, which can be a major barrier for intelligence creation from the data collected. This research looked deeper into reference recent literature to find the different sources of data related to an IR examination. It was found that exam, image, object of interest, environmental and equipment data are required for a comprehensive dataset. This dataset will enforce quality assurance and drive decision making through being the basis for intelligence generation.

1. Introduction

Infrared thermal (IRT) imaging has been used as a monitoring and complimentary diagnostic and treatment method. It provides information in the physical property of surface temperature to characterize the object state underneath its surface. It can be applied to several fields ranging from engineering to medicine.

The thermal imaging recording process involves several aspects such as: the object preparation, the recording equipment, the environmental conditions and the examination room preparation, all these factors may influence the measurement. It is very important to record the data that characterizes all these domains. The lack of any of this will affect the quality assurance and further investigation. Nowadays we live in the data intelligence era, to drive this, the digitalization of the process of thermal imaging capture is required to maximize the use of Artificial Intelligence methods to create insights that can be used for taking decisions.

Despite this study will be focused on the clinical application of IRT but it can be easily extrapolated to be used in other application fields. It is aim of this research to identify the required minimal dataset to characterize the process of IRT imaging capture to be useful for further AI analysis to effectively fulfil the task of correct decision making.

2. Methodology

Relevant literature [1-6] in the process of thermal imaging recording and thermographic file formats were considered to identify the dataset definition. The dataset definition will be divided into exam, image, object of interest, environmental and equipment data.

3. Results

The IRT imaging recording process generates the required data for its characterization and further analysis, it can be of different sources, such as: exam, image, environment, equipment and object of interest (fig. 1).

The exam data would specify the date of its prescription, the examination question, the possible answers, the name of the requester, the examination date, the examinator name, the examination local, the examination entity, the indication whether it is a static or a dynamic test, the number of image required, the views of the images, the acclimatization period, type of provocation (thermal, mechanical or chemical), the duration of the provocation, the placing of the provocation, the value of provocation (e.g. thermal: temperature), the description of the protocol followed and the distance and angle between the object of interest and camera.

A image data is composed of: the format, the timestamp, the configured emissivity, the configured object distance, the configured reflected apparent temperature, the configured atmospheric temperature, the configured relative humidity, the configured minimal and maximum recording temperature, the Planck constants (B, F, O, R1 and R2), the image width, the image height, the radiometric array, the camera model, the camera serial number, the camera software, the lens model, the field of view, the focus distance, the frame rate, the encoding process, the false color palette, the presence or not of a visual camera, the bits per sample, the color component, the visual image width, the visual image height, the color type, the gamma and the megapixels.

For the object of interest, in this manuscript the human or animal subject, the data to be recorder is: the emissivity, the date of birth (age), the sex, the height and weight, the ethnicity, if is a smoker (units per day), if is a drinker (units per day), if takes drugs (active principle and posology), if has physical activity (type and duration), time of the last heavy meal, time of the last coffee and/or tea intake, time of the last alcohol intake, time of the last smoke, time of the last drug intake,

presence of ointments or cosmetics in the skin, time of the last shower, time of the last sunbath, any massage / electrotherapy / cryotherapy / hydrotherapy and the indication when it took place and for how long, the dryness of the skin, and some complementary data such as: metabolic rate, blood pressure (diastolic and systolic), hearth rate, body core temperature (method and value) and skin conductivity.

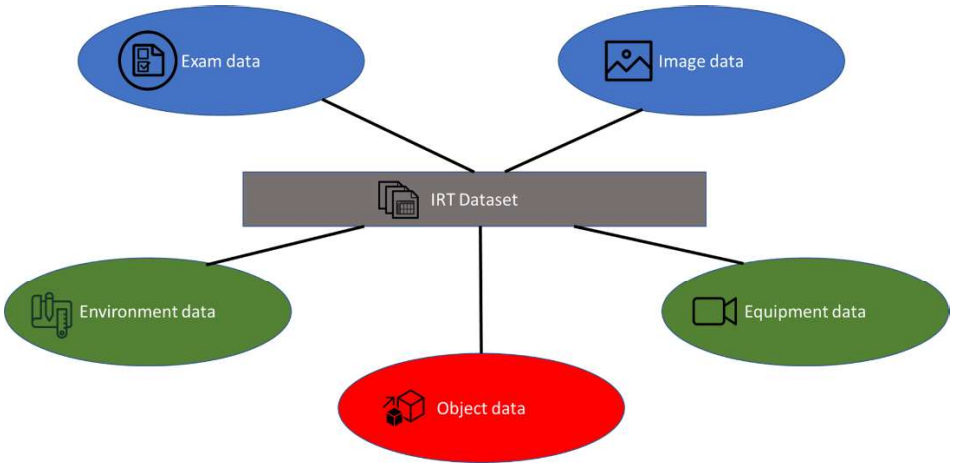

Fig. 1. *The components of the IRT examination process dataset.*

The environment data that needs to be registered is: the time and date, the ambient temperature, the relative humidity, the air flow, the incident lightning, the background color, the presence of objects in the background, the examination room size, the atmospheric pressure and the disclose of the sources of radiation. Most of these values can be automatically obtained through the usage of sensors and an Internet of things system [5].

Recording equipment data consist of: manufacturer name, model, indication of being cooled/uncooled, NETD, IFOV, lens angle, the sensor array size, the sensor dot pitch, the IR spectrum operating wavelength, the measurement uncertainty, temperature recording range, the date of last calibration checking, the time the equipment was switched on before examination took place, presence or not of a calibration source (if yes, which?) and the software of analysis.

4. Discussion and conclusion

The definition of the IRT recording dataset is proposed in this document, it accommodates reference literature [1-6] about aspects and factors that can influence a recording, ensuring its quality verification and further analysis. Some of the various sources of data that forms the IRT dataset can generate redundant data, but that is relevant for quality assurance purposes. More data from other complimentary methods can be added to enrich the dataset (e.g. a x-ray or ECG exam dataset).

To the authors opinion this proposal of a IRT dataset is enough to build a comprehensive exam and images analysis tool that can accommodate the most recent AI methods and allows the development of information from the data, knowledge from the information and drive correct decision making from driving intelligence from the knowledge, being this dataset definition the basis of it all.

REFERENCES

[1] Ring, E. F. J., Ammer, K., “The technique of infrared imaging in medicine”. Thermology international, vol. 10, no.1, pp. 7-14, 2000.
[2] Ammer, K., Ring, F., “The thermal human body: a practical guide to thermal imaging”. Jenny Stanford Publishing, 2019.
[3] Fernández-Cuevas, I., Marins, J. C. B., Lastras, J. A., Carmona, P. M. G., Cano, S. P., García-Concepción, M. Á., Sillero-Quintana, M. “Classification of factors influencing the use of infrared thermography in humans: A review”. Infrared Physics & Technology, vol. 71, pp. 28-55, 2015.
[4] Moreira, D. G., Costello, J. T., Brito, C. J., Adamczyk, J. G., Ammer, K., Bach, A. J., ... Sillero-Quintana, M., “Thermographic imaging in sports and exercise medicine: a Delphi study and consensus statement on the measurement of human skin temperature”. Journal of Thermal Biology, vol. 69, pp. 155-162, 2017.
[5] Vardasca, R., Correia, R., Gabriel, J. “Remote sensing lab for medical thermal physiological assessment”. In IEEE 2015 3rd Experiment International Conference (exp. at'15), pp. 1-6, 2015.
[6] Vardasca, R., “The influence of angles and distance on assessing inner-canthi of the eye skin temperature”. Thermology international, vol. 27, no. 4, pp. 130-135, 2017.