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Comparison of Image based and Laser based technique for Non contact Heart beat monitoring system

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***Abstract*— Physiological monitoring of the heart rate is of great importance. As concerned with the treatments for cardiac, Now-a-days, non-contact heart beat is the area of interest for many researchers. We introduce a method that uses webcam to obtain heart rate. A webcam is used to capture the video of the person for a few seconds that would record the raw data signals. Explicitly, a realistic video recording method is deployed to acquire pulse signals. Among the measurement of other physiological parameters, the heart rate measurement is thriving interest. Many researches on cost efficient and contactless methods for monitoring heart beat lead to development of many other approaches like technique of face detection etc., In the existing system, Electrocardiogram (ECG) panics the patients; this makes the heart rate measurement complex. We aim to bring about a convenient, an easy and effortless way of measuring heart beat. The proposed system is a realistic heart beat detection system.**

Keywords—Non-contact heart monitoring; ECG; Video-based physiological; RGB; FFT.

I. INTRODUCTION

Tremendous efforts have been spent to measure the heart rate. In the hospitals, the equipment (MRI) are used to know the brain condition, Electroencephalogram, Electrocardiogram is used to obtain the heart rate. It would be comfortable for the patient, if these techniques are un-intrusive. Many researches on cost efficient and contactless methods for monitoring heart beat lead to development of many other approaches like technique of face detection. So in this paper the Heart Rate Variability (HRV) is used to indicate physiological parameters. HRV technique gives the variations in the heartbeat example, when other signals except PQRST are found, then those signals shows that the person has some health issues. If the person undergoes fitness program then his HRV increases and decreases if the person has health issue. Hence HRV is used to depict the health conditions of a person. BVP signals are used to obtain HRV data. HRV can be measured using other devices like, a chest belt is used for safety purpose and this keeps on monitoring the heart rate. Other method is based on Photoplethysmography (PPG) to acquire BVP through variations in optical source. In this system, the pulse measurements can be obtained with sufficient light which obtains bvp signals out from recorded data. In present conditions the Contact less method is seeking more attention. The webcam is used to record the video of the person and then it is processed using an image processing tool. The BVP pulses are achieved under sufficient light. The MATLAB helps us in fast computing of the recorded video. The video should be 5sec. The central idea in this paper is to create a contactless ECG. We present a Contactless approach for measuring the heart beat. This paper describes a realistic & un-intrusive method for detecting heart beat. It makes use of a webcam to record video images. A study about the performance of this proposal and some results are presented.

II. BACKGROUND

In the past few years many researchers have been working on the non-contact heart rate monitoring. A technique based on thermal imaging system was developed. The thermal energy from the skin is collected by the high sensitive thermal imaging methodology. The blood flow changes are impinged or modulated on to the BVP signal. These signals contribute to the calculation of instantaneous hear beat values. Fast Fourier transform is applied to the average of RGB values. The drawback of this technique is distortion due to compression of muscles [2]. Then in another approach, the author presents the unevenly detrend sampled series and apply it to RR series. The approach is based on the motion of weighted quadratic variation, which is a suitable measure of variability for unevenly sampled series. Drawback here is, it overestimates the total power in the LF and HF band [3]. In another paper, much modified concept when compared to previous one was introduced. There are 3 such concepts. The smoothness prior approach, the wavelet & the empirical mode decomposition. Among the above mentioned methods, wavelet method gives accurate and efficient outcomes. [4]. In the [5], a wearable health device was introduced which detects the health issues before hand and works on preventing the health problems. There are many other PPG devices that introduce method for obtaining the heart rate using a basic webcam. By applying ICA

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on the RGB channels in recorded data, the pulse signals are drawn out from the selected face area. [6]. In this paper the author presents a un-intrusive technology for monitoring the pulse rate during sleep using a wearable sensor. Three types of sensors are used to build this wearable wrist sensor. Drawback is that, it was not suitable for daily use [7]. The author introduces an adaptive technique based on PPG. In this method the AAM technique is used to recognize the facial region, then ROI, RGB colors are obtained and the heart rate is measured [8].

III. METHODOLOGY FOR PHYSIOLOGICAL PARAMETERS EXTRACTION

The non-contact heart rate monitoring uses a webcam for flexibility and static heart beat measurement and is a cost efficient method. The blood volume variations can be detected from the compression and expansion of blood vessels on face. The skin color of face varies with blood circulation. The first step is to convert the video into frames, then the RGB pixel for each frame is calculated and average is taken. Now the frame with RGB may contain some noise, hence we use a median filter to remove the noise. Each channel should be normalized, using non-linear filter. And then finally perform the Fast Fourier transform. Figure 1 shows the block diagram for measuring heart rate.

A. *Upload the video file*

The true values of the heart rate signal that is drawn out is decided by the precise face recording, field strength of light, atmospheric noise, and identification of person's emotion. In this paper the person's video is uploaded initially. Face recognition and extraction are dependent on skin color. We convert the image from RGB to Y, C_b, and C_r. The formulas to convert are as follows [1].

$$Y = 0.257*R + 0.5054*G+0.098*B+16 \quad (1)$$

$$C_b = 0.148*R-0.291*G+0.478*B+128 \quad (2)$$

$$C_r = 0.478*R-0.368*G-0.071*B+128 \quad (3)$$

The coefficients in the above three equations are obtained from MATLAB. Depending upon the color of facial skin, the region of interest is found.

B. *Frame conversion, Facial detection and processing*

After obtaining the video, they are converted into frames and then the face is detected to confirm whether it matches with the uploaded videos and average of pixels that are calculated [1]:

$$V_i = \frac{1000 \times (\sum_1^n \sum_1^m (I_i))}{n \times m} \quad (4)$$

n, m denote row and column of the pixels. For the each i=R, G, B, I_i is the pixels of each frame, $I_i=I_R$, , I_G, I_B.

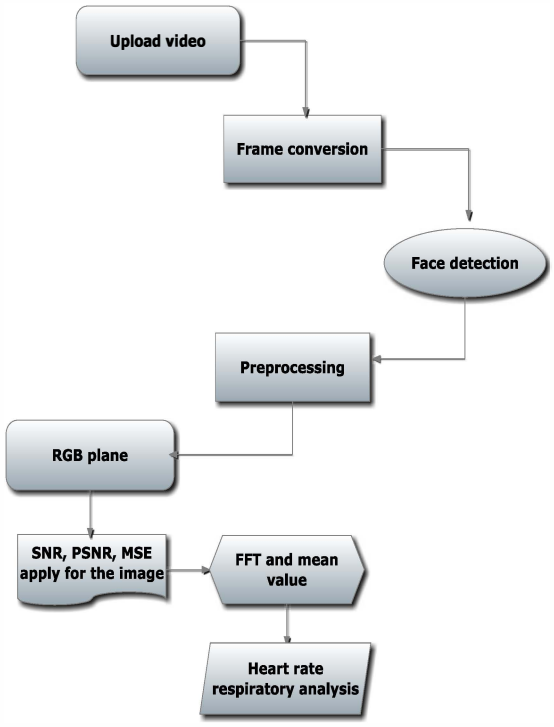


Fig 1: Block diagram for measuring heart rate

C. *Filtered and Normalized*

When there is a change in person surroundings, the recorded image will contain some noise. The heart rate extracted is raw signals with noise and hence the median filter is used remove the noise. To prove that the noise has been removed completely we find the mean average, variance, MSE, PSNR of the red, green, blue pixels in a frame.

D. *Applying FFT*

Finally the FFT is applied on the filtered signal. FFT is used to reduce the processing time and computation complexness. The average or mean of all the pixels in each frame is converted in corresponding frequency components. Then we use a trial and error mapping method to map the heart rate to respective frequency.

IV. REAL-TIME IMPLEMENTATION

This non-contact method needs time in the order of a minute to process and acquire the heart beat value. The video is applied as an input to the system that contains the MATLAB. The image processing consist a display. It shows the RGB values

and recognized area of the person's face. Results obtained from median filter are the normalized values of each RGB space that will be displayed. The results show the processed signal after FFT.

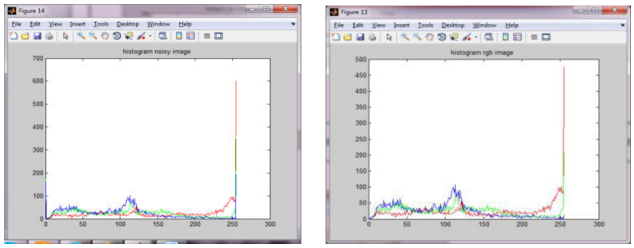


Fig 2: RGB average in a frame

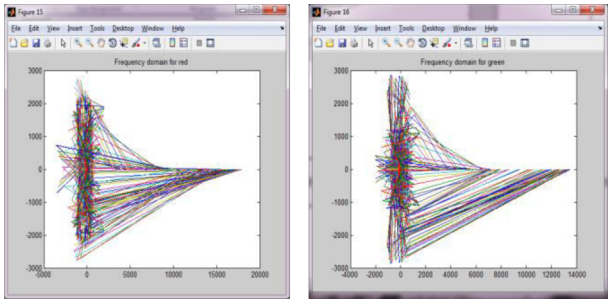


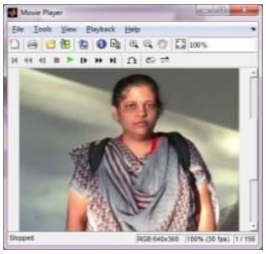
Fig 2.1: Frequency domain representation

Figure 2, indicates the amount of raw RGB data in the frame- in noisy and noiseless frame. Figure 2.1, indicates the frequency domain representation of the RGB pixels.

Figure 3, shows the flowchart for the calculation of physiological parameters. In the real case scenario, the original video can be taken for several minutes, but the processing becomes tedious and delays the output.

V. EXPERIMENTAL RESULTS

The image is captured by the webcam. The video is recorded at a pixel resolution of 640*480. The persons heart beat been verified using the ECG. It shows that the results of this experiment and ECG are more or less same. The following is the one person's complete analysis of heart rate using the webcam.



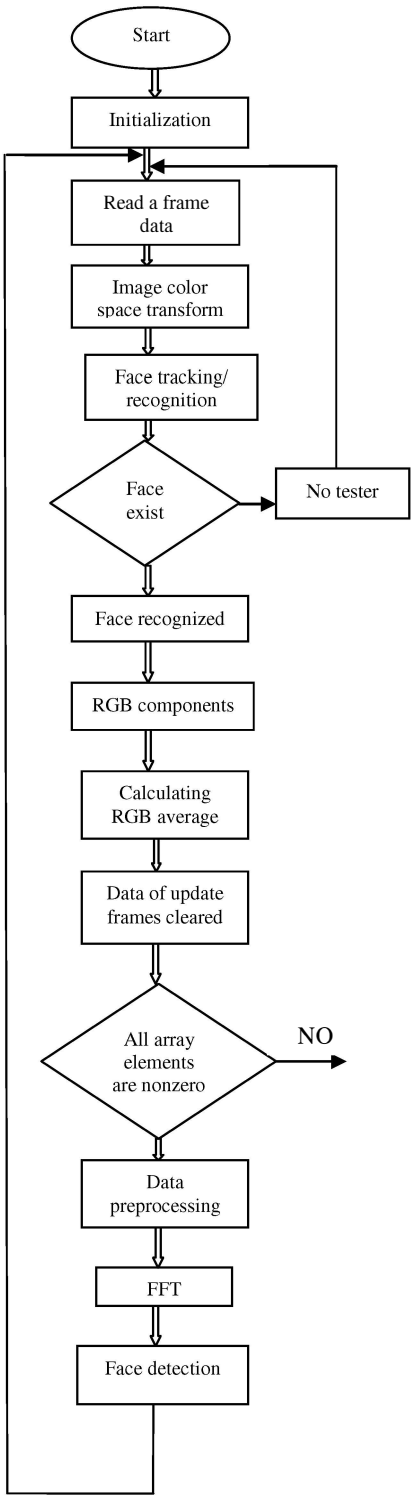
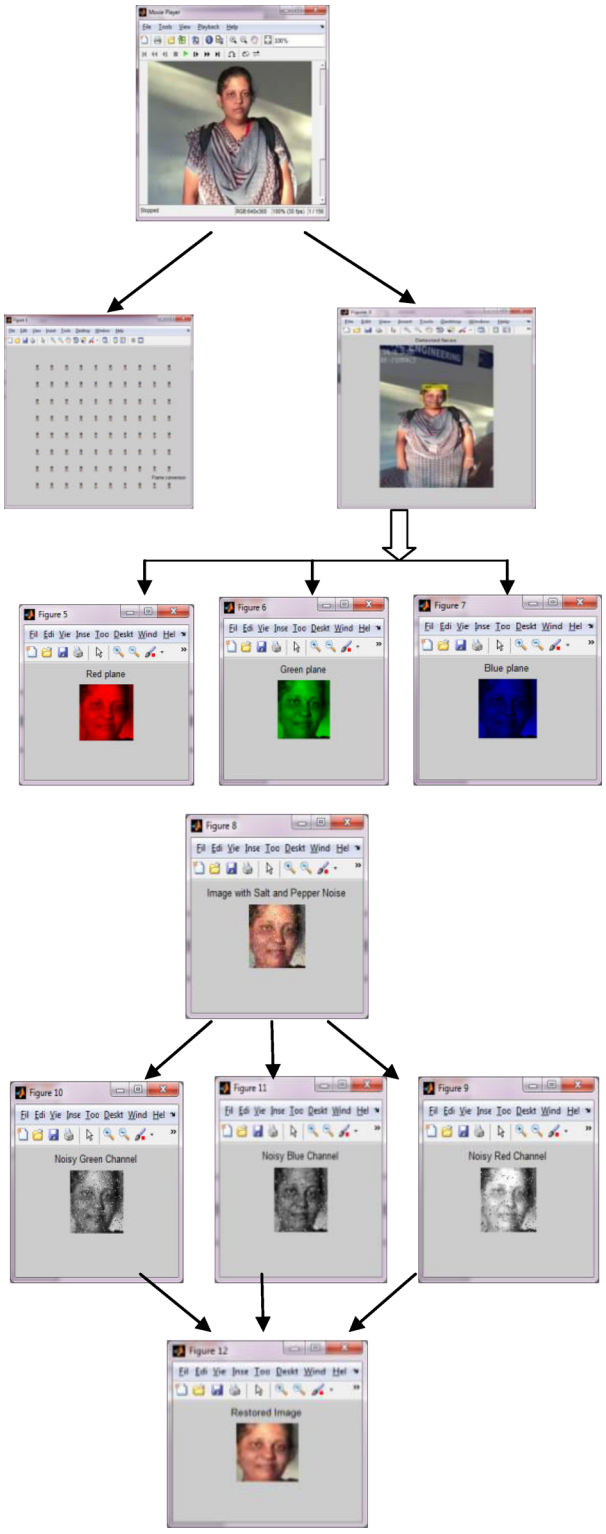
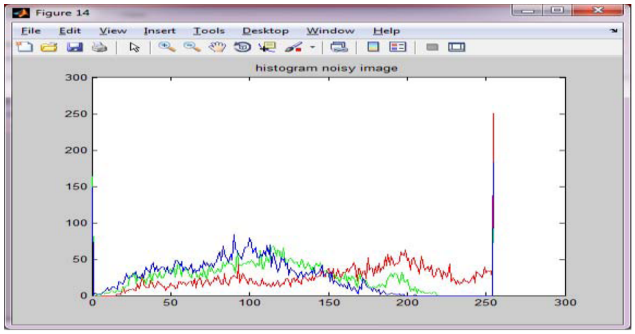


Fig 3: Flowchart representation for calculating physiological parameters





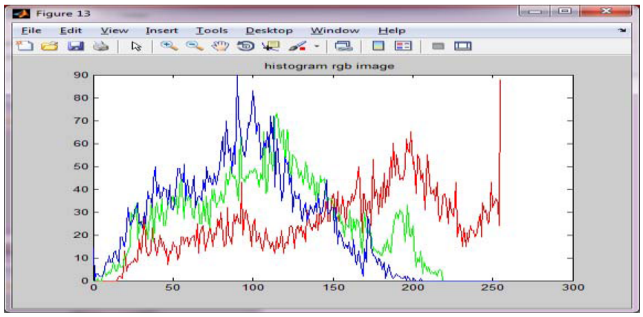


Fig 4: Result of one person

Figure 4, shows the detailed analysis of the method. Initially the video is taken and uploaded, then they are converted into frames, then face is detected, after which the RGB colors are separated, the noise is removed and then the average of the raw RGB signal is shown in the histogram. Finally the FFT is applied and the approximate heart rate is detected.

Table 1: Heart rate calculated for a person

Parameters	Result
SNR	6.0350
MSE	6.30
MSE	6.39
MSE	6.29
PSNR	40.1695511 dB
PSNR	40.1115049 dB
PSNR	40.1765790 dB

Heart rate is low for this person. The heart rate ranging from 40-72 is considered to be normal and healthy. People who have their heart rate in the range of 40-50 may be sports person or person who exercises daily. The person having heart rate in between 80-100 is considered as medium. Then if the person has heart rate greater than 100 have abnormal heart beat.

VI. CONCLUSION

Contact less heart-beat detection method based on recording images using the webcam is ideally suitable in real time to measure the heart-beat. As it is a non-contact process, it is easy to measure the heart-beat. It does not cause any discomforts or pain, patient need not get panic because of the probes and it is simple and non-time consuming process. This experiment mainly depends on some factor; light intensity should be same, less atmospheric noise and person's emotion. The Contact less heart-beat detection technique can obtain the heart-beat but unnecessary movements from the person can affect the true values.

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