

SVM Based Classification & Remote Detection of Photoplethysmographic Signal

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Abstract— Cardiology is one of the medicine branch which deals with the heart diseases. Here we present the new system for monitoring the heart by using ambient light and digital camera. Photoplethysmography is the new technique which deals with the heart and we can measure heart rate, heart rate variability, and respiration rate and oxygen saturation. But due to rapid advancement in the imaging devices there is trend to convert traditional PPG into remote PPG. Remote photoplethysmography is most recent method for measuring the heart rate according to skin color variations. Firstly we have to consider ROI for experiment and hence Viola Jones algorithm is used for the face detection. The peak-to-peak time between systolic and diastolic point is related to the heart rate. After extraction of BVP pulse, we are extending our work toward classification of these pulses in to six different types as Normal Sinus Rhythm (NSR), Premature Ventricular Contraction (PVC), Atrial Premature Contraction (APC), Ventricular Tachycardia (VT), Ventricular Fibrillation (VF) and Supraventricular Tachycardia (SVT). For classification we will use Support Vector Machine Classifier (SVM).

Key words: Photoplethysmography (PPG), Blood Volume Pulse (BVP), Heart Rate Variability (HRV)

I. INTRODUCTION

Presently days stress has turned into the piece of life which begin numerous heart ailments, hypertension, mid-section torments and sporadic heartbeats. The principle capacity of heart is knocking the blood through the system of supply routes and vein which is otherwise called cardiovascular framework. The cardiovascular sign investigation is utilized to screen heart rate and heart thumps. There are two sorts of systems utilized for investigation heart signals, ECG (Electrocardiography) and PPG (Photoplethysmography).

ECG is most normal procedure used to screen the heart rate and heart thumps, yet once in a while ECG is bad for the examination. ECG cathodes and some different sensors are acquired from the metal which is not helpful in the MRI in view of solid attractive field. ECG sensors are immoderate than the PPG sensor. Photoplethysmography has two procedures utilized for estimation of heart rate. In conventional strategy one and only contact sensor is utilized to concentrate signal from the fingertip. PPG have capacity to recognize the physiological parameters, for example, heart rate, breathe rate and blood oxygen immersion. In this paper we consider latest method otherwise called remote PPG utilized for investigation of heart rate. For every last heartbeat, heart pushes volume of blood to the next piece of bodies, for example, arm, legs, face and again it comes back to the heart which causes beat.

This heartbeat is otherwise called blood volume beat (BVP) and which is distinguished utilizing computerized camera and surrounding light in RPPG. As blood touches base at body part from heart, measure of blood underneath the skin increments and henceforth all the more light is reflected which causes an ascent in sign. At the point when deoxygenated blood comes back to the heart then volume of blood abatements and sign tumbles down. The rising crest in the sign is known as the systolic crest of BVP and then again falling top is known as diastolic point. We can appraise heart rate utilizing taking after terms:

- Systolic-Diastolic crest to-crest time
- IBI (Inter beat interim): Time interim between two adjoining systolic/diastolic focuses

Photoplethysmography operates on the principle that volume changes in the limb or digit result in changes in the optical density through and just beneath the skin over a vascular region. A light source in an obscure chamber enlightens a little range of the fingertip or other locale to which transducer is connected. Light scattered and transmitted through the vessels of the area is grabbed by the photocell, which is protected from all other light. As the vessels load with blood, the blood thickness increments, along these lines lessening the measure of light achieving the photocell.

The outcome causes resistance changes in the photocell that can be measured on Wheatstone connect and recorded. Principle utilizations of PPG incorporate checking of oxygen immersion, and in measuring the lower leg brachial weight list (ABPI) to distinguish fringe vascular infection formatter should make these segments, consolidating the appropriate criteria that take after gives the BVP waveform in which we obviously identify the systolic/diastolic focuses and bury beat interim.

A. Design Considerations

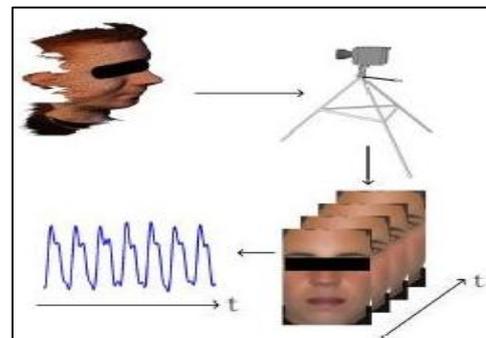


Fig. 1: Basic Working Principle

The proposed postulation work hopes to arrange a structure for measuring the physiological parameters, for instance, heart rate, breath rate and heart rate variability. Past methodologies are adequately terrible to evaluate PPG

signals remotely, so here present another methodology for measuring photoplethysmogram (PPG) hails remotely using encompassing light and a propelled camera that considers exact recovery of the waveform morphology.

Here advanced camera is centered around the facial area which is considered as locale of interest (ROI). An arrangement of pictures extricated from the face and utilized for the further investigation. As we realize that for every heart beat blood volume underneath the skin firstly increments and after that abatements. These outcomes into change in shade of skin, however these shading varieties are not noticeable to human eyes. We need to utilize optical gadget (Digital camera) for such perceptions.

II. PROPOSED SYSTEM

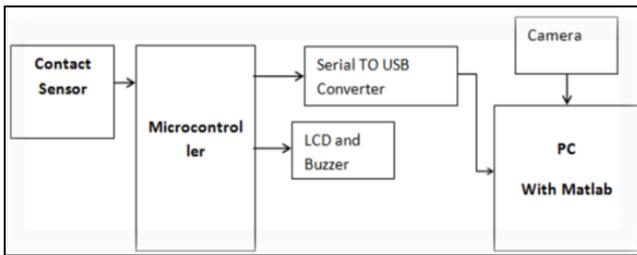


Fig. 2: System Block Diagram

Complete image processing task will be performed on PC. For this we will use Matlab Software. A USB adapter is a type of protocol converter which is used for converting USB data signals to and from other communications standards. Commonly, USB adaptors are used to convert USB data to standard serial port data and vice versa. Most commonly the USB data signals are converted to either RS232, RS485, RS422 or TTL serial data. The older serial RS423 protocol is rarely used anymore, so USB to RS423 adapters are less common.

A. Image Acquisition

Image is acquired by high resolution web camera. Following are the specifications of camera used. IBall Face2Face C8.0 web camera with interpolated 8.0MP Still Image resolution, 4.0MP Video resolution and 5G Wide angle lenses provides smooth video.

Features of I Ball Face2Face C8.0 web camera:

- Interpolated 8.0 Mega Pixel Still Image Resolution
- Interpolated 4.0 Mega Pixel Video Resolution
- High quality 5G wide angle lens
- 6 LEDs for night vision, with brightness controller
- Snapshot button for still image capture
- Built-in high sensitive USB microphone
- 7. Built-in 10 Photo frames and 16 special effects for more fun
- 8.4X Digital Zoom and Auto Face Tracking Function

B. Software

Matlab: Matlab performs following operations,

- Image acquisition and pre-processing
- Face detection and Face part segmentation
- Color channel estimation
- ICA (Independent component analysis)
- Systolic and Diastolic Peak Detection

C. Image Processing

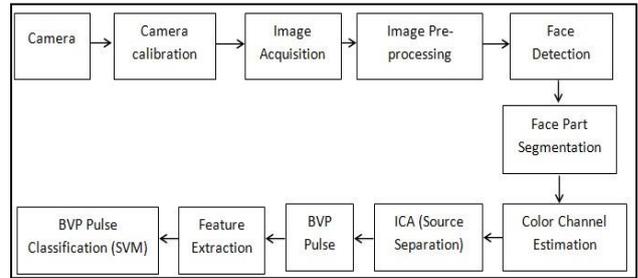


Fig. 5: Block Diagram for Image Processing

After acquisition of image some preprocessing is done on acquired image. Preprocessing includes following processes,

- Image adjustment
- Histogram equalization.
- Median filtering.
- Image binarization

D. Analysis

In the framework advancement we should consider two noteworthy investigations for the heart rate observing.

- 1) Signal extraction: Photoplethysmography (PPG) strategy is utilized for measuring cardiovascular blood volume beat (BVP) by means of light transmitted through, or reflected from, the human body. Here computerized camera is utilized to obtain signal from the face as per shading varieties in the skin.
- 2) Classification: Finally order BVP signals in taking after classifications which give the diverse heart conditions. By utilizing these heart conditions one can without much of a stretch distinguish the heart issues at early stage.

Characterization of BVP in 6 Types:

- Normal Sinus Rhythm (NSR),
- Premature Ventricular Contraction (PVC),
- Atrial Premature Contraction (APC),
- Ventricular Tachycardia (VT),
- Ventricular Fibrillation (VF)
- Supraventricular Tachycardia (SVT).

III. RESULTS AND OBSERVATIONS

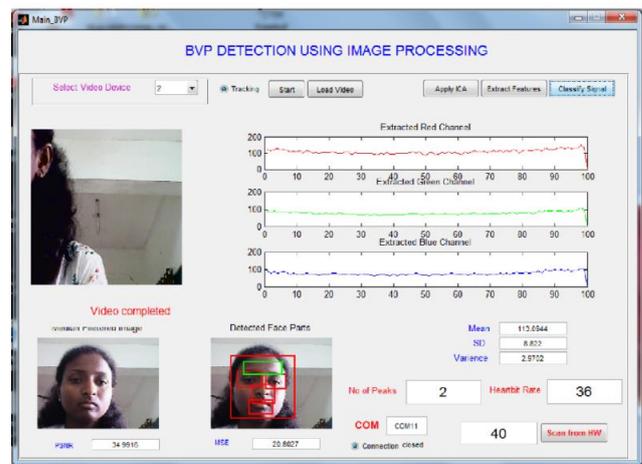


Fig. 4: GUI Window

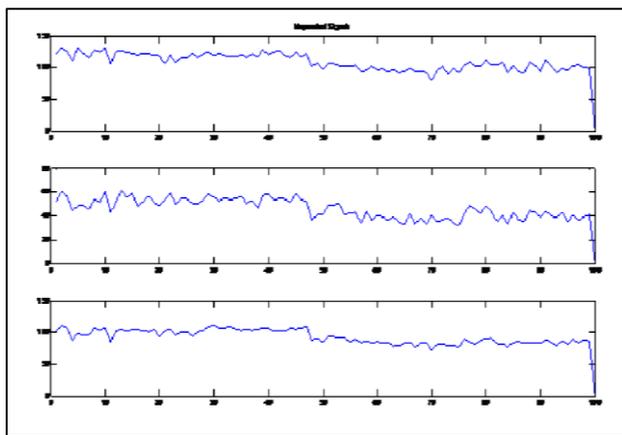


Fig. 5: ICA Result

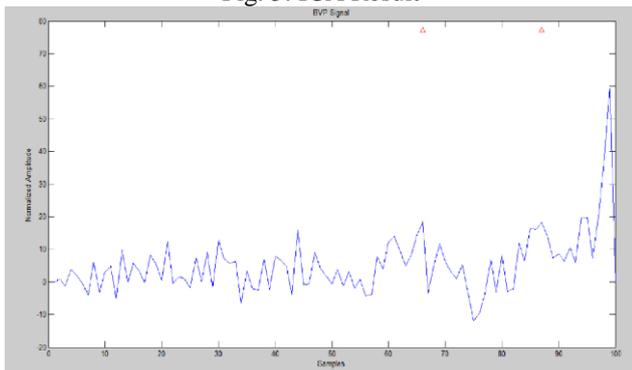


Fig. 6: BVP Signal

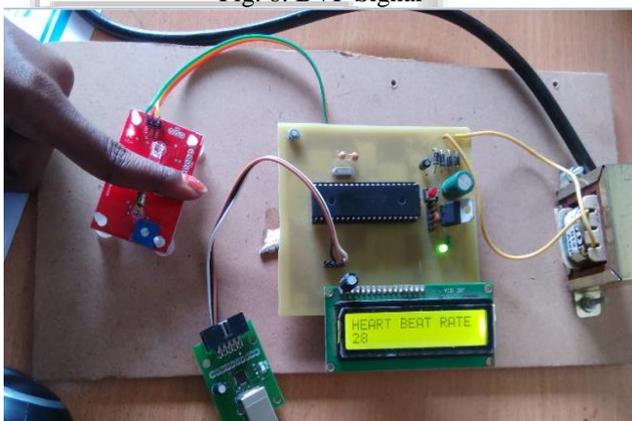


Fig. 7: Hardware Output

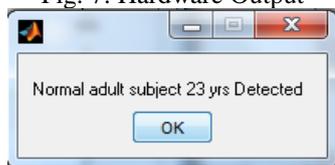


Fig. 8: Output Window

From fig.8 and fig.9, we can predict that color variations due to blood volume for child are greater than adult and hence heart rate for children is higher than the heart rate of adults.

Table below gives the standard values of heart rate

Sr. no	Condition	Mean	Variance	Std Deviation
1	Normal	-1.8135	1.4300	1.1985
2	Normal Subject- 23 yrs	-0.1774	1.7543	1.3245
3	Abnormal	-0.8566	1.7776	1.333

Table 1: Standard Heart Rate

IV. CONCLUSION AND FUTURE SCOPE

In this project, we present a new method for measuring photoplethysmogram signals remotely using ambient light and a digital camera that allow for accurate recovery of the wave form morphology (from a distance of 3 m). Until now, we will take signals from contact sensors and compare them with digital taken signals to see the accuracy, so that we completely remove the hardware part from the system to make it more reliable. Development of such system helps us to detect the heart rate anytime and anywhere by using just digital camera and ambient light. We are collecting the data from facial video and analyze this data for estimation of heart rate. We can predict the heart problems at early stage according to six heart conditions.

We can develop the application for smart phone which is used to estimate the heart rate.

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