CLAIMS

1. A method of tuning a wearable device for collecting physiological data of a wearer, the method comprising ~~the steps of~~:

collecting a PPG signal using the device;

determining whether or not the collected PPG signal is attributable to the wearer being human or animal; and

discontinuing the tuning if the collected PPG signal is not attributable to the wearer being human or animal;

wherein determining whether or not the collected PPG signal is attributable to the wearer being human or animal comprises determining that the wearer is human or animal if information about at least one cardiac cycle based only on one or more pulses in the collected PPG signal is in a first range.

2. The method of claim 1, wherein the information about the at least one cardiac cycle comprises one or more of a group consisting of a rise time, a fall time, time information relating to the dicrotic notch, time information relating to the diastolic peak, and information about the shape of the at least one pulse in the collected PPG signal or the shape(s) of one or more portions of the at least one pulse in the collected PPG signal.

3. The method of claim 2, comprising, when it is determined that the information about the at least one cardiac is not within a predetermined range, increasing an intensity of a light source for the PPG measurements.

~~4. The method of claim 3, comprising determining whether a driving current of the light source has reached a maximum, and determining a fail of tuning if yes.~~

~~5. The method of claim 4, comprising repeating collecting a PPG signal using the device if the driving current of the light source has not reached the maximum.~~

4~~6~~. The method of any one of claims 1 to 3~~5~~, comprising determining whether an amplitude of the collected PPG signal is greater than a first threshold and whether the driving current of the light source is above a minimum, and reducing the intensity of the light source if both conditions are fulfilled.

~~7. The method of claim 6, comprising determining whether the driving current of the light source has reached the minimum, and determining a fail of tuning if yes.~~

~~8. The method of claim 7, comprising repeating collecting a PPG signal using the device if the driving current of the light source has not reached the minimum.~~

5~~9~~. The method of any one of claims 1 to 4~~8~~, comprising determining whether an amplitude of the collected PPG signal is equal or greater than a second threshold and whether the driving

current of the light source is below the maximum, and increasing the intensity of the light source if both conditions are fulfilled.

~~10. The method of claim 9, comprising determining whether the driving current of the light source is equal to or greater than the maximum and determining whether the PPG amplitude is smaller than a third threshold, and determining a fail of tuning if at least one of the conditions is fulfilled.~~

~~11. The method of claim 10, comprising repeating collecting a PPG signal using the device if both conditions are not fulfilled.~~

~~12. The method of any one of claims 1 to 11, comprising determining whether in a plurality of pairs of pulses in the collected PPG signal a correlation of a power spectrum density is above a fourth threshold and determining whether a difference in the information about the at least one cardiac cycle is less than a fifth threshold, and repeating collecting a PPG signal using the device if at least one of the conditions is not fulfilled.~~

6~~13~~. The method of any one of claims 1 to 5~~11~~, comprising determining whether in a plurality of pairs of pulses in the collected PPG signal a correlation of a power spectrum density is above a fourth threshold, whether a difference in the information ~~–~~about the at least one cardiac cycle is less than a fifth threshold, and whether the difference in heart rate, HR, based on the collected PPG signal is less than sixth threshold relative to a normal resting heart rate, and repeating collecting a PPG signal using the device if at least one of the three conditions is not fulfilled.

~~14~~7. The method of any one of claims 1 to 6~~13~~, comprising determining whether HR is in a normal range for a human and/or animal.

8~~15~~. A wearable device for collecting physiological data of a wearer, the device comprising:

a PPG sensor;

a signal collecting unit coupled to the PPG sensor for collecting a PPG signal using the PPG sensor for tuning of the device; and

a processor coupled to the signal collecting unit for determining whether or not the collected PPG signal is attributable to the wearer being human or animal;

wherein the processor is configured to discontinue the tuning if the collected PPG signal is not attributable to the wearer being human or animal; and

wherein determining whether or not the collected PPG signal is attributable to the wearer being human or animal comprises determining that the wearer is human or animal if information about at least one cardiac cycle based only on one or more pulses in the collected PPG signal is in a first range.

9~~16~~. The device of claim 8~~15~~, wherein the information about the at least one cardiac cycle comprises one or more of a group consisting of a rise time, a fall time, time information relating

to the dicrotic notch, time information relating to the diastolic peak, and information about the shape of the at least one pulse in the collected PPG signal or the shape(s) of one or more portions of the at least one pulse in the collected PPG signal.

10~~17~~. The device of claim 9~~16~~, wherein the processor is configured, when it is determined that the information about the at least one cardiac cycle is not within the predetermined range, increasing an intensity of a light source of the PPG sensor for the PPG measurements.

~~18. The device of claim 17, wherein the processor is configured to determine whether a driving current of the light source has reached a maximum, and to determine a fail of tuning if yes.~~

~~19. The device of claim 18, wherein the signal collecting unit is configured to repeat collecting a PPG signal if the driving current of the light source has not reached the maximum.~~

11~~20~~. The device of any one of claims 8~~15~~ to 10~~19~~, wherein the processor is configured to determine whether an amplitude of the collected PPG signal is greater than a first threshold and whether the driving current of the light source is above a minimum, and to reduce the intensity of the light source if both conditions are fulfilled.

~~21. The device of claim 20, wherein the processor is configured to determine whether the driving current of the light source has reached the minimum, and to determine a fail of tuning if yes.~~

~~22. The device of claim 21, wherein the signal collecting unit is configured to repeat collecting a PPG signal if the driving current of the light source has not reached the minimum.~~

12~~23~~. The device of any one of claims 8~~15~~ to 11~~22~~, wherein the processor is configured to determine whether an amplitude of the collected PPG signal is equal or greater than a second threshold and whether the driving current of the light source is below the maximum, and to increase the intensity of the light source if both conditions are fulfilled.

~~24. The device of claim 23, wherein the processor is configured to determine whether the driving current of the light source is equal to or greater than the maximum and determining whether the PPG amplitude is smaller than a third threshold, and to determine a fail of tuning if at least one of the conditions is fulfilled.~~

~~25. The device of claim 24, wherein the signal collecting unit is configured to repeat collecting a PPG signal if both conditions are not fulfilled.~~

~~26. The device of any one of claims 15 to 25, wherein the processor is configured to determine whether in a plurality of pairs of pulses in the collected PPG signal a correlation of a power spectrum density is above a fourth threshold and determining whether a difference in the information about the at least one cardiac cycle is less than a fifth threshold, and the signal collecting unit is configured to repeat collecting a PPG signal if at least one of the conditions is not fulfilled.~~

13~~27~~. The device of any one of claims 8~~15~~ to 12~~25~~, wherein the processor is configured to determine whether in a plurality of pairs of pulses in the collected PPG signal a correlation of a power spectrum density is above a fourth threshold, whether a difference in the information about the at least one cardiac cycle is less than a fifth threshold, and whether the difference in HR is less than sixth threshold relative to a normal resting heart rate, and the signal collecting unit is configured to repeat collecting a PPG signal using the device if at least one of the three conditions is not fulfilled.

~~28. The device of any one of claims 15 to 27, wherein the processor is configured to determine whether HR is in a normal range for a human and/or animal.~~

14~~29~~. A method of controlling a wearable device for collecting physiological data of a wearer, the method comprising ~~the steps of~~:

collecting a PPG signal using the device;

processing the PPG signal to obtain analysis results;

determining that the device is not being worn by the wearer if information only about the collected PPG signal does not fulfill at least one condition; and

disabling display of the analysis results by the device and/or turning off a light source of the device if the collected PPG signal is attributable to the device not being worn by the wearer.

~~30. The method of claim 29, wherein determining whether or not the collected PPG signal is attributable to the device not being worn by the wearer comprises extracting one or more features from respective time windows of the collected PPG data.~~

15~~31~~. The method of claim~~s 29 or 30~~14, wherein determining whether or not the collected PPG signal is attributable to the device not being worn by the wearer comprises determining a mean and a variance of a DC component of the collected PPG signal, a variance of an AC component of the collected PPG signal, a number of times the amplitude of the AC component is saturated, and a number of times the amplitude of the AC component is zero.

~~32. The method of claim 31, comprising determining, as a plurality of conditions, whether the means of the DC component is within a first range, whether the variance of the DC component is within a second range, whether the variance of the AC component is within a third range, and whether a sum of the number of times the amplitude of the AC component is saturated and the number of times the amplitude of the AC component is zero is lower than a first threshold, and determining that the device is not being worn by the wearer if any one of the plurality of conditions is not fulfilled.~~

~~33~~16. The method of ~~any one of~~ claims ~~29 to 32~~14 or 15, wherein determining whether or not the collected PPG signal is attributable to the device not being worn by the wearer comprises calculating a signal to noise ratio of the collected PPG signal.

~~34. The method of claim 33, wherein the signal to noise ratio of the collected PPG signal is determined in the frequency domain.~~

~~35. The method of claims 33 or 34, wherein the signal to noise ratio of the collected PPG signal is determined based on root mean square of the collected PPG signal in a signal range and in a noise range, respectively.~~

~~36. The method of claim 35, wherein it is determined that the device is not worn if the root mean square in the signal range is not larger than a second threshold and/or the root mean square in the noise range is not larger than a third threshold.~~

~~37. The method of any one of claims 33 to 36, wherein it is determined that the device is not worn if the calculated signal to noise ratio is not larger than a fourth threshold.~~

~~38~~17. A wearable device for collecting physiological data of a wearer, the device comprising:

a signal collection unit for collecting a PPG signal; and

a processor coupled to the signal collection unit for processing the PPG signal to obtain analysis results;

wherein the processor is configured to determine that the device is not being worn by the wearer if information only about the collected PPG signal does not fulfill at least one condition and for disabling display of the analysis results and/or turning off a light source of the device if the collected PPG signal is attributable to the device not being worn by the wearer,

~~39. The device of claim 38, wherein the processor is configured to determine whether or not the collected PPG signal is attributable to the device not being worn by the wearer based on extracting one or more features from respective time windows of the collected PPG data.~~

~~40~~18. The device of claim~~s 38 or 39~~17, wherein the processor is configured to determine whether or not the collected PPG signal is attributable to the device not being worn by the wearer based on determining a mean and a variance of a DC component of the collected PPG signal, a variance of an AC component of the collected PPG signal, a number of times the amplitude of the AC component is saturated, and a number of times the amplitude of the AC component is zero.

~~41. The device of claim 40, wherein the processor is configured to determine, as a plurality of conditions, whether the means of the DC component is within a first range, whether the variance of the DC component is within a second range, whether the variance of the AC component is within a third range, and whether a sum of the number of times the amplitude of the AC component is saturated and the number of times the amplitude of the AC component is zero is lower than a first threshold, and to determine that the device is not being worn by the wearer if any one of the plurality of conditions is not fulfilled.~~

~~42~~19. The device of ~~any one of~~ claims ~~38 to 41~~17 or 18, wherein the processor is configured to determine whether or not the collected PPG signal is attributable to the device not being worn by the wearer based on calculating the signal to noise ratio of the collected PPG signal.

~~43. The device of claim 42, wherein the signal to noise ratio of the collected PPG signal is determined in the frequency domain.~~

~~44. The device of claims 42 or 43, wherein the signal to noise ratio of the collected PPG signal is determined based on root mean square of the collected PPG signal in a signal range and in a noise range, respectively.~~

~~45. The device of claim 44, wherein the processor is configured to determine that the device is not worn if the root mean square in the signal range is not larger than a second threshold and/or the root mean square in the noise range is not larger than a third threshold.~~

~~46. The device of any one of claims 42 to 45, wherein the processor is configured to determine that the device is not worn if the calculated signal to noise ratio is not larger than a fourth threshold.~~

~~47~~20. A computer-readable medium comprising instructions which, when executed by a computing device, instruct the device to execute a method according to one of claims 1 to 7 ~~14~~ and/or any one of claims ~~29~~ 14 to ~~37~~16.