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(54) **Title**: TRANSPORTABLE DEVICE COMPRISING A CONTROLLED LOGGING FUNCTIONALITY

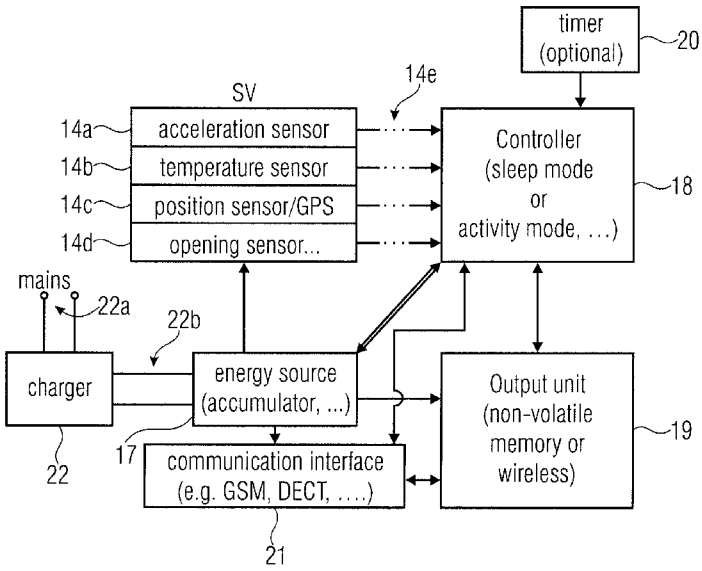

FIGURE 2

(57) **Abstract**: A transportable device (10) includes a device body (12), a sensor device (14) having one or several electric sensors for detecting one or several physical variables acting on the device body and for providing one or several sensor signals, an output unit (19) comprising a wireless output interface or a permanent memory, an energy source (17) for supplying the sensor device (14) with energy, and a controller (18) supplied with energy by the energy source (17) which is implemented to be set from a sleep mode into an activity mode by the sensor device (14), to log the sensor signal or a signal dependent thereon in allocation with a time signal which may be provided by a timer (20) using the output unit (19) or to quantitatively detect the sensor signal or a signal dependent thereon and to quantitatively log the same using the output unit (19), and to be capable of being put into a sleep mode after a control of the output unit (19) for the purpose of logging.

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Transportable Device comprising a controlled Logging Functionality

Description

The present invention relates to the monitoring of transportable devices and, in particular, to the monitoring of transportable devices comprising an electric functionality.

With large or small events, like, for example, concerts, TV-shows, open air events and the like, typically many spotlights are needed. These spotlights do not only serve for illuminating the scene, but also serve to generate artistic and specifically controlled light effects by a simultaneous actuation of many spotlights. In this respect, modern spotlights like, for example, the spotlight Impression of the company GLP are equipped with a highly sophisticated electronics and highly developed mechanical elements. Such a spotlight includes, in a housing, a light source, at least one movable effect element, at least one control board, at least one motor for moving the effect elements and at least one motor for moving the light source itself. The light source may be moved around several axes and for this purpose receives control signals from a central controller, wherein controlling may be effected wirelessly or wired, like, for example, via ArtNet, RDM or DMX. An array of individually controllable LEDs serves as a light source, which are controllable both with respect to their color and also their color temperature to generate any light effects together with the effect elements. The effect elements include effect wheels, Gobo-wheels, swivel-mounted or hinged prisms, lenses, etc. A control board or several separately arranged control boards serve to execute signal processing both of the control signals and also the signal processing of the required electric energy to supply the light source, like, for example, the LEDs or mercury vapor discharge lamps or similar light elements with current.

The market place for such spotlights is such that events managers do not buy spotlights but rent spotlights from spotlights lenders. For this purpose, the spotlight lenders will transport the spotlights sometimes over far distances by air plane, ship, rail or motor vehicle. Spotlights, but also any other transportable devices are thus typically transported often and over long distances. This further has to be done quickly. This may often be to the disadvantage of the devices, i.e. the transportable devices. For example, spotlights typically used to consist of a light bulb in a sheet metal housing. Light bulbs were cheap and sheet metal housings could be straightened out easily by simple means.

Effect spotlights today are densely packaged with up-to-date technology, however, which makes them a lot more prone to transport damaging. Otherwise, the development of new effect spotlights lead to the fact that due to the substantially increased functionality also the costs of the spotlights increased, so that lending the spotlights has become even more attractive and thus even more to and fro transporting of the spotlights takes place.

Such sensitive transportable devices may be transported in especially manufactured transport containers, which are also called flightcases. But if you let these flightcases drop down a certain distance, the transport goods will still be damaged.

Further, the flightcases still have another disadvantage. Damages of the transportable device arranged in the flightcase may hardly be seen from the outside, as due to the packaging the impact effect is not punctual onto the transportable device. The case rather is now that the impact energy is distributed onto the complete device. Thus, damages of the outer case are scarce. Damages of the interior of the spotlight or of a transportable device, like, for example, the breaking of glass, hairline cracks of the printed circuit boards or hidden drives may still occur.

Thus, more and more lenders change their strategy to applying corresponding test labels to the flightcases. A manufacturer of such test labels is the company Shockwatch (hppt://www.transportcontrol.de/).

These labels or stickers have a small window, which changes its color to red when, depending on the model, the transport good was subjected to high acceleration, high air humidity or extreme temperatures.

Further, sensors exist, which detect whether transport goods were turned upside down. For example, large plasma or LCD TVs may only be transported upright in order to reduce the risk of breaking glass.

In particular, for the sector of event technology, but also for other sectors these labels have disadvantages. First of all, labels are subject to wear and tear. Once it came off, the label has to be replaced by a new label before the flightcase is shipped. Further, these labels are easily available. If the customer hiring is also the transporter, in case of an error, just before giving back the devices, he might simply replace the labels by new ones in order to suggest to the receiver of the devices that they were transported carefully, although actually a rough handling took place during transport such that an interior damaging, which

is, however, not easily obvious when the spotlight is looked at from the outside, probably was caused.

Further, the labels are large and have luminescent colors. Applying such labels to the effect spotlights is thus basically not intended as the effect spotlights have to fulfill an aesthetic function in a stage setting. Large luminescent labels on the spotlights are thus not acceptable in a stage setting.

It is further, in particular, a problem that labels applied to the flight cases primarily give information on what happened to the flight case. Whether the device packed therein actually was located therein during a triggering of the sensor or whether the device maybe was damaged outside the flightcase may thus not be determined despite such a transport label.

All of this leads to the fact that again and again disputes result when transport damages resulted, as it is hard to determine or may not be determined who was responsible for the transport damaging, in particular, when several persons are in question and when all of these persons want a clear proof and when this clear proof cannot be given, direct liability to the respective other person. This has the consequence that high transport insurances have to be taken out and thus prices for lending or renting increase, which results to a general increase of costs which finally the consumer has to pay.

This is not the only problem, however. To prevent transport damages on the side of the manufacturer, efforts are made to manufacture the devices more stable. This again leads to increased costs, however, to a higher weight and to an increased resource consumption of material in manufacturing and energy in transport and, not least, to a difficult handling of the spotlights, which, as illustrated, continuously have to be mounted and dismounted. A higher weight of the spotlights does again not only lead to a frustration of those, which have to mount and dismount the spotlights, but again to an increased price and increased resource consumption.

These problems do not only result for spotlights, but for any transportable devices, which are prone to transport damaging and for which finally the question has to be solved into whose field of responsibility an infringement of transport specifications falls.

It is thus the object of the present invention to provide an improved transportable device.

This object is achieved by a transportable device according to claim 1, a method for monitoring a transportable device according to claim 19 or a computer program according to claim 20.

The present invention is based on the finding that electrical sensors are easy to use for different physical sizes to monitor a transportable device with respect to the physical quantities applied to a device body. The sensors are supplied by a self-sufficient energy source, like, for example, a battery. The sensors are implemented to set a control of the transportable device from a sleep mode into an activity mode. In the activity mode, the controller will cause a logging of the sensor signal or a signal dependent thereon, allocated to a time signal, which may be provided by a timer, using an output unit. Alternatively or additionally the sensor signal is also detected quantitively and logged quantitively, wherein this may be done with or without a time stamp. A temporal sequence already results from a subsequent logging of quantitive sensor quantities. After logging, the controller is again set into the sleep mode, such that a high battery lifetime is achieved. The log file is stored in a permanent storage or output wirelessly and now provides an overview over the detected physical quantities, which acted on the device body during monitoring. The use of the sleep mode, when no threshold is exceeded, guarantees that only the sensors have to be continuously supplied with current but that also the controller only has to be in a minimal standby mode to be able to react to an alarm signal of the sensor. The output unit for writing or transmitting the log file may be completely deactivated and is activated by the controller when an alarm signal of a sensor occurs.

By this, a minimum current consumption is achieved, which leads to a complete monitoring of the physical quantities acting on the transport device. On the other hand, the log file is clear and easy to handle due to the fact that a writing is executed not continuously but only when needed.

According to the invention, thus any disputes with regard to when or where or in whose field of responsibility or time of responsibility damage occurred may be solved using logging. This leads to the fact that only a responsible party has to compensate for damage and that a damage has not to be generally expected which would lead to the increase of insurance costs or other costs. Apart from that, the invention leads to the fact that the consciousness of those who deal with the transportable device is improved in so far as he may not rely on the fact that he may not be identified. Instead, the transporter will now treat the transportable device more carefully as he now has to assume that any rude handling is detectable later and he will be accused of same. This also leads to the fact that on the sides of the manufacturers no unnecessary oversizing has to be done with respect to

functionality, but that devices may become lighter, be handled more efficiently and, in particular, consume less resources.

Also the battery needed may be kept small according to the invention, as it may be assumed that the transportable device is handled according to regulations over a large period of time, which means that the controller will be in the low-energy sleep mode.

In the following, preferred embodiments of the present invention will be explained in more detail with reference to the accompanying drawings, in which:

Fig. 1 shows a transportable device in a schematical illustration;

Fig. 2 shows a block diagram of a cooperation between the sensor device (SV) and the electric device (EV) of Fig. 1;

Fig. 3 shows a schematic illustration of a spotlight with a sensor device and an electric device;

Fig. 4 shows a flow chart for a processing mainly on the side of the sensor device;

Fig. 5 shows a flow chart for a battery monitoring;

Fig. 6 shows a flow chart of processing mainly on the side of the controller;

Fig. 7a shows a functional diagram of diverse participating components of the electric device and the sensor device;

Fig. 7b shows an overview of different power modes; and

Fig. 8 shows a flow chart for an embodiment of the inventive method for monitoring a transport device, as it is illustrated in Fig. 1.

Fig. 1 shows a transportable device 10, comprising a device body 12, a sensor device 14 and an electric device 16. The device body 12, in the embodiment illustrated in Fig. 1, is implemented as a housing 12a and a housing interior 12b, wherein in the interior of the housing 12a different functional groups FG1, FG2, FG3 are arranged, schematically indicated in Fig. 1. Within the housing preferably also the sensor device (SV) 14 and the electric device (EV) 16 are located.

However, the transportable device not necessarily has to comprise a device body with a housing and functional groups arranged therein, but may also be any other object, which may suffer from transport damaging and for which it is important that a monitoring of the state during transport is guaranteed.

Preferably, the device body is implemented as a spotlight, as it is illustrated in Fig. 3, the spotlight comprising different functional groups, like for example a spotlight head 30 as a first functional group, a spotlight neck 31 as a second functional group or a spotlight base 32 as a further functional group. In the embodiment illustrated in Fig. 3 the sensor device 14 and the electric device 16 are arranged within the base, although also other possibilities exist.

Fig. 9 shows an alternative spotlight. This spotlight which is also sold by the company GLP as "Impression" includes an LED light source 90 held by a U-shaped holder 91, so that the light source may be swiveled by the drive mechanisms arranged in the U-shaped holder 91. Further, the U-shaped holder 91 is attached to a base 92, wherein the holder 91 may be twisted with respect to the base 92 by further provided drive devices. The controllers for the light source and for the drive devices are mounted in the U-shaped holder in the embodiment illustrated in Fig. 9. In particular, here a main control board and electronic ballast for providing the LEDs in the light source 90 with energy are located. Preferably, both the sensor device 14 and also the electric device 16 of Fig. 1 are arranged within the housing of the arm 91.

Fig. 2 shows a sensor device, wherein the sensor device SV, for example, comprises one or several electric sensors for detecting one or several physical quantities acting upon the device body 12. Further, the sensor device is implemented to provide a sensor signal. For example, the sensor device includes an acceleration sensor or shock sensor 14a, a temperature sensor 14b, a position sensor 14c or a GPS sensor including a geographical position. The position sensor is here implemented as an orientation sensor to measure, typically using gravity, whether the transportable device was transported upright, lying or even upside down. Further, an opening sensor 14d is, for example, provided which detects whether a housing of the transport device has been opened. In this respect, sensors are provided at opening screws which detect whether a screw at the housing was unscrewed and, if applicable, again screwed in. Such screws are, for example, illustrated at 93 in Fig. 9.

The sensor device is supplied with energy by an energy source 17. The energy source is, for example, an accumulator, a super condenser or the like. The energy source is further implemented to supply a controller 18 with energy. In particular, the controller 18 is implemented to be set from a sleep mode into an activity mode by a sensor 14a-14d of the sensor device. This is, for example, done via an alarm signal on a sensor line 14e, wherein in the embodiment illustrated in Fig. 2 each sensor is connected to the controller via its own sensor line. From this, the controller may directly see which sensor triggered the alarm, as the alarm signal arrives from a sensor at the controller 18 exactly via the line between the sensor and the controller. Possibly, a very fast detection has to take place, e.g. if a free fall is detected and severe damages are to be expected and the device and also electronics is partially damaged so that enough data may be stored. Based on these measurement values, also findings regarding further development and improvement may be gained. If, however, one single data line is provided between the sensor device and the controller, and these individual sensor signals for example with a time or frequency multiplexing are combined into one data stream, the controller 18 is implemented to execute a demultiplexing in order to find out which sensor the alarm signal comes from.

Further, the controller 18 is implemented to control an output unit 19. The output unit includes a wireless output interface and/or a permanent storage, like for example an SD card or a fixedly build-in RAM in the form of a permanent or non-volatile semiconductor memory. The output unit 19 is just like the controller and all other elements in Fig. 2 supplied by the energy source 17. However, the output unit 19 is in one implementation only supplied with current by a controller 18 when receiving a signal from a sensor and checking whether the value measured by the sensor actually exceeds a threshold, so that the output unit 19 really only consumes current when it actually has something to do. In particular, the controller 18 is implemented to log the sensor signal which was received via a sensor line 14e in association with a time signal which may be provided by an optional timer 20 and using the output unit 19. Alternatively or additionally, the controller 18 is implemented to quantitatively detect and quantitatively log the sensor signal or a signal dependent thereon. Further, the controller 18 is implemented, after a control of the output unit 19 for the purpose of logging, to be settable into a sleep mode again. This setting into the sleep mode may either be executed automatically or also by the control device itself or may be done by the output unit 19 in response to a message on a successfully returned logging process.

In the embodiment illustrated in Fig. 2, further a communication interface 21 exists which comprises a GSM functionality, a DECT functionality, a Bluetooth functionality, a WLAN functionality or the like in order to be remotely responsive and e.g. to read out the output

unit, activate the controller or execute other processes in response to a signal received from a remote position. Apart from that, a charger 22 is provided comprising a mains terminal 22a and a charge output 22b. It is thus guaranteed that the energy source is charged always when the spotlight is used, i.e. when a mains supply is connected, so that then, during transport, when no mains supply is connected at the terminal 22a, always sufficient energy is provided so that a continuous supply of the sensor device is guaranteed. It is preferred that in the sleep mode only the sensor device is supplied with energy and further only one input interface of the controller 18 which is implemented to monitor whether a signal comes in from a server. All other functionalities of the controller and the output unit are deactivated, however. Additionally, by a decrease of the clock frequency energy may be saved. In addition to that, the timer 20, if present, or used for logging, is supplied with current. If only a quantitative logging is performed, however, the timer 20 is not necessary for the present invention. A timer will be provided, however, e.g. as a clock source in a main processor unit (CPU board). In this case, the timer is also deactivated in the sleep mode in order to save a maximum amount of current. In other implementations, the timer may also be active continuously in the form of a clock for a continuous measurement of system time.

Fig. 3 shows an implementation in which the sensor device 40 is arranged within a housing. Within the base housing, further a motor M2 is provided controllable by a control board 34. Further, a motor M1 35 is provided which is also controllable by the control board 34. The electric device EV further includes, as an output unit, a memory 19 and a communication interface 21 which may also be implemented as a wired serial interface alternatively to the possibilities mentioned in Fig. 2 in order to control the functionality of the spotlight. Such an interface would be a wireless interface, an ArtNet interface, an RDM interface or a DMX interface. Independent of the mentioned protocols, control may be executed via memories, e.g. SD card, SRAM, ..., wire-bonded communication, like e.g. ArtNet, DMX, RDM, ACN, ..., or wireless communication, like e.g. Wireless LAN, Bluetooth, Wireless DMX, etc. Thus, any transmission protocol may be applied to the different transmission media.

The motor M1 35 is implemented to control effect elements in the function group 30, if present. In contrast, the motor 33 is implemented to achieve a movement of the function group 30 with respect to the base 33. Preferably, the controller 18 of Fig. 2 is also arranged on the control board 34 using the typical processor resources of the spotlight. This is easily possible as monitoring is to be executed mainly at times in which the transportable device is out of operation. Thus, processor resources are easily available there in order to cause the functionalities described with reference to Fig. 2.

Fig. 4 shows a flowchart regarding the functionality of a preferred implementation of the sensor device 14 or an individual sensor 14a-14d. In particular, the sensor is implemented to continuously detect a physical quantity for which the sensor is implemented. Such a physical quantity is an acceleration, a temperature, humidity, radiation, a magnetic field, an existing housing opening or a gap or a distance sensor for detecting a distance of an element, like for example a housing lid, from the device body or from the rest of the housing.

The sensor device is implemented to compare the sensor signal or the detected physical quantity to one or several threshold values, as it is illustrated at 41. If it is determined that a threshold value is exceeded (42), then in one implementation an alarm signal is transmitted from the sensor, at which the threshold value was exceeded, to the controller, as it is illustrated at 43. This alarm signal which may, for example, be implemented as a processor interrupt signal or IRQ signal is then received by the controller which thereupon goes from the sleep mode into the activity mode, as it is illustrated at 44. If, however, the sensor itself determines that a measured quantity has not exceeded the threshold value, which is normally the case, then as illustrated at 45, no alarm signal is transmitted and all components and in particular the controller and the output unit 19 of Fig. 2 remain in the sleep mode.

In a preferred implementation of the present invention, as a further sensor a battery level sensor is implemented to measure the battery level (50). If the battery level sensor determines that the battery level falls below a critical limit (52), then analogue to step 43 an alarm signal is triggered and the controller is set into the activity mode, as illustrated at 53. Hereupon, as illustrated at 54, the undershoot or falling below a critical level is logged with an associated time stamp provided by the timer 20 of Fig. 2. If, however, as illustrated at 55, no undershoot of a level is determined, the controller and preferably also the output unit 19 remain in the sleep mode. The functionality in Fig. 5 guarantees that in the protocol file which is gradually written in the output unit or in the memory of the output unit, it is to be clearly verified when the battery supplied no more energy. In such a case one at least knows that the previously logged events were true. Further, one also knows after a logged battery level undershoot that data possibly provided later may not be reliable any more, or that the fact that subsequently no data was recorded does not necessarily indicate that the device body was not carefully handled.

Fig. 6 shows a preferred implementation of the functionality of the controller 18. In a step 60, the controller acquires an alarm signal or an interrupt signal from a sensor via an associated sensor line 14e. In a step 61, the sensor is identified, that is either via the line from which the sensor signal was received or via a multiplex regulation on the basis of which a demultiplexing of a sensor signal data stream has been executed. As a reaction to this, the controller passes from the sleep mode into the activity mode and starts a query or request of the sensor signal from the identified sensor. In order to enable this the sensor is implemented to store a sensor signal for a certain time. If the controller then determines in a step 62 that the signal exceeded a threshold, as indicated at 63, the output unit 19 is activated, i.e. supplied with energy, while the output unit previously was deactivated, i.e. not supplied with energy or only with little energy. In a step 64, then a quantitative logging by recording a maximum and a duration of exceeding and/or a recording of exceeding with an associated time stamp is executed. If the controller determines in step 62, however, that the signal has not exceeded the threshold, the controller 18 again goes back into the sleep mode, as it is illustrated at 65.

According to the invention, the transportable transport device which preferably comprises a device body having a housing and an "inner life", comprises suitable sensors, like for example a temperature sensor, XYZ acceleration sensor(s), air humidity sensor, magnetic field sensor, switches to monitor different openings of the housing, etc. These sensors are supplied with little current by a battery being an example for an energy source and will, when deviating from a preset setpoint window, wake up the controller or the micro processor of the controller from the sleep mode by an interrupt, and the same may then log the events which occurred in the memory. The output of the logfile by the output unit 19 may then take place in different ways. For example, the results may be read out at the display of the device or the memory content is transferred to an external computer. This may take place by ArtNet or RDM via the DMX line. Likewise, a USB host terminal is available to connect a USB stick or the like. Alternatively, the data carrier with the logfile may be removed and be read out by a computer. The data management is preferably executed so that the owner of the device may gain a secure knowledge on the device state without the device user previously having had a possibility of manipulation. In order to guarantee this, it is preferred that data is rejected encoded in the memory and only may be retranslated by corresponding decoding programs with the device owner. Alternatively, if the data is to be accessible also for third parties, which is for example the case in a transmission by ArtNet as an open standard, it is preferred for the data to be stored in the device so that the user may not manipulate them from the outside for example by deleting or changing the logfile. It is further preferred to also detect manipulation attempts at the file.

Data gained this way have the great advantage for the device holder or owner, that is the device lender, that he may manage the same in electronic form. With, for example, some hundred devices per company, the electronic management of the monitoring data is definitely an important feature increasing overall efficiency. The owner further has the possibility, by corresponding data bases, to record for each device some kind of "life story", i.e. a sequence of events of exceeding threshold values regarding different ambient conditions, which may help increase the price in case of reselling.

In contrast to external monitoring mechanisms like the above mentioned labels, the electronic measurement concept according to the present invention has further advantages. With the labels it may be reenacted that an event exceeding a certain threshold value took place. With what intensity and frequency this took place may not be determined this way, however. This is guaranteed, however, by the present invention and its individual aspects.

Apart from that, the present invention comprises diverse secondary useful effects. By the corresponding sensors provided anyway, the device detects its orientation in space. This is, for example, important when an orientation-dependent display is to be implemented. Depending on whether the device is mounted to the ceiling or standing on the floor, the display graphics output is inverted. It is thus guaranteed that an operator standing upright may always correctly read the display. This feature is especially important for spotlights as in particular with especially flexibly usable spotlights, like for example the spotlight illustrated in Fig. 9, the arrangement, depending on aesthetic and illumination-technical directions, may be random and in particular in any orientation.

In one implementation, the sensors are located in the device head, i.e. within the function group 90. Thus, it is also possible to compensate balancing problems of the drives, as an additional use, like for example of the motor M1 or the motor M2 of Fig. 3. If, for example, the driving belt for the device head is slightly loose, and if in the head an assembly drives from front to back, like for example a focus lens, wherein the movement may be beyond the point of the rotational axis, this leads to the fact that the assembly slightly shines downward in the front position. In the back position, a light beam will be slightly directed upward, however. With a position sensor as part of the sensor device 14, this is also detected and a dynamic position correction may take place via the control board 34 at the corresponding motor.

In order to execute a position correction, on the drive motors for the main rotational axes an incremental encoder device may be used. If here one of the rotational axes is manually

twisted from the outside, the device detects this and corrects the rotational angle. A change of the position of the device relative to the underground may not be detected this way, however. This means, if the device is standing on the stage floor, where the device is usually not fixed, and a person runs into it, this change of position is not electrically detected. The light beam does not hit a preprogrammed target anymore but another location. With one aspect of the present invention, the position sensor is not only used in the standby operation, i.e. e.g. during transport in order to detect critical situations, but the position sensor is also used in operation in order to generate a signal in case of a deviation from the zero position which may for example easily be set by calibration, wherein the signal is then passed on to a technician so that it brings the spotlight again in a correct orientation and its correct position.

Spotlights and, in particular, high performance spotlights often have to be cooled. The cooling tunnels of the devices often have a defined direction. There are inlet and outlet openings at opposing sides of the housing. When the device, for example, absorbs air at the front end (at the light output) and the warm air leaves the device at the back, cooling is most efficient when the device shines downwards. If its head is swivelled to the top, theoretically the hot air would leave the device at the bottom, rise outside along the device, and be drawn in again at the top. Such a problem may be monitored by a temperature sensor. If this temperature sensor responds due to higher temperatures, however, a heating up already took place. It is thus preferred, by position detection, to detect disadvantageous positions directly and in response thereto, for example, to immediately increase a fan revolution so that as a consequence no stronger heating up takes place. It is further preferred that the controller, in response to an output signal of the position sensor 14c, controls a fan arranged in a cooling system such that the same increases its revolution in a first detected position, and in a second detected position which deviates from the first detected position reduces its number of revolutions again. The first position would thus be a disadvantageous position with regard to cooling considerations, while the second position is an advantageous position regarding cooling considerations.

In particular with LED light sources this is an advantage, as LEDs in contrast to discharge lamps have a lower efficiency even with slight temperature increases. A first temperature regulation depending on a position sensor is thus advantageous.

The temperature detection is also further useful for several reasons. High power devices will be working more and more with liquid cooling or heat pipes in future. These may, however, not or only very restrictedly be operated with frost. A temperature sensor 14b in

the sensor device 14 of Fig. 2 is implemented to detect an undershooting of the lowest possible temperature during transport. This functionality is particularly important for air transportation, as in aircraft cargo holds very low temperatures may occur. According to the invention, an undershooting of the lowest possible temperature during transport is detected. In the next startup, based on the detected undershooting of the minimum temperature an alarm signal detectable for the user may be generated, that is due to temperature undershot. This means that the user has to consider possible leakages and that the device has to be sent to service. If such a failure would not be detected and such a device would be hanging above the audience, cooling liquid might leak from the device. The cooling liquid mainly consists of water and a bit of glycol. The glycol is typically colored and would damage the clothing of the people below.

It is further preferred, as it was explained with reference to Fig. 2, to provide a discrete communication interface 21 and operate the same together with a GPS sensor 14c. Such a combination of GPS module and WLAN or GSM is advantageous insofar as the device would now be trackable for the device owner worldwide at anytime. It is then further possible that such devices may download the parameters for the respective event online. Further, such sensors also allow "pay per use" billing models.

Subsequently, with reference to Fig. 7a, the hardware for a shock sensor with a diagnostic unit preferably for an LED spot is illustrated. The hardware includes a main board 70 on which different components like for example a CPU are provided and in particular also controller 18 of Fig. 2 is provided. Different elements are connected to the main board, like for example the battery charger 22 and a battery level sensor 71 which is required to execute the functionality described with reference to Fig. 5. Further, the acceleration sensor 14a is provided in the form of an MEMS semiconductor sensor. Apart from that, the temperature sensor 14b is also provided. Apart from that, different interfaces UART-SIO (internal) 72a and UART-remote-PCB are provided. The output unit 19 is further implemented as a data flash fault memory step and in particular implemented as an SD card. Apart from that, a display 74 is provided. In addition to that a controller exists for touch screen inputs either at switches or at a touch sensitive display.

It is further illustrated in Fig. 7a what components are always supplied with current. In this implementation, the components marked with a circle, i.e. components 70, 71, 14a, 14b, 74, 76, 19 are always supplied by battery. Apart from that, the elements 72b, 72c, 72a, 22 are supplied by means of a 5V standby, but are not supplied by the battery.

Fig. 7b shows different power states that the main board 70 may preferably have.

The online-on mode has a high energy consumption and is possible when the device is connected to a mains supply and both a 27V power supply and a 5V standby power supply are active. Further, all boards and components are co-supplied.

A power mode with an average energy consumption is the online standby mode. Here, the device is also connected to the mains, but only the 5V standby power supply is active. Only the main PCB and the remote input PCB (ArtNet, DMX, WDMX) are supplied with voltage. The device may here again change into the online-on mode via external control signals (ArtNet, DMX, WDMX).

A further power mode with a low energy consumption is the Offline-Config-Mode or the activity mode. Here, the device is no longer connected to the power supply and the main PCB is supplied by the buffer battery. Only the following components are still supplied with voltage: main CPU, SD card, battery level display, acceleration sensor, temperature sensor, display 74 and touch panel 76. At the device, settings may be monitored and changed.

The power mode with the lowest energy consumption is the sleep mode or offline standby mode. Here, the device is not connected to the mains and all components are in the power saving mode. The SD card has its own power switch to additionally save current. From this, a very low current consumption of a maximum of about 300 µA results. All three sensors, i.e. the MEMS sensor 14a, the temperature sensor 14b and the battery level sensor 71, still check their measurement data with regard to validity and should a threshold value be exceeded an interrupt is triggered at the main CPU.

Preferably, in the temperature sensor 14b a temperature window is stored. As soon as this window is left, an alarm signal or IRQ is triggered at the main CPU.

The battery level sensor is implemented such that when reaching a minimum value an IRQ is triggered. The shock sensor is implemented such that when on one of the XYZ axes a threshold value is achieved, an IRQ is triggered.

All sensors are connected via the I^2C-Bus to the main CPU 70 and have their own IRQ line 14e. Thus, the respective sensor may quickly be determined and the data may be read out. Using the measurement values the CPU decides on the further proceedings.

In the sleep mode or offline standby mode the sensors may be set into a sleep mode in order to save energy. If an event occurs at the sensor then the main CPU is woken up from standby and may determine the sensor using IRQ power and execute further required measurements. If only in standby about half a year may be bridged for typical spotlights and typical battery power.

For temperature monitoring it is preferred to record the time t1 when leaving the temperature window. It is further preferred to execute hereupon a periodic recording of the measurement values in a period of time between 1 and 30 minutes distance between two measurement values. Apart from that it is preferred to record or capture a time t2 when entering the valid temperature range again, so that from a difference of the two points in time the duration of temperature undershooting or exceeding may be determined. It is finally preferred, as a quantitative detection, to determine at least the maximum value t_{max} when exceeding/undershooting the upper or lower threshold value.

For shock or impact detection it is preferred to detect the time or the start time, as illustrated in Fig. 7c, when exceeding a minimum value. It is further also preferred to execute a periodic recording of the current acceleration, wherein however in contrast to the temperature sensor a low period duration is used, like for example a recording with a period between 1 ms and 1 s. Apart from that, a point in time of undershooting a threshold is determined, like for example the "end time" in Fig. 7c. The difference between the start time and the end time is the duration of the acceleration process or the threshold value infringement of the acceleration process. It is further preferred to determine and quantitatively store the maximum value or the maximum in Fig. 7c. An alternative, quantitative evaluation is to form an integral of the measurement values to determine an impulse associated with the acceleration activity. Typically the impulse will be proportional to the damage so that an impulse value is an important and helpful variable.

Subsequently, with respect to Fig. 8, a preferred embodiment for a controller according to the present invention is illustrated.

In step 43, a sensor triggers an alarm signal (IRQ). In a step 44 the main processor is woken up from the sleep mode for example on the board 70 of Fig. 7a. Using the IRQ line the processor may then identify which sensor executed triggering and may thus specifically request the data of the sensor as it is illustrated at 61a. At step 61b finally the data retrieval of the sensor signal from the sensor which triggered the alarm takes place.

In a step 80 the data is then possibly rendered. With a shock sensor or acceleration sensor, from the X, Y, Z values, the resulting vector is calculated. Then, in a step 62, the vector would be compared to a valid range for the vector, wherein this range may both include an acceleration regarding amount and also an acceleration regarding direction. If step 62 determines that the rendered data is within limits, the processor again enters the standby mode in a step 66b, which is also illustrated for example in Fig. 6.

If it is determined in step 62, however, that the rendered data is without the valid range, the SD card of the output unit 19 of Fig. 2 is supplied with current, as it is illustrated at 63. Hereupon, the output unit 19 opens a fault or error memory file, wherein in particular an entry is written with the beginning of the measurement. For this, a time stamp of an inner clock is used which allows conclusions regarding data and time. In a step 82 another query of the sensor values is executed. In a step 83 then a data rendering of the queried values takes place an in a step 84 the measurement value is stored in the error memory and a random access memory (SRAM). In a step 85, then the values located in the random access memory are examined in order to search the maximum value and to finally store the maximum value in the error memory, i.e. in the nonvolatile memory on the SD card. If, in a step 86, it is determined that the measurement value is still outside the valid range, after a certain number of milliseconds (XX ms) a measurement is again executed and steps 82, 83, 84 and 85 are again passed. If, however, it is determined in step 86 that the measurement value is now within the limits, in a step 87 an entry is written including the end or end time of the measurement. From the start and end time of the measurement the duration of exceeding results. Additionally, for the shock sensor using the acceleration values integrated over time, the impulse and thus the strength of impact is calculated. Additionally, the maximum value is stored as it was illustrated with respect to Fig. 7c. In a step 66a the error memory is then closed and the SD card or the control device for the SD card again switched off.

Then, when the complete cycle described in Fig. 8 has been passed, all elements are again in the sleep mode and the device is ready for recording a next extraordinary state of the device body of the transportable device.

Although certain elements are described as device elements, it is to be noted that this description is also to be regarded as a description of steps of a method and vice versa. Thus, for example the block diagram illustrated in Fig. 2 shows a flowchart of a corresponding inventive method which accordingly also applies to block diagrams of Figs. 4, 5, 6 and 8.

Depending on the circumstances, the inventive method for analyzing an information signal may be implemented in hardware or in software. The implementation may be on a digital storage medium, in particular a floppy disk or a CD having electronically readable control signals which may cooperate with a programmable computer system so that the method is executed. In general, the invention thus also consists of a computer program product having a program code stored on a machine readable carrier for executing the method, when the computer program product is executed on a computer. In other words, the invention may thus be realized as a computer program having a program code for executing the method, when the computer program is executed on a computer.

Claims

1. A transportable device (10) comprising:

a device body (12);

a sensor device (14) having one or several electric sensors for detecting one or several physical variables acting on the device body and for providing one or several sensor signals from the one or several electric sensors for detecting one or several physical variables acting on the device body;

an output unit (19) comprising a wireless output interface or a permanent memory;

an energy source (17) for supplying the sensor device (14) with energy; and

a controller (18) supplied by the energy source (17) which is implemented

to be set from a sleep mode into an activity mode by the sensor device (14),

to log the one or the several sensor signals or a signal dependent thereon in allocation with a time signal which may be provided by a timer (20) using the output unit (19) or to quantitatively detect the one or the several sensor signals or a signal dependent thereon and to quantitatively log the same using the output unit (19), and

to be capable of being put into a sleep mode after a control of the output unit (19) for the purpose of logging.

2. The transportable device according to claim 1,

wherein the device body comprises a housing (12a) and an electric device (FG1, FG2, FG3) mounted in the housing (12a),

wherein the one or the several sensors (14a, ..., 14b) are integrated within the housing (12a) or at the housing (12a) or in the housing (12a) itself,

wherein the electric device comprises a processor and wherein the processor comprises the controller (18).

3. The transportable device according to claim 1 or 2, wherein the sensor device (14) is implemented to examine a sensor signal of the one or several sensors with respect to a threshold value infringement, wherein the sensor device is implemented to transmit an alarm signal or interrupt signal to the controller (18) when a threshold value infringement occurs in order to thus bring the controller (18) in the activity mode.

4. The transportable device according to one of the preceding claims, wherein the sensor device (14) comprises one or several sensors from the following group:

an acceleration sensor (14a), a temperature sensor (14b), a humidity sensor, a radiation sensor, a magnetic field sensor, a light sensor, a contact sensor for detecting a distance of an element from the device body, a position sensor (14c), a GPS sensor and an opening sensor (14d).

5. The transportable device according to one of the preceding claims,

wherein the sensor device comprises a plurality of different sensors, wherein each sensor is connected to the controller via its own line (14e), and wherein each sensor is implemented to identify itself via the sensor signal at the controller.

6. The transportable device according to one of the preceding claims, further comprising a level display (71) for the energy source (17), and

wherein the controller is implemented, when undershooting a level threshold (52), to be set into the activity state (53) and to log the level undershooting using a time stamp provided by the timer (20) using the output interface (19).

7. The transportable device according to one of the preceding claims, wherein the device body comprises an electric device with a mains connection, wherein the energy source (17) comprises an accumulator and an accumulator charger (22), and wherein the energy source is configured so that when the mains is connected the accumulator is charged by the accumulator charger.

8. The transportable device according to one of the preceding claims, wherein the controller (18) is implemented to call the sensor signal in response to receiving an alarm signal from the sensor device (61) in order to determine whether the sensor

signal represents a threshold value infringement of a predetermined sensor threshold value (62), to supply the output unit with energy (63) by the energy source in case of a threshold value infringement.

9. The transportable device according to one of the preceding claims,

wherein the controller (18) is implemented to control the output unit (19) in the activity mode such that an error file is opened in the permanent memory to store (64) a current start time of the timer (64), at which the sensor signal represents a threshold value infringement, and to store (87) a current end time in the permanent memory at which the threshold value infringement ends.

10. The transportable device according to one of the preceding claims,

wherein the controller (18) is implemented to determine and to log a maximum value of the sensor signal (85) and/or a time course of the sensor signal during a threshold value infringement.

11. The transportable device according to one of the preceding claims,

wherein the controller (18) is implemented to encode logged data using a secret key and to only store them in an encrypted way or to output the encrypted data via a wireless interface.

12. The transportable device according to one of the preceding claims, wherein the controller (18) is implemented to provide a log file, written in case of logging, with a write protection so that the log file may not be deleted or changed by a user of the device.

13. The transportable device according to one of the preceding claims, wherein the sensor device (14) comprises a position sensor by which the controller (18) may be set into the activity mode, and by which further in the activity mode a position of the device body may be determined, wherein the controller (18) is implemented to influence a functionality of the device in the activity mode using the sensor signal from the position sensor.

14. The transportable device according to one of the preceding claims, wherein the device body comprises a liquid cooling, wherein the sensor device (14) comprises a

temperature sensor by which the controller (18) may be set into the activity mode, and

wherein the controller (18) is implemented to generate, in case of a preceding undershooting of a predetermined minimum temperature, in a subsequent taking into operation of the transportable device, a warning signal which indicates a potential leak in a line of the liquid cooling to a user.

15. The transportable device according to one of the preceding claims, wherein the sensor device further comprises a geographical sensor, and

wherein the controller is implemented to log geographical positions at predetermined times.

16. The transportable device according to one of the preceding claims, further comprising a telecommunications interface (21) coupled to the controller (18) so that a remote query of a current geographical position or an operating state or of logged data may be executed.

17. The transportable device according to one of the preceding claims,

wherein the device body comprises an electric device having a central control unit (70) which includes the controller (18),

wherein the central control unit or the electrical device may take one of the preceding operating states:

an online-on state in which the central control unit is connected to an external mains supply;

an online standby state in which the central control unit is connected to the external mains supply and in which a power consumption is lower than in the online-on state, wherein the central control unit may be set into the online-on state via a remotely generated signal;

an offline configuration state which corresponds to the activity mode in which the central control unit is not connected to the external mains supply and may be supplied only by the energy source (17), and

an offline standby state which corresponds to the sleep mode in which the sensor device and the timer may be supplied by the energy source (17) and in which further an alarm signal detection unit of the controller (18) is supplied with energy,

wherein the energy consumption of the electric device in the offline standby state is lower than in the offline configuration state, and wherein the energy consumption of the electric device in the online standby state is higher than in the offline configuration state.

18. The transportable device according to one of the preceding claims,

wherein the device body is a spotlight comprising a light source (30, 90), movable effect elements, at least one control board (34), at least one motor (35) for moving an effect element and at least one motor (33) for moving the light source (30),

wherein the sensor device comprises an impact sensor and/or a temperature sensor, which are arranged within the housing, wherein further the energy source (17), the output unit (19) and the controller (18) are also arranged in the housing.

19. A method for monitoring a transportable device having a device body, a sensor device (14) having one or several electric sensors for detecting one or several physical quantities acting on the device body, an output unit (19) comprising a wireless output interface or a permanent memory, and comprising an energy source (17) for supplying the sensor device (14) with energy, comprising:

acquiring an alarm signal (60) from the one or the several electric sensors,

retrieving (61) the one or the several sensor signals from the one or the several electric sensors for detecting one or several physical quantities acting on the device body;

setting a controller from a sleep mode into an activity mode;

logging, using the output unit, the one or the several sensor signals or a signal depending thereon in allocation with a time signal, or quantitatively logging the one or the several sensor signals or a signal depending on the one or the several sensor signal; and

setting (66a, b) the controller in a sleep mode after controlling the output unit (19) for the purpose of logging.

20. A computer program having a program code for executing the method according to claim 19, when the computer program is executed on a computer or a processor.

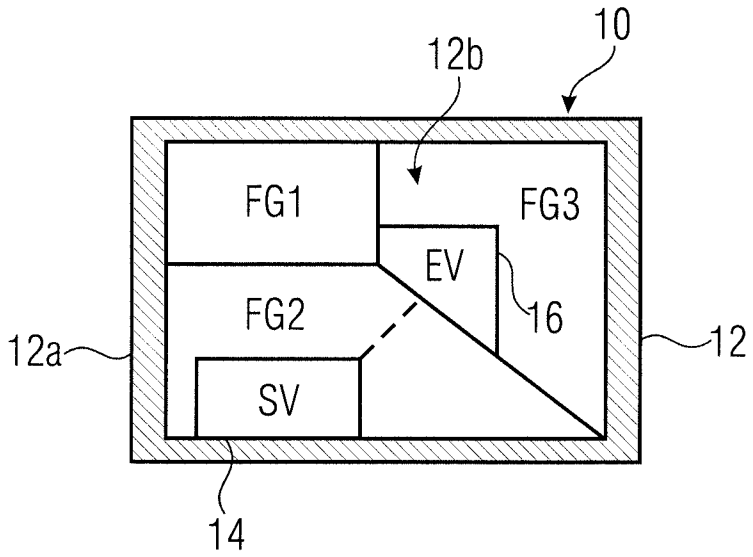

FIGURE 1

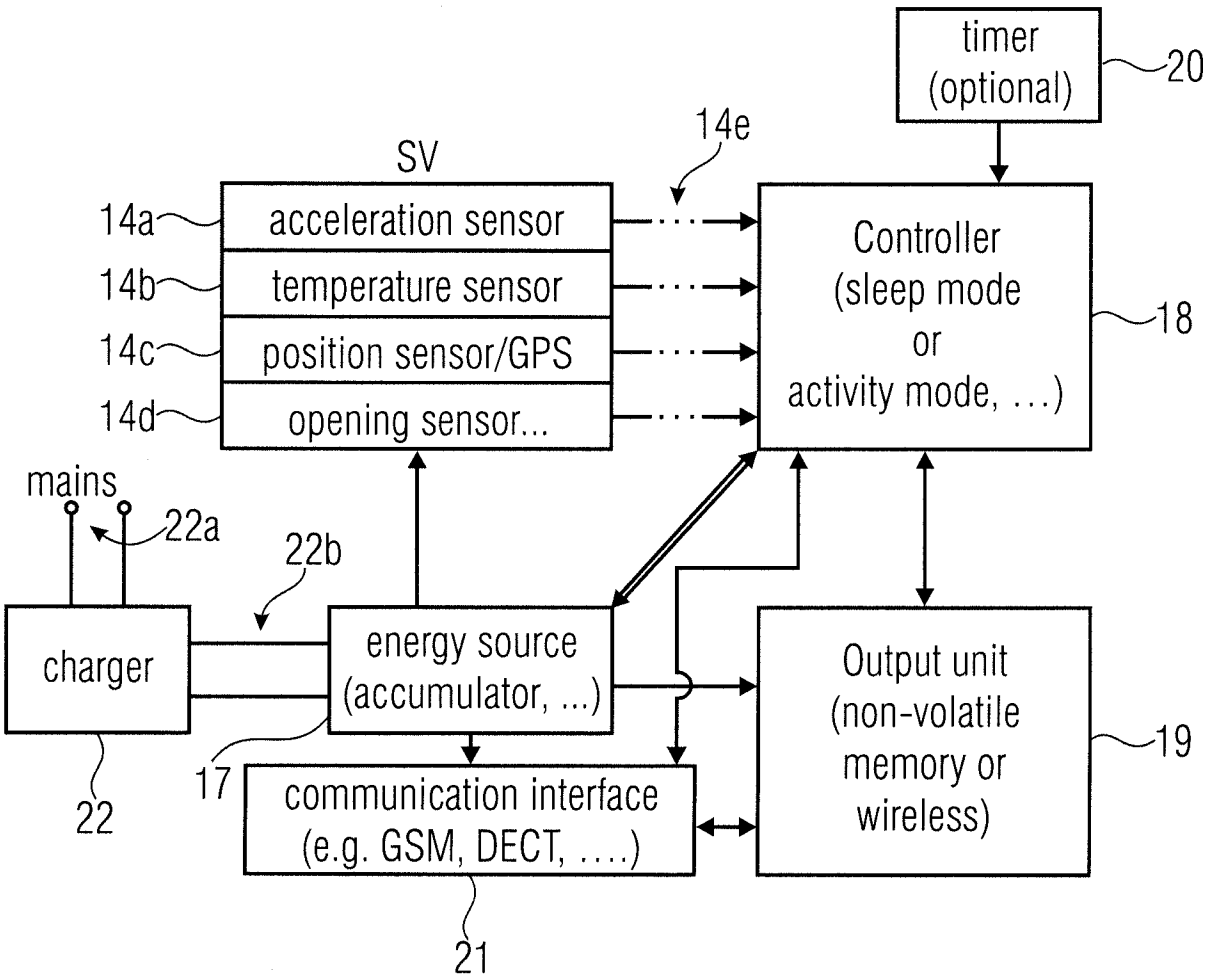

FIGURE 2

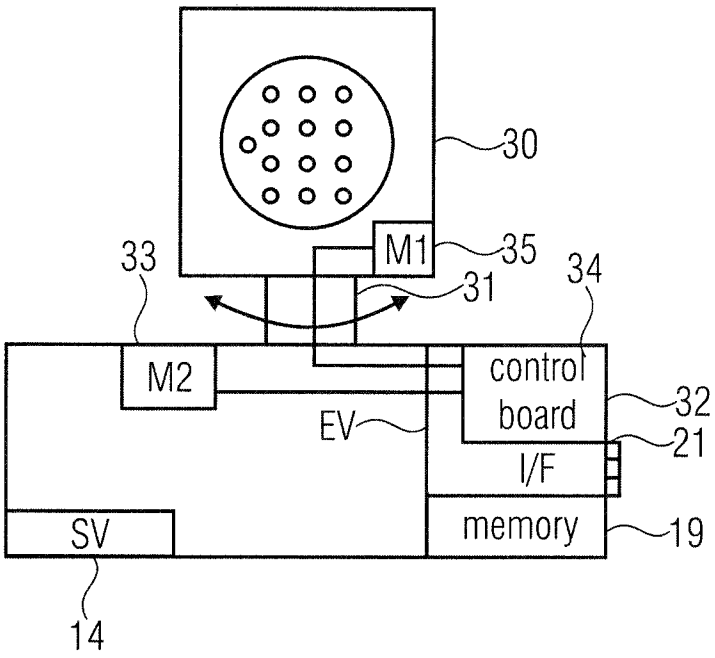

FIGURE 3

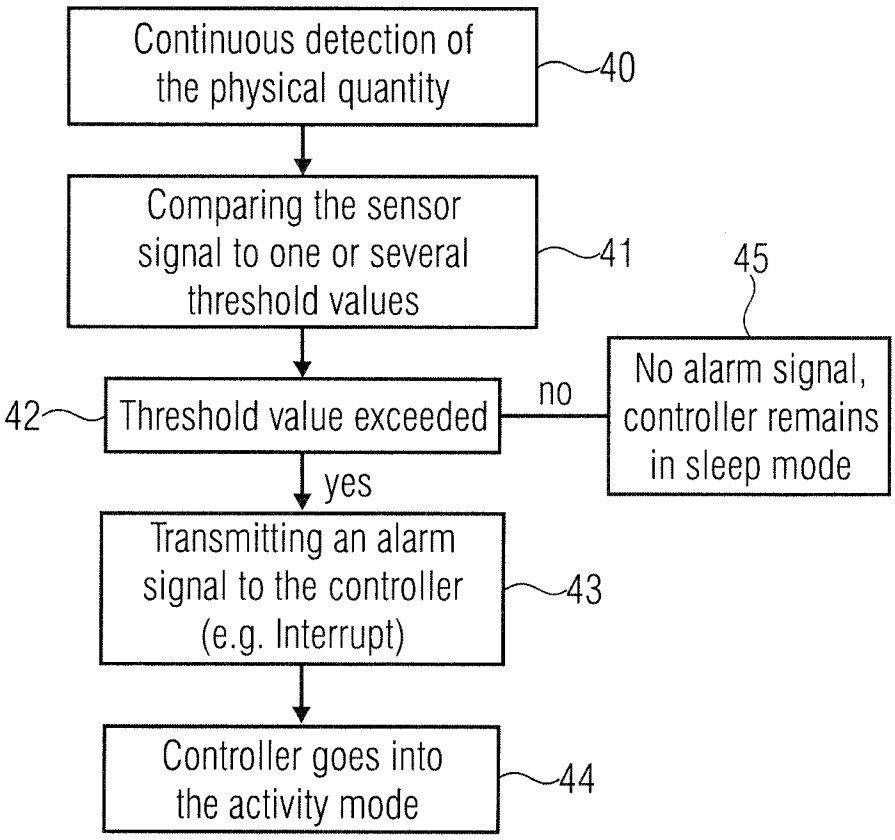

FIGURE 4

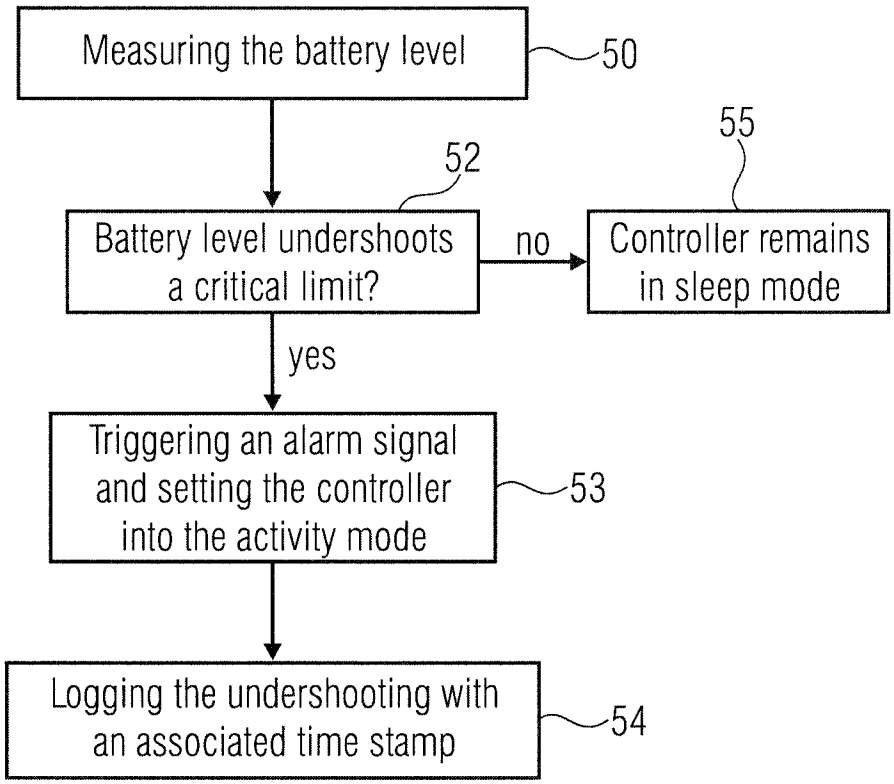
Measuring the battery level
50
52
55
Battery level undershoots a critical limit?
no
Controller remains in sleep mode
yes
Triggering an alarm signal and setting the controller into the activity mode
53
Logging the undershooting with an associated time stamp
54

FIGURE 5

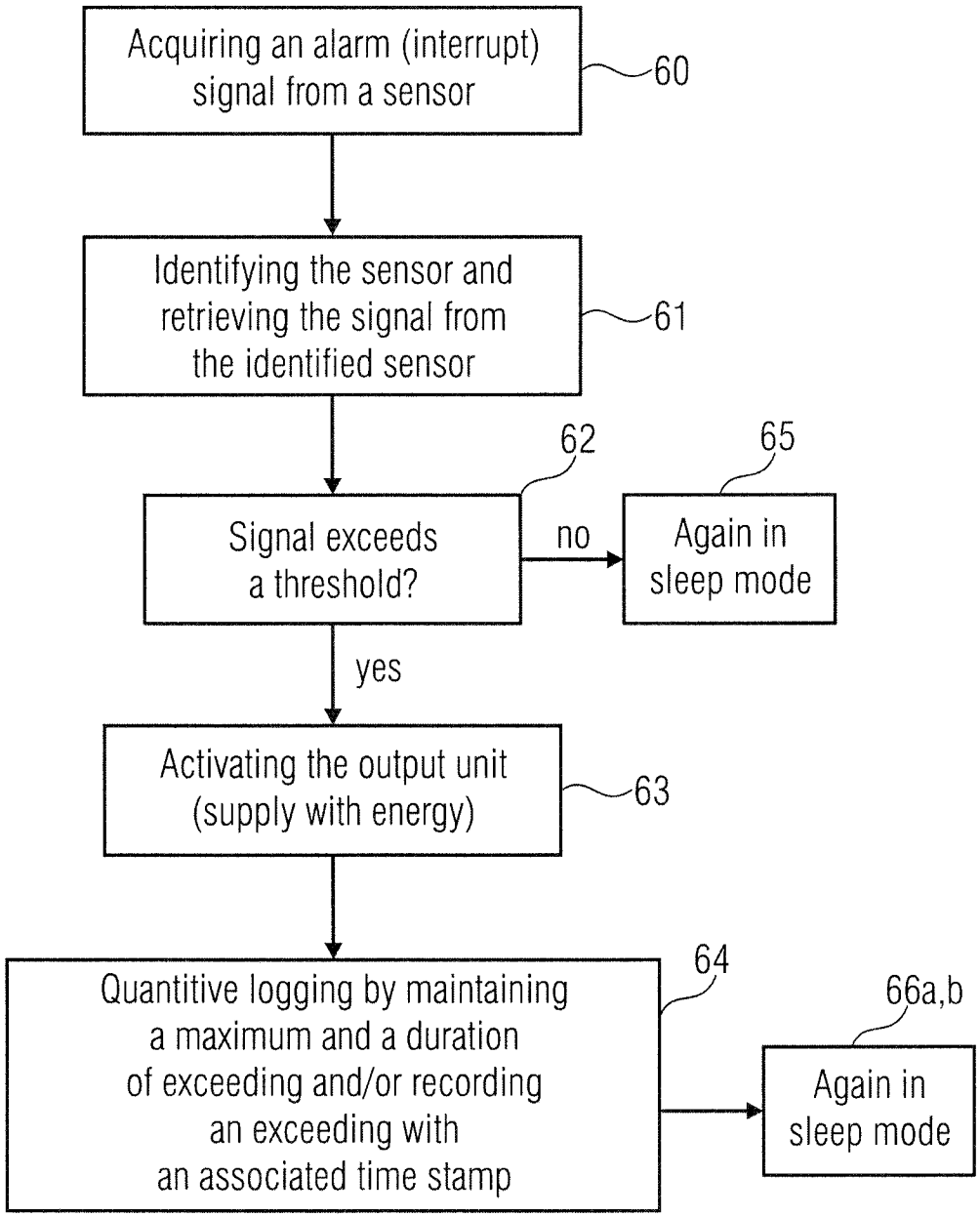
Acquiring an alarm (interrupt) signal from a sensor
60
Identifying the sensor and retrieving the signal from the identified sensor
61
62
65
Signal exceeds a threshold?
no
Again in sleep mode
yes
Activating the output unit (supply with energy)
63
64
66a,b
Quantitive logging by maintaining a maximum and a duration of exceeding and/or recording an exceeding with an associated time stamp
Again in sleep mode

FIGURE 6

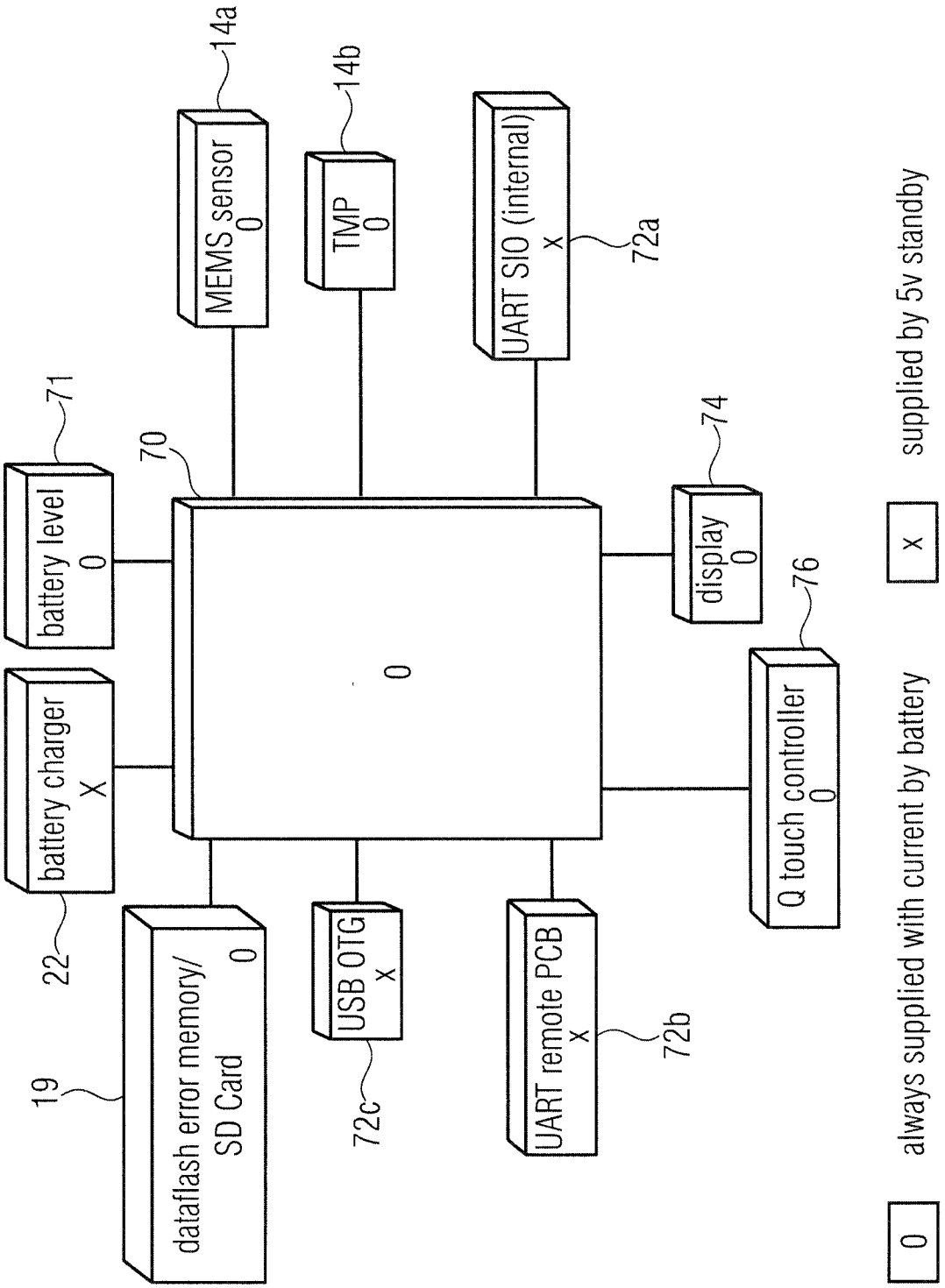
14a
MEMS sensor
0
14b
TMP
0
UART SIO (internal)
x
72a
71
battery level
0
70
74
display
0
battery charger
X
0
76
Q touch controller
0
22
19
dataflash error memory/
SD Card
0
USB OTG
x
72c
UART remote PCB
x
72b
0
always supplied with current by battery
x
supplied by 5v standby

FIGURE 7A

power mode	energy consumption
online-on	high
online-standby	average
activity mode or offline configuration	low
sleep mode or offline-standby	very low

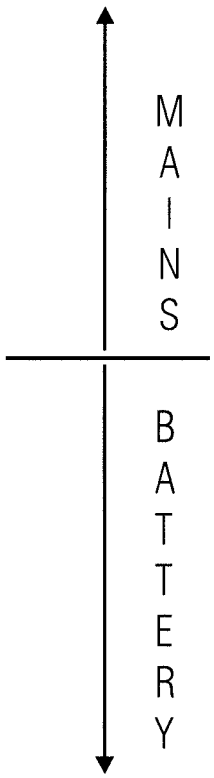

FIGURE 7B

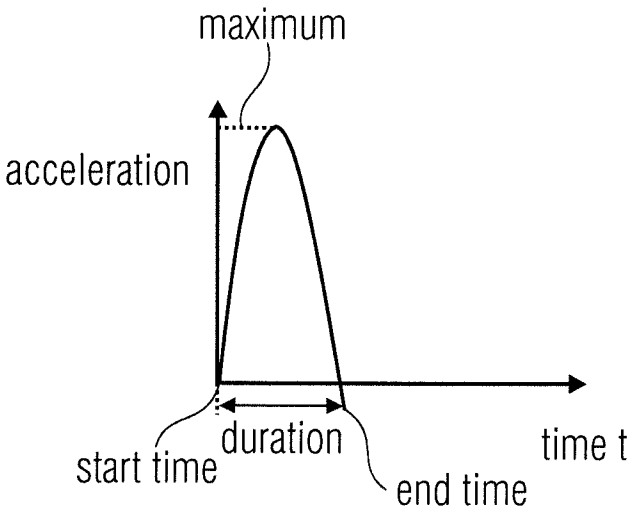

FIGURE 7C

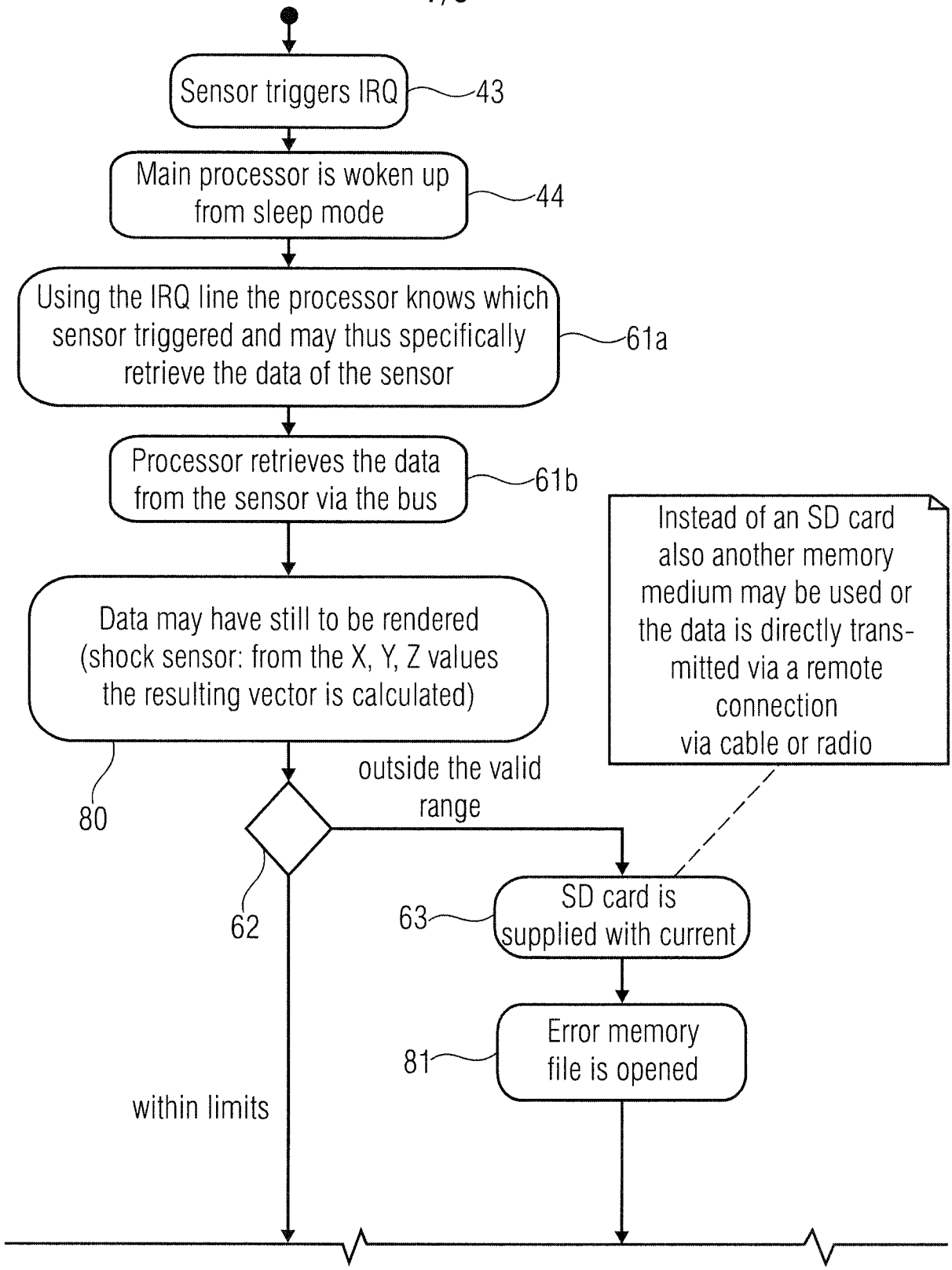

FIGURE 8 FIGURE 8A FIGURE 8B

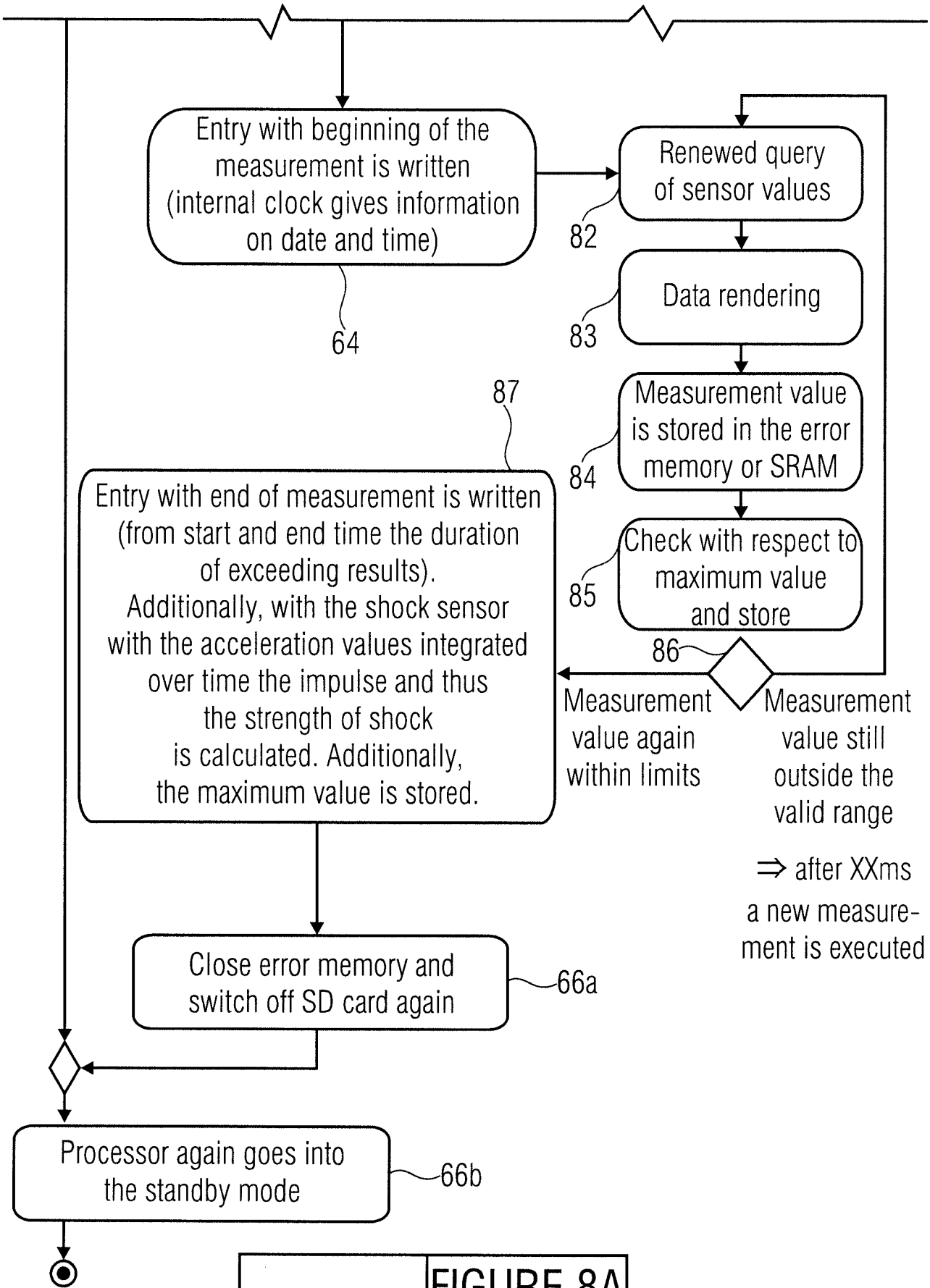

FIGURE 8 FIGURE 8A FIGURE 8B

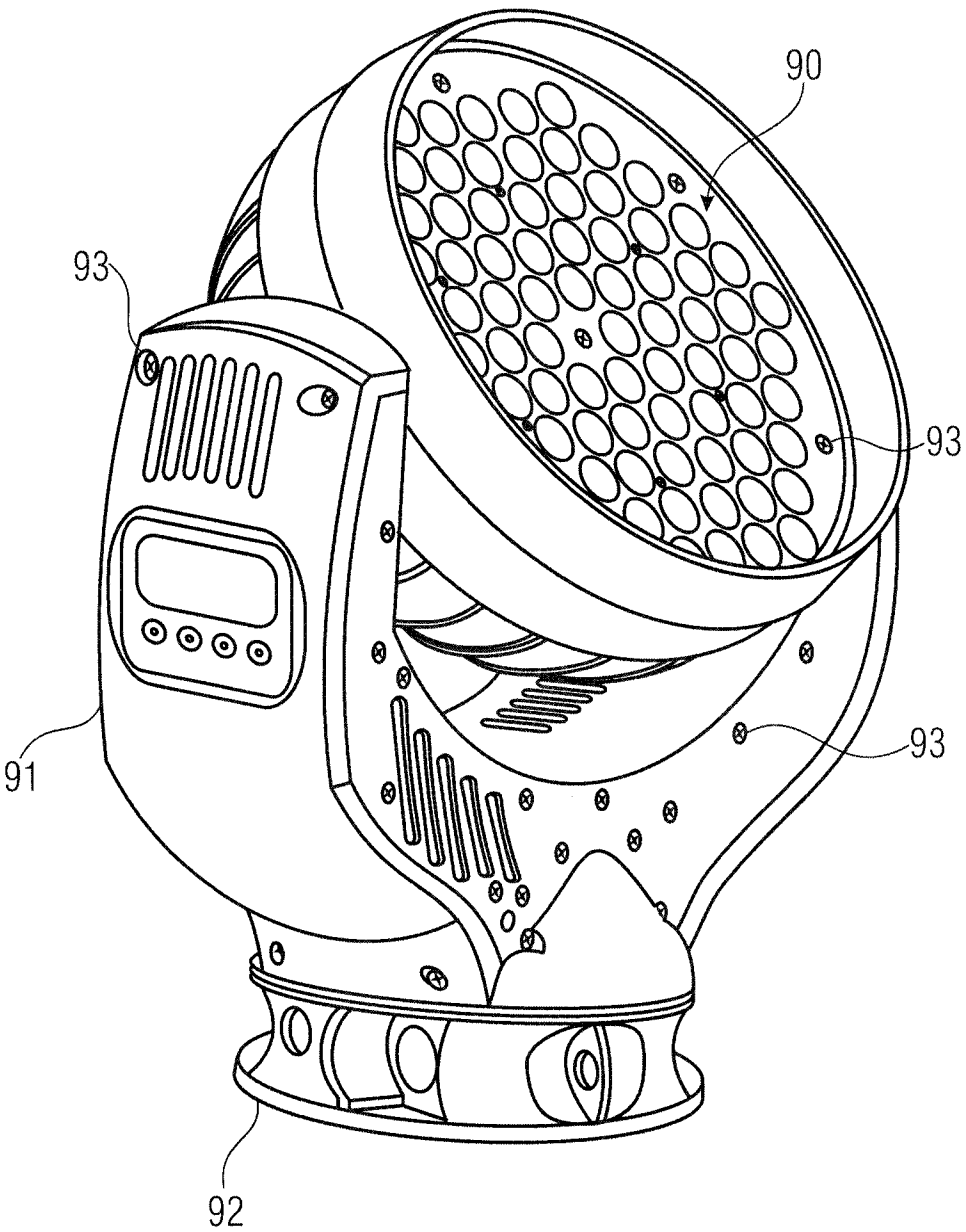

FIGURE 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2011/065485

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06Q10/00 F21S10/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06Q F21S

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 804 810 A (WOOLLEY LOUIS A [US] ET AL) 8 September 1998 (1998-09-08) abstract column 1, line 40 - column 14, line 17 column 19, line 6 - column 20, line 58; figures 11-13 column 21, line 39 - column 22, line 4; figure 14 column 30, lines 6-30; figure 26	1-20

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 November 2011	25/11/2011

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Dedek, Frédéric

1

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2011/065485

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/080566 A1 (VOCK CURTIS A [US] ET AL) 14 April 2005 (2005-04-14) abstract paragraphs [0007] - [0014] paragraph [0036] paragraph [0044] paragraph [0062] paragraph [0069] paragraphs [0193] - [0198]; figures 1,1a paragraphs [0214], [0215]; figure 6 paragraph [0233]; figure 10E paragraphs [0278] - [0284]; figures 33-35 paragraphs [0345] - [0346]; figures 55,56	1-7,9-18
A	US 2006/181413 A1 (MOSTOV KIRILL [US]) 17 August 2006 (2006-08-17) abstract	1-20
A	US 2009/058593 A1 (BREED DAVID S [US]) 5 March 2009 (2009-03-05) abstract	1-20
A	US 5 816 690 A (ROMANO RICHARD J [US] ET AL) 6 October 1998 (1998-10-06) abstract; figure 4 column 4, lines 1-24; figure 7	18

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2011/065485

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		US 5816690 A	06-10-1998