

## Heart Beat Sensing Without Physical Contact Using Signal and Image Processing

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**Abstract :** Heart Rate Variability analysis has been gaining attention from researches due to its wide range of applications. As we know there are many ways to sense heart beat but there are very few techniques by which we can sense heart beat without any physical contact. The subtle changes in static scene which are invisible to the naked eye can be detected using signal and image processing. This technique involves color change detection and evaluation of heart rate using frequency change. This technique also monitors the abnormal movements which cannot be seen by naked eyes.

**Keywords** – Fast Fourier Transform, Heart Rate Variability, Independent Component Analysis, MATLAB, Non-contact

### I. INTRODUCTION

One of the most frequent examinations performed in health care monitoring is cardiac pulse i.e. heartbeat measurement. Heartbeat information is crucial indicator in the clinical detection of life parameters. Current mainstream methods used for detecting heartbeats are contact based technologies, such as electrocardiography (ECG) and photoplethysmography (PPG).[7]

Heart Rate means number of time heart beats within a time interval. Heart rate differs with respect to every individual, situation, time and age. Changes in heart rate helps in measuring physiological features, emotional arousal, cardiac problems etc.

Methods for measuring heart rate can be classified into two types: contact and non-contact. Contact methods are the most widely used techniques for extracting heart rate. Contact based methods uses various sensors which are in physical contact with human body. Some contact-based sensors like ECG sensor, Pulse Oximeter Sensor etc. Non-contact methods rely on optical sensors without directly placed on human body.

Non-contact methods involve the use of highly specialized sensors like laser, radar and microwave-doppler[7][2][8]. These techniques can have some negative effect on the human health because of laser light and radar signal.

Heart beat sensing without any physical contact using signal and image processing is one of the best technique. Image and Signal processing is the use of computer algorithms to perform image processing and for improving the accuracy of digital images/ videos. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing.

Image and Signal processing can be easily implemented on MATLAB Platform as MATLAB platform provides inbuilt functions and consists of various libraries for calculation and evaluation of signals.

Heart Rate Variability can be estimated from simple recorded facial video which makes evaluation easier, cheaper. Our basic approach is to consider the time series of color values at any spatial location and amplify variation in a given temporal frequency band of interest.

#### 1.1 Need

This system will provide better heart rate measure without having any physical contact as we are using Image and Signal Processing which can be efficiently implemented on MATLAB Platform. System provides safety to the people especially new born baby, sensitive to physical contact and can be affected cause of harmful radiation.

Basic needs are as follows:

1. To measure heart rate variability
2. To detect minute colour changes
3. Detection of minute movements which cannot be seen by naked eyes.

## 1.2 Basic concept

“Heart Beat Sensing without physical contact using Image and Signal Processing” system uses concepts of image and signal processing to measure the heartbeat rate. The system works in phases. It captures video by the Webcam in sufficient light then it detects region of interest and create frames of different parts of the face. After creating frames, system extracts RGB components and detects the colour changes. Wavelet filtration is applied on each of the RGB component. Then by applying Fourier transform to the colour components Heartbeat rate is calculated. Depending upon the heart rate measured graph is generated.

## II. LITERATURE SURVEY

H. Rahman, M.U. Ahmed, S. Begum, P. Funk [1] have proposed Heart Rate Monitoring system using image processing and signal processing. The system uses Webcam of laptop computer for detection of facial expression. The heart rate is calculated by change in facial skin colour variation by blood circulation.

The system uses three signal processing methods such as Fast Fourier Transform (FFT), Independent Component Analysis (ICA), and Principal Component Analysis (PCA). They have also developed Graphical user interface using MATLAB to monitor heart rate in real time. They have used RSQ(R-Squared) and CORREL (Correlation Coefficient) parameters for real time and HR values for statistical analysis. This non-contact technology Is promising medical care and others indoor applications due to widespread availability of camera.[1]

Florian Michahelles, Ramon Wicki, Bernt Schiele [2], In this proposed system, for the measurement of heart rate in contact free manner micro-impulse radar(MIR) is used. The system uses algorithm which includes basic arithmetic operations like filtering, local maxima detection, evaluation of distance between maxima and division. With a sequence of tests, the robustness of radar to different placements and even distances from the subjects are shown. The ultimate goal of this system is development of the wearable heart rate sensing device. The system provides cheap and power efficient way of measuring heart rate. [2]

Janus Nortoft Jensen, Morten Hannemose [3], In the proposed system, various methods are used for measuring heart rate. Face detection techniques is used in this method and Independent Component Analysis (ICA) technique is used for separation of observed signal into heart rate signal.

The system tried to find the alternatives to ICA for extracting heart rate and also aimed to create Heart Rate Intensity Map (HRIM) of the face to show the heart rate is most visible.

The system uses FPS, ROI extraction and FFT techniques for entire procedure of measurement of heart rate. [3]

Biju V.G., Anith Mohan, Summayya M have proposed a webcam based robust, low- cost method of measuring heart rate. The method is based on blind source separation of the colour channels into independent components. In this technique they have extracted the heart rate from the webcam recordings via ICA and compared with an FDA approved finger blood volume pulse sensor and achieved high accuracy. The project illustrate an innovative approach to monitor health, based on image processing.

Yang-Han Lee, Hsien-Wei Tseng, Chien-Da Huang have proposed a set of image- based noncontact heartbeat measurement methods that involves using varying human face absorptions of light to detect heartbeats. This experiment was conducted in an indoor space. The hardware part used in this study involved employing a video camera embedded in basic laptop computers for filming human faces. The software part involved using the LabVIEW platform. The control group in the test used ECG device. During experiment measurement, the participants wore the measurement device to facilitate comparison with the experimental data in this study. By performing image processing and ICA the hidden information in image were identified and concentrated.

## III. EXISTING SYSTEM

The Eulerian video magnification for vital signs monitoring was introduced in the year 2013.[4] The methodology used was Euler video magnification and it had its advantages and disadvantages. Its advantages included its high signal to noise ratio and its disadvantage was that the Euler video magnification method provided motion magnification which introduced many problems.

In this system, the video is recorded using low-cost camera and ambient light to achieve better result and also to determine the influence of the various colour chosen.

The system tried to find the alternatives to ICA for extracting heart rate and also aimed to create Heart Rate Intensity Map (HRIM) of the face to show the heart rate is most visible.[3]

The system uses FPS, ROI extraction and FFT techniques for entire procedure of measurement of heart rate and thus the system provides cheap and power efficient way of measuring heart rate.

## IV. PROPOSED SYSTEM

Heartbeat information is very important and crucial indicator in the clinical detection of life parameters. It is one of the most frequent examinations performed in health care monitoring is cardiac pulse to calculate

heart rate. Heart Rate means number of time heart beats within a time interval. This differs from person to person and varies in different age group.

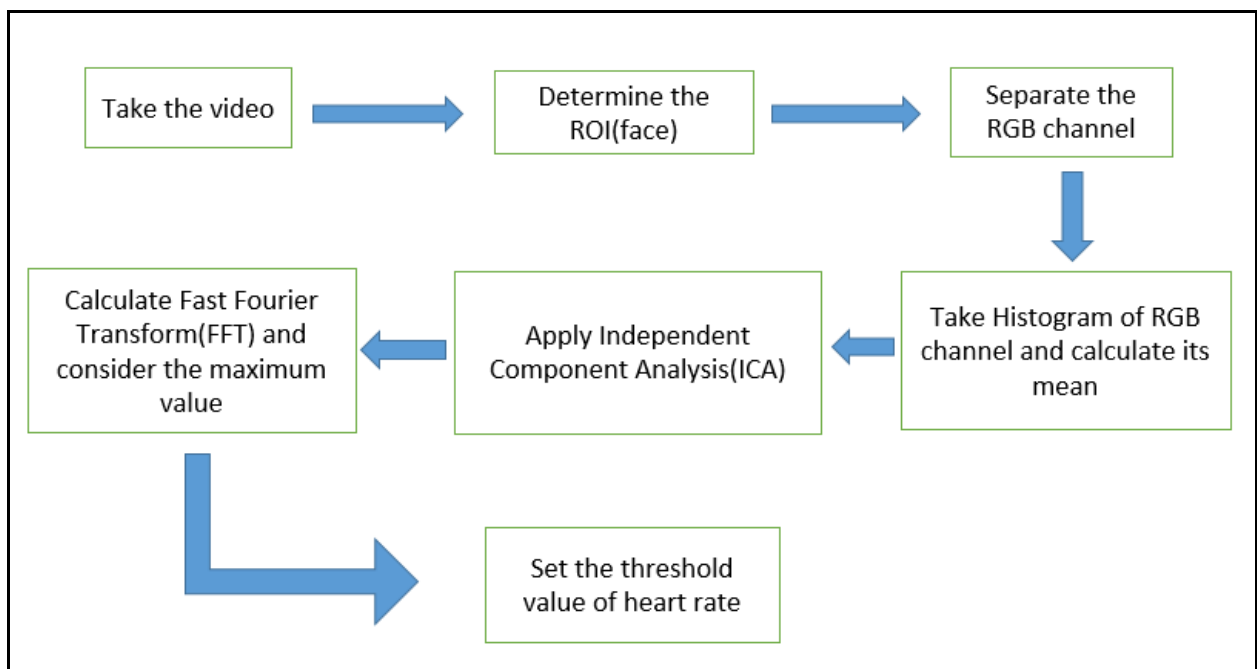
The system measures the heartbeats without any physical contact to the person. It makes use of concepts of image and signal processing on MATLAB platform. It also provides the graphical representation at the end, of the heart rate calculated.

MATLAB platform is a high-performance language for technical computing. It integrates computations, visualization and programming in easy to use environment where problems and solutions are expressed in mathematical notation. MATLAB have various inbuilt functions and also have its own libraries which helps in implementation of every programs on MATLAB.

The system measures the heartbeats without any physical contact to the person. It makes use of concepts of image and signal processing. It also provides the graphical representation of the heart rate calculated at the end.

The steps involved in working of system are as follows:

- The Webcam captures the video of the person.
- Determining the region of interest i.e. face of the person from the video.
- Extracting colour components i.e.RGB from the selected frame.
- Calculating average value for each component and sum of reconstructed signal for each component.
- Rectification of heart rate using Fourier transformation formula.
- Generation of the heart beat value and graphical representation of the heart rate.



**Figure 1:** Block Diagram

## V. CONCLUSION

The proposed system will provide heart rate without having physical contact. This system uses image and signal processing methods to measure the heart rate. The system can also detect subtle changes or movements of the objects which cannot be seen by naked eyes. Thus, will be beneficial in Medical field as well as in many other fields like military, custom, construction, etc.

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