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TOPICAL REVIEW

A Review of Facial Thermography Assessment for Vital Signs Estimation

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ABSTRACT Estimated vital signs might include a variety of measurements that can be used in detecting any abnormal conditions by analyzing facial images from continuous monitoring with a thermal video camera. To overcome the limitless human visual perceptions, thermal infrared has proven to be the most effective technique for visualizing facial colour changes that could have been reflected by changes in oxygenation levels and blood volume in facial arteries. This study investigated the possibility of vital signs estimation using physiological function images converted from thermal infrared images in the same ways that visible images are used, with a need for an efficient extractor method as correction procedures that have used datasets that include images with and without wearing glasses or protective face masks. This paper, summarize thermal images using advanced machine learning and deep learning methods with satisfactory performance. Also, we presented the evaluation matrices that were included in the assessment based on statistical analysis, accuracy measures and error measures. Finally, to discuss future gaps and directions for further evaluations.

INDEX TERMS Thermal images, features extractions, vital signs estimation, evaluation matrices.

I. INTRODUCTION

Many clinical applications have included vital signs estimation for monitoring an individual based on physical or mental health. These vital signs estimation, such as measurements based on pulse rate, heart rate (HR), blood pressure (BP), blood glucose, respiration (breathing) rate (RR), oxygen saturation (SpO2) and temperature variations are among the most important indicators to predict abnormal conditions, including the detection of chronic illness progression for identifying patients at risks [1], [2]. For this reason, delaying seeking appropriate treatment may have serious consequences not only for themselves but also for their families and communities. Previous studies have shown an increase in research trends particularly for vital signs estimation as an effective marker, specifically using facial imagery such as facial thermography [3], [4], [5]. The facial region is highly suggested because direct confrontation in social interaction and communication that makes it possible for measuring vital signs using the facial region has been identified to be the best way of conveying valuable information such as the state of our organs without stressing on the facial skin area [6].

For this purpose, varied vital signs estimation is essentially needed because the assessment of vital signs differs according to gender, age, body compositions and pathological developments in organ systems depending on the manner of their use [7], [8]. For instance, prior research has suggested developing monitoring systems that require the use of temperature variations in addition to the selection of vital signs measurement to achieve the highest accuracy readings in addressing human states [2]. In this case, instead of relying on the attachment of sensors to skin patients in any part of the body where blood vessels are close to the skin's surface which may result in pain, discomfort, stress, infection risk and invasiveness, most

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