Claims

1. An integrated electrocardiogram (ECG) and phonocardiogram (PCG) apparatus comprising:

a housing having a top part and a bottom part, the bottom part of the housing includes a tapered surface extending from a perimeter of a bottom surface to an opening at the top of the bottom part forming an acoustic chamber;

a power source housed within the top part;

an audio receiver arranged to seal the opening for obtaining PCG signal;

a plurality of dry sensors arranged at the bottom surface for obtaining ECG signal;

another dry sensor arranged apart from the bottom surface and in parallel connection with one of the plurality of dry sensors; and

a processing unit powered by the power source and communicatively connectable to the audio receiver and the plurality of dry sensors, wherein the bottom part of the housing is adaptably configured to create a snug fit on a subject preventing the audio receiver from picking acoustic noise from outside the acoustic chamber.

2. The integrated ECG and PCG apparatus according to claim 1 wherein the audio receiver is an electret microphone which covers frequencies of 20Hz~20kHz.

3. The integrated ECG and PCG apparatus according to claim 1, wherein the another dry sensor is arranged at the top part of the housing.

4. The integrated ECG and PCG apparatus according to claim 1 further comprising a pair of attachment rings on a side surface of the housing.

5. The integrated ECG and PCG apparatus according to claim 1 further comprising a touch sensor for activating the processing unit.

6. The integrated ECG and PCG apparatus according to claim 5 wherein the touch sensor is skin resistance based sensor.

7. The integrated ECG and PCG apparatus according to claim 1 wherein the processing unit comprises: a processor, memory, transceiver, analogue to digital converter, and instructions stored on the memory and executable by the processor to:

receive signals from dry sensors and audio receiver and store the signals from the dry sensors as ECG signals and the signals from the audio receiver as PCG signals in the memory;

receive a request to connect via the transceiver and in response, attempt to connect to a requestor; and

transmit the ECG and PCG signals stored on the memory to the requestor upon successful connection with the requestor.

8. The integrated ECG and PCG apparatus according to claim 5 wherein the processing unit comprises: a processor, memory, transceiver, analogue to digital converter, and instructions stored on the memory and executable by the processor to:

receive signal from the touch sensor and in response, initiate collection of ECG and PCG signals from the dry sensors and audio receiver respectively;

receive signals from dry sensors and audio receiver and store the signals from the dry sensors as ECG signals and the signals from the audio receiver as PCG signals in the memory;

receive a request to connect via the transceiver and in response, attempt to connect to a requestor; and

transmit the ECG and PCG signals stored on the memory to the requestor upon successful connection with the requestor.

9. The integrated ECG and PCG apparatus according to claim 1 wherein the tapered surface is tapered at an angle between 23° to 25° between the bottom surface of the bottom part and the opening at the top of the bottom part.

10. The integrated ECG and PCG apparatus according to claim 9 wherein the bottom surface defines an inner perimeter and an outer perimeter and the tapered surface extends from the inner perimeter to the outer perimeter of the opening.

11. A heart monitoring system comprising:

the integrated ECG and PCG apparatus according to any one of claims 1-10;

a processing unit comprising a processor, memory and instructions stored on the memory and executable by the processor to:

receive the signal from the integrated ECG and PCG apparatus;

apply a low pass filter to each of the ECG and PCG signals;

process the filtered ECG signal to obtain a start point (SP) and an ending point (EP);

select a region between the SP and EP of the filtered PCG signal and analyse the PCG discrete signal of the selected region to determine a first segment, a second segment, a third segment and a fourth segment.

12. The heart monitoring system according to claim 11 wherein the instruction to process the filtered ECG signal to obtain a start point (SP) and an end point (EP) comprises instructions to:

apply a wavelet decomposition to the filtered ECG signal and zeroing all coefficients other than a selected level value;

apply a wavelet reconstruction to resynthesize the signal;

determine the R peaks of the ECG signal by taking the absolute of the square values;

shift the first and second R peaks values left by a predetermined range; and

assign the first shifted R peak as the SP and the second shifted R peak as the EP.

13. The heart monitoring system according to claim 12 wherein the instruction to analyse the PCG discrete signal of the selected region to determine a first segment, a second segment, a third segment and a fourth segment comprises instructions to:

apply a wavelet decomposition to the filtered ECG signal and zeroing all coefficients other than a selected level value;

apply a wavelet reconstruction to resynthesize the signal;

determine the S peaks of the PCG signal by taking the absolute of the square values; and

identify the first, second, third and fourth segments of the cardiac cycle which includes the first heart sound (S1) and second heart sound (S2) based on the detected S peaks of the PCG signal.

14. The heart monitoring system according to claim 13 wherein the instruction to identify the first, second, third and fourth segments of the cardiac cycle which includes the first heart sound (S1) and second heart sound (S2) based on the S peaks of the PCG signal comprises instructions to:

identify the first segment from -50 ms of the first S peak to +50ms of the first S peak, the first segment containing the first heart sound (S1);

identify the third segment 3 from -30 ms of the second S peak to +30ms of the second S peak, the third segment containing the second heart sound (S2);

identify the second segment from +50 ms of the first S peak to -30ms of the second S peak; and

identify the fourth segment from +30ms of the second S peak to end of selected region.

15. The heart monitoring system according to claim 14 further comprises instructions to:

determine heart sound anomaly based on the second segment;

determine heart sound anomaly based on the fourth segment; and

classify as abnormal in response to determining heart sound anomaly.

16. The heart monitoring system according to claim 15 wherein the instruction to determine heart sound anomaly based on the second segment comprises instructions to:

calculate frequency and energy from the second segment;

compare the frequency and energy with a predetermined threshold; and

classify as abnormal in response to the frequency and energy being above the predetermined threshold.

17. The heart monitoring system according to claim 15 wherein the instruction to determine heart sound anomaly based on the fourth segment comprises instructions to:

calculate frequency and energy from the fourth segment;

compare the frequency and energy with a predetermined threshold; and

classify as abnormal in response to the frequency and energy being above the predetermined threshold.