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Contactless Heart Rate Measurement using Image Processing

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Abstract— **Non-contact methods of determining the human body's heart rate are of interest for clinical use. This research used a video magnification technique on the individual frames from a 15-second video taken using a digital single-lens reflex (DSLR) camera. It was possible to determine the beats per minutes of the heart rate by extracting the green spectrum from a region of interest information from the video frames. In this paper, three methods are presented using this colour change between the frames transform as a signal to find the heart rate.**

***Clinical Relevance*— Measurement of human physiological parameters such as heart rate using a non-contact method is becoming a vital technique compared to traditional monitoring systems in the clinical environment.**

I. INTRODUCTION

Heart rate (HR) variability is an essential parameter in the clinical environment for assessing the heart's function. It is helpful as an indicator of health status and diagnostics and assessing cardiovascular diseases and chronic diseases [1].

PPG became a popular method for measuring the heart rate: it is invasive, less expensive, and less complex [2]. A pulse oximeter is designed to fit over a finger or, in some cases, an ear, toe, wrist and send wavelengths of red and near-infrared through the body.

II. METHODS

The videos used were recorded from five participants using a mirror-less DSLR, Olympus Pen Lite E-PL5 16-megapixels CMOS sensor camera fitted with an Olympus M Zuiko Digital 14-150mm F4-5.6 lens. The videos used were recorded from five participants. All the videos were recorded at 30 frames per second with a resolution of 1920×1080 pixels. The camera was positioned at the required distance to have the participants face in the camera frame; this distance was 1.5 metres. Video capture took placein a large room with natural light and artificial light.

The video is separated into a sequence of image frames then passed through a series of image processing techniques. The spatial decomposition of each frame will characterize the variation over space; this process will reduce image noise and increase the temporal signal-to-noise ratio. Temporal image processing of signal followed to characterize the variation over time [3].

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Region of interest (ROI) was identified by using object detection application; the algorithm is performed on each video frame.

Three methods were used: *Method 1* is the mean heart rate (HR) from the highest frequency occurrence. *Method* 2 is the mean HR from total peak count with respect to total time. *Method 3:* is the mean HR from the mean peak value across interval.

III. RESULTS

The results presented in this paper, which used video filename: P1001 gave HR values for (a) method 1 equal to 65.74 bpm, (b) method 2 a mean value HR of 65.67 bpm and (c) method 3 a mean HR of 67.73 bpm. A commercially purchased pulse oximeter was used to validate all the results.

Table I shows the experimental results from three recorded videos taken from participant one from five participants who taken part in this research.

TABLE I. VIDEO RESULT VALUES OF PARTICIPANT ONE

Video	Experimental HR Values (bpm)			Validation HR Values from Pulse Oximeter (bpm)	
	Method 1	***Method 2***	***Method 3***	***Range***	***Average***
P1001	65.74	65.74	67.73	68-65	66.5
P1002	63.69	63.69	64.93	60-63	61.5
P1003	87.19	79.92	86.68	108-80	94.0

IV. DISCUSSION & CONCLUSION

This research has demonstrated that it is possible to acquire HR measurement without physical contact with the participant by obtaining a signal through image processing of a video recording. However, precision drops under non-ideal conditions. Though the delivered product is promising, these limitations would be significant for real-world application.

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