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(54) **OPERATING MODE SWITCHING METHOD, WIRELESS SENSOR AND SYSTEM**

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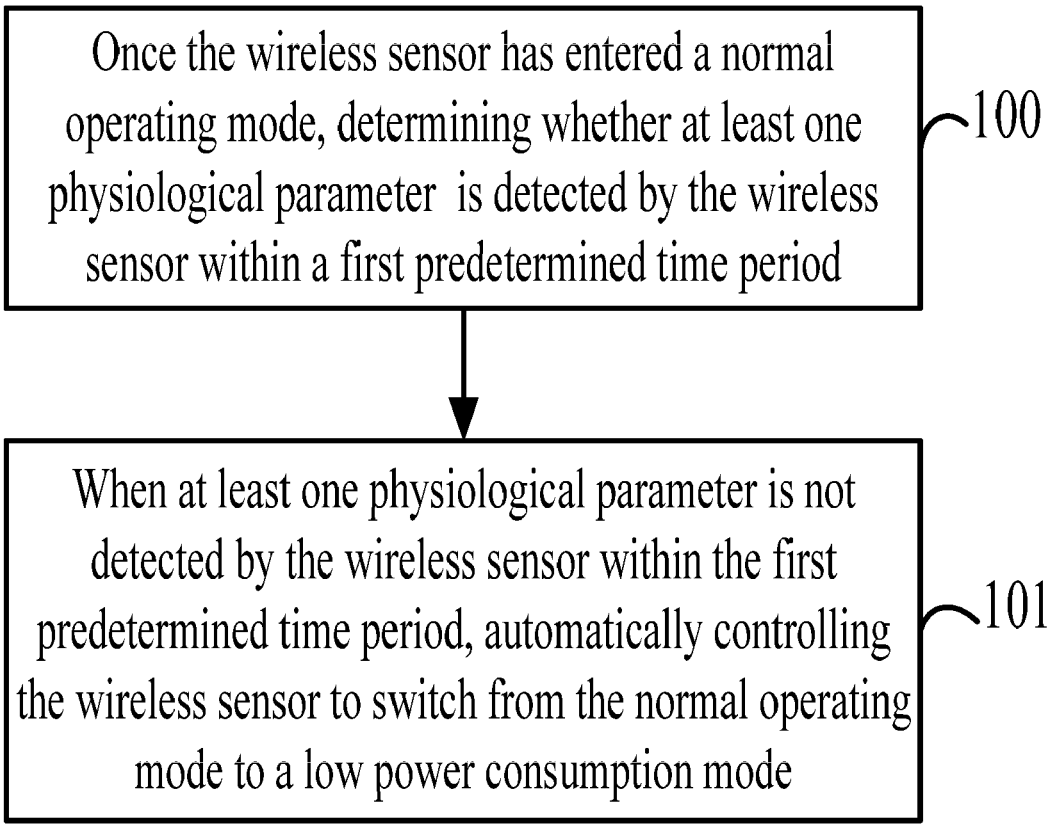
(57) **ABSTRACT**

A method of switching an operating mode of a wireless sensor includes determining, once a wireless sensor has entered a normal operating mode, whether physiological parameters are detected by the wireless sensor within a predetermined time period; and when no physiological parameters are detected by the wireless sensor within the predetermined time period, automatically controlling the wireless sensor to switch from the normal operating mode into a power saving mode.



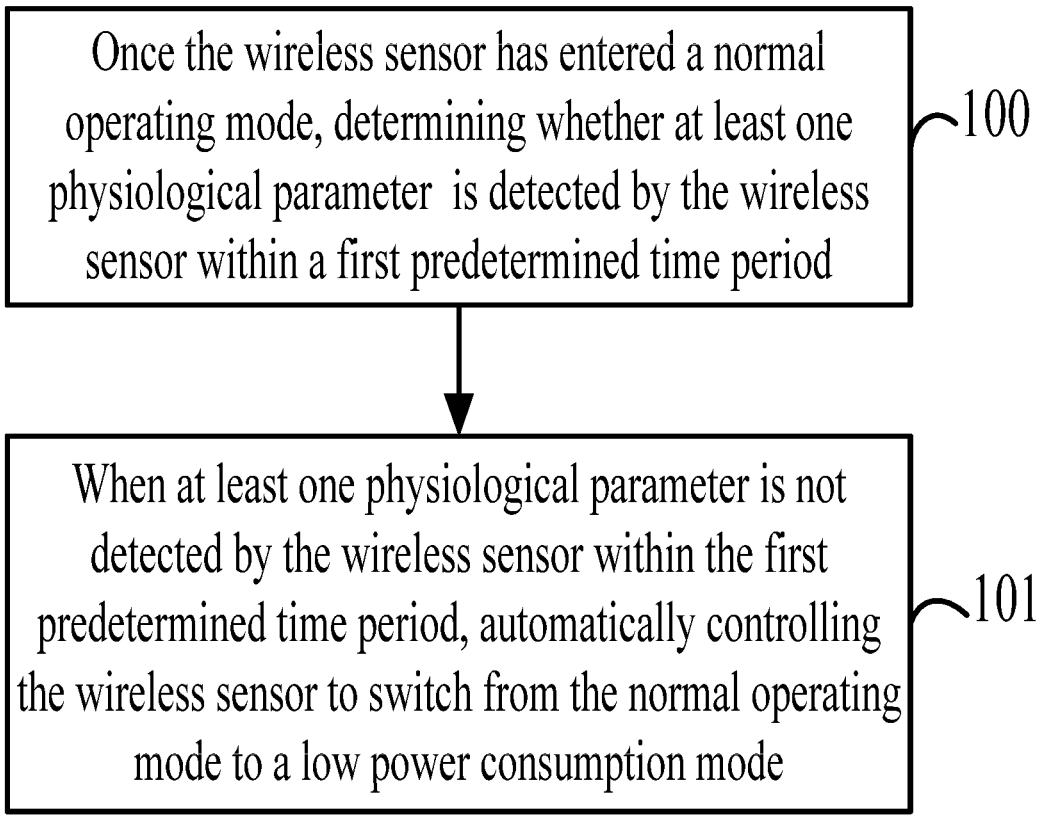

Once the wireless sensor has entered a normal operating mode, determining whether at least one physiological parameter is detected by the wireless sensor within a first predetermined time period
100
When at least one physiological parameter is not detected by the wireless sensor within the first predetermined time period, automatically controlling the wireless sensor to switch from the normal operating mode to a low power consumption mode
101

Fig. 1

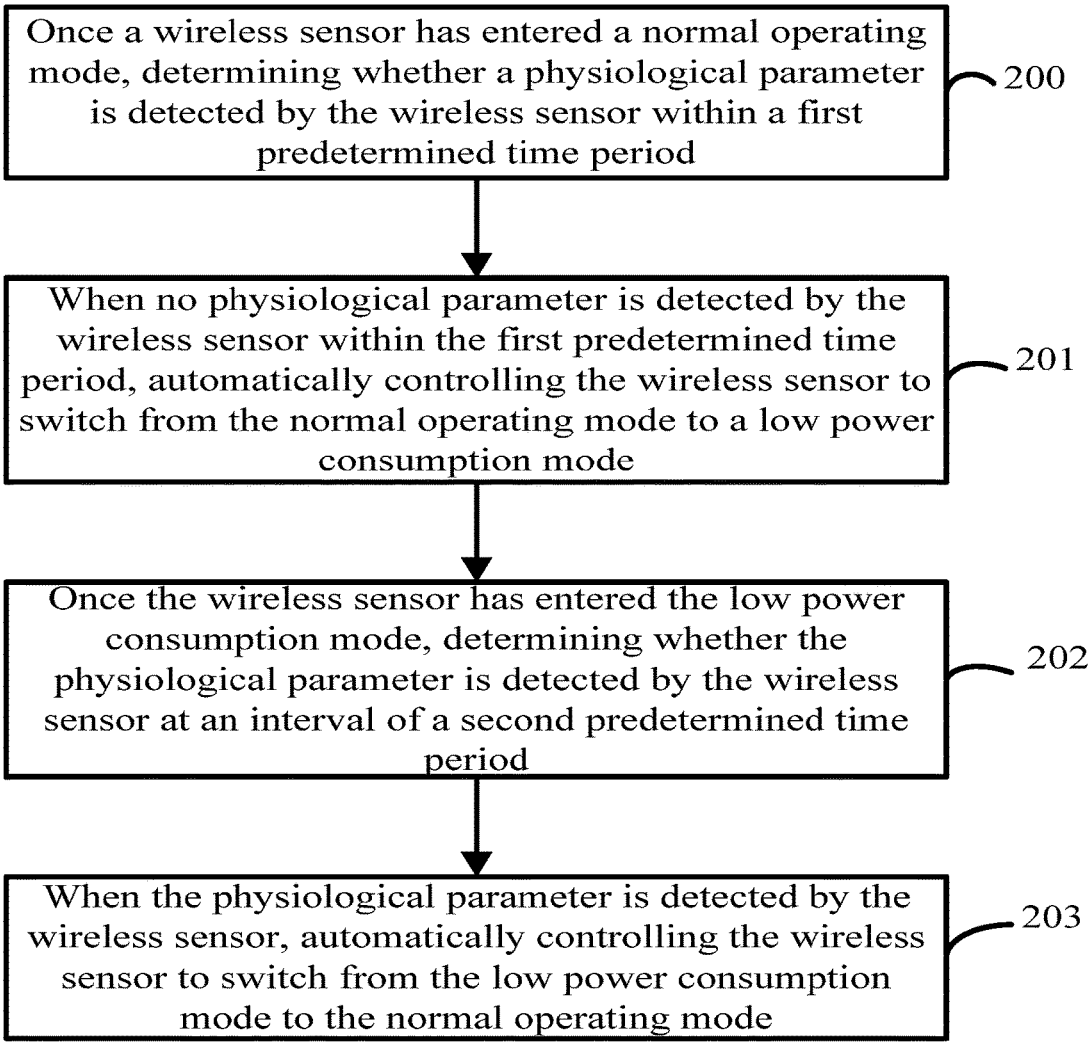

Once a wireless sensor has entered a normal operating mode, determining whether a physiological parameter is detected by the wireless sensor within a first predetermined time period
200
When no physiological parameter is detected by the wireless sensor within the first predetermined time period, automatically controlling the wireless sensor to switch from the normal operating mode to a low power consumption mode
201
Once the wireless sensor has entered the low power consumption mode, determining whether the physiological parameter is detected by the wireless sensor at an interval of a second predetermined time period
202
When the physiological parameter is detected by the wireless sensor, automatically controlling the wireless sensor to switch from the low power consumption mode to the normal operating mode
203

Fig. 2

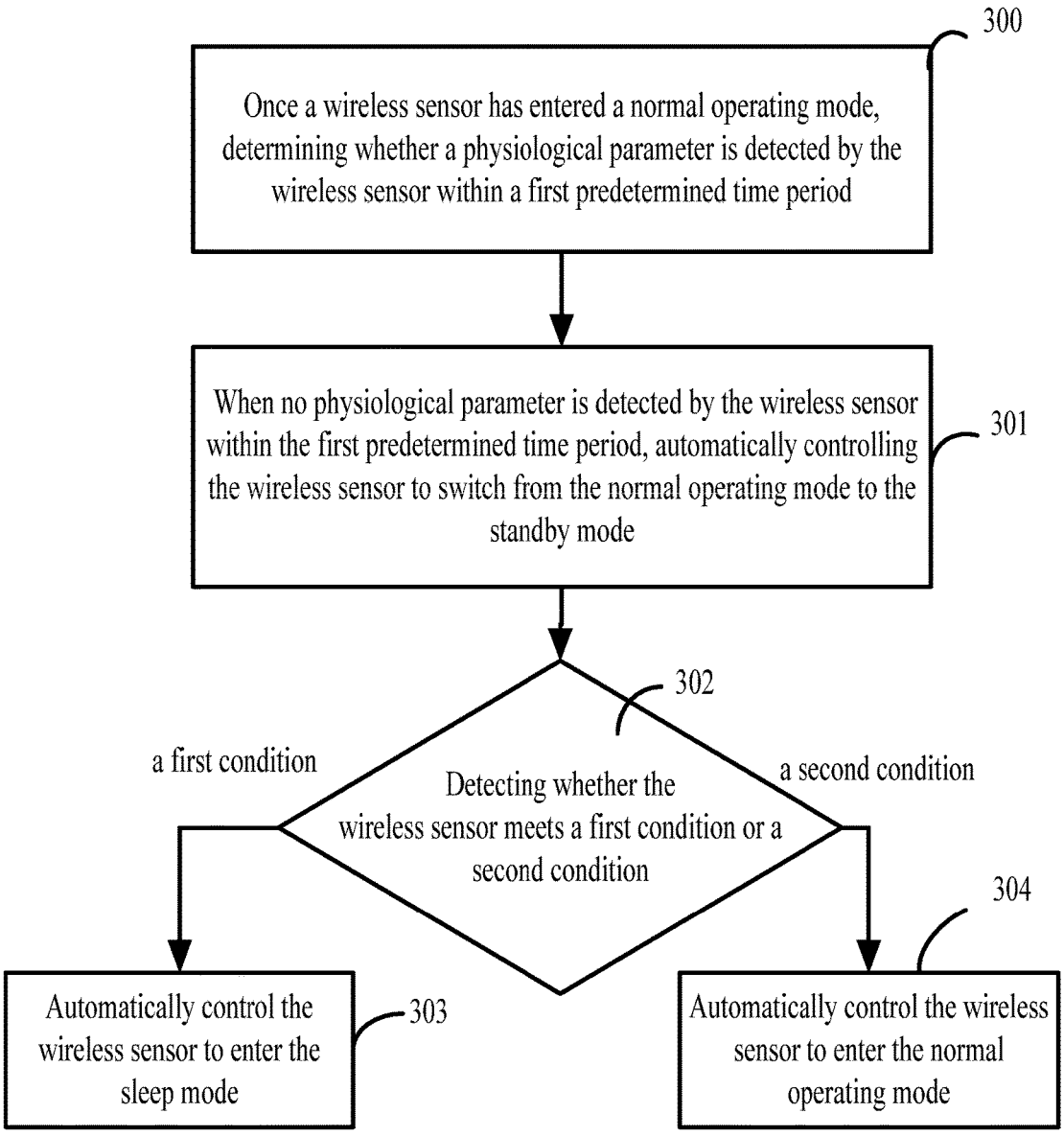

300
Once a wireless sensor has entered a normal operating mode, determining whether a physiological parameter is detected by the wireless sensor within a first predetermined time period
When no physiological parameter is detected by the wireless sensor within the first predetermined time period, automatically controlling the wireless sensor to switch from the normal operating mode to the standby mode
301
302
Detecting whether the wireless sensor meets a first condition or a second condition
a first condition
a second condition
Automatically control the wireless sensor to enter the sleep mode
303
Automatically control the wireless sensor to enter the normal operating mode
304

Fig. 3

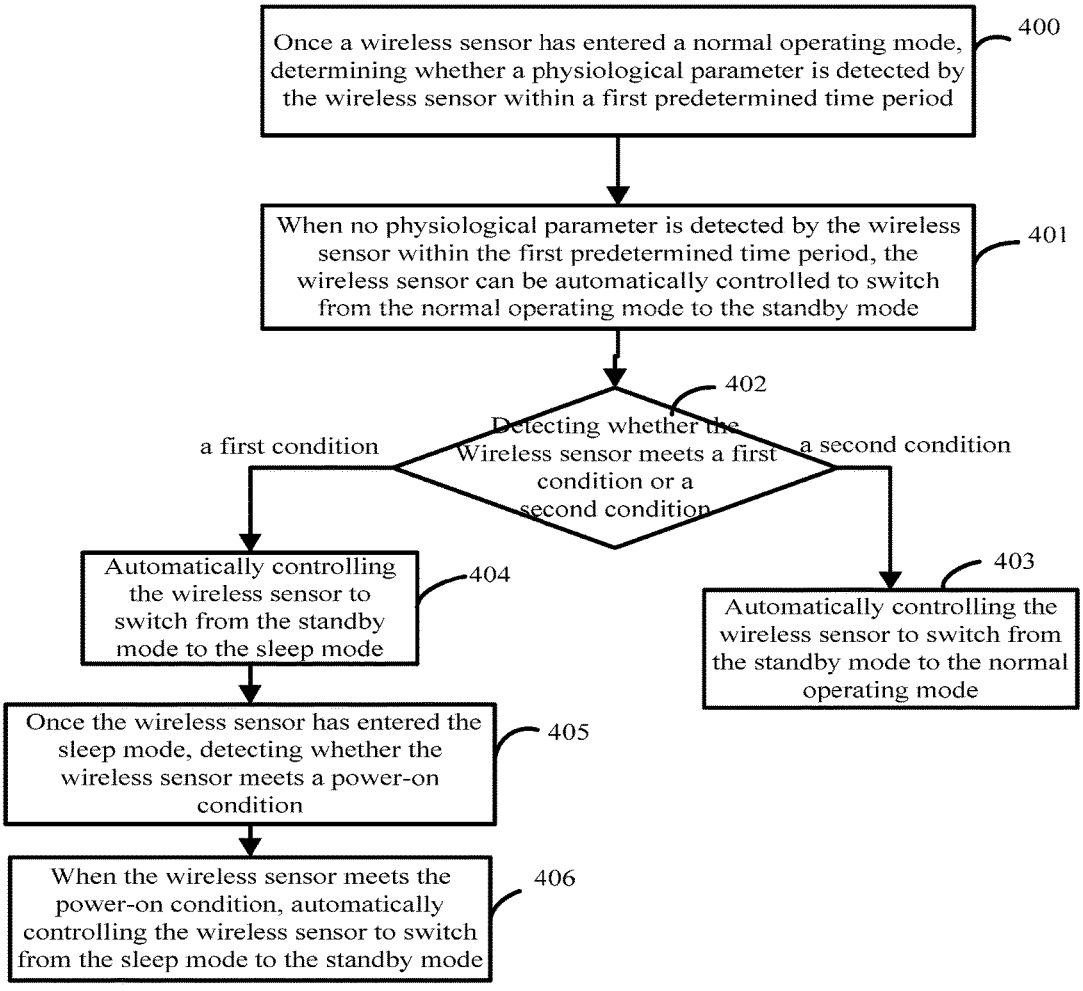

Once a wireless sensor has entered a normal operating mode, determining whether a physiological parameter is detected by the wireless sensor within a first predetermined time period
400
When no physiological parameter is detected by the wireless sensor within the first predetermined time period, the wireless sensor can be automatically controlled to switch from the normal operating mode to the standby mode
401
402
Detecting whether the Wireless sensor meets a first condition or a second condition
a first condition
a second condition
Automatically controlling the wireless sensor to switch from the standby mode to the sleep mode
404
403
Automatically controlling the wireless sensor to switch from the standby mode to the normal operating mode
Once the wireless sensor has entered the sleep mode, detecting whether the wireless sensor meets a power-on condition
405
When the wireless sensor meets the power-on condition, automatically controlling the wireless sensor to switch from the sleep mode to the standby mode
406

Fig. 4

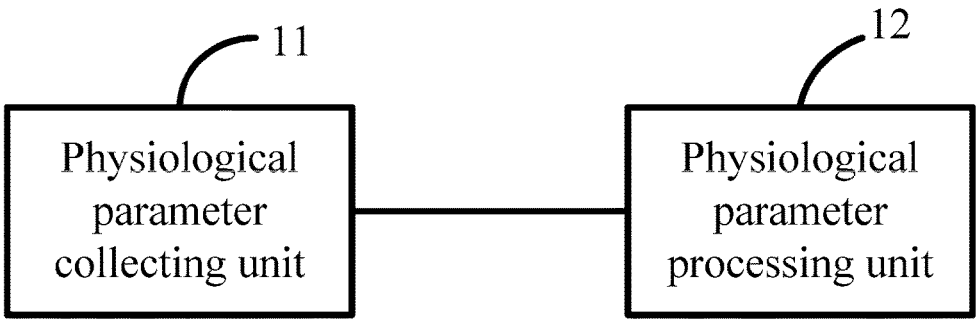

11
12
Physiological parameter collecting unit
Physiological parameter processing unit

Fig. 5

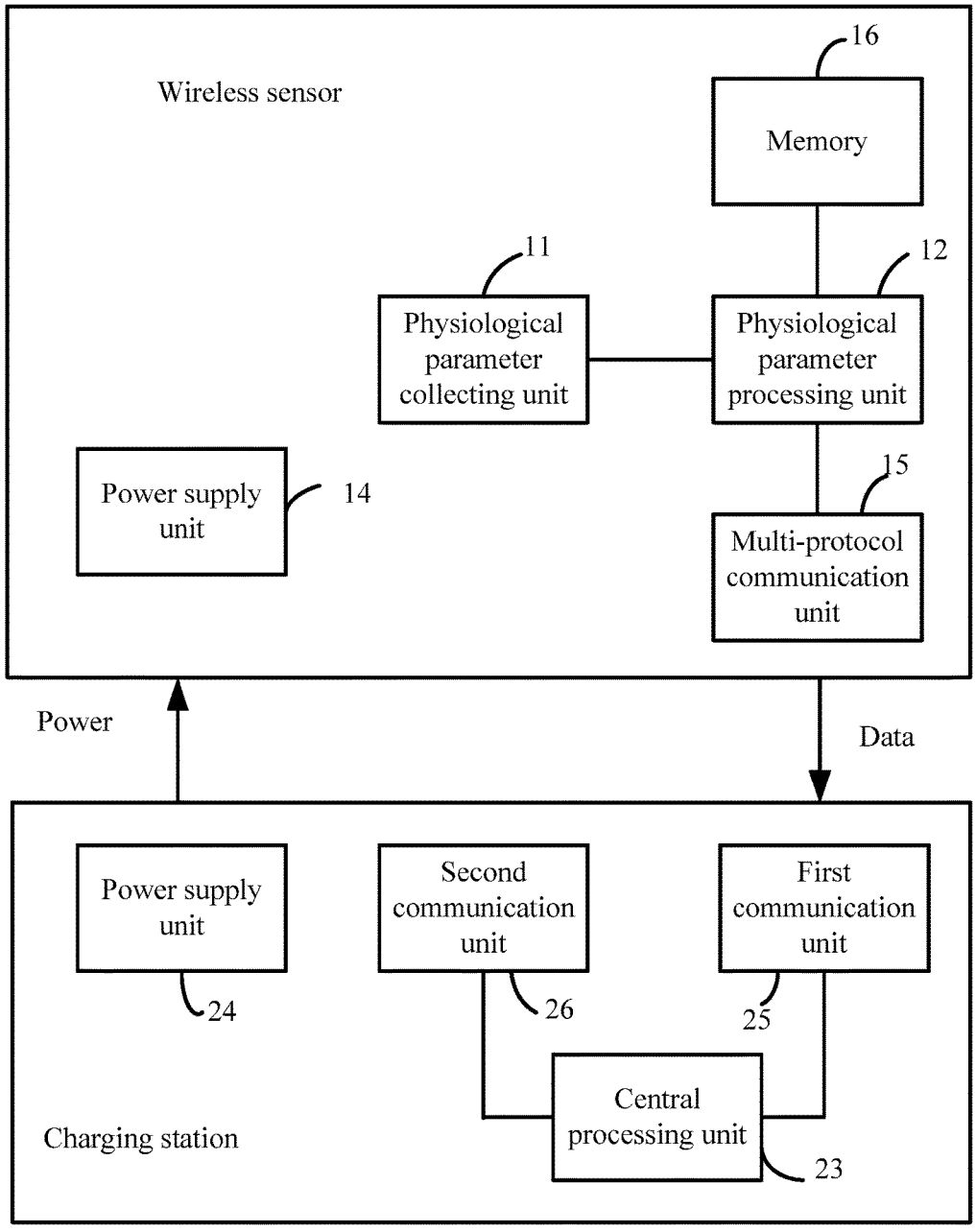

Wireless sensor
16
Memory
11
12
Physiological parameter collecting unit
Physiological parameter processing unit
Power supply unit
14
15
Multi-protocol communication unit
Power
Data
Power supply unit
24
Second communication unit
26
First communication unit
25
Central processing unit
23
Charging station

Fig. 6

OPERATING MODE SWITCHING METHOD, WIRELESS SENSOR AND SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a continuation-in-part of PCT Application No. PCT/CN2016/076430, filed Mar. 15, 2016, for OPERATING MODE SWITCHING METHOD, WIRELESS SENSOR AND SYSTEM, which is incorporated herein by reference.

TECHNICAL FIELD

[0002] The present disclosure relates to wireless sensors and in particular to an operating mode switching method and system involving a wireless sensor.

BACKGROUND

[0003] Power saving has always been a crucial goal in the development of portable electronic products. A power saving design not only brings energy savings, but also allows the entire product to achieve a better balance in terms of volume, weight, and endurance. To achieve lower power consumption, many new wearable wireless sensors now use various power saving techniques at the functional level. Such techniques include, for example, greatly reducing the sampling rate and the communication interval, reducing sampling accuracy, a plurality of low power consumption modes, and switching various function modules on and off as needed. However, these approaches either sacrifice performance or require more user participation to cause the product to enter a low power consumption mode, making the product more complicated to use.

SUMMARY

[0004] Various embodiments of the present disclosure include an operating mode switching method, a wireless sensor, and related system, which can enter a power-saving mode without any participation of a user, thereby greatly improving the user experience.

[0005] In one embodiment, an operating mode switching method includes the following steps: once the wireless sensor has entered a normal operating mode, determining whether at least one physiological parameter is detected by the wireless sensor within a first predetermined time period; and, when the at least one physiological parameter is not detected by the wireless sensor within the first predetermined time period, automatically controlling the wireless sensor to switch from the normal operating mode to a low power consumption mode.

[0006] In one embodiment, the operating mode switching method further includes: once the wireless sensor has entered the low power consumption mode, determining whether the at least one physiological parameter is detected by the wireless sensor at an interval of a second predetermined time period; and, when the at least one physiological parameter is detected by the wireless sensor, automatically controlling the wireless sensor to switch from the low power consumption mode to the normal operating mode.

[0007] The low power consumption mode may include a standby mode and a sleep mode. When the at least one physiological parameter is not detected by the wireless sensor within the first predetermined time period, the method includes automatically controlling the wireless sensor to switch from the normal operating mode to a low power consumption. When the at least one physiological parameter is not detected by the wireless sensor within the first predetermined time period, the method includes automatically controlling the wireless sensor to switch from the normal operating mode to the standby mode.

[0008] In one embodiment, the operating mode switching method further includes the following steps: once the wireless sensor has entered the standby mode, detecting whether the wireless sensor meets a first condition or a second condition at an interval of a second predetermined time period, wherein the first condition is a power-off condition, and the second condition is detecting the at least one physiological parameter; when the wireless sensor meets the first condition, automatically controlling the wireless sensor to switch from the standby mode to the sleep mode; and when the wireless sensor meets the second condition, automatically controlling the wireless sensor to switch from the standby mode to the normal operating mode.

[0009] The operating mode switching method may further include the steps of: once the wireless sensor has entered the sleep mode, detecting whether the wireless sensor meets a power-on condition; and, when the wireless sensor meets the power-on condition, automatically controlling the wireless sensor to switch from the sleep mode to the standby mode.

[0010] In one embodiment, the power-on condition may include at least one of: detecting that a motion intensity is greater than a predetermined threshold, detecting a body contact, detecting that a change in brightness is greater than a predetermined value, detecting a change in pressure, detecting a change in audio, and detecting a change in temperature.

[0011] In one embodiment, a wireless sensor may include: a physiological parameter collecting unit and a physiological parameter processing unit connected to the physiological parameter collecting unit. The physiological parameter collecting unit may collect at least one physiological parameter. The physiological parameter processing unit may perform the following steps: once the wireless sensor has entered a normal operating mode, determining whether at least one physiological parameter is detected by the wireless sensor within a first predetermined time period; and when the at least one physiological parameter is not detected by the wireless sensor within the first predetermined time period, automatically controlling the wireless sensor to switch from the normal operating mode to a low power consumption mode.

[0012] In one embodiment, the physiological parameter processing unit may further perform the following steps: once the wireless sensor has entered the low power consumption mode, determining whether the at least one physiological parameter is detected by the wireless sensor at an interval of a second predetermined time period; and when the at least one physiological parameter is detected by the wireless sensor, automatically controlling the wireless sensor to switch from the low power consumption mode to the normal operating mode.

[0013] In one embodiment, the low power consumption mode includes a standby mode and a sleep mode; when the at least one physiological parameter is detected by the wireless sensor within the first predetermined time period, the physiological parameter processing unit automatically controlling the wireless sensor to switch from the normal operating mode to the low power consumption mode

includes: when the at least one physiological parameter is not detected by the wireless sensor within the first predetermined time period, the physiological parameter processing unit automatically controlling the wireless sensor to switch from the normal operating mode to the standby mode; and the physiological parameter processing unit may further perform the following steps: once the wireless sensor has entered the standby mode, detecting whether the wireless sensor meets a first condition or a second condition at an interval of a second predetermined time period, wherein the first condition is a power-off condition, and the second condition is detecting the at least one physiological parameter; and when the wireless sensor meets the first condition, automatically controlling the wireless sensor to switch from the standby mode to the sleep mode; and when the wireless sensor meets the second condition, automatically controlling the wireless sensor to switch from the standby mode to the normal operating mode.

[0014] In one embodiment, the physiological parameter processing unit further performs the following steps: once the wireless sensor has entered the sleep mode, detecting whether the wireless sensor meets a power-on condition; and when the wireless sensor meets the power-on condition, automatically controlling the wireless sensor to switch from the sleep mode to the standby mode.

[0015] In one embodiment, the wireless sensor further includes at least one of: an inertial sensor, an electric field sensor, a light sensor, a pressure sensor, an audio sensor, and a temperature sensor; and the power-on condition includes at least one of the following conditions: a motion intensity detected by the inertial sensor is greater than a predetermined threshold, a body contact is detected by the electric field sensor, a change in brightness detected by the light sensor is greater than a predetermined value, a pressure detected by the pressure sensor changed, an audio signal detected by the audio sensor changed, and a temperature detected by the temperature sensor changed.

[0016] In one embodiment, the wireless sensor further includes a power supply unit, a multi-protocol communication unit and a memory, wherein the multi-protocol communication unit supports a first communication protocol and a second communication protocol, and the physiological parameter processing unit automatically controls the multi-protocol communication unit to switch a communication protocol from the first communication protocol to the second communication protocol when detecting that the power supply unit can acquire power from a charging station, and transfes data stored in the memory to the charging station over the second communication protocol when detecting that the wireless sensor establishes a communication connection with the charging station.

[0017] In one embodiment, the physiological parameter processing unit switches the communication protocol of the wireless sensor from the second communication protocol to the first communication protocol when detecting that the wireless sensor meets a switching condition.

[0018] In one embodiment, the switching condition includes at least one of the following conditions: the wireless sensor has completed data transmission; the communication connection between the wireless sensor and the charging station is interrupted; and the wireless sensor fails to acquire power from the charging station.

[0019] In one embodiment, a system may include a wireless sensor, which automatically switches from the normal operating mode to a low power consumption mode when the wireless sensor determining that, under a normal operating mode, the at least one physiological parameter is not detected within a first predetermined time period; and supporting a first communication protocol and a second communication protocol, the wireless sensor automatically switches a communication protocol from the first communication protocol to the second communication protocol, when detecting that power can be acquired from a charging station under the normal operating mode or the low power consumption mode, and transfers stored data to the charging station over the second communication protocol when establishing a communication connection with the charging station; and the charging station, supporting the second communication protocol and a third communication protocol, once having established the communication connection with the wireless sensor over the second communication protocol, receiving the data transferred by the wireless sensor, and transferring the received data to an external electronic device over the third communication protocol.

[0020] In one embodiment, when the wireless sensor is under the low power consumption mode, the wireless sensor determines whether the at least one physiological parameter is detected at an interval of a second predetermined time period; and when the at least one physiological parameter is detected, the wireless sensor automatically switches from the low power consumption mode to the normal operating mode, wherein the low power consumption mode includes a standby mode and a sleep mode; and, when the wireless sensor is under the standby mode, the wireless sensor detects whether a first condition or a second condition is met at an interval of the second preset time period, and when the first condition is met, the wireless sensor automatically switches from the standby mode into the sleep mode; and when the second condition is met, the wireless sensor automatically switches from the standby mode into the normal operating mode, wherein the first condition is a power-off condition, and the second condition is detecting the at least one physiological parameter; and when the wireless sensor detects that the power-on condition is met under the sleep mode, the wireless sensor automatically switches from the sleep mode into the standby mode.

[0021] In one embodiment, the wireless sensor further includes at least one of: an inertial sensor, an electric field sensor, a light sensor, a pressure sensor, an audio sensor, and a temperature sensor; and the power-on condition includes at least one of the following conditions: a motion intensity detected by the inertial sensor is greater than a predetermined threshold, a body contact is detected by the electric field sensor, a change in brightness detected by the light sensor is greater than a predetermined value, a pressure detected by the pressure sensor changed, an audio signal detected by the audio sensor changed, and a temperature detected by the temperature sensor changed.

[0022] In one embodiment, the wireless sensor switches a communication protocol from the second communication protocol to the first communication protocol when the wireless sensor still meets the switching condition.

[0023] The switching condition may include at least one of the following conditions: the wireless sensor has completed data transmission, the communication connection between the wireless sensor and the charging station is interrupted, and the wireless sensor fails to acquire power from the charging station.

[0024] In the present disclosure, when no physiological parameter is detected, the wireless sensor is automatically controlled to switch from the normal operating mode to the low power consumption mode. In other words, when the wireless sensor is not actually used, it enters a power-saving mode to save power. Therefore, without any participation of a user, the wireless sensor can automatically enter the power-saving mode, so that the power is saved, thereby greatly improving the user experience.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] FIG. **1** is a flowchart of an operating mode switching method;

[0026] FIG. **2** is a flowchart of an operating mode switching method;

[0027] FIG. **3** is a flowchart of an operating mode switching method;

[0028] FIG. **4** is a flowchart of an operating mode switching method;

[0029] FIG. **5** is a schematic diagram of a wireless sensor; and

[0030] FIG. **6** is a schematic diagram of a system.

DETAILED DESCRIPTION

[0031] The technical solutions of the embodiments of the present application will be described below clearly and comprehensively in conjunction with the drawings of the embodiments of the present disclosure. The embodiments described are merely some embodiments of the present disclosure and are not all possible embodiments. Based on the embodiments presented herein, all other embodiments that would be obtained by those of ordinary skill in the art without expending inventive effort shall all fall within the scope of protection of the claims herein.

[0032] FIG. **1** is a flowchart of an operating mode switching method applied to a wireless sensor according to one embodiment of the present disclosure. The wireless sensor may be a wearable wireless sensor, and may include a wireless sensor that can sense a physiological parameter, such as an electrocardiogram parameter and/or the respiratory rate. The method may include the following steps.

[0033] Step **100**: once the wireless sensor has entered a normal operating mode, determining whether at least one physiological parameter (hereinafter referred to as the physiological parameter) is detected by the wireless sensor within a first predetermined time period. The physiological parameter may include one or a combination of an electrocardiogram lead, an electrocardiogram QRS wave, an oximetry pulse wave, a blood pressure pulse wave, a body temperature, an electroencephalogram waveform, a cardiogram, a respiratory wave, a respiratory gas concentration change, etc. A physiological parameter collecting unit of the wireless sensor may be composed of one or more different collecting modules, for example, the collecting modules may be electrocardiogram electrodes, and temperature sensors, etc., so as to collect different physiological parameters.

[0034] Under the normal operating mode, core functions of the wireless sensor are all turned on, for example, functions of collection, analysis, storage, wireless transmission, etc., such that the power consumption of the wireless sensor is high.

[0035] Step **101**: when at least one physiological parameter is not detected by the wireless sensor within the first predetermined time period, automatically controlling the wireless sensor to switch from the normal operating mode to a low power consumption mode.

[0036] Under the low power consumption mode, one or more of the core functions of the wireless sensor are turned off, so that the wireless sensor consume less power under the low power consumption mode.

[0037] In this embodiment, when at least one physiological parameter is not detected, the wireless sensor is automatically controlled to switch from the normal operating mode to the low power consumption mode. In other words, when the wireless sensor is not actually used, the wireless sensor automatically enter a power-saving mode to save power. Therefore, without any participation or operation of a user, the wireless sensor can automatically enter the power-saving mode, such that power is saved, thereby improving the user experience of the wireless sensor.

[0038] FIG. **2** is a flowchart of an operating mode switching method of another embodiment of the present disclosure.

[0039] Step **200**: once a wireless sensor has entered a normal operating mode, determining whether a physiological parameter is detected by the wireless sensor within a first predetermined time period.

[0040] Step **201**: when no physiological parameter is detected by the wireless sensor within the first predetermined time period, automatically controlling the wireless sensor to switch from the normal operating mode to a low power consumption mode.

[0041] Step **202**: once the wireless sensor has entered the low power consumption mode, determining whether the physiological parameter is detected by the wireless sensor at an interval of a second predetermined time period.

[0042] The second predetermined time period is a break period for collecting the physiological parameter. Turing the break period, some power consumption functions of the wireless sensor are turned off, e.g., functions of collection, analysis, transmission, etc., so that the wireless sensor is in a power saving state. When the break period expires, the functions of data collection and analysis are turned on to determine whether the physiological parameter is detected. The wireless sensor periodically performs physiological parameter detections under the low power consumption mode, instead of continuously performing the physiological parameter detections, and thus the power consumption become low.

[0043] Step **203**: when the physiological parameter is detected by the wireless sensor, automatically controlling the wireless sensor to switch from the low power consumption mode to the normal operating mode.

[0044] In this embodiment, when the physiological parameter is detected, the wireless sensor is automatically controlled to enter the normal operating mode without any participation of a user, so that the wireless sensor can be ensured to be normally used.

[0045] FIG. **3** is a flowchart of an operating mode switching method of another embodiment of the present disclosure.

[0046] Step **300**: once a wireless sensor has entered a normal operating mode, determining whether a physiological parameter is detected by the wireless sensor within a first predetermined time period.

[0047] Step **301**: when no physiological parameter is detected by the wireless sensor within the first predeter-

mined time period, automatically controlling the wireless sensor to switch from the normal operating mode to the standby mode.

[0048] Step **302**: once the wireless sensor has entered the standby mode, detecting whether the wireless sensor meets a first condition or a second condition at an interval of a second predetermined time period. The first condition is a power-off condition, and the second condition is detecting the physiological parameter. When the first condition is met, step **303** is performed, and when the second condition is met, step **304** is performed.

[0049] The power-off condition may include one or a combination of the conditions of: the duration of the standby mode exceeding a first predetermined duration, the power amount of the wireless sensor being lower than a predetermined threshold, and the duration of not meeting a power-on condition continuously exceeding a second predetermined duration.

[0050] The power-on condition may include one or a combination of the conditions of: a motion intensity detected by the inertial sensor is greater than a predetermined threshold, a body contact is detected by a body contact, a change in ambient brightness detected by the light sensor is greater than a predetermined value, a pressure detected by the pressure sensor changed, an audio signal detected by the audio sensor changed, and a temperature detected by the temperature sensor changed, etc. The changes in pressure, audio and temperature are consistent with predetermined modes, and, for example, the pressure is consistent with a force curve when the person presses, the audio is consistent with a predetermined voice command, and the temperature is consistent with a temperature rise curve after contact with the body. Motion intensity can be detected via an inertial sensor, for example, an MEMS (Micro Electro Mechanical System) accelerometer, a gyroscope, and a geomagnetic sensor, etc. An electric field sensor, such as a capacitive touch button, can be used to detect the body contact. A light sensor, such as a photocell, a photodiode, a phototransistor, can be used to detect the change in ambient brightness. A pressure sensor, such as a piezoelectric film, can be used to detect the change in pressure applied on the wireless sensor, and an audio sensor, such as an MEMS microphone, can be used to detect the change in audio change (e.g., when a voice command is input, audio changes). A temperature sensor, such as a thermistor made from a PTC/NTC material, a thermopile, can be used to detect the change in temperature, e.g., when a body temperature is detected, the temperature changes. As described above, the above sensors are used to perceive the user, that is, to perceive whether the user is ready to use the wireless sensor. The above sensors are all power saving sensors which have a data processing function, and when an operation by a user is detected, a trigger signal can be automatically generated to wake up a physiological parameter processing unit of the wireless sensor. Since the power saving sensor is used, low power consumption may be maintained under the standby mode.

[0051] Step **303**: automatically controlling the wireless sensor to switch from the standby mode to the sleep mode.

[0052] If the first condition is that the duration of the standby mode exceeds the first predetermined duration, then when the first condition is met, it indicates that the wireless sensor is not in use by the user for a long time, and therefore the wireless sensor can be controlled to enter the sleep mode. If the first condition is that the power amount of the wireless sensor is lower than a predetermined threshold, then when the first condition is met, it indicates that the wireless sensor is operating at an insufficient power level, and therefore the wireless sensor can be controlled to enter the sleep mode. If the third condition is that the duration of not meeting the power-on condition continuously exceeds the second predetermined duration, it also indicates that the wireless sensor is not in use by the user for a long time, and therefore the wireless sensor can be controlled to enter the sleep mode.

[0053] The wireless sensor uses less power in the sleep mode than in the standby mode. Therefore, by designing a two-stage power-saving mode, higher reductions in power consumption may be achieved.

[0054] Step **304**: automatically controlling the wireless sensor to switch from the standby mode to the normal operating mode.

[0055] FIG. **4** is a flowchart of an operating mode switching method of another embodiment of the present disclosure.

[0056] Step **400**: once a wireless sensor has entered a normal operating mode, determining whether a physiological parameter is detected by the wireless sensor within a first predetermined time period.

[0057] Step **401**: when no physiological parameter is detected by the wireless sensor within the first predetermined time period, the wireless sensor can be automatically controlled to switch from the normal operating mode to the standby mode.

[0058] Step **402**: once the wireless sensor has entered the standby mode, detecting whether the wireless sensor meets a first condition or a second condition at an interval of a second predetermined time period. The first condition is a power-off condition, and the second condition is detecting the physiological parameter. When the second condition is met, step **403** is performed, and when the first condition is met, step **404** is performed.

[0059] Step **403**: automatically controlling the wireless sensor to switch from the standby mode to the normal operating mode.

[0060] Step **404**: automatically controlling the wireless sensor to switch from the standby mode to the sleep mode.

[0061] Step **405**: once the wireless sensor has entered the sleep mode, detecting whether the wireless sensor meets a power-on condition. The power-on condition is the same as that described above, and will not be described here again.

[0062] Step **406**: when the wireless sensor meets the power-on condition, automatically controlling the wireless sensor to switch from the sleep mode to the standby mode.

[0063] In this embodiment, under different conditions, the wireless sensor can automatically switch seamlessly among the sleep mode, the standby mode, and the normal operating mode. Therefore, not only can the user's needs be met, but the wireless sensor can automatically enter the power-saving mode when it does not need to be used, thereby saving power.

[0064] FIG. **5** is a structural schematic diagram of a wireless sensor of an embodiment of the present disclosure, which may include a physiological parameter collecting unit **11** and a physiological parameter processing unit **12** connected to the physiological parameter collecting unit **11**. The physiological parameter collecting unit **11** collects at least one physiological parameter (hereinafter referred to as the physiological parameter).

[0065] In this embodiment, the physiological parameter collecting unit **11** may include one or more collecting

modules, and may collect one or more different physiological parameters. For example, the physiological parameter collecting unit **11** may include one or more of an electrocardiogram electrode, a temperature sensor, etc. The physiological parameter may include one or a combination of an electrocardiogram lead, an electrocardiogram QRS wave, an oximetry pulse wave, a blood pressure pulse wave, a body temperature, an electroencephalogram waveform, a cardiogram, a respiratory wave, a respiratory gas concentration change, etc.

[0066] In this embodiment, the wireless sensor can automatically switch between the normal operating mode and the low power consumption mode. Typically, under the normal operating mode, core functions of the wireless sensor are all turned on, for example, functions of collection, analysis, storage, wireless transmission, etc., so that the power consumption of the wireless sensor is high. However, under the low power consumption mode, one or more of the core functions of the wireless sensor are turned off, so as to ensure low power consumption under the low power consumption mode.

[0067] In this embodiment, once the wireless sensor has entered a normal operating mode, the physiological parameter processing unit **12** determines whether at least one physiological parameter (hereinafter referred to as the physiological parameter) is detected by the wireless sensor within a first predetermined time period; and when determining that no physiological parameter is detected by the wireless sensor within the first predetermined time period, the physiological parameter processing unit automatically controls the wireless sensor to switch from the normal operating mode to a low power consumption mode.

[0068] In this embodiment, when no physiological parameter is detected, the wireless sensor is automatically controlled to switch from the normal operating mode to the low power consumption mode, i.e., when the wireless sensor is not actually used, to enter a power-saving mode to save power. Therefore, without any participation of a user, the wireless sensor can automatically enter the low power consumption mode, so that the power is saved, thereby greatly improving the user experience.

[0069] Furthermore, once the wireless sensor has entered the low power consumption mode, the physiological parameter processing unit **12** determines whether the physiological parameter is detected by the wireless sensor at an interval of a second predetermined time period; and when determining that the physiological parameter is detected by the wireless sensor, the physiological parameter processing unit automatically controls the wireless sensor to switch from the low power consumption mode to the normal operating mode.

[0070] The second predetermined time period is a break period for collecting the physiological parameter. During the break period, some power consumption functions of the wireless sensor are turned off, e.g., functions of collection, analysis, transmission, etc., so that the wireless sensor is in a power saving state. When the break period expires, the functions of data collection and analysis are turned on to detect the physiological parameter. The wireless sensor periodically performs physiological parameter detections under the low power consumption mode, instead of continuously performing the physiological parameter detections, and thus the power consumption become low.

[0071] When the physiological parameter is detected, the wireless sensor is automatically controlled to enter the normal operating mode, so that the wireless sensor can be normally used without any participation of a user.

[0072] The low power consumption mode may include a standby mode and a sleep mode. Once the wireless sensor has entered a normal operating mode, the physiological parameter processing unit **12** determines whether the physiological parameter is detected by the wireless sensor within a first predetermined time period; and when determining that no physiological parameter is detected by the wireless sensor within the first predetermined time period, the physiological parameter processing unit automatically controls the wireless sensor to switch from the normal operating mode to the standby mode.

[0073] The physiological parameter processing unit **12** further detects whether the wireless sensor meets a first condition or a second condition at an interval of a second predetermined time period, once the wireless sensor has entered the standby mode. The first condition is a power-off condition, and the second condition is detecting the physiological parameter. The physiological parameter processing unit **12** further controls the wireless sensor to switch from the standby mode to the sleep mode when the first condition is met; and automatically controls the wireless sensor to switch from the standby mode to the normal operating mode when the second condition is met.

[0074] The power-off condition may include one or a combination of the conditions of: the duration of the standby mode exceeding a first predetermined duration, the power amount of the wireless sensor being lower than a predetermined threshold, and the duration of not meeting a power-on condition continuously exceeding a second predetermined duration.

[0075] The power-on condition may include one or a combination of the conditions of: a motion intensity detected by the inertial sensor is greater than a predetermined threshold, a body contact is detected by a body contact, a change in ambient brightness detected by the light sensor is greater than a predetermined value, a pressure detected by the pressure sensor changed, an audio signal detected by the audio sensor changed, and a temperature detected by the temperature sensor changed, etc. Motion intensity can be detected via an inertial sensor, e.g., an MEMS (Micro Electro Mechanical System) accelerometer, a gyroscope, and a geomagnetic sensor, etc. An electric field sensor, such as a capacitive touch button, can be used to detect the body contact. A light sensor, such as a photocell, a photodiode, a phototransistor, can be used to detect the change in ambient brightness. A pressure sensor, such as a piezoelectric film, can be used to detect the change in pressure applied on the wireless sensor, and an audio sensor, such as an MEMS microphone, can be used to detect the change in audio change (e.g., when a voice command is input, audio changes). A temperature sensor, such as a thermistor made from a PTC/NTC material, a thermopile, can be used to detect the change in temperature, i.e., when a body temperature is detected, the temperature changes. As described above, the above sensors are used to detect whether the user is ready to use or is using the wireless sensor. The above sensors are all power saving sensors which have a data processing function, and when an operation by a user is detected, a trigger signal can be automatically generated to wake up the physiological parameter processing unit **12**. Since the power saving sensor is used, low power consumption may be maintained under the standby mode.

[0076] The wireless sensor uses less power in the sleep mode than in the standby mode. Therefore, by designing a two-stage power-saving mode, greater power savings can be achieved.

[0077] In one embodiment, the physiological parameter processing unit **12** further detects whether the wireless sensor meets a power-on condition once the wireless sensor has entered the sleep mode; and when the wireless sensor meets the power-on condition, automatically controls the wireless sensor to switch from the sleep mode to the standby mode.

[0078] Under different conditions, the wireless sensor can automatically switch seamlessly among the sleep mode, the standby mode, and the normal operating mode. Therefore, not only the user's needs can be met, but the wireless sensor can automatically enter the power-saving mode when it does not need to be used, thereby saving power.

[0079] FIG. **6** is a structural schematic diagram of a system of an embodiment of the present disclosure. The system includes a wireless sensor and a charging station, wherein the charging station can charge the wireless sensor. The charging station can be a wired or wireless charging station. In one embodiment, wireless charging is used to avoid problems such as oxidation, rust, and wear of a mechanical socket, and skin scratching and allergies, etc.

[0080] In addition to the physiological parameter collecting unit **11** and the physiological parameter processing unit **12** connected to the physiological parameter collecting unit **11** as shown in FIG. **5**, the wireless sensor further includes a power supply unit **14**, a multi-protocol communication unit **15**, and memory **16**. The power supply unit **14** and the multi-protocol communication unit **15** may be physically independent or may be integrated together.

[0081] The wireless sensor can switch between the normal operating mode and the low power consumption mode. The physiological parameter processing unit **12** automatically controls the wireless sensor to switch from the normal operating mode to a low power consumption mode when the at least one physiological parameter (hereinafter referred to as the physiological parameter) is not detected by the wireless sensor within a first predetermined time period under the normal operating mode.

[0082] The physiological parameter processing unit **12** further determines whether the at least one physiological parameter is detected by the wireless sensor at an interval of a second predetermined time period when the wireless sensor is under the low power consumption mode; and when the at least one physiological parameter is detected by the wireless sensor, automatically controls the wireless sensor to switch from the low power consumption mode to the normal operating mode.

[0083] In one embodiment, the low power consumption mode includes a standby mode and a sleep mode. When the wireless sensor is under the standby mode, the physiological parameter processing unit **12** detects whether the wireless sensor meets a first condition or a second condition at an interval of a second predetermined time period; when the wireless sensor meets the first condition, the physiological parameter processing unit automatically controls the wireless sensor to switch from the standby mode to the sleep mode; and when the wireless sensor meets the second condition, the physiological parameter processing unit automatically controls the wireless sensor to switch from the standby mode to the normal operating mode, wherein the first condition is a power-off condition, and the second condition is detecting the physiological parameter. The specific description of the first condition is the same as the above description, and will not be reiterated here.

[0084] The physiological parameter processing unit **12** may further automatically control the wireless sensor to switch from the sleep mode to the standby mode when the wireless sensor detects the power-on condition satisfied under the sleep mode. The specific description of the power-on condition is the same as the above description, and will not be reiterated here.

[0085] The multi-protocol communication unit **15** can support a first communication protocol and a second communication protocol. In this embodiment, the first communication protocol is a low-speed, standard protocol, and the second communication protocol is a high-speed, non-standard protocol. The low-speed, standard protocol can be the Bluetooth 4.0 power saving protocol, the ZigBee protocol, and the ANT+ protocol, etc. The low-speed, standard protocol is suitable for a periodic and continuous data transmission. Therefore, in general, the communication mode of the wireless sensor is the low-speed, standard protocol to enable a normal communication with a smart device, such as, for example, a smart phone, a tablet, and a personal digital assistant. The high-speed, non-standard protocol is simple, efficient, and low-cost, but has poor protocol compatibility, so that it can only be directly connected to limited devices, and is suitable for transmitting large amounts of data in a short time period. In this embodiment, the wireless sensor can establish a communication connection with the charging station over the high-speed, non-standard protocol.

[0086] The charging station may include a central processing unit **23**, a power supply unit **24**, a first communication unit **25**, and a second communication unit **26**. The power supply unit **24** is typically a module that combines charging and discharging together to provide power for the wireless sensor. The first communication unit **25** can support the second communication protocol, i.e., the high-speed, non-standard protocol. The communication connection is established between the wireless sensor and the charging station over the high-speed, non-standard protocol. The high-speed, non-standard protocol is typically set by the manufacturer. The second communication unit **26** can support the third communication protocol. In this embodiment, the third communication protocol is the high-speed, non-standard protocol. The communication under the high-speed standard protocol can be via Wi-Fi, Bluetooth, USB, optical fiber, Ethernet, 3G/4G/5G, etc., and can be in communication with a smart device such as a smart phone and a tablet, a Wi-Fi hotspot, and a mobile base station, etc.

[0087] In this embodiment, when detecting that the power supply unit **14** can acquire power from the charging station (i.e., the wireless sensor is in a charged state), the physiological parameter processing unit **12** automatically controls the multi-protocol communication unit **15** to switch the communication protocol of the wireless sensor from the low-speed, standard protocol to the high-speed, non-standard protocol. After switching the communication protocol of the wireless sensor to the high-speed, non-standard protocol, the wireless sensor can establish the communication connection with the charging station.

[0088] The physiological parameter processing unit **12** further transfer data stored in the memory **16** to the charging station over the high-speed, non-standard protocol when

detecting that the wireless sensor establishes the communication connection with the charging station. The stored data are typically physical parameters.

[0089] After switching the communication protocol of the wireless sensor to the high-speed, non-standard protocol, the communication connection may not be established successfully between the wireless sensor and the charging station for reasons, e.g., too much interference. Therefore, when the wireless sensor fails to establish a communication connection with the charging station within a predetermined time period, the physiological parameter processing unit **12** restarts to enable the communication connection.

[0090] If the wireless sensor is charged wirelessly, during charging, a relative position of the wireless sensor and the charging station can be adjusted, and a transmitting end of the wireless sensor is moved close to a receiving end of the charging station as much as possible. Therefore, during data transmission, the data transmission can be performed with low transmission power, so as to avoid crosstalk.

[0091] Typically, the wireless sensor is generally charged when the wireless sensor has insufficient power. Typically, the wireless sensors generally enter the low power consumption mode when insufficient power is detected. Therefore, when the communication connection is established with the charging station for data transmission, the operating mode of the wireless sensor is switched to the normal operating mode to enable data transmission. It is also possible to charge the wireless sensor when the wireless sensor is in the normal operating mode. In this case, when it is detected that the wireless sensor is in the charged state, the switching of the communication modes, the determination of the communication connection with the charging station, and the transferring of the data to the charging station after establishing the communication connection can also be performed.

[0092] After the central processing unit **23** of the charging station receives the data from the wireless sensor, it can transfer the received data to an external device via the second communication unit **26** (i.e., the high-speed, standard protocol), wherein the external device can be a cloud server, a smart device, etc. The central processing unit **23** may first buffer the received data, and after the data transfer is finished, transfer the buffered data out, or it may also not buffer the data, but immediately transfers the data out after receiving the data.

[0093] At the end of use, much of the power will have been consumed, and the wireless sensor needs to be charged. After the use is finished, the wireless sensor itself buffers a large amount of data. In this embodiment, during charging, the buffered data can be automatically transferred out by means of the charging station without any participation of a user, thereby greatly facilitating the use of the wireless sensor, and further improving the user experience. On the other hand, compared with the wireless sensor transferring the buffered data to a smart terminal over the low-speed, standard protocol in the prior art, the present embodiment can complete the data transmission faster by using the high-speed, non-standard protocol to transfer the buffered data to the charging station.

[0094] Furthermore, the physiological parameter processing unit **12** switches the communication protocol of the wireless sensor from the high-speed, non-standard protocol to the low-speed, standard protocol when detecting that the wireless sensor meets the switching condition.

[0095] The switching condition may include at least one of the following conditions:

[0096] the physiological parameter processing unit **12** switches the communication protocol of the wireless sensor from the high-speed, non-standard protocol to the low-speed, standard protocol when the wireless sensor has completed the data transmission;

[0097] the physiological parameter processing unit **12** switches the communication protocol of the wireless sensor from the high-speed, non-standard protocol to the low-speed, standard protocol when the communication connection between the wireless sensor and the charging station is interrupted, and

[0098] the physiological parameter processing unit **12** switches the communication protocol of the wireless sensor from the high-speed, non-standard protocol to the low-speed, standard protocol when the wireless sensor fails to acquire power from the charging station (charging is no longer performed).

[0099] When the switching condition is met, it indicates that the data transmission is finished or the data transmission cannot be performed. At this time, the communication mode is automatically switched to the low-speed, standard protocol used under a normal condition without manually switching by the user, so as to facilitate the use of the wireless sensor by the user again.

[0100] Described above are various embodiments of the present disclosure, and it should be noted that a person of ordinary skill in the art could also make some improvements and modifications without departing from the principles of the present disclosure and these improvements and modifications would all fall within the scope of protection of the claims.

What is claimed is:

1. A method of switching an operating mode of a wireless sensor, the method comprising:

once the wireless sensor has entered a normal operating mode, determining whether at least one physiological parameter is detected by the wireless sensor within a first predetermined time period; and

when the at least one physiological parameter is not detected by the wireless sensor within the first predetermined time period, automatically controlling the wireless sensor to switch from the normal operating mode to a low power consumption mode.

2. The method of claim **1**, further comprising:

once the wireless sensor has entered the low power consumption mode, determining whether the at least one physiological parameter is detected by the wireless sensor at an interval of a second predetermined time period; and

when the at least one physiological parameter is detected by the wireless sensor, automatically controlling the wireless sensor to switch from the low power consumption mode to the normal operating mode.

3. The method of claim **1**, wherein the low power consumption mode comprises a standby mode and a sleep mode; when the at least one physiological parameter is not detected by the wireless sensor within the first predetermined time period, automatically controlling the wireless sensor to switch from the normal operating mode to the low power consumption mode comprises:

when the at least one physiological parameter is not detected by the wireless sensor within the first prede-

termined time period, automatically controlling the wireless sensor to switch from the normal operating mode to the standby mode.

4. The method of claim **3**, further comprising:

once the wireless sensor has entered the standby mode, detecting whether the wireless sensor meets a first condition or a second condition at an interval of a second predetermined time period, wherein the first condition is a power-off condition, and the second condition is detecting the at least one physiological parameter;

when the wireless sensor meets the first condition, automatically controlling the wireless sensor to switch from the standby mode to the sleep mode; and

when the wireless sensor meets the second condition, automatically controlling the wireless sensor to switch from the standby mode to the normal operating mode.

5. The method of claim **4**, further comprising:

once the wireless sensor has entered the sleep mode, detecting whether the wireless sensor meets a power-on condition; and

when the wireless sensor meets the power-on condition, automatically controlling the wireless sensor to switch from the sleep mode to the standby mode.

6. The method of claim **5**, wherein the power-on condition comprises at least one of the conditions of: detecting that a motion intensity is greater than a predetermined threshold, detecting a body contact, detecting that a change in ambient brightness is greater than a predetermined value, detecting a change in pressure, detecting a change in audio, and detecting a change in temperature.

7. A wireless sensor, comprising:

a physiological parameter collecting unit; and

a physiological parameter processing unit connected to the physiological parameter collecting unit, the physiological parameter collecting unit for collecting at least one physiological parameter, wherein the physiological parameter processing unit performs the following steps: once the wireless sensor has entered a normal operating mode, determining whether at least one physiological parameter is detected by the wireless sensor within a first predetermined time period; and when the at least one physiological parameter is not detected by the wireless sensor within the first predetermined time period, automatically controlling the wireless sensor to switch from the normal operating mode to a low power consumption mode.

8. The wireless sensor of claim **7**, wherein the physiological parameter processing unit further performs the following steps: once the wireless sensor has entered the low power consumption mode, determining whether the at least one physiological parameter is detected by the wireless sensor at an interval of a second predetermined time period; and when the at least one physiological parameter is detected by the wireless sensor, automatically controlling the wireless sensor to switch from the low power consumption mode to the normal operating mode.

9. The wireless sensor of claim **7**, wherein the low power consumption mode comprises a standby mode and a sleep mode; when determining that the at least one physiological parameter is detected by the wireless sensor within the first predetermined time period, the physiological parameter processing unit automatically controlling the wireless sensor to switch from the normal operating mode to the low power consumption mode comprises:

when determining that the at least one physiological parameter is detected by the wireless sensor within the first predetermined time period, the physiological parameter processing unit automatically controlling the wireless sensor to switch from the normal operating mode to the standby mode; and

the physiological parameter processing unit further performs the following steps: once the wireless sensor has entered the standby mode, detecting whether the wireless sensor meets a first condition or a second condition at an interval of a second predetermined time period, wherein the first condition is a power-off condition, and the second condition is detecting the at least one physiological parameter; and when the wireless sensor meets the first condition, controlling the wireless sensor to switch from the standby mode to the sleep mode; and when the wireless sensor meets the second condition, automatically controlling the wireless sensor to switch from the standby mode to the normal operating mode.

10. The wireless sensor of claim **9**, wherein the physiological parameter processing unit further performs the following steps: once the wireless sensor has entered the sleep mode, detecting whether the wireless sensor meets a power-on condition; and when the wireless sensor meets the power-on condition, automatically controlling the wireless sensor to switch from the sleep mode to the standby mode.

11. The wireless sensor of claim **10**, further comprising at least one of: an inertial sensor, an electric field sensor, a light sensor, a pressure sensor, an audio sensor, and a temperature sensor; and the power-on condition comprises at least one of the following conditions:

a motion intensity detected by the inertial sensor is greater than a predetermined threshold,

a body contact is detected by the electric field sensor,

a change in ambient brightness is detected by the light sensor,

a pressure detected by the pressure sensor changed, an audio signal detected by the audio sensor changed, and

a temperature detected by the temperature sensor changed.

12. The wireless sensor of any one of claim **7**, further comprising a power supply unit, a multi-protocol communication unit, and a memory, wherein the multi-protocol communication unit supports a first communication protocol and a second communication protocol, and the physiological parameter processing unit automatically controls the multi-protocol communication unit to switch a communication protocol from the first communication protocol to the second communication protocol when detecting that the power supply unit can acquire power from a charging station, and transfers data stored in the memory to the charging station over the second communication protocol when detecting that the wireless sensor establishes a communication connection with the charging station.

13. The wireless sensor of claim **12**, wherein the physiological parameter processing unit switches the communication protocol of the wireless sensor from the second communication protocol to the first communication protocol when detecting that the wireless sensor meets a switching condition.

14. The wireless sensor of claim **13**, wherein the switching condition comprises at least one of the following conditions:

the wireless sensor has completed data transmission,

the communication connection between the wireless sensor and the charging station is interrupted, and

the wireless sensor fails to acquire power from the charging station.

15. A system comprising:

a wireless sensor, which automatically switches from the normal operating mode to a low power consumption mode when the wireless sensor determines that, under a normal operating mode, the at least one physiological parameter is not detected within a first predetermined time period;

wherein the wireless sensor, supporting a first communication protocol and a second communication protocol, automatically switches a communication protocol from the first communication protocol to the second communication protocol when detecting that power can be acquired from a charging station under the normal operating mode or the low power consumption mode, and transfers stored data to the charging station over the second communication protocol when establishing a communication connection with the charging station; and

wherein the charging station, supporting the second communication protocol and a third communication protocol, once having established the communication connection with the wireless sensor over the second communication protocol, receives the data transferred by the wireless sensor, and transfers the received data to an external electronic device over the third communication protocol.

16. The system of claim **15**, further comprising: when the wireless sensor is under the low power consumption mode, the wireless sensor determines whether the at least one physiological parameter is detected at an interval of a second predetermined time period; and when the at least one physiological parameter is detected, automatically switching from the low power consumption mode to the normal operating mode, wherein the low power consumption mode comprises a standby mode and a sleep mode; and

when the wireless sensor is under the standby mode, detecting whether a first condition or a second condition is met at an interval of the second preset time period, and when the first condition is met, automatically switching from the standby mode into the sleep mode; and when the second condition is met, automatically switching from the standby mode into the normal operating mode, wherein the first condition is a power-off condition, and the second condition is detecting the at least one physiological parameter; and

when the wireless sensor detecting that the power-on condition is met under the sleep mode, the wireless sensor automatically switches from the sleep mode into the standby mode.

17. The system of claim **16**, wherein the wireless sensor further comprises at least one of: an inertial sensor, an electric field sensor, a light sensor, a pressure sensor, an audio sensor, and a temperature sensor; and the power-on condition comprises at least one of the following conditions: a motion intensity detected by the inertial sensor is greater than a predetermined threshold, a body contact is detected by the electric field sensor, a change in ambient brightness detected by the light sensor is greater than a predetermined value, a pressure detected by the pressure sensor changed, an audio signal detected by the audio sensor changed, and a temperature detected by the temperature sensor changed.

18. The system of claim **15**, wherein the wireless sensor switches the communication protocol from the second communication protocol to the first communication protocol when the wireless sensor meets the switching condition.

19. The system of claim **18**, wherein the switching condition comprises at least one of the following conditions:

the wireless sensor has completed data transmission,

the communication connection between the wireless sensor and the charging station is interrupted, and

the wireless sensor fails to acquire power from the charging station.

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