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(54) Security system

(57) A security device including an application processor configured for accepting data input from components of the device and configured for providing instructions to the components, and a visual notice component configured for providing an indication when the security device is monitoring a protected area, characterized by further including a pane break detector configured for communicating signals which may indicate pane breakage to the application processor, the pane break detector including an accelerometer configured for communicating with the application processor, and a microphone configured for communicating with the application processor. A security device including a visual notice component, characterized by further including a communication component, in which the visual notice component is configured to provide an indication that the security device is monitoring a protected area based, at least in part, on instructions received from a server at an off-the-premises location via the communication component. A device including a solar panel, and a visual notice component, characterized by the visual notice component including an area substantially overlapping the area of the solar panel. Related apparatus and methods are also described.

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Description

FIELD AND BACKGROUND OF THE INVENTION

[0001] The present invention, in some embodiments thereof, relates to a security system, and, more particularly, but not exclusively, to a security system which includes a security device which provides visual notice of an alarm protected area.

[0002] Security systems are known which monitor inside spaces, such as rooms.

[0003] Some security systems are known which provide a glass break detector, to detect when and if a window is broken.

[0004] Some alarm protected areas provide a notice to the public at the outside of the area.

[0005] Background art includes:

[0006] US patent number 7,187,280 to Ko;

[0007] Published US patent application 2006/0273898 of Hagiwara;

[0008] Published United Kingdom patent application number GB 2 457 102 of Schaar;

[0009] Published Japan patent application number 01223051 of Mazda Motor Corp.;

[0010] Published Japan patent application number 2004005057 of Matsushita Electric Works Ltd.; and

[0011] Published Germany patent application number DE29609521 of Oskar D. Biffar GmbH & Co.

SUMMARY OF THE INVENTION

[0012] The present invention, in some embodiments thereof, includes a security device which is placed at or mounted on a transparent opening, such as a glass window or door. The security device displays, toward an outside of the glass, a notice of a protected area visible to the public.

[0013] In some embodiments, the security device functions, among other security functions, as a glass break detector.

[0014] In some embodiments, the glass break detector includes an acoustic detector, to detect glass break sounds. In some embodiments, the glass break detector includes an accelerometer, to detect a shock of glass breaking, and/or movement caused by forcing open a window. In some embodiments, the glass break detector includes both the acoustic detector and the accelerometer.

[0015] In some embodiments, the device includes a volume or area monitor.

[0016] In some embodiments, the device takes advantage of the transparent opening, and is wholly or partly energized by a solar panel which is positioned facing the transparent opening.

[0017] In some embodiments, the security device displays the notice of a protected area overlaid on the solar panel.

[0018] According to an aspect of some embodiments of the present invention there is provided a security device including an application processor configured for accepting data input from components of the device and configured for providing instructions to the components, and a visual notice component configured for providing an indication when the security device is monitoring a protected area, characterized by further including a pane break detector configured for communicating signals which may indicate pane breakage to the application processor, the pane break detector including an accelerometer configured for communicating with the application processor, and a microphone configured for communicating with the application processor.

[0019] According to some embodiments of the invention, further including a power component, which includes a solar panel, for providing electrical power to the device.

[0020] According to some embodiments of the invention, the security device is adapted to use the microphone to pick up sounds for some period of time after detecting pane breakage.

[0021] According to some embodiments of the invention, the security device is further adapted to communicate the sounds to a remote unit.

[0022] According to some embodiments of the invention, the visual notice component includes an area substantially overlapping the area of the solar panel.

[0023] According to some embodiments of the invention, the visual notice component includes an area substantially greater than an area of the solar panel.

[0024] According to some embodiments of the invention, the visual notice component is configured to provide an indication that the security device is monitoring the protected area based, at least in part, on instructions from a remote unit.

[0025] According to some embodiments of the invention, the remote unit is one of a group consisting of a gateway, a server, a remote computer, and a mobile device.

[0026] According to an aspect of some embodiments of the present invention there is provided a security system including a first security device according to any one of the above-described embodiments, and a gateway adapted to communicate with the first security device and to communicate with a remote security center.

[0027] According to some embodiments of the invention, further including a camera for imaging the pane upon receiving an instruction from the first security device.

[0028] According to an aspect of some embodiments of the present invention there is provided a method of monitoring a window for breakage including attaching a security device including a microphone and an accelerometer to a window, using the accelerometer to detect a first signal produced by breakage of a pane of the window to which the security device is attached, using the microphone to detect a second signal produced by a sound of breakage of the pane of the window, using an application processor connected to the microphone and to the accelerometer for analyzing at least one of the first signal

and the second signal and detecting pane breakage.

[0029] According to some embodiments of the invention, further including monitoring a plurality of windows for breakage, using the microphone to detect a third signal produced by a sound of breakage of a pane of another window, and using the application processor for also analyzing the third signal.

[0030] According to some embodiments of the invention, further including recording the sound based, at least in part, on the analyzing at least one of the first signal and the second signal.

[0031] According to an aspect of some embodiments of the present invention there is provided a security device including a visual notice component, characterized by further including a communication component, in which the visual notice component is configured to provide an indication that the security device is monitoring a protected area based, at least in part, on instructions received from a server at an off-the-premises location via the communication component.

[0032] According to an aspect of some embodiments of the present invention there is provided a device including a solar panel, and a visual notice component, characterized by the visual notice component including an area substantially overlapping the area of the solar panel.

[0033] According to an aspect of some embodiments of the present invention there is provided a security device including a power component, which includes a solar panel, for providing electrical power to the device, an application processor for accepting data input from components of the device and providing instructions to the components, and a visual notice component for providing an indication when the security device is monitoring a protected area, characterized by further including a pane break detector for providing indication of pane breakage to the application processor, the pane break detector including an accelerometer connected to the application processor, and a microphone connected to the application processor.

[0034] According to some embodiments of the invention, the accelerometer is adapted to produce an interrupt for waking up the application processor.

[0035] According to some embodiments of the invention, the security device is adapted to use the microphone to pick up sounds for some period of time after detecting pane breakage. According to some embodiments of the invention, the security device is further adapted to communicate the sounds to a remote unit. According to some embodiments of the invention, the security device is further adapted to record the sounds.

[0036] According to some embodiments of the invention, the pane break detector instructs a video camera to image the pane for some period of time after detecting pane breakage.

[0037] According to some embodiments of the invention, the visual notice component includes an area substantially greater than an area of the solar panel. According to some embodiments of the invention, the visual notice component provides providing an indication that the security device is monitoring the protected area based, at least in part, on instructions from the remote unit. According to some embodiments of the invention, the visual notice component includes an area substantially overlapping the area of the solar panel.

[0038] According to an aspect of some embodiments of the present invention there is provided a security system including a first security device according to any one of the above-mentioned embodiments, and a gateway adapted to communicate with the first security device and to communicate with a remote security center.

[0039] According to some embodiments of the invention, further including a camera for imaging the pane upon receiving an instruction from the first security device.

[0040] According to some embodiments of the invention, the visual notice component provides an indication that the security device is monitoring the protected area based, at least in part, on instructions from the remote security center.

[0041] According to an aspect of some embodiments of the present invention there is provided a method of monitoring a window for breakage including attaching a security device including a microphone and an accelerometer to a window, using the accelerometer to detect a first signal produced by breakage of a pane of the window to which the security device is attached, using the microphone to detect a second signal produced by a sound of breakage of the pane of the window, using an application processor connected to the microphone and to the accelerometer for analyzing at least one of the first signal and the second signal and detecting pane breakage.

[0042] According to some embodiments of the invention, further including monitoring a plurality of windows for breakage, using the microphone to detect a third signal produced by a sound of breakage of a pane of another window, and using the application processor for analyzing the third signal.

[0043] According to some embodiments of the invention, further including recording the sound. According to some embodiments of the invention, further including using the microphone to pick up sounds for some period of time after detecting pane breakage, and communicating the sounds to a gateway. According to some embodiments of the invention, further including the security device instructing a video camera controlled by the gateway to image for some period of time after detecting pane breakage.

[0044] According to an aspect of some embodiments of the present invention there is provided a device including a solar panel, and a visual notice component, characterized by the visual notice component including an area substantially overlapping the area of the solar panel.

[0045] Unless otherwise defined, all technical and/or scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which the invention pertains. Although methods and materials similar or equivalent to those described herein

can be used in the practice or testing of embodiments of the invention, exemplary methods and/or materials are described below. In case of conflict, the patent specification, including definitions, will control. In addition, the materials, methods, and examples are illustrative only and are not intended to be necessarily limiting.

[0046] Implementation of the method and/or system of embodiments of the invention can involve performing or completing selected tasks manually, automatically, or a combination thereof. Moreover, according to actual instrumentation and equipment of embodiments of the method and/or system of the invention, several selected tasks could be implemented by hardware, by software or by firmware or by a combination thereof using an operating system.

[0047] For example, hardware for performing selected tasks according to embodiments of the invention could be implemented as a chip or a circuit. As software, selected tasks according to embodiments of the invention could be implemented as a plurality of software instructions being executed by a computer using any suitable operating system. In an exemplary embodiment of the invention, one or more tasks according to exemplary embodiments of method and/or system as described herein are performed by a data processor, such as a computing platform for executing a plurality of instructions. Optionally, the data processor includes a volatile memory for storing instructions and/or data and/or a non-volatile storage, for example, a magnetic hard-disk and/or removable media, for storing instructions and/or data. Optionally, a network connection is provided as well. A display and/or a user input device such as a keyboard or mouse are optionally provided as well.

BRIEF DESCRIPTION OF THE DRAWINGS

[0048] Some embodiments of the invention are herein described, by way of example only, with reference to the accompanying drawings. With specific reference now to the drawings in detail, it is stressed that the particulars shown are by way of example and for purposes of illustrative discussion of embodiments of the invention. In this regard, the description taken with the drawings makes apparent to those skilled in the art how embodiments of the invention may be practiced.

[0049] In the drawings:

Figure 1A is a simplified illustration of an example embodiment of a security device, attached, for example, to an inside of a window pane in, for example, a room;

Figure 1B is a simplified illustration of an example embodiment of a security system which includes a security device, the system and the device constructed and operational according to an example embodiment of the invention;

Figure 1C is a simplified illustration of a security device in which a visual notice component operates, at least in part, based on instructions received from a server at an off-the-premises location according to an example embodiment of the invention;

Figure 1D is a simplified illustration of a security device in which a visual notice component operates, at least in part, based on instructions received from a server at an off-the-premises location, according to another example embodiment of the invention;

Figure 2A is a simplified illustration of a solar array and a visual notice unit on a side of an example embodiment of a security device;

Figure 2B is a simplified illustration of a solar array and a visual notice unit on a side of an example embodiment of a security device;

Figure 3A is a simplified illustration of a cross section view through a visual notice unit, and a solar array, constructed according to an example embodiment of the present invention;

Figure 3B is a simplified illustration of a cross section view through a visual notice unit, and a solar array, constructed according to an example embodiment of the present invention;

Figure 3C is a simplified illustration of a cross section view through a visual notice unit, and a solar array, constructed according to another example embodiment of the present invention;

Figure 3D is an image of a security device 356, showing a visual notice 358 and a solar array 360, constructed according to another example embodiment of the present invention;

Figure 3E is a simplified illustration of a cross section through a window and a security device constructed according to an example embodiment of the present invention;

Figure 4 is a simplified illustration of an example embodiment of a power unit in an example embodiment of the invention;

Figure 5 is a simplified illustration of an example embodiment of a pane break detector unit, a logic unit, and visual notice unit in an example embodiment of the invention;

Figure 6A is a simplified flow chart of a method of using a security device to monitor a protected area according to an example embodiment of the present invention;

Figure 6B is a simplified flow chart of a method of using a security device to monitor a protected area according to yet another example embodiment of the present invention; and

Figure 6C is a simplified flow chart of a method of using a security device to monitor a different protected area according to an example embodiment of the present invention.

DESCRIPTION OF SPECIFIC EMBODIMENTS OF THE INVENTION

[0050] The present invention, in some embodiments

thereof, relates to a security system, and, more particularly, but not exclusively, to a security system which provides visual notice of an alarm protected area.

[0051] Before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not necessarily limited in its application to the details of construction and the arrangement of the components and/or methods set forth in the following description and/or illustrated in the drawings and/or the Examples. The invention is capable of other embodiments or of being practiced or carried out in various ways.

General Overview

[0052] The present invention, in some embodiments thereof, includes a security device attached to a transparent window pane. The security device monitors the window pane for breakage, and optionally monitors other window panes within the same room, and/or within sound carrying range.

[0053] The security device, in some embodiments, may be attached to the window without connection to external leads such as power and/or communication lines. The security device, in some embodiments, may be powered by batteries. In some embodiments, the batteries' life is extended by also having a solar panel to provide power. In some embodiments the solar panel provides power by charging a super-capacitor. In some embodiments the solar panel provides power by charging batteries.

[0054] The security device, in some embodiments, monitors the window pane against breakage, by having an accelerometer, by way of a non-limiting example a MEMS accelerometer, attached to the window pane. Upon breakage and/or forcing of the window, the accelerometer detects excessive movement and/or sudden movement and/or shock, and triggers an alarm.

[0055] The security device, in some embodiments, monitors the window pane against breakage, by having a microphone. Upon detecting sound of a breaking glass, the security device triggers an alarm.

[0056] The security device, in some embodiments, monitors additional windows, to which it is not attached, against breakage. Upon detecting sound of a breaking glass in any window within sound detection range, the security device triggers an alarm.

[0057] In some embodiments, either one of the methods of detection - using the microphone OR using the accelerometer can trigger an alarm signal. The probability of detecting a problem (possible intrusion) rises when the two methods are used, and either one OR the other raises an alarm.

[0058] The security device, in some embodiments, displays an indication when it is monitoring a protected space. In some embodiments the indication is by a light aimed toward the outside of the protected space, usually toward the outside of the window, typically through the window.

[0059] The security device, in some embodiments, uses the same window area for collecting light into a solar panel and for displaying the monitoring indication. The monitoring indication is technically designed so as not to substantially interfere with incoming light. For example, the monitoring indication may be a symbol or text etched onto an outward-facing side of the security device. A monitoring indication light source shines into the outward-facing side along the edges, at an angle which causes total reflection of the light. When the light hits the etched area, at least some of the light shines outward. Light collection by the solar panel is not compromised in any of the smooth surface, and only somewhat attenuated in the etched area. The monitoring indication is not limited in area by having to allow plenty of area for the solar panel - the monitoring indication and the solar panel can share, and each use a substantial fraction of a total area of a window side of the security device. The monitoring indication can now be a large logo, and/or text in large letters, clearly visible from afar.

[0060] The security device, in some embodiments, communicates wirelessly with an additional unit on the protected premises, termed a gateway unit. The on-premise gateway unit may instruct the security device when to monitor the protected space, and/or when to display the monitoring indication.

[0061] In some embodiments, the gateway unit optionally communicates with an off-site security service. In such embodiments, it may be the off-site security service which instructs the gateway unit to instruct the security device when to monitor the protected space, and/or when to display the monitoring indication.

[0062] The security device, in some embodiments, has a movement detector, such as an accelerometer, to detect tampering with its installation, over and beyond pane breakage monitoring and microphone sound monitoring.

[0063] The present invention, in some embodiments thereof, includes a security device optionally attached to a transparent pane, or even placed next to the transparent pane.

[0064] The term "protected area" in all its grammatical forms is used throughout the present specification and claims interchangeably with the terms "protected volume" and "protected space" and their corresponding grammatical forms, to define an area or a space which is being monitored by the device.

[0065] Reference is now made to Figure 1A, which is a simplified illustration of an example embodiment of the security device 110, attached, for example, to an inside of a pane of a window 105 in, for example, a room 100.

[0066] Figure 1A depicts the security device 110 in situ in an example location, with the reservation that the window 105 is but an example window 105, which could also be a window 105 in a door, having a pane break detector (not shown in Figure 1A, see Figure 5) which monitors the window 105 against breakage and displays an indication of the protection toward an outside 120 of the window 105.

[0067] The security device 110, when in a protection mode, optionally monitors the window 105, and displays an indication of the protection toward the outside 120.

[0068] In some embodiments the pane break detector includes an accelerometer (not shown in Figure 1A, see Figure 5), which monitors the window 105 against breakage and/or forcing.

[0069] In some embodiments the pane break detector includes a microphone (not shown in Figure 1A, see Figure 5), which is configured to detect sound of breakage of the window 105 and monitors the window 105 against breakage. In some embodiments the pane break detector is configured to detect sound of breakage of one or more additional windows 106, and monitors the windows 106 against breakage.

[0070] In some embodiments of the invention, the security device 110 is configured to be placed in an open opening in a wall without a pane, and monitor windows within sound distance, for example windows 106 within a room, using the microphone.

[0071] The security device 110, in some embodiments, has a movement detector, such as an accelerometer, to detect tampering with its installation, over and beyond pane breakage monitoring and microphone sound monitoring.

[0072] It is noted that in some embodiments, the security device 110 can be attached to an outside of the window 105. In such embodiments, a solar panel (not shown), typically faces toward sunlight. In such embodiments, the pane breakage detector is typically set up in contact with the window 105, optionally on an opposite side of the solar panel.

[0073] It is noted that tamper detection and producing an alarm based on tamper detection are deemed useful in a security device 110 which is optionally connected to an outside of a window 105, which may be tempting to attempt to separate the security device 110 from the window without breaking the window 105.

[0074] It is noted that the security device 110 may be attached to an open window, or a partly open window, and still monitor against breakage of the open window and other windows 106 within sound distance.

[0075] In some embodiments the security device 110 includes a volume sensor (not shown), and/or a movement sensor (not shown), providing additional monitoring by monitoring the inside of the room, and providing an additional mode for producing alarm signals. The additional sensors in such embodiments are optionally packaged within the package of the security device 110 and share the power supply of the security device 110.

[0076] Reference is now made to Figure 1B, which is a simplified illustration of an example embodiment of a security system which includes a security device, the system and the device constructed and operational according to an example embodiment of the invention.

[0077] Figure 1B depicts the security device 110 of Figure 1A, communicating with additional components of a security system constructed and operational according to an example embodiment of the invention.

[0078] The security device 110 of Figure 1B communicates, by way of a non-limiting example, by a first communication link 132, with an additional security component on the protected premises 130, termed a gateway 135.

[0079] In some embodiments of the invention the gateway 135 optionally communicates with an optional remote User Interface (UI) 140, via, by way of a non-limiting example, a second communication link 142.

[0080] In some embodiments of the invention the gateway 135 includes a UI (not shown) instead of, or in addition to, the remote UI 140.

[0081] In some embodiments of the invention the gateway 135 optionally communicates with an optional camera 145, via, by way of a non-limiting example, a third communication link 147.

[0082] In some embodiments, any one or more of the first communication link 132, the second communication link 142, and the third communication link 147, are optionally a wireless link operating in the Industrial, Scientific, and Medical (ISM) band. In some embodiments, any one or more of the communication links 132 142 147 are optionally a wireless Bluetooth link. In some embodiments, any one or more of the communication links 132 142 147 may even optionally be wired communication links.

[0083] The gateway 135 of Figure 1B optionally communicates, by way of a non-limiting example, via a network 150, with a server 155 at some remote, off-the-premises location 160. One typical, non-limiting example of a location 160 for the server 155 may be a security provider's premises. Another typical, non-limiting example of a location 160 for the server 155 may be a server 155 at a server farm, the server 155 optionally leased by the security provider, and maintained by a firm which provides the server 155 for lease.

[0084] In some embodiments a computer on the premises of the security provider provides an interface to the server 155, and thus optionally also to the components 135 110 145 140 on the protected premises 130.

[0085] In some embodiments an interface to the server 155, and thus optionally also to the components 135 110 145 140 on the protected premises 130, is provided to an optionally remote computer 165 via a network 170.

[0086] In some embodiments an interface to the server 155, and thus optionally also to the components 135 110 145 140 on the protected premises 130, is provided to an optional mobile device 175 via a fourth communication link 177.

[0087] In some embodiments, the fourth communication link 177 is optionally a cellular communication link, and the mobile device 175 is optionally a smart phone or a mobile computer or a tablet computer having cellular communication capability. In some embodiments, the fourth communication link 177 is optionally a WiMax communication link, and the mobile device 175 is optionally a smart phone or a mobile computer or a tablet computer

having WiMax capability. In some embodiments, the fourth communication link 177 is optionally a WiFi communication link, and the mobile device 175 is optionally a smart phone or a mobile computer or a tablet computer having WiFi capability.

[0088] The security device 110 described with reference to Figures 1 and 2 above optionally includes a visual notice component which provides a visual indication that the security device 110 is monitoring a protected area.

[0089] Security providers have historically placed a sticker on monitored premises, indicating that they are in charge of monitoring the premises. However, the sticker itself simply indicates who is in charge, and not whether monitoring is presently being performed. Additionally, when a customer quits using the services of the security provider, the sticker wrongly indicates that the premises may be still monitored by the security provider.

[0090] In some embodiments of the invention, a security provider can remotely turn the monitoring on and off, and/or turn the visual indication on and off. The remote activation of the security device and/or the visual indication provides some advantages over the "sticker" approach. Some advantages are: when the visual indication is on, the warning that the premises are monitored is more credible; when the customer quits using the services of the security provider, turning the visual indication off remotely may save sending a service person to remove a sticker.

[0091] Reference is now made to Figure 1C, which is a simplified illustration of a security device 110 in which a visual notice component operates, at least in part, based on instructions received from a server at an off-the-premises location 160 according to an example embodiment of the invention.

[0092] Figure 1C depicts the security device 110 of Figures 1A and 1B, communicating with additional components of a security system constructed and operational according to an example embodiment of the invention. The security device 110 of Figure 1C communicates, by way of a non-limiting example, by a first communication link 132, with the gateway 135 first described with reference to Figure 1B. The security device 110 and the gateway 135 are optionally both on the protected premises 130.

[0093] The gateway 135 optionally communicates, by way of a non-limiting example, via a network 150, with a server 155 at some remote, off-the-premises location 160.

[0094] The server 155 optionally provides instructions to the security device 110, which serve as a basis for turning a monitoring of the protected area on and off, and/or as a basis for turning a visual notice (not shown, see Figures 2A-2B, 3A-3E, and 5) on or off.

[0095] Reference is now made to Figure 1D, which is a simplified illustration of a security device 182 in which a visual notice component operates, at least in part, based on instructions received from a server at an off-the-premises location, according to another example embodiment of the invention;

[0096] Figure 1D depicts the security device 182, communicating with additional components of a security system constructed and operational according to a simpler example embodiment of the invention, optionally having less components. The security device 182 of Figure 1D, which is on the protected premises 130, communicates, via a communication link 185, with a server 187 at some remote, off-the-premises location 160.

[0097] The server 187 optionally provides instructions to the security device 110, which serve as a basis for turning a monitoring of the protected area on and off, and/or as a basis for turning a visual notice (not shown, see Figures 2A-2B, 3A-3E, and 5) on or off.

[0098] The communication link 185 optionally bridges a further distance than the communication link 132 of Figures 1B and 1C.

[0099] In some embodiments, the communication link 185 is optionally a WiMax communication link, and the security device 110 and the server 187 optionally include or are connected to a device with WiMax capability.

[0100] In some embodiments, the communication link 185 is optionally a WiFi communication link, and the security device 110 and the server 187 optionally include or are connected to a device with WiFi capability.

[0101] In some embodiments, the communication link 185 is optionally a cellular communication link, and the security device 110 and the server 187 optionally include or are connected to a device with cellular communication capabilities.

Solar panel and visual notice of protected area

[0102] Reference is now made to Figure 2A, which is a simplified illustration of a solar array 205 and a visual notice unit 210 on a side of an example embodiment of a security device 200.

[0103] Figure 2A depicts the visual notice unit 210 located next to the solar array 205, contrasting with an example embodiment of the security device which will be depicted in Figure 2B.

[0104] The solar array 205 in a typical in-house placement of the security device 200 faces toward the outside of the house, to pick up radiation from the sun. The visual notice unit 210 also faces toward the outside of the house, to optionally provide visual indication when the security device 200 is operative and monitors a protected area. In Figure 2A, the visual notice unit 210 is depicted as a LED.

[0105] In order to indicate that the security device 200 is ON, the visual notice unit 210 may optionally be ON, or flashing. Optionally, the visual notice unit 210 may be flashing during daylight, which is more noticeable during daylight, and ON during nighttime. Optionally, the visual notice unit 210 may be flashing while the solar panel 205 is charging the security device 200, during daylight, and ON when the solar panel 205 is not charging the security device 200.

[0106] The solar array 205 is optionally used additionally as a day-or-night sensor, which can optionally change protection settings of the security device, such as monitoring by night and not by day, or raising sensitivity of a microphone during the night, which is typically quieter than during the day.

[0107] Reference is now made to Figure 2B, which is a simplified illustration of a solar array 235 and a visual notice component 237 on a side of an example embodiment of a security device 230.

[0108] Figure 2B is intended to depict the visual notice component 237 substantially overlaying the solar array 235, contrasting with the example embodiment of the security device 200 which was depicted in Figure 2A.

[0109] In the example embodiment of Figure 2B, the visual notice component 237 has an area substantially greater than the area of light sources 250 comprised within the visual notice component 237. The light sources 250 include one or more light sources 250, by way of a non-limiting example one or more LEDs. The light sources provide light, which is piped toward visual notices 240 245.

[0110] By way of a non-limiting example, the visual notice 240 is a company logo.

[0111] By way of a non-limiting example, the visual notice 245 is text indicating a company name and/or brand name. It is noted that the text may include an indication that the security device 230 is monitoring the protected area, so that when the visual notice 245 is ON or flashing, the text may be read.

[0112] Reference is now made to Figure 3A, which is a simplified illustration of a cross section view through a visual notice unit 305, and a solar array 310, constructed according to an example embodiment of the present invention.

[0113] Figure 3A is intended to depict how light rays 320 are piped from a light source 315 to an area 330 where visual notices are marked on the visual notice unit 305.

[0114] It is noted that the area of the visual notice unit 305 which is above the solar array 310 is substantially transparent to light, in order to pass a substantial amount of light radiation through to the solar array 310.

[0115] The light rays 320 are emitted from light sources 315, such as, by way of a non-limiting example, one or more LEDs. The light rays 320 impinge upon surfaces of the visual notice unit 305, which preferable causes total internal reflection, upon which the light rays 320 are reflected toward the area 330 where the visual notices are marked. Light travels along the visual notice unit 305, which offers a smooth surface and continues to maintain total internal reflection, until the light hits a rough, or etched area, and/or sharp corners, at which point at least some of the light changes direction toward an outside of the visual notice unit 305.

[0116] In some embodiments of the invention the visual notices are marked in the area 330 by etching and/or carving shapes of a design and/or letters in the surface of the visual notice unit 305.

[0117] The light rays 320 travel along the surface of the area 330 at substantially shallow angles, preferable undergoing substantially total internal reflection as long as the surface of the area 330 is flat. When the light rays 320 impinge upon a non-uniformity such as, by way of a non-limiting example, an etching, a scratch, or an angle carved and/or otherwise shaped into the surface of the area 330, at least some of the light rays 320 are emitted toward the outside of the visual notice unit 305, at the non-uniformity.

[0118] In some embodiments of the invention the visual notices are marked in the area 330 by etching an inside surface of the visual notice unit 305 become not-smooth, and thereby not totally-reflective.

[0119] In some embodiments of the invention the visual notices are marked in the area 330 by etching an outside surface of the visual notice unit 305 become not-smooth, and thereby not totally-reflective.

[0120] In some embodiments of the invention the visual notices are marked in the area 330 by otherwise making an outside or an inside surface of the visual notice unit 305 not-smooth, and thereby not totally-reflective. Making the surface not-smooth may be done, for example, by casting a surface of the visual notice unit 305 partly with a smooth surface and partly with a rough surface; and/or producing the surface with steps or other shapes along the surface, so the surface is not always presented at an angle of total reflection toward the light rays 320.

[0121] In some embodiments of the invention the visual notices are marked in the area 330 by applying a decal.

[0122] In some embodiments the outline of the shape of the decal provides a non-uniformity which enables the light rays 320 to exit the visual notice unit 305.

[0123] In some embodiments the decal itself is non-smooth, which enables the light rays 320 to exit the visual notice unit 305 via the decal.

[0124] Reference is now made to Figure 3B, which is a simplified illustration of a cross section view through a visual notice unit 306, and a solar array 310, constructed according to an example embodiment of the present invention.

[0125] Figure 3B is intended to depict an alternative way by which light rays 320 are piped from a light source 315 to an area 330 where visual notices are marked on the visual notice unit 306.

[0126] It is noted that the area of the visual notice unit 306 which is above the solar array 310 is substantially transparent to light, in order to pass a substantial amount of light radiation through to the solar array 310.

[0127] The light rays 320 are emitted from light sources 316, such as, by way of anon-limiting example, one or more LEDs. The light rays 320 impinge upon a curvature 325 of the visual notice unit 306, upon which the light rays 320 are reflected toward the area 330 where the visual notices are marked.

[0128] In some embodiments of the invention the light rays 320 are reflected by total internal reflection due to the angle by which they impinge on the curvature 325.

[0129] In some embodiments of the invention, the light rays 320 are reflected due to the curvature 325 being coated with a reflective coating (not shown), such as, by way of a non-limiting example, silver, aluminum, reflective paint, and so on.

[0130] Reference is now made to Figure 3C, which is a simplified illustration of a cross section view through a security device 335, including a visual notice unit and a solar array 337, constructed according to another example embodiment of the present invention.

[0131] The security device 335 of Figure 3C depicts another layout of components, which also works for displaying a visual notice 347 through a same area as collects light to a solar array 337.

[0132] Figure 3C depicts an electronics section 339, and a solar array 337 overlaying most of the area of the solar array 337. A window 341 acts as a light guide, for guiding light from LEDs 343 acting as light sources. Chamfers 345 are produced as part of the window 341 in order to reflect light from the LEDs 343 along the window 341. Somewhere on the window a visual notice 347 is etched, or frosted, into the window. Where the visual notice 347 is etched into the window, the visual notice is displayed.

[0133] When the LEDs 343 are ON, the visual notice 347 emits the LED light. When the LEDs 343 are not ON, the frosting is visible by ambient light.

[0134] Turning the LEDs 343 ON optionally serves as notice that the security device 335 is monitoring the protected area.

[0135] Reference is now made to Figure 3D, which is an image of a security device 356, showing a visual notice 358 and a solar array 360, constructed according to another example embodiment of the present invention.

[0136] The security device 356 of Figure 3D depicts a frontal view of the visual notice 358 overlaying the solar array 360, illustrating how the visual notice 358 does not substantially interfere with light collection by the solar array 360.

[0137] In some embodiments of the invention the visual notice 358 is etched into the face of the security device 356 and does not substantially interfere with light collection by the solar array 360. Light which may be diffused at the visual notice 358 does not necessarily continue without deflection to the solar array 360, but even when the light is diffused and deflected, a substantial portion of the light reaches the solar array 360.

[0138] An additional feature which may be seen in the image of the security device 356 is an adhesive flange 362 which serves for attaching the security device 356 to a window (not shown).

Size of the security device

[0139] In some embodiments, the security device is sized to be attached to a window in a typical family home. Typical dimensions of the device can be, by way of a non-limiting example, 90 mm x 90 mm x 20 mm.

[0140] In some embodiments, the security device is sized to be smaller than described above, and unobtrusive. Solar powered embodiments of the device need enough space for the solar panel, which can be shrunk even down to a size of a wristwatch, as the example of solar powered wrist watches shows. Such a device can have dimensions of, by way of some non-limiting examples, 30 mm x 30 mm x 10 mm, or 40 mm x 40 mm x 15 mm.

[0141] In some embodiments, the security device is sized to be larger than described above, for example, to be seen from a greater distance than typically found in a typical home setting, for example in a skyscraper and/or a large house. Such a security device would include a larger visual notice area, enough to be seen from afar. The solar panel in such embodiments may optionally be larger, providing more energy for a larger display. Such a device can have dimensions, by way of some non-limiting examples, of 1000 mm x 1000 mm x 40 mm, or 500 mm x 500 mm x 20 mm.

[0142] Reference is now made to Figure 3E, which is a simplified illustration of a cross section through a window 370 and some components of a security device constructed according to an example embodiment of the present invention.

[0143] The illustration of Figure 3E emphasizes how sunlight 372 (or ambient light) passes through the window 370, through a window 374 of the security device, and impinges upon a solar panel 376, without interfering with LED 378 light 380 traveling along the window 374 of the security device.

[0144] Some of the LED 378 light 380 travels along the window 374 of the security device and is reflected by total internal reflection, while in an area 382 of the window 374 of the security device, some of the LED 378 light 380 is still reflected inside the window 374 of the security device, and some LED 378 light 384 is diffracted and exits through the window 370.

[0145] Some of the sunlight 372 impinges upon the window 370 and passes through to the solar panel 376 substantially without diffusion in the window 374 of the security device. In an area 382 of the window 374 of the security device, which may be wholly or partly diffusive, some of the sunlight 372 passes through to the solar panel 376, and some of the sunlight 372 is diffused away from the solar panel 376.

[0146] It is noted that when it is light outside, a visual notice in the area 382 of the window 374 of the security device, which may be wholly or partly diffusive, may be seen without light from the security device. However, during darkness, the visual notice in the area 382 of the window 374 of the security device may be seen when the security device emits light, while other areas of the window 374 of the security device may be substantially dark, due to total internal reflection in the areas.

Providing power

[0147] Power to the security device, and to a security system when the security device is part of a system, may be provided in one or more ways.

[0148] In some embodiments a solar panel powers the security device and/or system, and charges, when possible, a power store. In some embodiments the power store is a capacitor, possibly a super capacitor. In some embodiments the power store is a rechargeable battery (not shown). In some embodiments the power store is a combination of the capacitor and the rechargeable battery.

[0149] In the above embodiments installation of the security device is especially simple, since there is no need to connect the security device to electric mains.

[0150] In some embodiments an electric mains powers the security device and/or system, and charges, when possible, the power store.

[0151] In some embodiments a combination of the electric mains and the solar panel powers the security device and/or system, and charges, when possible, the power store.

[0152] In some embodiments, a logic unit optionally monitors a status of the power supply (e.g. - for how much longer the power supply may power the security device/system). In some embodiments the logic unit is capable of displaying the power status. In some embodiments the logic unit is capable of sending the status of the power supply to a remote unit.

[0153] In some embodiments, the remote unit is on-location, that is, by way of a non-limiting example, at a central location in a house. Such a remote unit is termed a gateway unit.

[0154] In some embodiments, the remote unit is off-location, that is, by way of a non-limiting example, at a security providing service center.

[0155] In some embodiments, the gateway unit can communicate with an off-location, remote unit, by way of a non-limiting example, at a security providing service center.

[0156] In some embodiments of the invention the security providing service center optionally controls operation of the security device. By way of a non-limiting example, the security providing service center instructs the security device, by communicating with the security device, to start monitoring the protected area, or to stop monitoring the protected area.

[0157] By way of another non-limiting example, the security providing service center instructs the security device, by communicating with the security device, to start providing visual notice (turn ON the visual notice), or to stop providing visual notice (turn OFF the visual notice).

[0158] Reference is now made to Figure 4, which is a simplified illustration of an example embodiment of a power component 402 in an example embodiment of the invention.

[0159] Figure 4 is provided with an intention of depicting how various optional power sources and stores may be put together to power a security device such as described herein.

[0160] Figure 4 depicts a solar panel 405, optionally supplying voltage in a range of 0.3-5.5V relative to ground.

[0161] An example solar panel which can serve as the solar panel 405 is optionally a 2x6 panel of high efficiency solar cells, such as, for example, IXYS XOB17, which includes solar cells using mono-crystalline silicon technology, which are outdoor and indoor compatible, are high efficiency with long life and stable output. The solar cells have 17% efficiency, 3.6V typical voltage, and 50 mA typical current.

[0162] Optionally, at an output of the solar panel 405 there is also an optional connection 424 for monitoring the voltage produced by the solar panel 405. Monitoring the voltage produced by the solar panel 405 enables an application processor 522 to react to lower voltage, for example by switching to power from a battery, or to react to what may be construed as darkness, for example by turning on a visual notice unit 515 (see Figure 5).

[0163] The example solar panel 405 inputs voltage to an energy harvester unit 410. A non-limiting example of such an energy harvester unit 410 is a STMicroelectronics ST SPV1040.

[0164] The ST SPV1040 is a high efficiency, low power and low voltage DC/DC converter which provides an output voltage of up to 5.5V. Start-up of the ST SPV1040 is guaranteed at 0.3V, and the ST SPV1040 operates down to 0.2V. The ST SPV1040 is a 100 kHz, fixed frequency Pulse-Width-Modulated (PWM) step-up converter able to maximize energy transferred from an input supply unit to output. The PWM step-up converter is controlled by an embedded unit running a Maximum Power Point Tracking (MPPT) algorithm. The MPPT algorithm takes into account an adjustment of output voltage and output current. The ST SPV1040 guarantees safety of application devices and of the converter itself stopping PWM switching in case of over-current or over-temperature conditions.

[0165] The energy harvester unit 410 accepts an input CTRL #1 415 of control signals from an application processor (see, for example, the application processor 522 of Figure 5) included in the security device.

[0166] The energy harvester unit 410 provides electric power, optionally stored on an energy store unit 420.

[0167] In some embodiments the energy store unit 420 is a super-capacitor.

[0168] A non-limiting example of such a capacitor is a 3 Farad 5.5V low-leakage low-ESR Super-Cap. Such a capacitor provides an option for cyclic charge/discharge. Such a Super-Cap has low degradation even after thousands of cycles. The Super-Cap can be charged in extreme cases where a rechargeable battery could not be charged.

[0169] In some embodiments the energy store unit 420 is a rechargeable battery (not shown).

[0170] Figure 4 depicts charging the energy store unit 420, by way of a non-limiting example, to 5 volts.

[0171] Optionally, at a high side of a connection to the energy store unit 420 there is also an optional energy store connection 425 for monitoring the voltage on the energy store unit 420. If voltage coming from the solar panel 405 via the energy store unit 420 is not high enough, a battery power supply 445 is connected as a power supply to an LDO 440, by activating a switch 437.

[0172] The energy store unit 420 optionally provides input to a step-up unit 430.

[0173] The step-up unit 430 enables use of the energy store unit 420 until voltage on the energy store unit 420 drops to 0.9 V, instead of, for example, requiring 2 V output from the energy store unit 420.

[0174] A non-limiting example of a step-up unit 430 is a Texas Instruments (TI) TPS61097-33. The TPS61097-33 has a low input voltage boost converter and a low quiescent current, both of which features are useful in this context. Another feature provided by the TPS61097-33 is an over voltage bypass, where voltages over 3.3v are bypassed downstream, optionally to a Low Drop-Out voltage regulator (LDO).

[0175] The step-up unit 430 provides output, through a diode 435 to an LDO unit 440.

[0176] A non-limiting example of the LDO unit 440 is a TOREX XC6206. The TOREX XC6206 is a very low quiescent current (~1uA), low ESR, positive voltage regulator. The TOREX XC6206 is capable of producing 2.4 V to different components of the security device.

[0177] In many use cases, a security device would not depend only on solar power.

[0178] In some embodiments of the invention, a battery power supply 445 is also provided.

[0179] A non-limiting example of such a battery is a Lithium 3V CR123A. The Lithium 3V CR123A battery enable a security device constructed according to an example embodiment of the invention to operate for about 5 years, with the exception for optionally not maintaining a constant blinking of backlight LEDs.

[0180] The battery power supply 445 also provides output, through a diode 450, to the LDO unit 440.

[0181] A voltage sensing connection termed CTRL #2 436 in Figure 4 senses voltage supplied to the LDO 440. If voltage coming from the solar panel 405 via the step-up unit 430 is not high enough, the battery power supply 445 is connected as a power supply to the LDO 440, by activating a switch 437.

[0182] It is noted that in some embodiments the power supply to the security device operates by charging a battery from a solar cell, and providing power from the battery. Such an embodiments optionally makes energy extraction therefrom more efficient, as the battery optionally has less internal resistance to current.

[0183] Reference is now made to Figure 5, which is a simplified illustration of an example embodiment of a pane break detector unit 505, a communication component 510, and visual notice unit 515 in an example embodiment of the invention.

[0184] Figure 5 is provided with an intention of depicting how optional sensors may be put together with an application processor 522 to produce an example pane break detector unit 505, how the pane break detector unit 505 may be connected to a communication component 510, and how the application processor 522 may be connected to one or more light sources 516 in the visual notice unit 515.

[0185] A non-limiting example of such an application processor 522 is an ARM Cortex™-M4 processor.

[0186] The pane break detector unit 505 of Figure 5 optionally includes a microphone 520, connected to the application processor 522. In the embodiment of Figure 5, the microphone 520 is connected to the application processor 522 through a shock detector 536, and also through a switch 542.

[0187] An optional accelerometer 524 is optionally also functionally connected to the application processor 522, and mechanically connected to a pane (not shown).

[0188] A non-limiting example of such an accelerometer 524 is a STMicroelectronics LIS331DLH MEMS 3-axis accelerometer.

[0189] In some embodiments the accelerometer 524 is mechanically connected to the security device 110, and the security device 110 is mechanically connected to the pane. Movement of the pane is transferred to corresponding movement of the security device 110, which is transferred to corresponding movement of the accelerometer 524.

[0190] In some embodiments the accelerometer 524 is mechanically connected to a Printed Circuit Board (PCB) included in the security device 110, and the security device 110 is mechanically connected to the pane. Movement of the pane is transferred to corresponding movement of the PCB, which is transferred to corresponding movement of the accelerometer 524.

[0191] In some embodiments the accelerometer 524 is mechanically connected to the pane, and electrically connected to the application processor 522. Movement of the pane is detected by the accelerometer 524, and corresponding signals are sent to the application processor 522, as described herein.

[0192] As described above, either the accelerometer 524, or the microphone 520, or both, provide signals which may be interpreted as pane breakage signals. Figure 5 depicts both types of sensors, while only one is needed in a minimal configuration.

[0193] Example operation of the pane break detector unit 505 is now described with respect to several scenarios, which illustrate features of example embodiments of the invention.

A first scenario

[0194] In a first scenario, a security device 110 (of Figure 1A), including the pane break detector unit 505, is attached to a window pane (not shown), in a room with

more than one window. One of the windows, to which the security device is not attached, breaks. The microphone 520 passes an electric signal, produced by the microphone 520 as a result of the sound of the breaking pane, to the application processor 522, which analyzes the sound and, upon recognizing the sound as a breaking pane, sends an alarm via an interface 527 to a transceiver 528 in the communication component 510.

[0195] A non-limiting example of such a transceiver 528 is a Texas Instruments CC1121 or a Texas Instruments CC1120.

Detecting pane break sounds

[0196] In some embodiments of the invention sounds from the microphone 520 pass through a basic shock detector 536. The shock detector 536 detects loud and/or sharp noises, and does not pass other noises. In such embodiments the application processor 522 is optionally substantially inactive unless it receives an interrupt 538 from the shock detector 536 (or an accelerometer 532, as described further below), thereby saving energy and optionally extending battery life. The interrupt 538 provides a feature termed herein "wake-on-break", although in the embodiment of Figure 5 the application processor 522 optionally wakes upon suspicion of a break, and optionally verifies the suspicion. When the application processor 522 receives the interrupt 538 from the shock detector 536, the application processor 522 optionally sends a control signal 540 to a switch 542, which connects the application processor 522 to the microphone 520. The application processor 522 optionally starts receiving sounds from the microphone 520, and optionally analyzes the sounds whether they indicate a pane breaking.

[0197] In some embodiments of the invention the sound analysis is performed by comparing sound frequencies, optionally acquired by Fourier Transforming the sound signal, optionally using an FFT, and comparing the sound frequencies to typical frequencies of a breaking pane.

[0198] In some embodiments of the invention the sound analysis is further aided by an optional Band Pass Filter (BPF) 544 filtering sound from the microphone 520, and passing sound frequencies most relevant to pane breakage.

What is done with sounds after pane break is detected

[0199] In some embodiments the communication component 510 optionally sends a pane-break-warning via an antenna 530 connected to the transceiver 528 to a remote unit (not shown). The remote unit, as described above, may be on-location (gateway) and/or off-location. If the remote unit is on-location (gateway), the gateway may further send the pane-break-warning to an off-location remote unit, for example at a security providing service center.

[0200] In some embodiments of the invention the application processor 522 optionally causes sound to be recorded, from a pane-break-warning onward for some period of time.

[0201] In some embodiments of the invention the sound recording is performed whether the trigger arises from the microphone or from the accelerometer.

[0202] In some embodiments of the invention the application processor 522 optionally sends sounds, via the transceiver 528, to the remote unit, whether for on-location storage and/or for off-location monitoring and/or storage by security service personnel.

Video after an alarm

[0203] In some embodiments the communication component 510 optionally sends a pane-break-warning via the transceiver 528 and the antenna 530 to gateway. The gateway causes a camera to capture a video signal of the broken window and/or of the entire protected area.

[0204] In some embodiments the camera is part of a broader aspect of a security system, and not part of the security device 110.

[0205] In some embodiments the camera, which is not shown in Figure 5, is part of the security device 110. In some embodiments the camera captures images from an outside of the window. In some embodiments the camera captures images from an inside of the window. In some embodiments two cameras are used, to capture images both from the outside of the window and from the inside of the window. In some embodiments the cameras use fish eye lenses to capture images from an especially broad angle.

[0206] In some embodiments the captured video signal is stored in the gateway, optionally for use by security service personnel.

[0207] In some embodiments the captured video signal is transmitted to an off-location remote unit, optionally for use by security service personnel.

A second scenario

[0208] In a second scenario, a security device 110, which includes the pane break detector unit 505, is attached to a window pane (not shown), in a room which may have more than one window. The window to which the security device is attached breaks. The microphone 520 passes an electric signal produced by the microphone 520 as a result of the sound of the breaking pane to the application processor 522, which analyzes the sound and, upon recognizing the sound as a breaking pane, sends an alarm via the interface 527 to a transceiver 528 within the communication component 510.

[0209] In some embodiments of the invention the application processor 522 sends an interrupt 526 to wake up the transceiver 528. In such embodiments the transceiver 528 is optionally not substantially active unless it receives the interrupt 526, thereby saving energy and

optionally extending battery life.

[0210] In some embodiments of the invention the interface 527 is a Serial Peripheral Interface (SPI).

[0211] An optional additional accelerometer 524, such as, by way of a non-limiting example, a Micro-Electro-Mechanical System (MEMS) accelerometer and/or acoustic sensor, is optionally used to detect a breaking of the pane to which the security device is attached, by detecting acceleration associated with a sudden movement such as breaking a window and/or forcing open a window which is supposed to be closed. A sound of a breaking pane is sometimes more difficult to detect by an attached and/or microphone 520 very near to a window. The accelerometer 524 detects pane breakage by contact, and such detection may be more reliable in a case where the security device is attached to, or close to, the breaking pane.

[0212] The accelerometer 524 optionally sends an electric signal 534 produced by the accelerometer 524 as a result of the breaking pane, to the application processor 522.

[0213] In some embodiments of the invention the accelerometer 524 sends an accelerometer interrupt 532 to wake up the application processor 522, acting with respect to the application processor 522 similarly to the shock detector 536 described above. In such embodiments the application processor 522 is optionally not substantially active unless it receives the accelerometer interrupt 532, thereby saving energy and optionally extending battery life. The interrupt 532 provides a feature termed herein "wake-on-break", although in the embodiment of Figure 5 the application processor 522 optionally wakes upon suspicion of a break, and optionally verifies the suspicion.

[0214] It is noted that the security device monitors breakage of all panes in a room. The security device monitors breakage of the pane to which it is attached, as well as any other panes in a room.

[0215] Figure 5 depicts some additional example connections to the application processor 522:

a solar cell monitor 424 connection, connected to the power component 402 as described above with reference to Figure 4;
an energy store connection 425 connection, connected to the power component 402 as described above with reference to Figure 4;
a CTRL #1 415 connection, connected to the power component 402 as described above with reference to Figure 4, for optionally setting and/or reading settings of the energy harvester 410 of Figure 4; and
A CTRL #2 436 connection, connected to the power component 402 as described above with reference to Figure 4, for optionally sensing voltage supplied to the LDO 440.

[0216] In some embodiments of the invention light sources 516 in the visual notice unit 515 are turned on and off by the security device itself, based on whether the security device is monitoring the protected area. In some embodiments of the invention light sources 516 in the visual notice unit 515 are turned on and off by the security device based on instructions from the gateway unit. In some embodiments of the invention light sources 516 in the visual notice unit 515 are turned on and off, based on instructions from the off-location remote unit.

[0217] Reference is now made to Figure 6A, which is a simplified flow chart of a method of using a security device to monitor a protected area according to an example embodiment of the present invention.

[0218] The example method of Figure 6A includes:

attaching a security device comprising a microphone and an accelerometer to a window (605);
using the accelerometer to detect a first signal produced by breakage of a pane of the window to which the security device is attached (610);
using the microphone to detect a second signal produced by a sound of breakage of the pane of the window (615); and
using an application processor connected to the microphone and to the accelerometer for analyzing at least one of the first signal and the second signal and detecting pane breakage (620).

[0219] Reference is now made to Figure 6B, which is a simplified flow chart of a method of using a security device to monitor a protected area according to yet another example embodiment of the present invention.

[0220] Figure 6B describes a method of using a security device to monitor a protected area and to provide an indication when the security device is monitoring the protected area.

[0221] The example method includes:

attaching a security device comprising a microphone and an accelerometer to a window (660);
using the accelerometer to detect a first signal produced by breakage of a pane of the window to which the security device is attached (665);
using the microphone to detect a second signal produced by a sound of breakage of the pane of the window (670);
using an application processor connected to the microphone and to the accelerometer for analyzing at least one of the first signal and the second signal and detecting pane breakage (675); and
providing an indication that the security device is monitoring for window breakage based, at least in part, on instructions from a remote unit (680).

[0222] The flow charts of Figures 6A and 6B describe monitoring a protected area by monitoring a window to which the security device is attached. When the protected area includes additional windows, such as the additional windows (106) of Figure 1A, the security device optionally

monitors the additional windows, as described below with reference to Figure 6C.

[0223] Reference is now made to Figure 6C, which is a simplified flow chart of a method of using a security device to monitor a different protected area according to an example embodiment of the present invention.

[0224] The example method of Figure 6C describes monitoring a plurality of windows for breakage, and includes:

attaching a security device comprising a microphone and an accelerometer to a window (630);
using the accelerometer to detect a first signal produced by breakage of a pane of the window to which the security device is attached (635);
using the microphone to detect a second signal produced by a sound of breakage of the pane of the window (640);
using the microphone to detect a third signal produced by a sound of breakage of a pane of another window (645); and
using an application processor connected to the microphone and to the accelerometer for analyzing at least one of the first signal, the second signal, and the third signal, and detecting pane breakage (650).

[0225] In some embodiments the monitoring the protected area includes monitoring the pane to which the security device is mounted for breakage, optionally by an accelerometer.

[0226] In some embodiments the monitoring the protected area includes monitoring windows and/or other panes for breakage, optionally by a microphone.

[0227] In some embodiments, in order to include the above capabilities in a pane-mountable or pane-attachable security device, the following components are packaged in a pane-attachable device: a power unit, which optionally comprises a solar panel for providing electrical power to the device; a logic unit for accepting data input from components of the device and providing instructions to the components; a monitoring unit for monitoring of the protected area; a visual notice unit for providing an indication when the security device is monitoring the protected area; and a pane break detector for providing indication of pane breakage to the logic unit.

Some potential synergistic advantages provided by some embodiments of the invention

[0228] It is noted that some embodiments of the invention provide synergistic advantages compared to existing technology.

[0229] The security device optionally provides a compact from factor, which combines glass breakage protection, wireless installment, long life without replacing batteries, easy access to battery replacement, and optional area protection.

[0230] Providing an illuminated visual display through substantially a same area as serves for collecting light to a solar panel provides a saving in space/area.

[0231] When a device is desired to have a small area, the device can be made as small as the solar panel can be while still providing sufficient power. The solar panel can use virtually all the surface area of the device, without requiring use of additional area to produce the visual display, and without limiting the visual display to just small illuminated "dots" such as LED lamps.

[0232] When a device is desired to have a large visual display, the device can be made the size of the visual display, and the solar panel can use the same area, without requiring additional area.

[0233] Producing a self-powered window-attachable security device greatly simplifies installing the device. Adding a solar panel to the security device extends battery life greatly, and minimizes periodic maintenance such as replacing batteries.

[0234] Adding a communication module to the security device enables remote monitoring, from a gateway and/or from a remote security center. Adding the communication module may cause a problem, because of the additional power drain of the communication module, but adding the solar panel alleviates the problem.

[0235] The "wake-on-break" feature further extends battery life, and minimizes periodic maintenance such as replacing batteries.

[0236] It is expected that during the life of a patent maturing from this application additional relevant solar panels will be developed, and the scope of the terms solar panels, solar arrays, photo-voltaic panels, and so on, are intended to include all such new technologies *a priori.*

[0237] It is expected that during the life of a patent maturing from this application additional relevant energy stores will be developed, and the scope of the terms energy store, super-cap, battery, and so on, are intended to include all such new technologies *a priori.*

[0238] As used herein the term "about" refers to $\pm$ 20 %.

[0239] The terms "comprising", "including", "having" and their conjugates mean "including but not limited to".

[0240] As used herein, the singular form "a", "an" and "the" include plural references unless the context clearly dictates otherwise. For example, the term "a unit" or "at least one unit" may include a plurality of units, including combinations thereof.

[0241] The words "example" and "exemplary" are used herein to mean "serving as an example, instance or illustration". Any embodiment described as "example" or "exemplary" is not necessarily to be construed as preferred or advantageous over other embodiments and/or to exclude the incorporation of features from other embodiments.

[0242] The word "optionally" is used herein to mean "is provided in some embodiments and not provided in other embodiments". Any particular embodiment of the invention may include a plurality of "optional" features unless such features conflict.

[0243] Throughout this application, various embodiments of this invention may be presented in a range format. It should be understood that the description in range format is merely for convenience and brevity and should not be construed as an inflexible limitation on the scope of the invention. Accordingly, the description of a range should be considered to have specifically disclosed all the possible sub-ranges as well as individual numerical values within that range. For example, description of a range such as from 1 to 6 should be considered to have specifically disclosed sub-ranges such as from 1 to 3, from 1 to 4, from 1 to 5, from 2 to 4, from 2 to 6, from 3 to 6 etc., as well as individual numbers within that range, for example, 1, 2, 3, 4, 5, and 6. This applies regardless of the breadth of the range.

[0244] Whenever a numerical range is indicated herein, it is meant to include any cited numeral (fractional or integral) within the indicated range. The phrases "ranging/ranges between" a first indicate number and a second indicate number and "ranging/ranges from" a first indicate number "to" a second indicate number are used herein interchangeably and are meant to include the first and second indicated numbers and all the fractional and integral numerals therebetween.

[0245] It is appreciated that certain features of the invention, which are, for clarity, described in the context of separate embodiments, may also be provided in combination in a single embodiment. Conversely, various features of the invention, which are, for brevity, described in the context of a single embodiment, may also be provided separately or in any suitable sub-combination or as suitable in any other described embodiment of the invention. Certain features described in the context of various embodiments are not to be considered essential features of those embodiments, unless the embodiment is inoperative without those elements.

[0246] Although the invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, it is intended to embrace all such alternatives, modifications and variations that fall within the spirit and broad scope of the appended claims.

[0247] All publications, patents and patent applications mentioned in this specification are herein incorporated in their entirety by reference into the specification, to the same extent as if each individual publication, patent or patent application was specifically and individually indicated to be incorporated herein by reference. In addition, citation or identification of any reference in this application shall not be construed as an admission that such reference is available as prior art to the present invention. To the extent that section headings are used, they should not be construed as necessarily limiting.

Claims

1. A security device (110) comprising:

an application processor (522) configured for accepting data input from components of the device (110) and configured for providing instructions to the components; and
a visual notice component (237) configured for providing an indication when the security device (110) is monitoring a protected area,

characterized by:

further comprising a pane break detector (505) configured for communicating signals which may indicate pane breakage to the application processor (522), the pane break detector (505) comprising:
an accelerometer (524) configured for communicating with the application processor (522); and
a microphone (520) configured for communicating with the application processor (522).

2. The security device (110) according to claim 1 and further comprising a power component (402), which comprises a solar panel (405), for providing electrical power to the device (110).

3. The security device (110) according to any one of claim 1 or claim 2, in which the security device (110) is adapted to use the microphone (520) to pick up sounds for some period of time after detecting pane breakage.

4. The security device (110) according to claim 3 in which the security device (110) is further adapted to communicate the sounds to a remote unit.

5. The security device (110) according to any one of claims 2-4 in which the visual notice component (237) comprises an area substantially overlapping the area of the solar panel (405).

6. The security device (110) according to any one of claims 2-5 in which the visual notice component (237) comprises an area substantially greater than an area of the solar panel (405).

7. The security device (110) according to any one of claims 1-6 in which the visual notice component (237) is configured to provide an indication that the security device (110) is monitoring the protected area based, at least in part, on instructions from a remote unit.

8. The security device (110) according to claim 7 in

which the remote unit is one of a group consisting of:

a gateway (135);
a server (155);
a remote computer (165); and
a mobile device (175).

9. A security system comprising:

a first security device (110) according to any one of claims 1-8; and
a gateway adapted to communicate with the first security device (110) and to communicate with a remote security center.

10. The security system according to claim 9, and further comprising a camera for imaging the pane upon receiving an instruction from the first security device (110).

11. A method of monitoring a window for breakage comprising:

attaching a security device comprising a microphone and an accelerometer to a window;
using the accelerometer to detect a first signal produced by breakage of a pane of the window to which the security device is attached;
using the microphone to detect a second signal produced by a sound of breakage of the pane of the window;
using an application processor connected to the microphone and to the accelerometer for analyzing at least one of the first signal and the second signal and detecting pane breakage.

12. The method according to claim 11 and further comprising:

monitoring a plurality of windows for breakage;
using the microphone to detect a third signal produced by a sound of breakage of a pane of another window; and
using the application processor for also analyzing the third signal.

13. The method according to any one of claim 11 or claim 12 and further comprising recording the sound based, at least in part, on the analyzing at least one of the first signal and the second signal.

14. A security device (110) comprising:

a visual notice component (237);

characterized by:

further comprising a communication component (510),
in which the visual notice component (237) is configured to provide an indication that the security device (110) is monitoring a protected area based, at least in part, on instructions received from a server (155) at an off-the-premises location (160) via the communication component (510).

15. A device comprising:

a solar panel (405); and
a visual notice component (237), **characterized by**:

the visual notice component (237) comprising an area substantially overlapping the area of the solar panel (405).

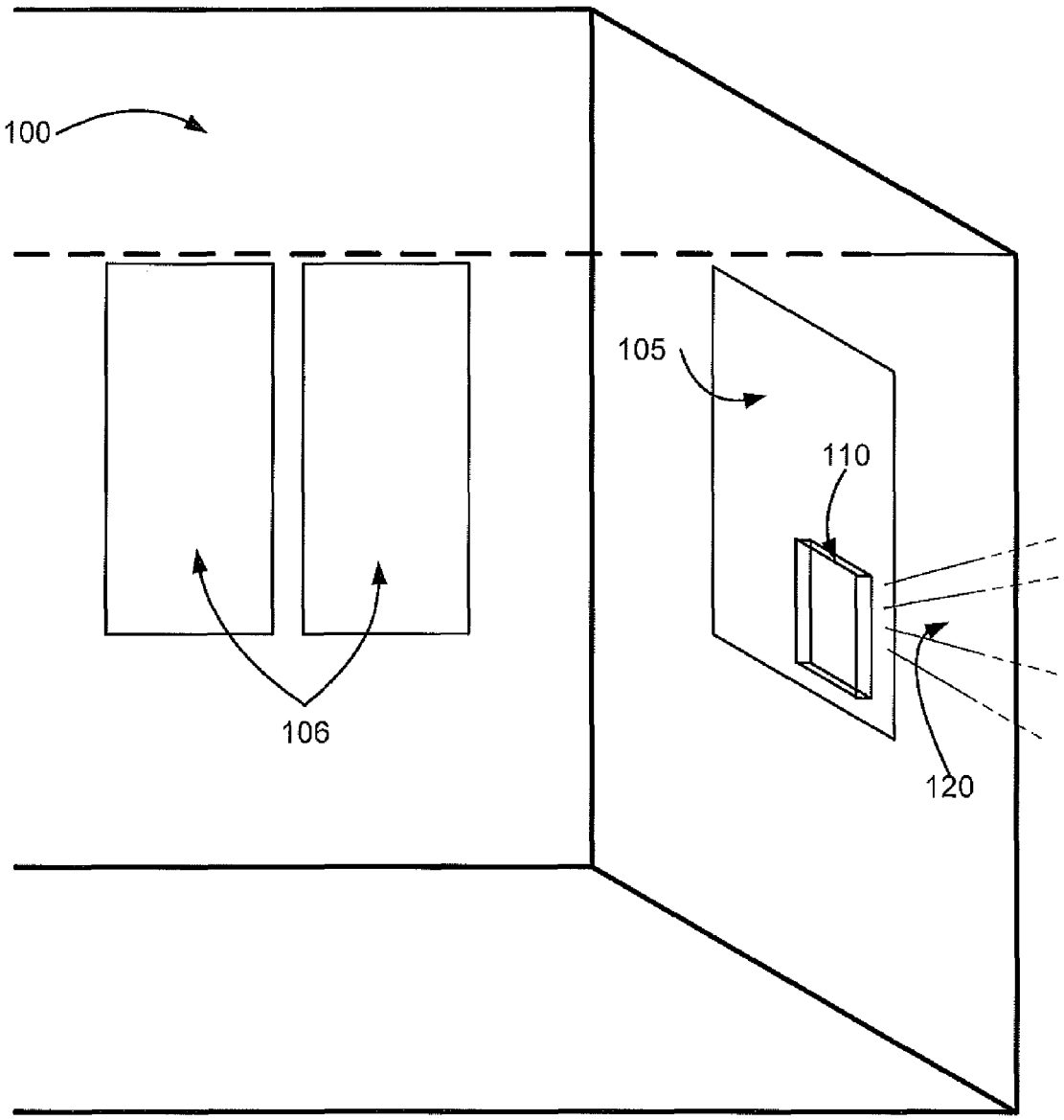

FIGURE 1A

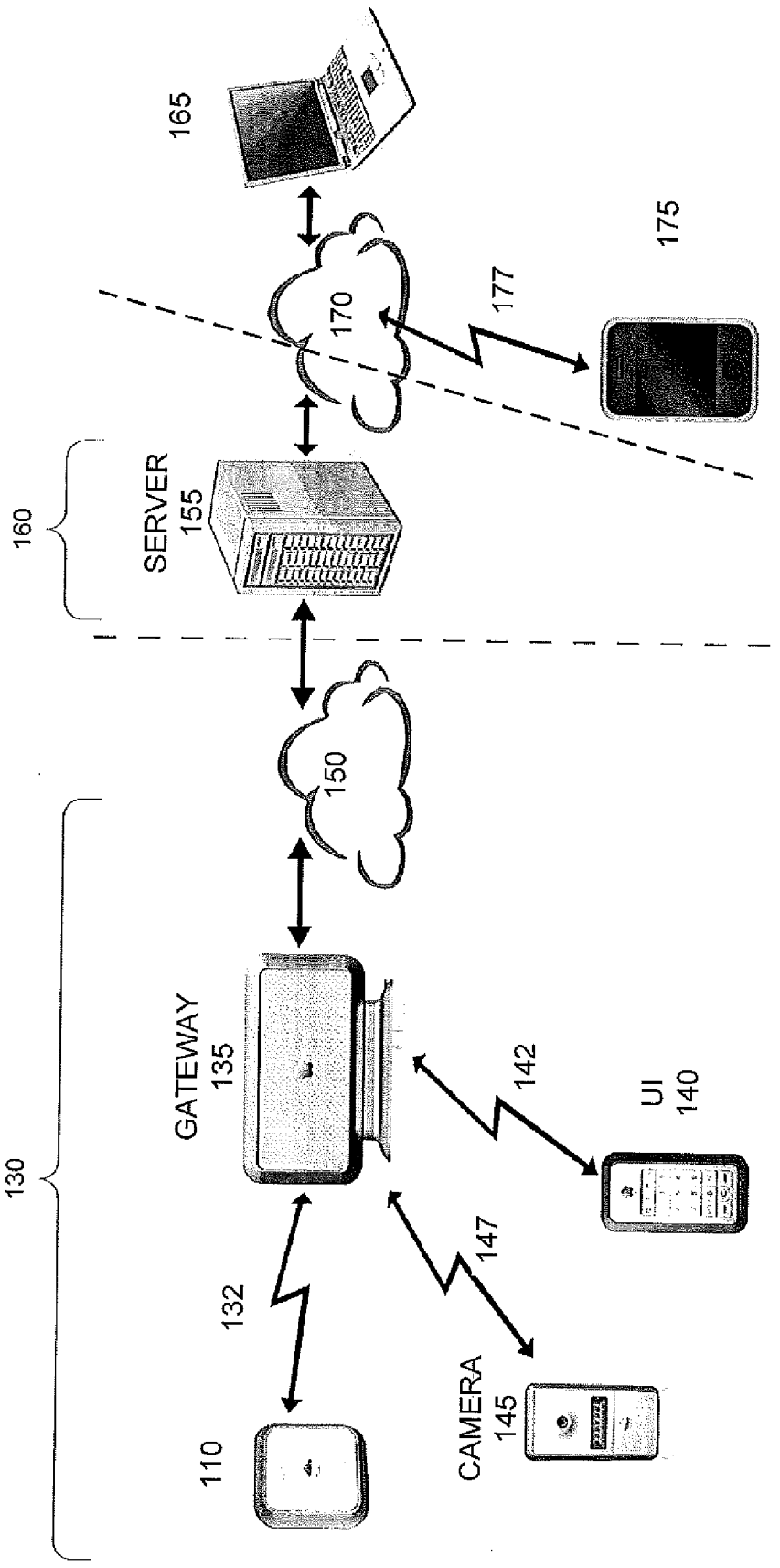
165
175
170
177
160
SERVER
155
150
130
GATEWAY
135
142
UI
140
132
147
110
CAMERA
145

FIGURE 1B

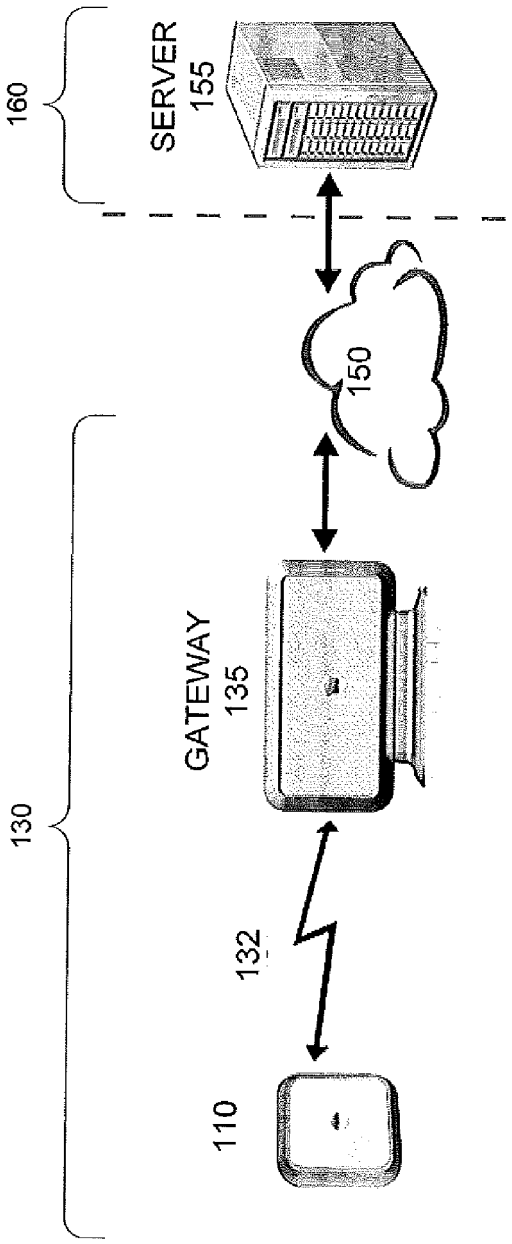

FIGURE 1C

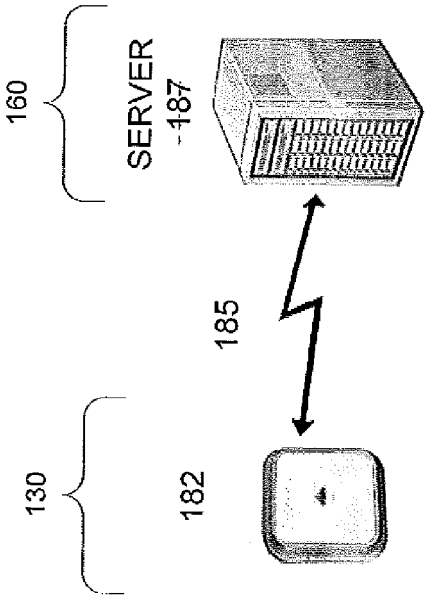

FIGURE 1D

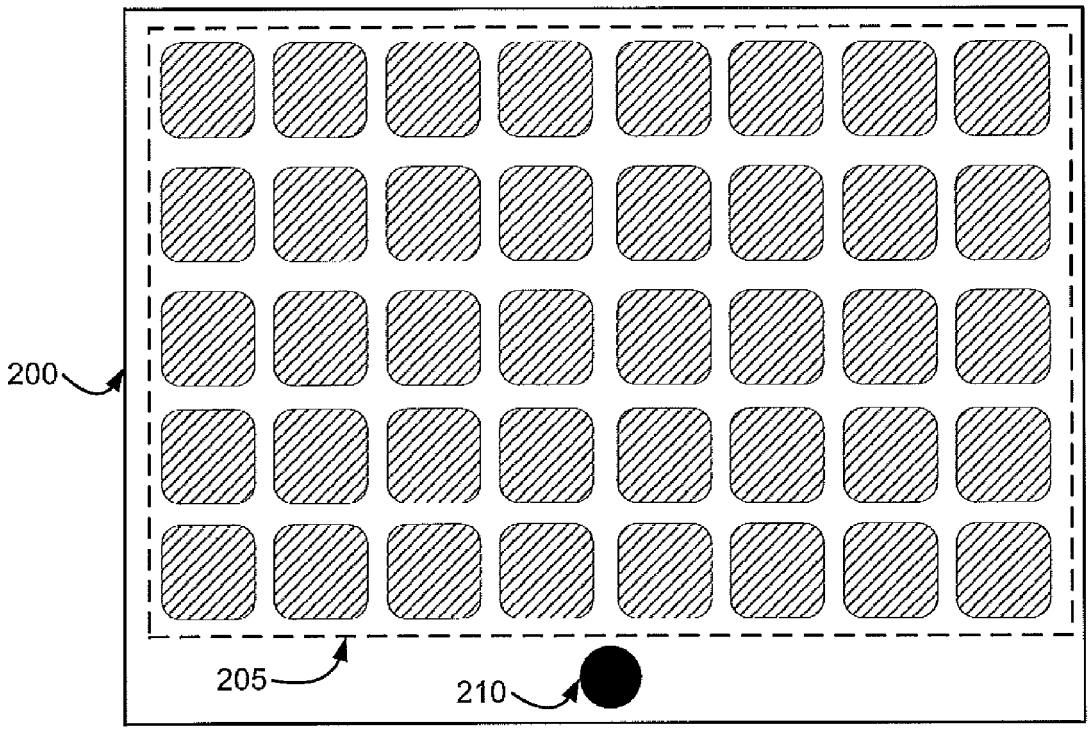

FIGURE 2A

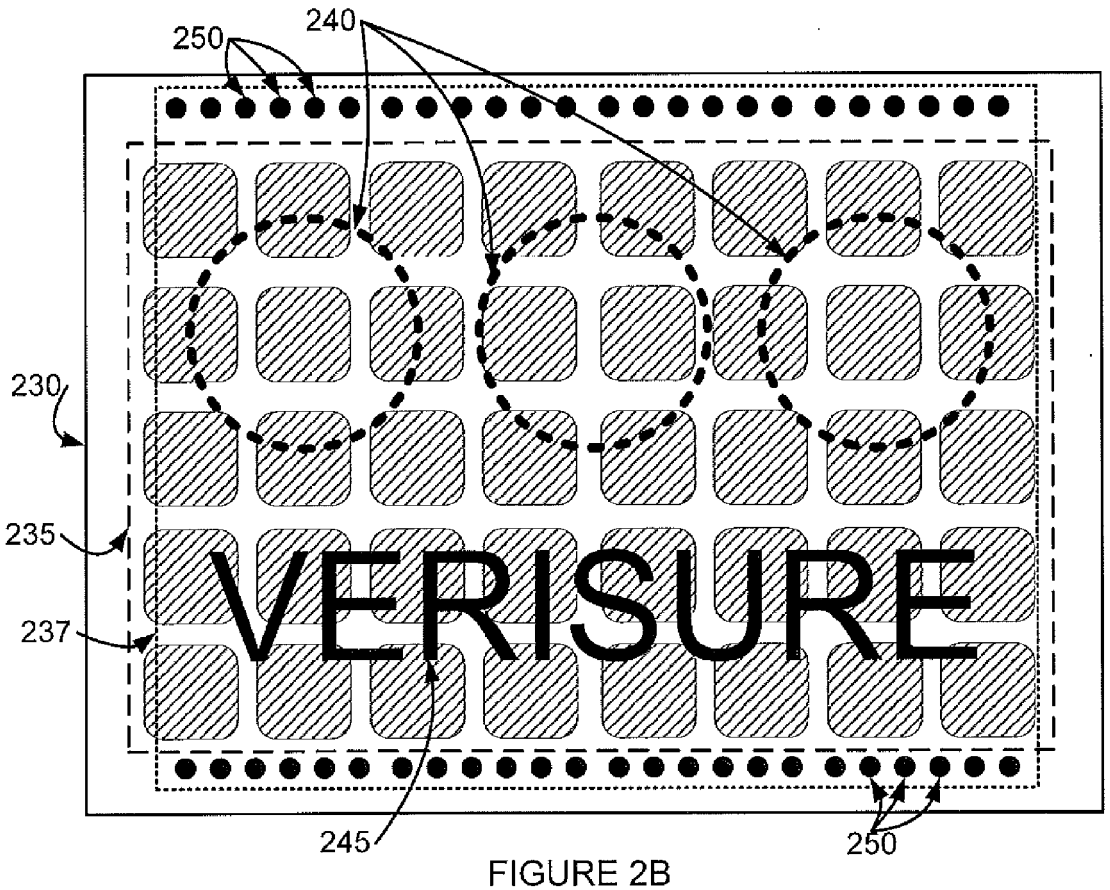

FIGURE 2B

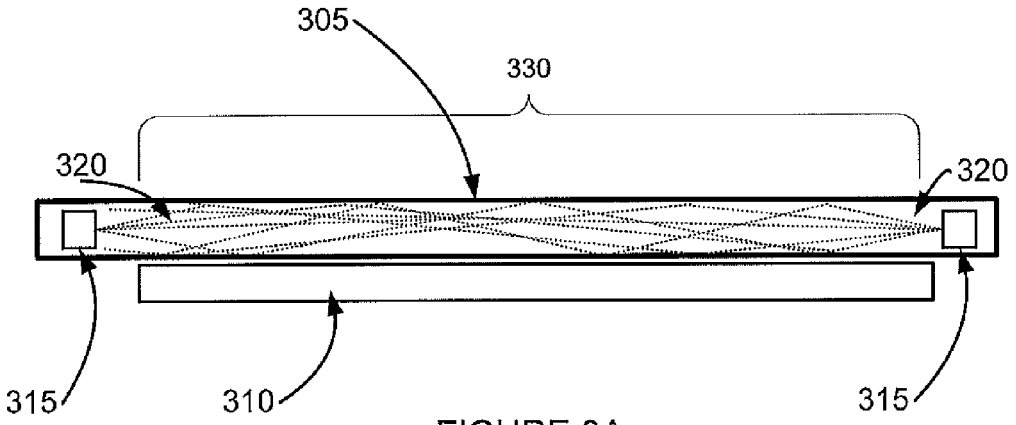

FIGURE 3A

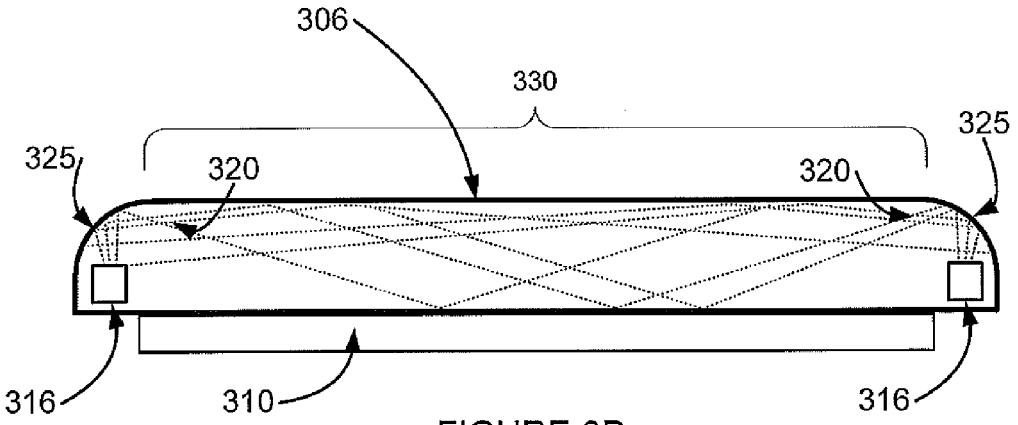

FIGURE 3B

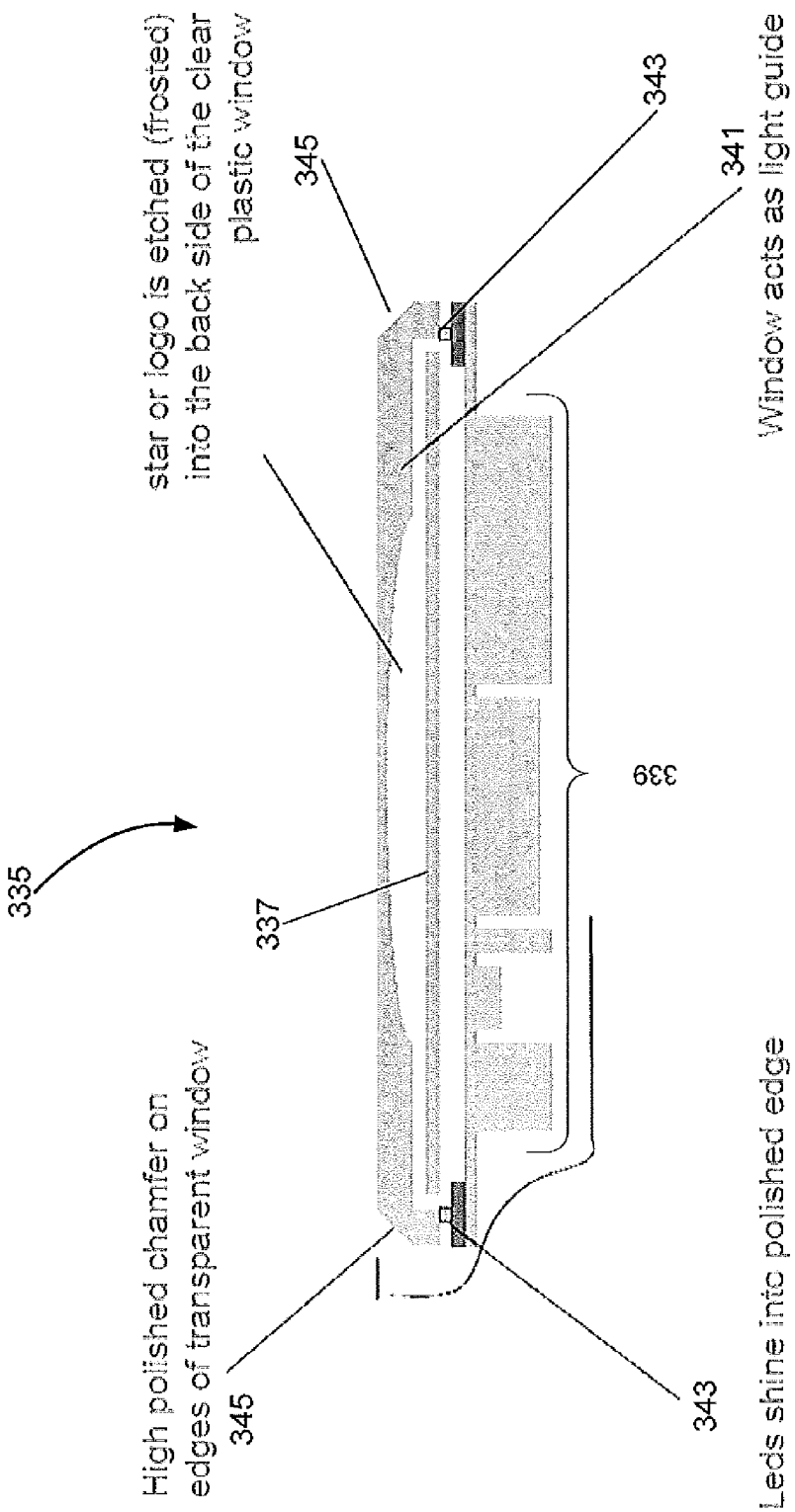
335
High polished chamfer on edges of transparent window
345
337
star or logo is etched (frosted) into the back side of the clear plastic window
345
343
341
Window acts as light guide
339
343
Leds shine into polished edge of transparent window

FIGURE 3C

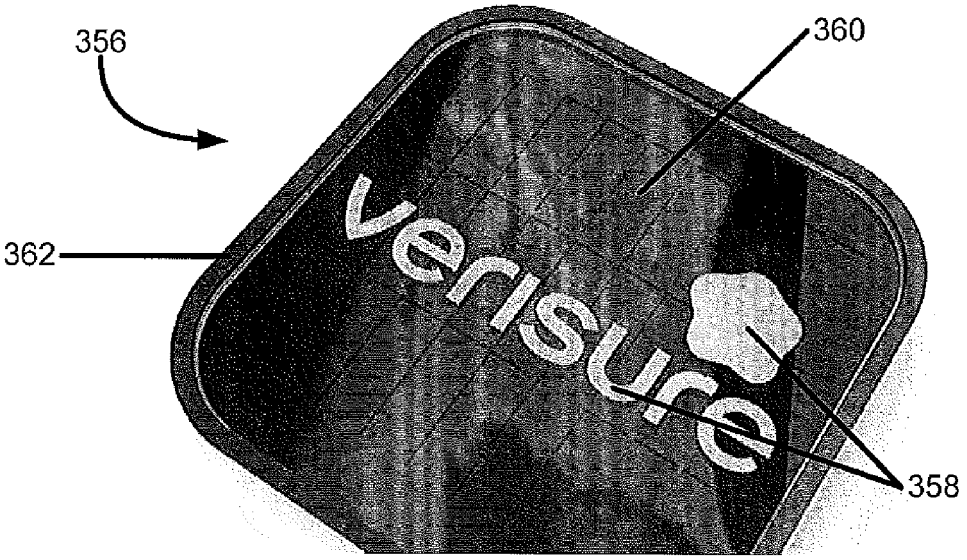

FIGURE 3D

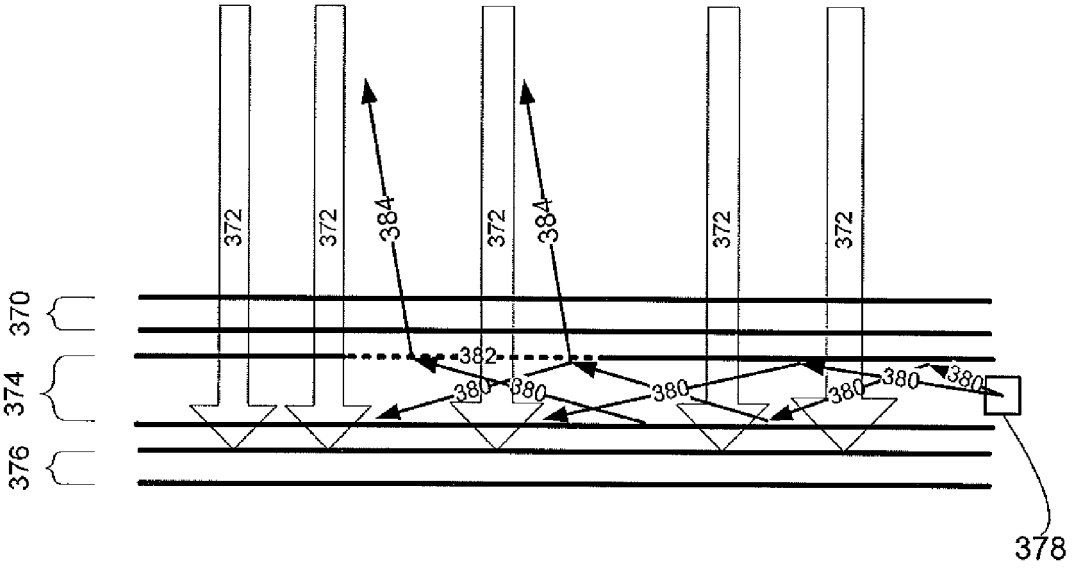

FIGURE 3E

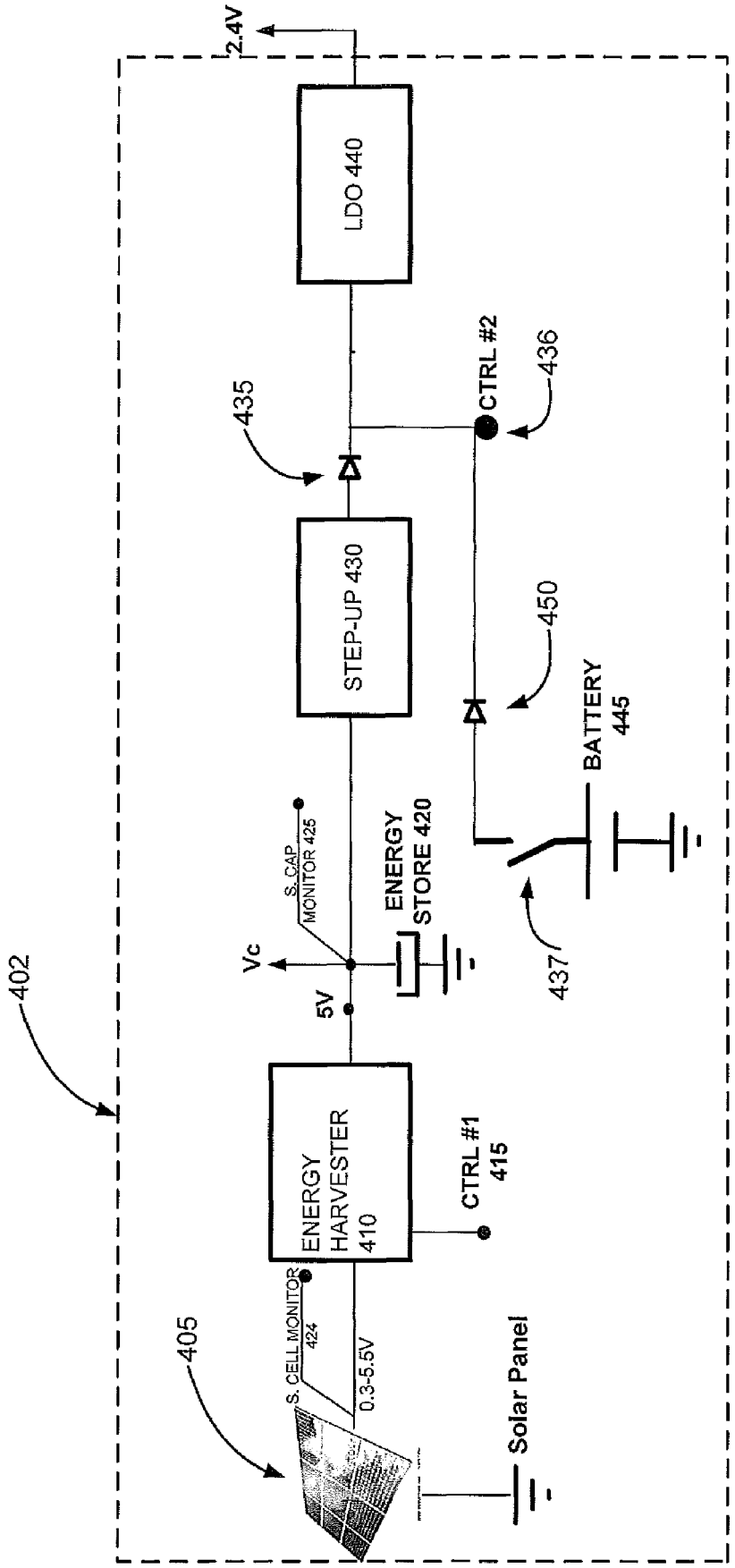
2.4V
LDO 440
CTRL #2
436
435
STEP-UP 430
450
BATTERY
445
S_CAP
MONITOR 425
ENERGY
STORE 420
Vc
5V
437
402
ENERGY
HARVESTER
410
CTRL #1
415
S. CELL MONITOR
424
0.3-5.5V
405
Solar Panel

FIGURE 4

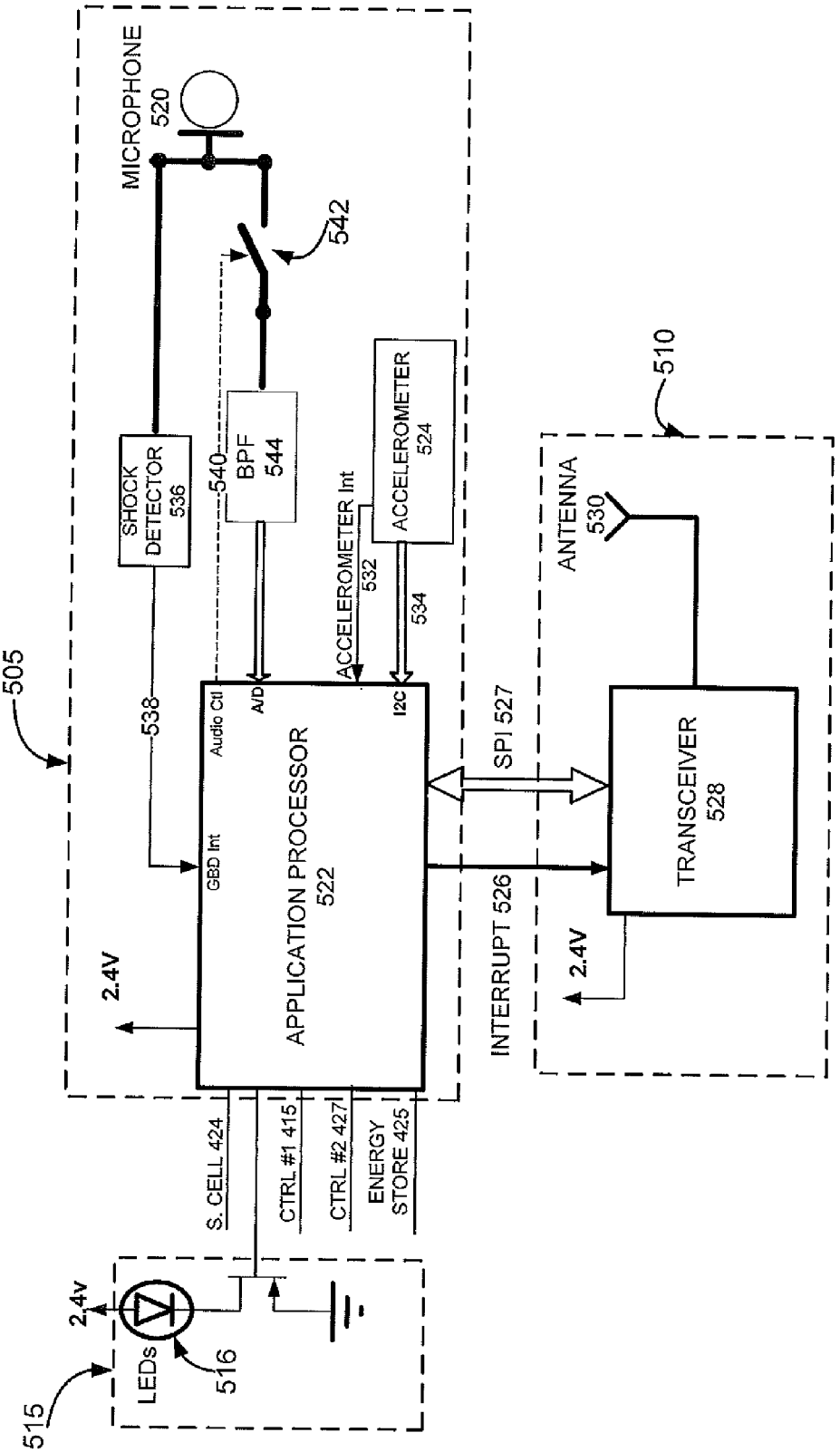
505
MICROPHONE
520
542
SHOCK DETECTOR 536
540
BPF 544
ACCELEROMETER Int
532
ACCELEROMETER 524
534
538
Audio Ctl
A/D
I2C
GBD Int
APPLICATION PROCESSOR 522
2.4V
SPI 527
INTERRUPT 526
510
ANTENNA 530
TRANSCEIVER 528
2.4V
S. CELL 424
CTRL #1 415
CTRL #2 427
ENERGY STORE 425
2.4v
LEDs
516
515

FIGURE 5

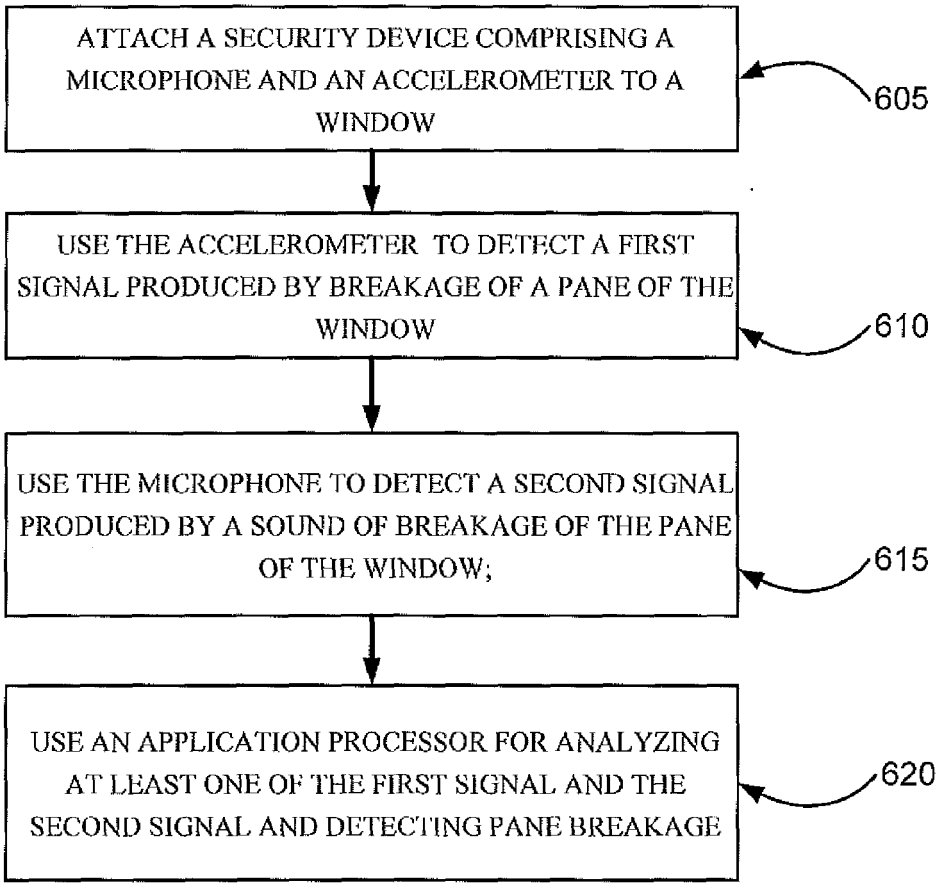
ATTACH A SECURITY DEVICE COMPRISING A MICROPHONE AND AN ACCELEROMETER TO A WINDOW
605
USE THE ACCELEROMETER TO DETECT A FIRST SIGNAL PRODUCED BY BREAKAGE OF A PANE OF THE WINDOW
610
USE THE MICROPHONE TO DETECT A SECOND SIGNAL PRODUCED BY A SOUND OF BREAKAGE OF THE PANE OF THE WINDOW;
615
USE AN APPLICATION PROCESSOR FOR ANALYZING AT LEAST ONE OF THE FIRST SIGNAL AND THE SECOND SIGNAL AND DETECTING PANE BREAKAGE
620

FIGURE 6A

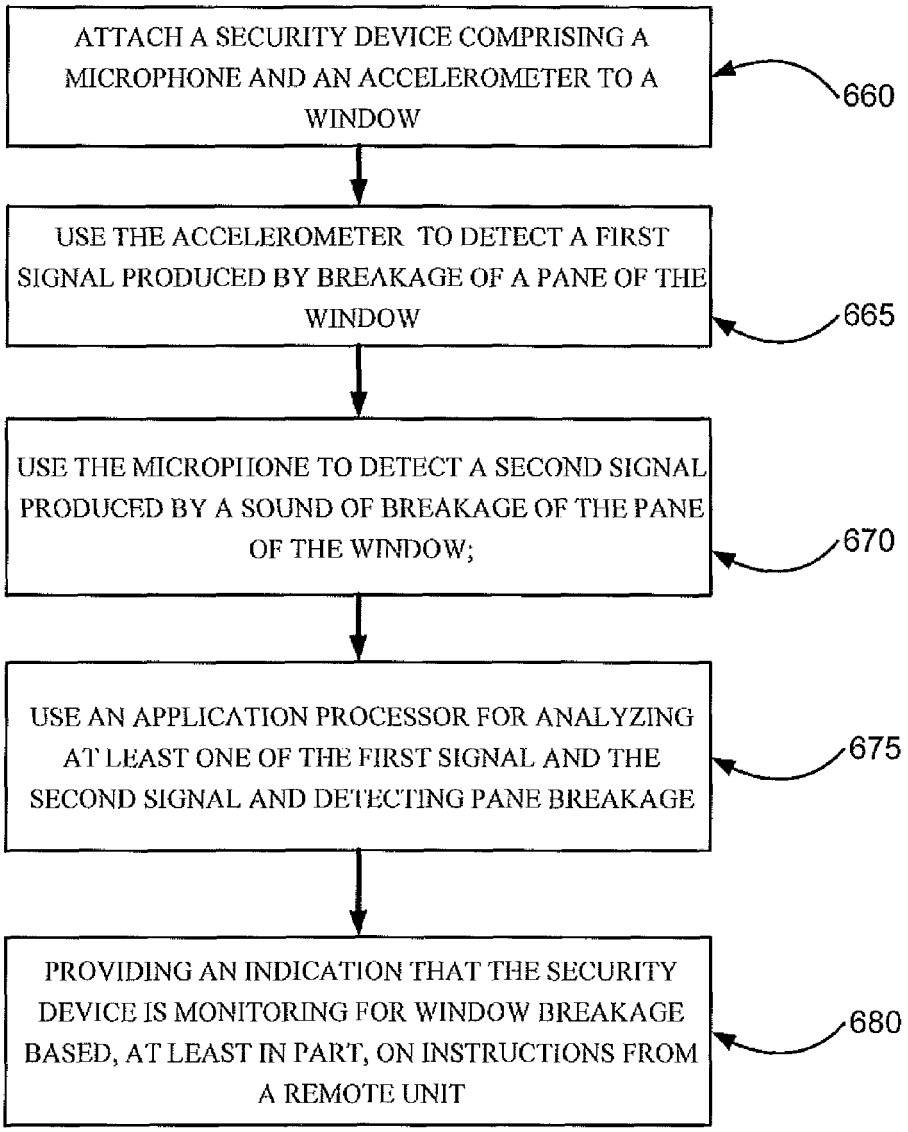
ATTACH A SECURITY DEVICE COMPRISING A MICROPHONE AND AN ACCELEROMETER TO A WINDOW
660
USE THE ACCELEROMETER TO DETECT A FIRST SIGNAL PRODUCED BY BREAKAGE OF A PANE OF THE WINDOW
665
USE THE MICROPHONE TO DETECT A SECOND SIGNAL PRODUCED BY A SOUND OF BREAKAGE OF THE PANE OF THE WINDOW;
670
USE AN APPLICATION PROCESSOR FOR ANALYZING AT LEAST ONE OF THE FIRST SIGNAL AND THE SECOND SIGNAL AND DETECTING PANE BREAKAGE
675
PROVIDING AN INDICATION THAT THE SECURITY DEVICE IS MONITORING FOR WINDOW BREAKAGE BASED, AT LEAST IN PART, ON INSTRUCTIONS FROM A REMOTE UNIT
680

FIGURE 6B

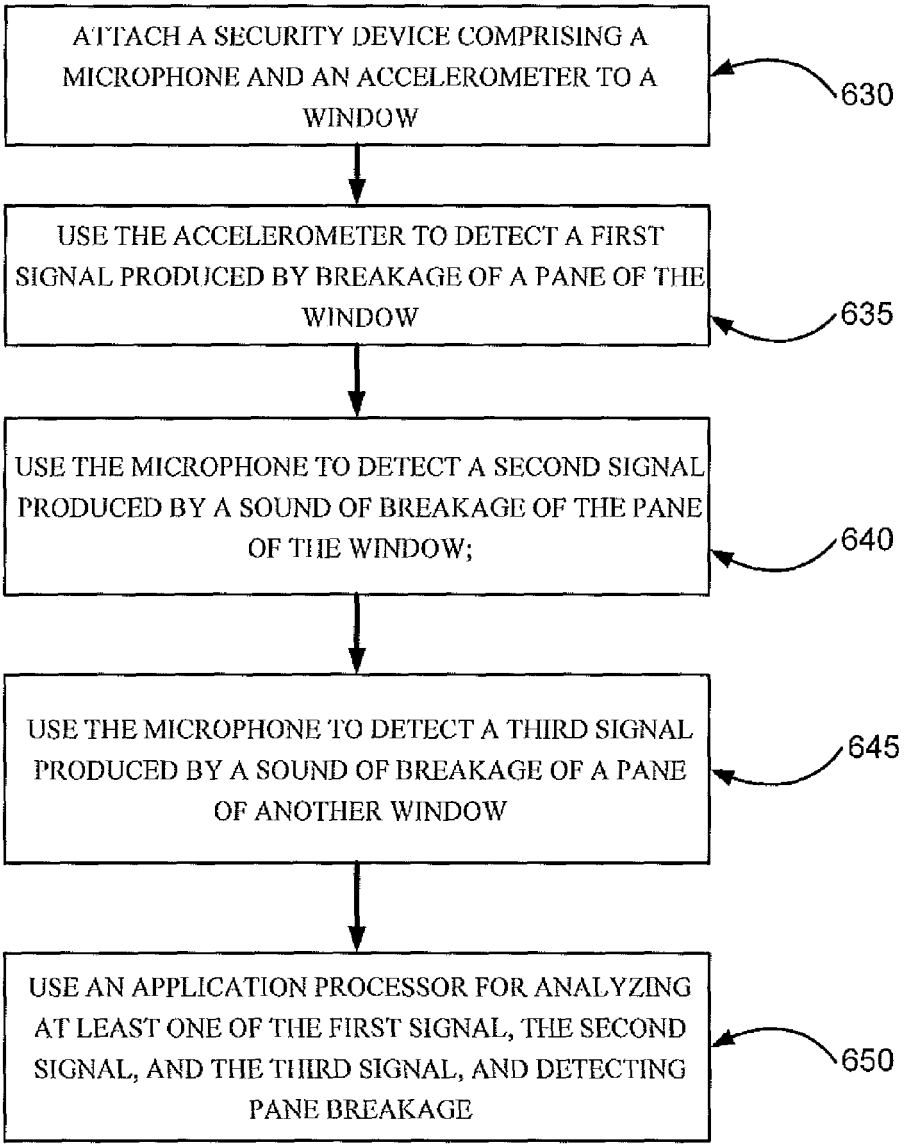
ATTACH A SECURITY DEVICE COMPRISING A MICROPHONE AND AN ACCELEROMETER TO A WINDOW
630
USE THE ACCELEROMETER TO DETECT A FIRST SIGNAL PRODUCED BY BREAKAGE OF A PANE OF THE WINDOW
635
USE THE MICROPHONE TO DETECT A SECOND SIGNAL PRODUCED BY A SOUND OF BREAKAGE OF THE PANE OF THE WINDOW;
640
USE THE MICROPHONE TO DETECT A THIRD SIGNAL PRODUCED BY A SOUND OF BREAKAGE OF A PANE OF ANOTHER WINDOW
645
USE AN APPLICATION PROCESSOR FOR ANALYZING AT LEAST ONE OF THE FIRST SIGNAL, THE SECOND SIGNAL, AND THE THIRD SIGNAL, AND DETECTING PANE BREAKAGE
650

FIGURE 6C

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EUROPEAN SEARCH REPORT

Application Number
EP 11 16 3497

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	GB 2 088 107 A (SHORROCK SECURITY SYSTEMS LTD) 3 June 1982 (1982-06-03) * the whole document * * page 1, line 30 - page 1, line 65; figure 1 * -----	1,7,8, 11-13 2,5,6,9, 10	INV. G08B5/36 G08B13/04 G08B13/16
Y A	US 5 565 843 A (MEYVIS DANIEL V [US]) 15 October 1996 (1996-10-15) * the whole document * * column 2, line 42 - column 4, line 23 * * column 2, line 66 - column 3, line 10; figures 1,2,3 * -----	14 1-13	
X Y	US 2007/075854 A1 (TYLER ROBERT B [US]) 5 April 2007 (2007-04-05) * the whole document * * paragraphs [0015], [0020], [0021], [0023], [0025]; figures 1,2 * -----	15 2,5,6	
Y	US 2010/277300 A1 (COHN ALAN WADE [US] ET AL) 4 November 2010 (2010-11-04) * paragraphs [0026] - [0038]; figures 1-11 * -----	9,10,14	

TECHNICAL FIELDS SEARCHED (IPC)

G08B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 August 2011	Wright, Jonathan

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

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22-08-2011

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2088107 A	03-06-1982	NONE	
US 5565843 A	15-10-1996	NONE	
US 2007075854 A1	05-04-2007	NONE	
US 2010277300 A1	04-11-2010	US 2010277302 A1	04-11-2010
		US 2010281312 A1	04-11-2010
		US 2010280635 A1	04-11-2010
		US 2010281135 A1	04-11-2010
		US 2010280637 A1	04-11-2010
		US 2010277315 A1	04-11-2010
		US 2010281161 A1	04-11-2010
		WO 2010127009 A1	04-11-2010
		WO 2010127194 A2	04-11-2010
		WO 2010127200 A1	04-11-2010
		WO 2010127203 A1	04-11-2010

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Patent documents cited in the description

- US 7187280 B, Ko **[0006]**
- US 20060273898 A, Hagiwara **[0007]**
- GB 2457102 A, Schaar **[0008]**
- JP 01223051 A **[0009]**
- JP 2004005057 B **[0010]**
- DE 29609521 **[0011]**