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Heartbeat Detection Using Machine learning

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ABSTRACT: Heart Rate (HR) is one of the most important Physiological parameter and a vital indicator of people's physiological state and is therefore important to monitor. Monitoring of HR often involves high costs and complex application of sensors and sensor systems. Research progressing during last decade focuses more on noncontact based systems which are simple, low-cost and comfortable to use. Still most of the noncontact based systems are fit for lab environments in offline situation but needs to progress considerably before they can be applied in real time applications. This project presents a real time HR monitoring method using a webcam. The heart rate is obtained through facial skin color variation caused by blood circulation.Three different signal processing methods such as Fast Fourier Transform (FFT) have been applied on the color channels in video recordings and the blood volume pulse (BVP) is extracted from the facial regions. The obtained results show that there is a high degrees of agreement between the proposed experiments and reference measurements.

I. INTRODUCTION

The non-contact physiological parameters monitoring idea has come from the cardiovascular system of human body. The cardiovascular system permits blood to circulate in the body due to continuous blood pumping by heart. Our Heart pumps blood through the blood vessels of this system and for each heart beat blood circulation creates color variation in Facial skin. Therefore, it is possible to extract HR from the color variation of the facial skin.They used camera images in order to extract physiological parameters using color variation of the skin. Heart rate is a crucial factor for the diagnosis of heart diseases and one of the dominant parameters for cardiovascular diseases. Heart rate is defined as the rate at which heart contracts per minute. It is a vital physiological signal measured in the human body that reflects the physical and mental state. Heart rate variability is a measure of variations between each heartbeat that indicates the effects of stress on a person's body. With the rise of unhealthy eating habits and sedentary lifestyles across the world, mortality rates due to cardiovascular diseases (CVDs), stroke, septic shock, coronary heart diseases (CHDs) are rapidly increasing. Ischemic heart disease and stroke are the two major cardiovascular diseases responsible for 80% deaths in India . on neonates. Due to the complex hardware, usage of these machines at home can become complicated without any specialist's supervision. Therefore, interest is growing to measure heart rate without any contact between patients skin with the hardware so that it can be measured without any discomfort.

II. SYSTEM ANALYSIS

A. Problem Statement

Heart rate is a crucial factor for the diagnosis of heart diseases and one of the dominant parameters for cardiovascular diseases. Heart rate is defined as the rate at which heart contracts per minute.

It is a vital physiological signal measured in the human body that reflects the physical and mental state. Heart rate variability is a measure of variations between each heartbeat that indicates the effects of stress on a person's body.

B. Motivation

Doctors generally use Various methods used to measure heart rate include Electrocardiography, Photoplethysmography, Oscillometry (Blood pressure monitor method) and Phonocardiography.Each of these methods measures different phenomenon that occur in human body during the heart beat or cardiac cycle to determine heart rate.But sometimes this may be an inaccurate way. Many times, doctors needs to call the experts for detecting the diseases which is also time consuming in large farms.

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C. Proposed Study

Heart rate is a crucial factor for the diagnosis of heart diseases and one of the dominant parameters for cardiovascular diseases. Heart rate is defined as the rate at which heart contracts per minute.

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III. IMPLEMENTATION

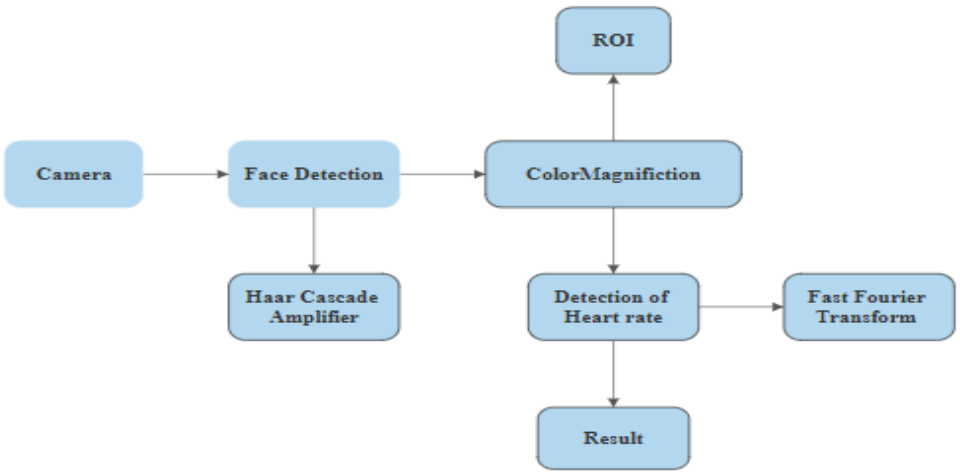

Fig 1. System architecture

Fig shows the block diagram of heartbeat detection system. In this system to detect the person's heartbeat first person's face detected using face detection algorithm using webcam.

For detection of face haar cascade classifier is used. Haar Cascade is a set of Haar-Like Features that are combined to form a classifier. Feature is the sum of pixels value in the white subtracted from the pixels value in the black area.The base of the face detector is 24 × 24.After face detection it given to color magnification block where it will do ROI selection, filtering, normalization using this some process finally heartbeat is detected.

A. Understanding the Objective

Design machine learning based system for detection of heartbeat. Give the prevention and cure for the heart related problem.Help find the cause of symptoms, such as an irregular or rapid heartbeat (palpitations), dizziness, fainting, chest pain, or shortness of breath.

B. Algorithm

1. Cascade amplifier

In this system to detect the person's heartbeat first person's face detected using face detection algorithm using webcam. Facial image is the input of the proposed non-contact HR monitoring algorithm and therefore it is very important to track facial part of the user. The real time method needs a powerful face tracking method to perform higher face detection rate. After extracting an image frame in real time, the automatic faced detection function '*CascadeObjectDetector'* of Computer Vision Toolbox provided by MATLAB[2] was applied which has been implemented using Viola and Jones method.

Later the function was modified to fulfill our own purposes. Fig. 2(b) indicates the detected face.

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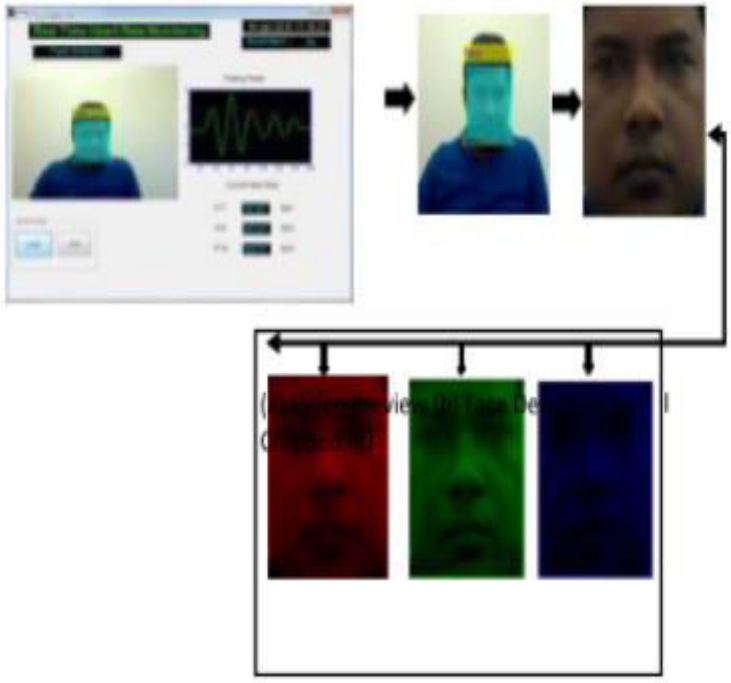

(d) RGB Frame

Figure 2. Feature Extraction from each image frame

2. Color Magnification

R, G and B color values of each pixel of the facial image frames are the most essential part for this experiment. Hence it was searched a perfect Region of Interest (ROI) over the detected face. The detected face using Viola and Jones method contains some unwanted part which needs to eliminate. Only the ROI was then separated from the entire facial image shown in Fig. 2(c) and this ROI is used for further calculations.

R, G, B color values are the fundamental elements of R, G and B signals (together they are called RGB signals) which were extracted from the facial cropped RIO image [40]. Each pixel of the image has 3x1 matrix of color values which consists of Red (R), Green (G) and Blue (B) color of the image. Then the three desired signals Red, Green and Blue signals are produced in two phases. In the first phase the average R, G and B color values are calculated for each image frame shown in Fig. 2(d) and in the second phase the red, green and blue signals are calculated from the summation of all the averaged R, G and B color values indicated in Fig. 2(e- g).

3. Fast Fourier Transform [FFT]

The RGB signal has been detrended using the method used in based on smoothness priors approach with the smoothing parameter λ =10 and cutoff frequency =

0.059 Hz shown in Fig. 2(h). Before applying PCA, ICA and FFT the Red, Green and Blue signals in Fig. 2(d-f) formed from all red, green and blue image frames

in Fig. 2(a-c) are filtered by Hamming window (128 point, 0.6-2 Hz, for normal HR 36-120) for heart rate.

The signal needs to be normalized and the normalization has been performed according to the method mentioned in Fig. 2(i). Equation (1) shows the normalization formula as below:

$$X_{(t)} = \frac{Yi(t) - \mu i(t)}{}$$

For each i = R, G and B signals where μi is the mean and δi is the standard deviation of Yi.

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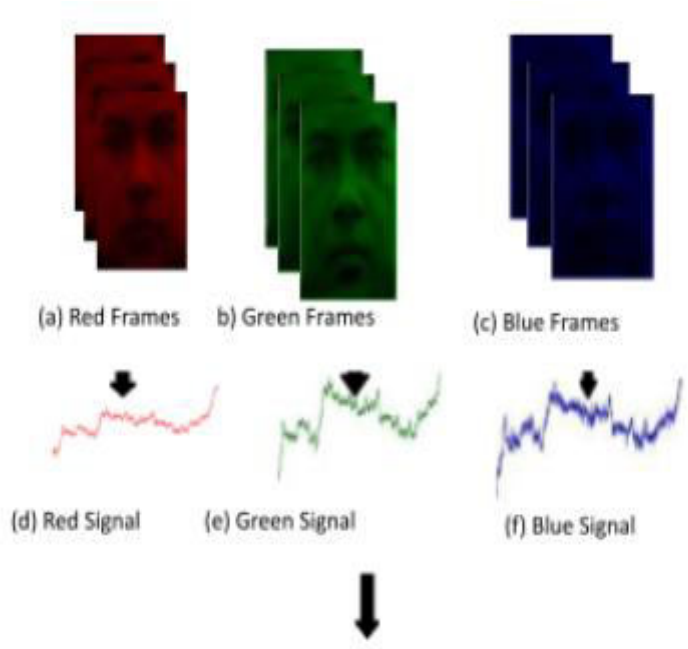

Figure 3. Feature Extraction from each image frame

C. **Advantages and Disadvantages**

Advantages:

1. Increase efficiency
2. Saves time.

Disadvantages:

1. System requires much cost.

D. **Future Scope**

Future work will focus on applying the model processing techniques on real measurements obtained at low transmitted power.As a future work, implemented methods can be rebuilt to work with many classes (Ex: more than 5 types of heartbeats), the work can be developed to be used in real time and be trained continuously to enhance it and increase its accuracy. Moreover, the whole process of classification can be used with other types of datasets such as stress and clinical datasets

E. Application

To gain the most from your training it is crucial that you monitor your heart rate on a regular basis. Each person's heart rate helps to determine their fitness level and by monitoring this, you are able to avoid overtraining, which in turn can reduce the risk of injury and mental fatigue.

G. View and Analysed Results

In the next section, we provide some of the screenshots by which the patient can analyze and predict heartbeat without touch to patients.

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H. SCREENSHOTS

Fig 1. Home Page

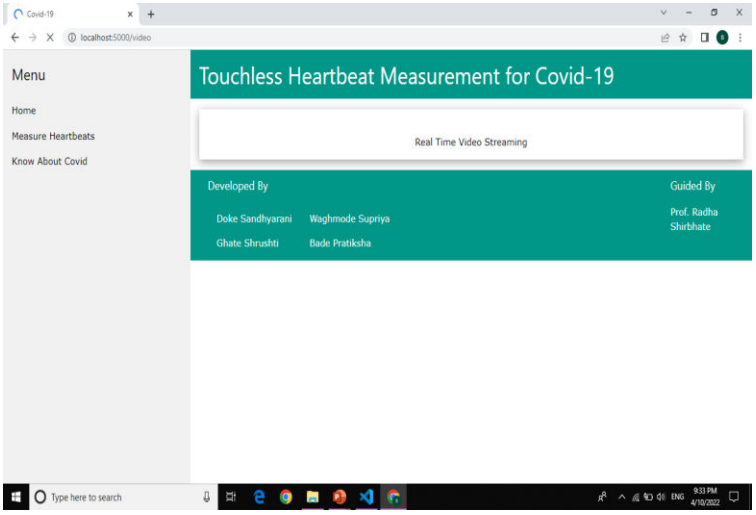

Fig 2. Realtime video Streaming

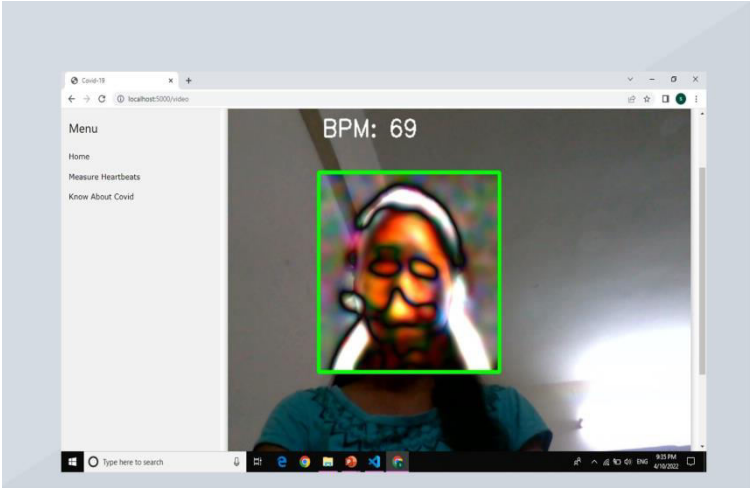

Fig 3. Calculation the heartbeat in BPM

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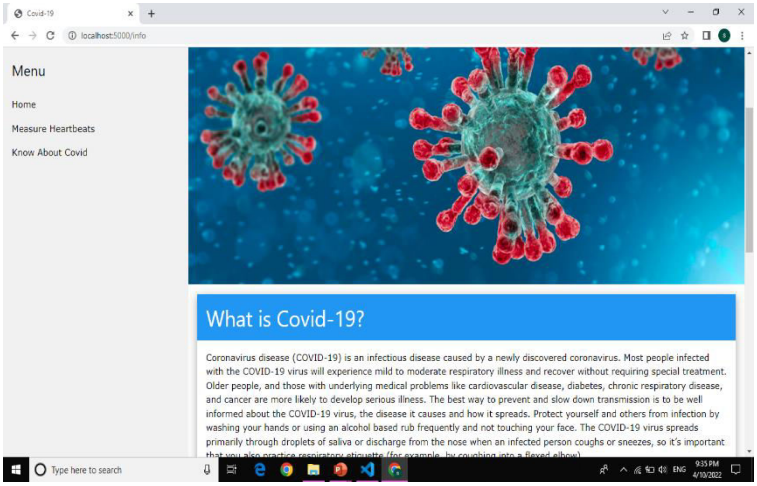

Fig 4. Information Of Covid-19

IV. CONCLUSION

In this project, we presented a simple and efficient contactless method for detecting individual heartbeats. The method has lower latency, lower computational complexity and an easier implementation on an machine learning platform when compared to the traditional methodologies described in the literature, while still achieving a good heart rate estimation accuracy. With the promising results presented in this project, we could foresee the application of the system in uses that require real-time operation, such as human detection in an industrial, automotive or clinical environment.

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