



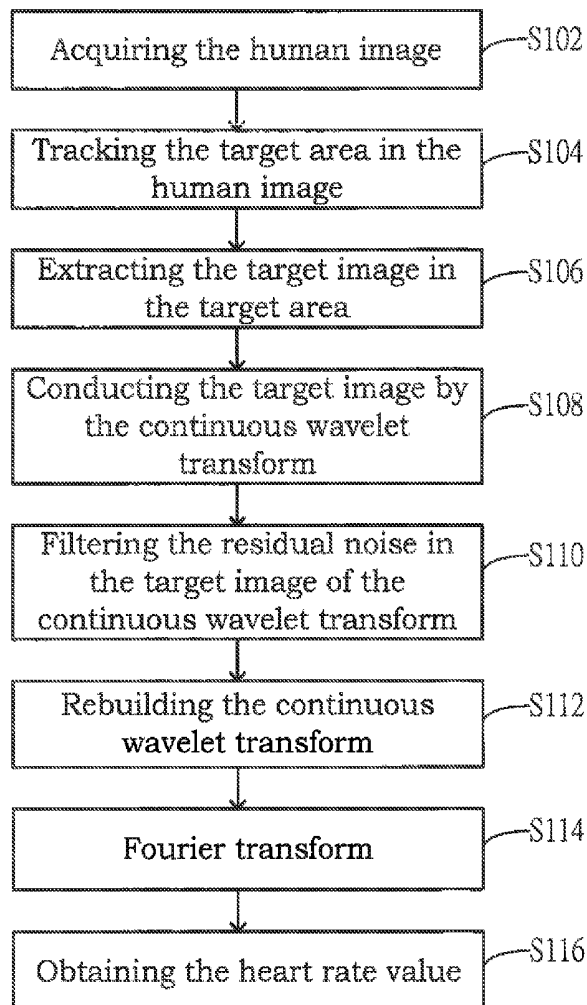
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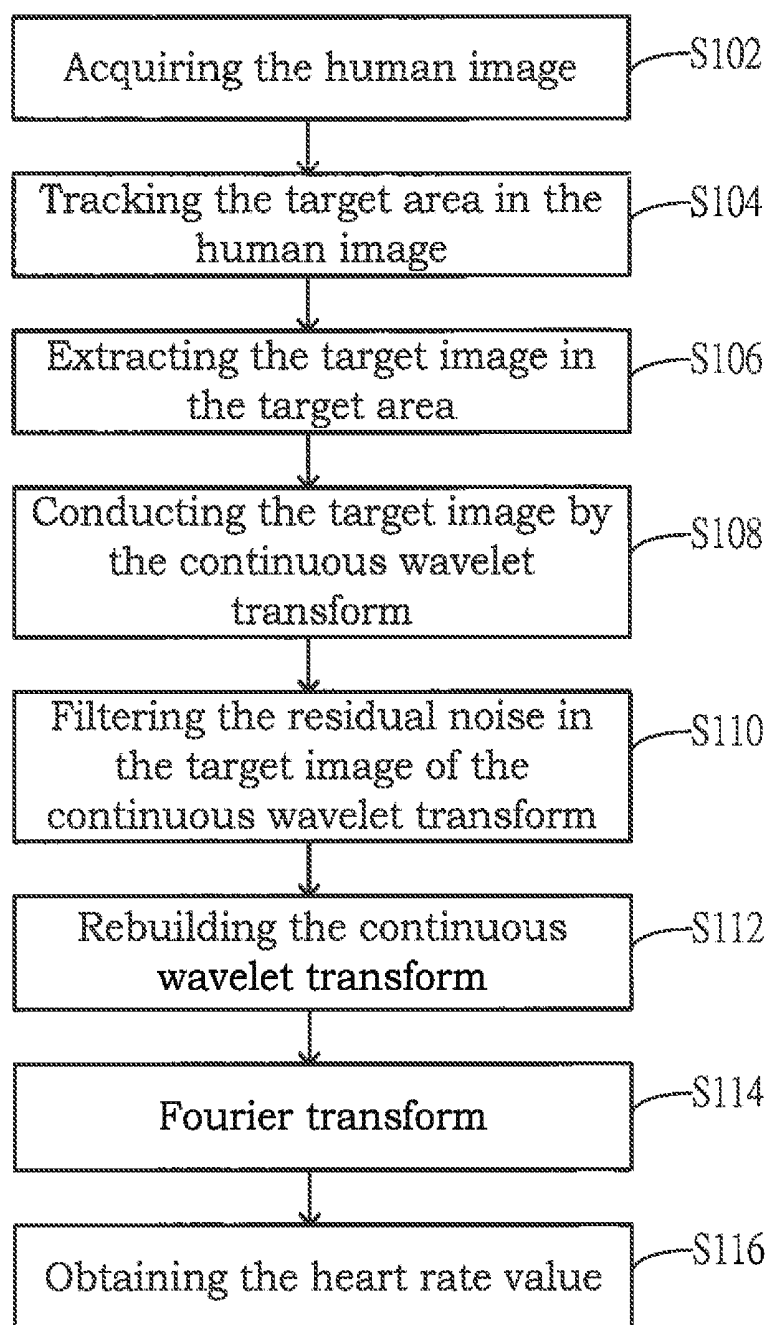
(19) **United States**(12) **Patent Application Publication**
Wu et al.(10) **Pub. No.: US 2019/0246910 A1**(43) **Pub. Date: Aug. 15, 2019**(54) **IMAGING-TYPE HEART RATE
MONITORING DEVICE AND METHOD
THEREOF****Publication Classification**(51) **Int. Cl.***A61B 5/024* (2006.01)*A61B 5/00* (2006.01)(52) **U.S. Cl.**CPC *A61B 5/024* (2013.01); *A61B 5/726*(2013.01); *A61B 5/0402* (2013.01); *A61B**5/7257* (2013.01); *A61B 5/725* (2013.01);*A61B 5/0013* (2013.01)(71) Applicant: **National Chiao Tung University,**
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Hsinchu City (TW)(21) Appl. No.: **16/039,776**(22) Filed: **Jul. 19, 2018****Related U.S. Application Data**(60) Provisional application No. 62/629,945, filed on Feb.
13, 2018.

(57)

ABSTRACT

The present invention provides an imaging-type heart rate monitoring device and method thereof. It acquires the human image information tracks the target area in the human image information, and extracts the target image in the target area. It transforms the human image information through the first frequency domain transform. It filters the residual noise of the continuous wavelet transform information. It rebuilds the residual noise filtered information by the continuous wavelet transform. It transforms the continuous wavelet transform rebuilt information by the Fourier transform. It obtains a heart rate value through the second frequency domain transformed information.



**Figure 1**

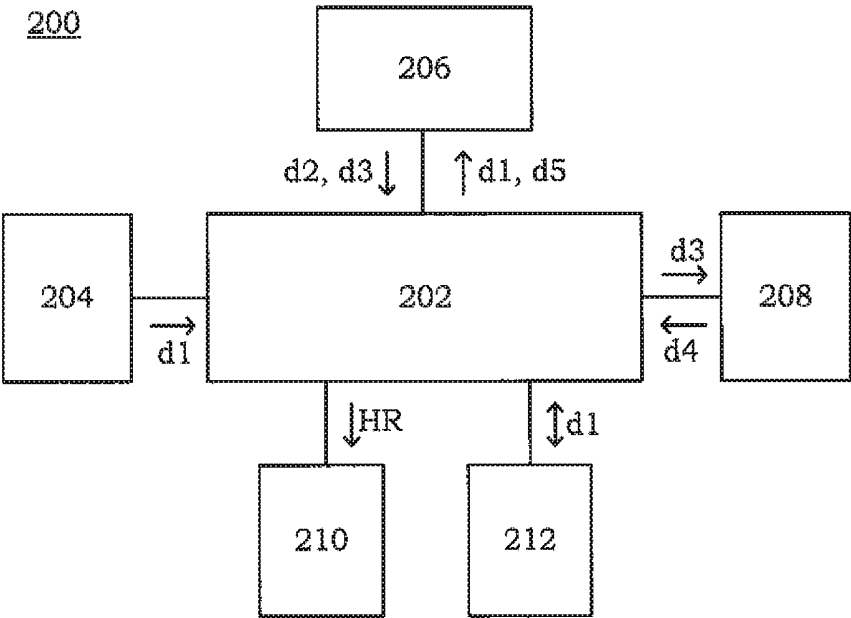


Figure 2

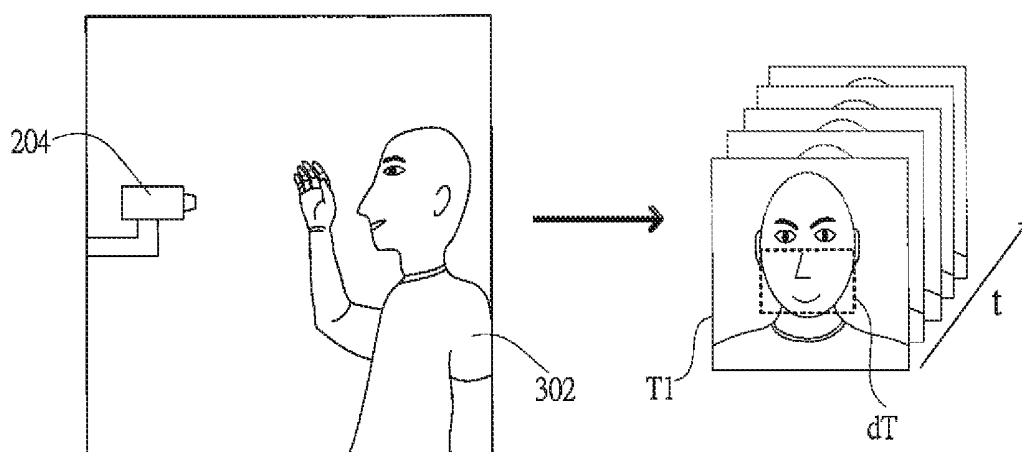


Figure 3

IMAGING-TYPE HEART RATE MONITORING DEVICE AND METHOD THEREOF

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to an imaging-type physiological information monitoring device and method thereof, particularly to a device and method for an imaging-type heart rate monitoring without the need to contact human body directly.

2. Description of the Prior Art

[0002] The heart rate (HR) can be regarded as an important physiological characteristic information in humans. It also can be regarded as an important parameter for assessing the human health. Furthermore, it is an important factor for identifying the heart health state and other clinical diagnosis risk prediction. The daily measurement will contribute to the monitoring of human health, and the prevention of relevant diseases, particularly to the prediction for the body function degradation and disease risk of aging people.

[0003] At present, the Electrocardiogram (EKG/ECG) is the most popular and most accurate method for measuring the heart rate. However, because the electrocardiogram is a contact HR measurement, it is necessary to employ the sensors to contact with the human skin, which might often cause the inconvenience of operation and the peeling or sticking.

[0004] The conventional non-contact HR measurement includes electrocardiography (EGG), Doppler radar, microwave Doppler radar, photoplethysmography (PPG), remote photoplethysmography (rPPG) and thermal imaging etc. However, the cost of the above-mentioned methods will very high, and the relevant information only can be obtained by the professional operation method.

[0005] On the other hand, in recent years, the family medical diagnostic measurement and remote health state monitoring have seen increased attention. However, at present, it is still at the starting stage, thus it is quite urgent to find a robust low-cost, convenient-operation, and real time non-contact HR measurement method.

[0006] In addition, the development of wearable devices has already been grown vigorously now, and has become the mainstream of HR measurement technology in sports. However, the wearable devices still have some uncomfortable problems to the users, such as the perspiration after exercise, skin allergic phenomenon by contacting wearable device, or physical discomfort by the constraint of wearable device. Therefore, in order to solve the problems faced by wearable devices, there are a lot of non-contact HR measurement studies in recent years.

[0007] In the past few years, with the development of computer vision technology, the photoplethysmography (PPG) had been utilized to treat the video frequency adopted from human skin, to realize the HP measurement. However, these methods often adopt the linear wave filter to reduce the residual noise of video frequency, which is unable to reduce the residual noise located at the same frequency range of HR signal, and cause the decrease of HR extraction accuracy.

[0008] In the HR monitoring of conventional non-contact photoplethysmography (PPG), the best signal in three opti-

cal channels of image is extracted for analysis mainly, in order to obtain the HR value. Even with the obtained HR value, there is still some residual noise with short time duration but high energy, which will cause the decrease of HR extraction accuracy. In addition, the human face contacts the surrounding environment directly, and has great influence from the ambient temperature, which will cause the decrease of human face HR extraction accuracy and stability. Thus, the abovementioned non-contact HR measurement method still have several drawbacks, such as high noise at the same HR frequency range, great influence of ambient temperature, and lack for judging the authenticity of separated signal etc.

[0009] In view of this, in order to meet the abovementioned demand, the present invention provides an imaging-type heart rate monitoring device and method thereof. Through extracting the human image information and time-frequency analysis, filtering the residual noise, rebuilding the continuous wavelet and further Fourier transform, to obtain the HR value with lesser noise and higher accuracy.

SUMMARY OF THE INVENTION

[0010] The embodiment of the present invention provides an imaging-type physiological information monitoring device and method thereof. Through the time-frequency analysis and the filtering of residual noise, dissolve the problem of residual noise with short time duration but high energy generated from present non-contact imaging-type physiological information monitoring, and increase the accuracy of measurement.

[0011] In order to achieve the abovementioned purpose, the embodiment of the present invention provides an imaging-type physiological information monitoring device and method, comprising: acquiring at least a human image information of at least a human skin area; tracking at least a target area in the human image information; extracting the target image of the target area; transforming the human image information through a first frequency domain, to obtain a first frequency domain transformed information; filtering the first frequency domain transformed information, to obtain a residual noise filtered information; rebuilding the residual noise filtered information by the first frequency domain transform, to obtain a first frequency domain rebuilt information; transforming the first frequency domain rebuilt information by a second frequency domain transform, to obtain a second frequency domain transformed information; and obtaining a physiological information by the second frequency domain transformed information.

[0012] The embodiment of the present invention is after acquiring at least a human image information of at least a human skin area, further comprises tracking at least a target area in the human image information.

[0013] The embodiment of the present invention is after tracking at least a target area in the human image information, further comprises extracting the target image of the target area.

[0014] In the embodiment of the present invention, the first frequency domain transform is a time-frequency analysis, which includes but not limited to continuous wavelet transform or Short Time Fourier Transform.

[0015] In the embodiment of the present invention, the physiological information of the invention comprises gen-

erating a heart rate information, generating a heart rate variability information, and generating a respiratory information.

[0016] In the embodiment of the present invention, the first frequency domain transformed information is a time-frequency analysis, which includes but not limited to continuous wavelet transform or Short Time Fourier Transform, and the first frequency domain rebuilt information is an inverse time-frequency analysis, which includes but not limited to continuous wavelet transform rebuilt information or inverse Short Time Fourier Transform rebuilt information.

[0017] In the embodiment of the present invention, the second frequency domain transform includes but not limited to Fourier transform.

[0018] In the embodiment of the present invention, the second frequency domain transformed information includes but not limited to Fourier transformed information.

[0019] The embodiment of the present invention provides an imaging-type physiological information monitoring device, comprising: an image acquisition unit to acquire at least a human image information of at least a human skin area; an image treatment unit to electrically connect the image acquisition unit, in order to receive the human image information transmitted from the image acquisition unit; a continuous wavelet transform unit to electrically connect the image treatment unit, in order to conduct the continuous wavelet transform to the human image information to obtain a continuous wavelet transform information, or rebuild the continuous wavelet transform information to obtain a continuous wavelet transform rebuilt information; a Fourier transform unit to electrically connect the image treatment unit, to receive the continuous wavelet transform rebuilt information, and employ a Fourier transform unit to conduct Fourier transform to obtain a Fourier transform information; a storage unit to electrically connect the image treatment unit, to store human image information; and an output unit to electrically connect the image treatment unit, to output the heart rate value; where the image treatment unit filters the residual noise in the continuous wavelet transform information, to obtain a residual noise filtered information, and the image treatment unit obtain the physiological information in accordance with the Fourier transform information.

[0020] In the embodiment of the present invention, the image acquisition unit tracks at least a target area in the human image information.

[0021] In the embodiment of the present invention, the image treatment unit extracts a target image in the target area.

[0022] In order to further understand the features and technological content of the present invention, please refer to the following detailed description and attached figures of the present invention. Nevertheless, the attached figures are used for reference and description, which are not used for limiting the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The foregoing aspects and many of the attendant advantages of this invention will become more readily appreciated as the same becomes better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:

[0024] FIG. 1 illustrates a flowchart of image-type heart beat measurement method of the present invention;

[0025] FIG. 2 illustrates an image-type heart beat monitoring device of the present invention; and

[0026] FIG. 3 schematically illustrates the use of an image-type heart beat monitoring device of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0027] In the following context, the specific embodiments are used to describe the imaging-type physiological information monitoring device and method of the present invention. The people who are familiar to this art can understand the advantages and efficacies of the present invention easily from the content disclosed in this article. The present invention can also be implemented or applied by other different embodiments. Every detail in this article can also be modified and changed based on different viewpoints and applications without violating the spirit of the present invention. In addition, the figures in the present invention are only brief description, and they are not drawn in actual dimension to reflect the actual size. The following description of preferred embodiment describes the viewpoint of the present invention in more detail, which will not limit the scope of the present invention by any viewpoint.

[0028] Please refer to FIG. 1. FIG. 1 illustrates a flowchart of image-type heart beat measurement method of the present invention. The imaging-type physiological information monitoring method comprises the following steps:

[0029] Continuously, please refer to Step S102 in FIG. 1, in which acquiring at least a human image information of at least a human skin area.

[0030] Then, please refer to Step S102 FIG. 1, and further including Step S104 and Step S106.

[0031] Again, please refer to Step S104 in FIG. 1, in which tracking at least a target area in the human image information. It has to describe that this target area is the exposed skin area of human, which includes but not limited to the face, hand or neck of human.

[0032] Then, refer to Step S106 in FIG. 1, in which extracting the target image of the target area.

[0033] Further refer to Step S108 in FIG. 1, in which transforming the human image information through a first frequency domain, in order to obtain a first frequency domain transformed information, where the first frequency domain transform is a time-frequency analysis, which includes but not limited to continuous wavelet transform or Short Time Fourier Transform.-That is the human image information is transformed through the time-frequency analysis to obtain a time-frequency transform information.

[0034] In Step S110 of FIG. 1, in which filtering the first frequency domain transformed information, in order to obtain a residual noise filtered information.

[0035] Further in Step S112 of FIG. 1, in which rebuilding the residual noise filtered information by the first frequency domain transform, in order to obtain a first frequency domain rebuilt information.

[0036] And in Step S114 of FIG. 1, in which transforming the first frequency domain rebuilt information by a second frequency domain transform, in order to obtain a second frequency domain transformed information. Where the second frequency domain transform is a Fourier transform. The second frequency domain transformed information includes but limited to Fast Fourier transform information. That is, a first frequency domain rebuilt information is transformed by

a second frequency domain transform, to obtain a second frequency domain transformed information.

[0037] Further in Step S116 of FIG. 1, in which obtaining a physiological information by the second frequency domain transformed information.

[0038] The physiological information includes but not limited to heart rate (HR), heart rate variability, or respiratory. Normally, the physiological information of the invention comprises generating a heart rate information, generating a heart rate variability information, and generating a respiratory information.

[0039] In another embodiment, please refer to FIG. 2. FIG. 2 illustrates an imaging-type heart beat monitoring device of the present invention.

[0040] FIG. 2 shows an imaging-type heart rate monitoring device 200, comprising: an image treatment unit 202, an image acquisition unit 204, a continuous wavelet transform unit 206, a Fourier transform unit 208, an output unit 210, and a storage unit 212. Where the function of the image acquisition unit 204 is to acquire at least a human image information of at least a human skin area.

[0041] The function of the image treatment unit 202 in FIG. 2 is to receive the human image information d1 transmitted from the image acquisition unit 204, and the image treatment unit 202 is electrically connected to the image acquisition unit 204.

[0042] The function of the time-frequency analysis unit 206 in FIG. 2 is to conduct the continuous wavelet transform for the human image information d1 to obtain a continuous wavelet transform information d2, or rebuild the continuous wavelet transform information S2, to obtain a continuous wavelet transform rebuilt information d3. It has to describe that rebuild the continuous wavelet transform information S2 is an inverse continuous wavelet transform step. The continuous wavelet transform unit 206 is electrically connected to the image treatment unit 202. In fact, time-frequency analysis comprises the continuous wavelet transform, or the short time Fourier transform.

[0043] The function of the frequency transform unit 208 in FIG. 2 is to receive a continuous wavelet transform rebuilt information, in which the frequency transform is conducted by a Fourier transform unit 208, to obtain a Fourier transform information d4. The frequency transform unit 208 is electrically connected to the image treatment unit 202. In fact, frequency transform unit 208 comprises the Fourier transform, or fast Fourier transform.

[0044] The output unit 210 in FIG. 2 is electrically connected to the image treatment unit 202, its function is to output the heart rate value HR. The image treatment unit 202 filters the residual noise in the continuous wavelet transform information d1, to obtain a residual noise filtered information d5. The image treatment unit 202 obtains the heart rate value HR in accordance with the Fourier transform information d4. The output unit 210 is electrically connected to the image treatment unit 202. Also, "HR" for the output unit 210 in FIG. 2 is shown as the heart rate (HR).

[0045] The function of the storage unit 212 in FIG. 2 is to store the human image information d1. The storage unit 212 is electrically connected to the image treatment unit 202.

[0046] Please refer to FIG. 2 and FIG. 3. FIG. 3 schematically illustrates the use of an imaging-type heart beat monitoring device of the present invention. As shown in FIG. 3, the image acquisition unit 204 takes the photo image of human body 302. The image acquisition unit 204 tracks at

least a target area T1 in the human image information d1. The image treatment unit 202 in FIG. 3 is used to extract a target image dT in the target area T1.

[0047] It is understood that various other modifications will be apparent to and can be readily made by those skilled in the art without departing from the scope and spirit of the invention. Accordingly, it is not intended that the scope of the claims appended hereto be limited to the description as set forth herein, but rather that the claims be construed as encompassing all the features of patentable novelty that reside in the present invention, including all features that would be treated as equivalents thereof by those skilled in the art to which the invention pertains.

What is claimed is:

1. An imaging-type heart rate monitoring method, comprising:

acquiring at least a human image information of at least a human skin area;

transforming said human image information through a first frequency domain transform in order to obtain a first frequency domain transformed information;

filtering said first frequency domain transformed information in order to obtain a residual noise filtered information;

rebuilding said residual noise filtered information by said first frequency domain transform in order to obtain said first frequency domain rebuilt information;

transforming said first frequency domain rebuilt information by a second frequency domain transform in order to obtain a second frequency domain transformed information; and

obtaining a physiological information by said second frequency domain transformed information.

2. The method according to claim 1, wherein physiological information comprises generate a heart rate information.

3. The method according to claim 1, wherein physiological information comprises generate a heart rate variability information.

4. The method according to claim 1, wherein physiological information comprises generate a respiratory information.

5. The imaging-type heart rate monitoring method according to claim 1, wherein after the step of acquiring at least a human image information of at least a human skin area, further comprising tracking at least a target area in the human image information.

6. The imaging-type heart rate monitoring method according to claim 5, wherein after the step of tracking at least a target area in the human image information, further comprising extracting the target image of the target area.

7. The imaging-type heart rate monitoring method according to claim 6, wherein the first frequency domain transform is a continuous wavelet transform.

8. The imaging-type heart rate monitoring method according to claim 7, wherein the first frequency domain transform information is a continuous wavelet transform information, the first frequency domain rebuilt information is a continuous wavelet transform rebuilt information.

9. The package structure according to claim 6, wherein the second frequency domain transform is a Fourier transform.

10. The imaging-type heart rate monitoring method according to claim 9, wherein the second frequency domain transform information is a Fourier transform information.

11. An imaging-type heart rate monitoring device, comprising:

- an image acquisition unit, said image acquisition unit for acquiring at least a human image information of at least a human skin area;
- an image treatment unit, said image treatment unit for electrically connecting said image acquisition unit in order to receive said human image information transmitted from said image acquisition unit;
- a time-frequency transform unit, said time-frequency transform unit for electrically connecting said image treatment unit in order to conduct said time-frequency transform to said human image information to obtain a time-frequency transform information, or rebuild said time-frequency transform information to obtain a time-frequency transform rebuilt information;
- a frequency transform unit, said Fourier transform unit for electrically connect said image treatment unit in order to receive said time-frequency analysis rebuilt information, and employ a Fourier transform unit in order to conduct Fourier transform to obtain a Fourier transform information;
- a storage unit, said storage unit for electrically connect said image treatment unit in order to store a human image information; and

an output unit to electrically connect said image treatment unit in order to output a physiological information;

wherein, said image treatment unit filters a residual noise in said time-frequency analysis, to obtain said residual noise filtered information, and said image treatment unit obtain said physiological information in accordance with said Fourier transform information.

12. The imaging-type heart rate monitoring device according to claim 11, wherein said time-frequency transform unit comprises a continuous wavelet transform unit.

13. The imaging-type heart rate monitoring device according to claim 11, wherein said time-frequency transform unit comprises a short time Fourier transform unit.

14. The imaging-type heart rate monitoring device according to claim 11, wherein said frequency transform unit comprises a fast Fourier transform unit.

15. The imaging-type heart rate monitoring device according to claim 11, wherein said image acquisition unit tracks at least a target area in said human image information.

16. The imaging-type heart rate monitoring device according to claim 11, wherein said image treatment unit extracts a target image in said target area.

* * * * *

专利名称(译)	成像型心率监测装置及其方法		
公开(公告)号	US20190246910A1	公开(公告)日	2019-08-15
申请号	US16/039776	申请日	2018-07-19
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IPC分类号	A61B5/024 A61B5/00		
CPC分类号	A61B5/024 A61B5/726 A61B5/0013 A61B5/7257 A61B5/725 A61B5/0402 A61B5/7207 G06T7/20 A61B5/0077 A61B5/02405 G06F3/015 G06F3/0304 G06K9/522 G06K9/527 G06K2009/00932 G06K2009/00939 A61B5/02125 A61B5/02416 A61B5/7203 A61B5/7264 A61B5/7275 A61B5/7278 A61B5/7485 A61B2576/00 G06F3/017 G06K9/00302 G06T7/246		
优先权	62/629945 2018-02-13 US		
外部链接	Espacenet USPTO		

摘要(译)

本发明提供一种成像型心率监测装置及其方法。它获取人类图像信息跟踪人类图像信息中的目标区域，并提取目标区域中的目标图像。它通过第一频域变换来变换人体图像信息。它过滤连续小波变换信息的残留噪声。它通过连续小波变换重建残留噪声滤波信息。它通过傅里叶变换转换连续小波变换重建信息。它通过第二频域变换信息获得心率值。

