Heart Rate Evaluation from Face Reflectance using Hilbert-Huang Transform

Neha Deshmukh  
M.Tech Student  
Department of ISE  
Dayanand Sagar College of Engineering,  
Bangalore, India

Sunanda Dixit  
Associate Professor  
Department of ISE  
Dayanand Sagar College of Engineering,  
Bangalore, India

B. I. Khodanpur  
Professor  
Department of ISE  
Dayananda Sagar College of Engineering,  
Bangalore, India

Abstract—The Monitoring of the heart rate is done using conventional electrocardiogram. In order to measure the electrocardiogram of a patient the patient need to wear adhesive gel patches or chest straps that can cause skin irritation and discomfort. To achieve a robust estimation, empirical mode decomposition of the Hilbert–Huang transform is used to achieve the primary heart rate while reducing the effect of ambient light changes. This paper throws light on different methods to evaluate the heart rate using different methods such as different view of face, under different illumination conditions.

Keywords—Heart rate, Hilbert-Huang transform

I. INTRODUCTION

Heart rate is an important indicator of human physiological state. The normal heart rate of a human is between 60 bpm-100 bpm. Nowadays we can observe that most of the deaths in the worldwide areas rising due to heart attack. The main reason for heart attack can be high blood pressure, sudden cardiac.

In order to measure the heart rate of a patient, the patient need to wear adhesive gel patches and chest straps that can cause skin irritation and discomfort.

In this paper, we have focused on touchless heart rate monitoring which does not require physical contact. For touchless heart rate monitoring heart rates can be evaluated from consecutive visual images of subjects face by measuring periodic variation of reflectance resulting from varying hemoglobin absorptivity across visible light spectrum as blood volume in blood vessels increases and decreases with each heartbeat.

II. LITERATURE SURVEY

Mariusz et al.[1] proposed the verification method which does not require physical contact. For touchless heart rate monitoring heart rates can be evaluated from consecutive visual images of subjects face by measuring periodic variation of reflectance resulting from varying hemoglobin absorptivity across visible light spectrum as blood volume in blood vessels increases and decreases with each heartbeat.

M.z poh et al.[2] has proposed Bland-Altman and correlation analysis. Where cardiac pulse and FDA-approved finger blood volume pulse comparative analysis has been done. This method gives high accuracy and correlation.

Shuhang wang et al.[3] have proposed naturalness preserved enhancement algorithm for non-uniform illumination images. The method uses enhancement technique which plays an important role in image processing. Image enhancement technique are of two types: spatial domain method and transform domain method. The images enhance are good, error-free.

Jie Chan et al.[4] proposed a simple yet very useful and robust local descriptor, weber local descriptor. web local descriptor have two components: differential excitation and orientation.

The similar approach has been proposed where Ihsanullah et al.[5] proposed web local descriptor for gender recognition. web local descriptor is a texture descriptor and is extended using local spatial information.

Wim verkryse et al.[6] proposed the cardio-vascular pulse wave travelling through body is detected using plethysmography. PPG uses light reflectance and its principle is it absorbs light more than surrounding tissue. Spatial averaging method is used to improve SNR digital filtering and spatial analysis.

Chihiro and yuji et al.[7] has proposed a non-contact device by applying auto-aggressive spectral analysis to a time-lapse image from a handy-video.

S.Cook et al.[8] Heart rate is one of the simplest cardiovascular parameters. Heart rate is indicated as a risk factor for cardiovascular diseases which causes death in both adults and infants. Heart rate is a parameter of high significance not only because of monitoring cardiovascular diseases rather heart rate is also caused by physical exercise, mental stress and also require monitoring.

Ralph gross et al. [9] have proposed a large improvement in performance.
V Blanz et al.[10] have proposed for recognizing faces from different directions and different illuminations. The main approach is to capture the class specific properties of face.

Athinodoros S Georgiades et al.[11] proposed illumination variability that is the thing appear different when viewed from fixed pose. So, For this illumination cone which models the complete set of images with Lambertian reflectance of object

Peter N Belhumeur et al.[12] have proposed a face recognition algorithm which is unconcerned to variation in lighting direction and facial expression. Eigenface is used to perform dimensionalityreduction. Fisherface is the next result of the eigenface. Correlation algorithm is used to extract important information from images. Fisherface gives less errors compared to Fisherface.

Survey of different methodologies

<table>
<thead>
<tr>
<th>Year</th>
<th>Author</th>
<th>Methods</th>
<th>pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>Shuhang wang et al</td>
<td>Retinex based algorithm</td>
<td>Preserve naturalness</td>
<td>May produce blurred quality of image/video</td>
</tr>
<tr>
<td>2010</td>
<td>Mariusz et al</td>
<td>Preprocessing method, Histogram equalisation</td>
<td></td>
<td>Variations in pose and illumination</td>
</tr>
<tr>
<td>2010</td>
<td>M.Z.poh et al</td>
<td>Bland-Altman, correlation analysis</td>
<td>Low cost, accurate, Contact free heart rate measurement, Motion tolerant, Can perform measurement on more than one person</td>
<td>This method may not be able to provide details as ECG, variations in sunlight can cause decreasing SNR, uses inbuilt webcam with laptop as videos can undergo changes due to different resolution of camera</td>
</tr>
<tr>
<td>2008</td>
<td>Jie chen et al</td>
<td>Webers law</td>
<td>Simple, fast, reliable</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>Wim verkryssy et al</td>
<td>Reflectance perception model</td>
<td>Least expensive, simple to use, Efficient</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>Chiro et al</td>
<td>Autoregressive spectural analysis</td>
<td>Can measure heart rate and respiratory rates based on brightness on cheeks</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>R.Gross et al</td>
<td>Histogram Equalization, Photographic Normalization, Preprocessing method</td>
<td>Improves verification rate</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>V.Blanz et al</td>
<td>3D Morphable Model</td>
<td>High performance, Improve face recognition accuracy, reliable, robustness</td>
<td>Not reliable</td>
</tr>
<tr>
<td>1998</td>
<td>Athinodoros georgiades et al</td>
<td>Illumination cone</td>
<td>Improvement of other techniques, Error rates are improved by cast shadow</td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>Peter N Belhumeur et al</td>
<td>Eigenfaces, Fisherface, correlation analysis</td>
<td>Fisherface has low error rates, Eigenface improves performance in the presence of lighting variation</td>
<td>Sensitive to lightening conditions and position of head.</td>
</tr>
</tbody>
</table>

III CONCLUSION

Detection of heart rate in human beings is very important to see how well the heart is working. This paper provides a detailed survey of different methodologies of heart rate detection using different methods such as different view of face, under different illumination conditions.

REFERENCES


