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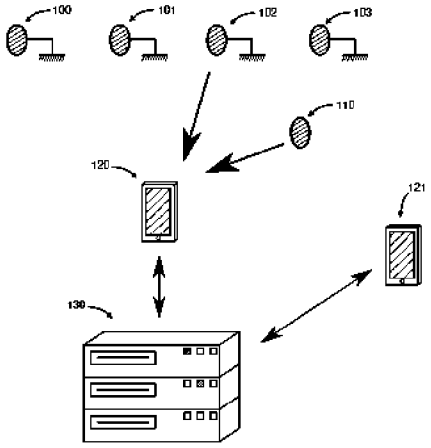
(71)	Applicant	FDVLINK AS, Utsikten 3, 4326 SANDNES, Norge
(72)	Inventor	Gunnar Hansen Kjestveit, Utsikten 3, 4326 SANDNES, Norge
(74)	Agent or Attorney	HÅMSØ PATENTBYRÅ AS, Postboks 171, 4301 SANDNES, Norge

(54) Title **Communication system for gathering data about the location of an object in a building**

(57) Abstract

The application discloses a communication system for gathering data about the location of an object in a building. The communication system includes an electronic device for emitting a wireless signal identifying the object, at least one electronic device for emitting a wireless signal identifying a location in the building, a server configured with a database for storing gathered data, and at least one computing device adapted to receive wireless signals from the electronic devices and to communicate with the server. The communication system can gather data by having computing devices, such as tablets or smartphones, detecting signals around them, and processing if the detected objects are positioned in the detected locations. If positive, the computing devices communicate to the server that the objects are in the detected locations. The solution can be useful in many kinds of buildings, such as a hospital, an airport terminal, or a School.



Communication system for gathering data about the location of an object in a building

The present invention relates to a communication system for gathering data about the location of an object in a building. Also, the present invention relates to a building including the communication system. Moreover, the present invention relates to a method of installing the communication system in a building.

Nowadays, there is often a need to know where an object is inside a building. For example, the building may be a hospital and the object may be a hospital bed. There may exist several reasons for this need. First, it may be that the object is difficult to substitute. For example, the cost of acquiring a substitute object may be too high, or obtaining the substitute object may require a lot of effort and time. Secondly, the loss of the object may constrain the ability to perform tasks in the building. It may be that the object is critical for performing a task in the building, or that without the object there is less capacity to handle the same amount of work. Thus, it is relevant to provide a solution that allows a user to have an idea of where an object is in a building.

However, it can be challenging to gather data about the location of an object in a building. Known solutions typically require that a specialised team is hired for the purpose of installing and maintaining them.

A known solution makes use of Radio Frequency Identification (RFID) to automatically identify and track a tag attached to an object. This solution has several drawbacks. It requires the installation of active antennas at fixed locations in the building for reading the information provided by the tag. The active antennas are typically expensive and have big components. Also, in order to register that an active antenna has detected a tag, the tag itself has to pass nearby the antenna. This does not allow to register the location of the object if it is simply standing still between active antennas.

Another known solution involves installing a WiFi network in the building and attaching portable WiFi sensors to the objects being monitored. This solution also has drawbacks. Although this solution allows to obtain the position of the object in real-

time, it can be expensive to install and maintain. And the portable WiFi sensors can be expensive and difficult to maintain. This kind of device too often requires recharging its battery, such as every week, which is undesirable.

The invention will now be disclosed.

According to an aspect of the invention, there is provided a communication system for gathering data about the location of an object in a building. The communication system comprises:

- an electronic device for emitting a wireless signal identifying the object;
- at least one electronic device for emitting a wireless signal identifying a location in the building;
- a server configured with a database for storing data about at least one detection of an object in a location of the building; and
- at least one computing device adapted to receive wireless signals from the electronic devices and to communicate with the server.

Optionally, the at least one computing device may be a mobile device.

It has been realised that the computing devices already present in the building, such as smartphones, tablets, or desktop computers, could be used to detect objects around them. In many cases, the staff working in the building carry computing devices with them. Also, instead of opting to put the task of communicating with the server in each object, it has been realised that a computing device detecting the objects around itself could do the communication with the computer server.

Also, each of the at least one computing device may be configured to:

- scan for at least one wireless signal emitted by an electronic device;
- if at least one wireless signal identifying a location in the building is detected, select one of the at least one identified location for representing the location in which the computing device is;
- if the wireless signal identifying the object is detected and a location is selected, communicate the detected object and the selected location to the server.

Alternatively, the step, configured in each of the at least one computing device, of selecting one of the at least one identified location for representing the location in which the computing device is may comprise the steps:

- for each detected wireless signal identifying a location, obtain an estimate of the distance between the computing device and the electronic device that emitted the detected wireless signal;

- select the location identified by the detected wireless signal with the lowest estimated distance for representing the location in which the computing device is.

Moreover, the step, configured in each of the at least one computing device, of selecting one of the at least one identified location for representing the location in which the computing device is may further comprise the step:

- if a detected wireless signal identifying a location is estimated to have been emitted from a distance longer than a pre-configured maximum distance, ignore the detection of the wireless signal.

Optionally, each computing device may be configured with at least one maximum distance for ignoring the detection of a wireless signal based on the location which is identified by the wireless signal.

Also, each computing device may be further configured with the step:

- if a detected wireless signal identifying an object was emitted from a distance longer than a pre-configured maximum distance, ignore the detection of the wireless signal.

Alternatively, each computing device may be configured with at least one maximum distance for ignoring the detection of a wireless signal based on the object which is identified by the wireless signal.

Moreover, each computing device may be configured with at least one maximum distance for ignoring the detection of a wireless signal based on a pre-configured group of objects comprising the wireless signal which is identified by the wireless signal.

Optimally, each computing device may be configured with at least one maximum distance for ignoring the detection of a wireless signal based on the selected location.

According to another aspect of the present invention, there is provide a building comprising the communication system as described above.

Optionally, each room in the building may comprise at least one electronic device for emitting a wireless signal identifying the room.

Also, each floor in the building may comprise at least one electronic device for emitting a wireless signal identifying the floor.

Additionally, the building may comprise at least one electronic device for emitting a wireless signal identifying the building.

According to a further aspect of the present invention, there is provided a method of installing a communication system as described above in a building. The method comprises:

- for at least one location in the building, installing an electronic device to emit a wireless signal from the location, the wireless signal identifying the location; and
- for at least one object inside the building, installing an electronic device to emit a wireless signal from the object, the wireless signal identifying the object.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a schematic view of a communication system embodiment according to the present invention;

Figure 2 is a schematic view of a communication system embodiment installed in a building;

Figures 3A–3C are a series of schematic screenshots of a computing device

when a user searches for an object in a building;

Figure 4 is a schematic screenshot of a computing device when a user configures a group of objects.

Turning now to Figure 1, it shows a communication system embodiment gathering data about the location of an object in a building, such as the location of a hospital bed in a hospital. The embodiment includes the computing device 120, which in this example is a mobile device such as a tablet or a smartphone. After searching for wireless signals, the computing device 120 detects two signals that are being emitted at a short distance: one is a signal identifying an object, which is being emitted by the electronic device 110; and the other is a signal identifying a location in the building, which is being emitted by the electronic device 102. As a result of both electronic devices having been detected near the computing device 120, the latter therefore processes that the identified object is in the identified location. This result is then communicated by the computing device 120 to the server 130 which registers this detection in a database.

By registering the received information in the database, the server 130 keeps a record of where the object was last detected in the building. The database may then be consulted to find where the object may be. For example, at a later moment, the same computing device 120 that has communicated the information to the server 130 may now be operated by a user to ask for information about where the object was last seen; the server 130 queries the database and forwards the response to the computing device 120. Another example would be to have a second computing device 121 being operated by some other user to ask the server 130 about the location of the object. In this case, the server 130 also queries the database and forwards the obtained answer to the second computing device 121.

In most cases, the communication system embodiment may be installed without needing to hire a specialized team to do that job. For example, someone responsible for the technical services in a hospital may him/herself place and configure the electronic devices as intended, without requiring specialised knowledge about the building such as knowledge about the electrical wiring in the building.

Some options may be taken when installing the embodiment. It may be decided which objects are to be monitored, and which locations in the building are to be used for locating the monitored objects. For example, in a hospital, it may be useful to monitor all hospital beds when these are in a location in which they are expected to stay still, such as patient bedrooms or service rooms in which the hospital beds are washed. Or, for example, in an airport terminal, it may be useful to monitor all luggage trolleys near boarding gates. Or yet, in a school, it may be useful to monitor all portable projectors that are being used in the classrooms.

Also, the electronic devices may be positioned so that an estimate of the distance up to the object or location being identified may be obtained by measuring the distance up to the electronic device. In the case of the electronic device 110 being installed for emitting a wireless signal identifying an object, it may be useful to attach or incorporate the electronic device 110 to/in the object. In the case of an electronic device 10X being installed for emitting a wireless signal identifying a location in the building, it may be useful to position the electronic device 10X within the area of the location. For example, if the location being identified is a room in a hospital, the electronic device 10X may be installed inside the room.

It may also be decided which type of electronic devices will be used for emitting wireless signals. Some options are: a Bluetooth beacon, a Zigbee beacon or a Z-Wave beacon. For example, in the case of a Bluetooth beacon, the signal emitted by it may travel through walls and may be detected in a typical maximum range of 100 meters. It is known that there are several choices available regarding portability and the type of Bluetooth technology. A Bluetooth beacon may be powered from an electrical wall socket or by a battery, and in many cases, it is possible to measure the distance up to the Bluetooth beacon. Also, the Bluetooth technology may be of the so called ‘low energy’ type, which is useful for achieving a lower consumption of power and a longer battery life.

Generally, the function of an electronic device may be to transmit a wireless signal with an identifier that is unique among electronic devices. In some cases, the identifier may be unique among all electronic devices made by a vendor, and in other cas-

es, the identifier may be configured when installing the electronic device and, at that moment, made unique among all the installed electronic devices. Thus, after having positioned an electronic device, a further step may be configuring it so that the emitted signal transmits a unique identifier.

Moreover, the server 130 may be implemented in a machine operating inside the building or outside such as at a remote location. Also, the data in the database may be structured so that an entry exists for each known object and its fields are updated every time a detection of the object is received by the server 130. This implementation has the advantage that the entry related to an object always reflects the last detection received. Alternatively, each entry in the database may include a field with the time and date on which the object was detected. This implementation allows to keep a record of past detections and sort them by time and date. Another field may be used for identifying the computing device 120 from which the information was received. For this purpose, a unique identifier possibly would have to be configured among computing devices.

Also, the communication between computing device 120 and the server 130 may be achieved using any wireless means, such as WiFi or cellular data.

In Figure 1, the detection of an object in a location is presented in a simplified manner, as the computing device 120 detects only two wireless signals. However, in many cases, a computing device 120 may detect several wireless signals, since more than two electronic devices may be near enough and the signals may be transmitted through walls. Figure 2 shows an example of such a case.

Figure 2 shows a schematic view of a communication system embodiment installed in a building. A schematic cutaway of the building is shown including two bedrooms (201 and 202) separated by a wall. Each bedroom (201 and 202) has an electronic device (101 and 102) fixed to one of its walls. The electronic device 101 is emitting a wireless signal identifying the bedroom 201, and the electronic device 102 is emitting a wireless signal identifying the bedroom 202. Also, in the bedroom 202 there is the bed 210 which is being identified with a wireless signal emitted by the electronic device 110 that is fixed to one of its legs.

In the bedroom 202, there is also the computing device 120, which may be a tablet or a smartphone being carried by someone who works in the building. The computing device 120 scans for wireless signals and detects the three signals identifying the two bedrooms (201 and 202) and the bed 210. It then proceeds to process the identified locations and object, so that it may communicate that the bed 210 has been found in the bedroom 202 to the server.

In order to process the identified locations and object, the computing device 120 starts by selecting one of the identified bedrooms as its current location, which can be done with several methods. One method is to select the bedroom which is identified by the nearest electronic device. Another method is to consider only bedrooms which are identified by electronic devices staying within a pre-configured maximum distance from the computing device 120. A further method is to consider a different maximum distance for each electronic device. Another method is a combination of at least two of these options, such as selecting the bedroom which is identified by the nearest electronic device and which is within a maximum distance from the computing device 220.

The choice of method may depend on the disposition of the identified locations within the building or on the number of objects being monitored by the communication system embodiment. For example, when having two bedrooms next to each other and one bedroom having at least double the area of the other, it may be advantageous to configure different maximum distances for each electronic device, so that the spatial disproportion between the two bedrooms may be accounted for. Or, for example, it may be preferable to have a maximum distance pre-configured in order to avoid that a signal from an electronic device on one floor is admitted by a computing device on another floor. In this case, the maximum distance may be defined by considering features of the building in which the embodiment is installed, such as the expected ceiling height.

In the case of Figure 2, it is preferable that the chosen method results in the bedroom 202 being selected as the current location of the computing device 120, such as would result by using the method of selecting the nearest electronic device. However, it may happen that the chosen method results in the other bedroom 201 being

the one selected as the current location of the computing device 120. In this case, any admissible object will likely be placed at the wrong location. Notwithstanding, this may be acceptable, as it may be useful in giving a hint of where the object may be in the building. In the case of the building being a hospital, a nurse looking for the bed 210 may have to go to both bedrooms before finding the bed 210. Although not ideal, this approach can still prove to be advantageous for the nurse, since he/she gets a hint of where the bed 210 may be in the building, and possibly avoids excessive effort in looking for the bed 210.

Once the bedroom 202 has been selected as its current location, the computing device 120 filters the identified objects that may also be in the bedroom 202. In this respect, there are also several methods available. One method is to consider only identifiers which were emitted by electronic devices staying within a pre-configured maximum distance from the computing device 120. A further method is to consider a maximum distance from each electronic device for identifying an object. A variant of this method may be instead to define the maximum distance for each group of objects, such as, in a hospital, all hospital beds being considered at most within five meters and all wheel chairs being considered at most within two meters. Another method is to define the maximum distance in which an object is to be considered, based on the information about the selected current location. In this method, there are further variants possible. The maximum distance towards an object may be configured to change depending on the current location. Alternatively, the maximum distance for a group of objects may be configured to change depending on the current location.

In Figure 2, the filtering of objects is simple, as there is only one object that is being detected—the bed 210—and this object is in the same bedroom as the computing device 120. For example, if there is a maximum distance configured for the filtering of all objects, the distance between the computing device 120 and the electronic device 110 would be estimated and compared against the maximum distance: if the measured distance complies with maximum distance, the computing device 120 proceeds to inform the server 130 that the bed 210 has been detected in the room 202; otherwise, the computing device 120 ignores the detection of the signal emitted by the electronic device 110.

The examples shown in Figures 1 and 2 may give an idea that the computing device 120 must be a mobile device such as a tablet or a smartphone; however, the computing device 120 does not have to be of the mobile kind in order for the communication system embodiment to carried out. The computing device 120 can be staying still in the building. For example, a desktop computer can scan the wireless signals around it, in particular the wireless signals emitted from objects passing near it. This arrangement of having a static computing device 120 can be advantageous in locations of the building where some of the monitored objects pass frequently, or in locations of the building which connect different operational areas.

As described above, the computing device 120 can be used for finding an object in a building. Figures 3A to 3C show schematic screenshots obtained in the computing device 120 when a user is searching for the hospital bed numbered 10001 in a hospital, the hospital having a communication system embodiment according to the present invention installed therein.

In Figure 3A, there is illustrated an interface that may be useful when there are a lot of objects being monitored by the communication system embodiment. In this case, the objects are grouped so that it may be easier for the user to find the intended object. Some groups are shown: the group numbered G10001 for hospital beds 300, the group G10002 for wheel chairs, among others. Since the user wants to find a hospital bed, he or she pushes the button for hospital beds 300, so that the screen on Figure 3B shows up.

In Figure 3B, the user is presented with the list of hospital beds, each being accompanied with information about where it was last seen. In order to show this list, the computing device has queried the server 130 for obtaining the information about where each hospital bed in the list was last seen. The first item 301 of the list is the hospital bed numbered 10001, which is the object that the user is looking for. The hospital bed is indicated to have been last seen in the location labelled ‘Zone 1’. The user then walks to the so called ‘Zone 1’ and, once there, looks for the hospital bed by using the radar interface shown in Figure 3C.

The radar interface shown in Figure 3C is optional, as the user may try to find the object when he/she gets to the indicated location. However, if implemented, the screen shown Figure 3C could be observed by the user when walking in the so called 'Zone 1'. In this example, three electronic devices are showing up on the radar map, and one of them—the electronic device 302—is labelled with the number of the bed that the user is looking for. The user may therefore walk towards the hospital bed with the help of the radar interface.

The screenshots shown in Figures 3A to 3C are examples only, and it is appreciated that a computing device can be configured in many other obvious manners in order to accomplish an interface with the similar functionality. Also, the organisation of the monitored objects in a building using groups as shown in Figure 3A is optional. Moreover, with respect to the listing of the objects, the server 130 may be configured so that it stores the necessary information listing the monitored objects and its groups, and the computing device may be configured so that it downloads that information from the server 130 before showing it to the user as in Figure 3A and 3B.

The computing device 120 may also be configured for providing an interface to configure the groups stored in the server. Figure 4 shows a schematic screenshot of the computing device 120 for configuring the group G10001 for hospital beds. The computing device 120 obtains the inserted data from its user, and then sends it to the server 130. This data is then download by all computing devices that are connected to server 130. In this example, the group G10001 is being configured with a maximum distance of 10 meters. This allows the computing device 120 to ignore all signals detected from hospital beds that are measured to be at a distance of more than 10 meters.

The communication system embodiment may be implemented with any additional functionality which may be useful for the tasks being carried out in the building. For example, in a hospital, there is typically a service room in which the hospital beds are periodically washed. In that instance, it can be quite advantageous to provide the users with the ability to register when a hospital bed has been washed. This could be achieved by adding the necessary fields to the database configured in the server 130, and by configuring the computing device 120 with the necessary interface for

registering that a hospital bed has been washed.

Invention embodiments may have some or all of the following advantages:

- communication system embodiments are simple and require few devices
- the number of devices communicating with the server does not depend on the number of objects being monitored; for example, a floor in a hospital can have twenty hospital beds, yet only one computing device is needed to register the location of those twenty beds
- simple indoor positioning system for a computing device

Generally, the terms used in this description and claims are interpreted according to their ordinary meaning the technical field, unless explicitly defined otherwise. Notwithstanding, the terms “comprises” and “comprising” and variations thereof mean that the specified features, steps or integers are included. These terms are not interpreted to exclude the presence of other features, steps or integers. Furthermore, the indefinite article “a” or “an” is interpreted openly as introducing at least one instance of an entity, unless explicitly stated otherwise. An entity introduced by an indefinite article is not excluded from being interpreted as a plurality of the entity.

The features disclosed in the foregoing description, or in the following claims, or in the accompanying drawings, expressed in their specific forms or in terms of a means for performing the dis-closed function, or a method or process for obtaining the disclosed results, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

While the invention has been described in conjunction with the embodiments described above, many equivalent modifications and variations will be apparent to those skilled in the art when given this disclosure. Accordingly, the embodiments of the invention set forth above are considered to be illustrative and not limiting. Various changes to the described embodiments may be made with-out departing from the spirit and scope of the invention.

CLAIMS

1. A communication system for gathering data about the location of an object in a building, the communication system comprising:

- an electronic device for emitting a wireless signal identifying the object;

- at least one electronic device for emitting a wireless signal identifying a location in the building;

- a server configured with a database for storing data about at least one detection of an object in a location of the building; and

- at least one computing device adapted to receive wireless signals from the electronic devices and to communicate with the server.

2. Communication system according to the preceding claim, wherein at least one computing device is a mobile device.

3. Communication system according to any of the preceding claims, wherein each of the at least one computing device is configured to:

- scan for at least one wireless signal emitted by an electronic device;

- if at least one wireless signal identifying a location in the building is detected, select one of the at least one identified location for representing the location in which the computing device is;

- if the wireless signal identifying the object is detected and a location is selected, communicate the detected object and the selected location to the server.

4. Communication system according to the preceding claim, wherein the step, configured in each of the at least one computing device, of selecting one of the at least one identified location for representing the location in which the computing device is comprises the steps:

- for each detected wireless signal identifying a location, obtain an estimate of the distance between the computing device and the electronic device that emitted the detected wireless signal;

- select the location identified by the detected wireless signal with the lowest estimated distance for representing the location in which the computing device is.

5. Communication system according to the preceding claim, wherein the step, configured in each of the at least one computing device, of selecting one of the at least one identified location for representing the location in which the computing device is further comprises the step:

- if a detected wireless signal identifying a location is estimated to have been emitted from a distance longer than a pre-configured maximum distance, ignore the detection of the wireless signal.

6. Communication system according to the preceding claim, wherein each computing device is configured with at least one maximum distance for ignoring the detection of a wireless signal based on the location which is identified by the wireless signal.

7. Communication system according to any of the claims 3 to 6, wherein each computing device is further configured with the step:

- if a detected wireless signal identifying an object was emitted from a distance longer than a pre-configured maximum distance, ignore the detection of the wireless signal.

8. Communication system according to claim 7, wherein each computing device is configured with at least one maximum distance for ignoring the detection of a wireless signal based on the object which is identified by the wireless signal.

9. Communication system according to claim 7, wherein each computing device is configured with at least one maximum distance for ignoring the detection of a wireless signal based on a pre-configured group of objects comprising the wireless signal which is identified by the wireless signal.

10. Communication system according to claim 7, wherein each computing device is configured with at least one maximum distance for ignoring the detection of a wireless signal based on the selected location.

11. A building comprising the communication system as claimed in any of the preceding claims.

12. Building according to claim 11, wherein each room in the building comprises at least one electronic device for emitting a wireless signal identifying the room.

13. Building according to any of the claims 11 to 12, wherein each floor in the building comprises at least one electronic device for emitting a wireless signal identifying the floor.

14. Building according to any of the claims 11 to 13, the building comprising at least one electronic device for emitting a wireless signal identifying the building.

15. A method of installing a communication system in accordance with any of the claims 1 to 10 in a building, the method comprising:

- for at least one location in the building, installing an electronic device to emit a wireless signal from the location, the wireless signal identifying the location; and

- for at least one object inside the building, installing an electronic device to emit a wireless signal from the object, the wireless signal identifying the object.

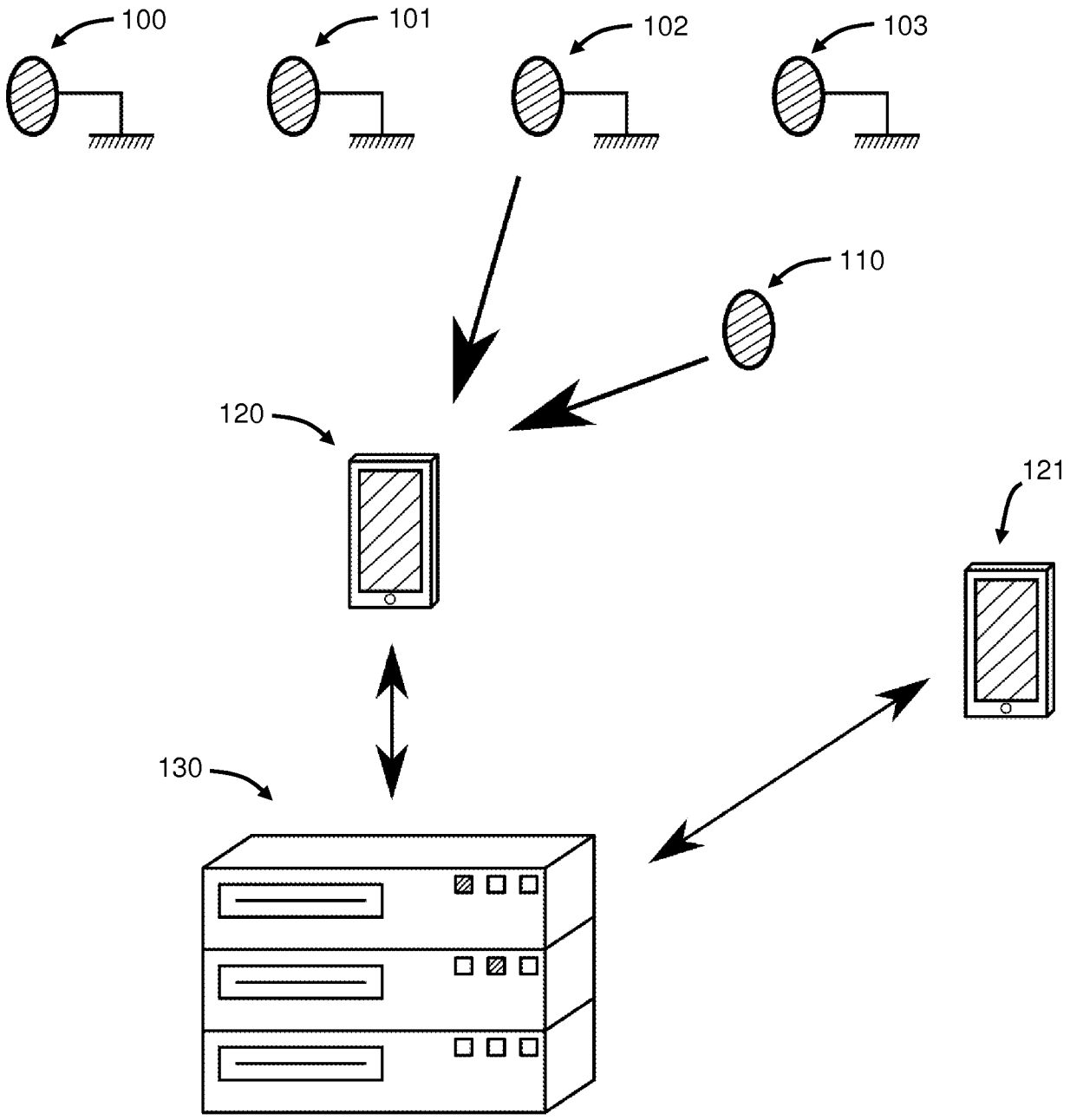


FIG. 1

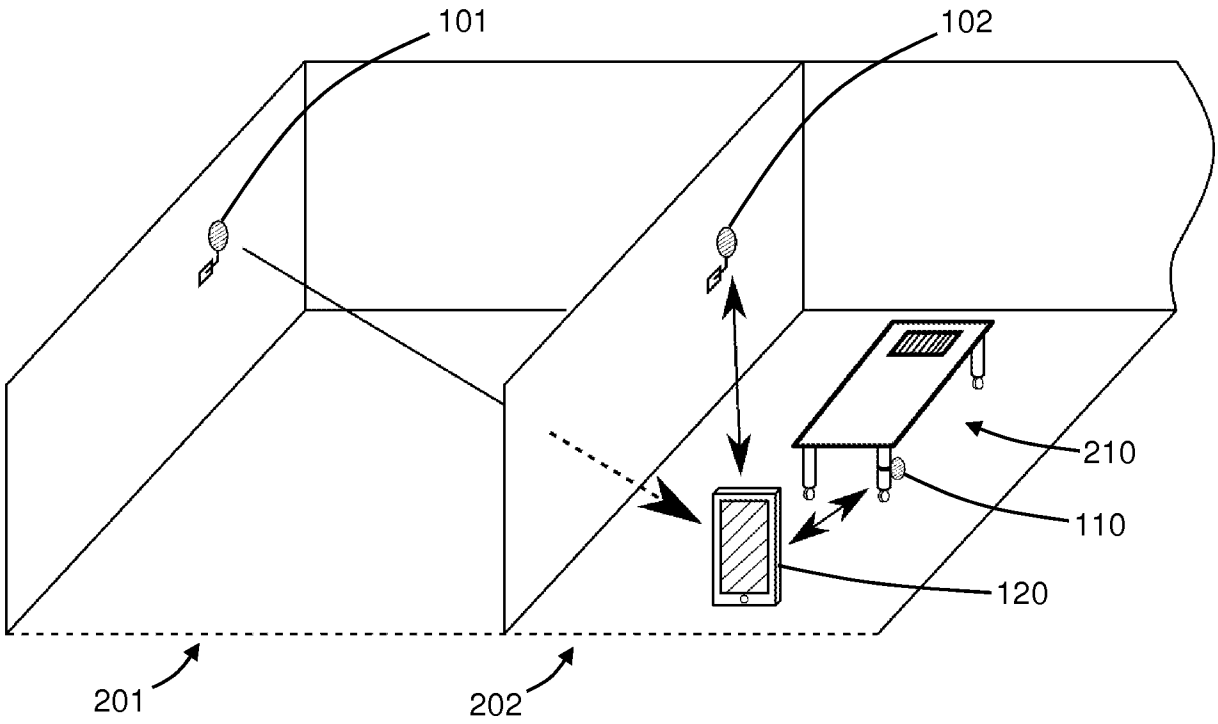


FIG. 2

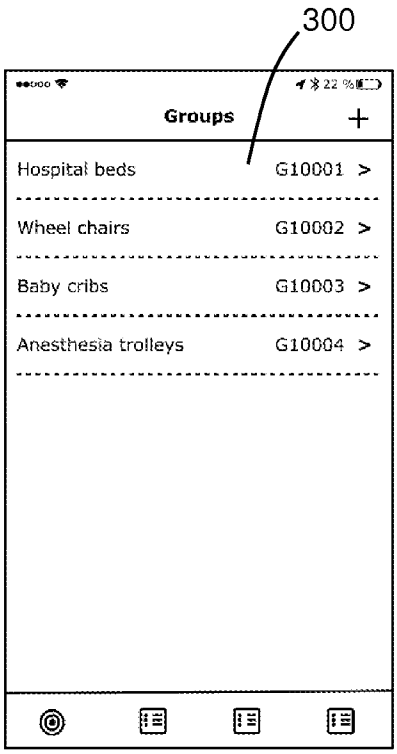


FIG. 3A

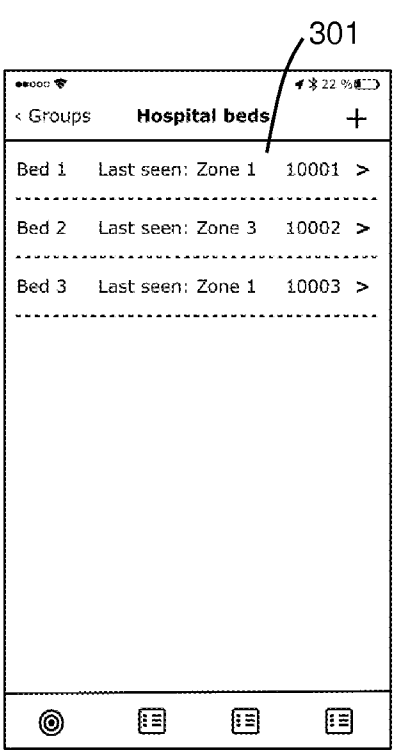


FIG. 3B

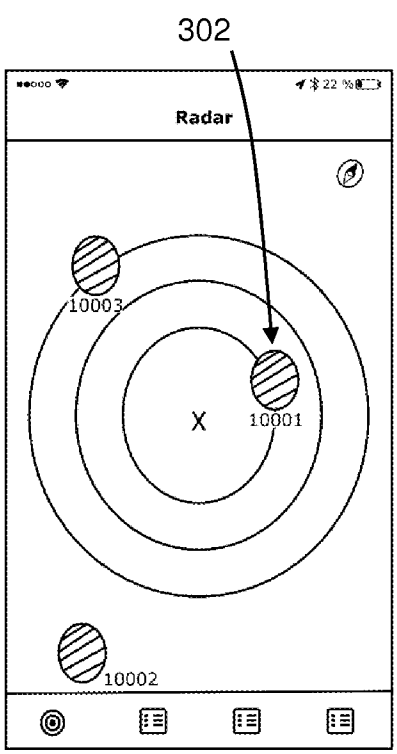


FIG. 3C

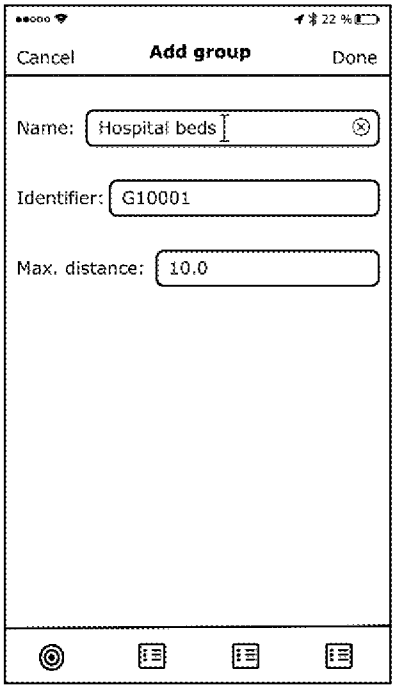

22 %
Cancel
Add group
Done
Name:
Hospital beds
Identifier:
G10001
Max. distance:
10.0

FIG. 4