Temperature Detection from Images Using Smartphones

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***Abstract*— Since late 2019, the global spread of Covid-19 has affected people's daily life. Temperature is an early and common symptom of Covid, so finding cases of the pandemic has relied heavily on it. Due to the virus's nature, a non-contact, convenient, and simple-to-use remote diagnosis platform is needed. In this study, a non-contact method for detecting body temperature is proposed. A developed algorithm based on blackbody radiation calculates the body temperature of a user-selected area from an obtained image. The findings were confirmed with FLIR Thermal Camera and Infrared Thermometer.**

***Clinical Relevance*—This allows a quality of service with remote and convenient solution of detecting temperature of specific body parts using smartphone.**

I. INTRODUCTION

Approximately 464 million people have been infected worldwide due to covid, according to WHO [1]. A common symptom of Covid-19 is fever with high body temperature, which may lead to death [2]. Non-contact infrared thermometer sensors, devices, thermal imaging systems, are being used in everywhere to measure a person's temperature. Emissivity and reflections make these measurements inconvenient, costly, time consuming, and more infectious, as a contraction with people might spread more coronavirus. Also, these cannot differentiate the temperature between specific body parts of humans and objects [3], resulting in inaccurate temperature measurements. Considering all these factors, this work provides a smartphone-based approach for detecting the temperature of any specific body part of a human from an obtained image.

II. METHODS

Pseudocolor image generation has been used for thermal image color-mapping [4]. Since the temperature relationship is not linear, estimating the temperature from the thermal images is difficult. The temperature is calculated using the obtained RGB image by creating a pseudo color space. Then, a linear relationship between temperature and color intensity was established. According to blackbody radiation theory, a low temperature increases the visibility of red light (700nm). In contrast, a high temperature increases the visibility of blue light (490nm) [5]—the dominant color changes with the temperature. In the pseudo color space, each image pixel represents a specific temperature data point. These data points are assigned a unique color or shade based on their value. As the temperature changes, it'll express this by adjusting the color of a pixel. As for lower temperatures (<800K), the red color channel is better for estimating temperature [5], and pixel values of pseudocolor images are scaled according to the red color bar from the original RGB image. A linear relationship (1) is established between the temperature and the pixel intensities by using the indexed images (grayscale image with a color map where the pixel values corresponding to RGB values) maximum and minimum pixel intensity. The temperature detection algorithm described above can approximate the temperature of different points in degrees Celsius.

$$Temp = low_{temp} + intensity * (high_{temp} - low_{temp})/255 \quad (1)$$

III. RESULTS

Initially, the smartphone is used to acquire an image (Fig. 2(a)), then the temperature estimating processing algorithm is executed. Fig. 2(b) shows the acquired RGB image into pseudo color space. Finally, Fig. 2(c) shows the temperature (33.8˚C.) of the user selected region (forehead) after establishing the linear relationship between the pixel intensity value and temperature. An infrared thermometer (shown in Fig 2(d)) and a FLIR Thermal camera (shown in Fig 2(e, f)) are used to validate the data. The obtained accuracy is 97%.

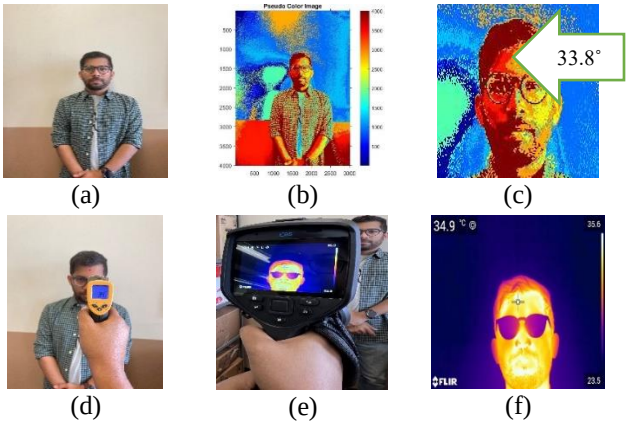

Figure 1: Temperature Detection Algorithm Results (a) RGB Image, (b) pseudo color Image, (c) ROI, (d) Validation of detected temperature using infrared thermometer, (e) Taking an image with a thermal camera, (f) Validation of temperature using a thermal camera

IV. DISCUSSION & CONCLUSION

The main goal of this paper is to develop a smartphone-based temperature measurement solution that can rapidly and conveniently estimate human temperature from obtained images. As a result, there would be no waste of time, fewer human encounters, and a lower risk of the virus spreading.

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