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Description

TECHNICAL FIELD

[0001] The present subject matter relates, in general, to photoplethysmography and, particularly but not exclusively, to estimating physiological parameters of a subject based on photoplethysmography.

BACKGROUND

[0002] With the advancement in technology, (PPG) has been developed for measuring physiological parameters, such as heart rate of individuals. The PPG is a non-intrusive optical technique and involves use of light for measuring change in blood volume of the individual. Based on the measurement, a PPG signal indicative of changes in blood volume may be obtained. The PPG signal may then be used for estimating the physiological parameters associated with the individual. US2014153800 discloses a method for obtaining a signal to characterize a periodic component, which involves applying a time-varying factor in parallel sequences of operations and a signal corresponding to respective signals is taken as the input.

BRIEF DESCRIPTION OF DRAWINGS

[0003] The detailed description is described with reference to the accompanying figures. In the figures, the left-most digit(s) of a reference number identifies the figure in which the reference number first appears. The same numbers are used throughout the drawings to reference like features and components.

Figure 1 illustrates a physiological parameter measurement device for determining physiological parameter associated with a subject, in accordance with an implementation of the present subject matter; and

Figure 2 illustrates a method for determining physiological parameter associated with a subject, in accordance with an implementation of the present subject matter.

DETAILED DESCRIPTION

[0004] The present subject matter relates to determining physiological parameter of a subject, for example, an individual, using photoplethysmography (PPG). The PPG is a non-intrusive optical technique used for measuring physiological parameters, such as heart rate of the subject.

[0005] In PPG, a PPG signal associated with an individual is recorded using standard medical grade equipment. The PPG signal is indicative of volumetric changes in blood flow of the individual and is used for determining the heart rate of the individual. However, such medical equipment are costly to procure and thus, individuals who seek to get their heart rate measured on a periodic basis may have to repeatedly visit clinics with such medical equipments for getting their heart rate measured. Further, the medical equipments may only be operated by a skilled personal thereby limiting the operational utility of the medical equipments.

[0006] With the development of technology, individuals can nowadays measure their physiological parameters using smart phones equipped with a light source, such as a light emitting diode (LED) flash and a video capturing device, for example, a camera. For estimating a physiological parameter of the individual using a smart phone, a video of a body part, typically a finger, of the individual is recorded using the camera of the smart phone with LED flash ON. The video is then processed for extracting a PPG signal associated with the individual. Based on the PPG signal, the physiological parameter of the individual is estimated.

[0007] In a conventional approach for extracting PPG signal from the video, a central block of predefined dimensions is selected from each frame of the video. The central block may be understood as a block located in the center of the frame. Thereafter, based on a mean value corresponding to each of the central blocks the PPG signal is extracted. Owing to the location of the flash with respect to the camera, the PPG signal obtained based on the central blocks may be of a poor quality. For instance, the flash may cause saturation of the pixels of the frame which are nearer to the flash. Thus, the PPG signal extracted from such a region, for example, the central block, may be of a poor quality. Therefore, any physiological parameter determined based on such a PPG signal may not reflect an accurate value of the physiological parameter. Additionally, skin tone of the individual may also affect the quality of the PPG signal obtained. For example, in case of fair skinned individuals, most of the light from the LED flash is reflected back and the video recorded is high in intensity. Thus, the PPG signal extracted from such a video may be of a poor quality and may not be useful for estimating the physiological parameter of the individual.

[0008] The present subject matter describes systems and methods for estimating physiological parameter of a subject. According to an aspect, each of a plurality of frames corresponding to a video of a body part of the subject may be divided into a plurality of blocks. Thereafter, the PPG signal based on which the physiological parameter of the subject may be determined may be extracted from the video based on a block having highest peak signal to noise ratio (PSNR) from amongst the plurality of blocks. The high PSNR indicates that a region of the frame corresponding to the block contains least noise component and thus, the PPG signal extracted based on such a block results in a good quality PPG signal. As a result, an accuracy of determination of the physiological parameter may be increased.

[0009] The frames of the video may be divided into the plurality of blocks. In an example, the frames of the video may be divided in a manner such that each of the blocks may be of a same predetermined dimension. In an implementation, a peak signal to noise ratio (PSNR) for each of the blocks may be computed. The PSNR may indicate a level of noise in a region of the frame corresponding to the block. For instance, a block with high PSNR may indicate a region of the frame having less noise component while, a block having low PSNR may indicate a region of the frame having high noise component. Based on the PSNRs of the blocks, the block having the highest PSNR may be selected.

[0010] As mentioned above, the PPG signal may be extracted from the video based on the block having the highest PSNR. For extracting the PPG signal, a block identifier associated with the block may be ascertained. The block identifier may be understood as an identifier, for example, a block number or co-ordinates associated with the block, indicative of a region of the frame. In an example, the block identifier may be ascertained using known techniques. On ascertaining the block identifier, a region corresponding to the block identifier is identified in each frame of the video. As the regions correspond to the block identifier, the PSNRs corresponding to such regions may also be high and therefore, may represent a region of the video having least noise component.

[0011] Subsequently, the PPG signal may be extracted from the identified regions of the frames of the video. For reasons mentioned above, the PPG signal extracted from such regions may be of good quality and may facilitate determination of the physiological parameter with greater accuracy.

[0012] As may be understood, the PPG signal is in frequency domain and a dominant peak in the frequency spectrum of the PPG signal is used for calculating the physiological parameter. In an implementation, the PPG signal may be enhanced for increasing the accuracy of determination of the physiological parameter. For example, the PPG signal may be passed through an adaptive filter, such as a normalized Least Mean Square (NLMS) filter, to obtain a filtered PPG signal having reduced noise. Thereafter, an interpolation technique may be applied to the filtered PPG signal for enhancing the filtered PPG signal. Examples of the interpolation technique may include, but are not limited to, linear interpolation and Jacobsen interpolation. The enhancement of the PPG signal may result in a fine tuned form of the frequency domain representation of the filtered PPG signal. As a result, dominant peak in the frequency spectrum of the PPG signal is easier to determine from the enhanced PPG signal. Thus, enhancement of the PPG signal further increases the accuracy of determination of the physiological parameter.

[0013] As will be clear from the foregoing description, selection of the block having the highest PSNR for extracting the PPG signal facilitates in obtaining a good quality PPG signal having less noise component. As a result, physiological parameters determined from such a PPG signal are determined with greater accuracy. Further, in contrast to extracting the PPG signal from the complete video, the PPG signal may be extracted from the video based on the block identifier. As a result, devices having less computational power, such as low processing capability smart phones, may be implemented for extraction of the PPG signal and, in turn, determination of the physiological parameters. Further, the enhanced PPG signal further increases the accuracy of determination of the physiological parameter of the subject.

[0014] These and other advantages of the present subject matter would be described in greater detail in conjunction with the following figures. While aspects of described systems and methods can be implemented in any number of different computing systems, environments, and/or configurations, the embodiments are described in the context of the following device(s).

[0015] Figure 1 illustrates a physiological parameter measurement device 100 for determining physiological parameters associated with a subject, in accordance with an implementation of the present subject matter. The physiological parameter measurement device 100, hereinafter referred to as the device 100, can be a handheld device and can include any of the devices, for example, mobile phones, personal digital assistant (PDA), smart phones, or tablet personal computers. In another example, the device 100 may be an electrical device, such as those used in clinical setting for monitoring or estimating the physiological parameters associated with subjects.

[0016] In one implementation, the device 100 includes processor(s) 102 and memory 104. The processor(s) 102 may be implemented as one or more microprocessors, microcomputers, microcontrollers, digital signal processors, central processing units, state machines, logic circuitries, and/or any devices that manipulate signals, based on operational instructions. Among other capabilities, the processor(s) 102 is provided to fetch and execute computer-readable instructions stored in the memory 104. The memory 104 may be coupled to the processor(s) 102 and can include any computer-readable medium known in the art including, for example, volatile memory, such as Static Random Access Memory (SRAM) and Dynamic Random Access Memory (DRAM), and/or non-volatile memory, such as Read Only Memory (ROM), erasable programmable ROM, flash memories, hard disks, optical disks, and magnetic tapes.

[0017] Further, the device 100 may include module(s) 106 and data 108. The module(s) 106 and the data 108 may be coupled to the processor(s) 102. The module(s) 106, amongst other things, include routines, programs, objects, components, data structures, etc., which perform particular tasks or implement particular abstract data types. The module(s) 106 may also be implemented as, signal processor(s), state machine(s), logic circuitries, and/or any other device or component that manipulate signals based on operational instructions.

[0018] In an implementation, the module(s) 106 include a video processing module 110, a signal enhancement module 112, and other module(s) 114. The other module(s) 114 may include programs or coded instructions that supplement applications or functions performed by the device 100. Additionally, in said implementation, the data 108 includes video processing data 116, signal enhancement data 118, and other data 120. The other data 120 amongst other things, may serve as a repository for storing data that is processed, received, or generated as a result of the execution of one or more modules in the module(s) 106. Although the data 108 is shown internal to the device 100, it may be understood that the data 108 can reside in an external repository (not shown in the figure), which may be operably coupled to the device 100. Accordingly, the device 100 may be provided with interface(s) (not shown) to communicate with the external repository to obtain information from the data 108.

[0019] During operation, to commence measurement of the physiological parameter, the subject, i.e., person whose heart rate is to be measured, positions a body part 126 on a camera 128 of the device 100. In an example, the subject can position the body part 126 in contact with a lens of the camera 128, or vice-versa, while a flash light of the camera 128 is switched on. For instance, the subject can position a finger tip of his hand on the camera 128 for capturing the video. In such position, according to an implementation, a video of the body part 126 of the subject is captured using the camera 128 of the device 100. In an example, the flash light can be a light-emitting diode (LED) type of flash light and can provide appropriate illumination to the body part 126 for effectively capturing the video for further processing. In one example, the camera 128 of the device 100 can capture the video at a rate of about 30 frames per second (fps). The video captured may then be stored in the video processing data 116 of the device 100.

[0020] In an example, the video may be processed for obtaining a PPG signal based on which the physiological parameter of the subject is estimated. For instance, the video processing module 110 may divide the frames of the video into a plurality of blocks. In an example, the video processing module 110 may divide the frames in a manner such that each of the blocks is of same predetermined dimension. Further, the video processing module 110 may generate a block identifier for each of the blocks. For instance, the video processing module 110 may generate a block number for each of the blocks for identifying the blocks. In another example, the video processing module 110 may generate co-ordinates corresponding to each of the blocks. The video processing module 110 may store the block identifiers in the video processing data 116 for identification of the blocks in future.

[0021] Upon dividing the frames into blocks, the video processing module 110 may compute a PSNR for each of the blocks. The PSNR associated with a block of a frame may indicate a measure of noise component present in a region of the frame corresponding to the block. In an example, the video processing module 110 may compute the PSNRs using known conventional techniques. Further, the video processing module 110 may store the PSNRs in the video processing data 116.

[0022] Thereafter, the video processing module 110 may select a block having highest PSNR from amongst the plurality of blocks for extracting the PPG signal based on the block. In order to extract the PPG signal, the video processing module 110 may, at first, ascertain the block identifier corresponding to the block. As mentioned previously, the block identifiers are stored in the video processing data 116. For ascertaining the block identifier corresponding to the block, the video processing module 110 may access the video processing data 116 and may, subsequently, ascertain the block number corresponding to the block. The video processing module 110 may then identify a region corresponding to the block number in each of the frames of the video for extracting the PPG signal from the regions. As may be understood, the region corresponding to the block number and, in turn, the block having the highest PSNR may have high PSNR. As a result, the corresponding regions may have less noise component and thus, the PPG signal obtained from such regions may be of good quality. On identifying the regions, the video processing module 110 may extract the PPG signal from the video based on the regions.

[0023] In an implementation, the signal enhancement module 112 may enhance the PPG signal. For instance, the signal enhancement module 112 may pass the PPG signal through a filter for obtaining a filtered PPG signal. Filtering of the PPG signal reduces the noise present in the PPG signal. In an example, the filter may be an adaptive filter, such as a normalized Least Mean Square (NLMS) filter. Thereafter, the signal enhancement module 112 may apply an interpolation technique to the filtered PPG signal. Application of the interpolation techniques facilitates peak detection in frequency domain thereby, increasing the accuracy of determination of the physiological parameter. Examples of the interpolation technique may include, but are not limited to, linear interpolation and Jacobsen interpolation.

[0024] In an implementation, the device 100 may use the enhanced PPG signal, i.e., the PPG signal after enhancement, for determining the physiological parameter, for example, heart rate of the subject.

[0025] In an embodiment, while recording the video of the body part 126 of the subject, flash brightness of the camera 128 may be adjusted based on a skin tone of the individual. For instance, an intensity level of a flash of the camera 128 of the PPM device 100 to operate the camera 128 at one or more intensity levels of the flash for capturing a test video of the subject at each of the one or more intensity levels of the flash. Thereafter, for each of the one or more intensity levels of the flash, a PSNR for the test video captured at the intensity level of flash may be determined. Subsequently, a test video having highest PSNR from amongst the test videos captured at the one or more intensity levels of the flash may be determined and the video of the subject may be captured at the intensity level of flash corresponding to the test video having the highest PSNR. In an example, the video processing module 110 may adjust the flash in a manner as described above.

[0026] Figure 2 illustrates a method 200 for estimating physiological parameter of a subject, according to an embodiment of the present subject matter. The order in which the method 200 is described is not intended to be construed as a limitation, and any number of the described method blocks can be combined in any order to implement the method or any alternative methods. Additionally, individual blocks may be deleted from the method without departing from the spirit and scope of the subject matter described herein. Furthermore, the method can be implemented in any suitable hardware, software, firmware, or combination thereof.

[0027] The method may be described in the general context of computer executable instructions. Generally, computer executable instructions can include routines, programs, objects, components, data structures, procedures, modules, functions, etc., that perform particular functions or implement particular abstract data types. The method may also be practiced in a distributed computing environment where functions are performed by remote processing devices that are linked through a communication network. In a distributed computing environment, computer executable instructions may be located in both local and remote computer storage media, including memory storage devices.

[0028] In an implementation, one or more of the method described herein may be implemented at least in part as instructions embodied in a non-transitory computer-readable medium and executable by one or more computing devices. In general, a processor, for example, a microprocessor, receives instructions from a non-transitory computer-readable medium, for example, a memory, and executes those instructions, thereby performing one or more method, including one or more of the method described herein. Such instructions may be stored and/or transmitted using any of a variety of known computer-readable media.

[0029] Referring to Figure 2, at block 202, each of a plurality of frames of a video of a subject whose physiological parameter is to be estimated is divided into a plurality of blocks. In an example, the vide of the subject may be a pre-recorded video, i.e., a video recorded at an instant of time prior to estimation of the physiological parameter. In another example, the video may be captured when the estimation is being done in real-time. For instance, the video may be captured using the camera 128. While capturing the video, a flash of the camera 128 may be switched on. Further, the flash brightness may be adjusted based on a skin tone of the subject. In an example, each of the blocks is of same predetermined dimension. In an implementation, the video processing module 110 may divide each of the frames into plurality of blocks.

[0030] At block 204, a PSNR for each of the blocks is computed. In an example, the video processing module 110 may compute the PSNR.

[0031] At block 206, a block having highest PSNR is selected from amongst the plurality of blocks. In an example, the PSNRs of the blocks may be analyzed for identifying the block having the highest PSNR. The block may then be selected for extraction of PPG signal.

[0032] At block 208, a PPG signal is extracted from the video based on a block identifier associated with the block. In an example, the video processing module 110 may extract the PPG signal from the video in a manner as described above in Figure 1.

[0033] At block 210, the PPG signal is enhanced. As a part of enhancement, in an example, the PPG signal may be filtered to obtain a filtered PPG signal. Further, an interpolation technique may be applied to the filtered PPG signal for further enhancement of the PPG signal. Thereafter, on completion of the enhancement, the physiological parameter of the subject may be determined.

[0034] Although implementations for methods and systems for estimating physiological parameters are described, it is to be understood that the present subject matter is not necessarily limited to the specific features or methods described. Rather, the specific features and methods are disclosed as implementations for estimating physiological parameters.

Claims

1. A physiological parameter measurement (PPM) device (100), the PPM device (100) comprising:

a processor (102);
a video processing module (110) coupled to the processor (102) to,

divide each of a plurality of frames of a video into a plurality of blocks, wherein the video is of a body part of a subject whose physiological parameter is to be determined;
select a block, from amongst the plurality of blocks, having highest peak signal to noise ratio (PSNR);
extract a photoplethysmogram (PPG) signal from the video based on a block identifier associated with the block; and

a signal enhancement module (112) coupled to the processor (102) to,

enhance the PPG signal for determining a value of the physiological parameter associated with the subject.

2. The PPM device (100) as claimed in claim 1, wherein the video processing module (110) further is to compute a PSNR for each of the plurality of blocks.

3. The PPM device (100) as claimed in claim 1, wherein the video processing module (110) further is to,
determine the block identifier associated with the block; and
identify a region in each frame of the video based on the block identifier; and select the identified region corresponding to each of the frames of the video for extracting the PPG signal.

4. The PPM device (100) as claimed in claim 1, wherein the signal enhancement module (112) further is to,
filter the PPG signal to obtain a filtered PPG signal; and
apply an interpolation technique on the filtered PPG signal to enhance the PPG signal.

5. The PPM device (100) as claimed in claim 1, wherein the video processing module (110) further is to,
adjust an intensity level of a flash of a camera (128) of the PPM device (100) to operate the camera (128) at one or more intensity levels of the flash for capturing a test video of the subject at each of the one or more intensity levels of the flash;
for each of the one or more intensity levels of the flash, determine a PSNR for the test video captured at the intensity level of flash;
determine, from amongst the test videos captured at the one or more intensity levels of the flash, a test video having highest PSNR; and
capture the video of the subject at the intensity level of flash corresponding to the test video having the highest PSNR.

6. A method comprising:

   dividing, by a processor (102), each of a plurality of frames of a video into a plurality of blocks, wherein the video is of a body part of a subject whose physiological parameter is to be determined;
   selecting a block, from amongst the plurality of blocks, having highest peak signal to noise ratio (PSNR);
   extracting a photoplethysmogram (PPG) signal from the video based on a block identifier associated with the block; and
   enhancing the PPG signal for determining a value of the physiological parameter for the subject.

7. The method as claimed in claim 6, wherein the method further comprises computing a PSNR for each of the plurality of blocks.

8. The method as claimed in claim 6, wherein the extracting comprises:

   ascertaining the block identifier associated with the block; and
   identifying a region in each frame of the video based on the block identifier; and
   selecting the region corresponding to each of the frames of the video for extracting the PPG signal.

9. The method as claimed in claim 6, wherein the enhancing the PPG signal further comprises:

   filtering the PPG signal to obtain a filtered PPG signal; and
   applying an interpolation technique on the filtered PPG signal to enhance the PPG signal.

10. The method as claimed in claim 6, wherein the physiological parameter comprises at least one of a heart rate, a blood pressure, and an oxygen saturation.

11. The method as claimed in claim 6, wherein the method further comprises:

   adjusting an intensity level of a flash of a camera (128) to operate the camera (128) at one or more intensity levels of the flash for capturing a test video of the subject at each of the one or more intensity levels of the flash;
   for each of the one or more intensity levels of the flash, determining a PSNR for a test video captured at the intensity level of flash;
   determining, from amongst the test videos captured at the one or more intensity levels of the flash, a test video having highest PSNR; and
   capturing the video of the subject at the intensity level of flash corresponding to the test video having the highest PSNR.

12. A non-transitory computer-readable medium having embodied thereon a computer program for executing a method comprising:

   dividing, by a processor (102), each of a plurality of frames of a video into a plurality of blocks, wherein the video is of a body part of a subject whose physiological parameter is to be determined;
   selecting a block, from amongst the plurality of blocks, having highest peak signal to noise ratio (PSNR);
   extracting a photoplethysmogram (PPG) signal from the video based on a block identifier associated with the block; and
   enhancing the PPG signal for determining a value of the physiological parameter for the subject.

Patentansprüche

1. Physiologische Parametermess-(PPM)-Vorrichtung

(100), wobei die PPM-Vorrichtung (100) Folgendes umfasst:

einen Prozessor (102);
ein Videoverarbeitungsmodul (110), das mit dem Prozessor (102) für Folgendes gekoppelt ist

Aufteilen jedes einer Mehrzahl von Rahmen eines Videos in eine Mehrzahl von Blöcken, wobei das Video von einem Körperteil eines Subjekts ist, dessen physiologischer Parameter bestimmt werden soll;
Auswählen eines Blocks, unter der Mehrzahl von Blöcken, der das höchste Peak-Signal-Rausch-Verhältnis (PSNR) aufweist;
Extrahieren eines photoplethysmographischen (PPG) Signals aus dem Video basierend auf einem Blockidentifikator, der dem Block zugeordnet ist; und ein Signalverbesserungsmodul (112), das mit dem Prozessor (102) für Folgendes gekoppelt ist
Verbessern des PPG-Signals zum Bestimmen eines Wertes des physiologischen Parameters, der dem Subjekt zugeordnet ist.

2. PPM-Vorrichtung (100) nach Anspruch 1, wobei das Videoverarbeitungsmodul (110) ferner zum Berechnen eines PSNR für jeden der Mehrzahl von Blöcken dient.

3. PPM-Vorrichtung (100) nach Anspruch 1, wobei das Videoverarbeitungsmodul (110) ferner für Folgendes dient
Bestimmen des Blockidentifikators, der dem Block zugeordnet ist; und
Identifizieren einer Region in jedem Rahmen des Videos basierend auf dem Blockidentifikator; und
Auswählen der identifizierten Region, die jedem der Rahmen des Videos entspricht, um das PPG-Signal zu extrahieren.

4. PPM-Vorrichtung (100) nach Anspruch 1, wobei das Signalverbesserungsmodul (112) ferner für Folgendes dient
Filtern des PPG-Signals, um ein gefiltertes PPG-Signal zu erhalten; und
Anwenden einer Interpolationstechnik auf das gefilterte PPG-Signal, um das PPG-Signal zu verbessern.

5. PPM-Vorrichtung (100) nach Anspruch 1, wobei das Videoverarbeitungsmodul (110) ferner für Folgendes dient
Einstellen einer Intensitätsstufe eines Blitzes einer Kamera (128) der PPM-Vorrichtung (100), um die Kamera (128) bei einer oder mehreren Intensitätsstufen des Blitzes zu betreiben, um ein Testvideo des Subjekts bei jeder der einen oder mehreren Intensitätsstufen des Blitzes zu erfassen;
für jede der einen oder mehreren Intensitätsstufen des Blitzes, Bestimmen eines PSNR für das Testvideo, das bei der Intensitätsstufe des Blitzes erfasst wird;
Bestimmen, unter den Testvideos, die bei der einen oder den mehreren Intensitätsstufen des Blitzes erfasst werden, eines Testvideos mit dem höchsten PSNR; und
Erfassen des Videos des Subjekts bei der Intensitätsstufe des Blitzes, die dem Testvideo mit dem höchsten PSNR entspricht.

6. Verfahren, das Folgendes umfasst:

Aufteilen, durch einen Prozessor (102), jedes einer Mehrzahl von Rahmen eines Videos in eine Mehrzahl von Blöcken, wobei das Video von einem Körperteil eines Subjekts ist, dessen physiologischer Parameter bestimmt werden soll;
Auswählen eines Blocks unter der Mehrzahl von Blöcken, der das höchste Peak-Signal-Rausch-Verhältnis (PSNR) aufweist;
Extrahieren eines photoplethysmographischen (PPG) Signals aus dem Video basierend auf einem Blockidentifikator, der dem Block zugeordnet ist; und
Verbessern des PPG-Signals zum Bestimmen eines Wertes des physiologischen Parameters für das Subjekt.

7. Verfahren nach Anspruch 6, wobei das Verfahren ferner das Berechnen eines PSNR für jeden der Mehrzahl von Blöcken umfasst.

8. Verfahren nach Anspruch 6, wobei das Extrahieren Folgendes umfasst:

Ermitteln des Blockidentifikators, der dem Block zugeordnet ist; und
Identifizieren einer Region in jedem Rahmen des Videos basierend auf dem Blockidentifikator; und
Auswählen der Region, die jedem der Rahmen des Videos entspricht, um das PPG-Signal zu extrahieren.

9. Verfahren nach Anspruch 6, wobei das Verbessern des PPG-Signals ferner Folgendes umfasst:

Filtern des PPG-Signals, um ein gefiltertes PPG-Signal zu erhalten; und
Anwenden einer Interpolationstechnik auf das gefilterte PPG-Signal, um das PPG-Signal zu verbessern.

10. Verfahren nach Anspruch 6, wobei der physiologischen Parameter mindestens einen einer Herzfrequenz, eines Blutdrucks und einer Sauerstoffsättigung umfasst.

11. Verfahren nach Anspruch 6, wobei das Verfahren ferner Folgendes umfasst:

Einstellen einer Intensitätsstufe eines Blitzes einer Kamera (128), um die Kamera (128) bei einer oder mehreren Intensitätsstufen des Blitzes zu betreiben, um ein Testvideo des Subjekts bei jeder der einen oder mehreren Intensitätsstufen des Blitzes zu erfassen;
für jede der einen oder mehreren Intensitätsstufen des Blitzes, Bestimmen eines PSNR für ein Testvideo, das bei der Intensitätsstufe des Blitzes erfasst wird;
Bestimmen, unter den Testvideos, die bei der einen oder den mehreren Intensitätsstufen des Blitzes erfasst werden, eines Testvideos mit dem höchsten PSNR; und
Erfassen des Videos des Subjekts bei der Intensitätsstufe des Blitzes, die dem Testvideo mit dem höchsten PSNR entspricht.

12. Nichtflüchtiges computerlesbares Medium, auf dem ein Computerprogramm zum Ausführen eines Verfahrens implementiert ist, das Folgendes umfasst:

Aufteilen, durch einen Prozessor (102), jedes einer Mehrzahl von Rahmen eines Videos in eine Mehrzahl von Blöcken, wobei das Video von einem Körperteil eines Subjekts ist, dessen physiologischer Parameter bestimmt werden soll;
Auswählen eines Blocks, unter der Mehrzahl von Blöcken, der das höchste Peak-Signal-Rausch-Verhältnis (PSNR) aufweist;
Extrahieren eines photoplethysmographischen (PPG) Signals aus dem Video basierend auf einem Blockidentifikator, der dem Block zugeordnet ist; und
Verbessern des PPG-Signals zum Bestimmen eines Wertes des physiologischen Parameters für das Subjekt.

Revendications

1. Dispositif de mesure de paramètres physiologiques (PPM) (100), le dispositif PPM (100) comprenant :

un processeur (102) ;
un module de traitement vidéo (110) couplé au processeur (102) destiné à

diviser chacune d'une pluralité de trames d'une vidéo en une pluralité de blocs, dans lequel la vidéo est celle d'une partie du corps d'un sujet dont un paramètre physiologique doit être déterminé ;
sélectionner un bloc, parmi la pluralité de blocs, possédant un rapport signal de crête sur bruit (PSNR) le plus élevé ;
extraire un signal de pléthysmogramme optique (PPG) à partir de la vidéo sur la base d'un identifiant de bloc associé au bloc ; et

un module d'amélioration de signal (112) couplé au processeur (102) destiné à

améliorer le signal de PPG pour déterminer une valeur du paramètre physiologique associé au sujet.

2. Dispositif PPM (100) selon la revendication 1, dans lequel le module de traitement vidéo (110) est en outre destiné à calculer un PSNR pour chacun de la pluralité de blocs.

3. Dispositif PPM (100) selon la revendication 1, dans lequel le module de traitement vidéo (110) est en outre destiné à
déterminer l'identifiant de bloc associé au bloc ; et
identifier une région de chaque trame de la vidéo sur la base de l'identifiant de bloc ; et
sélectionner la région identifiée correspondant à chacune des trames de la vidéo pour extraire le signal de PPG.

4. Dispositif PPM (100) selon la revendication 1, dans lequel le module d'amélioration de signal (112) est en outre destiné à
filtrer le signal de PPG pour obtenir un signal de PPG filtré ; et
appliquer une technique d'interpolation sur le signal de PPG filtré pour améliorer le signal de PPG.

5. Dispositif PPM (100) selon la revendication 1, dans lequel le module de traitement vidéo (110) est en outre destiné à
ajuster un niveau d'intensité d'un flash d'une caméra (128) du dispositif PPM (100) pour commander la caméra (128) à un ou plusieurs niveaux d'intensité du flash pour capturer une vidéo d'essai du sujet à chacun de l'un ou plusieurs niveaux d'intensité du flash ;
pour chacun de l'un ou plusieurs niveaux d'intensité du flash, déterminer un PSNR pour la vidéo d'essai capturée au niveau d'intensité du flash ;
déterminer, parmi les vidéos d'essai capturées à l'un ou plusieurs niveaux d'intensité du flash, une vidéo d'essai possédant le PSNR le plus élevé ; et
capturer la vidéo du sujet au niveau d'intensité du flash correspondant à la vidéo d'essai possédant le PSNR le plus élevé.

6. Méthode comprenant :

la division, par un processeur (102), de chacune d'une pluralité de trames d'une vidéo en une pluralité de blocs, dans laquelle la vidéo est celle d'une partie du corps d'un sujet dont un paramètre physiologique doit être déterminé ;
la sélection d'un bloc, parmi la pluralité de blocs, possédant un rapport signal de crête sur bruit (PSNR) le plus élevé ;
l'extraction d'un signal de pléthysmogramme optique (PPG) à partir de la vidéo sur la base d'un identifiant de bloc associé au bloc ; et
l'amélioration du signal de PPG pour déterminer une valeur du paramètre physiologique pour le sujet.

7. Méthode selon la revendication 6, dans laquelle la méthode comprend en outre le calcul d'un PSNR pour chacun de la pluralité de blocs.

8. Méthode selon la revendication 6, dans laquelle l'extraction comprend :

la confirmation de l'identifiant de bloc associé au bloc ; et
l'identification d'une région dans chaque trame de la vidéo sur la base de l'identifiant de bloc ; et
la sélection de la région correspondant à chacune des trames de la vidéo pour extraire le signal de PPG.

9. Méthode selon la revendication 6, dans laquelle l'amélioration du signal de PPG comprend en outre :

le filtrage du signal de PPG pour obtenir un signal de PPG filtré ; et
l'application d'une technique d'interpolation sur le signal de PPG filtré pour améliorer le signal de PPG.

10. Méthode selon la revendication 6, dans laquelle le paramètre physiologique comprend au moins l'une parmi une fréquence cardiaque, une pression artérielle et une saturation du sang en oxygène.

11. Méthode selon la revendication 6, dans laquelle la méthode comprend en outre :

l'ajustement d'un niveau d'intensité d'un flash d'une caméra (128) pour commander la caméra (128) à un ou plusieurs niveaux d'intensité du flash pour capturer une vidéo d'essai du sujet à chacun de l'un ou plusieurs niveaux d'intensité du flash ;
pour chacun de l'un ou plusieurs niveaux d'intensité du flash, la détermination d'un PSNR pour une vidéo d'essai capturée au niveau d'intensité du flash ;
la détermination, parmi les vidéos d'essai capturées à l'un ou plusieurs niveaux d'intensité du flash, d'une vidéo d'essai possédant le PSNR le plus élevé ; et
la capture de la vidéo du sujet au niveau d'intensité du flash correspondant la vidéo d'essai possédant le PSNR le plus élevé.

12. Support non transitoire lisible par ordinateur possédant un programme informatique incorporé à celuici pour exécuter une méthode comprenant :

la division, par un processeur (102), de chacune d'une pluralité de trames d'une vidéo en une pluralité de blocs, dans lequel la vidéo est celle d'une partie du corps d'un sujet dont un paramètre physiologique doit être déterminé ;
la sélection d'un bloc, parmi la pluralité de blocs, possédant un rapport signal de crête sur bruit (PSNR) le plus élevé ;
l'extraction d'un signal de pléthysmogramme optique (PPG) à partir de la vidéo sur la base d'un identifiant de bloc associé au bloc ; et
l'amélioration du signal de PPG pour déterminer une valeur du paramètre physiologique pour le sujet.

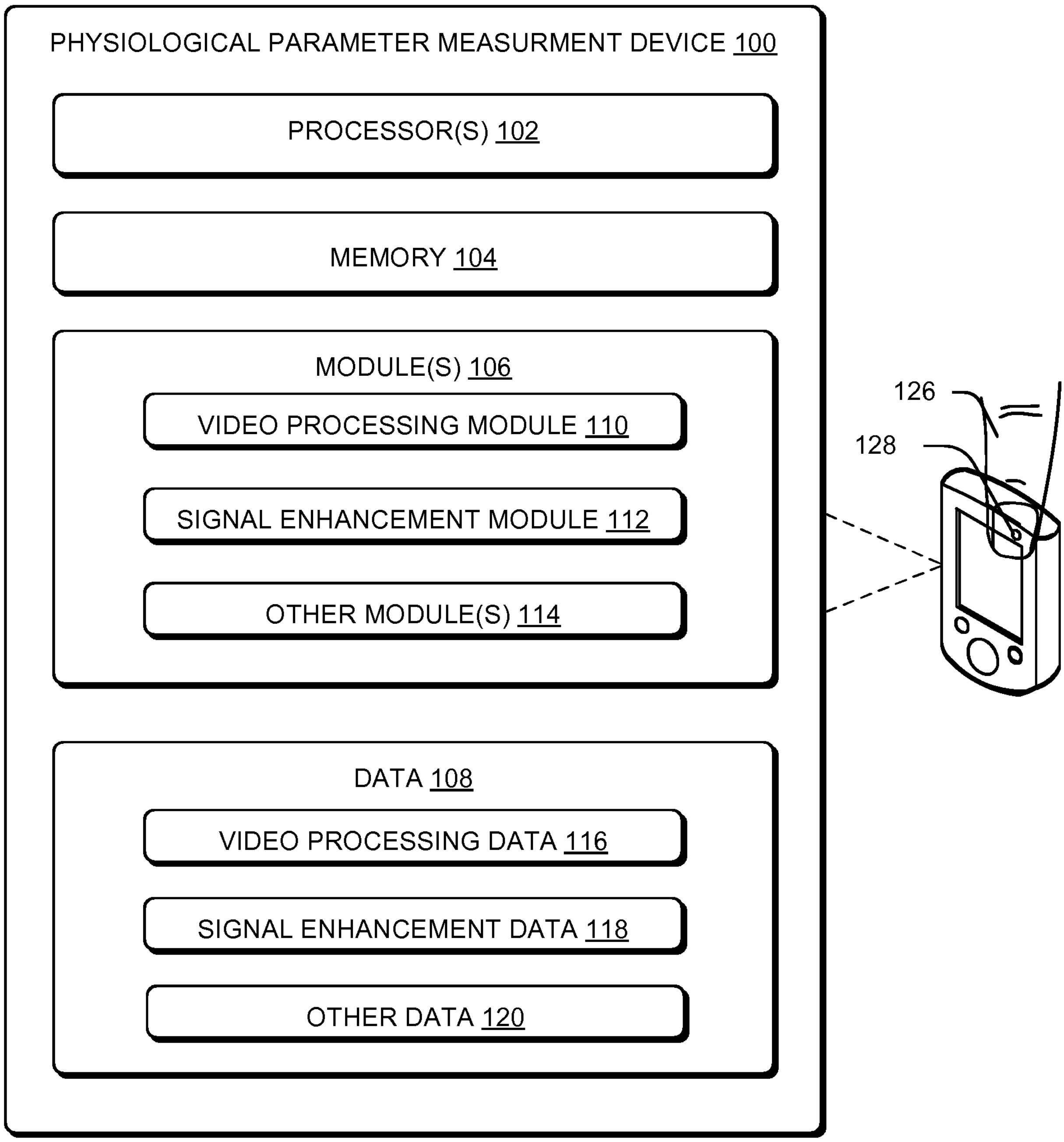
PHYSIOLOGICAL PARAMETER MEASURMENT DEVICE 100
PROCESSOR(S) 102
MEMORY 104
MODULE(S) 106
VIDEO PROCESSING MODULE 110
SIGNAL ENHANCEMENT MODULE 112
OTHER MODULE(S) 114
DATA 108
VIDEO PROCESSING DATA 116
SIGNAL ENHANCEMENT DATA 118
OTHER DATA 120
126
128

Figure 1

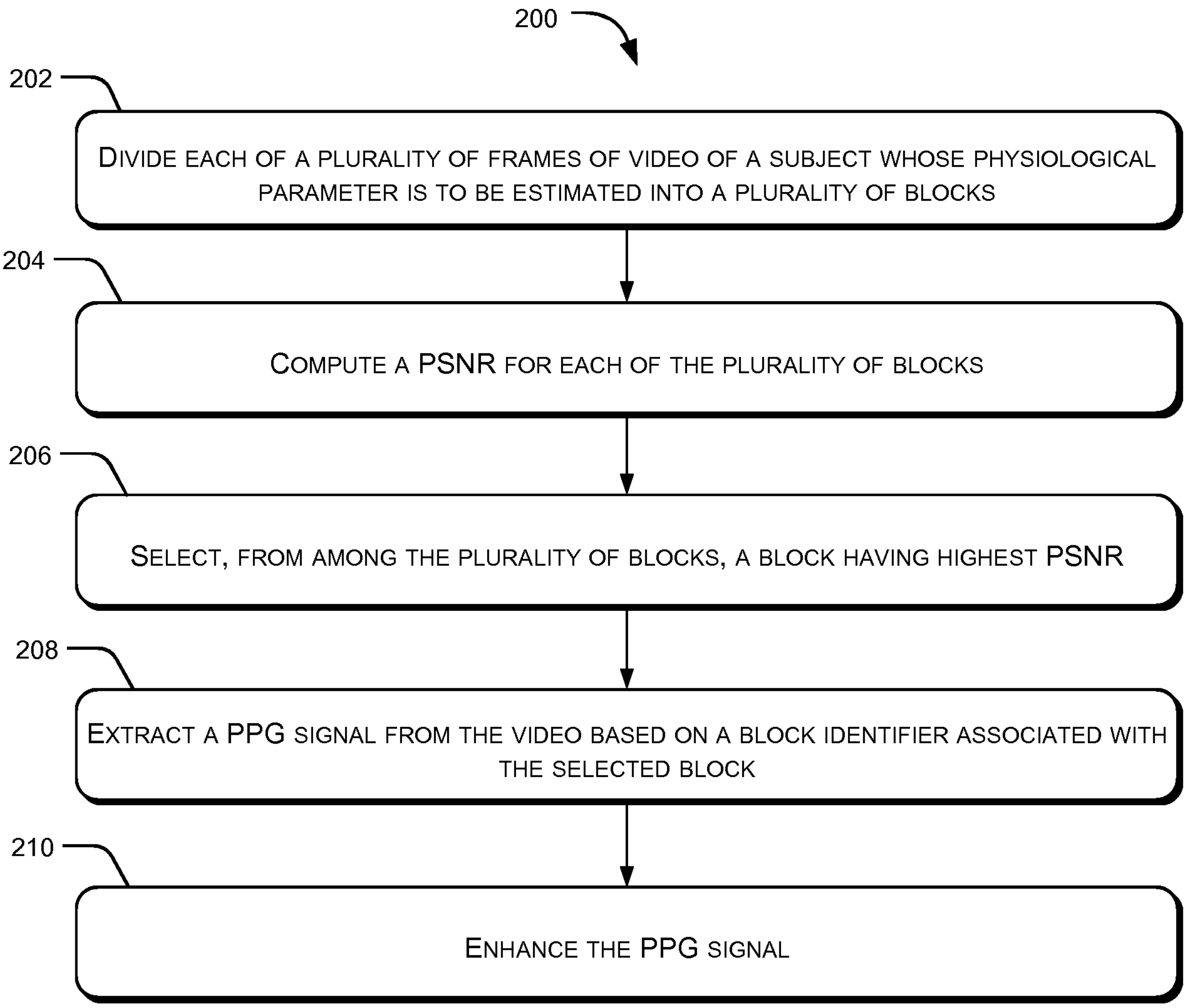
200
202
DIVIDE EACH OF A PLURALITY OF FRAMES OF VIDEO OF A SUBJECT WHOSE PHYSIOLOGICAL PARAMETER IS TO BE ESTIMATED INTO A PLURALITY OF BLOCKS
204
COMPUTE A PSNR FOR EACH OF THE PLURALITY OF BLOCKS
206
SELECT, FROM AMONG THE PLURALITY OF BLOCKS, A BLOCK HAVING HIGHEST PSNR
208
EXTRACT A PPG SIGNAL FROM THE VIDEO BASED ON A BLOCK IDENTIFIER ASSOCIATED WITH THE SELECTED BLOCK
210
ENHANCE THE PPG SIGNAL

Figure 2

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 2014153800 A **[0002]**

专利名称(译)	估计生理参数		
公开(公告)号	EP3015057B1	公开(公告)日	2017-09-06
申请号	EP2015160713	申请日	2015-03-25
申请(专利权)人(译)	塔塔咨询服务有限公司.		
当前申请(专利权)人(译)	塔塔咨询服务有限公司.		
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IPC分类号	A61B5/00 A61B5/0205 A61B5/024 A61B5/0402 A61B5/1455		
CPC分类号	A61B5/0082 A61B5/02416 A61B5/02438 A61B2560/0238 A61B5/14551		
优先权	3396MUM2014 2014-10-27 IN		
其他公开文献	EP3015057A1		
外部链接	Espacenet		

摘要(译)

一种生理参数测量装置（100），包括处理器（102）和耦合到处理器（102）的视频处理模块（110），以将视频的多个帧中的每一个划分为多个块，其中视频是需要确定其生理参数的受试者的身体部位。视频处理模块（110）还用于从多个块中选择具有最高峰值信噪比（PSNR）的块。此外，视频处理模块（110）基于与块相关联的块标识符从视频中提取光电容积描记图（PPG）信号。生理参数测量设备（100）还包括耦合到处理器（102）的信号增强模块（112），以处理PPG信号以获得增强的PPG信号，用于确定对象的生理参数的值。

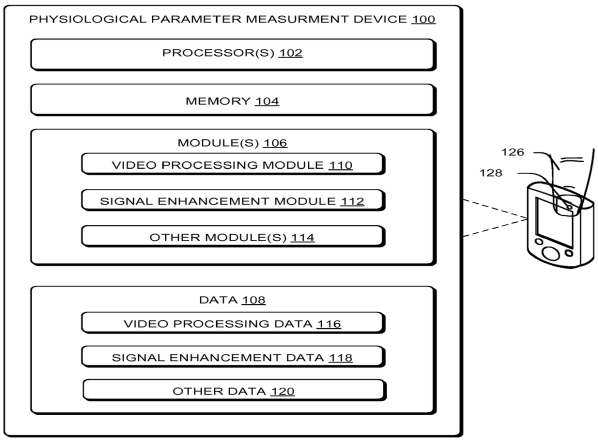

Figure 1