(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 576 034 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
25.06.2025 Bulletin 2025/26

(21) Application number: **23383377.1**

(22) Date of filing: **22.12.2023**

(51) International Patent Classification (IPC):
G08B 13/08 *(2006.01)* ***G08B 13/16*** *(2006.01)*
G08B 25/00 *(2006.01)* *G08B 29/04* *(2006.01)*

(52) Cooperative Patent Classification (CPC):
G08B 13/08; G08B 13/1672; G08B 25/008; G08B 29/046

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

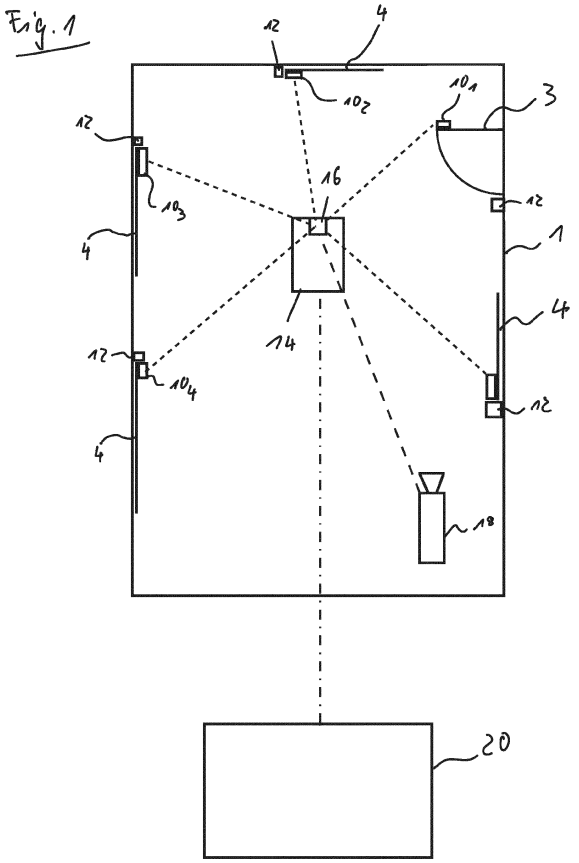
(71) Applicant: **Verisure Sàrl**
1290 Versoix (CH)

(72) Inventors:
- **NOBLE ECHEVERRÍA, Jon**
  28224 Pozuelo de Alarcón (Madrid) (ES)
- **ALFARO, César**
  28224 Pozuelo de Alarcón (Madrid) (ES)
- **OVEJERO, Iván**
  28224 Pozuelo de Alarcón (Madrid) (ES)

(74) Representative: **Elion IP, S.L.**
Paseo Castellana, 150-4 dcha
28046 Madrid (ES)

(54) ALARM SENSOR FOR A WINDOW OR A DOOR AND METHOD OF OPERATING AN ALARM SENSOR

(57) The invention relates to an alarm sensor for a window or a door, having a microphone and a memory for storing a recorded audio clip within the sensor. The invention further relates to an alarm installation comprising at least one sensor as defined above and a central unit, the central unit comprising a receiver. The invention finally relates to a method of operating a sensor in an alarm installation, the alarm installation comprising a central unit, the central unit comprising a receiver, wherein the method comprises the step of sending a request signal to the sensor and the step of the sensor sending, in response to the request signal, information relating to the audio clip.



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Description

[0001] The invention relates to an alarm sensor for a window or a door, and to a method of operating an alarm sensor of an alarm installation.

[0002] Alarm installations are used for monitoring premises/buildings and typically provide a means for detecting the presence and/or actions of people at the premises, and reacting to detected events. Commonly such alarm installations include alarm sensors to detect the opening and closing of doors and windows, movement detectors to monitor spaces for signs of movement, microphones to detect sounds such as breaking glass, and image sensors to capture still or moving images of monitored zones. Such alarm installations may be self-contained, with alarm indicators such as sirens and flashing lights that may be activated in the event of an alarm condition being detected. Such installations typically include a central unit that is coupled to the sensors, detectors, cameras, etc. ("nodes"), and which processes received notifications and determines a response. The central unit is typically linked to the various nodes wirelessly, rather than by wires, since this facilitates installation and provides some safeguards against sensors/detectors effectively being disabled by disconnecting them from the central unit. Similarly, for ease of installation and to improve security, the nodes of such alarm installations are typically battery rather than mains powered.

[0003] Alternatively, an alarm installation may include an installation at a premises, domestic or commercial, that is linked to a remote monitoring centre where typically human operators manage the responses required by different alarm and notification types. In such centrally monitored alarm installations, the central unit at the premises installation typically processes notifications received from the nodes in the installation, and notifies the remote monitoring centre of only some of these, depending upon the settings of the alarm installation and the nature of the detected events. In such a configuration, the central unit at the installation is effectively acting as a gateway between the nodes and the remote monitoring centre.

[0004] In both centrally-managed and self-contained alarm installations one of the most important issues, from a practical perspective, is the battery life of the nodes of the installation - that is, the battery life of the various detectors, sensors, cameras. Obviously, if a node's battery loses sufficient power, the node may be unable to sense a change of state or to contact the central unit, and consequently the security installation develops a weak spot where an intruder may gain access to the premises undetected. For centrally-managed alarm installations it is usually the responsibility of the company running the alarm installation, rather than the premises owner or occupier, to change batteries, and obviously the shorter the battery life in nodes, the more frequently site visits need to be made and the greater the administrative cost. Consequently, controlling power consumption in the nodes is a high priority.

[0005] Further, a very important issue for every alarm installation is a reduction of false alarms, or a means to distinguish between an incident and a false alarm when an event occurs which triggers one of the nodes.

[0006] The object of the invention is to provide means for reducing false alarms.

[0007] In order to solve this object, the invention provides an alarm sensor for a window or a door, having a microphone and a memory for storing a recorded audio clip within the sensor.

[0008] The microphone allows capturing audio signals when the alarm sensor is being triggered by the magnetic detector (indicating that the door or window is being opened) or by the shock/movement detector (indicating mechanical impact on the glass, the window or the door). The audio signal provides "context information" which allows an easier distinction between a false alarm and a critical situation. The audio clip can be stored locally in the alarm sensor for processing there, or for transmission to a central unit.

[0009] If the audio clip is to be sent to a central unit, the alarm sensor includes a transmitter.

[0010] Should it be desired that the alarm sensor "processes" the audio clip differently in response to requests received from the central unit and/or a remote monitoring centre, the sensor includes a receiver so that an upload signal, a deletion command signal etc. can be received by the alarm sensor.

[0011] In one embodiment, the sensor includes a classification device for classifying the audio signal of the audio clip. Classifying the audio signal is advantageous in that only the classification data has to be sent to the central unit in the first place, thereby saving transmission time and battery life. Should there be the need for a user of the alarm installation or an operator at the remote monitoring centre to listen to the entire audio clip, it can be uploaded by the alarm sensor upon receiving a specific request.

[0012] In an alternative embodiment, classification of the audio signal is not performed locally in the alarm sensor but at the central unit which comprises to this a classification device for classifying the audio clip. In the central unit, more sophisticated classification algorithms requiring more computing power can be used than in the alarm sensors.

[0013] In order to solve the above object, the invention also provides a method of operating a sensor as defined above in an alarm installation, the alarm installation comprising a central unit, the central unit comprising a receiver, wherein the method comprises the step of sending a request signal to the sensor and the step of the sensor sending, in response to the request signal, information relating to the audio clip. The trigger signal ensures that the audio signal is recorded only if there is "a need" such as suspicious activity which is detected by the alarm sensor or possibly by any other node of the alarm installation (such as a PIR or a camera), thereby increas-

ing the battery lifetime.

[0014] In one embodiment, the alarm sensor sends the entire audio clip so that it is available for a user of the alarm installation or an operator at the remote monitoring centre.

[0015] In another embodiment, the alarm sensor sends the result of the classification process which is advantageous regarding the transmission speed.

[0016] Should an operator feel that listening to the entire audio clip provides helpful context information for better assessing the situation, he/she can send an upload request so that the entire audio clip is sent to the remote monitoring centre. In combination with the result of the classification process, it is possible for an operator at the remote monitoring centre to quickly assess which of a plurality of recorded audio clips might be the most relevant one.

[0017] It is also possible that a deletion command signal is transmitted to the alarm sensor so that the audio clip is deleted after an alarm situation has been cleared.

[0018] In a related aspect, the invention provides an alarm sensor for a window or a door, having a microphone and a memory for storing a recorded audio clip within the sensor. The sensor may include any one or more of the following features, which are all optional:

(a) the sensor may include a transmitter.

(b) the sensor may include a receiver.

(c) the sensor may include a classification device for classifying the audio clip.

[0019] In a related aspect, the invention provides an alarm installation comprising at least one sensor as defined above and a central unit, the central unit comprising a receiver. Optionally, the central unit comprises a classification device for classifying the audio clip.

[0020] In a related aspect, the invention provides a method of operating a sensor as defined above in an alarm installation (optionally also as defined above), the alarm installation comprising a central unit, the central unit comprising a receiver, wherein the method comprises the step of sending a request signal to the sensor and the step of the sensor sending, in response to the request signal, information relating to the audio clip. The method may further comprise any one or more of the following steps, which are all optional:

(a) the sensor may send the entire audio clip.

(b) the sensor sends the result of a classification process.

(c) information relating to the audio clip is forwarded to a remote monitoring centre.

(d) transmitting the entire audio clip in response to a request sent from the remote monitoring centre.

(e) a step of deletion of the audio clip is performed.

[0021] In a related aspect, the invention provides an alarm sensor for a window or a door, comprising a detector for sensing a physical condition that is affected by opening and/or breach of the window or door, a microphone, digital processing circuitry for recording an audio clip from the microphone, and memory for storing a recorded audio clip within the sensor.

[0022] The sensor may be configured to record the audio clip in response to an event selected from at least one, optionally at least two, optionally all of:

(a) a trigger signal generated by the detector;

(b) a recording command signal received via a wireless receiver of the sensor;

(c) a tamper signal generated by a tamper detector of the sensor.

[0023] Additionally or alternatively, the sensor may be configured to delete a recorded audio clip in response to an event selected from at least one, optionally both, of:

(a) expiry of a predetermined time period after recording of the audio clip;

(b) a deletion command signal received via a wireless receiver of the sensor.

[0024] Additionally or alternatively to any of the above, the sensor may be configured to transmit the audio clip via a wireless transmitter of the sensor, in response to an upload command received via a wireless receiver of the sensor.

[0025] In some embodiments, the digital processing circuitry is configured to classify the audio clip and to generate a classification result, optionally wherein the processor is operable to classify the audio clip according to one or more of: contains human voices; contains animal noise; contains raised voices; contains sounds of breakage; contains sounds of glass breakage; contains mechanical tampering sounds.

[0026] The sensor of any preceding aspect may be configured to be surface mounted to a movable or fixed part of a door or a window, optionally independently of a locking mechanism of the door or window.

[0027] In a related aspect, the invention provides an alarm installation comprising at least one sensor, optionally as defined in any one of the preceding aspects, and a central unit, the central unit comprising a wireless transmitter for transmitting a signal to the sensor, and a wireless receiver for receiving a signal from the sensor, the central unit being configured to:

(a) receive an alarm trigger signal from the sensor; and

(b) transmit to the sensor a recording command signal to command the sensor to record an audio clip;

optionally wherein the central unit is further configured to:

(c) transmit to the sensor an audio information command signal in respect of an audio clip recorded by the sensor; and

(d) receive an audio information signal from the sensor, the audio information signal comprising at least one selected from: the recorded audio clip; and a classification result relating to the audio clip

[0028] Where the installation may comprise a plurality of sensors, the central unit may be configured to transmit to at least a group of said sensors one or more recording command signals for commanding those sensors to record respective audio clips.

[0029] The central unit may optionally comprise a classification device for classifying the audio clip. A classification device at the central unit may avoid some power consumption constraints compared to implementation at the sensor.

[0030] In a related aspect, the invention provides an alarm installation comprising at least one sensor, the sensor and/or the installation optionally as defined in any of the preceding aspects, the installation having a disarmed state and at least one armed state, wherein:

- in the disarmed state, the sensor is operable to transmit alarm trigger signals without recording audio clips; and
- in at least one of the armed states, the sensor is operable to transmit alarm trigger signals and to record audio clips, optionally selectively.

[0031] In a related aspect, the invention provides a method of operation of a sensor, optionally as defined in any of the preceding aspects, the method comprising the steps of:

(a) receiving wirelessly a command signal at the sensor; and

(b) in response to the command signal, an execution step selected from at least one of the sub-steps:

(b)(i) recording an audio clip, and storing in the sensor;

(b)(ii) transmitting wirelessly a recorded audio clip to another device;

(b)(iii) transmitting wirelessly to another device a result of classification of a recorded audio clip;

(b)(iv) deleting a recorded audio clip at the sensor.

[0032] Step (b) may optionally comprise selectively performing a sub-step from a group of said sub-steps in dependence on a function commanded by the command signal.

[0033] In a related aspect, the invention provides a method of operating a sensor, the sensor and/or the method optionally as defined in any of the preceding aspects, the alarm installation having a disarmed state and at least one armed state, the method comprising:

- in the disarmed state, controlling the sensor to transmit alarm trigger signals without recording audio clips; and
- in at least one of the armed states, controlling the sensor to transmit alarm trigger signals and to record audio clips, optionally selectively.

[0034] In a related aspect, the invention provides a method of operating a sensor, the sensor and/or the method optionally as defined in any of the preceding aspects, the method comprising:

(a) transmitting to the sensor a recording command signal to command the sensor to record an audio clip, optionally in response to receiving or having received an alarm trigger signal from the sensor;

(b) transmitting to the sensor an audio information command signal in respect of an audio clip recorded by the sensor, to command the sensor to transmit to the central unit an audio information signal comprising at least one selected from: the recorded audio clip; and a classification result relating to the audio clip;

(c) an optional step of transmitting to the sensor a deletion command signal to command the sensor to delete the audio clip stored at the sensor.

[0035] Where the alarm installation may comprise a plurality of said sensors, step (a) may optionally comprise transmitting a signal for commanding at least a group of said plurality of sensors to record an audio clip.

[0036] The invention will now be described with reference to the enclosed drawings. In the drawings,

- Figure 1 schematically shows an alarm installation,
- Figure 2 schematically shows an alarm sensor used in the alarm installation of Figure 1, and

- Figure 3 is a schematic flow diagram illustrating various functions and information flows during operation of the alarm installation, for example, at a sensor of Fig. 2, a central unit, and a remote monitoring centre.

[0037] In Figure 1, reference numeral 1 designates an example building to be protected with an alarm installation. The building 1 can, for example, be a house, an apartment in the house, or a small business building.

[0038] The building 1 comprises a door 3 and a plurality of windows 4.

[0039] Associated with the door 3 and one or more (for example, each) of the windows 4 is an alarm sensor 10 which is part of an alarm installation. The alarm installation is adapted for detecting an unauthorized intrusion or an attempt of unauthorized intrusion.

[0040] The alarm sensor 10 is mounted on at least one of the movable parts or fixed parts of the door or window, for example, a door leaf or door frame or on a window leaf or a window sash or a window frame. A magnet 12 may be mounted on the other of the movable or fixed parts.

[0041] The alarm installation comprises a central unit 14 which can communicate (typically via a wireless communication such as power-efficient transceivers in the frequency band between 862 MHz and 870 MHz, or LTE cat M) with each of the alarm sensors 10. To this end, central unit 14 comprises a transceiver 16. Dashed lines symbolize the wireless communication.

[0042] The alarm installation can further comprise at least one camera 18 which also communicates with the central unit 14. Although not shown, the alarm installation may also include other peripherals, for example, a motion detector (e.g. a passive infra-red detector), a keypad, a video-doorbell, and/or an obfuscation cloud generator (e.g. for hindering visibility and thus urging an intruder to leave).

[0043] The central unit 14 is connected to a remote monitoring centre 20 also via a wireless and/or wired communication means. An internet connection or, as a fall-back means, a cellular connection, can be used. The term "remote monitoring centre" may include one or more centres manned by human operators responsible for reacting to alarms, and/or one or more data processing centres, whether or not such centres are located on the same site as one another.

[0044] In an alternative embodiment, the central unit 14 may be omitted at the installation, and the or each alarm sensor 10 (and optionally the camera 18) may communicate independently with a remote monitoring centre 20, for example, via cellular wireless data communication, for example, LTE cat M communication.

[0045] In Figure 2, details of the alarm sensors 10 are shown.

[0046] The alarm sensor 10 comprises a microcontroller 30, and a power supply 42. In some forms, the sensor 10 comprises at least one detector for sensing a physical condition that is affected by opening and/or breach of the window or door. The at least one detector may include a magnetic detector 32, and a shock/movement detector 34. Additionally or alternatively, the sensor 10 comprises a microphone 36 and a memory 38.

[0047] Further, the alarm sensor 10 comprises a tamper detector 40.

[0048] Still further, the alarm sensor 10 comprises indicator lights 44 (preferably LEDs), and a wireless transceiver 46 (e.g. comprising a wireless transmitter and/or a wireless receiver).

[0049] The microcontroller 30 controls functionality of the alarm sensor 10.

[0050] The magnetic detector 32 is adapted to generate a signal when its position with respect to the magnet 12 changes, in particular to indicate that the door 3 or the window 4 is being opened. To this end, the magnetic detector 32 can comprise a hall sensor, a reed switch, or a magnetometer, e.g. multi-axis (e.g. 3-axis) magnetometer.

[0051] The shock/movement detector 34 is adapted to generate a signal when there is a movement of the door or window, and/or when there are vibrations in the door/-window. To this end, shock/movement detector 34 can comprises a piezo shock/vibration detector, or an accelerometer.

[0052] The microphone 36 is adapted to capture audio signals which are then recorded/stored as an audio clip in the memory 38. Memory 36 can in particular be a flash memory.

[0053] The tamper detector 40 is adapted for detecting an attempt to manipulate, remove or otherwise make the alarm sensor 10 inoperable. It can comprise electric contacts which are arranged so as to change state (for example, be interrupted) when a housing of the alarm sensor 10 is opened or when there is an unauthorized attempt to cut of the power supply of the alarm sensor 10.

[0054] The power supply 42 comprises a battery or a plurality of batteries which can be replaced when necessary.

[0055] The indicator lights 44 can provide an indication to the user that the alarm sensor 10 operates properly, e.g. by flashing a green light at specific intervals, or can provide an indication that there is a malfunction, e.g. by flashing a red light at specific intervals.

[0056] The transceiver 46 provides for bi-directional communication with the central unit 14.

[0057] The alarm sensor 10 is housed within a case that is configured for surface mounting to the window or door, for example, by adhesive or by one or more fixings, for example, screws. The alarm sensor 10 can be configured for mounting to the window or door independently of a locking mechanism for the window or door. Such an example is distinct from the locking mechanism, which may provide a degree of sensor independence sensitive to intrusion attempts whether or not the intrusion attempts focus on the locking mechanism or other regions of the door or window.

[0058] Referring to Figures 2 and 3, the alarm installa-

tion and the alarm sensor 10 can be operated as follows: Upon receipt of an audio capture trigger signal (S1; S2; S3), also referred to below as merely a trigger signal, the microphone 36 captures (S4) audio signals for a predetermined period of time. As the lifetime of the power supply 42 is an important aspect of the alarm sensor 10, the audio signals are captured for a short period of time only. As examples, the audio signal is captured for five or ten seconds.

[0059] The audio signal is stored (S4) as an audio clip in the memory 38.

[0060] The audio data may be compressed during recording for storage, and/or compressed for uploading.

[0061] The trigger signal can be of one or more, optionally any, of the following different origins.

[0062] In one embodiment, the trigger signal (S1) originates from the alarm sensor 10. In particular, the trigger signal (S1) can be the result of the magnetic detector 32 and/or the shock/movement detector 34 generating a signal which indicates that the door 3 or window 4 is being opened, or can be the result of the shock/movement detector 34 generating a signal which indicates that there is a vibration in the door/window, or that somebody is banging on the door/window. The trigger signal can also be the result of the tamper detector 40 generating a signal which indicates that there is an attempt to tamper with the alarm sensor 10.

[0063] Additionally or alternatively, the trigger signal (S2) originates from the central unit 14. The trigger signal can be sent in response to one of the plurality of alarm sensors 10 sending an alarm signal (S5) (as an indication that there is activity which is at least suspicious), or in response to a signal sent from the camera 18, indicating that there is movement somewhere within the building at a place where movement is not expected.

[0064] Additionally or alternatively to either of the above, the trigger signal (S3) originates from the remote monitoring centre 20. The trigger signal can be sent by personnel of the remote monitoring centre 20 in a situation in which the personnel notices suspicious activity in the building 1 because of an alarm notification signal (S6) sent from the central unit 14, and commands or requests an audio clip to be recorded by one particular alarm sensor 10 or by a plurality of alarm sensors 10, to provide additional context for helping clarify if there is a false alarm or if there is a true alarm situation.

[0065] The alarm installation may have, or be set in, a disarmed state, or at least one armed state. For the current embodiments, the trigger signal is preferably generated only when the alarm installation is in an armed state. This is advantageous in order to reduce the power consumption of the alarm sensors 10 (and thus to increase the lifetime of the batteries) and with respect to privacy laws and occupant privacy.

[0066] The armed state of the alarm installation can be one of an "armed-away" state (which is the state when no occupants are in the building so that there is a level of maximum protection), and an "armed at home" state (which is the state when occupants are in the building but have defined areas which are unoccupied so that these areas and the perimeter of the building are monitored by the alarm installation). In the "armed-away" state, potentially each and every of the alarm sensors 10 can be used for recording an audio clip, while in the "armed at home" state, only those alarm sensors 10 which are in areas supposedly unoccupied can be used for recording an audio clip.

[0067] In other words, the alarm sensors 10 are authorized to record an audio clip only in an armed state. In a disarmed state, there is no recording of an audio clip.

[0068] In one embodiment, the central unit 14 transmits (S7) the arm state (or changes to the arm state) to the alarm sensors 10. The sensors are authorised to self-record when in an armed state.

[0069] In another embodiment, the alarm sensors 10 behave the same way whether the alarm installation is armed or disarmed, and always transmit basic alarm triggers (S5) to the central unit 14 whether armed or disarmed. However, the alarm sensors 10 will only record audio when the central unit 14 (which knows the arm/disarmed state) authorises or commands (S8) audio recording. This requires a two-way exchange of information between the alarm sensors 10 and the central unit 14 for each trigger event. The sensor 10 is responsive to a command signal (S2) received via the transceiver, to record an audio clip.

[0070] In the current examples, an audio signal itself is not a trigger, as continuously monitoring and processing audio may consume battery power excessively. Instead, a low power trigger is used, which can be a movement signal (S1; S4) detected by the magnetic sensor or by the vibration/movement sensor, or a vibration signal (S1; S4) detected by a piezo shock detector, or a specific recording command signal (S2) sent by the central unit 14.

[0071] Should an audio clip be recorded, the alarm sensor 10 can upload (S9) it to the central unit 14 automatically (from where it can be sent to the remote monitoring centre 20 either automatically or upon request), or the audio clip can be uploaded to the central unit 14 only if there is a specific command or request (S10) (sent from the central unit 14 or by an operator in the remote monitoring centre 20 where alarms of alarm installations are monitored).

[0072] A user can, in some embodiments, replay the audio clip (either at the central unit 14 directly or remotely via a mobile device) to obtain additional context on the event which triggered the recording of the audio clip and the associated alarm.

[0073] The audio clip can be analysed in the remote monitoring centre 20 by an operator so that additional context on the alarm is made available to the personnel there, to help verify a true alarm or to help cancel or de-escalate a false alarm.

[0074] In some embodiments, an audio clip is recorded by the alarm sensor 10 which has detected a trigger. In other embodiments of the invention, a recording com-

mand signal (S2; S3) is sent to an alarm sensor 10 which has not (e.g. not yet) detected a trigger, by either the central unit 14 or the remote monitoring centre 20. A recording command signal (S2) can be sent from the central unit 14 automatically in response to some other trigger occurring at the premises and processed by the central unit 14. In addition or alternatively, a recording command signal (S3) can be sent from an operator at the remote monitoring centre 20 in order to make available additional context information.

[0075] As an example, an alarm installation is considered which comprises in the building several audio-equipped window/door alarm sensors 10, and perhaps other sensors (PIR motion detectors, or PIR-cameras). In response to an initial alarm trigger somewhere in the alarm installation, transmitted via the installation's central unit 14 to the remote monitoring centre 20, either the central unit 14 (automatically) or the operator at the remote monitoring centre 20 (acting via the central unit 14) may generate a recording command signal (S2; S3) to command all of the window/door alarm sensors to record an audio clip, even if the individual alarm sensors have not been triggered locally.

[0076] This gives the operator at the remote monitoring centre 20 access to audio from several different sources, to provide additional context information.

[0077] According to one possible embodiment, the audio clip or more precisely the audio signal is classified (S11; S12) by a classification device. Classification can be performed by a classification device incorporated into the microcontroller 30, incorporated into the central unit 14, or provided at the remote monitoring centre 20. The classification device may be implemented by software running on a processor of the sensor 10, or of the central unit 14, or at the monitoring centre.

[0078] Classification (S11; S12) is performed by a pre-trained machine-learning algorithm. As an example, input data is classified by a machine-learning model comprising a convolutional neural network (CNN) to produce a classification result, wherein the input data is based at least in part on an audio signal provided by the microphone 36 of the alarm sensor 10. The classification result indicates a correspondence of the input data with alarm installation related events such as glass-break, door-break, window-break, dog barking, humans, speaking, shouting, and screaming.

[0079] Classification result data is generated based on the classification. The classification result data can be a code word which indicates the nature of the identified incident which was recorded in the audio clip (e.g. a code word indicating "glass breaking").

[0080] If classification (S11) is performed by the alarm sensor 10, an embodiment of the invention provides that in a first step, not the entire audio clip is sent from the alarm sensor 10 to the central unit 14 but only the classification result data. This saves battery life as sending the classification result data requires less energy than sending the entire audio clip. Further, in view of the limited bandwidth of the transmission between the alarm sensor 10 and the central unit 14, sending classification result data is faster than sending an entire audio clip. Classification result data may be transmitted automatically, or it may be transmitted in response to an upload command (S10).

[0081] Should a user of the alarm installation or personnel in the remote monitoring centre want to listen to the entire audio clip, an upload request (S10) is sent to the alarm sensor, and the entire audio clip is sent to the central unit 14 from where it can be sent to the remote monitoring centre 20.

[0082] An advantage of making available to the personnel in the remote monitoring centre 20 the classification result data is that a decision on the nature of the alarm can be taken faster as compared to a scenario in which a couple of audio clips are being sent which an operator in the remote monitoring station 20 has to listen to, possibly a few times until he/she understands what sound has been recorded. Instead, the operator can either take a decision immediately based on the classification result data (indicating e.g. "glass breaking") or replay only the audio clip which appears to be, based on the classification result data, the most relevant one.

[0083] The audio clip is preferably deleted at some point (S13), both with a view to memory constraints in the alarm sensor 10 and with a view to data privacy. Like camera images, audio is subject to data privacy considerations. This is potentially even more relevant than camera images as audio capture may be less directional compared to a camera. For example, if a window or door is open, it may record audio from outside the premises.

[0084] Deletion (S13) can be done in response to reception at the sensor 10 of a deletion command signal (S14) or automatically after a predefined time period has lapsed.

[0085] A deletion command signal (S14) can be sent from the remote monitoring centre 20 or the control unit 14 after an alarm situation has been cleared.

[0086] Should an audio clip have been recorded without there being a subsequent upload request from the control unit 14 or the remote monitoring centre 20, the audio clip can be automatically deleted (S14) when enough time has lapsed so that it is clear that the audio clip will no longer be used. Examples of such time periods are 24 hours, 12 hours, or 1-2 hours, 30 minutes, 20 minutes, 10 minutes, or less.

[0087] In an embodiment of the invention, the audio clip is automatically deleted after a predetermined time has lapsed, and also in a situation in which the audio clip has been uploaded to the central unit 14. Such automatic-delete ensures, with a view to data privacy, that the audio clip is deleted even if there is no explicit deletion command signal.

[0088] The clip might be over-written anyway by a subsequent audio clip recording, but using explicit automatic-deletion would ensure that no clip is retained on-device for longer than is justifiable.

[0089] Deletion of an audio clip can be performed by actual erasure, by over-writing with other data, or by erasing a pointer to the recording in memory, or by destroying an access or encryption key to the recording.

[0090] In the foregoing example, communication with the alarm sensor 10 is generally via the central unit 14. For example, in Figure 3, communications to and from the remote monitoring centre 20 generally pass via the central unit 14. However, as mentioned above, in some embodiments, the central unit 14 of the installation may be omitted. In such case, where the functionality of the central unit 14 is not implemented at the installation itself (e.g. in another sensor, camera, keypad, doorbell, etc), the sensors 10 may communicate independently with the remote monitoring centre. Communications to and from the central unit 14, described above, will then be understood to be with the remote monitoring centre 20. In Figure 3, the functionalities represented in the central unit 14 would be merged into the functionalities at the remote monitoring centre 20.

Claims

1. An alarm sensor for a window or a door, comprising a detector for sensing a physical condition that is affected by opening and/or breach of the window or door, a microphone, digital processing circuitry for recording an audio clip from the microphone, and memory for storing a recorded audio clip within the sensor.

2. The sensor of claim 1, **characterized in that** the sensor is configured to record the audio clip in response to an event selected from at least one, optionally at least two, optionally all of:

    (a) a trigger signal generated by the detector;
    (b) a recording command signal received via a wireless receiver of the sensor;
    (c) a tamper signal generated by a tamper detector of the sensor.

3. The sensor of claim 1 or 2, wherein the sensor is configured to delete a recorded audio clip in response to an event selected from at least one, optionally both, of:

    (a) expiry of a predetermined time period after recording of the audio clip;
    (b) a deletion command signal received via a wireless receiver of the sensor.

4. The sensor of claim 1, 2 or 3, wherein the sensor is configured to transmit the audio clip via a wireless transmitter of the sensor, in response to an upload command received via a wireless receiver of the sensor.

5. The sensor of claim 1, 2, 3 or 4, wherein the digital processing circuitry is configured to classify the audio clip and to generate a classification result, optionally wherein the processor is operable to classify the audio clip according to one or more of: contains human voices; contains animal noise; contains raised voices; contains sounds of breakage; contains sounds of glass breakage; contains mechanical tampering sounds.

6. The sensor of any preceding claim, configured to be surface mounted to a movable or fixed part of a door or a window, optionally independently of a locking mechanism of the door or window.

7. An alarm installation comprising at least one sensor as defined in any one of the preceding claims and a central unit, the central unit comprising a wireless transmitter for transmitting a signal to the sensor, and a wireless receiver for receiving a signal from the sensor, the central unit being configured to:

    (a) receive an alarm trigger signal from the sensor; and
    (b) transmit to the sensor a recording command signal to command the sensor to record an audio clip;

    optionally wherein the central unit is further configured to:

    (c) transmit to the sensor an audio information command signal in respect of an audio clip recorded by the sensor; and
    (d) receive an audio information signal from the sensor, the audio information signal comprising at least one selected from: the recorded audio clip; and a classification result relating to the audio clip

8. An alarm installation of claim 7, comprising a plurality of said sensors, wherein the central unit is configured to transmit to at least a group of said sensors one or more recording command signals for commanding those sensors to record respective audio clips.

9. The alarm installation of claim 7 or 8, **characterized in that** the central unit comprises a classification device for classifying the audio clip.

10. An alarm installation comprising at least one sensor according to any of claims 1 to 6, the installation optionally according to any of claims 7 to 9, the installation having a disarmed state and at least one armed state, wherein:

    - in the disarmed state, the sensor is operable to transmit alarm trigger signals without recording

audio clips; and
- in at least one of the armed states, the sensor is operable to transmit alarm trigger signals and to record audio clips, optionally selectively.

11. A method of operation of a sensor as defined in any one of claims 1 to 6 in an alarm installation, wherein the method comprises the steps of:

(a) receiving wirelessly a command signal at the sensor; and
(b) in response to the command signal, an execution step selected from at least one of the sub-steps:

(b)(i) recording an audio clip, and storing in the sensor;
(b)(ii) transmitting wirelessly a recorded audio clip to another device;
(b)(iii) transmitting wirelessly to another device a result of classification of a recorded audio clip;
(b)(iv) deleting a recorded audio clip at the sensor.

12. The method of claim 11, wherein step (b) comprises selectively performing a sub-step from a group of said sub-steps in dependence on a function commanded by the command signal.

13. A method of operating a sensor as defined in any one of claims 1 to 6 in an alarm installation, the method optionally according to claim 11 or 12, the alarm installation having a disarmed state and at least one armed state, the method comprising:

- in the disarmed state, controlling the sensor to transmit alarm trigger signals without recording audio clips; and
- in at least one of the armed states, controlling the sensor to transmit alarm trigger signals and to record audio clips, optionally selectively.

14. A method of operating a sensor as defined in any one of claims 1 to 6 in an alarm installation, the method optionally according to claim 11, 12 or 13, the method comprising:

(a) transmitting to the sensor a recording command signal to command the sensor to record an audio clip, optionally in response to receiving an alarm trigger signal from the sensor;
(b) transmitting to the sensor an audio information command signal in respect of an audio clip recorded by the sensor, to command the sensor to transmit to the central unit an audio information signal comprising at least one selected from: the recorded audio clip; and a classification result relating to the audio clip;
(c) an optional step of transmitting to the sensor a deletion command signal to command the sensor to delete the audio clip stored at the sensor.

15. The method of claim 14, wherein the alarm installation comprises a plurality of said sensors, and wherein step (a) comprises transmitting a signal for commanding at least a group of said plurality of sensors to record an audio clip.

Fig. 1

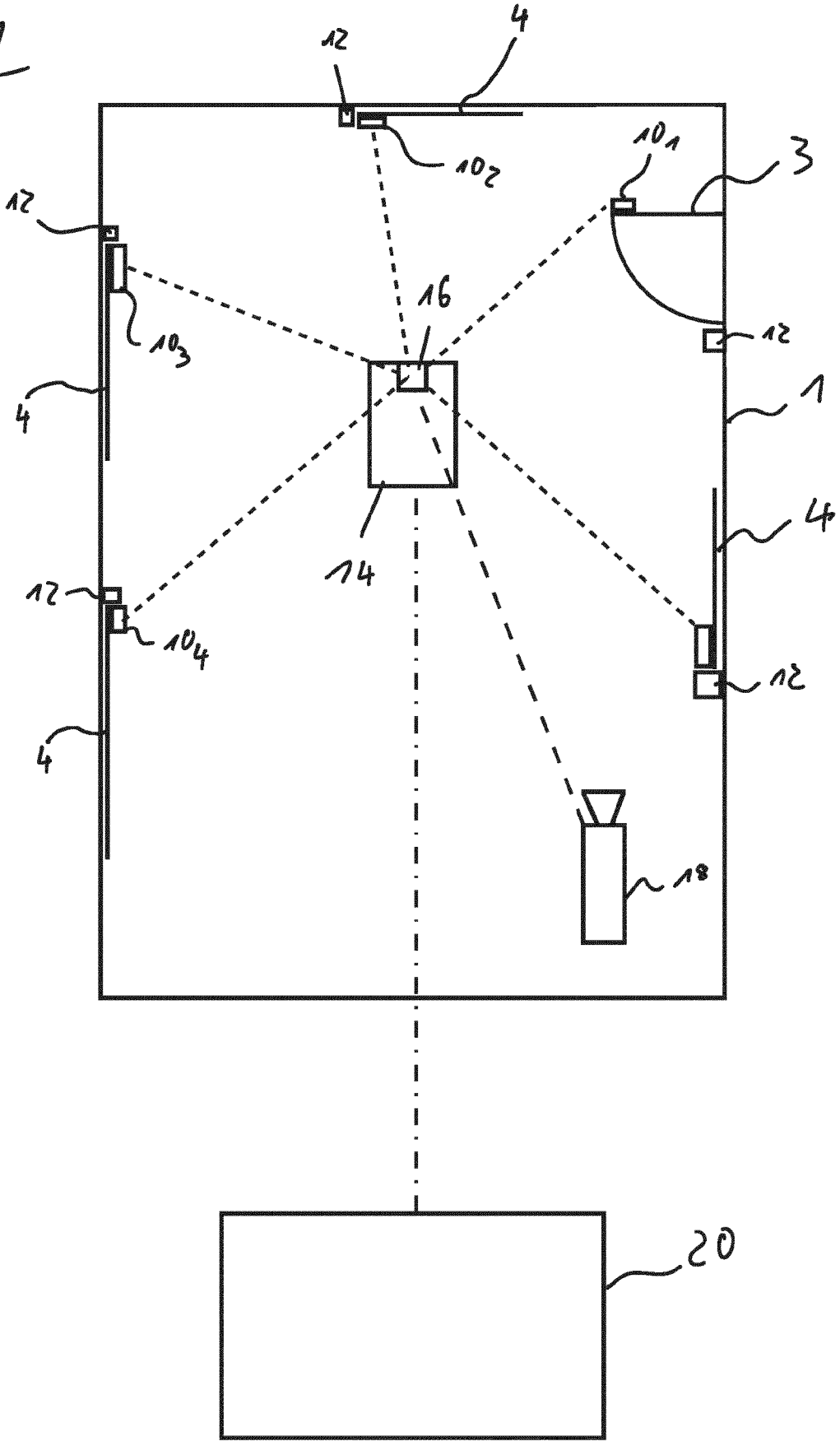
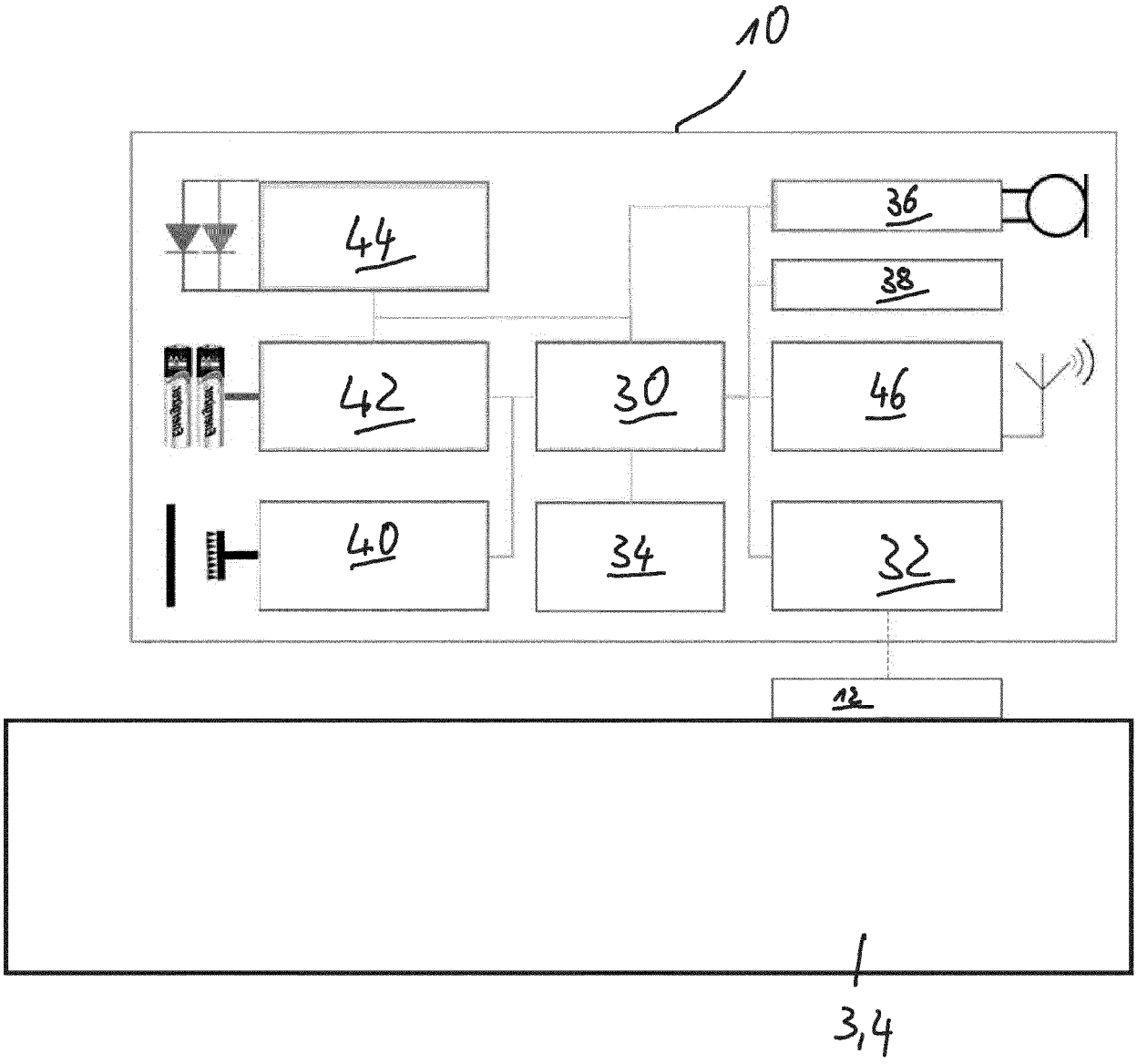


Fig.2



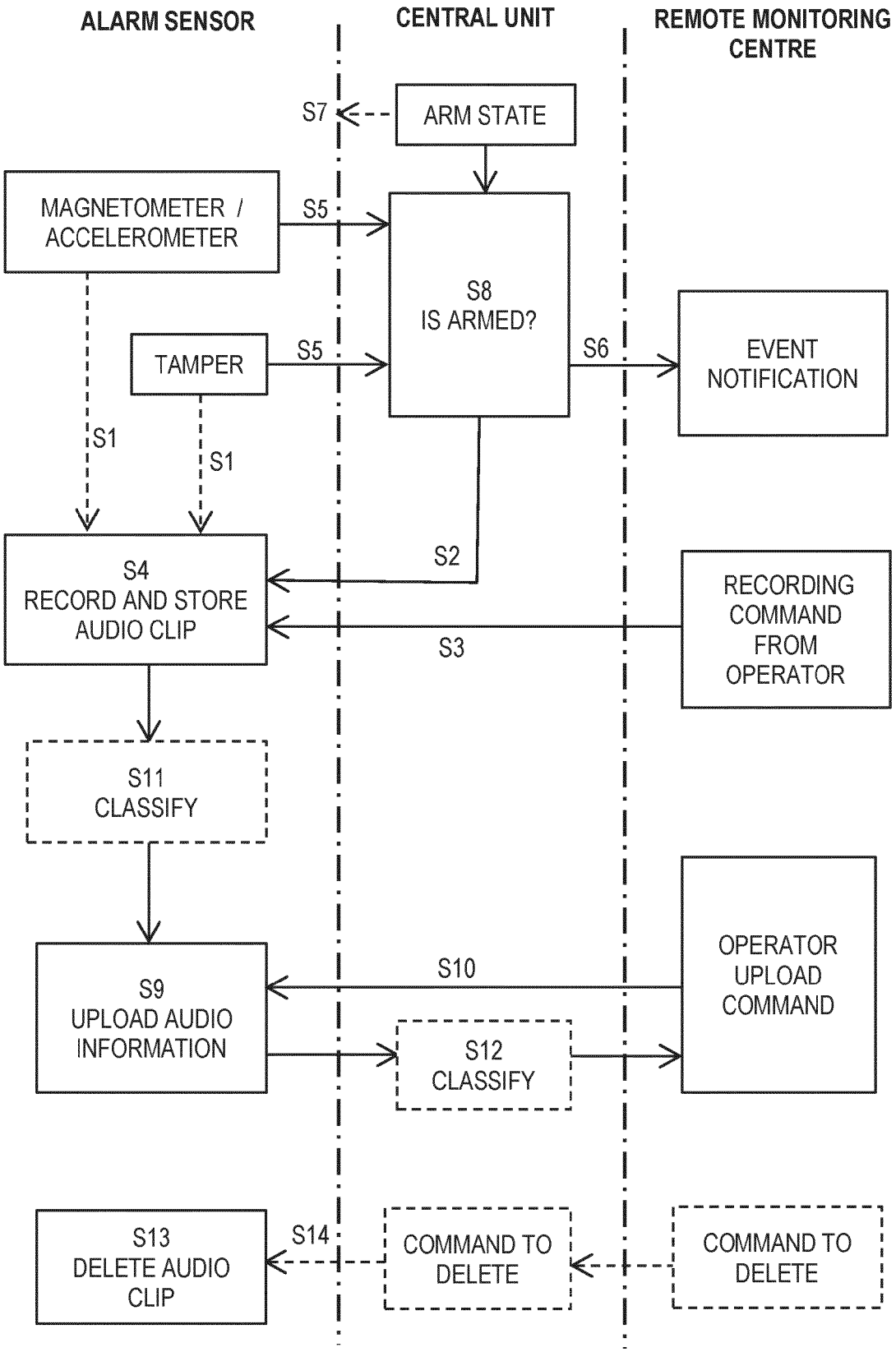

ALARM SENSOR
CENTRAL UNIT
REMOTE MONITORING CENTRE
S7
ARM STATE
MAGNETOMETER / ACCELEROMETER
S5
S8 IS ARMED?
S6
EVENT NOTIFICATION
TAMPER
S5
S1
S1
S2
S4 RECORD AND STORE AUDIO CLIP
RECORDING COMMAND FROM OPERATOR
S3
S11 CLASSIFY
S10
S9 UPLOAD AUDIO INFORMATION
S12 CLASSIFY
OPERATOR UPLOAD COMMAND
S13 DELETE AUDIO CLIP
S14
COMMAND TO DELETE
COMMAND TO DELETE

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 23 38 3377

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	US 2023/143806 A1 (REIMER MARK [US] ET AL) 11 May 2023 (2023-05-11) * abstract * * paragraph [0016] - paragraph [0018]; figure 1 * * paragraph [0022] - paragraph [0048]; figures 2-6 *	1-11, 13-15	INV. G08B13/08 G08B13/16 ADD. G08B25/00 G08B29/04
X	US 2010/302025 A1 (SCRIPT MICHAEL H [US]) 2 December 2010 (2010-12-02) * paragraph [0082] - paragraph [0093]; figure 1 * * paragraph [0115]; figure 12 * * paragraph [0123] - paragraph [0125]; figure 15 * * paragraph [0121] - paragraph [0122]; figures 14B,14C * * paragraph [0136]; figure 19 *	1,2,4, 6-8, 10-15	
X A	WO 2020/187859 A1 (VERISURE SARL [CH]) 24 September 2020 (2020-09-24) * page 6, line 25 - page 7, line 3; figure 2 * * page 7, line 4 - page 8, line 22; figure 7 *	1-4,6-8, 10-13 14,15	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	6 June 2024	Heß, Rüdiger

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

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Application Number
EP 23 38 3377

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☒ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 23 38 3377

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-15

Window/door sensor, comprising a detector for sensing opening and/or breach of the window/door, a microphone, processor, and memory for storing a recorded audio clip

1.1. claims: 10, 13

Window/door sensor only recording audio clips when in the armed state of the alarm installation

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Please note that all inventions mentioned under item 1, although not necessarily linked by a common inventive concept, could be searched without effort justifying an additional fee.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 38 3377

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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06-06-2024

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		WO 2020187859 A1	24-09-2020

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