Pulse Detection through Webcam

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Abstract— In this paper the simple and robust method of quantifying the pulse rate is presented. Elaborated algorithm sanctions for efficient pulse rate registration directly from face image captured from webcam. The desired signal was obtained by opportune channel cull and principal component analysis. A developed non-contact method of pulse monitoring is shown within the paper. The proposed technique may have an excellent value in monitoring person health at his own place after adequate enhancements are introduced.

Keywords: Pulse Detection through Webcam

I. INTRODUCTION

HOME health care is nowadays growing and transmuting discipline. The remote monitoring of vital signs includes not only the high precision diagnostic contrivances but withal simple ones and accessible for everyone. One of the most frequent examinations performed in health care monitoring is cardiac pulse quantification. There are many different methods of contact quantification of a heart rate among which the golden standard is an electrocardiography (ECG). However, recording electric potential engendered by the heart requires felicitous application of the electrodes what may be too perplexed and vexing in home conditions. Other methods of quantifying cardiac pulse involve thermal imaging [1], Doppler phenomenon both optical [2] and ultrasonic [3] or piezoelectric quantifications. Photo plethysmography (PPG) is another method that is being utilized in detecting pulse rate. It utilizes changes of the optical properties of a culled skin area involved by pulsating blood contents. The typical implementation of Photo plethysmography (PPG) uses dedicated light sources, near-infrared light. Changes of the light intensity reflected from the skin correspond to a volume of tissue blood perfusion. Moreover, it has been proved that pulse quantification from human face is withal possible utilizing daylight as the illumination source has developed a robust method for computation of the heart rate from digital colour video recordings of the human face.

II. METHODS

A. Experimental setup and Quantification Procedure

The experimental setup consisted of web and thermo graphic cameras, and synchronized recorder of ECG (Fig. 1).

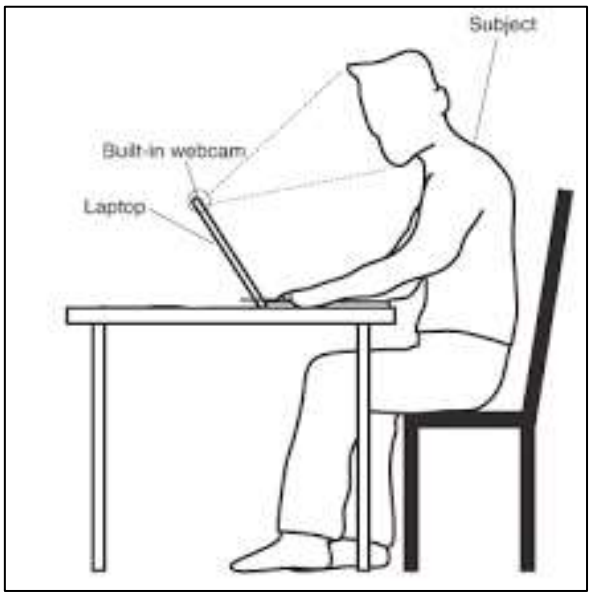

Fig. 1: Experimental setup

The quantifications were performed indoor and the only light source was sunlight. The 30 seconds long video sequences were recorded by denotes of a Logitech Webcam 9000 Pro. The resolution of the videos was 640x480 pixels and the frame rate was 20 fps. Sequences of images were preserved in AVI format without compression. While the video Quantifying Pulse Rate with a Webcam – a Non-contact Method for Evaluating Cardiac Activity was being recorded the ECG signal was amassed utilizing the As CARD electrocardiograph. The sampling rate of ECG signal was 400 Hz.

B. ROI's selection

The analysis was performed for 2 different ROI's (regions of interest) sizes. First, the rectangle containing the face region was culled at the first frame of video recording (Fig. 2a). Coordinates of the culled face region remained the same for the whole sequence of images. The second ROI was a rectangular-shaped a part of the forehead area. It was defined predicating on pupils' coordinates and distance calculated between them (Fig. 2b). It was expected that it would be possible to find a component of forehead to be visible "uniformly". To prove these postulation thermo graphic images were taken for all examined persons. Thermo grams were recorded by the FLIR ThermaCam SC3000 thermal camera having temperature resolution equal 0.1°K.

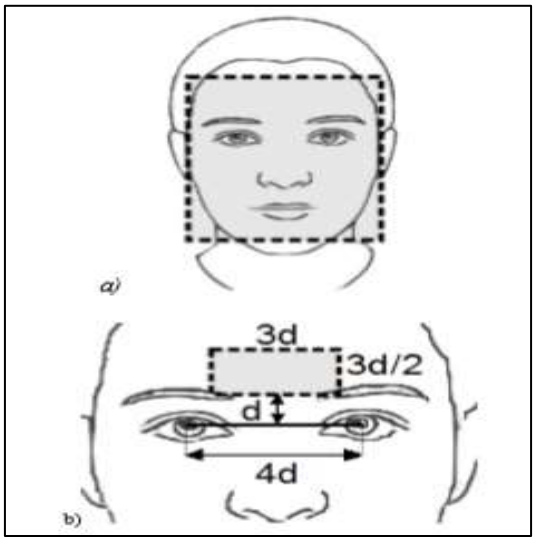

Fig. 2: Definition of ROI's for two approaches utilized in the paper, a) the whole face as a ROI, b) culled part of the forehead as a ROI

C. Sensor Design

In this paper we are utilizing a Logitech Webcam with maximum pixel resolution of 1280x1024. The experiment was conducted only indoors and with a varying magnitude of ambient sunlight entering through windows because the only source of illumination.[8] During the experiment, the person was asked to keep still and breathe correspondingly and face the webcam while their video was recorded for one minute utilizing Vision Acquisition block in Labview software. All videos were recorded in color of range (24- bit RGB with three channels × 8 bits/channel) at 30 frames per second (fps)with a pixel resolution of 640 × 480. The recordings were taken with the person at many stages of positions like rest and kineticism, firstly at rest to minimize kineticism and those of the second were taken with the person performing sundry intensities of exercise [5]. Hence, the present study employed individual image-processing procedures for every instant of action. Categorically, a spatial averaging approach was first conducted to engender the truncated frames for the experiment [6]. All the video and physiological recordings were analysed utilizing custom software indited in Labview called NI Vision Acquisition. Fig. 1 provides an overview of the stages involved in our approach to instaurate the PPG from the webcam videos. We utilized the NI Vision library To automatically identify the coordinates of the face location in the first frame of the video recording. The Sample PPG which is to be obtained will be as follows:

Fig. 3: Sample PPG signals at rest and motion

The above figure in the paper shows the PPG of the same person at different stages of action like rest and kineticism. The main part of the sensor here is the Logitech Webcam, which works on the substructure of the sensing mechanism as the contact sensor. The face is the target for remote detection because it is denuded during the exercise/kineticism, and it has been kenned that the facial PPG.signal is typically more vigorous than that from other anatomical locations of the body during the non-contact quantification. For the video recording utilizing NI Vision Acquision Block in Labview software was utilized. The person was asked to move naturally with his face pointing directly toward the direction of camera, along with focusing the IR light on the facial surface where the camera is kept in the contact. Care has to be taken that the person has to be remained seated and to maintain planar alignment of his face with the camera during the kineticism and rest positions. Images of 512×512 pixels were taken from the face at a lower frame rate (30 fps, Texposure = 40 ms) to sanction image capture over an incremented duration of exercise (1min).The distance between the camera lens and the face was~300 mm. Separate plethysmographic Waveforms obtained from each of these two functions rest and kineticism by calculating the cognate pulse rate for each minute. This consummate apparatus is interfaced with Lab view software utilizing vision acquisition by the following code consisting of Coloredhistogram for the analysis of image in the red plane.

This consummate apparatus described above is now interfaced with NI Lab view software utilizing vision acquisition by the following code consisting of Colored histogram for the analysis of image in the red plane. In the exhibited NI Lab view program, the captured images are perpetual and may additionally be considered as video recording configured through obtained RGB image and the distortions are abstracted by utilizing the Filters.

D. Methods of analysis

1) System Architecture:

The test contrivance consists of a Logitech webcam of resolution 1280 × 1024 pixels which is kept proximate to the non-contact surface of the human body that is the face. The measured distance between the camera and face was approximately 350 mm. The ambient IR light needs to be focused on the non-contact face. The person is to be tested and all equipment was situated in a room with no artificial light present. During the cardiac cycle, some volumetric transmutations in the facial blood vessels modify the path length of the incident ambient light such that the vicissitudes in amplitude of reflected light designate the timing of cardiovascular events. By recording a video of the facial region with a webcam, the red, green, and blue (RGB) color sensors pick up an amalgamation of the reflected plethysmographic signal along with other sources of fluctuations in light due to different artifacts.

III. RESULT

The obtained waveform is the PPG which is analysed for the calculation of average pulses is as follows:

This PPG gives different values for different persons, depending on the Kineticism of the body and varies accordingly, when the person is in rest and Kineticism (motion). The below shown is the PPG signal when the person is in rest.

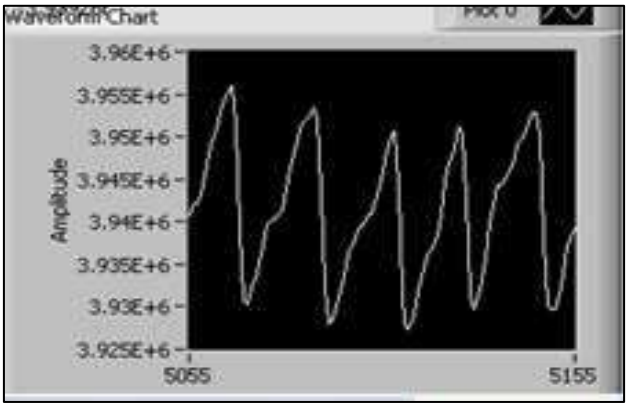

Fig. 4: Graphical representation of the obtain

IV. DISCUSSION

The IR light from the IR led is focused on the non-contact face of the human body. The Logitech 9000 webcam is placed closed to the non-contact face with a maximum resolution and the imaging is now interfaced to the NI lab view, a VI is engendered in lab view which consists of NI Vision acquisition through which the video of the led focused non-contact face is acquired and is analysed by the corresponding lab view program utilizing color histogram and clusters. All the above explicates about the occurrence and analyzing of the obtained PPG.

V. CONCLUSION

A simple processing of image data, and then applying PCA sanctions extracting the mutable component containing information of the heart rate. The presented algorithm seems to be quite efficacious and facile to utilize in the quotidian monitoring of home care patients. However, an additional study must be performed on moving persons, and also the same with more than one camera.

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