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(71) Applicant: THOMSON LICENSING [FR/FR]; 1-5 rue Jeanne d'Arc, F-92130 Issy-Les-Moulineaux (FR).

(72) Inventors: MA, Wenchao; 8th Floor, Building A, Technology Fortune Center, No. 8 Xueqing Road, Haidian District, Beijing 100192 (CN). ZHANG, Jie; 8th Floor, Building A, Technology Fortune Center, No. 8 Xueqing Road, Haidian District, Beijing 100192 (CN).

(74) Agent: LIU, SHEN & ASSOCIATES; 10th Floor, Building 1, 10 Caihefang Road, Haidian District, Beijing 100080 (CN).

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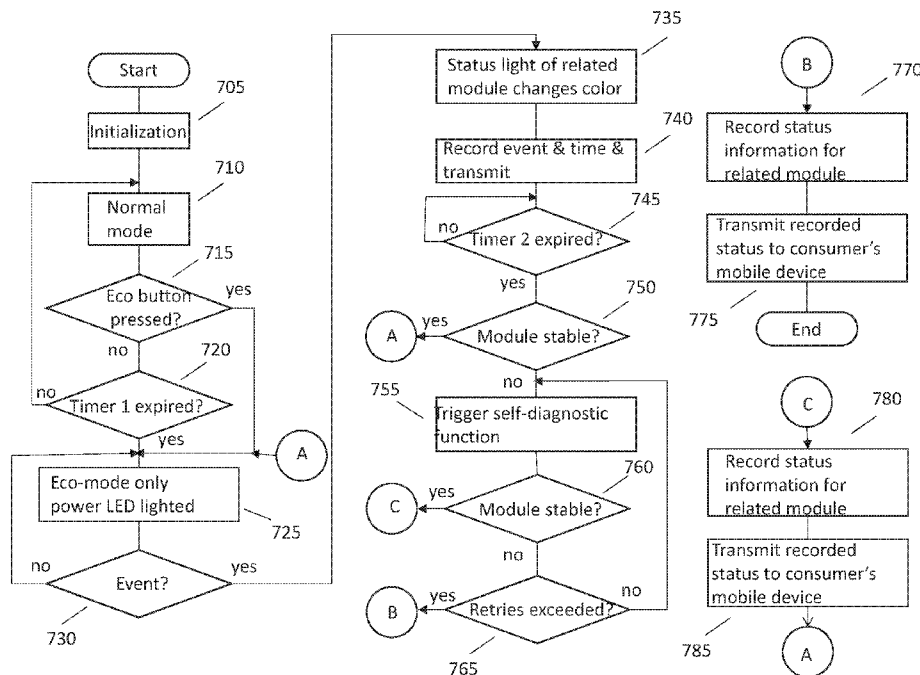


Fig. 7

(57) Abstract: A method is described including lighting an LED representing a module of a consumer device exhibiting abnormal behavior in addition to an LED representing power to the consumer device, upon detection of an event indicative of the module of the consumer device exhibiting abnormal behavior, triggering execution of a self-diagnostic function if the module continues to exhibit abnormal behavior for a given period of time and transitioning the consumer device to one of the eco-mode and the normal mode, upon detecting a return to a stable state of the module that exhibited abnormal behavior.

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INTELLIGENT DIAGNOSTICS AND LIGHT EMITTING DIODE BEHAVIOR REPORTING SYSTEM

FIELD

5 The proposed method and apparatus relates to a diagnostic reporting system and the use of light emitting diodes in eco-modes.

BACKGROUND

10 This section is intended to introduce the reader to various aspects of art, which may be related to the present embodiments that are described below. This discussion is believed to be helpful in providing the reader with background information to facilitate a better understanding of the various aspects of the present disclosure. Accordingly, it should be understood that these statements are to be read in this light.

15 Nowadays, consumer devices (apparatuses) such as home gateways, modems (e.g., cable modems, satellite modems etc.), routers, brouters, printers, fax machines, scanners, combination printers-fax machines-scanners, phones etc. are configured with light emitting diode (LED) status lights, such as for power, broadband, internet, wireless and voice, which can reflect different consumer devices states for each related module. A home gateway device will be used to explain the proposed method and apparatus but is
20 not limited to a home gateway device. Some customers have observed that the LED status lights are always on (in the full light energy) even if it is already dark and people are asleep. This is wasteful of power (energy). Based on this point, some suppliers support an ECO mode, which can possibly shut down (power off, power down) all of the LEDs. Additionally, customers have to learn to diagnose problems (issues, faults) in the
25 consumer device using the LEDs and the different colors that the LEDs can assume. This leads to confusion on the part of the consumer.

30 The ECO mode is also called a power-saving or energy-saving mode. When the consumer device enters ECO mode, the related LEDs will turn to "off" mode except perhaps for the power LED. The two common technical methods for ECO mode are introduced below:

 When the consumer device transitions into the basic eco mode, the related LEDs

turn into "off" mode, until an event occurs that triggers the LED to cease operating in the basic eco mode, at which time the LEDs return to normal (lighted) status. While in basic eco mode, no matter what happens on the consumer device, the LEDs remain in basic eco mode (indicator lights "off" mode) and never change status. Although this method achieves power-energy-saving capacity, internal problem (issues) of the consumer device cannot be found in time. Internal problems (issues) can only be identified when basic eco mode is stopped. Thus, the customer experience lacks intelligent interaction with the consumer device.

When the consumer device transitions into service eco mode, the consumer device can support the service-check function. The service-check function is a service function which is defined as critical or very important to the operation of the consumer device so as to take the corresponding LED out of service eco mode. For example, the voice service may include voip, iptv. Once the consumer device has completed start-up and enters a stable operating condition (status, mode) and when the voice service is also normal and in stable operating condition (status, mode), the corresponding service related LEDs will automatically transition into "off" mode (eco mode). If any one of the functions related to voice service has an issue (problem), then the LED is removed from service eco mode and is lighted indicating a voice service issue (problem) that needs to be diagnosed. If the problem is corrected or corrects itself then the LED returns to service eco mode and the voice service LED is once again turned to "off" mode.

In general, customers can learn to use the different light color of LEDs to diagnose the consumer device states with the customer manual. Many consumers are confused by issues (problems) related to their consumer devices so the LEDs can aid the consumer in diagnosing problems (issues) with their consumer devices.

SUMMARY

A first aspect provides method including lighting an LED representing a module of a consumer device exhibiting abnormal behavior in addition to an LED representing power to the consumer device in eco-mode, upon detection in eco-mode of an event indicative of the module of the consumer device exhibiting abnormal behavior, triggering execution of a self-diagnostic function if the module continues to exhibit abnormal

behavior for a given period of time and transitioning the consumer device to one of the eco-mode and the normal mode, upon detecting a return to a stable state of the module that exhibited abnormal behavior.

5 In an embodiment, the method further provides transitioning a consumer device from a normal mode to an eco-mode, upon expiration of a first timer or upon depression of a button, wherein in the eco-mode, a light emitting diode (LED) representing power to the consumer device is lighted.

In an embodiment, the method provides first recording at least one of the event, a time of occurrence of the event and status of the LEDs in memory.

10 In an embodiment, the method provides for second recording the transition of the consumer device to the eco-mode or the normal mode and status of the LEDs in the memory or third recording the continued exhibition of abnormal behavior and status of the LEDs in memory if the module exhibiting abnormal behavior continues to exhibit abnormal behavior for a number of retriggers of execution of the self-diagnostic function.

15 In an embodiment, the method further provides transmitting information in the first recording and one of the second recording and the third recording to a mobile device.

In an embodiment, the method further provides initialization of the consumer device and upon completion of the initialization transitions to normal mode in response to being powered on.

20 In an embodiment, the method provides triggering the execution of the self-diagnostic function upon the expiration of a second timer and a determination that the module exhibiting abnormal behavior has not returned to the stable state.

25 In another embodiment, the method provides lighting the LED representing the module exhibiting abnormal behavior to yellow or orange, and wherein the LED representing the module exhibiting abnormal behavior is subsequently lighted to red if the abnormal behavior continues.

30 A second aspect provides a consumer device including a memory, a wireless communication interface, the wireless communication interface in communication with the memory and at least one processor, the memory in communication with the at least one processor, the at least one processor configured to light an LED representing a module of the consumer device exhibiting abnormal behavior in addition to an LED

representing power to the consumer device in eco-mode, upon detection in eco-mode of an event indicative of the module of the consumer device exhibiting abnormal behavior, trigger execution of a self-diagnostic function if the module continues to exhibition abnormal behavior for a given time period and transition the consumer device back to one of the eco-mode and the normal mode, upon detecting a return to a stable state of the module that exhibited abnormal behavior.

In an embodiment, the at least one processor of the consumer device is configured to transition the consumer device from a normal mode to an eco-mode, upon expiration of a first timer or upon depression of a button, wherein in the eco-mode, a light emitting diode (LED) representing power to the consumer device is lighted.

In an embodiment, the at least one processor of the consumer device is further configured to first record at least one of the event, a time of occurrence of the event and status of the LEDs in memory.

In an embodiment, the at least one processor of the consumer device is further configured to second record the transition of the consumer device back to the eco-mode or the normal mode and status of the LEDs in the memory or third record the continued exhibition of abnormal behavior and status of the LEDs in memory if the module exhibiting abnormal behavior continues to exhibit abnormal behavior.

In an embodiment, the wireless communications interface of the consumer device transmits information of the first recording and at least one of the second recording and the third recording to a mobile device.

In an embodiment, the consumer device is initialized and upon completion of the initialization transitions to normal mode in response to being powered on.

In an embodiment, the triggering of execution of the self-diagnostic function occurs upon the expiration of a second timer and a determination that the module exhibiting abnormal behavior has not returned to the stable state.

In another embodiment, the LED representing the module exhibiting abnormal behavior is lighted to yellow or orange, and wherein the LED representing the module exhibiting abnormal behavior is subsequently lighted to red if the abnormal behavior continues.

BRIEF DESCRIPTION OF THE DRAWINGS

The proposed method and apparatus is best understood from the following detailed description when read in conjunction with the accompanying drawings. The drawings include the following figures briefly described below:

5 Fig. 1 is a flow diagram of the intelligent diagnostic and LED behavior of a consumer device according to one or more embodiments of the invention.

Fig. 2 show the LEDs of a home gateway, which is a consumer device in normal operating mode according to one or more embodiments of the invention.

10 Fig. 3 depicts the LEDs when the consumer device is in an eco-mode according to one or more embodiments of the invention.

Fig. 4 depicts the LEDs when the consumer device is in an eco-mode and there is a fault (error, problem, issue) in the internet module according to one or more embodiments of the invention.

15 Fig. 5 depicts a consumer's mobile device having received a message from the consumer device indicating the LED status according to one or more embodiments of the invention.

Fig. 6 shows a consumer's mobile device having received a message from the consumer device indicating the LED status indicating that the error has not been resolved so the LED remains lighted according to one or more embodiments of the invention.

20 Fig. 7 is a flowchart of an exemplary embodiment of the consumer device operating in accordance with an embodiment of the proposed method.

Fig. 8 is a block diagram of an exemplary embodiment of the consumer device.

25 It should be understood that the drawing(s) are for purposes of illustrating the concepts of the disclosure and are not necessarily the only possible configuration for illustrating the disclosure.

DETAILED DESCRIPTION

30 The present description illustrates the principles of the present disclosure. It will thus be appreciated that those skilled in the art will be able to devise various arrangements that, although not explicitly described or shown herein, embody the principles of the disclosure and are included within its scope.

All examples and conditional language recited herein are intended for educational purposes to aid the reader in understanding the principles of the disclosure and the concepts contributed by the inventor to furthering the art, and are to be construed as being without limitation to such specifically recited examples and conditions.

5 Moreover, all statements herein reciting principles, aspects, and embodiments of the disclosure, as well as specific examples thereof, are intended to encompass both structural and functional equivalents thereof. Additionally, it is intended that such equivalents include both currently known equivalents as well as equivalents developed in the future, i.e., any elements developed that perform the same function, regardless of
10 structure.

 Thus, for example, it will be appreciated by those skilled in the art that the block diagrams presented herein represent conceptual views of illustrative circuitry embodying the principles of the disclosure. Similarly, it will be appreciated that any flow charts, flow diagrams, state transition diagrams, pseudocode, and the like represent various
15 processes which may be substantially represented in computer readable media and so executed by a computer or processor, whether or not such computer or processor is explicitly shown.

 The functions of the various elements shown in the figures may be provided through the use of dedicated hardware as well as hardware capable of executing software
20 in association with appropriate software. When provided by a processor, the functions may be provided by a single dedicated processor, by a single shared processor, or by a plurality of individual processors, some of which may be shared. Moreover, explicit use of the term “processor” or “controller” should not be construed to refer exclusively to hardware capable of executing software, and may implicitly include, without limitation,
25 digital signal processor (DSP) hardware, read only memory (ROM) for storing software, random access memory (RAM), and nonvolatile storage.

 Other hardware, conventional and/or custom, may also be included. Similarly, any switches shown in the figures are conceptual only. Their function may be carried out through the operation of program logic, through dedicated logic, through the interaction
30 of program control and dedicated logic, or even manually, the particular technique being selectable by the implementer as more specifically understood from the context.

In the claims hereof, any element expressed as a means for performing a specified function is intended to encompass any way of performing that function including, for example, a) a combination of circuit elements that performs that function or b) software in any form, including, therefore, firmware, microcode or the like, combined with appropriate circuitry for executing that software to perform the function. The disclosure as defined by such claims resides in the fact that the functionalities provided by the various recited means are combined and brought together in the manner which the claims call for. It is thus regarded that any means that can provide those functionalities are equivalent to those shown herein.

Embodiments of the proposed method and apparatus can support the LEDs' power-energy-saving mode and dynamically switch LEDs on and/or off or to a different color when the status changes or a problem (issue) arises. Embodiments of the proposed method and apparatus may also support the self-diagnostic (self-detection) feedback to confirm the issue with the related modules and help to avoid/resolve the above described limitations in all existing solutions/technologies. Additionally, embodiments of the proposed method and apparatus may be used to support the self-diagnostic (self-detection) information being sent to a consumer's mobile terminal, which will not only detect the issue with related module and confirm the principal problem, but more importantly to enable the consumer receive an error message rather than be forced to use the manual associated with the particular consumer device. This has the added advantage that there is less confusion and frustration on the consumer's part especially whether the consumer device is functioning (operating) properly in an eco-mode.

Some embodiments of the proposed method and apparatus, therefore, have three distinct operating modes. In a first mode (normal mode) all modules are functioning (operating) normally and all status LEDs are lighted. In the second mode (eco-mode), all modules are functioning (operating) normally and only the power LED is lighted. The consumer device transitions to eco-mode upon the user (consumer, subscriber) pressing an eco-button on the consumer device or upon the expiration of a timer (e.g., timer 1). In the third mode (error-eco-mode), a fault (error, abnormal behavior) of a module (at least one module) has occurred and been detected. In this case, the LED associated with (related) to the module exhibiting abnormal behavior (error, fault) is lighted as well as the

power LED. The status LED of the module exhibiting abnormal behavior (error, fault) may be simply lighted or may exhibit a yellow or orange color, which would aid (help) the user in diagnosing the situation of the consumer device. The other LEDs of the consumer device remain unlighted in error eco-mode. The event (abnormal behavior, error, fault) and the time of occurrence of the event are recorded and a timer (e.g., timer 2) is started. The module exhibiting abnormal behavior (error, fault) is checked to determine if it has stabilized. Checking that the module is stable means that the module is back to normal and not exhibiting any abnormal behavior. If the module has stabilized the module returns to eco-mode. If the module has not stabilized by the time that the timer (e.g., timer 2) has expired then self-diagnostics are triggered. Upon completion of the self-diagnostics then the module is once again checked to see if it has stabilized. If the module has stabilized then the status information is recorded for the module that had exhibited abnormal behavior (error, fault) and the recorded status information is transmitted (sent, forwarded) to the mobile device of the user (consumer). If the module that has been exhibiting abnormal behavior has not stabilized, then self-diagnostics may be re-executed if the retry limit for this module has not been exceeded. If the module that has been exhibiting abnormal behavior (error, fault) has not been stabilized and the retry limit for this module has been exceeded, then the status information is recorded for the module that has exhibited abnormal behavior (error, fault) and the recorded status information is transmitted (sent, forwarded) to the mobile device of the user (consumer). The status LED associated with the module that has been exhibiting abnormal behavior (error, fault) remains lighted but the color of the light may be changed to red to indicate a continuing failure of that module. This color change of the LED may further help the user (consumer) to diagnose the problem or aid the user (consumer) when reporting the problem to customer service for the consumer device.

Fig. 1 is a flow diagram of the intelligent diagnostic and LED behavior of a consumer device according to one or more embodiments of the invention. The proposed method and apparatus includes a power-saving LED system and dynamically diagnoses issues (problems) of the separate modules of the consumer device. An object is to recover the functionality of the module(s) having issues (problems). This is accomplished by sending messages related to the functionality of the consumer device to the consumer's

mobile terminal. As used herein, mobile terminal may include a mobile phone, personal digital assistant, laptop computer, notebook computer, tablet or any other mobile device capable of communicating with the consumer device concerning the LED actions, issues, or problems associated with the consumer device. When the consumer device is in the power-saving mode and an event occurs 115, which is associated with an LED, the related (associated) LED will turn on (power on) 145 until the triggering event is resolved and the consumer device state (status, condition) becomes stable (normal). Once the consumer device becomes stable 125 then the associated (related) LED returns to the power-saving mode and the LED is powered off (turned off) 120. If the consumer device is in normal mode and there are no abnormal conditions (errors, faults) then the consumer device may enter power-saving (eco) mode and the LEDs associated with (related to) the various modules (components) of the consumer device will be turned off (powered off) 110. If the consumer device is in normal mode 105 and one or more modules (components) have abnormal conditions (error states) then the consumer device will remain in normal (non-power-saving, non-eco) mode and the LEDs associated with (related to) the modules (components) of the consumer device which are exhibiting abnormal (error, erratic) behavior will remain lighted (turned on, powered on). The LED associated with (related to) the module exhibiting abnormal behavior may, however, transition to a different color, such as yellow or orange. The consumer device may send (transmit) a signal to the module(s) (components(s)) exhibiting abnormal (error, erratic, faulty) behavior to trigger a restart (re-initialization) of the effected module(s) (component(s)). In an alternative, the consumer device may initiate self-diagnostic functions (130, 135) a number of times and if the abnormal status (condition) remains, the consumer device can confirm there is something wrong with one or more modules (components) and transition to or remain in error eco-mode and keep the LEDs associated with (related to) the modules (components) exhibiting abnormal (error, erratic, faulty) behavior lighted. If, upon completion of the self-diagnostics, the module exhibiting abnormal behavior (errors, faults) becomes stable 140 then the consumer device transitions back to eco-mode. The number of times that the self-diagnostic functions are initiated may vary depending on the particular module (component), which is exhibiting abnormal (error, erratic) behavior.

The entire process of an embodiment shown in Fig. 1 and described above can be stored in the memory of the consumer device. As the device progresses through the various stages (phases) messages can be sent to the owner's mobile device.

5 The process for the operation of the consumer device described above may be as follows:

Step 1: Upon completion of the initialization process of the consumer device, all of the LEDs come into stable and normal operational status.

Step 2: The user may press the eco-mode button or by timer the eco-mode may be automatically triggered.

10 Step 3: When an event, such as a module (component) exhibiting abnormal behavior (error, erratic), the associated (related) LED status light is re-lighted (powered on, turned on) perhaps to a yellow or orange color to indicate a warning. Only the LED associated with (related to) the malfunctioning module will be re-lighted. The other LEDs remain in eco-mode. The consumer device will record the time that the first LED changes.

15 Step 4: When the malfunctioning module (component) continues to exhibit abnormal (error, erratic) behavior, the consumer device will trigger the self-diagnostic function for diagnosing the issue (problem). The triggering of the self-diagnostic function may also trigger a change in the color of the LED. If the LED was yellow or orange then the LED may be changed to red upon initiation of the self-diagnostic function.

20 Step 5: After execution of the self-diagnostic function, if the malfunctioning module (component) returns to normal, the consumer device returns to eco-mode and the LED will power off (turn off) and look like it did in step 2. If, after a number of times that the self-diagnostic function has been executed, the module (component) continues to exhibit abnormal behavior, then the LED associated with (related to) the abnormally
25 behaving module (component) will remain lighted. Again, the color of the LED associated with (related to) the module exhibiting abnormal behavior may change color to red to indicate a continuing problem (issue, error, fault). The number of times that the self-diagnostic function will be executed may vary with the particular module (component) and the LEDs appear as indicated in step 3. The consumer device will
30 record the final LED status information.

Step 6: The consumer device sends (transmits, forwards) the time of the LED first lighting and the final LED status information to the user-end mobile terminal. The LED status information may be sent (transmitted, forwarded) to the user-end mobile terminal whether or not the consumer device is in eco-mode.

5 The proposed method and apparatus for Intelligent Diagnostics and Reporting benefits the customer and engineering (consumer device manufacturer) by providing an easy way to diagnose malfunctions (abnormal behavior) of a consumer device. Fig. 2 show the LEDs (205 – 245) and the eco button 250 of a home gateway, which is a consumer device, in normal operating mode. The internet LED of a home gateway
10 (consumer device) is used to explain the operation of the proposed method and apparatus.

The home gateway completes initialization and all of the LEDs are in normal status and all the LEDs are lighted as shown in Fig. 2.

When the user presses the eco-mode button 250 or when a time has passed which automatically triggers the eco-mode, the home gateway goes into eco-mode as shown in
15 Fig. 3 where all of the LEDs (210 – 245) are in power off mode except for the power LED 205, which is lighted.

When the home gateway is in eco-mode and there is a fault (malfunction, error, abnormal behavior) in the internet module (component), then the LED associated with (related to) the internet module (component) 215 will re-light and the other LEDs will
20 remain in eco-mode (not lighted except power LED is lighted) as shown in Fig 4.

When the internet module (component) continues to exhibit abnormal behavior (error, erratic, fault) then the home gateway may send (transmit, forward) an event to trigger the self-diagnostic function for diagnosing errors (faults, malfunctions) of the internet module (component). After a number of times executing the self-diagnostic
25 function, the self-diagnostic function may trigger re-initialization of the internet module. The number of times that self-diagnostic function is executed may vary with the module (component).

After the self-diagnostic function has completed and/or the internet module (component) has been re-initialized then the home gateway returns to normal operational
30 status and the internet LED 215 (un-lighted) will return to eco-mode. The home gateway LEDs (205 – 245) will look as they did in Fig. 3. The home gateway may send (transmit,

forward) the time that the internet LED first changed (to re-light) 505 and the time of the final internet LED status information to the user-end mobile terminal 510 as shown in Fig. 5.

After the self-diagnostic function has executed a number of times and re-initialization of the internet module (component) has also failed, then the internet LED 215 will remain lighted as shown in Fig. 4 (internet and power LED are lighted). The internet LED 215 may be lighted red to indicate continuing abnormal behavior. The home gateway may send (transmit, forward) the time that the internet LED first changed (to re-light) and the time of the final internet LED status information 605 to the user-end mobile terminal as shown in Fig. 6, showing that an error (fault) remains unresolved.

It should be noted that Figs. 5 and 6 are “either or”. That is, the recording of the occurrence of the event (first recording) will be transmitted to and displayed on the user’s mobile device in both Figs. 5 and 6. However, then either the second recording of the return to stable status (Fig. 5) will be transmitted to and displayed on the user’s mobile device or the third recording of the continued abnormal behavior (error, fault) will be transmitted to and displayed on the user’s mobile device (Fig.6).

Fig. 7 is a flowchart of an exemplary embodiment of the consumer device operating in accordance with the principles of the proposed method. At 705, the consumer device is initialized. The initialization is generally a response to powering the consumer device on and includes initialization of the operation of the device in terms of eco mode, the LEDs and the self-diagnostic functions of the proposed method but also initialization of the operational features and functions of the consumer device as it was intended to operate. This is, of course, different for each type of consumer device. Just before completion of the initialization process, a first timer is started. The first timer may be a count-up or count-down timer. Upon completion of the initialization process, the consumer device transitions to normal mode at 710. At 715 a test is performed to determine if the consumer pressed the eco-mode button. If the user has not pressed the eco button then at 720 a test is performed to determine if the first timer has expired (gone to zero in a count-down timer or reached a limit in a count-up timer). If the first timer has not expired, then the consumer device remains in normal mode. If the first timer has expired, then the consumer device transitions to eco-mode at 725. If the eco button was

pressed by the user, then the consumer device transitions to eco-mode at 725. That is, the consumer device may transition to eco-mode either when the user (consumer) presses the eco-button or upon expiration of a timer (e.g., timer 1). At 730, a test is performed to determine if an event, such as a module (component) exhibiting abnormal behavior (error, erratic, faulty) has occurred. If such an event has not occurred, then the consumer device remains in eco-mode (returns to 725). If such an event has occurred, then the LED associated with the module exhibiting the abnormal behavior is lighted, perhaps initially to a yellow or orange color indicating a warning. Only the LED associated with (related to) the malfunctioning module will be re-lighted. The other LEDs remain unlighted. At 740, the consumer device will record the time that the first LED changes/is lighted. A second timer is started. The second timer may be a count-up or count-down timer. At 740, the event and the time is recorded in memory/storage/a database. At 745, a test is performed to determine if the second timer has expired (gone to zero in a count-down timer or reached a limit in a count-up timer). If the second timer has not expired, then 745 is repeatedly executed until the second timer has expired. Once the second timer has expired then a test is performed at 750 to determine if the module that was exhibiting abnormal behavior has returned to a stable state. Checking that the module is stable means that the module is back to normal and not exhibiting any abnormal behavior. If the module that was exhibiting abnormal behavior has returned to a stable state, then the processing proceeds to eco-mode 725. In an alternative embodiment, instead of processing proceeding to eco-mode, it is possible for the consumer device to return to normal mode, which would then transition to eco-mode upon the depression of the eco button or upon the expiration of a timer (e.g., timer 1). If the module that was exhibiting abnormal behavior has not returned to a stable state, then at 755 a self-diagnostic function is triggered. Upon completion of a self-diagnostic function, a test is performed at 760 to determine if the module that was exhibiting abnormal behavior has returned to a stable state. It should be noted that as part of the self-diagnostic function, the module that was exhibiting abnormal behavior may be re-initialized. It should also be noted that the self-diagnostic function may initiate changing the already lighted LED to red if the LED was not just lighted upon the detection of an event but was lighted yellow or orange. If the module that was exhibiting abnormal behavior has not returned to a stable state, then at

765 a test is performed to determine if the number of retries for performing the self-diagnostic function has been exceeded. The number of retries may vary depending upon which module was exhibiting abnormal behavior. If the number of retries for performing the self-diagnostic function has not been exceeded, then processing proceeds to 755. If
5 the number of retries for performing the self-diagnostic function has been exceeded, then at 770 the status information for the module related to the lighted LED is recorded (stored) in memory/storage/ a database. If, after a number of times that the self-diagnostic function has been executed, the module (component) continues to exhibit abnormal behavior, then the LED associated with (related to) the abnormally behaving module
10 (component) will remain lighted and may be red in color. The number of times that the self-diagnostic function will be executed may vary with the particular module (component). At 775 the recorded status information is transmitted to the consumer's mobile device. If at 760 the module that was exhibiting abnormal behavior is now stable, then at 780 the status information for the module related to the lighted LED is recorded
15 (stored) in memory/storage/ a database. At 785, the recorded status information is transmitted to the consumer's mobile device. Processing then proceeds to eco-mode 725. In an alternative embodiment, instead of processing proceeding to eco-mode, it is possible for the consumer device to return to normal mode, which would then transition to eco-mode upon the depression of the eco button or upon the expiration of a timer (e.g.,
20 timer 1). The LED status information may be sent (transmitted, forwarded) to the user-end mobile terminal whether or not the consumer device is in eco-mode.

It should be noted that the recording of the occurrence of the event (first recording) 740 will be transmitted to and displayed on the user's mobile device. However, then either the second recording of the return to stable status (shown in Fig. 5) will be
25 transmitted to and displayed on the user's mobile device (780, 785) or the third recording of the continued abnormal behavior (error, fault) will be transmitted to and displayed on the user's mobile device (770, 775) shown in Fig. 6.

Fig. 8 is a block diagram of an exemplary embodiment of the consumer device 800. The consumer device includes a processor/controller/CPU 805, a
30 memory/storage/database unit 855, a wireless communications interface module (unit) 860, and an eco button 820. The processor and other assorted modules not shown perform

the function for which the consumer device was designed. Additionally, the processor/controller/CPU 805 may include modules (which may be implemented in hardware, software and/or firmware or any combination thereof including application specific integrated circuits (ASICs, reduced instruction set computers (RISCs) and/or field programmable gateways (FPGAs)). Such modules may be fewer or greater in number than those shown on Fig. 8 which is an exemplary implementation. There may be a single self-diagnostic function (module) which is started at different points depending upon which module is exhibiting abnormal behavior or there may be a self-diagnostic function (module) for each module of the consumer device. The wireless communications interface module (unit) transmits the recorded status information of any module that exhibited abnormal behavior and the status of the LEDs associated with the module that exhibited abnormal behavior. The recorded status information is communicated to the wireless communications interface module (unit) 860 by the memory/storage unit 855. The wireless communications interface module (unit) transmits the recorded status information using antenna 865.

The processor/controller/CPU includes the modules in this exemplary embodiment that are within the box formed by dotted lines. When the consumer device is powered on the consumer device commences initialization 810. The initialization is generally a response to powering the consumer device on and includes initialization of the operation of the device in terms of eco mode, the LEDs and the self-diagnostic functions of the proposed method but also initialization of the operational features and functions of the consumer device as it was intended to operate. This is, of course, different for each type of consumer device. Just before completion of the initialization process, a first timer 825 is started. The first timer 825 may be a count-up or count-down timer. Upon completion of the initialization process, the consumer device transitions to normal mode at 815. The normal mode module signals the LED control module 835 to light all of the LEDs. If the consumer pressed the eco-mode button 820 or the first timer 825 has expired (gone to zero in a count-down timer or reached a limit in a count-up timer) then normal mode module 815 is notified and the normal mode module starts the eco mode module 830. The eco mode module 830 signals the LED control module 835 to turn off (power off) all LEDs except the power on LED.

The event monitoring module 840 continually monitors the functioning of the modules of the consumer device. As long as an event indicating abnormal behavior has not occurred, then the consumer device remains in eco mode. If an event, such as a module (component) exhibiting abnormal behavior (error, erratic) has occurred then the event monitoring module 840 signals the LED control module 835 and the LED associated with (related to) the module exhibiting abnormal behavior is lighted, perhaps initially to a yellow or orange color indicating a warning. Only the LED associated with (related to) the malfunctioning module will be re-lighted. The other LEDs remain in eco-mode. The event monitoring module 840 records the time that the first LED changes/is lighted in memory/storage unit 855. A second timer 845 is started by the event monitoring module 840. The second timer may be a count-up or count-down timer.

If the second timer 845 has not expired, then event monitoring continues until the second timer 845 has expired. Once the second timer 845 has expired (gone to zero in a count-down timer or reached a limit in a count-up timer) the event monitoring function (module) 840 determines if the module that was exhibiting abnormal behavior has returned to a stable state. If the module that was exhibiting abnormal behavior has returned to a stable state then the consumer device 800 returns to normal mode 815 or alternatively, return to eco-mode and the time of the return to the stable state is recorded by event monitoring function (module) 840 in memory 855.

If the module that was exhibiting abnormal behavior has not returned to a stable state, then the event monitoring module 840 signals the self-diagnostic function (module) 850 to execute. Upon completion of execution of the self-diagnostic function a determination is made by the self-diagnostic function (module) 850 if the module that was exhibiting abnormal behavior has returned to a stable state. It should be noted that as part of the self-diagnostic function, the module that was exhibiting abnormal behavior may be re-initialized. It should also be noted that the self-diagnostic function may initiate changing the already lighted LED to red if the LED was not just lighted upon the detection of an event but was lighted yellow or orange. If the module that was exhibiting abnormal behavior has not returned to a stable state, then the self-diagnostic function (module) 850 determines if the number of retries for performing the self-diagnostic function has been exceeded. The number of retries may vary depending upon which

module was exhibiting abnormal behavior. If the number of retries for performing the self-diagnostic function has not been exceeded, then the self-diagnostic function (module) 850 continues executing or re-executes.

If the number of retries for performing the self-diagnostic function has been exceeded, then the status information for the module related to the lighted LED is recorded (stored) in memory/storage/ a database 855. If, after a number of times that the self-diagnostic function has been executed, the module (component) continues to exhibit abnormal behavior, then the self-diagnostic function (module) 850 signals the LED control module 835 to light the LED or change the color of the LED associated with (related to) the abnormally behaving module (component). For example, the color of the LED may be changed to red. The number of times that the self-diagnostic function will be executed may vary with the particular module (component). The memory/storage/database unit may be signaled by either the event monitoring module (unit) 840 or the self-diagnostic module (function) to transmit the recorded status information to the consumer's mobile device. The LED status information may be sent (transmitted, forwarded) to the user-end mobile terminal whether or not the consumer device is in eco-mode.

It is to be understood that the proposed method and apparatus may be implemented in various forms of hardware, software, firmware, special purpose processors, or a combination thereof. Special purpose processors may include application specific integrated circuits (ASICs), reduced instruction set computers (RISCs) and/or field programmable gate arrays (FPGAs). Preferably, the proposed method and apparatus is implemented as a combination of hardware and software. Moreover, the software is preferably implemented as an application program tangibly embodied on a program storage device. The application program may be uploaded to, and executed by, a machine comprising any suitable architecture. Preferably, the machine is implemented on a computer platform having hardware such as one or more central processing units (CPU), a random access memory (RAM), and input/output (I/O) interface(s). The computer platform also includes an operating system and microinstruction code. The various processes and functions described herein may either be part of the microinstruction code or part of the application program (or a combination thereof),

which is executed via the operating system. In addition, various other peripheral devices may be connected to the computer platform such as an additional data storage device and a printing device.

It should be understood that the elements shown in the figures may be implemented in various forms of hardware, software or combinations thereof. Preferably, these elements are implemented in a combination of hardware and software on one or more appropriately programmed general-purpose devices, which may include a processor, memory and input/output interfaces. Herein, the phrase "coupled" is defined to mean directly connected to or indirectly connected with through one or more intermediate components. Such intermediate components may include both hardware and software based components.

It is to be further understood that, because some of the constituent system components and method steps depicted in the accompanying figures are preferably implemented in software, the actual connections between the system components (or the process steps) may differ depending upon the manner in which the proposed method and apparatus is programmed. Given the teachings herein, one of ordinary skill in the related art will be able to contemplate these and similar implementations or configurations of the proposed method and apparatus.

For purposes of this application and the claims, using the exemplary phrase "**at least one of A, B and C,**" the phrase means "only A, or only B, or only C, or any combination of A, B and C."

CLAIMS

1. A method, said method comprising:

5 lighting (735) an LED representing a module of a consumer device exhibiting abnormal behavior in addition to an LED representing power to the consumer device in eco-mode, upon detection (730) in the eco-mode of an event indicative of the module of the consumer device exhibiting abnormal behavior;

triggering execution (755) of a self-diagnostic function if said module continues to exhibit abnormal behavior for a given period of time; and

10 transitioning (725) said consumer device to one of said eco-mode and said normal mode, upon detecting a return to a stable state of said module that exhibited abnormal behavior.

2. The method according to claim 1, further comprising transitioning (725) a consumer device from a normal mode to an eco-mode, upon expiration of a first timer (720) or upon depression of a button (715), wherein in said eco-mode, a light emitting diode (LED) representing power to the consumer device is lighted.

3. The method according to claim 1 or 2, further comprising first recording (740) at least one of said event, a time of occurrence of said event and status of said LEDs in memory.

20 4. The method according to claim 3, further comprising second recording (780) said transition of said consumer device to said eco-mode or said normal mode and status of said LEDs in said memory or third recording (770) said continued exhibition of abnormal behavior and status of said LEDs in memory if said module exhibiting abnormal behavior continues to exhibit abnormal behavior for a number of retriggers of execution of said self-diagnostic function.

25 5. The method according to claim 4, further comprising transmitting information (740, 775, 785) in said first recording and at least one of said second recording and said third recording to a mobile device.

30 6. The method according to any of said preceding claims, wherein said consumer device is initialized (705) and upon completion of said initialization transitions (710) to normal mode in response to being powered on.

7. The method according to any of the preceding claims, wherein said triggering of execution of said self-diagnostic function occurs upon the expiration of a second timer (745) and a determination (750) that the module exhibiting abnormal behavior has not returned to said stable state.

5 8. The method according to any of the preceding claims, wherein said LED representing the module exhibiting abnormal behavior is lighted to yellow or orange, and wherein said LED representing the module exhibiting abnormal behavior is subsequently lighted to red if said abnormal behavior continues.

9. A consumer device, comprising:

10 a memory;
a wireless communication interface, said wireless communication interface in communication with said memory; and

at least one processor, said memory in communication with said at least one processor, said at least one processor configured to:

15 light (835) an LED representing a module of said consumer device exhibiting abnormal behavior in addition to an LED representing power to the consumer device in eco-mode, upon detection (840) in eco-mode of an event indicative of the module of the consumer device exhibiting abnormal behavior;

20 trigger execution (850) of a self-diagnostic function if said module continues to exhibition abnormal behavior for a given time period; and

transition (830) said consumer device back to one of said eco-mode and said normal mode, upon detecting a return to a stable state of said module that exhibited abnormal behavior.

25 10. The consumer device according to claim 9, wherein said at least one processor is configured to transition (815) the consumer device from a normal mode to an eco-mode, upon expiration of a first timer (825) or upon depression of a button (820), wherein in said eco-mode, a light emitting diode (LED) representing power to the consumer device is lighted.

11. The consumer device according to claim 9 or 10, wherein said at least one processor is further configured to first record (840, 855) at least one of said event, a time of occurrence of said event and status of said LEDs in memory.

12. The consumer device according to claim 11, wherein said at least one processor is configured to second record (840, 855) said transition of said consumer device back to said eco-mode or said normal mode and status of said LEDs in said memory or third record (850, 855) said continued exhibition of abnormal behavior and status of said LEDs in memory if said module exhibiting abnormal behavior continues to exhibit abnormal behavior for a number of retries executing said self-diagnostic function.

13. The consumer device according to claim 12, wherein said wireless communications interface transmits information (860) of said first recording and at least one of said second recording and said third recording to a mobile device.

14. The consumer device according to any of claims 9 to 13, wherein said consumer device is initialized (810) and upon completion of said initialization transitions (815) to normal mode in response to being powered on.

15. The consumer device according to any of claims 9 to 14, wherein said triggering (850) of execution of said self-diagnostic function occurs upon the expiration of a second timer (845) and a determination (840) that the module exhibiting abnormal behavior has not returned to said stable state.

16. The consumer device according to any of claims 9 to 14, wherein said LED representing the module exhibiting abnormal behavior is lighted to yellow or orange, and wherein said LED representing the module exhibiting abnormal behavior is subsequently lighted to red if said abnormal behavior continues.

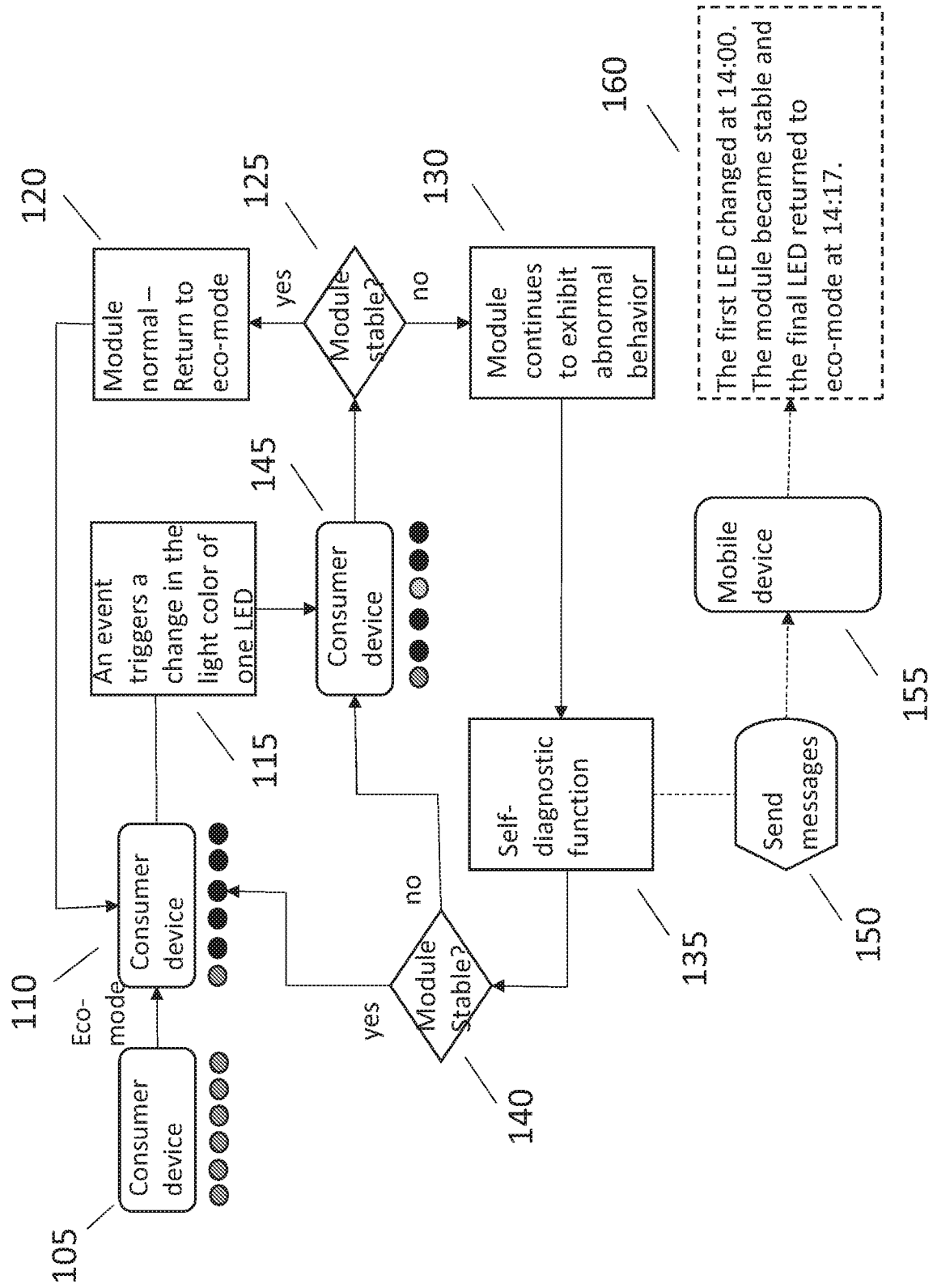


Fig. 1

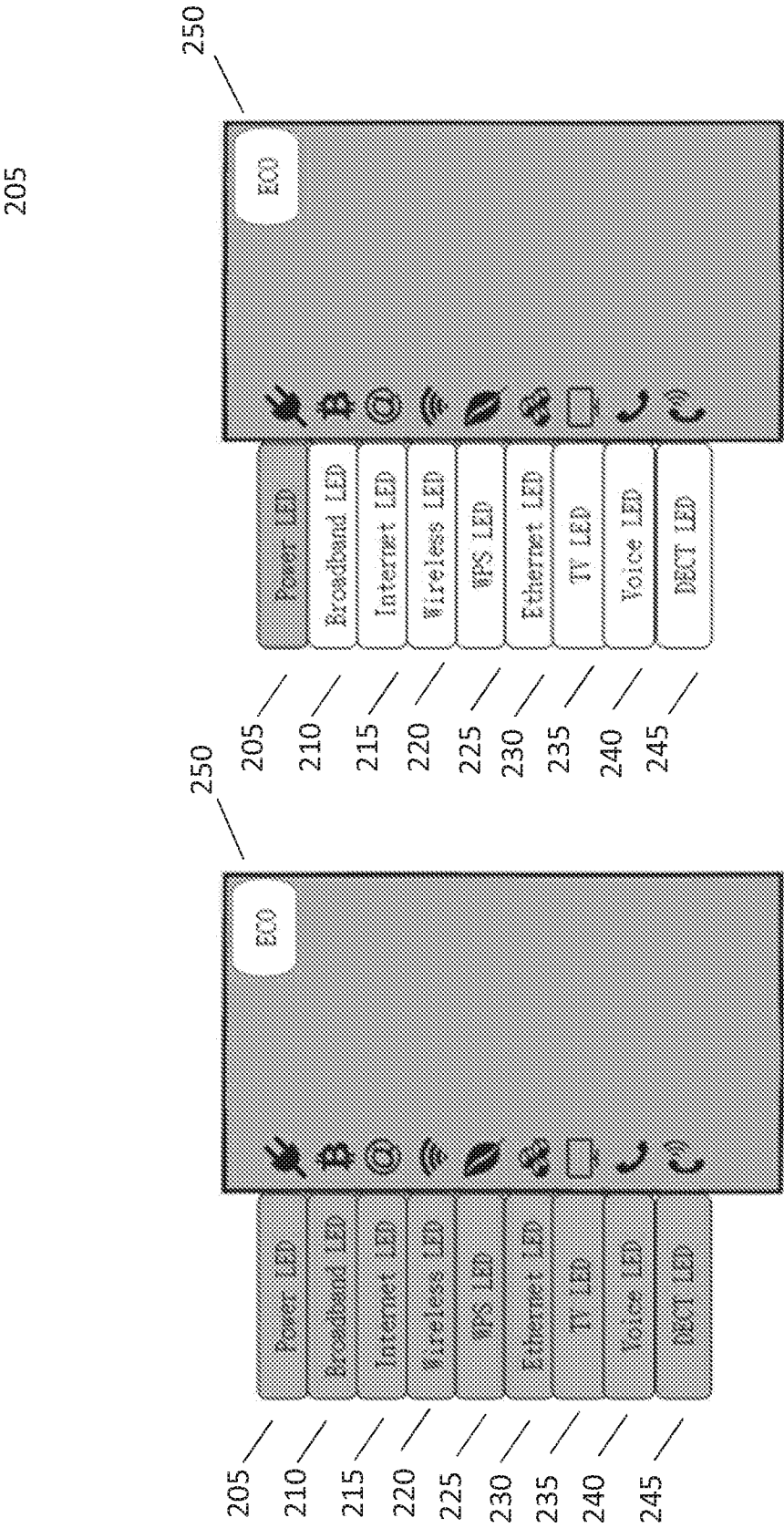


Fig. 3

Fig. 2

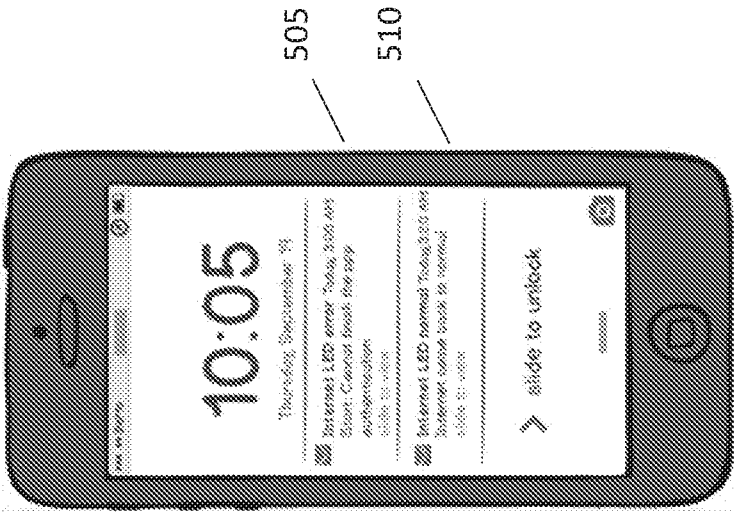


Fig. 5

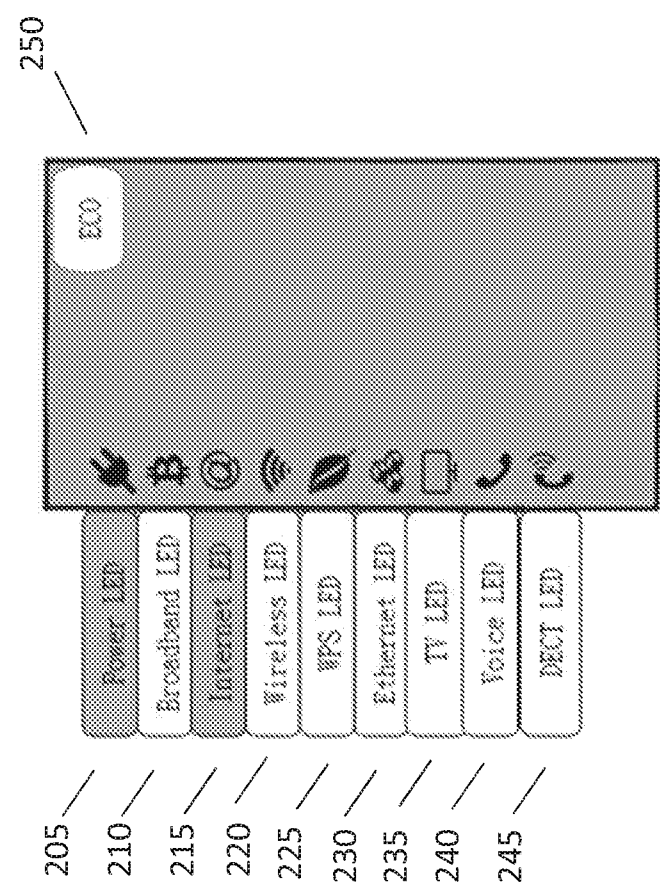


Fig. 4

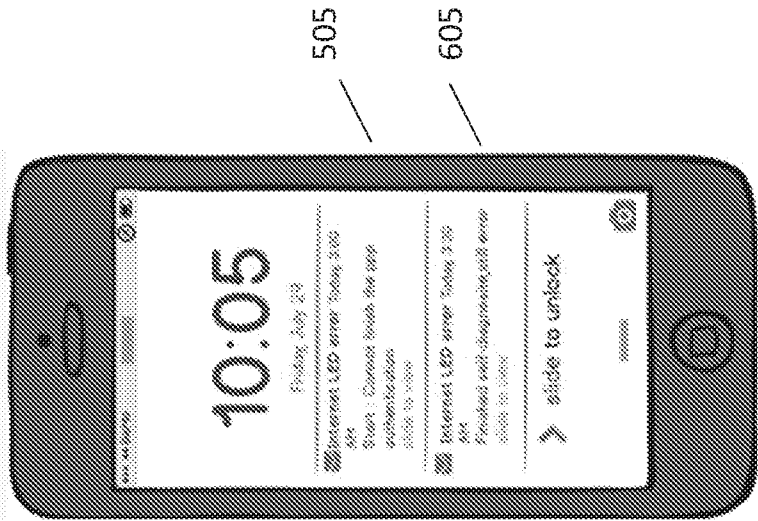


Fig. 6

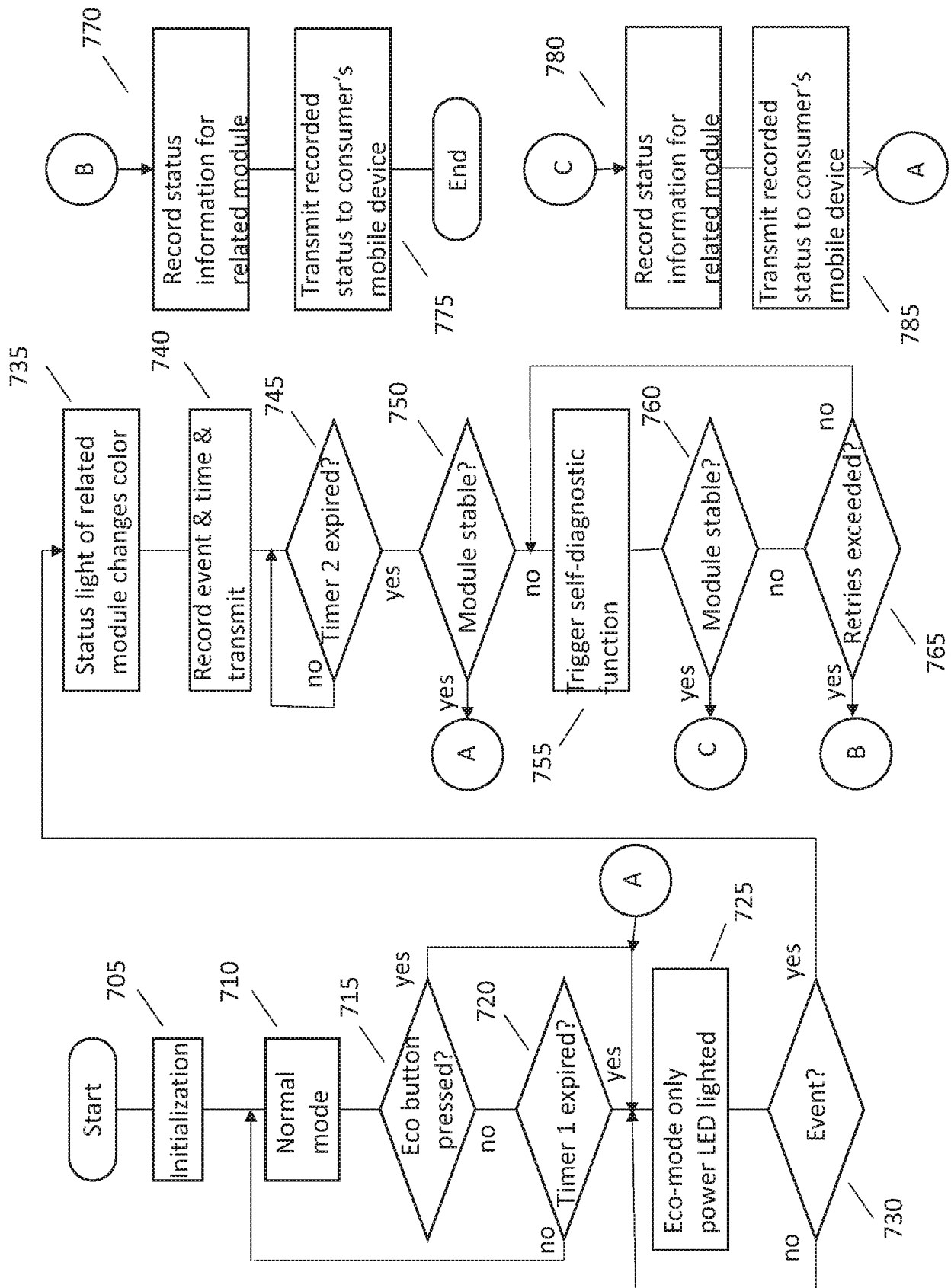


Fig. 7

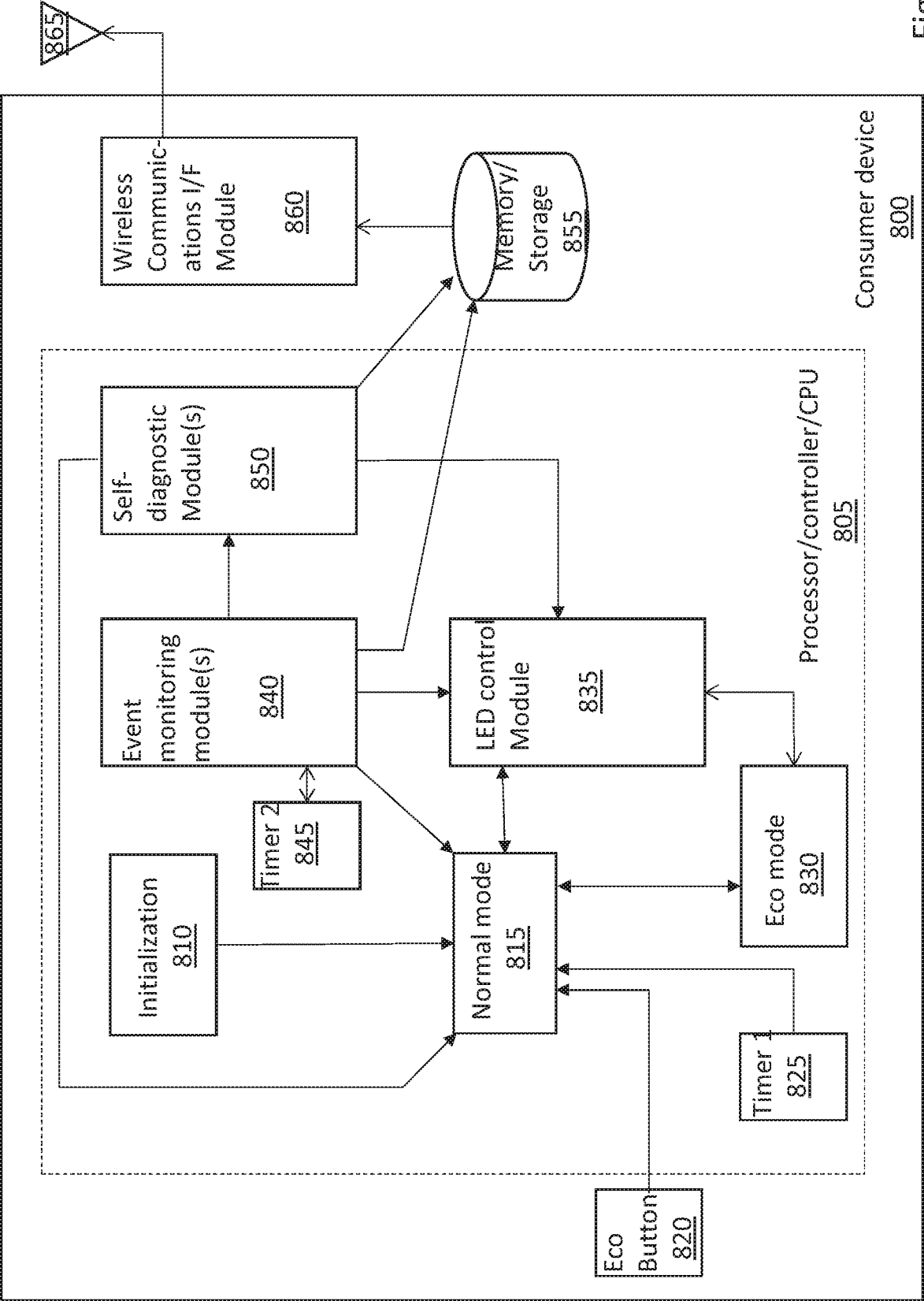


Fig. 8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2016/107316

A. CLASSIFICATION OF SUBJECT MATTER

G08B 5/22(2006.01)i

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)

G08B

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 practicable, search terms used)

WPI,EPODOC,CNPAT,CNKI:gateway,router,LED,ECO,energy-saving,abnormal,stable,steady,timer

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012068821 A1 (VAN OOST, KOEN ET AL.) 22 March 2012 (2012-03-22) description, paragraphs [0022]-[0038], figures 1-4	1-16
A	CN 101014174 A (HUAWEI TECHNOLOGIES CO., LTD.) 08 August 2007 (2007-08-08) the whole document	1-16
A	US 5938772 A (COMPAQ COMPUTER CORPORATION) 17 August 1999 (1999-08-17) the whole document	1-16

☐ Further documents are listed in the continuation of Box C.☒ 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 application or patent 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

02 August 2017

Date of mailing of the international search report

24 August 2017

Name and mailing address of the ISA/CN

STATE INTELLECTUAL PROPERTY OFFICE OF THE
P.R.CHINA
6, Xitucheng Rd., Jimen Bridge, Haidian District, Beijing
100088
China

Authorized officer

ZHANG, Yan

Facsimile No. (86-10)62019451

Telephone No. (86-10)62413647

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2016/107316

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				JP	5639644	B2	10 December 2014
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				WO	2008089653	A1	31 July 2008
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