Covideo: An Automated Febrile Detection

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Abstract

Fever is one of the most critical signs of COVID-19, which is found in 90% of individuals infected by the virus and should be measured, as strictly recommend, using non-contact infrared thermometers to minimize the risk of virus transmission. However, laser-assisted infrared thermometers can be risky to be used to measure the inner canthus temperature due to the potential eye damage. To remedy this, we designed a system called Covideo, which is an automated febrile detection using thermal images aiming to minimize the need for close examination of individuals potentially infected by COVID-19, by the first responders.

1 Project statement

Measuring the internal body temperature of individuals potentially infected by COVID-19 is the first and essential step executed by first responders, as it has been seen in more than 90% of individuals with COVID-19. However, close examination is strongly prohibited to minimize the risk of disease transmission and as a practice of physical distancing. Alternatively, forehead temperature measurement is performed using laser-assisted infrared thermometers, which is not the best practice. Based on ISO documentation number IEC 80601-2-59 [1], the inner canthus area has the closest temperature to internal body temperature and is highly recommended to be the source of examinations. Therefore, an accurate and reliable approach which eliminates the required labour and risk involved through current methods in addition to minimizing eye damage resulting from the exposure to laser-equipped infrared thermometers is desired.

Although thermal cameras can be used manually as handled devices to measure inner canthus temperature, they still require operator input to measure the desired spots. Also, ambient temperature noise resulting from the body temperature of the operator can affect the readings. To eliminate the required labour and potential of inaccurate readings, the proposed system will use reliable machine learning and image processing methods to actively detect face features using only thermal images without the need for RGB images. It is worth noting

that most of the current face detection methods are only valid and reliable when dealing with RGB images, where our approach only demands thermal images. Then, the extracted face features will be used to accurately locate the inner canthus area using our in-house developed algorithm and compute the maximum and the average temperature. To have a history of the collected temperatures for each individual, their IDs are processed using optical character recognition module of the system and their information including their names, visiting date and time as well as their temperature readings are encrypted and stored in password protected internal servers of hospitals. Any future visit of the same individuals will be recorded along with their history, so any suspicious change in their body temperature can be detected by the system and automatically reported to the hospital officials. In case of detecting out of range temperature of an individual, the operator, who only attend to handle these situations, will be notified by an alarm and pop-up message.

2 Proposed Approach

Our proposed system has two main modules, the detection and reporting. The detection module includes the system that will actively read thermal images from the thermal camera and process them using machine learning methods to detect an individual's face. Then, the region of interest will be passed to a function to locate inner canthus and compute the maximum and the average temperature of the area. This process is executed three times to provide the highest possible accuracy in the reading using three independent captures of thermal images. All the machine learning and image processing designs and developments will be implemented in-house. After finalizing the readings, if the maximum temperature exceeds 38°, the operator will be notified by an alarm sound, screen flashing and pop-up message to take necessary actions. The code is available on Github[1].

The reporting module is responsible for creating a database and records of individuals who visited the hospital. The main component of this module is capturing images of visitors' IDs presented to an RGB camera and processing them using an optical character recognition algorithm to extract their names. Then, for a first-time visitor, a new record with their current reading is created, encrypted and stored in a password protected hospital server. Otherwise, their record will be updated with the newly generated and encrypted readings. In case of detecting any unusual fluctuation in their data, the operator will be notified. To keep improving the performance of the system and adding new features to the system, we will continuously be rolling out updates.

Setting up and installation of the proposed system requires minimum expertise as every step will be precisely documented and instructed. Also, the simplicity of the hardware setup of the system makes it portable and easy-to-install as it only demands 2.0m^3 of space. The thermal camera will be installed on a tripod, pointing at a clear background placed at 1.5m of the subject and

[1] `https://github.com/jranaraki/covideo`

0.7m off the ground. The RGB camera will be looking down at a white background table where a visitor will place their IDs. After each placement of the ID, the surface will be automatically sprayed and cleaned by disinfecting liquid. The output of the RGB camera will not be stored or displayed to the operator to protect visitors' privacy.

3 Outcome

One significant and immediate impact of Covideo system is the decrease in the number of clinical hospital staff required for active screening of visitors, who can be redeployed to other departments where more help is needed in the current situation. Also, the proposed system will help to practice and promote physical distancing as it is a fully automated system that requires one non-clinical and non-technical operator for only the cases where an individual with high temperature ($> 38°$) is detected. The accuracy of the system is highly dependent on the calibration of the thermal camera; therefore, daily calibration with be performed at midnight to ensure the applicability and effectiveness of the system.

References

[1] Medical electrical equipment - part 2-59: Particular requirements for the basic safety and essential performance of screening thermographs for human febrile temperature screening. `https://www.iso.org/standard/69346.html`. Accessed: 2020-04-14.