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(54) SURVEILLANCE SYSTEM

(57) A surveillance system comprising multiple detectors (10), each equipped with several motion detection sensors (12), a control unit (18) for data processing, communication means (13), a locator (14), and a battery (16). The control unit (18) receives motion data from the

motion detection sensors (12) and location data from the locator (14), and generates an alert based on this information. The motion detection sensors (12) are positioned to detect movement from all directions, making the detectors (10) orientation-independent.

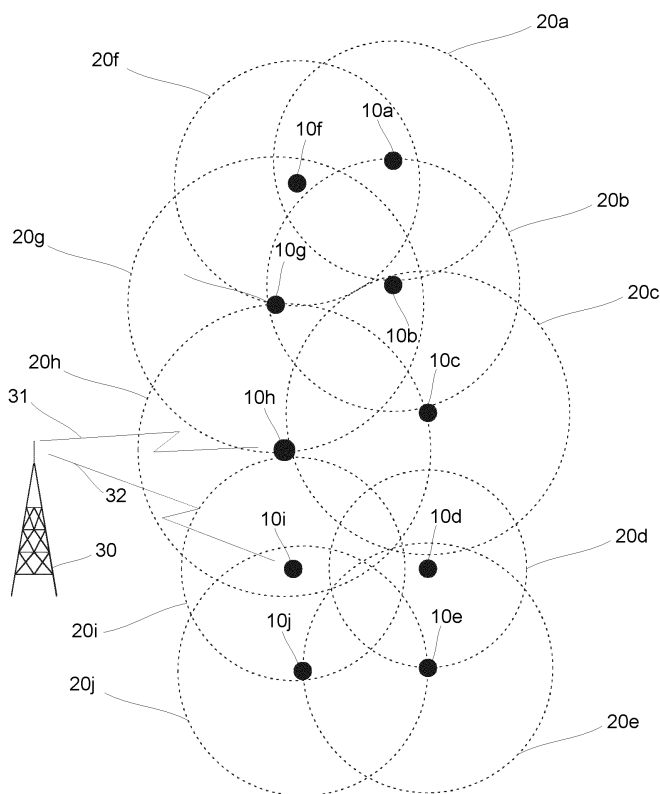


Fig. 4

Description

FIELD OF THE INVENTION

[0001] The invention relates to surveillance systems, and particularly to surveillance systems based on motion detection.

PRIOR ART

[0002] Various surveillance systems based on motion detection are known from many different contexts. A typical system consists of stationary or portable motion detectors, which are connected to a central unit. Upon detecting motion, the motion detector sends a signal to the central unit, which then activates an alarm or other predefined actions.

[0003] Installing a large and centrally monitored surveillance system is slow and labor-intensive, making them unsuitable for sudden and temporary surveillance needs.

OBJECT OF THE INVENTION

[0004] The objective of the invention is a surveillance system that aims to minimize the shortcomings of known technical solutions. The surveillance system according to the invention can be quickly brought into operational condition and cover even extensive areas.

BRIEF DESCRIPTION OF THE INVENTION

[0005] The object of the invention is achieved with a surveillance system according to claim 1. Preferred embodiments are presented in claims 2 to 9.

BRIEF DESCRIPTION OF THE FIGURES

[0006] The invention is now described in more detail in connection with preferred embodiments, with reference to the accompanying drawings, in which:

- Figure 1 shows a detector according to an embodiment;
- Figure 2 shows a block diagram of a detector according to an embodiment;
- Figure 3 shows a detector according to an embodiment; and
- Figure 4 shows a surveillance system according to an embodiment.

DETAILED DESCRIPTION OF THE INVENTION

[0007] The invention concerns a surveillance system designed for temporary use in the field. The surveillance system can easily cover even large areas and can be quickly deployed when needed.

[0008] Figure 1 shows a detector 10 according to an

embodiment of the invention. From an external perspective, the detector 10 may be quite simple, and only the casing 11 of the detector may be visible, with possibly the surface of the motion detection sensors 12 being distinguishable. The surface of the sensors is preferably either flush with the casing, slightly recessed, or substantially flush with the casing. The motion detection sensors 12 can be of the type, for example, PIR sensors, i.e., passive infrared sensors.

[0009] The casing is preferably spherical or a polyhedron resembling a sphere. In the case of a polyhedron, the casing is preferably a regular polyhedron, such as a dodecahedron or an icosahedron. The spherical or spherical-like shape of the casing allows the motion detection sensors 12 to be positioned freely or nearly freely at various angles relative to each other, and it also makes the structure of the casing 11 strong and durable. The material of the casing 11 is preferably plastic or another polymer. The casing is preferably watertight and also airtight. The casing must be strong enough to withstand a free fall, possibly onto a hard surface. It is advantageous if the casing is made of slightly flexible material, so it does not crack from the impact of a fall. The casing must withstand at least weeks or months of exposure to outdoor conditions with varying weather. In some embodiments, a lightweight casing relative to its size is advantageous, as its terminal velocity in free fall would be lower than that of a heavier casing. Preferably, the entire detector 10 is designed to be significantly lighter than water, so that if it falls into water, the detector remains afloat. The casing 11 may also be a multi-part casing, where the inner part is made of hard material to protect the internal technology, and the outer shell is made of softer and more flexible material that withstands impacts well. The casing is preferably between 50-150 mm in diameter, more preferably 50-100 mm, and even more preferably 60-80 mm. A very large casing is easy to spot in the field, and transporting it to the monitored area is laborious. A very small casing may not have enough space for the necessary technology, and it may also settle into depressions in the terrain, which can create large blind spots for the motion detection sensors.

[0010] Figure 2 shows a simplified and exemplary block diagram of a detector 10 according to an embodiment. The block diagram shows eight motion detection sensors 12, although it is preferable to have more in order to avoid significant blind spots, regardless of the detector's orientation. All the motion detection sensors 12 are connected to a control unit 18, which functions similarly to a computer. The control unit preferably includes at least a microprocessor, memory, and connections to the motion detection sensors and other sensor technology. The control unit 18 controls the operation of the device according to how it is programmed. This disclosure presents examples of preferred functions and operating principles, which a person skilled in the art can implement based on what is presented here.

[0011] The control unit 18 is connected to communica-

tion means 13, allowing the detector 10 to communicate with other detectors and preferably also with other devices and systems. In practice, the communication means 13 may include one or more radio frequency transceivers and one or more antennas for sending and receiving signals. Preferably, communication between different detectors of the same surveillance system uses short-range, low-power connections or networks. The range may be, for example, at most 100 m, at most 50 m, or at most 30 m. It is important to note that in field conditions, and when in random orientations, the detector's range can vary significantly in different directions. Preferably, the communication means 13 can create a wireless routing network, or so-called mesh network, between detectors within range, where each detector 10 functions as a node and relays information through the network. The detectors may also exchange information using other communication methods and protocols. Preferably, two or more frequency bands can be used, either in parallel or as alternative connections, to reduce or eliminate interference and disruption. In an embodiment, the communication means use data transmission methods known from defense systems, designed to withstand significant interference.

[0012] The communication means 13 preferably also include connection means for establishing a connection and transmitting data from the detector to a different type of receiver. These connection means are preferably suited for medium- or long-range connections, practically ranging from a few kilometers to tens or even hundreds of kilometers, depending on the embodiment. The connection means may use existing networks, such as cellular networks or mobile data. Medium- and especially long-range connections are preferably encrypted. Two or more frequency bands and/or connections can be used, either in parallel or as alternatives, to reduce or eliminate interference and disruption. In an embodiment, the communication means use data transmission methods known from defense systems, designed to withstand significant interference.

[0013] The control unit 18 is also connected to a locator 14, which is preferably a satellite locator. For example, known GPS modules can be utilized. The locator provides location data to the control unit, allowing the location of the detector in the field to be determined. With location data, it is also possible to determine whether the detector is moving for some reason or remains stationary.

[0014] All the detector's technology receives the necessary electrical energy from a primary battery 16 or a rechargeable battery. Preferably, primary batteries are used, as the lifespan of the surveillance system in the field is limited, and the detectors would need to be retrieved for recharging their rechargeable batteries. The battery capacity is determined based on the detector's average power consumption and the desired operating time. When using a rechargeable battery, solar panels can be integrated into the surface of the detector's casing 11 to recharge the battery during daylight hours. In an

embodiment, the primary battery or the rechargeable battery is completely replaced by solar panels integrated into the surface of the casing, with at least two solar panels, ensuring that at least one of them is exposed to light in any orientation.

[0015] Figure 3 shows a detector 10 according to an embodiment. The detector shown in Figure 3 differs from the detector in Figure 1 only in the addition of protrusions 15 attached to the casing 11. The protrusions are preferably elongated and have a length that is at least equal to the diameter of the spherical casing 11. The protrusions 15 are preferably oriented along the radius of the spherical casing 11, i.e., perpendicular to the surface of the sphere, making the detector resemble a spiked ball. Other shapes can also be used, but an elongated shape perpendicular to the surface does not significantly cause the detectors to become entangled during transport, even if a large number of detectors are in the same container. This is further helped if the protrusions taper towards the tip. The protrusions can be made of the same or similar material as the casing 11. The protrusions 15 can serve several functions. First, the protrusions increase air resistance and reduce terminal velocity during free fall, thus reducing the impact force when hitting the ground. Second, the protrusions 15 reduce the forces on the casing 11 when the detector falls to the ground. Third, the protrusions keep the casing off the ground in most cases, thereby reducing the blind spots of the motion detection sensors 12.

[0016] Figure 4 shows a surveillance system according to an embodiment, with an exemplary set of ten detectors 10a-10j. The detectors are placed in the field, for example, at a distance of approximately 30-100 meters from each other. The detectors can be deployed into the field by being dropped from an aircraft, helicopter, drone, or other flying vehicle. The detectors can also be fired or launched into the target area using various projectile devices. Alternatively, they can be released from the back of a vehicle or thrown from a vehicle into the surrounding terrain. Of course, the detectors can also be manually placed in the field by foot or using other appropriate methods. Depending on the intended deployment method, the details of the detector casing 11 can be designed according to the teachings provided in this publication.

[0017] In an embodiment, the arrangement associated with the detector includes a float. The float can have any shape, such as a spherical shape or a tubular shape. In an embodiment, a tubular shape is used, on which the detector is on one end and a counterweight on the opposite end. Additionally, embodiments having a float may include an anchor and a rope, chain, or cable (or similar) to attach the anchor to the float, for example, to its weighted end. When the float is dropped into water, for example the tubular float, due to its weight, the float will settle in a vertical position with the detector above the water surface, and the anchor keeps the detector substantially in its place. Additionally, a solar panel can be used, for example, on the upper surface of the float or as a

separate panel, to charge the detector's rechargeable battery and extend the detector's operating time. Also, a primary battery can be used instead.

[0018] In another embodiment, the arrangement associated with the detector includes a pole or post, to which the detector can be attached at the top, with the bottom end inserted into the ground to keep the pole or post upright. A solar panel can also be used, for example, on the surface of the pole or post, or as a separate panel, to charge the detector's rechargeable battery and extend its operating time. Also, a primary battery can be used instead.

[0019] Each of the detectors 10a-10j is marked with a dashed line indicating the range 20a-20j of their short-range communication means, respectively. The figure is interpreted as follows: when the circle representing one detector falls within or under the dashed line indicating the communication range of another detector, these detectors can communicate with each other. For example, the range 20a of detector 10a covers detectors 10b and 10f, meaning detector 10a can communicate with both detectors 10b and 10f. Similarly, detector 10h can communicate with detectors 10c, 10g, and 10i. detector 10d can only communicate with detector 10e, because the range 20d of detector 10d is smaller than that of the other detectors. This could be due to the terrain surrounding detector 10d or a malfunction in one of detector 10d's components. In any case, detector 10d is still connected to all the other detectors in the system through the other detectors, as each detector can both send and receive information.

[0020] The detection range of the motion detection sensors 12 in detectors 10a-10j is preferably set to cover at least half of the short-range communication means' range. This ensures that there are no significant blind spots between two connected detectors unless terrain features block the motion detection sensors from detecting movement. Preferably, the detection range of the motion detection sensors in open space is 50-100% of the short-range communication means' range in open space.

[0021] In the embodiment depicted in Figure 4, the detectors 10a-10j form a wireless routing network using short-range communication devices. Through this routing network, any detector can send information to any other detector in the network. Each detector also attempts to establish a connection via communication devices outside of the routing network, for example, to a mobile network or a receiver of the surveillance system, through which the system user can monitor and control the surveillance system. Detector 10h is the closest to receiver 30 and, after comparing the signal strength or number of errors in the connection with other detectors, detector 10h establishes connection 31 with receiver 30 because it has the best connection to the receiver out of all the routing network's detectors. Similarly, detector 10i receives information through the network that it has the second-best connection to receiver 30, so it establishes

connection 32 with receiver 30. Connection 32 can be used either as a parallel connection to connection 31 or as a backup for connection 31. In the event that detector 10h loses connection with receiver 30 and notifies the other detectors through the network, the data transfer switches to connection 32. At this point, other detectors can also be activated to attempt reconnection to the receiver, and a new main connection and backup (or parallel) connection can be selected from the detectors with the best available connections.

[0022] As described above, in an embodiment, the surveillance system comprises several detectors 10. These detectors 10 include multiple motion detection sensors 12, a control unit 18 for processing data, communication devices 13, a positioning system 14, and either a rechargeable or primary battery 16 or solar panels. Preferably, there are at least four motion detection sensors, more preferably at least six, and even more preferably at least eight. The detector's control unit 18 is configured to receive motion data from the multiple motion detection sensors 12, as well as location data from the locator 14, and to generate alert data based on the motion and location data. The communication devices 13 are configured to send and receive alert data. The multiple motion detection sensors 12 are positioned within the detectors 10 to detect motion in all directions, making the detectors 10 orientation-independent. Orientation-independence means that the detectors do not need to be placed in a specific position to function, but they detect motion in much the same way regardless of their orientation.

[0023] In an embodiment, the multiple detectors 10 are configured to form a wireless routing network for transmitting the alert data between the detectors 10.

[0024] In another embodiment, the communication devices 13 include means for transmitting both the alert data generated by the detector and the alert data received from another detector to receiver 30 or, more generally, to a communication network such as a mobile network or a mobile data network. In an embodiment, the mentioned receiver 30 is an external communication network to the surveillance system.

[0025] In an embodiment, the detectors 10 include a waterproof casing 11 with multiple protrusions 15 pointing in different directions.

[0026] In another embodiment, the motion data and the alert data generated from it indicate the intensity of the motion detected by the motion detection sensors 12. The control unit 18 is preferably configured to generate and send alert data only when the intensity of the motion detected by the motion detection sensors 12 exceeds a predetermined threshold. Each detector 10 is preferably configured to independently determine this threshold based on the intensity of the motion detected by the motion detection sensors 12, for example, by measuring the signal from the motion detection sensors over a certain period and setting the threshold based on the average or maximum value recorded during that period.

[0027] In an embodiment, each detector 10 includes one or more cameras. The camera can take a photograph when the motion detection sensor 12 detects movement. The photograph can be attached to the alert data along with the motion data and location data, meaning the alert data includes a photograph taken by the camera. When using more than one camera, the photograph is taken by the camera that faces the direction from which the motion detection sensor 12 provides the strongest signal. In an embodiment, image recognition is used to process the photographs. Image recognition attempts to identify humans in the images, and the control unit 18 sends an alert whenever a human is recognized in the image, even if other conditions for sending alert data are not met. In an embodiment, images produced by the camera can be processed by artificial intelligence, which is trained to recognize specific figures, such as people or vehicles, and generate an alert only when such a figure is recognized.

[0028] It is obvious to professionals in the field that as technology and materials advance, the basic concept of the invention can be implemented in many different ways. The invention and its embodiments are therefore not limited to the examples described above, but may vary within the scope of the claims.

Claims

1. A surveillance system comprising multiple detectors (10), wherein the detectors (10) include:

multiple motion detection sensors (12),
 a control unit (18) for processing data,
 communication means (13),
 a locator (14), and
 a rechargeable battery or a primary battery (16),
 wherein the control unit (18) is configured to receive motion data from the multiple motion detection sensors (12) and location data from the locator (14) and to generate alert data from the motion data and the location data, and wherein the communication means (13) are configured to transmit and receive the alert data, the surveillance system being **characterized in that** the multiple motion detection sensors (12) are positioned within the detectors (10) to detect motion from all directions, making the detectors (10) orientation-independent.

2. The surveillance system according to claim 1, wherein the multiple detectors (10) are configured to form a wireless routing network for transmitting the alert data between the detectors (10).

3. The surveillance system according to claim 1 or 2, wherein the communication means (13) comprise means for transmitting both the alert data generated

by the detector (10) and the alert data received from another detector to a receiver (30).

4. The surveillance system according to any of claims 1-3, wherein the detectors (10) comprise a water-proof casing (11) with multiple protrusions (15) pointing in different directions.
5. The surveillance system according to any of claims 1-4, wherein the motion data and the alert data generated from it indicate the intensity of the motion detected by the motion detection sensors (12).
6. The surveillance system according to claim 5, wherein the control unit (18) is configured to generate and send the alert data only when the intensity of the motion detected by the motion detection sensors (12) exceeds a predetermined threshold.
7. The surveillance system according to claim 6, wherein each detector (10) is configured to independently determine the threshold based on the intensity of the motion detected by the motion detection sensors (12).
8. The surveillance system according to any of claims 1-7, wherein each detector (10) comprises one or more cameras.
9. The surveillance system according to claim 8, wherein the alert data includes a photograph taken by the camera.

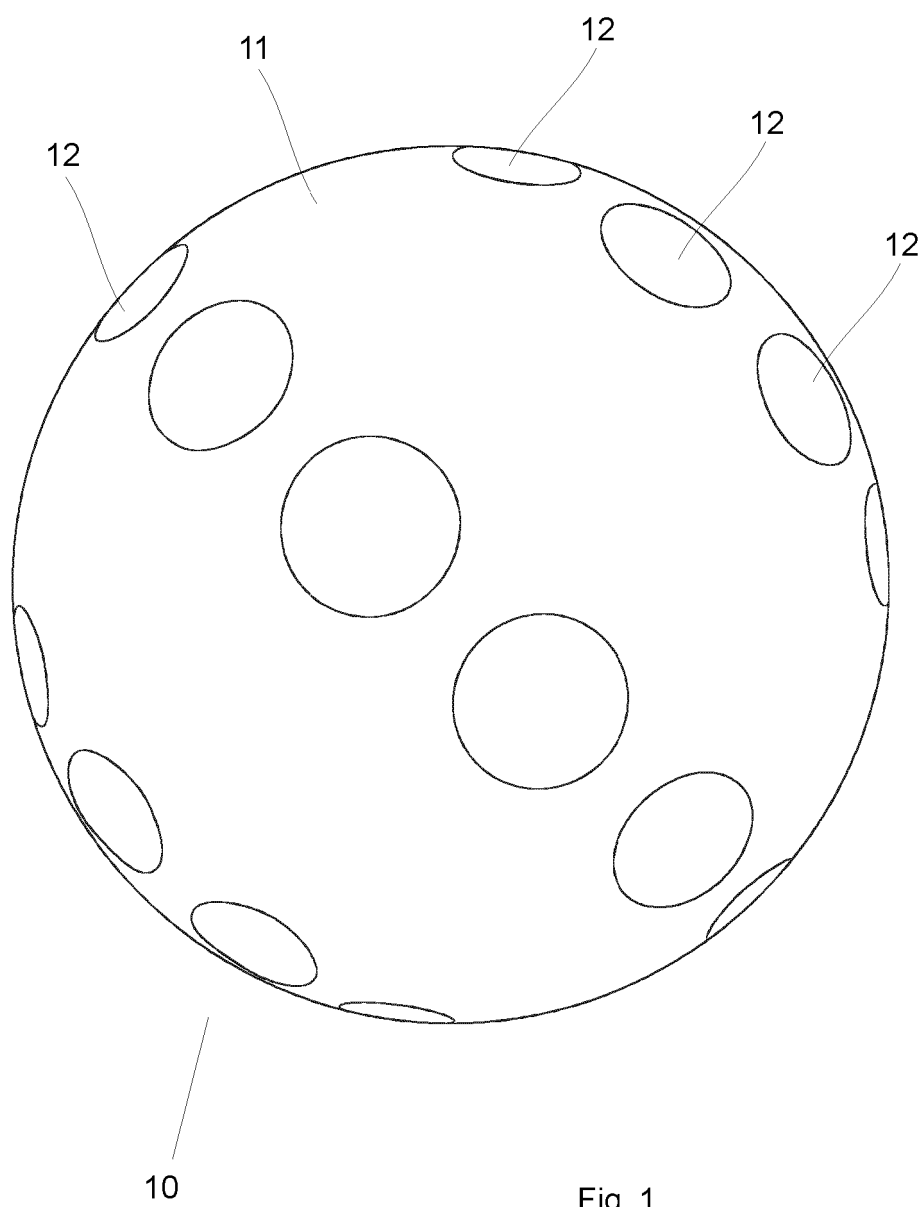


Fig. 1

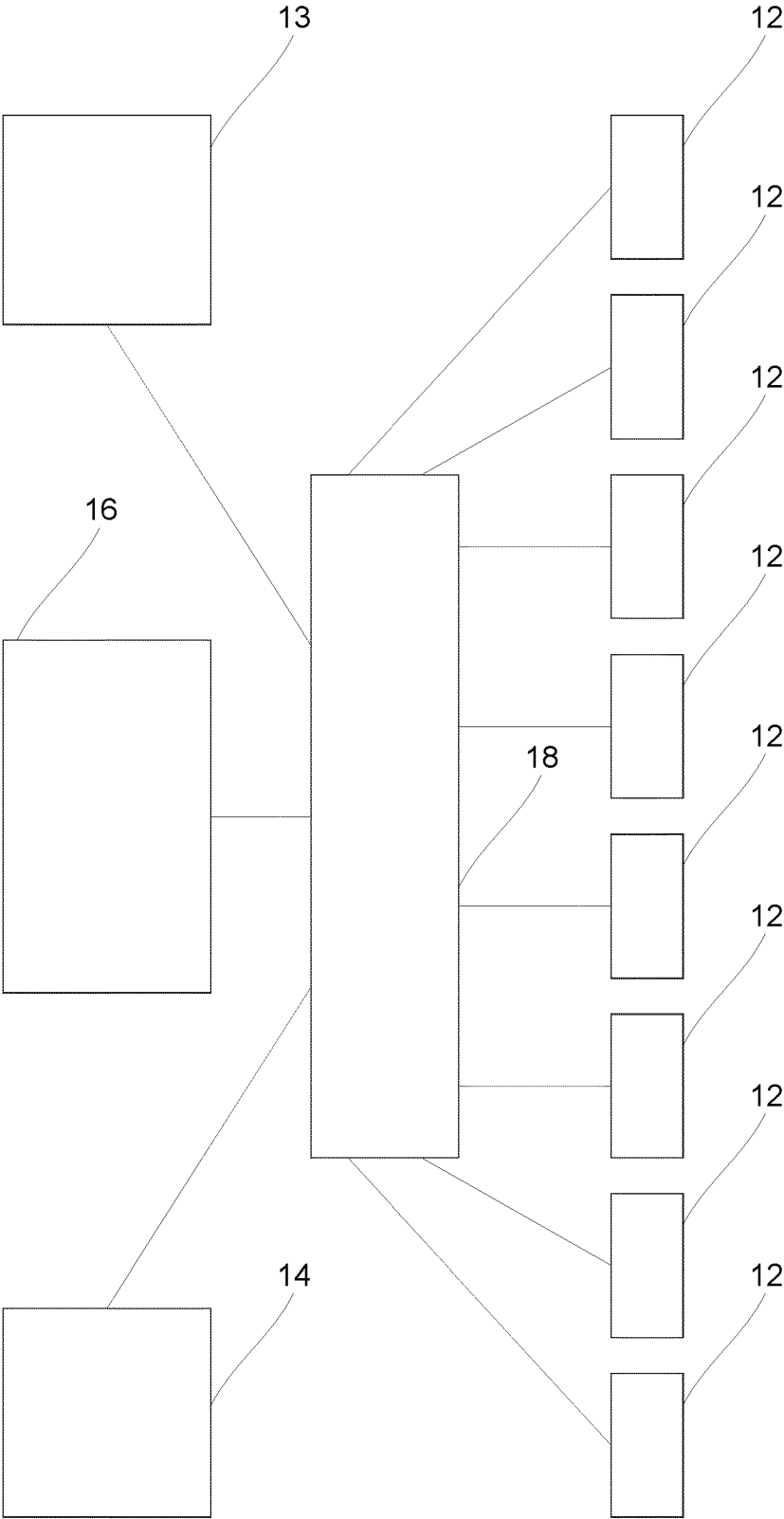


Fig. 2

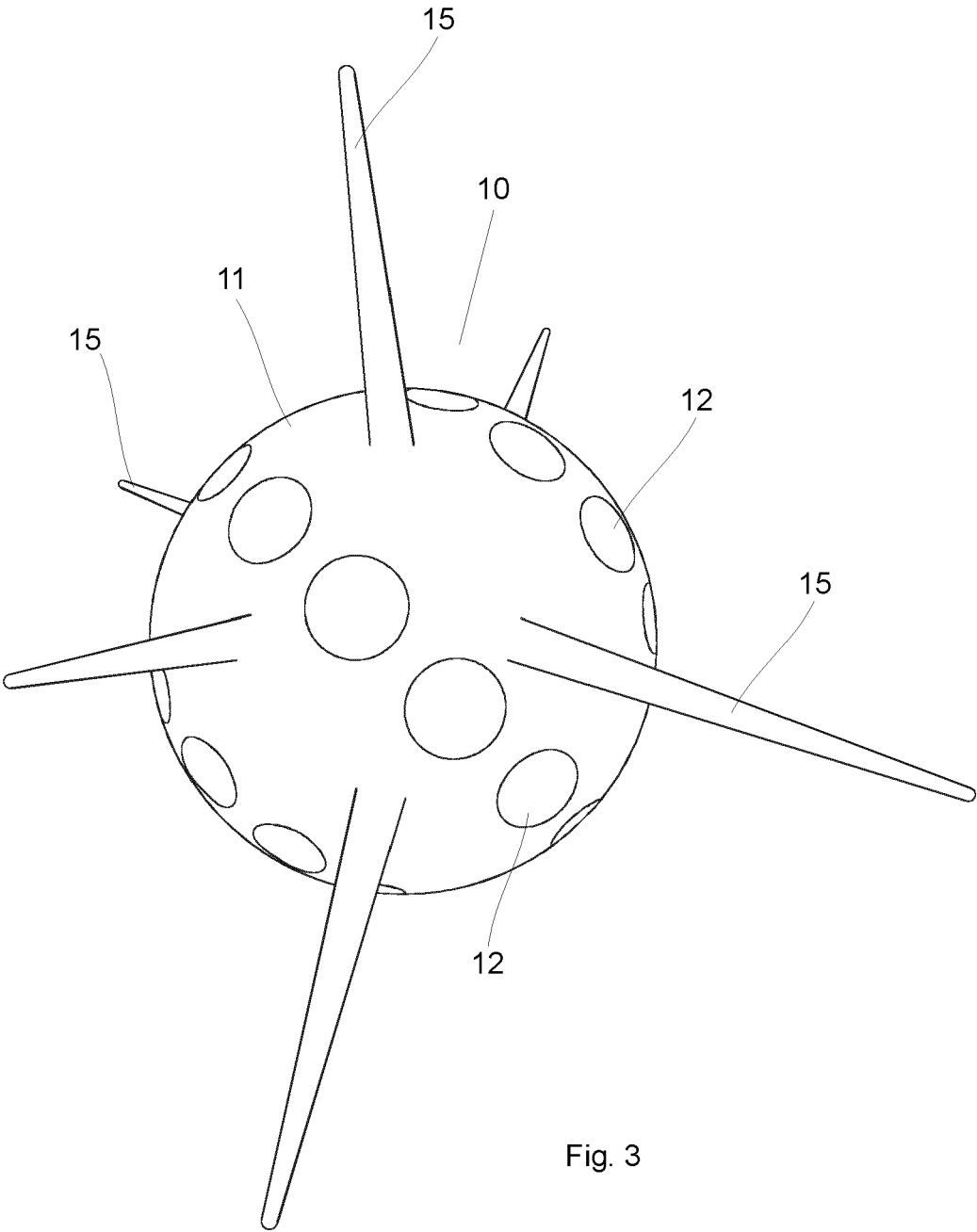


Fig. 3

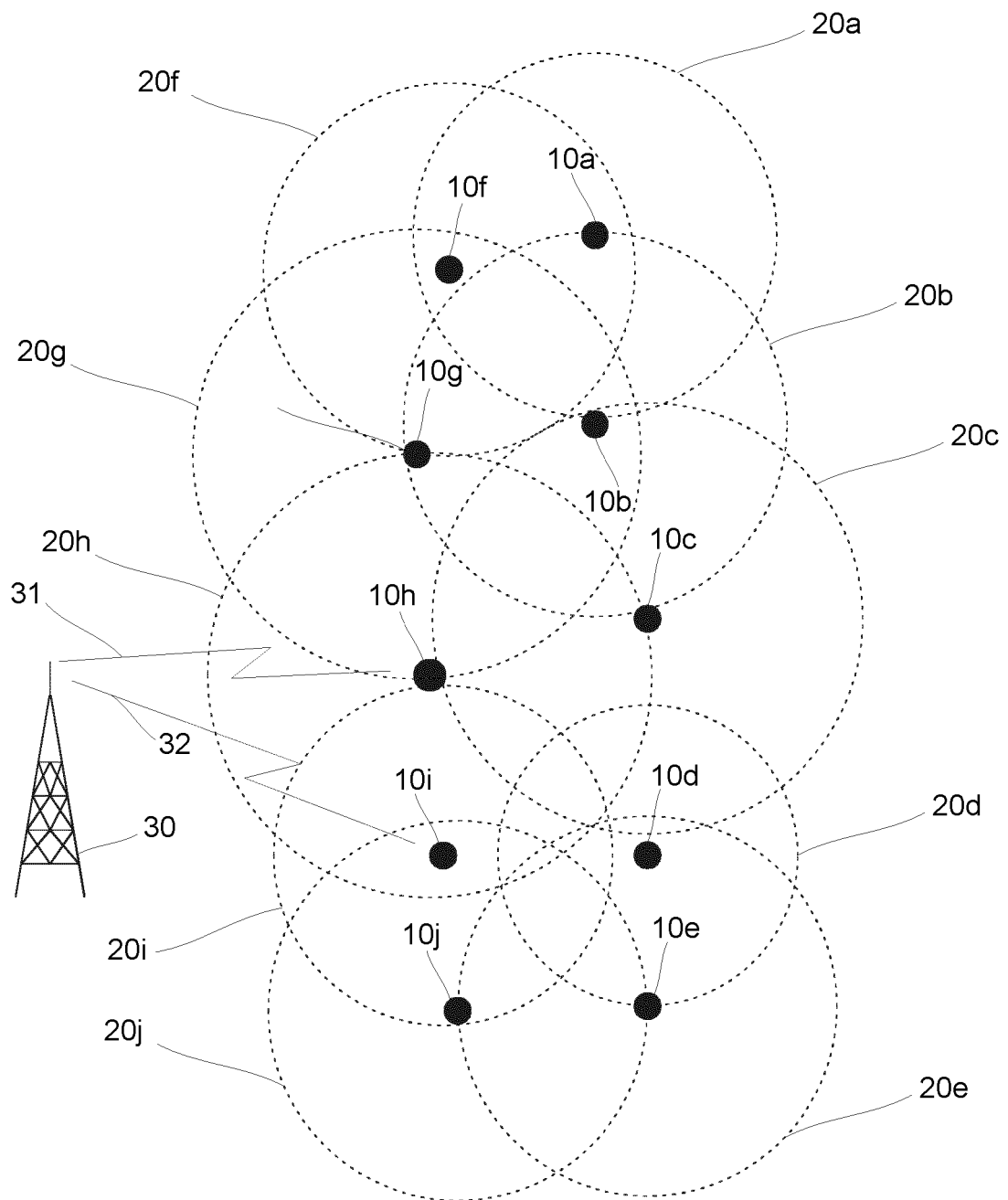


Fig. 4



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Application Number

EP 24 20 9520

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Place of search Munich		Date of completion of the search 12 March 2025	Examiner Kurzbauer, Werner
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

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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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