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A mobile framework for personalized health assessment

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***Abstract*— This paper deals with the use of smart phone in detecting the users heart rate. And fetching the breath rate form that result.it also illustrate the way to calculate the calories burnt with the help of obtained heart rate and breath rate.It also deals with storing the history of results and sharing it in social network sites.**

***Index Terms* — Heart rate, Breath rate, Calorie, Smart phone.**

I. INTRODUCTION

The rapid growth of mobile phones and technology has paved the way to the development of many applications which helps the users to assess their health conditions and remote monitoring. The build in sensors in today's smart phones makes those applications to get success in the market. The contact sensors such as chest straps, electrodes or finger clips are commonly used for measuring the vital signs. However, these sensors are not comfortable and user friendly. And also these sensors may affect the user's habits. Thus the use of external sensors poses concerns before using them. The smart phones with embedded sensors paved the new way for measuring these vital signs. Lots of applications are available today in today's market under health care. In Google play store, application store for IOs and app stores. The examples for this kind of applications are: cardiograph, what's my heart rate. These applications use mobile phone camera and flash to measure the heart rate. Our proposed system is intended in a way to measure heart rate, breath rate and calculating the calories in a single application. And it also provides the options to store, view the history of results and to share their results in the social network sites.

II. RELATED WORKS

Previous studies have demonstrated the use of mobile phone camera in measuring the heart rate.The camera's flash is used to record the changes in blood volume in the finger tips. Then the changes are recorded in the form of videos.Then,the video is processed frame by frame to obtain the Photoplethysmography signal.After that the PPG signal is processed to extract the heart rate.The algorithm used in those applications and their efficiency also studied. A smart-phone has the potential to be used as an accurate medical equipment for monitoring physiological measurements such as HR, HRV, cardiac R-R intervals (i.e. the time between two consecutive R waves in a ECG machine), breathing rate and oxygen saturation level in the blood.

III. EXISTING AND PROPOSED SYSTEM

The existing system is developed in a way only to the measure the heart rate. The output of many applications is not that much reliable since they have higher percentage of the relative error.

The proposed system integrates many features such as storing the history, sharing them in social network sites, extracting the breath rate and calories from the obtained heart rate. And also a new improved algorithm is used in our proposed system.

IV. METHOD

The main objective of our work is to measure heart rate, breath rate and calories burnt using a mobile phone camera. The requirement is only smart phone with camera, flash and embedded accelometer sensor. There are various algorithms used they are explained in the consecutive sessions.

Algorithms used

1. Peak detection algorithm
2. Improved Algorithm for extracting heart rate
3. Fast Fourier transform
4 .2nd generation first beat algorithm

Abbreviations and Acronyms

HR = Heart rate
BR = Breath rate
PPG = Photoplethysmography signal
FFT = Fast fourier transform

Units

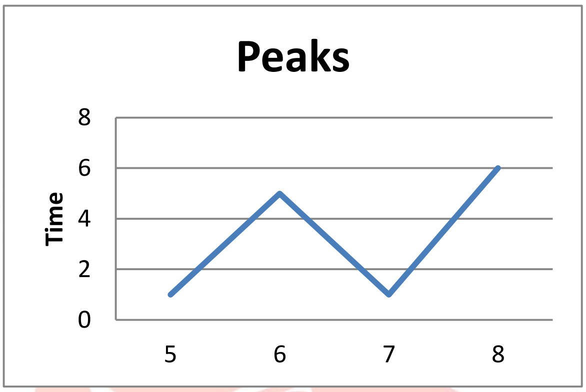
Bpm = Beats per minute

Equations

1. HR = 60/peak difference
2. Calories burned (men) = [(Age*0.2017) + (weight*0.09036)+(Heart rate*0.6309)—55.0969]*Time/4.184.
3. Calories burned (women) = [(Age*0.0741)-(weight*0.05741)+(Heart rate*0.4472)—20.4022]*Time/4.184.
4. Relative error = 100*|Actual heart rate-Measured heart rate|/Actual heart rate.

V. EXTRACTING HEART RATE

The most common technique that is used is Photo-plethysmographic (PPG) to obtain heart rate measurements. The smart-phone camera technology enables PPG measurements of HR by collecting data from the tip of the finger of the subject.Generally the process works by placing the subject's index finger on the smart-phone camera in such a way that it covers both camera and Light Emitting Diode (LED). The area of skin under the light is illuminated with LED while color changes are recorded with the video camera. As the heart beats the level of oxygen contained in the blood changes, as a result, the volumetric change of blood in the finger changes the light absorption or reflection. By measuring these fluctuations (the amount of reflected light) makes i possible to compute the PPG.



Peaks in the obtained signal

Algorithm used

S — time series of the average red component values of captured by camera frames; *FR*— frame rate of captured data; *m*— maximum number of the peaks in the chosen set (default value equals 20); *max diff* — maximum deviation of distances between peaks.

d= derivative of the signal

for value ∈ signal do

if value == max of the value's 2-neighbourhood then

peaks += value

end if

end for

for k = 5 : m do

distances = distances between adjacent peaks of k highest peaks from peaks

variances += variance of the distances

end for

if min(variances) == m then

chosen set = set of distances that variance equals to first local minimum in variances

else

chosen set = set of distances that variance equals to min(variances)

end if

remove all values that are lower than frame rate×10=33 from chosen set *repeat*

R = values of chosen set that differ from mean(chosen set) for more than max diff

remove R from chosen set

until R ==0

heart rate = 60×frame rate

return heart rate

VI. Extracting breath rate

After acquiring HR from the PPG signal, the next step was extracting BR from the HR in the spectrum domain. This is possible because respiration rate modulates amplitude and frequency of a signal. Before spectral analysis, the HR signal was interpolated in order to address the issue of irregular sampling from the cell phone and because R-wave are not equidistantly timed events. After this, the fast Fourier transform (FFT) of the HR was computed. We observed that the FFT plots showed a clear harmonic peak at the frequencies, which corresponded to the respective breathing rate.

VII. calculating calories

Calorie is the measurement of enery.For every work expenditure some amount of calories will be burned. To calculate the amount of calories burned the subject's age,weight and gender will e required.Then this information will be combined with the heart rate obtained. The following equations is used to calculate the calories:

Calories burned (men) = [(Age*0.2017) + (weight*0.09036)+(Heart rate*0.6309)—55.0969]*Time/4.184.

Calories burned (women) = [(Age*0.0741)-(weight*0.05741)+(Heart rate*0.4472)—20.4022]*Time/4.184.

VIII. Implementation

The snapshot of implemented application is shown in the figure. The user is provided with three options to measure their HR,BR and calories. The users can select the options they wish.

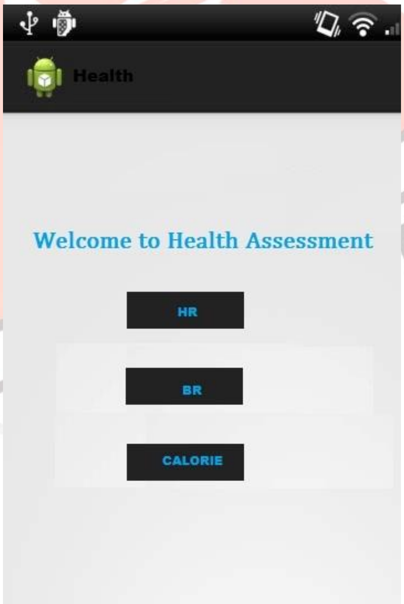


Fig: Implementation snapshot home page

IX. Future work

The final goal of this project is to monitor the users health condition without the use of mobile phone camera. The aim is to develop a 24*7 monitoring system.If there is any changes in the users vital signs then alarm will be invoked and also sms will be sent to the specified people. The vital signs will be measured by observing changes in the user's face. This information is recorded and from that user's complete health condition will be analyzed.

X. Conclusion

In this paper we illustrated our framework for measuring the heart rate, breath rate and calculating the calories. We also explained the algorithms used and the method how it works. We checked our obtained results with the one obtained from the vital signs measuring devices. The relative error is calculated by using the equation4.The results shows that percentage of error is affordable.

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