



- (51) **International Patent Classification:**
G08B 13/196 (2006.01) *H04N 7/18* (2006.01)
- (21) **International Application Number:**
PCT/IB2019/056236
- (22) **International Filing Date:**
22 July 2019 (22.07.2019)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
102018000007995 09 August 2018 (09.08.2018) IT
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- (81) **Designated States** (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ,

CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

(54) **Title:** PUBLIC PLACES SURVEILLANCE SYSTEM

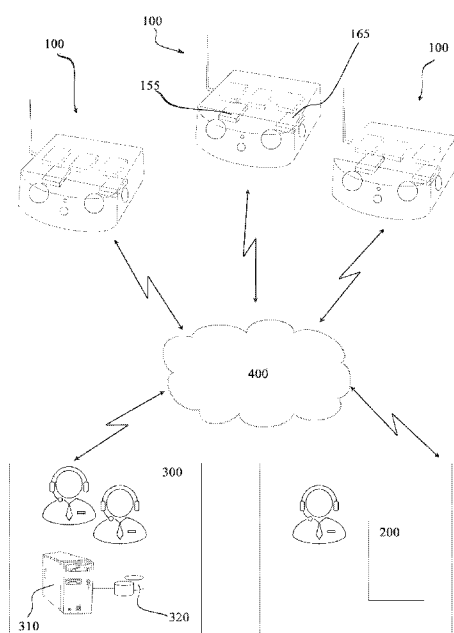


Fig. 2

(57) **Abstract:** Public places surveillance system, comprising: - fixed day/night video camera (110); - thermographic camera (120); - motor-driven day/night video camera (160); - directional microphone (130); - removable protection mask (185) with tinted finish; - an events correlation module (190) which combines the processing operations carried out by the video analysis module (170) and by the semantic analysis module (180) to generate an alarm signal to be sent to said operations centre (300); - a light signalling device (150) suitable to light up to signal the transmission of the images to the operations centre (300); - an audio speaker (140) for the emission of alarm acoustic signals for vocal communication from the operations centre (300) towards the environment subject of surveillance; - a power-supply system; - a system for connection to the internet network (400); said operations centre (300) viewing the images and sounds in streaming and assessing the dangerousness of dangerous situations, thus taking due action, or filing the report as a false alarm.

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*
- *in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE*

“Public places surveillance system”Description5 **Field of the art**

The present invention regards the field of remote surveillance systems applied to scenario analysis contexts carried out through correlation events between video analysis systems with semantic analysis systems.

More in detail, the present invention regards an integrated hardware and software system for
10 the remote management of safety and emergencies in a plurality of places (school environments, facilities for the elderly, banks, malls, railway stations, airports) where acts of violence, bullying, mistreatments, terrorism could occur.

Prior art

15 Known at the current state of the art are a plurality of video surveillance systems which integrate video analysis algorithms aimed at highlighting emergent situations (crossing borders, presence in areas, concentration of resources, moving masses, direction of movements, etc.) detected by algorithms not sufficient to process and/or signal emergent situations deriving from an analysis of the context in which the algorithm is called upon to
20 operate to identify specific behaviours to be examined (mistreatments, acts of bullying, public aggression, pickpocketing, shop lifting, robbery terrorism attacks, etc.).

The guarantee of the intervention and/or report with respect to such specific scenarios currently reveals several challenges arising from:

- legal aspects, especially relating to privacy which could be breached by the
25 continuous monitoring of areas such as schools, hospitals, nursing homes;
- organisational aspects, as regards providing resources dedicated to continuous monitoring of the scenarios filmed by the video cameras.

As regards international patents, domestic alarm systems suitable to monitor domestic

accesses and walls to sound an alarm in case of detection of an intruder are predominant. “Verisure”, which has been providing optimal anti-theft alarm and anti-intrusion systems for homes and workplaces over the years, is a leader in the industry. The company owns several patents (EP 2698774; EP 2640110; EP 3145211; EP 3211379 and others) all regarding the same field.

However, the Applicant identified some shortcomings in the alarm systems currently available in the market, including those of “Verisure”, which are not capable of understanding the dynamics in progress in a crowded context.

The most advanced systems regarding context analysis of a scene, based on neural algorithms, have started appearing in the market and they constitute the study base for the implementation of the invention described hereinafter. As a matter of fact, such algorithms are capable of discriminating objects and things to be searched in a scene being capable of for example recognising the presence of a man or a child, a vehicle or an animal, if the detected movements derive from moving leaves or from developing flames, if the filmed people belong to determined ethnic groups (oriental, European, African, etc.).

Furthermore, the developments in the semantic analysis industry allow to offer added value in analysing scene context.

Thus, a first object of the present invention is to provide a “smart” system for the safety and surveillance of places in which event correlation engines (video analysis + semantic analysis) guarantee an efficient use thereof in schools and nursing homes, which are often scenarios of acts of bullying and mistreatments and in places open to the public for fighting criminality and for preventing acts of terrorism.

A second criticality that the present invention intends to solve regards the respect of the privacy of the persons filmed by the video cameras, according to the regulations in force in many Countries.

Description of the invention

Provided according to the present invention is bullying, violence and mistreatment

prevention system that effectively overcomes the problems outlined above through technological systems installed in loco and remote services at at least one operations centre.

The present invention is easily applicable, with the same advantages, to various safety and first aid monitoring environments and in circumscribed places such as schools, hospitals, nursing homes, facilities for the elderly, banks as well as places open to the public such as malls, spaces next to night clubs, airports, railway stations and so on and so forth.

The system subject of the invention is suitable to send possible emergency signals to a remotely positioned operations centre that will receive a streaming of the video fraction that read to the report.

Advantageously, with respect to the privacy regulations in force in Italy and in many Countries, the video received from the operations centre can be that of the thermographic camera, so as to make the recorded persons unrecognisable but being able to view the shape only. A common face masking filter can alternatively be provided.

The system has the advantage of being easy to install. It consists of at least one local device to be installed at each environment subject of surveillance. Each local device contains at least three types of video cameras whose specific optical features will be modulated depending on the scenario subject of analysis.

The three types of video cameras present in each local device are:

a fixed thermographic camera, a fixed day/night video camera and a motor-driven day/night video camera. Furthermore, the following will be present in the local device:

- a directional microphone designated to detect any clues relating to possible ill-intentioned acts in progress or about to occur;
- an acoustic box for sending possible messages coming from the operations centre or from a local control station;
- an alarm light signalling device which is automatically activated upon detecting situations deemed emergent;
- at least three modules for processing the scene and, specifically: a video analysis module, semantic analysis module and a third events correlation module which is the

one designated to detect potentially dangerous situations to be signalled to the remote and/or local station. Said analysis modules are also capable of generating alarms following obscuring of the video cameras or cover of the microphone sensors.

Externally, the local devices appear as boxes made of sheet whose front part, i.e. the one
5 from which the video cameras are seen, is protected by a protection mask preferably made of glass or tinted plexiglass.

Advantageously, each time the various processors detect a dangerous situation, the video streaming stored in the memory of a dedicated server, accessible to the operators of the operations centre, in an encrypted form that can be deciphered only following a request by
10 law enforcers.

Advantageously, as regards the continuity of the provided service, all hardware components of the system will be power-supplied both by the mains power supply and, in case of absence of power, by common internal rechargeable batteries.

The communication with the remote station and/or with the local station is advantageously
15 guaranteed by the connection to the internet network, wired or via Wi-fi router integrated in the local device with external antennas.

Advantageously, a preferred version of the present invention also integrates inertial sensors suitable to recognise possible attempts to tamper with the local device, thus generating an alarm.

20 A further preferred version of the present invention also includes a central device, which can be easily arranged in a place under continuous surveillance such as for example an information office or reception desk.

Advantageously installed in this place will be a central device bearing, on a plan of the structure, the various areas placed subject of surveillance by the installed local devices.

25 In case of occurrence of a situation to be subjected to the attention of the personnel designated to carry out the control, an acoustic signalling device will enter into function to draw attention and the light signalling device regarding the area where the problem is occurring will start flashing.

Possibly, said central device may also be provided with a speakerphone communication device and a display to view the streaming (possibly a thermographic camera or with face masking) live from the area source of the problem.

The arrangement of the central device will advantageously allow an even more timely
5 intervention with respect sending rescue by the remote operations centre.

Duly calibrated and configured based on the field of application thereof, the system subject of the present invention will advantageously be capable of detecting, through the sensors thereof and specific correlation matrices, dangerous situations arising from:

- aggressive behaviour detected from the analysis of the scene in general; focusing the
10 possible position of the people on the ground; detecting screams or expressions typical of an attacking person or a person under attack; raising the noise thresholds; the movement of masses; the positioning of the hands; the rising of the body temperature of the attacker and/or of the person subject of attack and other situations;
- detection of situations relating to possible acts of terrorism, still by analysing the
15 situation in general; the possible position of the people on the ground; the shouts or expressions typical of a person attacking or under attack; the movement of masses; the positioning of the hands; the detection of suspicious explosive belts by means of thermal analysis, the detection of the ethnic group of the people being filmed and the conditioning of specific semantic analysis; the rising of the body temperature of the
20 attacker and/or the person subject of attack; the analysis of the body temperature and the detection of cold sweating and other similar situations, the detection of firearms.

Should the system be used in places attended always by the same people such as schools or nursing homes, it will be associated to a software suitable for the self-learning that is suitable to memorise and recognise the persons that are often source of false alarms over time, so as
25 to use custom-made parameters on each person who is a regular of the space subject of surveillance.

The fields of use of the system provide for fighting violent acts regarding which below is a list provided by way of non-exhaustive example: bullying in school; mistreatment by

medical and paramedical personnel on the elderly or disabled in specialised facilities; mistreatments on students or children by the educational institute personnel; violent actions in general, acts of terrorism.

In the specific case of use of the system for fighting terrorism events, the thermal analysis
5 allows, contrary to the current detection systems such as metal detector portals or radiogenic machines whose analysis is conditioned by a close range of the elements to be examined, to correlate the previously described events from a remote position, thus extending the field of prevention to the areas neighbouring the accesses of the facilities.

Advantageously, an even more accessorised embodiment of the system in question also
10 provides for the possibility of using the local devices for sending pre-recorded audio messages to be emitted in situations of general emergency such as fire and earthquake for example.

The advantages provided by the present invention will be clear in light of the description outlined up to now. Furthermore, they will be more apparent due to the attached figures and
15 relative detailed description.

Description of the figures

The invention will be described hereinafter in at least one preferred embodiment, provided by way of non-limiting example, with reference to the attached figures, wherein:

- 20 - FIGURE 1 schematically shows a local device 100 provided with a fixed day/night video camera 110, thermographic camera 120, motor-driven day/night video camera 160, directional microphone 130, audio speaker 140, light signalling device 150. Indicated inside the local device 100, with the dashed line, are the three analysis modules which participate in identifying emergency situations. They are a video analysis module 170, a
25 semantic analysis module 180 and an events correlation module 190. Installed outside the front part of the local device 100 is a crescent-like protection mask 185 with tinted glass.
- FIGURE 2 illustrates a plurality of local devices 100, also provided with Wi-fi router 155 and independent battery 165 in this case, which, through the internet network 400,

communicate with a central device 200, arranged in an administrative or monitoring area of the place of application of the present invention and with a remote operations centre 300 from which the operators have access to a dedicated server 310 and to the memory 320 connected thereto.

- 5 - FIGURE 3 shows an example of configuration of a central device 200 that could be installed, for example, in the information office or reception desk of a school or in the control room for monitoring the facility. Shown above is the hypothetical plan of the school with the layout of the rooms and light signalling device 210 for each room. An acoustic signalling device 220 and the speakerphone communication system 230 allow the
- 10 personnel of the school to be alerted whenever an emergency situation arises, to see in which room where the situation is occurring, through the light signalling device 210, to receive the audio coming from that room and communicate with them. At the bottom, in a special display 240 the images of the room in which the problem is occurring can be seen in real time.

15

Detailed description of the invention

Now, the present invention will be illustrated purely by way of non-limiting or non-binding example with respect to the field of application/function, with reference to the figures illustrating some embodiments regarding the present inventive concept.

- 20 In the preferred embodiment, the present invention is to be installed in rooms of the school so as to avert bullying among students and mistreatments by teachers or other personnel of the institute towards weaker persons, and thus similarly extendable to facilities like hospitals, facilities for the elderly etc.

Shown in detail with reference to FIG. 1 is one of the local devices 100 which will be

25 installed in each room of the school. It consists of a box made of sheet provided with an openable front protection mask 185, made of tinted glass which prevents from seeing the video cameras integrated in said local device 100 from being seen from the external.

In particular, three types of video cameras are installed just behind the mask 185:

- a fixed day/night video camera 110, which films the environment subject of surveillance continuously,
- a thermographic camera 120 which, similarly, films the environment subject of surveillance continuously;
- 5 - a motor-driven day/night video camera 160 which, upon command by a video analysis module 170 also integrated in the local device 100, is suitable to change the direction to accurately film the spots where an emergency could occur.

The video analysis module 170 is calibrated to detect and draw the attention of the system to
10 acts such as the position of people on the ground, the movement of masses, the positioning of the hands of the people being filmed or the rising of the body temperature of the attacker and/or of the person being attacked and other situations detectable by a general analysis of the specific scene even for anti-terrorism purposes as defined above.

The local device 100 also comprises a directional microphone 130 suitable to detect the
15 sound data from the environment subject of surveillance sending it to at least one integrated semantic analysis module 180. The latter identifies data such as the rising of the noise threshold, screams or expressions typical of a person attacking or under attack or other similar data, adapting the language based on the ethnic background resulting from the analysis.

20 An events correlation module 190 is the technological part that combines the processing operations carried out by the video analysis module 170 and by the semantic analysis module 180 to generate, according to a pre-established algorithm, an alarm report to be sent both to a central device 200 and to a remotely positioned operations centre 300;

The transmission of the report, with relative sending of a fraction in streaming both of the
25 video and of the audio coming from the environment considered as source of problem, occurs thanks to connection to the internet network 400 of the local device 100 by means of wired or Wi-fi router connection 155.

It should be observed that with the aim of respecting the privacy of the persons being filmed,

the images that will be viewed by the operators of the operations centre 300 and by the personnel present in proximity of the central device 200, will be those filmed by the thermographic camera 120 so that only the shapes of the people are visible whereas their identity remains unrecognisable.

- 5 In the memory 320 of the server 310 dedicated to the surveillance service, which is accessible from the operations centre 300, the images stored decrypted will be encrypted and made available for view only in case of report to the law enforcers.

The role of the operations centre 300 which receives the alarm report is the one that assesses the actual seriousness of the situation and take due action or file the event away as a false
10 alarm.

Should the alarm be classified as false alarm, the events correlation module 190 of the local device 100 is configured with a self-learning algorithm which will allow it to progressively recognise the behaviour of some persons who usually attend that environment and thus duly calibrate the tolerance thresholds thereof. In other words, in case of a student who usually
15 raises the voice, without revealing a dangerous behaviour in any manner whatsoever, it is likely that the shouts thereof be a source of alarm report when they occur for the first time. After the first and maybe even the second filing of the report as false alarm, the events correlation module 190, recognising that the shouts always come from the same person, will no longer send the report to the operations centre 300 and to the central device 200.

- 20 Any attempts to tamper with or cover the video cameras will trigger alarm reports.

Once the images and the sounds have been transmitted to the operations centre 300 and to the central device 200, a light signalling device 150 in the local device 100 which is transmitting them will light up to alert the present on the fact that the environment is being monitored from a remote position.

- 25 An audio speaker 140 integrated in the local devices 100 allows to emit alarm acoustic signals should the operations centre 300 and/or the person designated to monitor the central device 200, confirm the occurrence of grounds for emergency requirements. In addition, the audio speaker 140 allows the vocal communication from the operations centre 300 and/or

from the area where the central device 200 is installed, towards the environment subject of surveillance.

Said central device 200 is represented in Fig. 3 and, in case of the school, it will be installed in the information office or the reception desk or in any other place within the school that is
5 constantly under surveillance by at least one person in charge.

The presence of the central device 200 allows much more timely action to resolve solutions relating to violent acts or the like with respect to the intervention sent by an operations centre 300 located elsewhere.

The central device 200 consisting of a panel bearing the map of the school with the layout of
10 all the rooms and environments where at least one local device 100 is installed. Each local device 100 will be indicated with a relative light signalling device 210 at the room where it is positioned.

When the events correlation module 190 of a local device 100 identifies an emergency situation, a light signalling device 220 at said central device 200 will start sounding to draw
15 attention and the light signalling device 210 corresponding to the room where the event is occurring will flash simultaneously.

In the preferred embodiment of the central device 200, a display 240 will allow to view the video streaming, masking the faces or displaying the images coming from the thermographic camera 120 and a speakerphone communication system 230 will allow to receive the sounds
20 and send messages aimed at calming the people on site that led to triggering the danger report.

A secondary use of the system consisting of local devices 100, central device 200 and operations centre 300 is that of exploiting the local devices 100 to emit acoustic signals and pre-recorded messages indicating the actions to be taken in case of general emergency such
25 as fires or earthquakes.

Given the crucial importance of constant running of the devices 100-200 that contribute towards the surveillance of the school, it is obvious that, besides connection to the power mains, each device 100-200 must also be provided with integrated rechargeable batteries, to

take over in case of power failure.

Lastly, it is clear that the invention described up to now may be subjected to modifications, additions or variants obvious to a man skilled in the art, without departing from the scope of protection outlined by the attached claims.

Claims

1. Public places surveillance system, suitable to signal, in the bud, situations of violence or emergency or even terrorism-related, consisting of at least one local device (100) suitable to communicate through the internet network (400) with at least one remotely positioned operations centre (300) wherein at least one operator has access to a dedicated server (310) connected to memory (320) in which all emergency report events in encrypted form are saved; said system being **characterised in that** said at least one local device (100) comprises at least:
- 10 - one fixed day/night video camera (110) suitable to continuously record the environment subject of surveillance sending the data to at least one video analysis module (170) integrated in said local device (100);
 - one thermographic camera (120) suitable to continuously record the environment subject of surveillance sending the data to said video analysis module (170);
 - 15 - a motor-driven day/night video camera (160) suitable to change orientation, upon command, of said video analysis module (170) for precisely framing in the points where an emergency could occur;
 - a directional microphone (130) suitable to detect the sound data from the environment subject of surveillance sending it to at least one semantic analysis
 - 20 module (180) integrated in said local device (100);
 - a protection mask (185), preferably crescent-shaped, suitable to frontally protect said local device (100); said mask (185) being removable and being treated superficially so as to prevent seeing the video cameras (110-120-160) from the external, for example with tinted finish;
 - 25 - an events correlation module (190) suitable to combine the processing operations carried out by said video analysis module (170) and by said semantic analysis module (180) to generate, according to pre-set parameters, an alarm report to be sent to said operations centre (300);

- a light signalling device (150) suitable to light-up once said events correlation module (190) detects a potentially dangerous situation and thus the video streaming of the images recorded by the video cameras (110-120-160) and the audio streaming of the sounds detected by said directional microphone (130) is sent to the operations centre (300) and stored in the memory (320) of the dedicated server (310) in an encrypted version;
- an audio speaker (140) suitable to emit alarm acoustic signals should the operations centre (300) confirm the existence of emergency requisites; said audio speaker (140) also allowing vocal communication from the operations centre (300) towards the environment subject of surveillance;
- a common power-supply system for connection to the power mains and an integrated common rechargeable battery (165) suitable to power-supply the local device (100) even in case of electric power failure;
- a common system for connecting to the internet network (400) through wire and/or through a common Wi-fi router (155);

said operations centre (300) being suitable to view the images and sounds in streaming and assessing the actual occurrence of potentially dangerous situations, thus taking action, or filing the report as a false alarm.

2. Public places surveillance system, according to the preceding claim 1, **characterised in that** the operators of the operations centre (300) can view the video streaming whose images were previously processed with a face masking filter or they can view the video streaming coming from said thermographic camera (120).
3. Public places surveillance system, according to any one of the preceding claims 1 or 2, **characterised in that** the images and sounds recorded by the local device (100) are stored in the memory (320) of the dedicated server (310) in encrypted form, accessible in unencrypted form only following the presentation of a criminal case.

4. Public places surveillance system, according to any one of the preceding claims, **characterised in that** it comprises a central device (200) suitable to be installed in a place under permanent surveillance of the facility using said surveillance system; said
- 5 central device (200) comprising at least one panel bearing the map of the distribution of a plurality of local devices (100) installed in the facility and comprising at least one acoustic signalling device (220); each environment under surveillance being marked by a corresponding light signalling device (210); should an events correlation module (190) of a local device (100) detect a potentially dangerous situation, said central device (200)
- 10 determining the activation of said acoustic signalling device (220) and the switching ON of the light signalling device (210) regarding the environment in which the emergency is occurring.
5. Public places surveillance system, according to the preceding claim, **characterised in**
- 15 **that** said central device (200) comprises a display (240) suitable to transmit the images framed by the local device (100) which detected the emergency, by masking the faces or through images of the thermographic camera (120).
6. Public places surveillance system, according to any one of the preceding claims 4 or 5,
- 20 **characterised in that** said central device (200) also comprises a common speakerphone communication system (230) connected to the various environments in which the local device (100) was installed.
7. Public places surveillance system, according to any one of the preceding claims 4 to 6,
- 25 **characterised in that** said central device (200) comprises a key for the simultaneous sending, to all local devices (100) connected thereto, of a general alarm signal, to be used, by way of non-limiting example, in case of fire or earthquake, the sending of said general alarm signal determining the emission of an alarm sound by the audio speakers

(140) of all connected local devices (100) or the emission of a pre-recorded message.

8. Public places surveillance system, according to any one of the preceding claims,
characterised in that said events correlation module (190) of each local device (100)
5 uses a self-learning algorithm suitable to allow the recognition of people who usually
visit the place under surveillance, calibrating the report parameters of the emergencies
on the habitual behaviours thereof.
9. Public places surveillance system, according to any one of the preceding claims,
10 **characterised in that** said local device (100) is provided with inertial sensors suitable
to recognise any tampering attempts, thus generating an alarm to be sent to the
operations centre (300) and/or to the possible central device (200).
10. Public places surveillance system, according to any one of the preceding claims,
15 **characterised in that** said video analysis module (170) is suitable to recognise the
ethnic group of origin of the framed people determining a conditioning of the analysis
carried out by said semantic analysis module (180) according to the detected ethnic
group.
- 20 11. Public places surveillance system, according to any one of the preceding claims,
characterised in that it is suitable to be installed in the environments of hospitals,
schools, nursing homes, malls, stations, airports and the like.

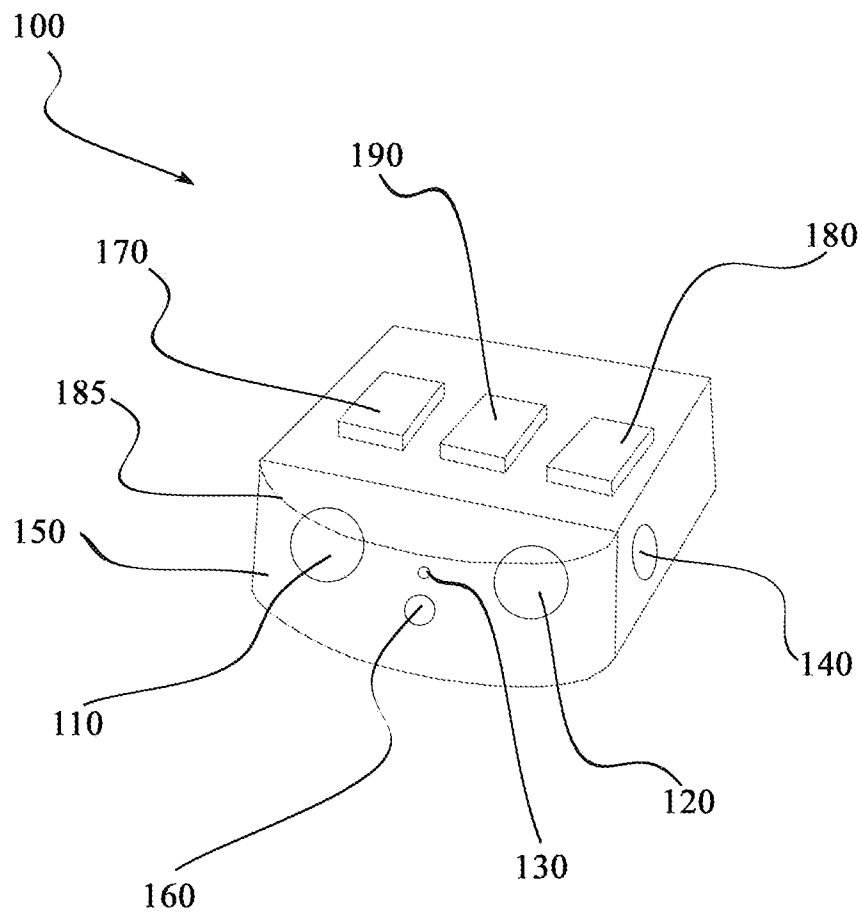


Fig. 1

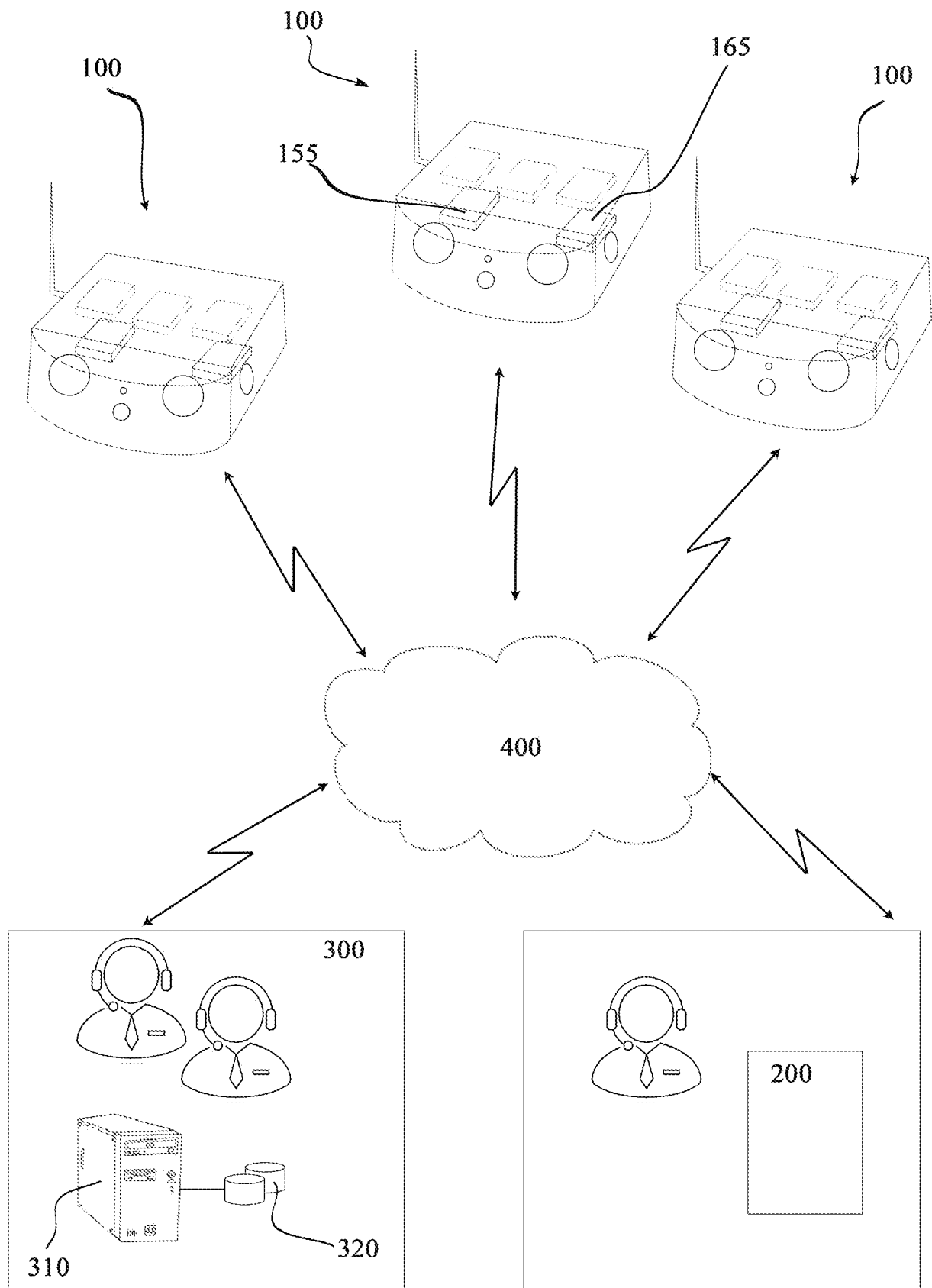


Fig. 2

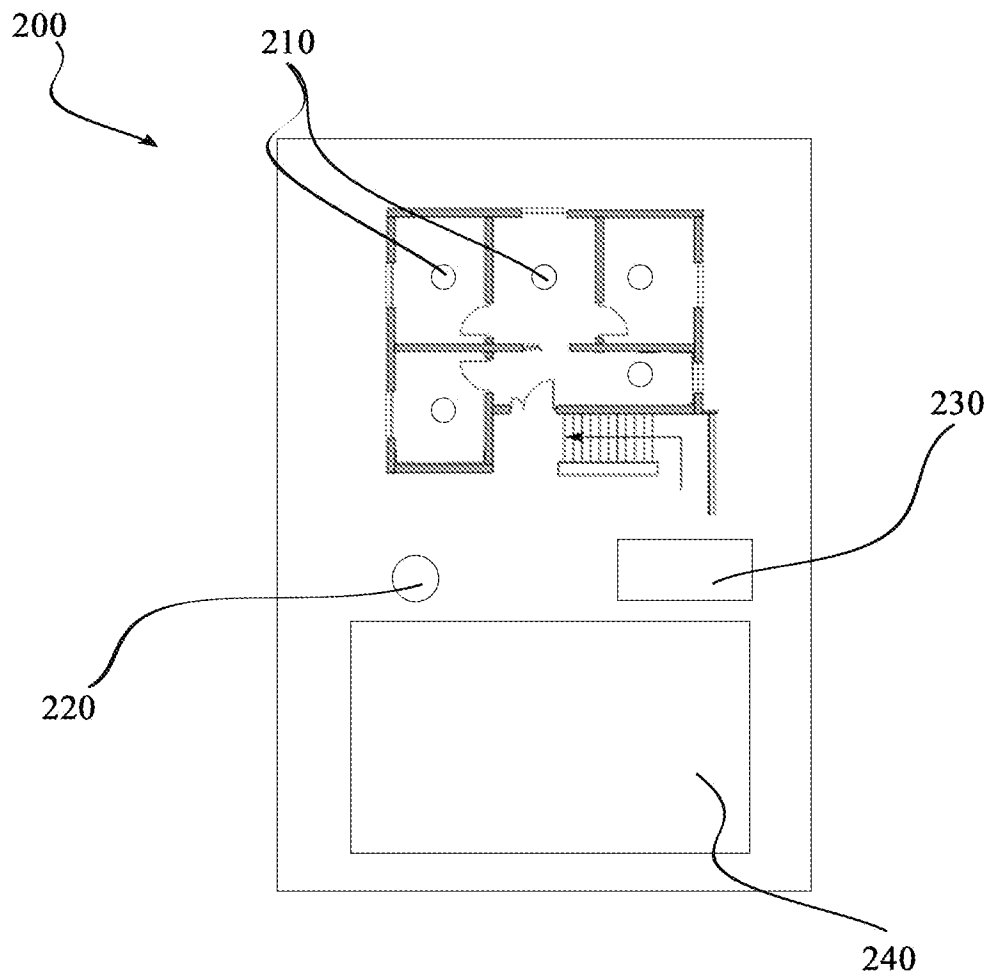


Fig.3

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2019/056236

A. CLASSIFICATION OF SUBJECT MATTER
INV. G08B13/196 H04N7/18
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G08B H04N

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

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

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2015/001528 A1 (ASELSAN ELEKTRONIK SANAYI VE TICARET ANONIM SIRKETI [TR]) 8 January 2015 (2015-01-08) page 3, line 6 - page 7, line 31; figures 1,2	1-11
A	----- DE 201 05 784 U1 (MEYER KARL OTTO [DE]) 5 July 2001 (2001-07-05) abstract page 7, line 1 - page 9, line 24; figure 1	1-11
A	----- CA 2 529 869 A1 (JOHNSON DOUGLAS M [CA]) 6 June 2007 (2007-06-06) page 4, line 30 - page 5, line 15; figures 1-3	1-11
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Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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

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

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Date of the actual completion of the international search

18 November 2019

Date of mailing of the international search report

02/12/2019

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2019/056236

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 064 430 A (LEFKOWITZ STEPHEN [US]) 16 May 2000 (2000-05-16) column 2, line 34 - column 2, line 50 column 3, line 64 - column 5, line 42; figures 1,2 -----	1-11

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2019/056236

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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