

NON-INVASIVE CORE TEMPERATURE MEASUREMENT METHOD FOR MASS SCREENING BASED ON INFRARED IMAGES OF THE BODY

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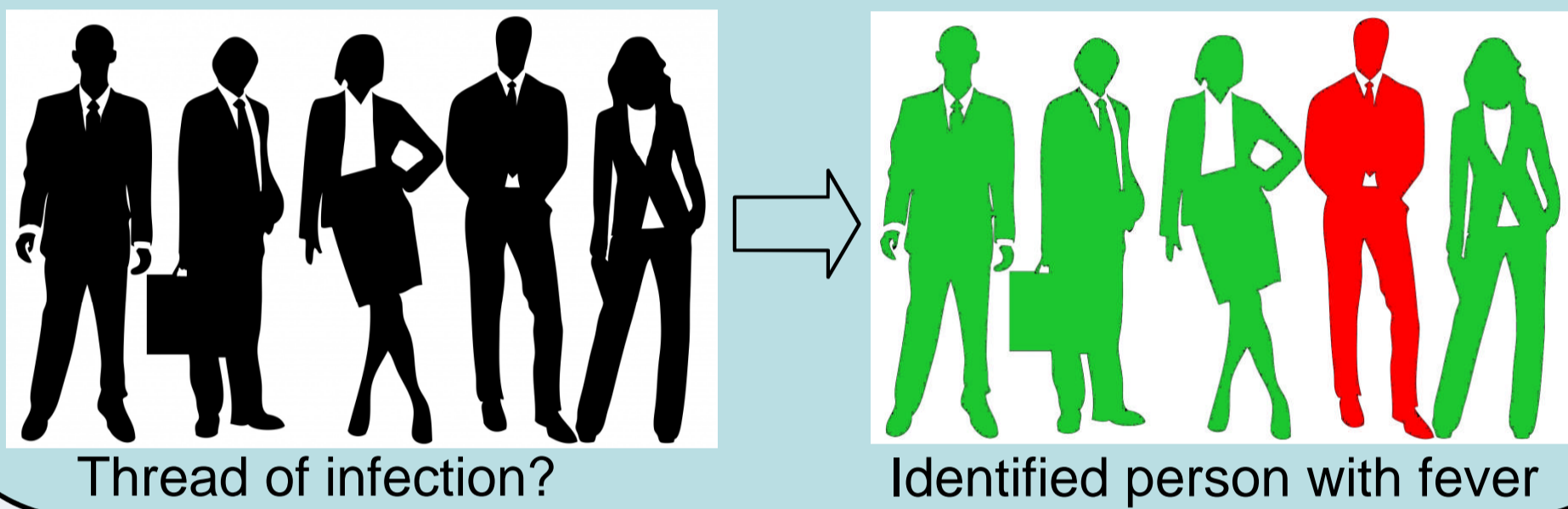
1. Motivation

Fever usually indicates an underlying infection. Mass screening for fever detection in high transit places such as airports or crowded places can help to control infectious outbursts such as SARS, Influenza A and currently Ebola.

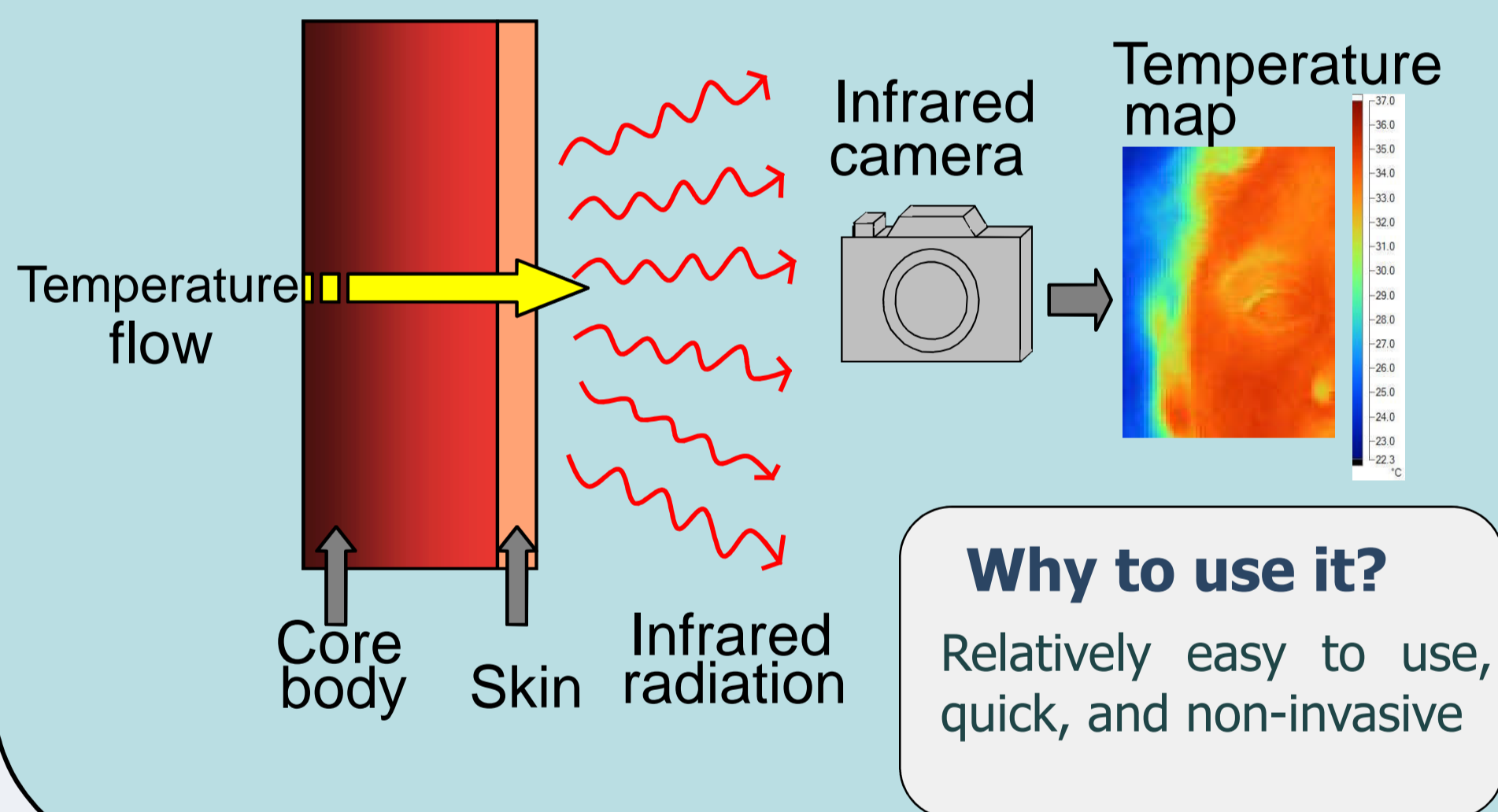
Infrared (IR) thermometry is a practical way for mass screening. However current options have limited accuracy and reliability, giving a false sense of security.

2. Aim

Identification of the IR technology limitations and development of a more robust and reliable methodology and accurate device for mass screening, which would alert when a person is likely to have fever.



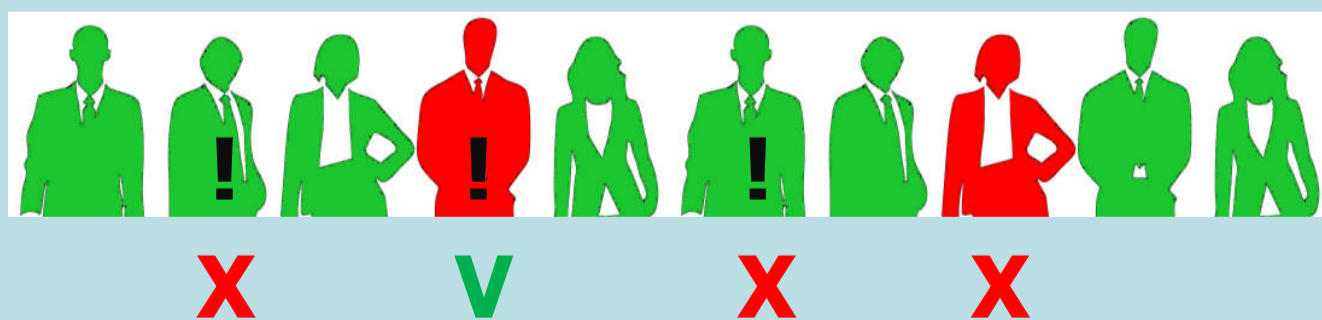
3. What is Infrared thermometry?



4. Challenges

(i) Question current systems

Some systems exist but fail in their diagnosis → More research is needed besides "popular belief".



X: miss feverish person or flag healthy person
V: correct fever identification

(ii) Model relation between core and skin temperature

Large amount of relevant factors: (a) set up factors e.g. distance between camera and person; (b) environmental factors e.g. room temperature and other radiation sources; (c) personal factors e.g. gender, age, and Body Mass Index.

(iii) Reduce measurement error inherent to IRT

Use of fixed temperature points for in-image calibration.

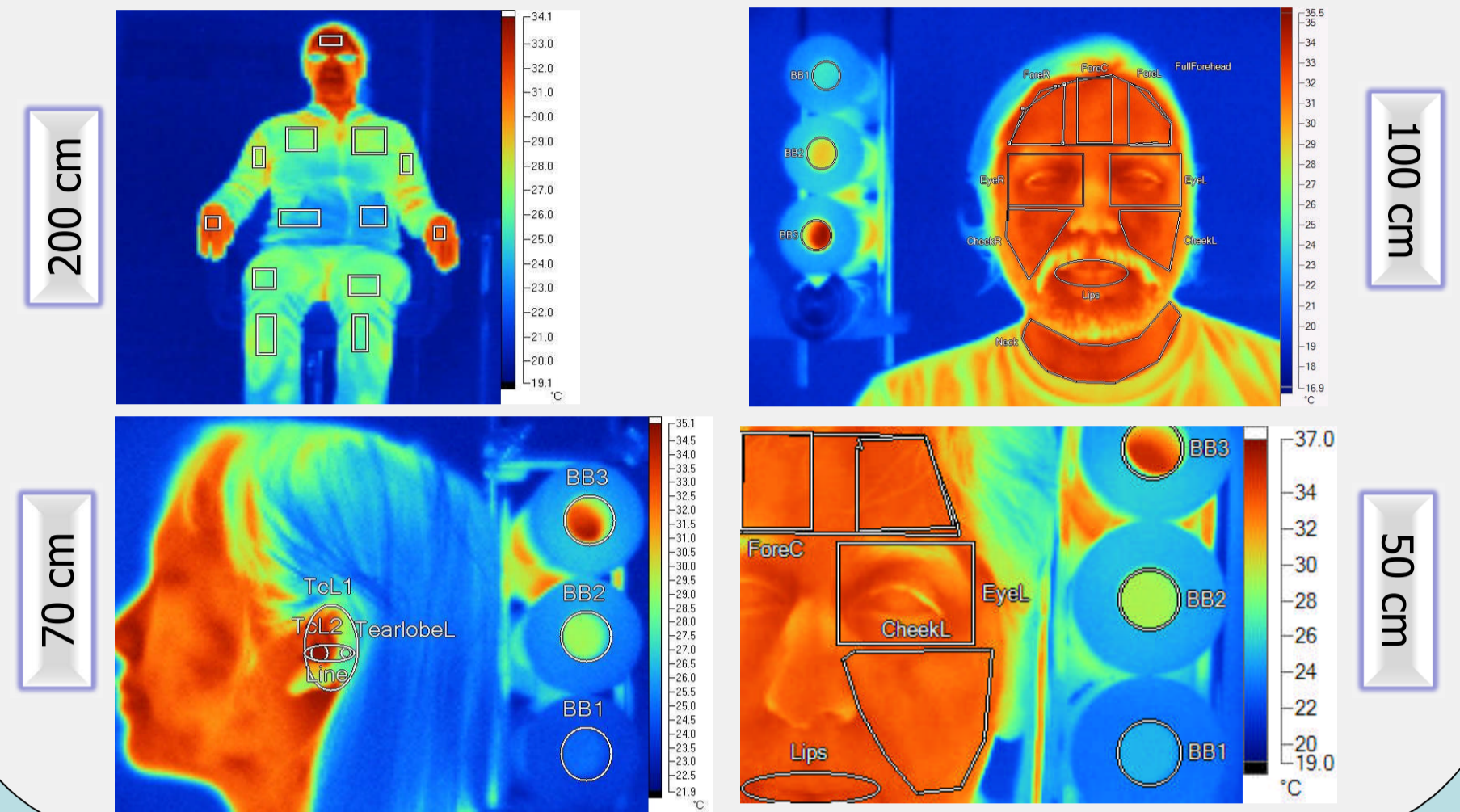
(iv) Reduce measurement error due to untrained users

Development of an automatic system.

5. Our contribution

(i) Extensive data collection (over 200 volunteers) in a range of settings:

environmental temperatures, body locations and area sizes, distance to camera (50-200cm), gender, etc.

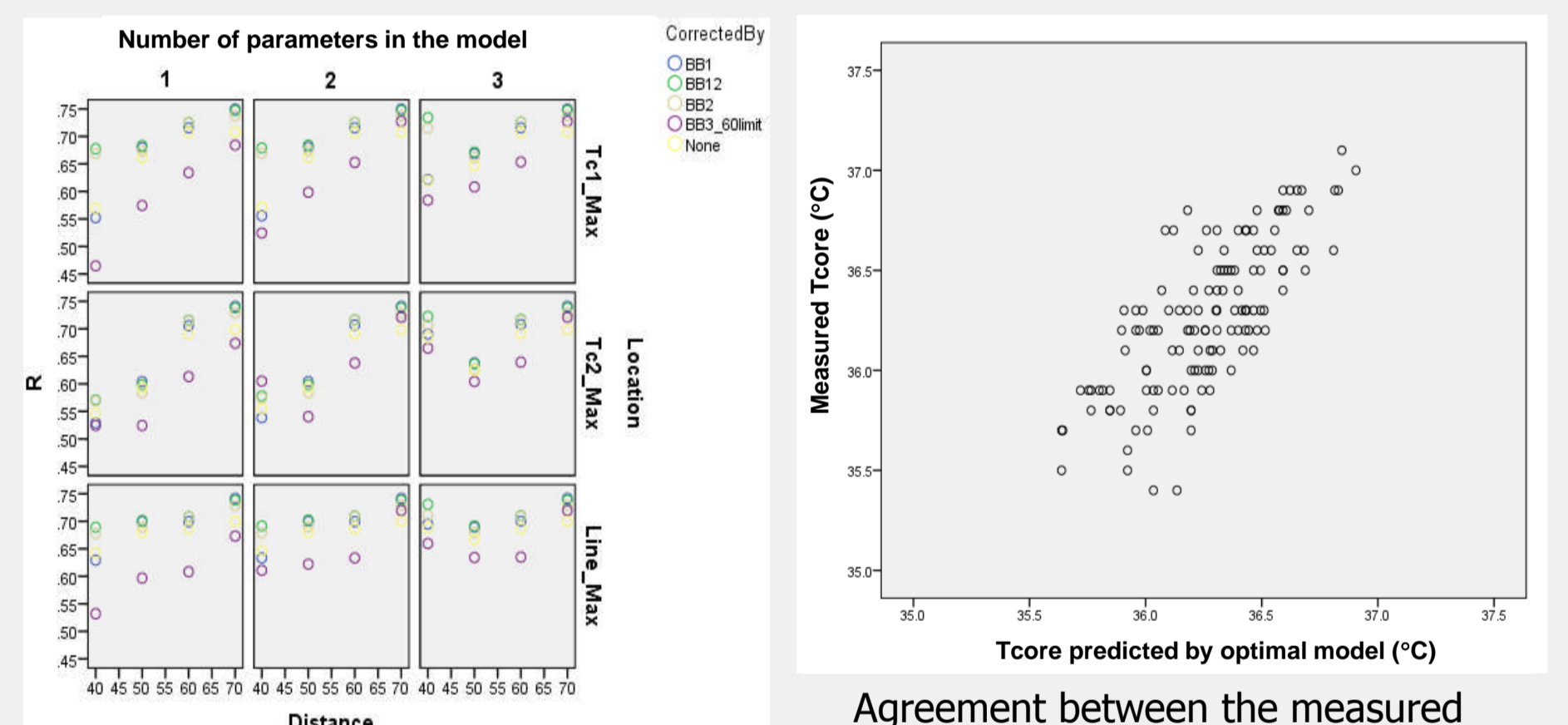


(ii) Calibration of each IR image to improve the measurement precision.

Use of fixed temperature points using black bodies (named as BB1, BB2, & BB3)- the prototypes developed by NPL

(iii) Development and comparison of an extensive number of models.

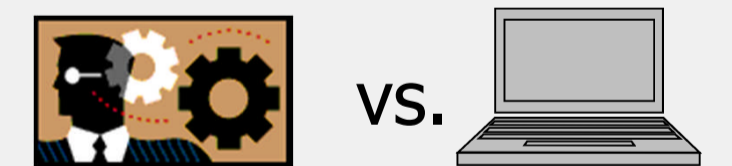
420 models just to study 5 body locations in lateral images, 5 distances, 6 types of calibration, 1-3 parameters



Performance in terms of R-value of a subset of the generated models

Agreement between the measured core temperature (Tcore) and the predicted value by the optimal model.

(iv) Man versus machine.



Development (in early stage) of a robust and reliable device that can automatically identify the area of interest and relevant information in real time.

6. Conclusions

- (i) We have identified and addressed various limitations of current mass screening systems for the identification of feverish people in crowded places such as airports.
- (ii) A large number of models relating core temperature and skin temperature are being studied (still in process).
- (iii) The optimal model so far (most efficient and simple) uses the maximum temperature in the ear canal at a distance of 70cm when the image is calibrated by BB1. R = 0.750.
- (iv) The distance from the camera to the person is relevant.
- (v) Image calibration improves the models (5.9% for the optimal model) and filters errors due to the IR cameras.



These discoveries bring us closer to the development of a reliable system that might help us to contain the spread of infectious diseases!



Acknowledgments

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