

The Touch less Heart Beat Detection and Measurements System Using Machine Learning

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Abstract: *Heart Rate is crucial part in medical field. Accurate and quick Calculation is necessary especially in the cases like covid-19 and Tuberculous (TB). We proposed a contactless heart rate calculation system without using any external hardware device but only mobile or laptop and its integrated web camera using Haar cascade classifier of viola-Johns for Return on Investment (ROI) selection of facial region and for RGB separation and colour detection. We are using Eulerian's colour magnification which detect colour changes according to pumping of blood .It forms the amplitude graph of variation and counts the peak using Fast Fourier Transfer (FFT).*

Keywords: *heart rate, fft . color variations , face detection,ROI,covid,RGB , TB,fourior Transform , colour magnification*

1. INTRODUCTION

The idea of non-contact physiological parameter monitoring is based on the human body's cardiovascular system. It is commonly understood that this system allows blood to circulate through the blood vessels by the heart's pumping action. With each heartbeat, blood circulates and creates color variations on the facial skin, making it possible to extract heart rate information from these color changes. In 1995, the first health monitoring system was introduced, which used camera images to extract parameters from skin color variations. However, this approach did not provide exact quantitative results, and only the heartbeats graph was displayed, failing to show any correlation with reference ECG signals. The progress of non-contact monitoring was moderate until 2005 when a novel method was introduced for measuring a computer user's emotional state using facial thermal measurements. The heart rate is a neural factor for diagnosing heart diseases and is one of the dominant and essential cardiovascular disease parameters. It measures the number of heart contractions per minute and reflects both mental and physical states, with each heartbeat indicating a person's stress level.

2. LITERATURE SURVEY

In 2014 Salamah et.al. Proposed an improved image magnification algorithm for colour image. [1] Image magnification algorithm is used for getting the better performance compared to original image sensor. In this context, the RGB concept is used, which consists of 24 bits with 8 bits for each of the red, green, and blue channels. This is used to represent multi-channel images, and RGB is designed to accurately reflect colors. The calculation of color is based on spectral reflectance measurements obtained using a UV-Vis spectrophotometer across this wavelength range. In 2014 Jingjing Luo et.al proposed Enhanced Eulerian Video Magnification. [2] Eulerian video magnification means a consist a set of simple and robust algorithm that can disclose and analyse flay motions. In the process. It is an advanced type of microscope which, take video as input and produce some changes. This method uses the Eulerian Video Spatiotemporal motion analyser for pixel level mapping then pixel from the input get wrapped on the basis of this mapping .As pixel value modification is not involved it supports large amplification and gets less influenced by frame noise In 2014 Wang et.al proposed An Analysis of the viola-johns Haar Cascade Classifier for face detection[3] As we all know in upcoming virtual and digital working under worldwide follow's huge methods for the detection and the Human face detection is one of the important process under it but human has been challenging issue under area image processing. & pattern recognition, under face detection algorithm forts under cascade algorithm Haar cascade algorithm, Combination of three factors 1) skin hue histogram matching 2) Eye detection 3) Mouth detection. . in 2018 Nisar et al introduced a video-based heartbeat detection system for drivers using a photoplethysmography (PPG) signal [4] The system was designed to measure the heart rate of drivers in moving cars, and they used remote PPG (rPPG) to process the image captured through the Voila Jones Cascade classifier at a frame rate of 30fps. To obtain accurate signal trending, signal normalization, illumination variation reduction, bandpass filtering, signal smoothing, and Joint Approximate Diagonalization Eigen Matrices (JADE) were used. The filtered signal was transferred using Fast Fourier Transform (FFT) for peak detection. In 2019,Bing .fei Wu et.al Proposed a system to avoid the traffic issues caused by heart diseases by implementing, drivers heart rate detector which works remotely using remote photoplethosmography [5]. They divide the input image into RGB variations And Obtain the Amplitude Graph. In Time And Frequency Domain Then used Fast Fourier transform they Calculate the peaks and convert into Beats per minute , for multiple personalised training they used ANN and To clear the Noise They Used K-nearest Neighbours Algorithms. In 2020 Nair et al. proposed optimizing Convolutional Neural Networks (CNN) using Fast Fourier Transform (FFT) for object

recognition. [6] FFT is typically used for color or image convolution to extract frequency information from signals. CRIN is also used for object detection but it has its imperfections, like this algorithm works. It is used for to transform an image between the spatial and Frequency domain. By using the FFT, it's useful for reducing the costs of image convolution in CNN and that's why it reduces the overall costs. This model of used for identify the object information from the images CNN is used for improving the image recognition rate.

From the above survey we confirmed that the Detection of Heart Rate Frequency of Human is possible With less Or Zero Hardware. For this We Can use Different Technologies Like photoplethysmography, Color Magnification, phonocardiography, sonar And Different types of Sensors. In Supporting We have to Use Optimised Technologies like, python,R,CNN,K-means which Helps to Develop The Robust System and Run this types of Systems Smoothly And Easily .

3. METHODOLOGY

- A. The Face Detection method proposed by Paul Viola and Michael Johns in 2001 was based on machine learning and a cascaded function of simple features. The function was trained using positive and negative images, and the features were then used to detect objects in other images, specifically faces. The classifier needed numerous positive and negative face images to train, and the process of detection was similar to convolution. As Shown in below Image each feature in the cascade is a single value obtained by subtracting the sum of pixels under black rectangles. This is Capable to real time Face Tracking to provide Robust and Accurate Output.

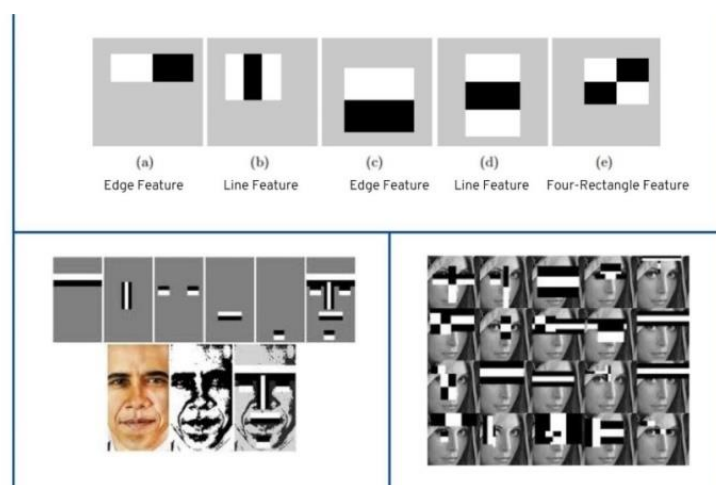


Fig.1: Visuals of the Face Detection Using Haar Classifier

B. Color Magnification: the current technique a technique called photoplethysmography (PPG) uses light scattering from the movement of blood in the body to quantify changes in blood volume. We are going to use the color magnification for color variation detection on face it captures the Red-Green-Blue coloured Frequency as Shown in Below Image which was founded and detected first and later converted into the HSI color the different shades on face in RGB format at minute level, Human Eye is not Capable for this observation. Red channels were proven to be the most effective colour channel through experimental results, closely followed by blue channels. Lueagebattan C. et al. used PCA to represent RGB Channels; as a result, a forward model and mean of that channel's size were computed.

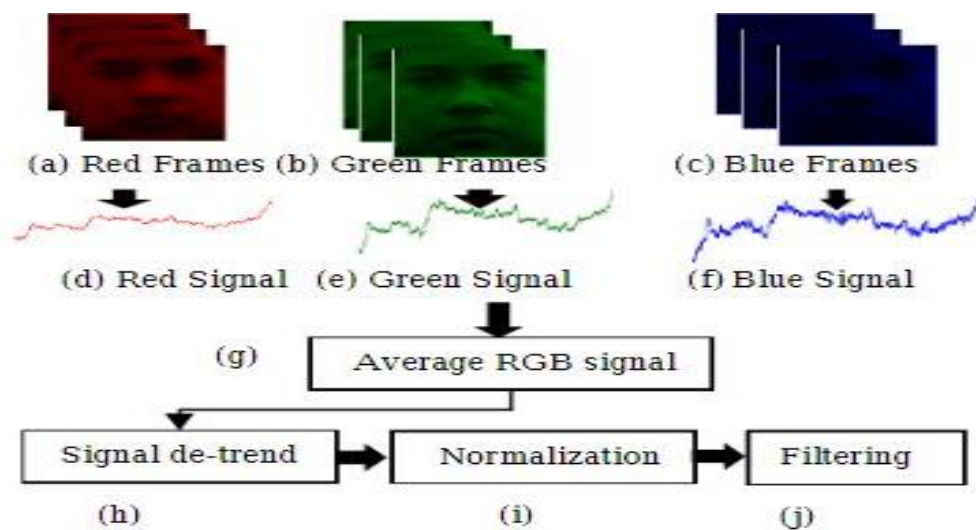


Fig.2: Visuals of Color variation in Color Magnification Module

C. FFT: A non-invasive approach for pulse detection is implemented and examined in this study. Different signals from the colour of the human face, such as the green channel, the hue channel, and various ICA and PCA components, will be examined. The heart rates that arise from these analyses will then be weighted together in accordance with the significance of their FFT peaks. Quick Fourier Band pass filter, transformation, and zeroes theorem come next. a methodology for measuring heart rate using a PCA channel .

4. EXPERIMENTAL SETUP

By Using Above three Algorithms And Modules We Are going to Develop A system , In which The Input Realtime Face Video to Detect The Face And ROI Selection And Selecting the Facial Region It Extract The RGB Signal Which Is Scattered Using Color Magnification It

Forms The Rhythmic Contraction And Relaxation graph Which Is basically yours Heart Rate And In the last We Are using FFT to Calculate That peaks From the graph And Converting it into Beats per Minutes.

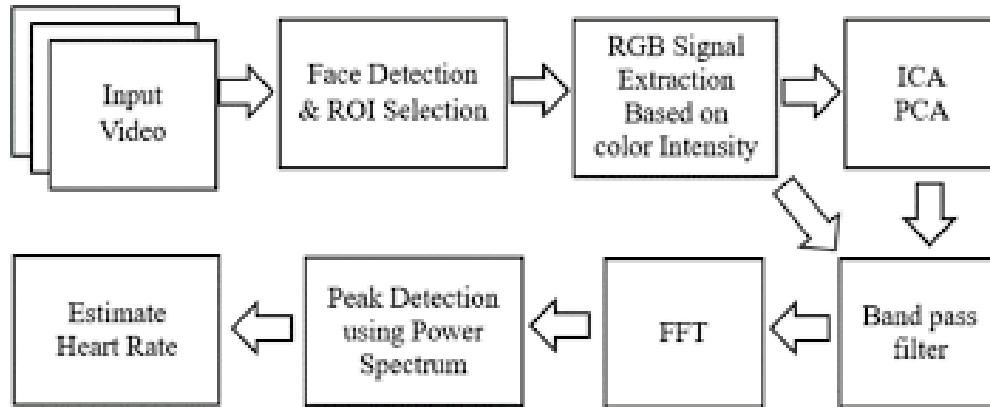


Fig.3: Flow Chart of the System

5. RESULT AND DISCUSSION

To Measure the Heart Rate We Develop the System Which Works Contact Lesly From facial Video for that we are using haar cascade Classifier In which We Are Selecting Facial Area using ROI Which Covers in Square Shape From Forehead to chin and left to right chick ICA Works under blind Source Separation Algorithm and Can applied to Biomedical Signal processing for independent Original Signal.

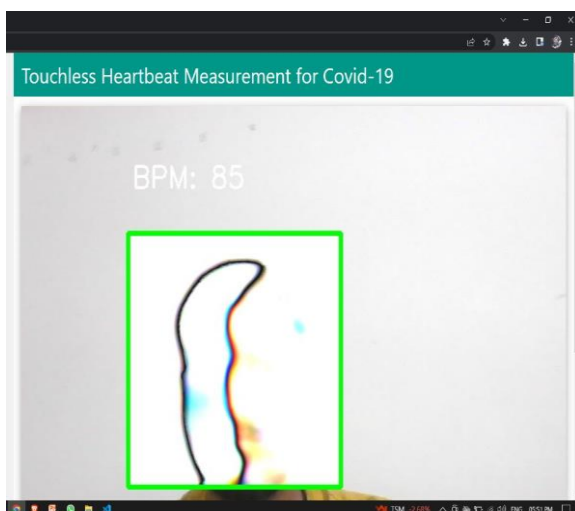


Fig.4: Object A

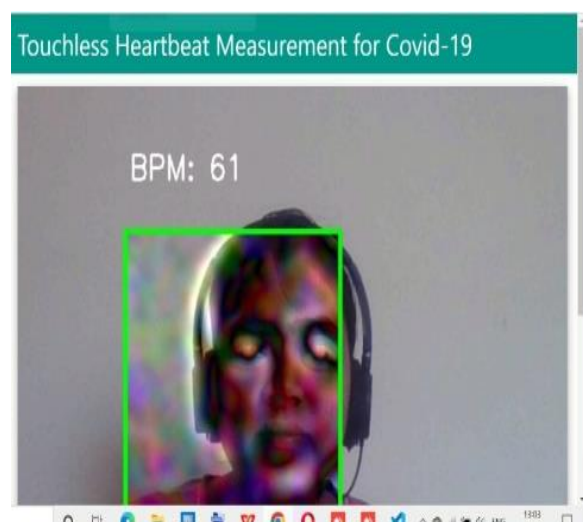


Fig.5: Object B

Object A: 21 year old Male, Brown in Skin tone, BPM = 85 in proposed System

Object B: 21 year old female, fair in skin tone, BPM : 61 in proposed System

Object A & B Measured the Heart Rate At All Normal Conditions on different Devices Works Properly. We Took Multiple Readings on this System also we cross checked with Oxymeter.

Method	Accuracy	Sensativity	Specificity
[4]	93%	74	96
[5]	94.3%	-	-
Proposed System	95.2%	89%	91%

As we Clearly See in Above Table Our System Is giving More Accurate than Existing Systems.

6. CONCLUSION

In this paper , we conclude a methodology for measuring heart rate using person's facial image by Detecting the Face Using Haar Cascade Classifier and detecting ROI image , it Enhance the image Quality To detect the Frequency .Our Second Algorithm is the Colour Magnification which is Basically Classify the image in RGB Format Then Identify the colour Variations On the skin at very micro level for All three Colours Then Identify That which Color has more variations According to that it Select The Colour And At the Last We Are Using Fast Furior Algorithm For Counting That frequency And It Will give Show To Heart Rate Of That Particular person. Currently We Achieved the Accuracy from 95-97%

7. FUTURE SCOPE

Our System is capable And Well Optimised Enough To install At Any Decent System. Currently our System is web based after deploying it on Cloud the Use of is also is very easy and user friendly. It's very useful in medical situations like covid19, TB, or any other viral based disease, also we can install in it into Security cameras to casually monitor Sport Players or Any Community.

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