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Remarks:
Amended claims in accordance with Rule 137(2) EPC.

(54) **DYNAMIC ALARM PRIORITY SYSTEM AND METHOD**

(57) A dynamic alarm priority system includes plural kinds of alarm devices (11A, 11B, 11C), an alarm signal being generated when the alarm device is triggered; a plurality of image capture devices (12), correspondingly coupled to the alarm devices respectively, the triggered alarm device activating the corresponding image capture device to capture an alarm image; an interface device (13) that receives the alarm signal; an assignment device (14) coupled to receive the alarm signals, which are as-

signed priorities in order of time, thereby generating an initial alarm signal sequence; and an object detection device (15) that performs object detection on the alarm image to determine whether an associated object is detected in the alarm image. The assignment device dynamically modifies the initial alarm signal sequence according to an object detection result from the object detection device, thereby generating an updated alarm signal sequence.

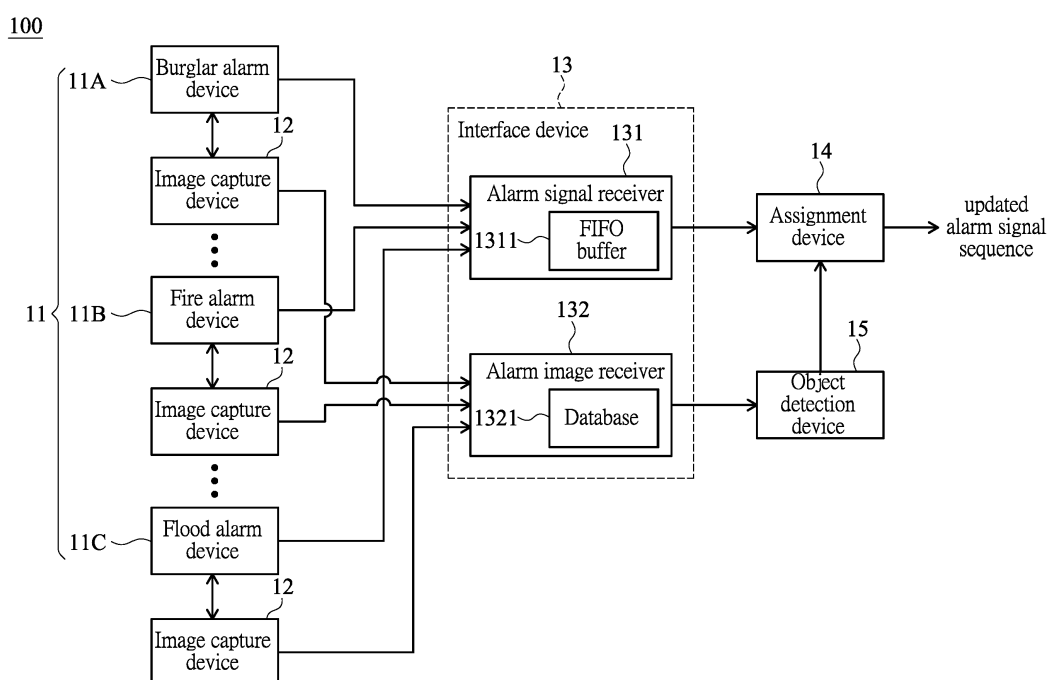


FIG. 1

Description

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

[0001] The present invention generally relates to an alarm system, and more particularly to a dynamical alarm priority system and method.

2. DESCRIPTION OF RELATED ART

[0002] An alarm device gives an audible, visual or other form of alarm signals when triggered, which warns a user to do some actions for preventing or reducing danger. A burglar alarm and a fire alarm (such as smoke detector) are some common alarm devices.

[0003] The trigger threshold of the alarm device should be considered comprehensively. A miss alarm may occur if the trigger threshold is high, and, contrarily, a false alarm may occur if the trigger threshold is low. The false alarm may waste and bind resources, which cannot be utilized in an event of a true alarm.

[0004] The conventional alarm control center may usually monitor tens or even thousands of alarm devices distributed over a wide area. Therefore, the control center, in a period, may receive many alarm signals, which are given priorities and processed in order of time when the alarm signals are received. As false alarms are common, opportunity to process the true alarm will be lost.

[0005] A need has thus arisen to propose a novel scheme to overcome drawbacks of the conventional alarm system.

SUMMARY OF THE INVENTION

[0006] In view of the foregoing, it is an object of the embodiment of the present invention to provide a dynamic alarm priority system and method capable of dynamically adjusting priorities of alarm signals. Therefore, a true alarm may be processed first and a false alarm may be deferred, thereby substantially enhancing overall efficiency of the alarm system.

[0007] According to one embodiment, a dynamic alarm priority system includes plural kinds of alarm devices, a plurality of image capture devices, an interface device, an assignment device and an object detection device. An alarm signal is generated when the alarm device is triggered. The image capture devices are correspondingly coupled to the alarm devices respectively, the triggered alarm device activating the corresponding image capture device to capture an alarm image. The interface device receives the alarm signal. The assignment device is coupled to receive the alarm signals, which are assigned priorities in order of time, thereby generating an initial alarm signal sequence. The object detection device performs object detection on the alarm image to determine whether an associated object is detected in the

alarm image. The assignment device dynamically modifies the initial alarm signal sequence according to an object detection result from the object detection device, thereby generating an updated alarm signal sequence.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

FIG. 1 shows a block diagram illustrating a dynamic alarm priority system according to one embodiment of the present invention;

FIG. 2 shows a flow diagram illustrating a dynamic alarm priority method according to one embodiment of the present invention;

FIG. 3 shows an example of a plurality of alarm devices that transmit alarm signals to a control center in order of time; and

FIG. 4 shows a block diagram illustrating a dynamic alarm priority system according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0009] FIG. 1 shows a block diagram illustrating a dynamic alarm priority system 100 according to one embodiment of the present invention, and FIG. 2 shows a flow diagram illustrating a dynamic alarm priority method 200 according to one embodiment of the present invention. The dynamic alarm priority system (system hereinafter) 100 of FIG. 1 or the dynamic alarm priority method (method hereinafter) 200 of FIG. 2 may dynamically determine priorities of alarms.

[0010] As shown in FIG. 1, the system 100 may include plural kinds of alarm devices 11 (step 21). When the alarm device 11 is triggered or actuated (step 22), an alarm signal may be generated (step 23). In one embodiment, the alarm devices 11 may include (but not exclusively) burglar alarm devices 11A, fire alarm devices 11B and flood alarm devices 11C.

[0011] In the embodiment, the system 100 may include image capture devices 12 (step 21) such as still cameras or video cameras. The image capture devices 12 may be correspondingly coupled (in wired or wireless manner) to the alarm devices 11, respectively. When the alarm device 11 is triggered (step 22), the triggered alarm device 11 may activate a corresponding image capture device 12 to capture an alarm image or video (step 23). In one embodiment, some alarm devices 11 have no corresponding image capture devices 12.

[0012] In the embodiment, the system 100 may include a (communication) interface device 13, which may include an alarm signal receiver 131 and an alarm image receiver 132, which are configured to receive the alarm signal (from the alarm device 11) and the alarm image (from the image capture device 12), respectively (step 24). It is noted that the alarm signal and the corresponding alarm image may have the same event identification

(ID). In one embodiment, the interface device 13 may be disposed in a control center (e.g., central monitor system or CMS) of an alarm system.

[0013] In one embodiment, the alarm signal receiver 131 may include a first-in-first-out (FIFO) buffer 1311 for storing the received alarm signals. The alarm image receiver 132 may include a database 1321 for storing the received alarm images. It is noted that the alarm image receiver 132 may receive the alarm image in a wired or wireless manner. Moreover, the alarm image receiver 132 may receive the alarm image directly from the image capture device 112, or may receive the alarm image indirectly from the image capture device 12, for example, via the Internet.

[0014] The system 100 of the embodiment may include an assignment device 14 (for example, disposed in the control center) coupled to receive the alarm signals from the alarm signal receiver 131 (of the interface device 13), and the received alarm signals are assigned priorities in order of time, thereby generating an initial alarm signal sequence (or queue) (step 25). The time mentioned above may be the time when the interface device 13 (or the assignment device 14) receives the alarm signals, or the time when the alarm signals are generated by the alarm devices 11. In another embodiment, the order of the initial alarm signal sequence may be in order of time, but may also be based on predetermined priorities of the alarm devices 11. For example, the alarm device 11 in a specific area may be given predetermined priority.

[0015] According to one aspect of the embodiment, the system 100 may include an object detection device 15 (for example, disposed in the control center), coupled to receive the alarm image from the alarm image receiver 132 (of the interface device 13), and performing object detection on the received alarm image (step 26) to determine whether an associated object is detected in the alarm image. For example, the object detection device 15 determines whether a person is detected in the alarm image captured by the burglar alarm device 11A, whether smoke or fire is detected in the alarm image captured by the fire alarm device 11B, or whether water is detected in the alarm image captured by the flood alarm 11C.

[0016] The object detection device 15 of the embodiment may perform object detection by a conventional computer vision or image processing technique. In one embodiment, the object detection device 15 adopts a machine learning-based technique to perform object detection according to feature. In another embodiment, the object detection device 15 adopts a deep learning-based technique, such as convolutional neural network (CNN), to perform object detection.

[0017] According to another aspect of the embodiment, the assignment device 14 may dynamically modify the initial alarm signal sequence according to an object detection result from the object detection device 15, thereby generating an updated alarm signal sequence (or queue) (step 27). For example, a high treat queue (HTQ) is generated by modifying the FIFO queue. In the

embodiment, when the object detection result of the object detection device 15 is positive (that is, an associated object has been detected), the assignment device 14 may assign highest priority to the corresponding alarm signal, and assign other alarm signals from the second-highest priority. Accordingly, the system 100/method 200 may dynamically adjust priorities of alarm signals such that a true alarm may be processed first and a false alarm may be deferred, thereby substantially enhancing overall efficiency of the alarm system.

[0018] FIG. 3 shows an example of a plurality of alarm devices 11A-11C that respectively transmit alarm signals 1 to N to a control center in order of time. Specifically, the assignment device 14 of the control center generates an initial alarm signal sequence according to the alarm signals 1 to N in order of time. Subsequently, the object detection device 15 of the control center performs object detection, and the assignment device 14 dynamically modifies the initial alarm signal sequence according to an object detection result from the object detection device 15, thereby generating an updated alarm signal sequence. In the example, a person is detected in the captured alarm image corresponding to the burglar alarm device 2 (11A), and the assignment device 14 thus re-assigns highest priority to the corresponding alarm signal 2, and re-assign second-highest priority to the alarm signal 1.

[0019] FIG. 4 shows a block diagram illustrating a dynamic alarm priority system 400 according to another embodiment of the present invention. The dynamic alarm priority system 400 is similar to the system 100 of FIG. 1 with the exception that (local) object detection devices 15 are correspondingly set with the alarm devices 11. When the alarm device 11 is triggered, the corresponding object detection device 15 receives and performs object detection on the alarm image captured by the corresponding image capture device 12. Subsequently, the alarm device 11 transmits the alarm signal and the object detection result (but not the alarm image) to the interface device 13 (which requires no alarm image receiver 132).

[0020] According to a further embodiment (not shown) of the invention, the system 100 of FIG. 1 and the system 400 of FIG. 4 are combined. Specifically, some alarm devices 11 are associated with corresponding object detection devices 15 to perform object detection; while other alarm devices 11 are not associated with corresponding object detection devices 15, in which the object detection is performed by the object detection device 15 of the control center.

Claims

1. A dynamic alarm priority system, comprising:

plural kinds of alarm devices, an alarm signal being generated when the alarm device is trig-

- gered;
 a plurality of image capture devices, correspondingly coupled to the alarm devices respectively, the triggered alarm device activating the corresponding image capture device to capture an alarm image;
 an interface device that receives the alarm signal;
 an assignment device coupled to receive the alarm signals, which are assigned priorities in order of time, thereby generating an initial alarm signal sequence; and
 an object detection device that performs object detection on the alarm image to determine whether an associated object is detected in the alarm image;
 wherein the assignment device dynamically modifies the initial alarm signal sequence according to an object detection result from the object detection device, thereby generating an updated alarm signal sequence.
2. The system of claim 1, wherein the interface device comprises an alarm signal receiver and an alarm image receiver, which receive the alarm signal and the alarm image, respectively.
 3. The system of claim 2, wherein the alarm signal receiver comprises a first-in-first-out (FIFO) buffer for storing the alarm signal.
 4. The system of claim 2, wherein the alarm image receiver comprises a database for storing the alarm image.
 5. The system of claim 1, wherein the object detection device adopts a machine learning-based technique to perform object detection according to feature.
 6. The system of claim 1, wherein the object detection device adopts a deep learning-based technique to perform object detection.
 7. The system of claim 1, wherein the assignment device assigns highest priority to the alarm signal when the associated object is detected in the corresponding alarm image.
 8. The system of claim 1, wherein the interface device, the assignment device and the object detection device are disposed inside a control center, and the interface device receives the alarm image.
 9. The system of claim 1, wherein the interface device and the assignment device are disposed inside a control center, but the object detection device is disposed outside the control center, and the interface device does not receive the alarm image.

10. A dynamic alarm priority method, comprising:

providing plural kinds of alarm devices, an alarm signal being generated when the alarm device is triggered;
 providing a plurality of image capture devices, correspondingly coupled to the alarm devices respectively, the triggered alarm device activating the corresponding image capture device to capture an alarm image;
 receiving the alarm signal and assigning priorities in order of time, thereby generating an initial alarm signal sequence;
 performing object detection on the alarm image to determine whether an associated object is detected in the alarm image; and
 dynamically modifying the initial alarm signal sequence according to an object detection result, thereby generating an updated alarm signal sequence.

11. The method of claim 10, wherein the object detection adopts a machine learning-based technique to perform object detection according to feature.
12. The method of claim 10, wherein the object detection adopts a deep learning-based technique to perform object detection.
13. The method of claim 10, wherein highest priority is assigned to the alarm signal when the associated object is detected in the corresponding alarm image.
14. The method of claim 10, wherein the object detection is performed inside a control center, and the control center receives the alarm image.
15. The method of claim 10, wherein the object detection is performed outside a control center, and the control center does not receive the alarm image.

Amended claims in accordance with Rule 137(2) EPC.

1. A dynamic alarm priority system (100), comprising:
 plural kinds of alarm devices (11), an alarm signal being generated when the alarm device is triggered;
 a plurality of image capture devices (12), correspondingly coupled to the alarm devices respectively, the triggered alarm device activating the corresponding image capture device to capture an alarm image;
 an interface device (13) that receives the alarm signal;
 an assignment device (14) coupled to receive

- the alarm signals, which are assigned priorities in order of time, thereby generating an initial alarm signal sequence; and **characterized in that** an object detection device (15) that performs object detection on the alarm image by image processing technique to determine whether an associated object is detected in the alarm image; wherein the assignment device dynamically modifies the initial alarm signal sequence according to an object detection result from the object detection device, thereby generating an updated alarm signal sequence.
2. The system of claim 1, wherein the interface device comprises an alarm signal receiver (131) and an alarm image receiver (132), which receive the alarm signal and the alarm image, respectively.
 3. The system of claim 2, wherein the alarm signal receiver comprises a first-in-first-out (FIFO) buffer (1311) for storing the alarm signal.
 4. The system of claim 2, wherein the alarm image receiver comprises a database (1321) for storing the alarm image.
 5. The system of claim 1, wherein the object detection device adopts a machine learning-based technique to perform object detection according to feature.
 6. The system of claim 1, wherein the object detection device adopts a deep learning-based technique to perform object detection.
 7. The system of claim 1, wherein the assignment device assigns highest priority to the alarm signal when the associated object is detected in the corresponding alarm image.
 8. The system of claim 1, wherein the interface device, the assignment device and the object detection device are disposed inside a control center, and the interface device receives the alarm image.
 9. The system of claim 1, wherein the interface device and the assignment device are disposed inside a control center, but the object detection device is disposed outside the control center, and the interface device does not receive the alarm image.
 10. A dynamic alarm priority method (200), comprising:
 - providing plural kinds of alarm devices (11), an alarm signal being generated when the alarm device is triggered; (21 and 22)
 - providing a plurality of image capture devices (12), correspondingly coupled to the alarm de-
- vices respectively, the triggered alarm device activating the corresponding image capture device to capture an alarm image; (23) receiving the alarm signal and assigning priorities in order of time, thereby generating an initial alarm signal sequence; (24 and 25) **characterized in that** performing object detection on the alarm image by image processing technique to determine whether an associated object is detected in the alarm image; (26) and dynamically modifying the initial alarm signal sequence according to an object detection result, thereby generating an updated alarm signal sequence. (27)
11. The method of claim 10, wherein the object detection adopts a machine learning-based technique to perform object detection according to feature.
 12. The method of claim 10, wherein the object detection adopts a deep learning-based technique to perform object detection.
 13. The method of claim 10, wherein highest priority is assigned to the alarm signal when the associated object is detected in the corresponding alarm image.
 14. The method of claim 10, wherein the object detection is performed inside a control center, and the control center receives the alarm image.
 15. The method of claim 10, wherein the object detection is performed outside a control center, and the control center does not receive the alarm image.

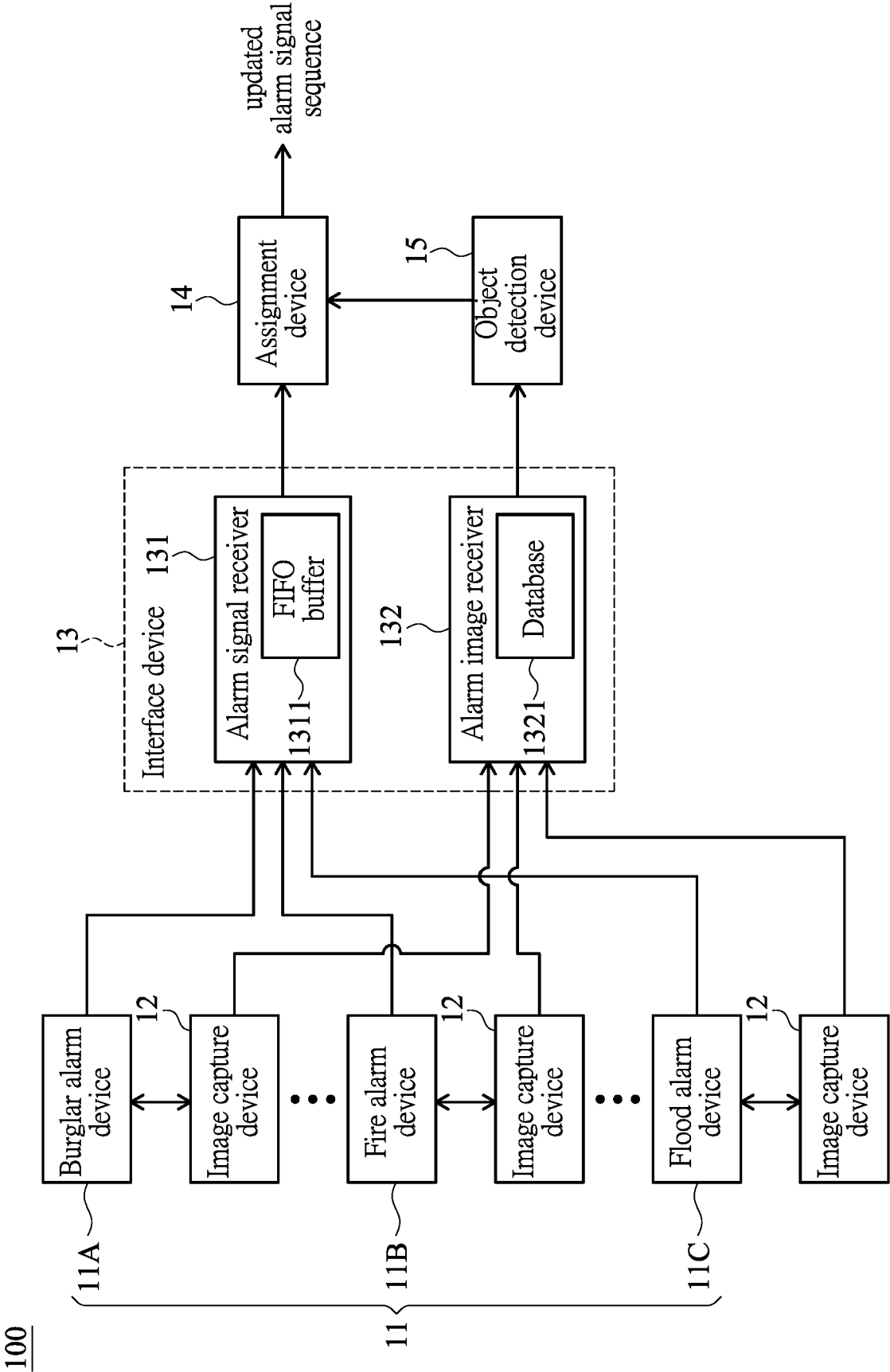
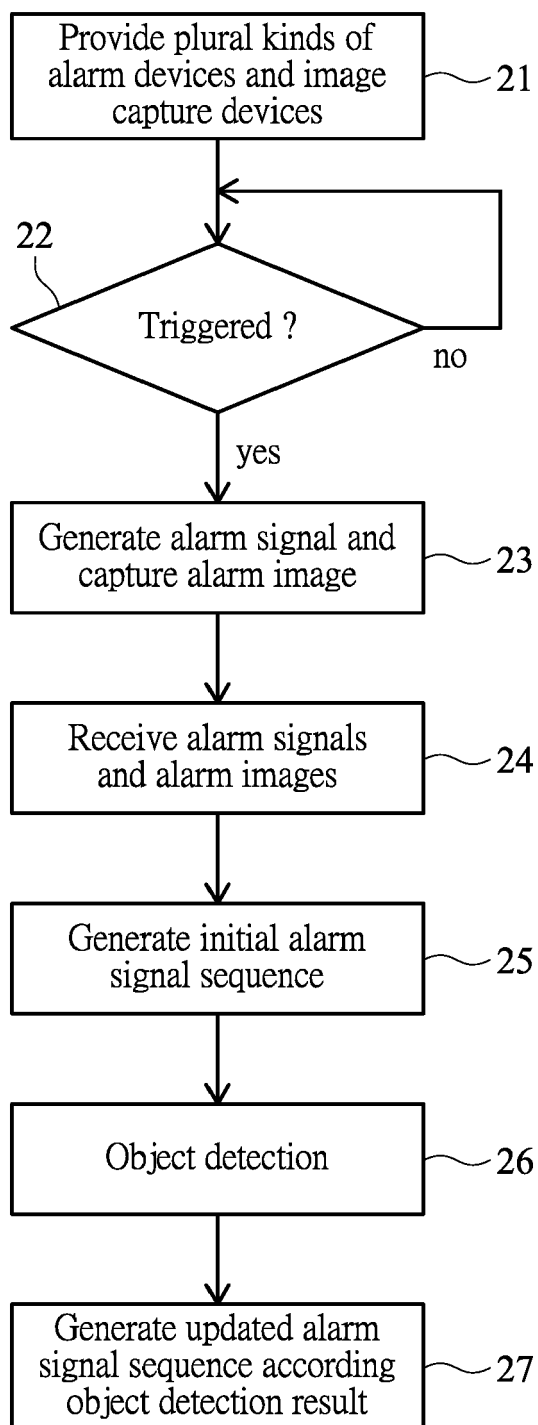


FIG. 1

200*FIG. 2*

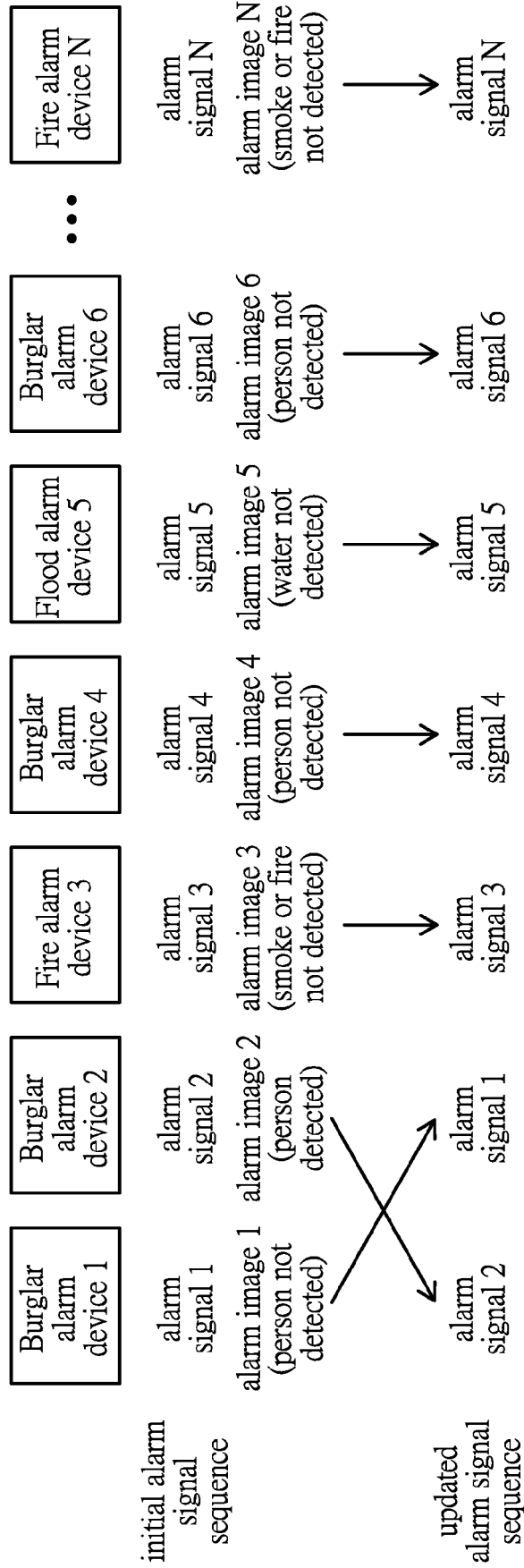


FIG. 3

400

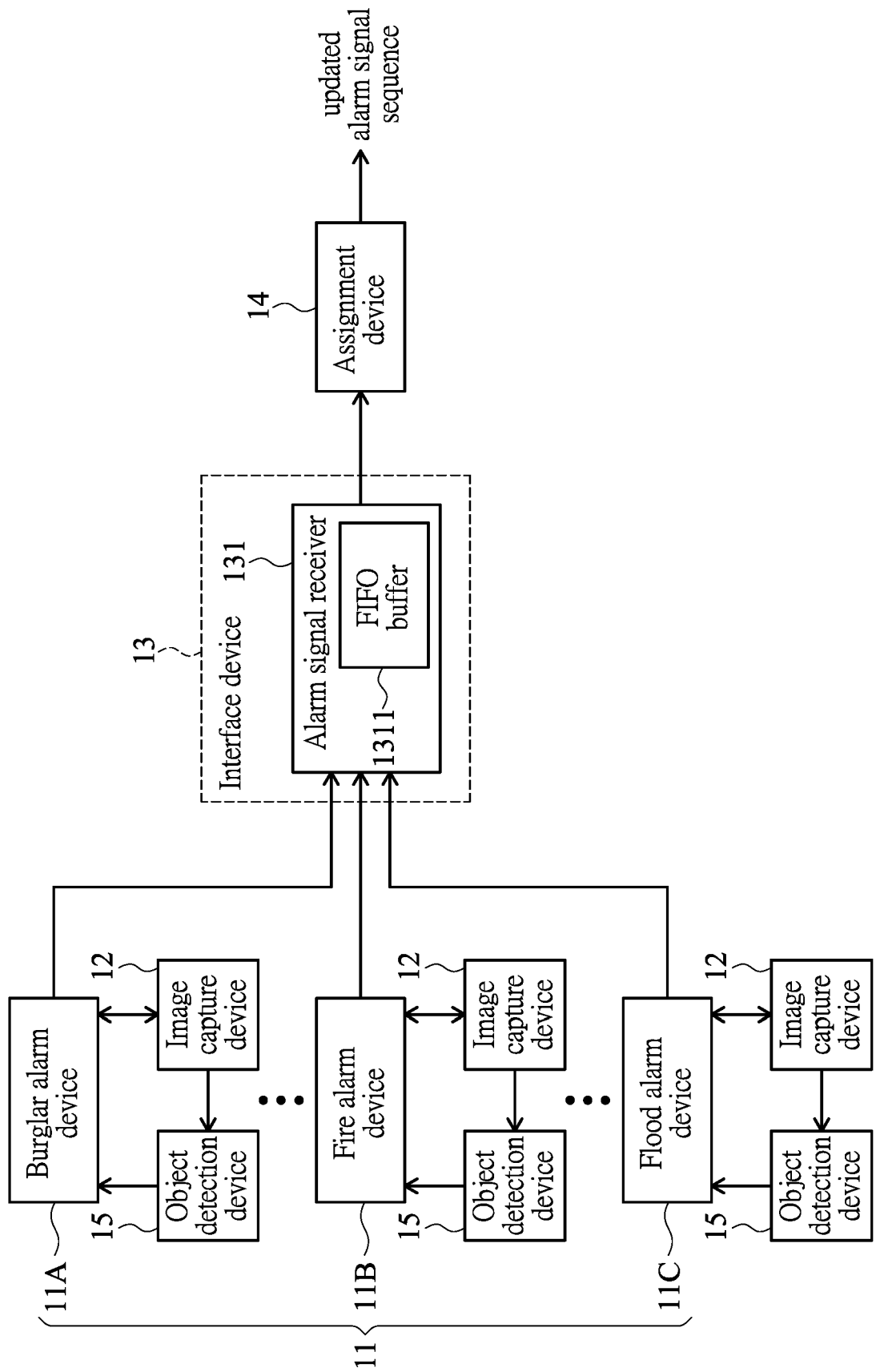


FIG. 4



EUROPEAN SEARCH REPORT

 Application Number
 EP 20 19 4004

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	EP 2 492 883 A1 (GUANGZHOU SAT INFRARED TECHNOLOGY CO LTD [CN]) 29 August 2012 (2012-08-29) * paragraph [0041] - paragraph [0045]; figures 1,2 * * paragraph [0052] *	1-15	INV. G08B19/00 ADD. G08B13/196 G08B29/18
Y	US 6 353 385 B1 (MOLINI JAMES [US] ET AL) 5 March 2002 (2002-03-05) * column 3, line 3 - column 4, line 49; figures 1,2 * * column 5, line 16 - line 41 * * column 6, line 15 - column 7, line 6 * * column 10, line 44 - column 11, line 12; figure 2 *	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			G08B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 16 February 2021	Examiner 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 O : non-written disclosure 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			

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 EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 20 19 4004

5 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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16-02-2021

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