CLAIMS

1. A processor-implemented method comprising:

(a) receiving synchronized photoplethysmograph (PPG) signal and 3-axis acceleration signal from sensors associated with the user of a wearable device;

(b) partitioning the received PPG signal and 3-axis acceleration signal into multiple windows;

(c) determining whether motion is present in one of the multiple windows of the 3-axis acceleration signal based on mean and standard deviation values of the 3-axis acceleration signal in the one of the multiple windows;

(d) performing Fourier transform on the 3-axis acceleration signal and PPG signal to obtain power spectra of the 3-axis acceleration signal and PPG signal in the one of the multiple windows when there is motion in the one of the multiple windows of the 3-axis acceleration signal, wherein the power spectra comprises fast Fourier transform (FFT) peaks of the 3-axis acceleration signal and PPG signal in the one of the multiple windows;

(e) pre-processing the 3-axis acceleration and PPG signal for conducting a mobility test, wherein the mobility test is performed using a threshold calculated by standard deviation and decision tree;

(f) determining whether a peak of the 3-axis acceleration signal is present in a range around a first highest peak of the PPG signal;

(g) determining whether the peak of the 3-axis acceleration signal affects heart rate of the user by performing random forest learning when the peak of the 3-axis acceleration signal is in the range around the first highest peak of the PPG signal; and

(h) estimating the heart rate of the user in the one of the multiple windows using a second highest peak of the PPG signal when the peak of the 3-axis acceleration signal affects heart rate of the user, wherein the heart rate estimated from the second highest peak of the PPG signal is captured for post-processing; and

(i) obtaining the post-processed heart rate of the user in one of the multiple windows of a server and estimating a final heart rate based on a histogram, wherein a median value of a most frequently occurring wave is selected as the final heart rate.

2. The method as claimed in claim 1, further comprising:

(j) estimating the heart rate of the user in the one of the multiple windows using the first highest peak of the PPG signal when at least one of the peak of the 3-axis acceleration signal is not present in a range around the first highest peak of the PPG signal and the peak of the 3-axis acceleration signal does not affect heart rate of the user.

3. The method as claimed in claim 1, further comprising:

(k) performing zero-phase digital filtering of the PPG signal in the one of the multiple windows when there is no motion in the one of the multiple windows of the 3-axis acceleration signal;

(l) performing Fourier transform on the filtered PPG signal to obtain power spectra of the PPG signal in the one of the multiple windows, wherein the power spectra comprises FFT peaks of the PPG signal in the one of the multiple windows; and

(m) estimating the heart rate of the user in the one of the multiple windows using a highest peak of the PPG signal.

4. The method as claimed in claim 3, further comprising:

estimating a heart rate of the user in remaining windows by repeating at least one of the steps of (c)-(m).

5. The method as claimed in 4, further comprising:

forming a histogram with a predefined bin size for the heart rates of the user in the multiple windows;

selecting a bin with a highest number of occurrence in the histogram; and

considering a median value of the selected bin as a heart rate of the user.

6. The method as claimed in claim 1, wherein performing Fourier transform on the 3-axis acceleration signal and PPG signal in the one of the multiple windows comprises:

performing zero-phase digital filtering of the 3-axis acceleration signal and PPG signal in the one of the multiple windows when there is motion in the one of the multiple windows of

the 3-axis acceleration signal; and

performing Fourier transform on the filtered 3-axis acceleration signal and PPG signal in the one of the multiple windows.

7. The method as claimed in claim 1, further comprising:

eliminating noise from each of the multiple windows of the PPG signal based on a threshold value for the PPG signal; and

removing direct current (DC) component from each of the multiple windows of the PPG signal upon eliminating the noise.

8. The method as claimed in in claim 1, wherein determining whether motion is present in one of the multiple windows of the 3-axis acceleration signal based on mean and standard deviation values of the 3-axis acceleration signal in the one of the multiple windows, comprises:

determining whether motion is present in one of the multiple windows of the 3-axis acceleration signal based on a threshold value calculated by the mean and standard deviation of the 3-axis acceleration signal in the one of the multiple windows and a decision tree.

9. The method as claimed in claim 1, wherein determining whether the peak of the 3-axis acceleration signal affects the heart rate of the user by performing the random forest learning, comprises:

performing the random forest learning based on power values of the first highest peak of the PPG signal, the second highest peak of the PPG signal and the peak of the 3-axis acceleration signal.

10. A system comprising:

a wearable device (102) associated with user, wherein the wearable device comprises:

multiple sensors (112);

one or more memories (110); and

one or more hardware processors (108), the one or more memories coupled to the one or more hardware processors, wherein the one or more hardware processors are configured to

execute programmed instructions stored in the one or more memories to:

(a) receive synchronized photoplethysmograph (PPG) signal and 3-axis acceleration signal from the multiple sensors;

(b) partition the received PPG signal and 3-axis acceleration signal into multiple windows;

(c) determine whether motion is present in one of the multiple windows of the 3-axis acceleration signal based on mean and standard deviation values of the 3-axis acceleration signal in the one of the multiple windows;

(d) perform Fourier transform on the 3-axis acceleration signal and PPG signal to obtain power spectra of the 3-axis acceleration signal and PPG signal in the one of the multiple windows when there is motion in the one of the multiple windows of the 3-axis acceleration signal, wherein the power spectra comprises fast Fourier transform (FFT) peaks of the 3-axis acceleration signal and PPG signal in the one of the multiple windows;

(e) pre-processing the 3-axis acceleration and PPG signal for conducting a mobility test, wherein the mobility test is performed using a threshold calculated by standard deviation and decision tree;

(f) determine whether a peak of the 3-axis acceleration signal is present in a range around a first highest peak of the PPG signal;

(g) determine whether the peak of the 3-axis acceleration signal affects heart rate of the user by performing random forest learning when the peak of the 3-axis acceleration signal is in the range around the first highest peak of the PPG signal; and

(h) estimate the heart rate of the user in the one of the multiple windows using a second highest peak of the PPG signal when the peak of the 3-axis acceleration signal affects heart rate of the user, wherein the heart rate estimated from the second highest peak of the PPG signal is captured for post-processing; and

(i) obtain the post-processed heart rate of the user in one of the multiple windows of a server and estimate a final heart rate based on a histogram, wherein a median value of a most frequently occurring wave is selected as the final heart rate.

11. The system as claimed in claim 10, wherein the one or more hardware processors are

further configured to execute programmed instructions to:

j) estimate the heart rate of the user in the one of the multiple windows using the first highest peak of the PPG signal when at least one of the peak of the 3-axis acceleration signal is not present in a range around the first highest peak of the PPG signal and the peak of the 3-axis acceleration signal does not affect the heart rate of the user.

12. The system as claimed in claim 10, wherein the one or more hardware processors are further configured to execute programmed instructions to:

(k) perform zero-phase digital filtering of the PPG signal in the one of the multiple windows when there is no motion in the one of the multiple windows of the 3-axis acceleration signal;

(l) perform Fourier transform on the filtered PPG signal to obtain power spectra of the PPG signal in the one of the multiple windows, wherein the power spectra comprises FFT peaks of the PPG signal in the one of the multiple windows; and

(m) estimate the heart rate of the user in the one of the multiple windows using a highest FFT peak of the PPG signal.

13. The system as claimed in claim 12, wherein the one or more hardware processors are further configured to execute programmed instructions to:

estimate a heart rate of the user in remaining windows by repeating at least one the steps of (c)-(m).

14. The system as claimed in claim 13, further configured to execute programmed instructions in the one or more memories to:

form a histogram with a predefined bin size for the heart rates of the user in the multiple windows;

select a bin with a highest number of occurrence in the histogram; and

consider a median value of the selected bin as a heart rate of the user.

15. The system as claimed in claim 10, wherein the one or more hardware processors are configured to execute programmed instructions to:

perform zero-phase digital filtering of the 3-axis acceleration signal and PPG signal in the one of the multiple windows when there is motion in the one of the multiple windows of the 3-axis acceleration signal; and

perform Fourier transform on the filtered 3-axis acceleration signal and PPG signal in the one of the multiple windows.

16. The system as claimed in claim 10, wherein the one or more hardware processors are further configured to execute programmed instructions to:

eliminate noise from each of the multiple windows of the PPG signal based on a threshold value for the PPG signal; and

remove direct current (DC) component from each of the multiple windows of the PPG signal upon eliminating the noise.

17. The system as claimed in claim 10, wherein the one or more hardware processors are configured to execute programmed instructions to:

determine whether motion is present in one of the multiple windows of the 3-axis acceleration signal based on a threshold value calculated by the mean and standard deviation of the 3-axis acceleration signal in the one of the multiple windows and a decision tree.

18. The system as claimed in claim 10, wherein the one or more hardware processors are configured to execute programmed instructions to:

perform random forest learning based on power values of the first highest peak of the PPG signal, the second highest peak of the PPG signal and the peak of the 3-axis acceleration signal.