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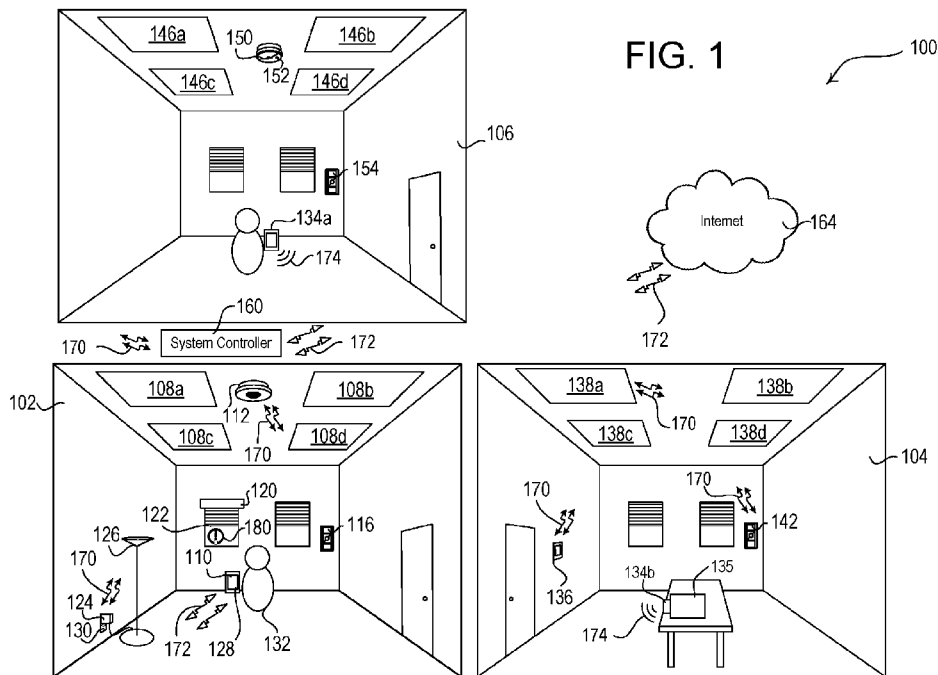
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(54) Title: REAL TIME LOCATING SYSTEM HAVING LIGHTING CONTROL DEVICES



(57) Abstract: A load control system for controlling a plurality of lighting loads located in a space may be configured to track the location of one or more tracked devices. The load control system may comprise a system controller, lighting control devices, e.g., for controlling a plurality of lighting loads, and tracked devices. The tracked devices may each transmit beacon messages. The lighting control devices may receive the beacon message. The lighting control devices may measure a communication quality metric of each of the beacon messages, and process the measured communication quality metrics received over a period of time to determine a processed communication quality metric for the tracked device. The lighting control devices may transmit tracking data to the system controller. The system controller may determine a location (e.g., an area location and/or a fixture location) of the tracked device.



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## REAL TIME LOCATING SYSTEM HAVING LIGHTING CONTROL DEVICES

### CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 63/121,537, filed December 4, 2021, the disclosure of which is incorporated herein by reference in its entirety.

### BACKGROUND

[0002] A user environment, such as a residence or an office building for example, may be configured using various types of load control systems. A lighting control system may be used to control the lighting loads in the user environment. A motorized window treatment control system may be used to control the natural light provided to the user environment. A heating, ventilation, and air conditioning (HVAC) system may be used to control the temperature in the user environment.

[0003] Each load control system may include various control devices, including control-source devices and control-target devices. The control-target devices may receive messages (*e.g.*, digital messages), which may include commands (*e.g.*, control instructions, such as load control instructions), for controlling an electrical load from one or more of the control-source devices. The control-target devices may be capable of controlling an electrical load. The control-source devices may be capable of controlling the electrical load via the control-target device. Examples of control-target devices may include lighting control devices (*e.g.*, a dimmer switch, an electronic switch, a ballast, or a light-emitting diode (LED) driver), a motorized window treatment, a temperature control device (*e.g.*, a thermostat), an AC plug-in load control device, and/or the like. Examples of control-source devices may include remote control devices, occupancy sensors, daylight sensors, temperature sensors, and/or the like.

**[0004]** Although control-source devices may be capable of controlling a control-target device, a control-source device may not be capable of controlling a control-target device, based on a user location and/or a mobile device. For example, a control-source device may not be capable of setting a control-target device to a lighting intensity, based on a user and/or mobile device located within the load control system. This may be desirable, for example, for users located in an office that may desire to have a lighting intensity, temperature level, and/or natural light provided at a predefined level.

## **SUMMARY**

**[0005]** A load control system for controlling a plurality of lighting loads located in a space may also be configured to track one or more tracked devices across the space. The load control system may include plurality of lighting control devices that are installed in the space, a system controller, and one or more tracked devices. Each of the lighting control devices may be configured to control a respective lighting load. For example, each of the lighting control devices may receive messages from the system controller for controlling the respective lighting load (*e.g.*, via a wireless communication network). Each of the lighting control devices may further be configured to receive beacon messages from a tracked device in the space. The tracked device may be configured to transmit the beacon messages at a given transmit power. Each of the beacon messages may include a beacon identifier of the tracked device. Each of the lighting control devices may be configured to generate tracking data for the tracked device, and transmit the tracking data for the tracked device to the system controller, which may use the tracking data to determine a location for the tracked device in the space. For example, the tracking data may include a beacon identifier of the tracked device and a processed communication quality metric associated with the tracked device.

**[0006]** The system controller may be configured to receive the tracking data for the tracked device from the lighting control devices. The system controller may be configured to determine a location for the tracked device, for example, based on the processed communication quality metric comprised within each of the received tracking data. For example, the determined location of the tracked device may include one of an area location of the tracked device in the space or a fixture location of the tracked device in the space.

**[0007]** In order to determine the location of the tracked device, the system controller may be further configured to identify, based on the tracking data, two lighting control devices of the plurality of lighting control devices that are closest to the tracked device. The two lighting control devices that are closest to the tracked device may include a first lighting control device and a second lighting control device. The system controller may further be configured to determine a distance between the tracked device and each of the first lighting control device and the second lighting control device, where the first lighting control device is closer to the tracked device than the second lighting control device. The system controller may identify the two lighting control devices of the plurality of lighting control devices that are closest to the tracked device by generating a path loss table for the tracked device. For example, the path loss table may include path loss values associated with each of the one more of the lighting control devices from which tracking data is received. Each of the path loss values in the path loss table may be based on the processed communication quality metric comprised within each of the received tracking data and the transmit power of the tracked device.

**[0008]** The system controller may further be configured to determine a gap between the distance between the tracked device and the first lighting control device and the distance between the tracked device and the second lighting control device. The system controller may be configured to determine whether the gap is greater than a threshold. If the gap is greater than the threshold, the system controller may be configured to retrieve an area of the first lighting control device, and the area location of the tracked device may be determined to be the retrieved area of the first lighting control device. In addition, the system controller may be further configured to retrieve a fixture location of the first lighting control device, and the fixture location of the tracked device is determined to be the retrieved fixture location of the first lighting control device.

**[0009]** If, however, the gap is not greater than the threshold, the system controller may be configured to retrieve areas associated with each of the lighting control devices from which tracking data for the tracked device is received. In addition, the system controller may be configured to determine a distance between the tracked device and each of the retrieved areas. Based on the distance between the tracked device and each of the retrieved areas, the system controller may determine an area that is closest to the tracked device, an area location of the tracked device may be

determined to be the area that is closest to the tracked device. The system controller may be further configured to identify one or more fixture pairs from the each of the lighting control devices from which tracking data for the tracked device is received. For example, each of the one or more fixture pairs may comprise adjacent lighting fixtures. The system controller may then identify a fixture pair of the one or more fixture pairs that is closest to the tracked device, and retrieve a fixture location of the identified fixture pair. For example, the fixture location of the tracked device may be determined to be the retrieved fixture location of the identified fixture pair.

**[0010]** The load control system may further include a network device. The system controller may be configured to transmit the determined location of the tracked device to the network device. The network device (*e.g.*, and/or the system controller) may be configured to retrieve a floorplan for the load control system and/or the space. For example, the floorplan may include coordinates for each of the lighting control devices installed in the space. The network device may be further configured to determine, based on the determined location for the tracked device, coordinates for the tracked device. The network device may further be configured to display a representation of the floorplan for the load control system. For example, the representation may comprise indications of the determined coordinates for the tracked device.

## **BRIEF DESCRIPTION OF THE DRAWINGS**

**[0011]** FIG. 1 is a diagram a depicting perspective view of an example environment for having lighting control devices.

**[0012]** FIG. 2 is top view of an example space.

**[0013]** FIG. 3 is flowchart of an example procedure for receiving beacon messages from one or more tracked devices.

**[0014]** FIG. 4 is a flowchart of an example procedure for transmitting tracking regarding the location of one or more tracked devices in a space.

**[0015]** FIG. 5 is a flowchart of an example procedure for determining locations of one or more tracked devices in a space.

[0016] FIG. 6 is a flowchart of an example procedure for determining locations of one or more tracked devices in a space.

[0017] FIG. 7 is a flowchart of another example procedure for determining locations of one or more tracked devices in a space.

[0018] FIG. 8 is a flowchart of an example procedure for reporting locations of one or more tracked devices in a space.

[0019] FIG. 9 is a flowchart of an example procedure for displaying locations of one or more tracked devices in a space.

[0020] FIG. 10 is a block diagram illustrating an example mobile device.

[0021] FIG. 11 is a block diagram illustrating an example system controller.

[0022] FIG. 12 is a block diagram illustrating an example control-target device.

[0023] FIG. 13 is a block diagram illustrating an example control-source device.

[0024] FIG. 14 is a block diagram illustrating an example tracked device.

## **DETAILED DESCRIPTION**

[0025] FIG. 1 depicts a representative load control environment 100 (*e.g.*, a load control area) comprising a load control system. The load control system may be commissioned for enabling control of electrical devices in the load control system. The commissioning of the load control system may include associating control devices, which may include control-source devices and/or control-target devices. As shown in FIG. 1, rooms 102, 104, and 106 in a building may be installed with one or more control-target devices, *e.g.*, load control devices for controlling the electrical loads within a room or building. Each load control device may be capable of directly controlling the amount of power provided to an electrical load and may be controlled by a control-source device. Example control-target devices may include lighting fixtures 108a, 108b, 108c, 108d in room 102; lighting fixtures 138a, 138b, 138c, 138d in room 104; and lighting fixtures 146a, 146b, 146c, 146d in room 106. Each lighting fixture may include a lighting load (*e.g.*, an LED light source) and a

respective lighting control device for controlling the respective lighting load of the lighting fixture. For example, the lighting control device of each of the lighting fixtures may comprise a load regulation device (*e.g.*, an LED driver, a ballast, a dimming module, or a switching module), a fixture controller that may interface with a separate load regulation device, and/or other lighting control device.). Other example control-target devices may include a motorized window treatment 120 having a motor drive unit (*e.g.*, including a motor) for controlling the position of covering material 122, a temperature control device (*e.g.*, thermostat 136) for controlling an HVAC system, and/or an AC plug-in load control device 124 for controlling a plug-in electrical load, such as a floor lamp 126, a table lamp or another electrical device that is plugged in to the AC plug-in load control device 124. The AC plug-in load control device 120 may be plugged into an electrical receptacle 130.

**[0026]** Control devices (*e.g.*, a control-source device and/or a control-target device) may communicate with each other and/or other devices via a wired and/or a wireless communication link. For example, the control devices may communicate on a first wireless communication link (*e.g.*, a first wireless network communication link) via radio frequency (RF) signals 170. The RF signal 170 may be transmitted via any known RF communication protocol (*e.g.*, a first wireless network communication protocol). For example, the first wireless network communication protocol may comprise a standard communication protocol (*e.g.*, the BLUETOOTH, BLUETOOTH LOW ENERGY (BLE), WI-FI, THREAD, and/or ZIGBEE protocols) and/or a proprietary communication protocol, such as the CLEAR CONNECT protocol (*e.g.*, the CLEAR CONNECT A and/or CLEAR CONNECT X protocols). A control device may be both a control-target and a control-source device. As described herein, the control devices of the load control environment 100 may use the RF signals 170 to communication with each other, for example, to enable control of the respective control devices in the load control environment 100.

**[0027]** A control-source device may be an input device that indirectly controls the amount of power provided to an electrical load by transmitting messages (*e.g.*, digital messages) to the control-target device. The messages may include commands (*e.g.*, control instructions, such as load control instructions) or another indication that causes the control-target device to determine commands for controlling an electrical load. Example control-source devices may include a remote control devices



116, 142, and 154, an occupancy sensor 112, a daylight sensor 150, a window sensor 180, and/or a network device 128. The control-source devices may include a wired or wireless device. The control-source devices may include a control device, such as a dimmer switch, an electronic switch, or the like. The first wireless network communication link may allow for communication of the commands (*e.g.*, load control instructions) via the RF signals 170.

**[0028]** The load control system 100 may be commissioned to enable control of electrical loads based on commands communicated between control devices (*e.g.*, control-source devices and control-target devices) configured to control the electrical loads. For example, control devices may be associated with one another and association information may be stored thereon, or at other devices, which may be used to communicate and identify digital commands at associated devices for controlling electrical devices in the system. The association information may include a device identifier (*e.g.*, a unique device identifier) of one or more of the associated devices. The association information may be stored at the control devices, or at other devices that may be implemented to enable communication and/or identification of digital commands between the control devices.

**[0029]** The remote control devices 116, 142, and 154 may be wireless devices capable of controlling a control-target device via wireless communications. The remote control devices 116, 142, and 154 may be attached to the wall or detached from the wall. Examples of remote control devices are described in greater detail in U.S. Patent No. 5,248,919, issued September 28, 1993, entitled LIGHTING CONTROL DEVICE; U.S. Patent No. 8,471,779, issued June 25, 2013, entitled WIRELESS BATTERY POWERED REMOTE CONTROL WITH LABEL SERVING AS ANTENNA ELEMENT; and U.S. Patent Application Publication No. 2014/0132475, published May 15, 2014, entitled WIRELESS LOAD CONTROL DEVICE, the entire disclosures of which are hereby incorporated by reference.

**[0030]** The occupancy sensor 112 may be configured to detect occupancy and/or vacancy conditions in the load control environment 100 in which the load control system is installed. The occupancy sensor 112 may transmit messages to control-target devices via the RF signals 170 in response to detecting the occupancy or vacancy conditions. The occupancy sensor 112 may operate as a vacancy sensor, such that messages are transmitted in response to detecting a vacancy condition (*e.g.*, messages may not be transmitted in response to detecting an occupancy condition). Examples

of RF load control systems having occupancy and/or vacancy sensors are described in greater detail in U.S. Patent No. 8,009,042, issued August 30, 2011, entitled RADIO-FREQUENCY LIGHTING CONTROL SYSTEM WITH OCCUPANCY SENSING; U.S. Patent No. 8,199,010, issued June 12, 2012, entitled METHOD AND APPARATUS FOR CONFIGURING A WIRELESS SENSOR; and U.S. Patent No. 8,228,184, issued July 24, 2012, entitled BATTERY-POWERED OCCUPANCY SENSOR, the entire disclosures of which are hereby incorporated by reference.

**[0031]** The daylight sensor 150 may be configured to measure a total light intensity in the visible area of the load control environment 100 in which the load control system is installed. The daylight sensor 150 may transmit messages including the measured light intensity via the RF signals 170 for controlling control-target devices in response to the measured light intensity. The daylight sensor 150 may enter an association mode and may transmit association messages via the RF signals 170 in response to actuation of a button 152 on the daylight sensor 150. Examples of RF load control systems having daylight sensors are described in greater detail in U.S. Patent No. 8,410,706, issued April 2, 2013, entitled METHOD OF CALIBRATING A DAYLIGHT SENSOR; and U.S. Patent No. 8,451,116, issued May 28, 2013, entitled WIRELESS BATTERY-POWERED DAYLIGHT SENSOR, the entire disclosures of which are hereby incorporated by reference.

**[0032]** The window sensor 180 may be configured to measure an exterior light intensity coming from outside the load control environment 100 in which the load control system is installed. The window sensor 180 may be mounted on a façade of a building, such as the exterior or interior of a window, to measure the exterior natural light intensity depending upon the location of the sun in the sky. The window sensor 180 may detect when direct sunlight is directly shining into the window sensor 180, is reflected onto the window sensor 180, or is blocked by external means, such as clouds or a building, and may send messages indicating the measured light intensity. The window sensor 180 may transmit messages including the measured light intensity via the RF signals 170. The messages may be used to control an electrical load via one or more control-target devices. The window sensor 180 may enter an association mode and may transmit association messages via the RF signals 170 in response to actuation of a button on the window sensor 180.

**[0033]** The load control system of the load control environment 100 may include other types of control-source devices, such as, for example, temperature sensors, humidity sensors, radiometers,

cloudy-day sensors, shadow sensors, pressure sensors, smoke detectors, carbon monoxide detectors, air-quality sensors, motion sensors, security sensors, proximity sensors, fixture sensors, partition sensors, keypads, multi-zone control units, slider control units, kinetic or solar-powered remote controls, key fobs, cell phones, smart phones, tablets, personal digital assistants, personal computers, laptops, timeclocks, audio-visual controls, safety devices, power monitoring devices (*e.g.*, power meters, energy meters, utility submeters, utility rate meters, *etc.*), central control transmitters, residential controllers, commercial controllers, industrial controllers, or any combination of control-source devices.

**[0034]** The load control system of the load control environment 100 may include a system controller 160 operable to transmit and/or receive messages via wired and/or wireless communications. For example, the system controller 160 may be configured to transmit and/or receive the RF signals 170 via the first wireless network communication link to communicate with one or more control devices (*e.g.*, control-source devices and/or control-target devices). The system controller 160 may communicate messages between associated control devices, for example. The system controller 160 may be also coupled to one or more wired control devices (*e.g.*, control-source devices and/or control-target devices) via a wired digital communication link. The system controller 160 may be on-site at the load control environment 100 or at a remote location. Though the system controller 160 is shown as a single device, the load control system of the load control environment 100 may include multiple system controllers and/or the functionality thereof may be distributed across multiple devices.

**[0035]** The system controller 160 may also be configured to communicate via a second wireless network communication link using RF signals 172. The RF signals 172 may be transmitted via any known RF communication protocol (*e.g.*, WI-FI protocol and/or another Internet-protocol-based protocol). For example, the second wireless network communication link may allow for high bandwidth communication. The system controller 160 may communicate over the Internet 164 and/or another network (*e.g.*, a local area network) using the RF signals 172. The RF signals 172 may be transmitted using a different protocol and/or wireless band than the RF signals 170. In addition, the RF signals 172 may be transmitted using the same protocol and/or wireless band as the RF signals 170.

**[0036]** The system controller 160 may be configured to transmit and receive messages between control devices. For example, the system controller 160 may transmit messages to the control-target devices in response to the messages received from the control-source devices. The messages may include association information for being stored at the control devices or commands (*e.g.*, control instructions) for controlling an electrical load. The commands may be used to control the electrical load of a control-target device or to control the electrical load according to control configuration information. The system controller 160 may receive commands from a control-source device and may perform a lookup of the control-target devices associated with the control-source device. The system controller 160 may send messages that include commands to the associated control-target devices for controlling electrical loads. The system controller 160 may store the association information from association messages communicated between control devices, or may query control devices for association information stored thereon.

**[0037]** Once a control-source device is associated with a control-target device, the control-source device may send messages to the control-target device to cause the control-target device to control an amount of power provided to an electric load. For example, the associated remote control device 116 may instruct the lighting control devices of the lighting fixtures 108a, 108b, 108c, 108d to increase or decrease the lighting level of the respective lighting loads, instruct the motorized window treatment 120 to raise or lower the covering material 122, instruct the AC plug-in load control device 124 to raise or lower the lighting level of the floor lamp 126, and/or instruct the temperature control device 136 to raise or lower the temperature in one or more rooms. The associated occupancy sensor 112 may send similar commands to a control-target device based on the detection of an occupancy or vacancy condition within the room 102. The daylight sensor 150 may send similar messages to a control-target device based on the detection of an amount of natural light within the room 106.

**[0038]** The lighting control devices in each of the lighting fixtures of the load control environment 100 (*e.g.*, lighting fixtures 108a, 108b, 108c, 108d in room 102; lighting fixtures 138a, 138b, 138c, 138d in room 104; and lighting fixtures 146a, 146b, 146c, 146d in room 106) may be configured to communicate messages using the RF signals 170. In certain scenarios, the lighting control device in each of the lighting fixtures may be a load regulation device including the

communication circuit that is configured to transmit and/or receive messages for controlling the lighting load of the lighting fixture via the RF signals 170. Also, or alternatively, the lighting control device in each of the lighting fixtures may be a fixture controller (*e.g.*, a separate communication device) that may include the communication circuit that is configured to transmit and/or receive messages for controlling the lighting load of the lighting fixture via RF signals 170, and may be configured to control a load regulation device (*e.g.*, a separate load regulation device) in the lighting fixture to control the lighting load. The lighting control devices in the lighting fixtures may communicate with and/or be responsive to commands (*e.g.*, control instructions included in the messages transmitted using RF signals 170) received from an associated control-source device.

**[0039]** The system controller 160 may include control configuration information according to which one or more control-target devices may be controlled. For example, control configuration information may include preset configurations. The system controller 160 may generate messages according to the preset configurations to set a dimming level of the lighting fixtures to a predefined level, to set a level of the covering material 122 to a predefined level, to set a dimming level of the floor lamp 126 to a predefined level, or to set a temperature of the temperature control device 136 to a predefined level. Different presets may be configured to control different control-target devices to control a corresponding electrical load differently. Example preset configurations may include bedtime preset for when a user is going to bed, a movie watching preset for when the user is watching television or a movie, an away preset for when a user is away from the building, a home preset for when the user is in the building, or other preset configurations a user may define for an occasion.

**[0040]** The control configuration information may include zone configurations. The zone configurations may define one or more zones in which control-target devices are defined for being controlled. The zones may be a group of control devices for being associated that have a group identifier. The control-target devices in different zones may be separately controlled by sending messages having commands for controlling each zone. Different zones may be identified by a zone identifier (*e.g.*, group identifier) that may be stored at the system controller 160 and/or the control devices in the zone. Each zone may be defined as a location having a zone identifier that is a

location identifier. Though the zone may be described herein as a location having a location identifier, other zone configurations may be similarly implemented as described herein for locations.

**[0041]** The load control system of the load control environment 100 may include a network device, such as the mobile device 128. The mobile device 128 may perform wired and/or wireless communications. Examples of the mobile device 128 may comprise a mobile device, *e.g.*, a wireless phone, a tablet, a laptop, a personal digital assistant (PDA), a wearable device (*e.g.*, a watch, glasses, *etc.*), or another computing device. In addition, the mobile device 128 may comprise a personal computer (PC), a server, and/or another computing device connected to the Internet 164. The mobile device 128 may be a user device operated by a user 132. The mobile device 128 may communicate wirelessly by sending messages on the second wireless network communication link via the RF signals 172 (*e.g.*, via the Internet and/or a local area network). The mobile device 128 may communicate by transmitting messages (*e.g.*, in one or more Internet protocol packets) over the Internet 164 and/or another network (*e.g.*, a local area network) using the RF signals 172. The mobile device 128 may communicate messages in response to a user actuation of one or more buttons on the mobile device 128. Examples of load control systems having control devices configured to transmit message via the Internet, such as smart phones and tablet devices, are described in greater detail in U.S. Patent Application Publication No. 2013/0030589, published January 31, 2013, entitled LOAD CONTROL DEVICE HAVING INTERNET CONNECTIVITY; and U.S. Patent No. 9,413,171, issued August 9, 2016, entitled NETWORK ACCESS COORDINATION OF LOAD CONTROL DEVICES, the entire disclosures of which are incorporated herein by reference.

**[0042]** Although not shown in FIG. 1, the load control environment 100 may also include a network device, such as a remote computing device. For example, the remote computing device may access the remote control load control environment 100 via the Internet 164 and RF signals 172. For example, the system controller 160 may communication with remote computing device using the Internet 164 and RF signals 172.

**[0043]** The mobile device 128 may communicate with the system controller 160 using messages transmitted on the second wireless network communication link via RF signals 172 to allow the mobile device 128 to associate control devices (*e.g.*, control-source devices and/or control-

target devices) and/or control electrical loads. When the RF signals 170 and the RF signals 172 are communicated using the same communication protocol, the mobile device 128 may operate as the system controller 160, as described herein.

**[0044]** The mobile device 128 may execute a control/configuration application for displaying information received from the system controller 160 and/or receiving user input for communicating information to the system controller 160. For example, the control/configuration application may be executed locally at the mobile device 128. Also, or alternatively, the control/configuration application or portions thereof may be executed by a network device external to the load control environment 100 (*e.g.*, connected to the Internet), and the mobile device 128 may access the control/configuration application using the RF signals 172. The mobile device 128 may comprise a visual display 110 for displaying information for the user 132 and may be configured to receive user inputs from the user 132. The system controller 160 may be accessed from the mobile device 128 via a web interface (*e.g.*, a web browser) and/or via the control/configuration application (*e.g.*, a load control application and/or configuration application) at the mobile device 128, for example. The user 132 may, using the control/configuration application, generate and store association information on the mobile device 128 for associating control-source devices and control-target devices.

**[0045]** The mobile device 128 may, using the control/configuration application, store configuration data for the load control environment 100 and/or the respective rooms 102, 104, 106. For example, using the mobile device 128, the user 132 may generate and/or store association information for associating control-source devices (*e.g.*, the remote control devices 116, 142, 154) and control-target devices (*e.g.*, the lighting fixtures 108a-d, 138a-d, 146a-d, and their respective lighting control devices). For example, the user 132 (*e.g.*, via the mobile device 128) may use the control/configuration application to generate and/or store association information for associating control-source devices using the control/configuration application executed at the mobile device 128. The user 132 (*e.g.*, via the mobile device 128) may also, or alternatively, use the control/configuration application for controlling the control devices in the load control environment 100.

**[0046]** The control/configuration application may be configured to display a graphical user interface (GUI) on the visual display 110 of the mobile device 128. The graphical user interface may

include one or more representations (*e.g.*, a floorplan) of the load control environment 100 and/or a respective room within the load control environment 100 (*e.g.*, one or more of the rooms 102, 104, and 106). These representations may also indicate or illustrate the control devices (*e.g.*, the lighting control devices of the lighting fixtures 108a-d, 138a-d, 146a-d) within the load control environment 100 and/or respective room. In addition, the user 132 (*e.g.*, via the mobile device 128) may define area data associated with each of the control devices (*e.g.*, a location of a respective control device within the load control environment 100). For example, each of the control devices in the load control system of the load control environment 100 may be assigned or associated with area data using the control/configuration application. For example, the area data for lighting fixtures 108a-d may indicate that they are located in room 102 and/or their respective positions (*e.g.*, represented by x-y coordinates) within the room 102. Similarly, the area data for lighting fixtures 1038a-d may indicate that they are located in room 104, and the area data for lighting fixtures 1046a-d may indicate that they are located in room 106.

**[0047]** The association information may be stored in the form of a table or database that associates a unique device identifier (*e.g.*, serial number) of a control-target device with a location and/or a unique device identifier (*e.g.*, serial number) of one or more control-source devices. The association information may include a device type identifier that indicates a device type of the control-target device (*e.g.*, lighting control device, motorized window treatment, plug-in load control device, temperature control device, *etc.*) and/or a device type of the control-source devices (*e.g.*, remote control device, occupancy sensor, daylight sensor, window sensor, *etc.*). The association information may be sent from the mobile device 128 to the system controller 160. The system controller 160 may store the association information. The system controller 160 may identify the association information corresponding to each control-target device by identifying the device identifier of the control-target device and the corresponding associated devices (*e.g.*, device identifiers of the control-source devices) to transmit the association information to each control-target device for storage thereon. The system controller 160 may identify other information, such as control configuration information, corresponding to each control-target device and may transmit the information to each control-target device for storage thereon, such that the control-target devices may respond according to the information.



**[0048]** The control devices may be associated with a location for enabling control of electrical loads in the location. The control devices may also be associated with other control devices in the location for enabling the control of the electrical loads. For example, a control device may be associated with a location by storing a location identifier at the control device, such that the control device may detect messages sent to control devices in the identified location. The control device (*e.g.*, control-target device) may be associated with other control devices (*e.g.*, control-source devices) by storing an identifier of the control devices, such that the control device (*e.g.*, control-target device) may detect messages sent from associated control devices (*e.g.*, control-source devices) for controlling an electrical load. When a control-target device is associated with a control-source device, the control-target device may be responsive to the control-source device.

**[0049]** The load control environment 100 may include one or more tracked devices, such as tracked devices 134a, 134b. A tracked device may include any device for which the location of the respective tracked device may be tracked through the load control environment 100. For example, the tracked device 134a may be a mobile device (*e.g.*, a wireless phone, a tablet, a laptop, a personal digital assistant (PDA), and/or a wearable device) used by a user 133. In some embodiments, the mobile device 128 may be the tracked device 134a. The tracked device 134b may be a battery powered communication device (*e.g.*, a tag), which may be attached to an object 135 (*e.g.*, another device or item, such as a piece of inventory, merchandise, test equipment, *etc.*) that is to be tracked across the load control environment 100. Also, or alternatively, the tracked devices 134a, 134b may be another control device within the load control environment that can perform wireless communications, such as the remote control devices 116, 142, and 154, and/or the mobile device 128. As further described herein, each of the tracked devices 134a, 134b may be configured to transmit beacon messages via a short-range wireless communication link. For example, the tracked devices may transmit the beacon messages via RF signals 174. The RF signals 174 may be transmitted via any known RF communication protocol (*e.g.*, a short-range wireless communication protocol, such as the BLUETOOTH LOW ENERGY (BLE) protocol). The beacon messages respectively transmitted by the tracked devices 134a, 134b may be used to determine the location of that tracked device in the load control environment 100. For example, the beacon messages transmitted by tracked device 134a may be used to determine that tracked device 134a is located in room 102. Similarly, the beacon messages transmitted by tracked device 134b may be used to

determine that tracked device 134b is located in room 104. In addition, the remote control devices 116, 142, and 154, and/or the mobile device 128 may be configured to transmit the beacon message on the short-range wireless communication link via the RF signals 174.

**[0050]** The lighting control devices in the lighting fixtures 108a-d, 138a-d, and 146a-d may also be configured to communicate via the short-range wireless communication link. For example, the lighting control devices in the lighting fixtures 108a-d, 138a-d, 146a-d may use a short-range wireless communication link to periodically receive the beacon messages transmitted by the tracked devices 134a, 134b (*e.g.*, via the RF signals 174). As further described herein, the lighting control devices in the lighting fixtures in the load control environment 100 may be configured to process the beacon messages received from a respective tracked devices to determine tracking data associated with that tracked device. As illustrated in FIG. 1, the load control environment 100 may include numerous lighting fixtures. Further, these lighting fixtures may be spread (*e.g.*, densely distributed) across the load control environment 100. Accordingly, the beacon messages transmitted by the tracked device 134a, 134b may be received by many of the lighting control devices in these lighting fixtures as the tracked devices 134a, 134b moves throughout the load control environment 100, which may lead to the accumulation of a large amount of tracking data associated with the tracked device. The increased number of lighting control devices in the lighting fixtures in the load control environment 100 may increase the accuracy of the tracking data.

**[0051]** The lighting control devices in the lighting fixtures may also be configured to transmit the tracking data to the system controller 160 (*e.g.*, or the mobile device 128 and/or other computing device, as described herein), which may further process the tracking data to identify a location of the tracked device 134a, 134b within the load control environment 100. For example, the lighting control devices in the lighting fixtures may transmit the tracking data to the system controller 160 via the RF signals 172. The lighting control devices in the lighting fixture may process the tracking data before transmitting processed tracking data to the system controller 160 to try to reduce the number of messages required to transmit the processed tracking data via the RF signals 172. The system controller 160 may process the tracking data to identify a location of the respective device. For example the system controller 160 may process the tracking data to identify an area location of a respective tracked device (*e.g.*, a room, or an area within the room, in which the

tracked device is located) or a fixture location of the respective tracked device (*e.g.*, a lighting fixture(s) that is closest to the tracked device). Further, the location (*e.g.*, area location and/or fixture location) of the respective tracked device may be displayed (*e.g.*, displayed on the floorplan that represents the load control environment 100) on the mobile device 128 and/or another computing device.

**[0052]** FIG. 2 is a top view of an example space 200 (*e.g.*, a room) in a building (*e.g.*, a load control environment) in which a load control system (*e.g.*, the load control system of the load control environment 100 shown in FIG. 1) is installed. The space 200 may comprise a plurality of lighting fixtures F<sub>1</sub>-F<sub>24</sub>. As described herein, each of the lighting fixtures F<sub>1</sub>-F<sub>24</sub> may comprise a lighting load (*e.g.*, such as a light-emitting diode (LED) light source) and a lighting control device for controlling the respective lighting load to control an intensity level and/or a color (*e.g.*, color temperature) of the light emitted by the respective lighting fixture. The space 200 may be divided up into multiple areas 202-208. Each of the areas 202-208 may comprise one or more of the fixtures F<sub>1</sub>-F<sub>24</sub>. For example, the areas 202-208 may correspond to rooms within the load control system (*e.g.*, the rooms 102, 104, 106 of the load control environment 100 shown in FIG. 1).

**[0053]** The lighting control device in each of the lighting fixtures F<sub>1</sub>-F<sub>24</sub> may be configured to transmit and/or receive wireless signals (*e.g.*, RF signals). The lighting control device in each of the lighting fixtures F<sub>1</sub>-F<sub>24</sub> may be configured to communicate messages via the RF signals via a first wireless communication link (*e.g.*, a wireless network communication link) using a first wireless communication protocol (*e.g.*, a wireless network communication protocol, such as the CLEAR CONNECT or THREAD protocols). The lighting control device in each of the lighting fixtures F<sub>1</sub>-F<sub>24</sub> may also be configured to communicate messages via the RF signals via a second wireless communication link (*e.g.*, a short-range wireless communication link) using a second wireless communication protocol (*e.g.*, a short-range wireless communication protocol, such as the BLUETOOTH LOW ENERGY (BLE) protocol). For example, the lighting control device in each of the lighting fixtures F<sub>1</sub>-F<sub>24</sub> may be configured to receive messages including commands for controlling the respective lighting load via the wireless network communication link and/or receive messages including configuration information via the short-range wireless communication link. In addition, the lighting control device in each of the lighting fixtures F<sub>1</sub>-F<sub>24</sub> may be configured to

periodically transmit and/or receive beacon messages via the short-range wireless communication link.

**[0054]** The space 200 may also comprise a system controller 210 (*e.g.*, the system controller 160 of the load control system of the load control environment 100 shown in FIG. 1). The system controller 210 may be configured to transmit messages including commands to the lighting control devices in the lighting fixtures F<sub>1</sub>-F<sub>24</sub> via the short-range communication link. The system controller 210 may store area data including area identifiers (*e.g.*, that indicate each area 202-208) along with device identifiers (*e.g.*, unique device identifiers) of the lighting fixtures F<sub>1</sub>-F<sub>24</sub> in each area. As described herein, the area data for each of the respective lighting fixtures F<sub>1</sub>-F<sub>24</sub> may be configured and/or defined using a control/configuration application executed at a network device (*e.g.*, the mobile device 128 of the load control environment 100 shown in FIG. 1). The system controller 210 may be configured to control the lighting fixtures F<sub>1</sub>-F<sub>24</sub> in one of the areas 202-208 as a group.

**[0055]** The space 200 may also comprise one or more tracked devices T<sub>1</sub>-T<sub>4</sub>. Each of the tracked devices T<sub>1</sub>-T<sub>4</sub> may be configured to transmit beacon messages via the short-range wireless communication link. The beacon messages transmitted by one of the tracked devices T<sub>1</sub>-T<sub>4</sub> may be used to determine the location of the tracked device in the space 200 and/or the building in which the space is located. The beacon messages may each include a beacon identifier (*e.g.*, a unique beacon identifier) of the tracked device T<sub>1</sub>-T<sub>4</sub> that transmitted the beacon message. For example, the beacon messages may be transmitted using the BLE protocol. Each time that one of the tracked devices T<sub>1</sub>-T<sub>4</sub> transmits a beacon message, the tracked device T<sub>1</sub>-T<sub>4</sub> may transmit the beacon message on three different communication channels (*e.g.*, at three different frequencies). For example, each of the tracked devices T<sub>1</sub>-T<sub>4</sub> may comprise a mobile device, such as a smart phone or a tablet. In addition, each of the tracked devices T<sub>1</sub>-T<sub>4</sub> may comprise a tag that may be configured to transmit beacon messages.

**[0056]** The lighting control devices in the lighting fixtures F<sub>1</sub>-F<sub>24</sub> may be configured to receive the beacon messages transmitted by the tracked devices T<sub>1</sub>-T<sub>4</sub> via the short-range wireless communication link. The lighting control device in each lighting fixture F<sub>1</sub>-F<sub>24</sub> may be configured to receive the beacon message on each of the three different communication channels that the beacon

message is transmitted on. The lighting control device in each lighting fixture F<sub>1</sub>-F<sub>24</sub> may be configured to determine a communication quality metric of each of the received beacon message on each of the different communication channels. For example, the communication quality metric may comprise a received signal strength magnitude of the received beacon message on one of the communication channels, *e.g.*, such as a received signal strength indicator (RSSI). The lighting control device in each lighting fixture F<sub>1</sub>-F<sub>24</sub> may be configured to store the received signal strength magnitude of each of the beacon messages received on the different communication channels.

**[0057]** The lighting control device in each lighting fixture F<sub>1</sub>-F<sub>24</sub> may be configured to transmit tracking data regarding the received beacon messages to the system controller 210. For example, the lighting control device may be configured to transmit the beacon identifier included in a received beacon message as well as the communication quality metric (*e.g.*, received signal strength magnitude) of the received beacon message to the system controller 210. However, a space, such as the space 200, may include numerous lighting fixtures (*e.g.*, the lighting fixture F<sub>1</sub>-F<sub>24</sub>). If, for example, each lighting control device transmits tracking data in response to every beacon message that the lighting control device receives, the network over which the tracking data is transmitted (*e.g.*, the first wireless network communication link via the RF signals 170) may be overloaded, which may cause the receipt of messages transited over that network to be delayed and/or fail. Message delays and/or failures may similarly increase as the number of tracked devices (*e.g.*, and/or the number of beacon messages transmitted by each of the tracked devices) in a space increases.

**[0058]** The system controller 210 may be configured to process the tracking data received from the lighting control devices in the lighting fixtures F<sub>1</sub>-F<sub>24</sub> in the space 200 to determine the locations of one or more of the tracked devices T<sub>1</sub>-T<sub>4</sub>. The system controller 210 may be configured to use the area data regarding the areas 202-208 in which the various lighting fixtures F<sub>1</sub>-F<sub>24</sub> are located to determine the locations of the tracked devices T<sub>1</sub>-T<sub>4</sub> in the space 200. The system controller 210 may be configured to determine an area location of one of the tracked devices T<sub>1</sub>-T<sub>4</sub>, which may be an area in which the tracked device may be located. In addition, the system controller 210 may be configured to determine a fixture location relative to one of the tracked devices T<sub>1</sub>-T<sub>4</sub>. For example, the fixture location may indicate the one or more lighting fixtures that are nearest to a

respective tracked device, which may allow the tracked device to be located. The determined area location for each of the tracked devices T<sub>1</sub>-T<sub>4</sub> may be based on the distances between the respective tracked device and the areas 202-208. Similarly, the determined fixture location for each of the tracked devices T<sub>1</sub>-T<sub>4</sub> may be based on the distances between the respective tracked device and the lighting fixture F<sub>1</sub>-F<sub>24</sub>. For example, these distances may be based on a calculated path loss of the beacon messages received by a respective lighting fixture.

**[0059]** FIG. 3 is a simplified flowchart of an example procedure 300 for receiving beacon messages from one or more tracked devices (*e.g.*, mobile devices and/or tags) in a space (*e.g.*, the space 200 shown in FIG. 2 and/or the building in which the space is located). The procedure 300 may be executed by a lighting control device of a load control system (*e.g.*, the lighting control devices located in the lighting fixtures 108a-d, 1038a-d, 146a-d shown in FIG. 1 and/or the lighting control devices located in the lighting fixtures F<sub>1</sub>-F<sub>24</sub> shown in FIG. 2). The lighting control device may be configured to receive the beacon messages on three different communication channels (*e.g.*, three different frequencies). For example, the lighting control device may execute the procedure 300 periodically at 310.

**[0060]** At 312, the lighting control device may select (*e.g.*, start on) an initial frequency (*e.g.*, an initial communication channel) for receiving and/or processing beacon message. At 314, the lighting control device may listen on the selected frequency for a beacon message. If the lighting control device receives a beacon message at 316, the lighting control device may determine a communication quality metric (*e.g.*, a received signal strength magnitude) of the received beacon message at 318. For example, the lighting control device may measure a received signal strength indicator of the received beacon message at 320. At 320, the lighting control device may store the received signal strength magnitude of the beacon message. In addition, the lighting control device may also store at 320 a transmit power  $p_t$  of the beacon message, which may be included in the received beacon message.

**[0061]** The lighting control device may be configured to listen on the selected frequency for a scan time period (*e.g.*, approximately 100 msec). If the scan time period is not complete at 322, the lighting control device may continue to listen on the selected frequency at 314. When the scan time period is complete at 322, the lighting control device may determine if the scan mode should be

exited at 324. If not, the lighting control device may switch to the next frequency at 326 and listen on the newly selected frequency at 314. When the scan mode should be exited at 324, the lighting control device exits the procedure 300. For example, the lighting control device may listen on each frequency (*e.g.*, each of the three frequencies on which a beacon message may be transmitted) before exiting the procedure 300. In addition, the lighting control device may continuously listen on each frequency and may only exit the procedure 300 upon receiving a command to exit the procedure 300.

**[0062]** FIG. 4 is a simplified flowchart on an example procedure 400 for transmitting tracking regarding the location of one or more tracked devices (*e.g.*, mobile devices and/or tags) in a space (*e.g.*, the space 200 shown in FIG. 2 and/or the building in which the space is located). The procedure 400 may be executed by a lighting control device of a load control system (*e.g.*, the lighting control devices located in the lighting fixtures 108a-d, 1038a-d, 146a-d shown in FIG. 1 and/or the lighting control devices located in the lighting fixtures F<sub>1</sub>-F<sub>24</sub> shown in FIG. 2). The lighting control device may be configured to transmit the tracking data to a system controller of the load control system (*e.g.*, the system controller 160 shown in FIG. 1 and/or the system controller 210 shown in FIG. 2). For example, the lighting control device may execute the procedure 400 periodically at 410 (*e.g.*, at a first interval, such as 1 sec).

**[0063]** At 412, the control circuit of the lighting control device may determine a list of beacon identifiers of the one or more tracked devices from which beacon messages were received during the first interval. At 414, the control circuit of the lighting control device may select a first beacon identifier from the list. At 416, the lighting control device may process the received signal strength indicators for a subset of beacon messages received from the tracked device having the selected beacon identifier over a second interval to determine a processed received signal strength indicator. The second interval may be longer than the first interval. For example, the control circuit of the lighting control device may determine at 416 a maximum value (*e.g.*, peak value) of the received signal strength indicators of the beacon messages received from the tracked device across all three frequencies (*e.g.*, communication channels) on which the beacon messages were transmitted. In addition, the lighting control device may determine at 416 an average value of the

received signal strength indicators of the beacon messages received from the tracked device across all three frequencies (*e.g.*, communication channels).

**[0064]** At 418, the lighting control device may be configured to calculate communication metric, such as a path loss  $\ell$ , for the tracked device. The path loss  $\ell$  calculated for the tracked device may indicate a distance between the lighting control device and the tracked device that transmitted a respective beacon message. For example, the path loss  $\ell$  may be calculated by subtracting a transmit power value  $p_t$  at which the beacon messages are transmitted by the tracked device on one of the communication channels from a receive power value of the beacon messages as received by the lighting control device. For example, the receive power value may be the processed received signal strength indicator  $RSSI_p$  (*e.g.*, as determined at 416). The transmit power value  $p_t$  may indicate a power level at which the beacon message was transmitted by the tracked device. The lighting control device may receive the transmit power value in the received beacon message from the tracked device. In addition, the transmit power value  $p_t$  for the tracked device may be stored in memory in the lighting control device, and may differ for different types of tracked devices. The lighting control device may calculate the path loss value  $\ell$  for the lighting control device by subtracting the transmit power value  $p_t$  from the receive power value (*e.g.*, the processed received signal strength indicator  $RSSI_p$ ), *e.g.*,

$$\ell = RSSI_p - p_t.$$

The path loss  $\ell$  may be an indicator of the distance between a respective lighting fixture and the tracked device. Although FIG. 4 illustrates an example where a path loss is calculated, it would be understood that any other suitable communication metric may also or alternatively be used, including, for example, a received signal strength indicator.

**[0065]** The lighting control device may only transmit the tracking data if the path loss value  $\ell$  calculated at 418 has changed (*e.g.*, as compared to a previously reported path loss value) at 420. As described herein, the load control system may include numerous lighting control devices. Accordingly, if the lighting control devices in the load control system only transmit tracking data for a respective tracked device when the path loss value  $\ell$  calculated has changed (*e.g.*, as compared to a previously reported path loss value), the volume of tracking data being transmitted may decrease. The lighting control device may transmit tracking data, including the path loss value  $\ell$ , at 422.



Alternatively or additionally, the lighting control device may determine if the processed received signal strength indicator  $RSSI_p$  has changed at 420, and transmit tracking data including the processed received signal strength indicator  $RSSI_p$  at 422. In addition, the lighting control device may include the transmit power value  $p_t$  in the tracking data with the processed received signal strength indicator  $RSSI_p$ . If the processed received signal strength indicator  $RSSI_p$  is included in the tracking data, step 418 may be omitted. If there are more beacon identifiers for which to transmit tracking data at 424, the lighting control device may select the next beacon identifier in the list at 426 and process the received signal strength indicators for the next beacon identifier at 416. If there are not more beacon identifiers for which to transmit tracking data at 424, the lighting control device may exit the procedure 400.

**[0066]** FIG. 5 is a simplified flowchart of an example procedure 500 for determining locations of one or more tracked devices (*e.g.*, mobile devices and/or tags) in a space (*e.g.*, the space 200 shown in FIG. 2 and/or the building in which the space is located). The procedure 500 may be executed by a system controller of a load control system (*e.g.*, the system controller 160 shown in FIG. 1 and/or the system controller 210 shown in FIG. 2) or another device, such as a mobile device (*e.g.*, the mobile device 128 shown in FIG. 1, and/or a remote computing device). The system controller may determine a location of one of the tracked devices, where the location may be an area location (*e.g.*, an area in which the tracked device may be located) and/or a fixture location (*e.g.*, one or more lighting fixtures near which the tracked device may be located). The system controller may be configured to receive tracking data from lighting control devices in one or more lighting fixtures (*e.g.*, the lighting fixtures  $F_1$ - $F_{24}$  shown in FIG. 2) in the space. The system controller may be configured to execute the procedure 500 at 510 in response to getting updated tracking data for a particular tracked device (*e.g.*, the tracking data received from a lighting control device at 422). The system controller may be configured to separately execute the procedure 500 for each of tracked devices that the system controller is tracking. The system controller may store in memory the beacon identifiers of the tracked devices that the system controller is tracking.

**[0067]** At 512, the control circuit of the system controller may be configured to determine a path loss table for the tracked device. The path loss table may include the path loss values for each of the lighting control devices from which the system controller received tracking data for the

tracked device. The path loss values for each lighting control device may be included in the received tracking data (*e.g.*, as determined by the lighting control device at 418), and the system controller may simply include the path loss values in the path loss table at 512. In addition, the system controller may be configured to receive a received signal strength indicator  $RSSI_n$  of a particular lighting control device (*e.g.*, an  $n^{\text{th}}$  lighting device) in the tracking data (*e.g.*, the processed received signal strength indicator  $RSSI_p$  as determined by the lighting control device at 416). The system controller may calculate a path loss value  $\ell_n$  for the lighting control device for by subtracting a transmit power value  $p_n$  at which the beacon messages are transmitted by the tracked device from the received signal strength indicator  $RSSI_n$  of the beacon messages as received by the lighting control device. The transmit power value  $p_n$  may also be included in the tracking data. The system controller may receive the transmit power value  $p_n$  in the tracking data from the lighting control device. In addition, the transmit power value  $p_n$  for the tracked device may be stored in memory in the system controller, and may differ for different types of tracked devices. The system controller may determine the transmit power value  $p_n$  and the received signal strength indicator  $RSSI_n$  from the tracking data, and calculate the path loss value  $\ell_n$  for the lighting control device by subtracting the transmit power value  $p_n$  from the received signal strength indicator  $RSSI_n$ , *e.g.*,

$$\ell_n = RSSI_n - p_n.$$

The system controller may calculate the path loss value  $\ell_n$  for each of the lighting devices from which the system controller received tracking data for the tracked device. The system controller may include all of the path loss values  $\ell_n$  in the path loss table along with the device identifiers of the respective lighting control devices associated with that path loss values  $\ell_n$ .

**[0068]** At 514, the control circuit of the system controller may determine the area location (*e.g.*, an area in which the tracked device may be located) using the path loss values  $\ell_n$  in the path loss table. For example, the system controller may determine if the path loss value  $\ell_n$  for one of the lighting control devices in the path loss table is much less than all of the other path loss values  $\ell_n$  in the path loss table (*e.g.*, separated by a threshold amount, such as 6 dB). If so, the control circuit of the system controller may determine that the tracked device is in the area in which the lighting fixture of that lighting control device is located. In addition, the system controller may determine an average value of the path loss values  $\ell_n$  of the lighting control devices in each area, and determine

that the tracked device is in the area that has the lowest average value of path loss values  $\ell_n$ . The control circuit of the system controller may use the area data stored in memory to determine the areas in which the lighting control devices are located.

**[0069]** At 516, the system controller may determine the fixture location (*e.g.*, one or more lighting fixtures near which the tracked device may be located) using the path loss values  $\ell_n$  in the path loss table. For example, the system controller may determine if the path loss value  $\ell_n$  for one of the lighting control devices in the path loss table is much less than all of the other path loss values in the path loss table (*e.g.*, separated by a threshold amount, such as 6 dB). If so, the system controller may determine that the tracked device is near the lighting fixture in which that lighting control device is installed. In addition, the system controller may determine a combined path loss value for each pair of lighting fixtures in each area in which there are lighting control devices having path loss values  $\ell_n$  in the path loss table, and determine that the tracked device is near the pair of lighting fixtures (*e.g.*, between the lighting fixtures) that has the lowest value of combined path loss values. If only the area location is desired, step 516 may be omitted from the procedure 500.

**[0070]** At 518, the control circuit of the system controller may report location data regarding the tracked device, before the procedure 500 exits. For example, the system controller may report the most-commonly determined area location (*e.g.*, as determined at 514 over a number of executions of the procedure 500) as well as the most-recently reported fixture location from that area of the most-commonly reported area location. In addition, the system controller may report a fixture location of the lighting fixture having the lighting control device with the minimum path loss value in the path loss table, *e.g.*, from all of the areas in the space (*e.g.*, which may be a different area than the most-commonly reported area location). The system controller may report (*e.g.*, only report) the location data when the number of times that the most-commonly determined area location exceeds a threshold value.

**[0071]** FIG. 6 is a simplified flowchart of an example procedure 600 for determining locations (*e.g.*, area locations) of one or more tracked devices (*e.g.*, mobile devices and/or tags) in a space (*e.g.*, the space 200 shown in FIG. 2 and/or the building in which the space is located). The procedure 600 may be executed by a system controller of a load control system (*e.g.*, the system

controller 160 shown in FIG. 1 and/or the system controller 210 shown in FIG. 2) or another device, such as a mobile device (*e.g.*, the mobile device 128 shown in FIG. 1) or a remote computing device (*e.g.*, a server, laptop, personal computer, or other upstream processing device). The system controller may determine an area location (*e.g.*, an area in which the tracked device may be located) of the tracked device. The system controller may be configured to receive tracking data from lighting control devices in one or more lighting fixtures (*e.g.*, the lighting fixtures F<sub>1</sub>-F<sub>24</sub> shown in FIG. 2) in the space. The system controller may be configured to execute the procedure 600 at 610 in response to getting updated tracking data for a particular tracked device. For example, the system controller may execute the procedure 600 at 514 of the procedure 500 shown in FIG. 5. The system controller may be configured to separately execute the procedure 600 for each of tracked devices that the system controller is tracking. The system controller may store in memory the beacon identifiers of the tracked devices that the system controller is tracking.

**[0072]** At 612, the control circuit of the system controller may determine a gap (*e.g.*, the difference) between the two lowest path loss values in the path loss table (*e.g.*, the path loss table determined at 512 of the procedure 500 shown in FIG. 5) for a particular tracked device. For example, the system controller may sort the path loss table by the path loss value in a decreasing manner. The system controller may determine the gap by subtracting the second path loss value from first path loss value (*e.g.*, the top path loss value in the table). If the gap is greater than or equal to a threshold value (*e.g.*, approximately 6 dB) at 614, the system controller may store an area of the lighting fixture having the minimum path loss value in the path loss table as the area location of the tracked device at 616, before the procedure 600 exits. For example, the system controller may use the device identifier of the lighting device having the minimum path loss value in the path loss table to determine the area identifier based on area data stored in memory. Referring to FIG. 2, if the lighting control device of the lighting fixture T<sub>19</sub> has the minimum path loss value in the path loss table for the tracked device T<sub>3</sub>, the system controller may store the area 206 as the area location of the tracked device T<sub>3</sub> at 616.

**[0073]** If the gap (*e.g.*, as determined at 612) is not greater than or equal to the threshold value at 614, the system controller may build a list of areas that have lighting control devices with associated path loss values in the path loss table at 618. For example, if the path loss table includes

path loss values for the lighting control devices in the lighting fixtures F<sub>3</sub>, F<sub>4</sub>, F<sub>7</sub>, F<sub>8</sub>, F<sub>11</sub>, F<sub>12</sub>, and F<sub>21</sub>, the system controller may build a list of areas (*e.g.*, areas 202, 204, and 208 of FIG. 2) at 618. At 618, the system controller may calculate an average value  $\ell_{\text{avg}}$  for the path loss values in each of the areas in the list of areas. For example, for the area 202, the system controller may calculate the average value  $\ell_{\text{avg}}$  of the path loss values for the lighting control devices in the lighting fixtures F<sub>3</sub>, F<sub>4</sub>, F<sub>7</sub>, and F<sub>8</sub> (*e.g.*,  $\ell_{\text{avg}} = [\ell_3 + \ell_4 + \ell_7 + \ell_8] / 4$ ). At 622, the control circuit of the system controller may determine the area from the list of areas that has the minimum average value for the path loss values of the lighting control devices in that area. At 624, the control circuit of the system controller may store the area that has the minimum average value for the path loss values (*e.g.*, as determined at 622) as the area location of the tracked device, and may exit the procedure 600.

**[0074]** FIG. 7 is a simplified flowchart of an example procedure 700 for determining locations (*e.g.*, fixtures locations) of one or more tracked devices (*e.g.*, mobile devices and/or tags) in a space (*e.g.*, the space 200 shown in FIG. 2 and/or the building in which the space is located). The procedure 700 may be executed by a system controller of a load control system (*e.g.*, the system controller 160 shown in FIG. 1 and/or the system controller 210 shown in FIG. 2) or another device, such as a network device (*e.g.*, the mobile device 128 shown in FIG. 1, or a remote computing device). The system controller may determine a fixture location (*e.g.*, one or more lighting fixtures near which the tracked device may be located) of the tracked device. The system controller may be configured to receive tracking data from lighting control devices in one or more lighting fixtures (*e.g.*, the lighting fixtures F<sub>1</sub>-F<sub>24</sub> shown in FIG. 2) in the space. The system controller may be configured to execute the procedure 700 at 710 in response to getting updated tracking data for a particular tracked device. For example, the system controller may execute the procedure 700 at 516 of the procedure 500 shown in FIG. 5. The system controller may be configured to separately execute the procedure 700 for each of tracked devices that the system controller is tracking. The system controller may store in memory the beacon identifiers of the tracked devices that the system controller is tracking.

**[0075]** At 712, the control circuit of the system controller may determine a gap (*e.g.*, the difference) between the two lowest path loss values in the path loss table (*e.g.*, the path loss table determined at 512 of the procedure 500 shown in FIG. 5) for a particular tracked device. For

example, the system controller may sort the path loss table by the pass loss value in a decreasing manner. The system controller may determine the gap by subtracting the second path loss value from first path loss value (*e.g.*, the top path loss value in the table). If the system controller is executing the procedure 700 immediately after executing the procedure 600 (*e.g.*, as shown at 514 and 516 of the procedure 500 shown in FIG. 5), the system controller may use the gap determined at 612 of the procedure 600, and step 712 of the procedure 700 may be omitted. If the gap is greater than or equal to a threshold value (*e.g.*, approximately 6 dB) at 714, the system controller may store the lighting fixture having the minimum path loss value in the path loss table as the fixture location of the tracked device at 716, before the procedure 700 exits. Referring to FIG. 2, if the lighting control device of the lighting fixture T<sub>19</sub> has the minimum path loss value in the path loss table for the tracked device T<sub>3</sub>, the system controller may store the lighting fixture T<sub>19</sub> as the fixture location of the tracked device T<sub>3</sub> at 716.

**[0076]** If the gap (*e.g.*, as determined at 712) is not greater than or equal to the threshold value at 714, the system controller may determine, at 718, a combined path loss value  $L_{m,n}$  for each pair of lighting fixtures (*e.g.*, a fixture pair  $\{m, n\}$ ) in each area of the lighting control devices in the path loss table. Fixture pairs may be limited to adjacent lighting fixtures (*e.g.*, side-by-side or diagonally adjacent, as shown in FIG. 2) and may not cross area boundaries. The system controller may be configured to determine lighting fixtures that are adjacent from the configuration data (*e.g.*, floorplan data) of the load control system. For example, if the path loss table includes path loss values for the lighting control devices in the lighting fixtures F<sub>3</sub>, F<sub>4</sub>, F<sub>7</sub>, and F<sub>8</sub> in the area 202, the fixture pairs in that area may be  $\{F_3, F_4\}$ ,  $\{F_3, F_7\}$ ,  $\{F_3, F_8\}$ ,  $\{F_4, F_7\}$ ,  $\{F_4, F_8\}$ , and  $\{F_7, F_8\}$ . The system controller may establish fixture pairs in each area in which there are lighting control devices having past loss values in the path loss table. If there are areas having a single lighting control device in the past loss table, the system controller may not establish a fixture pair for that area. The system controller may determine the combined path loss value  $L_{m,n}$  for one of the fixture pairs at 718, for example, by calculating the combined path loss value  $L_{m,n}$  using the fixture loss values  $l_m$  and  $l_n$  of the lighting control devices in each lighting fixtures, *e.g.*,

$$L_{m-n} = \text{cube root of } (l_m^3 + l_n^3).$$

In addition, the system controller may determine the combined path loss value  $L_{m-n}$  for one of the fixture pairs by calculating an average value of the fixture loss values  $l_m$  and  $l_n$  of the lighting control

devices in each lighting fixtures at 718. At 720, the control circuit of the system controller may determine the fixture pair (*e.g.*, from all of the areas in the space) that has the minimum value for the combined path loss value  $L_{m-n}$ . At 722, the system controller may store the fixture pair that has the minimum value for the combined path loss value  $L_{m-n}$  (*e.g.*, as determined at 720) as the fixture location of the tracked device, and may exit the procedure 700.

**[0077]** FIG. 8 is a simplified flowchart of an example procedure 800 for reporting locations of one or more tracked devices (*e.g.*, mobile devices and/or tags) in a space (*e.g.*, the space 200 shown in FIG. 2 and/or the building in which the space is located). The procedure 800 may be executed by a system controller of a load control system (*e.g.*, the system controller 160 shown in FIG. 1 and/or the system controller 210 shown in FIG. 2) or another device, such as a network device (*e.g.*, the mobile device 128 shown in FIG. 1, or a remote computing device). The system controller may determine a location of one of the tracked devices, where the location may be an area location (*e.g.*, an area in which the tracked device may be located) and/or a fixture location (*e.g.*, one or more lighting fixtures near which the tracked device may be located). The system controller may be configured to execute the procedure 800 at 810 in response to getting updated tracking data for a particular tracked device. For example, the system controller may execute the procedure 800 at 518 of the procedure 500 shown in FIG. 5. The system controller may be configured to separately execute the procedure 800 for each of tracked devices that the system controller is tracking. The system controller may store in memory the beacon identifiers of the tracked devices that the system controller is tracking.

**[0078]** At 812, the control circuit of the system controller may determine a most-commonly determined area location from a number  $N$  (*e.g.*, four) of consecutive iterations of the procedure 800 (*e.g.*, a number  $N$  of consecutive iterations of 514 of the procedure 500 of FIG. 5). At 814, the control circuit of the system controller may determine a number  $M$  of times that the most-commonly determined area location (*e.g.*, as determined at 812) was reported over the number  $N$  of the consecutive iterations of the procedure 800. At 816, the control circuit of the system controller may determine if the number  $M$  (*e.g.*, as determined at 814) is greater than or equal to a threshold value  $TH_M$ . For example, the threshold value  $TH_M$  may be equal to a percentage (*e.g.*, 50%) of the number  $N$  of consecutive iterations of the procedure 800. If the number  $M$  is greater than or equal to

the threshold value  $TH_M$  at 816, the system controller may exit the procedure 800 without reporting any location data regarding the tracked device.

**[0079]** If the number  $M$  is greater than or equal to the threshold value  $TH_M$  at 816, the system controller may report location data regarding the tracked device at 818, before the procedure 800 exits. For example, the system controller may report the most-commonly determined area location at 818. In addition, the system controller may report at 818 the most-recently reported fixture location from that area of the most-commonly determined area location (*e.g.*, as determined at 816 of the procedure 800). Further, the system controller may report at 818 a fixture location of the lighting fixture having the lighting control device with the minimum path loss value in the path loss table, *e.g.*, from all of the areas in the space (*e.g.*, which may be a different area than the most-commonly determined area location determined at 812). The system controller may report the area locations and/or fixture locations by transmitting the location data in one or more messages to a network device, such as a mobile device and/or a computing device (*e.g.*, a personal computer and/or server). Also or alternatively, the system controller may be configured to control one or more of the lighting control devices in the load control system to indicate the determined area locations and/or fixture locations. For example, the system controller may transmit messages to control the lighting control devices in the load control system such that the intensity of lighting loads near the determined area locations and/or fixture locations are increased (*e.g.*, as compared to the lighting loads that are not near the determined area locations and/or fixture locations). Further, the intensity of lighting loads may increase as the distance between a respective lighting load and the determined area locations and/or fixture locations decreases.

**[0080]** FIG. 9 is a simplified flowchart of an example procedure 900 for displaying locations of one or more tracked devices (*e.g.*, mobile devices and/or tags) in a space (*e.g.*, the space 200 shown in FIG. 2 and/or the building in which the space is located). The procedure 900 may be executed by a network device (*e.g.*, such as the mobile device 128 of the load control environment 100 shown in FIG. 1 or a remote computing device), which, as described herein, may be configured to execute a control/configuration application. The network device may receive location data that may indicate the location of the tracked devices from a system controller of a load control system (*e.g.*, the system controller 160 shown in FIG. 1 and/or the system controller 210 shown in FIG. 2).



The network device may be configured to store configuration data of the load control system and/or the space in which the load control system is installed, for example, using the control/configuration application. For example, the configuration data may comprise floorplan data including a floorplan image of the space. The network device may comprise a visible display (*e.g.*, a screen) for displaying the floorplan image and/or a marker identifying the locations of the tracked devices. The network device may be configured to execute the procedure 900 at 910 in response to getting updated location data for a particular tracked device (*e.g.*, in response to the location data transmitted by the system controller at 818 of the procedure 800 shown in FIG. 8). The network device may be configured to separately execute the procedure 900 for each of tracked devices that the system controller is tracking. The network device may store in memory the beacon identifiers of the tracked devices that the system controller is tracking.

**[0081]** At 912, the network device may receive and store new location data for a tracked device. At 914, the network device may determine if coordinates (*e.g.*, x-y coordinates) are available for the fixture locations included in the location data. For example, the configuration data (*e.g.*, floorplan data) stored by the network device may include x-y coordinates for the various lighting fixtures along with the device identifiers of the lighting control devices installed in the respective lighting fixtures. The x-y coordinates of a lighting fixture may indicate a location on the floorplan image at which the lighting fixture may be located. The configuration data may also include the locations of the areas of the load control system on the floorplan image. If the coordinates of the fixture locations are not known at 914, the network device may highlight the area associated with the area location of the tracked device (*e.g.*, as included in the location data) at 916, before the procedure 900 exits.

**[0082]** If the coordinates of the fixture locations are known at 914, the network device may determine the x-y coordinates of the fixture locations from the configuration data based on the device identifiers of the lighting control devices in the lighting fixtures at the fixture locations 918. For example, if the fixture location is a single lighting fixture (*e.g.*, as determined at 716 of procedure 700), the network device may determine a single set of x-y coordinates ( $x_0, y_0$ ) associated with the single lighting fixture using on the configuration data. If the fixture location is a fixture pair (*e.g.*, as determined at 722 of the procedure 700 shown in FIG. 7), the network device may

determine two sets of x-y coordinates  $(x_1, y_1)$  and  $(x_2, y_2)$  associated with the fixture pair from the configuration data. In addition, if the location data includes a fixture location of the lighting fixture having the lighting control device with the minimum path loss value in the path loss table, the network device may determine a single set of x-y coordinates  $(x_{low}, y_{low})$  associated with that lighting fixture from the configuration data.

**[0083]** At 920, the network device may determine a weighted fixture location  $(x_w, y_w)$  from the x-y coordinates determined at 918. For example, if the fixture location is a single lighting fixture, the network device may calculate the weighted fixture location  $(x_w, y_w)$  using the set of x-y coordinates  $(x_0, y_0)$  of the fixture location and the set of x-y coordinates  $(x_{low}, y_{low})$  of the fixture location of the lighting fixture having the lighting control device with the minimum path loss value in the path loss table, *e.g.*,

$$x_w = [(4 \cdot x_0) + x_{low}] / 5; \text{ and}$$

$$y_w = [(4 \cdot y_0) + y_{low}] / 5.$$

In addition, if the fixture location is a fixture pair, the network device may calculate the weighted fixture location  $(x_w, y_w)$  using the two sets of x-y coordinates  $(x_1, y_1)$  and  $(x_2, y_2)$  of the fixture location and the set of x-y coordinates  $(x_{low}, y_{low})$  of the fixture location of the lighting fixture having the lighting control device with the minimum path loss value in the path loss table, *e.g.*,

$$x_w = [(2 \cdot x_1) + (2 \cdot x_2) + x_{low}] / 5; \text{ and}$$

$$y_w = [(2 \cdot y_1) + (2 \cdot y_2) + y_{low}] / 5.$$

At 922, the network device may place a marker for the tracked device at the location of the weighted fixture location  $(x_w, y_w)$  on the floorplan image, before the procedure 900 exits.

**[0084]** Although FIG. 9 illustrates an example wherein the network device places a marker on a fixture location or highlights an area location, other examples of identifying the location of one or more tracked devices may be implemented. For example, a system controller may be configured to control one or more of the lighting control devices in the load control system to indicate the determined area locations and/or fixture locations. The system controller may transmit messages to control the lighting control devices in the load control system such that the intensity of lighting loads near the determined area locations and/or fixture locations are increased (*e.g.*, as compared to the lighting loads that are not near the determined area locations and/or fixture locations). Further, the

intensity of lighting loads may increase as the distance between a respective lighting load and the determined area locations and/or fixture locations decreases.

**[0085]** FIG. 10 is a block diagram illustrating an example mobile device 1000 as described herein. The mobile device 1000 may include the mobile device 128 shown in FIG. 1, for example. The mobile device 1000 may include a control circuit 1002 for controlling the functionality of the mobile device 1000. The control circuit 1002 may include one or more general purpose processors, special purpose processors, conventional processors, digital signal processors (DSPs), microprocessors, integrated circuits, a programmable logic device (PLD), application specific integrated circuits (ASICs), or the like. The control circuit 1002 may be configured to execute one or more software-based applications that include instructions that when executed by the control circuit may configure the control circuit to perform signal coding, data processing, power control, input/output processing, or any other function, feature, process, and/or operation for example that enables the mobile device 1000 to perform as described herein. One will recognize that functions, features, processes, and/or operations described herein for the control-source device 800 may also and/or alternatively be provided by firmware and/or hardware in addition to and/or as an alternative to computer-executable (*e.g.*, software-based) instructions. The control circuit 1002 may store information in and/or retrieve information from the memory 804. Memory 1004 may also store computer-executable (*e.g.*, software-based) instructions for execution by the control circuit 1002 and may also provide an execution space as the control circuit executes instructions. Memory 1004 may be implemented as an external integrated circuit (IC) or as an internal circuit of the control circuit 1002. Memory 1004 may include volatile and non-volatile memory modules/devices and may be non-removable memory modules/devices and/or a removable memory modules/devices. Non-removable memory may include random-access memory (RAM), read-only memory (ROM), a hard disk, or any other type of non-removable memory storage. Removable memory may include a subscriber identity module (SIM) card, a memory stick, a memory card, or any other type of removable memory.

**[0086]** The mobile device 1000 may include a communications circuit 1008 for transmitting and/or receiving information. The communications circuit 1008 may perform wireless and/or wired communications. The communications circuit 1008 may include an RF transceiver or other circuit

capable of performing wireless communications via an antenna. Communications circuit 1008 may be in communication with control circuit 1002 for transmitting and/or receiving information.

**[0087]** The control circuit 1002 may also be in communication with a display 1006 for providing information to a user. The processor 1002 and/or the display 1006 may generate GUIs for being displayed on the mobile device 1000. The display 1006 and the control circuit 1002 may be in two-way communication, as the display 1006 may include a touch screen module capable of receiving information from a user and providing such information to the control circuit 1002. The mobile device may also include an actuator 1012 (*e.g.*, one or more buttons) that may be actuated by a user to communicate user selections to the control circuit 1002.

**[0088]** Each of the modules within the mobile device 1000 may be powered by a power source 1010. The power source 1010 may include an AC power supply or DC power supply, for example. The power source 1010 may generate a supply voltage  $V_{CC}$  for powering the modules within the mobile device 1000.

**[0089]** Figure 11 is a block diagram illustrating an example system controller 1100. The system controller 1100 may include one or more general purpose processors, special purpose processors, conventional processors, digital signal processors (DSPs), microprocessors, microcontrollers, integrated circuits, programmable logic devices (PLD), field programmable gate arrays (FPGA), application specific integrated circuits (ASICs), or any suitable controller or processing device or the like (hereinafter collectively referred to as processor(s) or control circuit(s) 1102). The control circuit 1102 may be configured to execute one or more software-based applications that include instructions that when executed by the control circuit may configure the control circuit to perform signal coding, data processing, power control, input/output processing, or any other function, process, and/or operation for example that enables the system controller 1100 to perform as described herein. One will recognize that functions, features, processes, and/or operations described herein of the system controller 1100 may also and/or alternatively be provided by firmware and/or hardware in addition to and/or as an alternative to software-based instructions. The control circuit 1102 may store information in and/or retrieve information from the memory 1104, including configuration information/configuration information file(s), backup file(s), creation times, and signature(s) as described herein. Memory 1104 may also store software-based

instructions for execution by the control circuit 1102 and may also provide an execution space as the control circuit executes instructions. Memory 1104 may be implemented as an external integrated circuit (IC) or as an internal circuit of the control circuit 1102. Memory 1104 may include volatile and non-volatile memory modules/devices and may be non-removable memory modules/devices and/or a removable memory modules/devices. Non-removable memory may include random-access memory (RAM), read-only memory (ROM), a hard disk, or any other type of non-removable memory storage. Removable memory may include a subscriber identity module (SIM) card, a memory stick, a memory card, or any other type of removable memory. One will appreciate that the memory used to store configuration information file(s), and/or backup file(s), and/or computer-executable (*e.g.*, software-based) instructions, etc. that may be the same and/or different memory modules/devices of the system controller. As one example, configuration information file(s) and computer-executable (*e.g.*, software-based) instructions may be stored in non-volatile memory modules/devices while backup(s) may be stored in volatile and/or non-volatile memory modules/devices. The computer-executable instructions may be executed by the control circuit 1102 to operate as described herein.

**[0090]** The system controller 1100 may include one or more communications circuits/network interface devices or cards 1106 for transmitting and/or receiving information. The communications circuit 1106 may perform wireless and/or wired communications. The system controller 1100 may also, or alternatively, include one or more communications circuits/network interface devices/cards 1108 for transmitting and/or receiving information. The communications circuit 1106 may perform wireless and/or wired communications. Communications circuits 1106 and 1108 may be in communication with control circuit 1102. The communications circuits 1106 and/or 1108 may include radio frequency (RF) transceivers or other communications modules configured to perform wireless communications via an antenna(s). The communications circuit 1106 and communications circuit 1108 may be configured to perform communications via the same communication channels or different communication channels. For example, the communications circuit 1106 may be configured to communicate (*e.g.*, with a network device, over a network, *etc.*) via a wireless communication channel (*e.g.*, BLUETOOTH®, near field communication (NFC), WIFI®, WI-MAX®, cellular, *etc.*) and the communications circuit 1108 may be configured to communicate (*e.g.*, with control devices and/or other devices in the load control system) via another

wireless communication channel (*e.g.*, WI-FI® or a proprietary communication channel, such as CLEAR CONNECT™).

**[0091]** The control circuit 1102 may be in communication with an LED indicator(s) 1112 for providing indications to a user. The control circuit 1102 may be in communication with an actuator(s) 1114 (*e.g.*, one or more buttons) that may be actuated by a user to communicate user selections to the control circuit 1102. For example, the actuator 1114 may be actuated to put the control circuit 1102 in an association mode and/or communicate association messages from the system controller 1100.

**[0092]** Each of the modules within the system controller 1100 may be powered by a power source 1110. The power source 1110 may include an AC power supply or DC power supply, for example. The power source 1110 may generate a supply voltage  $V_{CC}$  for powering the modules within the system controller 1100. One will recognize that system controller 1100 may include other, fewer, and/or additional modules.

**[0093]** Figure 12 is a block diagram illustrating an example control-target device 1200, *e.g.*, a load control device, as described herein. The control-target device 1200 may be a dimmer switch, an electronic switch, an electronic ballast for lamps, an LED driver for LED light sources, an AC plug-in load control device, a temperature control device (*e.g.*, a thermostat), a motor drive unit for a motorized window treatment, or other load control device. The control-target device 1200 may include one or more communications circuits/network interface devices or cards 1202. The communications circuit 1202 may include a receiver, an RF transceiver, and/or other communications module configured to perform wired and/or wireless communications via communications link 1210. The control-target device 1200 may include one or more general purpose processors, special purpose processors, conventional processors, digital signal processors (DSPs), microprocessors, microcontrollers, integrated circuits, programmable logic devices (PLD), field programmable gate arrays (FPGA), application specific integrated circuits (ASICs), or any suitable controller or processing device or the like (hereinafter collectively referred to as processor(s) or control circuit(s) 1204). The control circuit 1204 may be configured to execute one or more software-based applications that include instructions that when executed by the control circuit may configure the control circuit to perform signal coding, data processing, power control,

input/output processing, or any other function, feature, process, and/or operation for example that enables the control-target device 1200 to perform as described herein. One will recognize that functions, features, processes, and/or operations described herein for the control-target device 1200 may also and/or alternatively be provided by firmware and/or hardware in addition to and/or as an alternative to software-based instructions. The control circuit 1204 may store information in and/or retrieve information from the memory 1206. For example, the memory 1206 may maintain a registry of associated control devices and/or control configuration information. Memory 1206 may also store computer-executable (*e.g.*, software-based) instructions for execution by the control circuit 1204 and may also provide an execution space as the control circuit executes instructions. Memory 1206 may be implemented as an external integrated circuit (IC) or as an internal circuit of the control circuit 1204. Memory 1206 may include volatile and non-volatile memory modules/devices and may be non-removable memory modules/devices and/or a removable memory modules/devices. Non-removable memory may include random-access memory (RAM), read-only memory (ROM), a hard disk, or any other type of non-removable memory storage. Removable memory may include a subscriber identity module (SIM) card, a memory stick, a memory card, or any other type of removable memory. The control circuit 1204 may also be in communication with the communications circuit 1202.

**[0094]** The control-target device 1200 may include a load control circuit 1208. The load control circuit 1208 may receive instructions from the control circuit 1204 and may control an electrical load 1216 based on the received instructions. The load control circuit 1208 may send status feedback to the control circuit 1204 regarding the status of the electrical load 1216. The load control circuit 1208 may receive power via a hot connection 1212 and a neutral connection 1214 and may provide an amount of power to the electrical load 1216. The electrical load 1216 may include any type of electrical load.

**[0095]** The control circuit 1204 may be in communication with an actuator 1218 (*e.g.*, one or more buttons) that may be actuated by a user to communicate user selections to the control circuit 1204. For example, the actuator 1218 may be actuated to put the control circuit 1204 in an association mode or discovery mode and may communicate association messages or discovery

messages from the control-target device 1200. One will recognize that control-target device 1200 may include other, fewer, and/or additional modules.

**[0096]** FIG. 13 is a block diagram illustrating an example control-source device 1300 as described herein. The control-source device 1300 may be a remote control device, an occupancy sensor, a daylight sensor, a window sensor, a temperature sensor, and/or the like. The control-source device 1300 may include a control circuit 1302 for controlling the functionality of the control-source device 1300. The control circuit 1302 may include one or more general purpose processors, special purpose processors, conventional processors, digital signal processors (DSPs), microprocessors, integrated circuits, a programmable logic device (PLD), application specific integrated circuits (ASICs), or the like. The control circuit 1302 may perform signal coding, data processing, power control, input/output processing, or any other functionality that enables the control-source device 1300 to perform as described herein.

**[0097]** The control circuit 1302 may store information in and/or retrieve information from the memory 1304. The memory 1304 may include a non-removable memory and/or a removable memory, as described herein.

**[0098]** The control-source device 1300 may include a communications circuit 1308 for transmitting and/or receiving information. The communications circuit 1308 may transmit and/or receive information via wired and/or wireless communications. The communications circuit 1308 may include a transmitter, an RF transceiver, or other circuit capable of performing wired and/or wireless communications. The communications circuit 1308 may be in communication with control circuit 1302 for transmitting and/or receiving information.

**[0099]** The control circuit 1302 may also be in communication with an input circuit 1306. The input circuit 1306 may include an actuator (*e.g.*, one or more buttons) or a sensor circuit (*e.g.*, an occupancy sensor circuit, a daylight sensor circuit, or a temperature sensor circuit) for receiving input that may be sent to a device for controlling an electrical load. For example, the control-source device may receive input from the input circuit 1306 to put the control circuit 1302 in an association mode and/or communicate association messages from the control-source device. The control circuit 1302 may receive information from the input circuit 1306 (*e.g.*, an indication that a button has been



actuated or sensed information). Each of the modules within the control-source device 1300 may be powered by a power source 1310.

**[00100]** FIG. 14 is a block diagram illustrating an example tracked device 1400 as described herein. The tracked device 1400 may be a battery powered communication device. The tracked device 1400 may include a control circuit 1402 for controlling the functionality of the tracked device 1400. The control circuit 1402 may include one or more general purpose processors, special purpose processors, conventional processors, digital signal processors (DSPs), microprocessors, integrated circuits, a programmable logic device (PLD), application specific integrated circuits (ASICs), or the like. The control circuit 1402 may perform signal coding, data processing, power control, input/output processing, or any other functionality that enables the tracked device 1400 to perform as described herein.

**[00101]** The control circuit 1402 may store information in and/or retrieve information from the memory 1404. The memory 1404 may include a non-removable memory and/or a removable memory, as described herein.

**[00102]** The tracked device 1400 may include a communications circuit 1406 for transmitting and/or receiving information. The communications circuit 1406 may transmit and/or receive information via wired and/or wireless communications. The communications circuit 1406 may include a transmitter, an RF transceiver, or other circuit capable of performing wired and/or wireless communications. The communications circuit 1406 may be in communication with control circuit 1402 for transmitting and/or receiving information. Each of the modules within the control-source device 1500 may be powered by a power source 1410.

**[00103]** In addition to what has been described herein, the methods and systems may also be implemented in a computer program(s), software, firmware, or other computer-executable instructions incorporated in one or more computer-readable media for execution by a computer(s) or processor(s), for example. Examples of computer-readable media include electronic signals (transmitted over wired or wireless connections) and tangible/non-transitory computer-readable storage media. Examples of tangible/non-transitory computer-readable storage media include, but

are not limited to, a read only memory (ROM), a random-access memory (RAM), removable disks, and optical media such as CD-ROM disks, and digital versatile disks (DVDs).

**[00104]** While this disclosure has been described in terms of certain embodiments and generally associated methods, alterations and permutations of the embodiments and methods will be apparent to those skilled in the art. Accordingly, the above description of example embodiments does not constrain this disclosure. Other changes, substitutions, and alterations are also possible without departing from the spirit and scope of this disclosure.

**[00105]** Although features and elements are described herein in particular combinations, each feature or element can be used alone or in any combination with the other features and elements. The methods described herein may be implemented in a computer program, software, or firmware incorporated in a computer-readable medium for execution by a computer or processor. Examples of computer-readable media include electronic signals (transmitted over wired or wireless connections) and computer-readable storage media. Examples of computer-readable storage media include, but are not limited to, a read only memory (ROM), a random access memory (RAM), removable disks, and optical media such as CD-ROM disks, and digital versatile disks (DVDs).

**CLAIMS**

1. A load control system for controlling a plurality of lighting loads located in a space, the load control system comprising:
  - a system controller configured to transmit and receive message via a wireless communication network;
  - a plurality of lighting control devices installed in the space, each of the plurality of lighting control devices configured to receive the messages from the system controller via the wireless communication network, and control at least one of the plurality of lighting loads in response to the message, each of the plurality of lighting control devices further configured to:
    - receive beacon messages from a tracked device in the space, the beacon messages including a beacon identifier of the tracked device; and
    - transmit tracking data associated with the tracked device to the system controller, the tracking data including a beacon identifier of the tracked device and a processed communication quality metric associated with the tracked device; andwherein the system controller is configured to:
  - transmit and receive messages for controlling one or more of the plurality of lighting loads via the wireless communication network;
  - receive tracking data for the tracked device from one or more of the plurality of lighting control devices, wherein each of the tracking data comprises a communication quality metric associated with the tracked device; and
  - determine a location for the tracked device based on the communication quality metric comprised within each of the tracking data, wherein the location of the tracked device comprises one of an area location of the tracked device or a fixture location of the tracked device.
2. The load control system of claim 1, wherein the system controller is further configured to:
  - identify, based on the tracking data, two lighting control devices of the plurality of lighting control devices that are closest to the tracked device, wherein the two lighting control devices comprise a first lighting control device and a second lighting control device; and

determine, based on the tracking data, that the first lighting control device is closer to the tracked device than the second lighting control device.

3. The load control system of claim 2, wherein the system controller is further configured to: generate, based on the received tracking data, a path loss table for the tracked device, wherein the path loss table includes path loss values associated with each of the one more of the plurality of lighting control devices from which tracking data is received, and wherein the two lighting control devices that are closest to the tracked device are identified based on the path loss table for the tracked device.

4. The load control system of claim 3, wherein the tracked device is associated with a transmit power, and wherein the path loss values included within the path loss table are calculated based on the processed communication quality metric comprised within each of the tracking data and the transmit power associated with the tracked device.

5. The load control system of claim 3, wherein each of the tracking data further comprises a path loss value calculated by a respective lighting control device.

6. The load control system of claim 2, wherein the system controller being configured to determine the location for the tracked device further comprises the system controller being configured to:

determine a difference between the communication quality metric measured by the first lighting control device and communication quality metric measured by the second lighting control device;

determine whether the difference is greater than a threshold; and

based on a determination that the difference is greater than the threshold, retrieve an area of the first lighting control device, wherein the area location of the tracked device is determined to be the retrieved area of the first lighting control device.

7. The load control system of claim 6, wherein the system controller being configured to determine the location for the tracked device further comprises the system controller being configured to:

based on a determination that the difference is not greater than the threshold, retrieve areas associated with the one or more of the plurality of lighting control devices from which tracking data for the tracked device is received;

estimate, based on the tracking data, a distance between the tracked device and each of the retrieved areas; and

determine, based on the estimate distance between the tracked device and each of the retrieved areas, an area that is closest to the tracked device, wherein the area location of the tracked device is determined to be the area that is closest to the tracked device.

8. The load control system of claim 6, wherein the system controller being configured to determine the location for the tracked device further comprises the system controller being configured to, based on a determination that the difference is greater than the threshold, retrieve a fixture location of the first lighting control device, wherein the fixture location of the tracked device is determined to be the retrieved fixture location of the first lighting control device.

9. The load control system of claim 6, wherein the at least one of the plurality of lighting loads that each of the plurality of lighting control devices are configured to control are comprised within lighting fixtures, and wherein the system controller being configured to determine the location for the tracked device further comprises the system controller being configured to:

based on a determination that the difference is not greater than the threshold, identify one or more fixture pairs from the one or more of the plurality of lighting control devices from which tracking data for the tracked device is received, wherein each of the one or more fixture pairs comprise adjacent lighting fixtures;

identify a fixture pair of the one or more fixture pair that is closest to the tracked device; and  
retrieve a fixture location of the identified fixture pair, wherein the fixture location of the tracked device is determined to be the retrieved fixture location of the identified fixture pair.

10. The load control system of claim 1, wherein the system controller is further configured to transmit the determined location of the tracked device, and wherein the load control system further comprises:

a mobile device configured to:

retrieve a floorplan for the load control system, wherein the floorplan includes coordinates for the plurality of load control devices,

determine, based on the locations for each of the one or more tracked devices, coordinates for each of the one or more tracked devices, and

display a representation of the floorplan for the load control system, wherein the representation comprises indications of the determined coordinates for each of the one or more tracked devices.

11. A system controller, comprising:

a communications circuit wherein the communications circuit is configured to communicate messages for controlling lighting control devices via a wireless communications network, and wherein the communication circuit is further configured to receive tracking data from the lighting control devices; and

a control circuit configured to:

transmit and receive messages for controlling one or more of the plurality of lighting loads via the wireless communication network;

receive tracking data for a tracked device from one or more of the lighting control devices, wherein each of the tracking data comprises a processed communication quality metric associated with the tracked device;

generate a table for the tracked device, wherein the table includes communication quality metrics associated with the tracked device and an indication of a respective lighting control device associated with each of the communication quality metrics; and

determine, based the table, a location of the tracked device, wherein the location of the tracked device comprises at least one of an area location of the tracked device or a fixture location of the tracked device.

12. The system controller of claim 11, wherein the control circuit being configured to determine the location of the tracked device further comprises the control circuit being configured to:
- identify, based on the table, two lighting control devices that are closest to the tracked device, wherein the two lighting control devices comprises a first lighting control device and a second lighting control device; and
  - determine, based on the table, that the first lighting control device is closer to the tracked device than the second lighting control device.
13. The system controller of claim 12, wherein the control circuit being configured to determine the location of the tracked device further comprises the control circuit being configured to:
- determine a difference between a communication quality metric for the tracked device measured by the first lighting control device and a communication quality metric for the tracked device measured by the second lighting control device;
  - determine whether the difference is greater than a threshold; and
  - based on a determination that the difference is greater than the threshold, retrieve an area of the first lighting control device, wherein the area location of the tracked device is determined to be the retrieved area of the first lighting control device.
14. The system controller of claim 13, wherein the control circuit being configured to determine the location of the tracked device further comprises the control circuit being configured to, based on a determination that the difference is greater than the threshold, retrieve a fixture location of the first lighting control device, wherein the fixture location of the tracked device is determined to be the retrieved fixture location of the first lighting control device.
15. The system controller of claim 13, wherein the control circuit being configured to determine the location of the tracked device further comprises the control circuit being configured to:

based on a determination that the difference is not greater than the threshold, retrieve areas associated with each of the one or more of the lighting control devices from which tracking data for the tracked device is received;

estimate, based on the table, a distance between the tracked device and each of the retrieved areas; and

determine, based on the estimated distance between the tracked device and each of the retrieved areas, an area that is closest to the tracked device, wherein the area location of the tracked device is determined to be the retrieved area that is closest to the tracked device.

16. The system controller of claim 13, wherein each of the lighting control devices are configured to control a lighting load that is comprised within a lighting fixture, and wherein the control circuit being configured to determine the location for the tracked device further comprises the control circuit being configured to:

based on a determination that the difference is not greater than the threshold, identify one or more fixture pairs from the one or more of the lighting control devices from which tracking data is received, wherein each of the one or more fixture pairs comprise adjacent lighting fixtures;

identify, based on the table, a fixture pair of the one or more fixture pairs that is closest to the tracked device; and

retrieve a fixture location of the identified fixture pair, wherein the fixture location of the tracked device is determined to be the retrieved fixture location of the identified fixture pair.

17. The system controller of claim 11, wherein the tracked device is associated with a transmit power, and wherein the communication quality metrics included within the table are calculated based on the processed communication quality metric comprised within each of the tracking data and the transmit power associated with the tracked device.

18. The system controller of claim 11, wherein each of the tracking data further comprises a communication quality metric.



19. The system controller of claim 11, wherein the control circuit is further configured to retrieve x-y coordinates for the tracked device based on the determined location of the tracked device.
20. The system controller of claim 11, wherein the control circuit is further configured to:  
determine, based on the table, location of the tracked device over a period of time;  
determine a most commonly determined location of the tracked device over the period of time; and  
report the most commonly determined location of the tracked device over the period of time.
21. A method for determining locations for tracked devices in a space, the method comprising:  
receiving tracking data for a tracked device from two or more lighting control devices, wherein each of the tracking data comprises a processed communication quality metric associated with the tracked device; and  
determining a location for the tracked device based on the processed communication quality metric comprised within each of the tracking data, wherein the location of the tracked device comprises one of an area location of the tracked device or a fixture location of the tracked device.
22. The method of claim 21, wherein determining the location for the tracked device further comprises:  
identifying, based on the tracking data, two of the two or more lighting control devices that are closest to the tracked device, wherein the two lighting control devices comprises a first lighting control device and a second lighting control device; and  
determining, based on the tracking data, that the first lighting control device is closer to the tracked device than the second lighting control device.
23. The method of claim 22, wherein determining the location for the tracked device further comprises:  
generating, based on the received tracking data, a table for the tracked device, wherein the table includes communication quality metrics associated with each of the two or more lighting

control devices from which tracking data is received, and wherein the two lighting control devices that are closest to the tracked device are identified based on the table for the tracked device.

24. The method of claim 23, wherein the tracked device is associated with a transmit power, and wherein the communication quality metrics included within the table are calculated based on the processed communication quality metric comprised within each of the tracking data and the transmit power associated with the tracked device.

25. The method of claim 23, wherein each of the tracking data further comprises a communication quality metric calculated by a respective lighting control device.

26. The method of claim 23, wherein determining the location for the tracked device further comprises:

- determining a difference between the communication quality metric measured by the first lighting control device and the communication quality metric measured by the second lighting control device;

- determining whether the difference is greater than a threshold; and

- based on a determination that the difference is greater than the threshold, retrieving an area of the first lighting control device, wherein the area location of the tracked device is determined to be the retrieved area of the first lighting control device.

27. The method of claim 26, wherein determining the location for the tracked device further comprises:

- based on a determination that the difference is not greater than the threshold, retrieving areas associated with each of the two or more lighting control devices from which tracking data for the tracked device is received;

- estimating a distance between the tracked device and each of the retrieved areas; and

- determining, based on the estimated distance between the tracked device and each of the retrieved areas, an area that is closest to the tracked device, wherein the area location of the tracked device is determined to be the area that is closest to the tracked device.

28. The method of claim 26, wherein determining the location for the tracked device further comprises, based on a determination that the difference is greater than the threshold, retrieving a fixture location of the first lighting control device, wherein the fixture location of the tracked device is determined to be the retrieved fixture location of the first lighting control device.

29. The method of claim 26, wherein each the two or more lighting control devices are configured to control a respective lighting load that is comprised within a lighting fixture, and wherein determining the location for the tracked device further comprises:

based on a determination that the difference is not greater than the threshold, identifying one or more fixture pairs from the two or more lighting control devices from which tracking data for the tracked device is received, wherein each of the one or more fixture pairs comprise adjacent lighting fixtures;

identifying a fixture pair of the one or more fixture pairs that is closest to the tracked device;  
and

retrieving a fixture location of the identified fixture pair, wherein the fixture location of the tracked device is determined to be the retrieved fixture location of the identified fixture pair.

30. The method of claim 21, wherein the determined location includes the fixture location, and wherein the method further comprises:

retrieving a floorplan for the space, wherein the floorplan includes coordinates for each of the two or more load control devices,

determining, based on the determined location for the tracked device, coordinates for the tracked device, and

displaying a representation of the floorplan for the space, wherein the representation comprises an indication of the determined coordinates for the more tracked device.

31. The method of claim 21, wherein the determined location includes the area location, and wherein the method further comprises:

retrieving a floorplan for the space, wherein the floorplan includes coordinates for each of the two or more load control devices,  
determining, based on the determined location for the tracked device, an area on the floorplan for the tracked device, and  
displaying a representation of the floorplan for the space, wherein the representation comprises an indication of the area on the floorplan for the more tracked device.

32. A method comprising:

receiving tracking data for a tracked device from one or more lighting control devices, wherein each of the tracking data comprises a communication quality metric associated with the tracked device; and

determining a location for the tracked device based on the communication quality metric comprised within each of the tracking data, wherein the location of the tracked device comprises one of an area location of the tracked device or a fixture location of the tracked device.

33. The method of claim 32, further comprising:

identifying, based on the tracking data, two lighting control devices of the plurality of lighting control devices that are closest to the tracked device, wherein the two lighting control devices comprise a first lighting control device and a second lighting control device; and

determining, based on the tracking data, that the first lighting control device is closer to the tracked device than the second lighting control device.

34. The method of claim 33, further comprising:

generating, based on the received tracking data, a path loss table for the tracked device, wherein the path loss table includes path loss values associated with each of the one more of the plurality of lighting control devices from which tracking data is received, and wherein the two lighting control devices that are closest to the tracked device are identified based on the path loss table for the tracked device.

35. The method of claim 34, wherein the tracked device is associated with a transmit power, and wherein the path loss values included within the path loss table are calculated based on the processed communication quality metric comprised within each of the tracking data and the transmit power associated with the tracked device.

36. The method of claim 34, wherein each of the tracking data further comprises a path loss value calculated by a respective lighting control device.

37. The method of claim 33, further comprising:

determining a difference between the communication quality metric measured by the first lighting control device and communication quality metric measured by the second lighting control device;

determining whether the difference is greater than a threshold; and

based on a determination that the difference is greater than the threshold, retrieving an area of the first lighting control device, wherein the area location of the tracked device is determined to be the retrieved area of the first lighting control device.

38. The method of claim 37, further comprising:

based on a determination that the difference is not greater than the threshold, retrieving areas associated with the one or more of the plurality of lighting control devices from which tracking data for the tracked device is received;

estimating, based on the tracking data, a distance between the tracked device and each of the retrieved areas; and

determining, based on the estimate distance between the tracked device and each of the retrieved areas, an area that is closest to the tracked device, wherein the area location of the tracked device is determined to be the area that is closest to the tracked device.

39. The method of claim 37, further comprising, based on a determination that the difference is greater than the threshold, retrieving a fixture location of the first lighting control device, wherein

the fixture location of the tracked device is determined to be the retrieved fixture location of the first lighting control device.

40. The method of claim 37, wherein the at least one of the plurality of lighting loads that each of the plurality of lighting control devices are configured to control are comprised within lighting fixtures, and wherein the method further comprises:

based on a determination that the difference is not greater than the threshold, identifying one or more fixture pairs from the one or more of the plurality of lighting control devices from which tracking data for the tracked device is received, wherein each of the one or more fixture pairs comprise adjacent lighting fixtures;

identifying a fixture pair of the one or more fixture pair that is closest to the tracked device; and

retrieving a fixture location of the identified fixture pair, wherein the fixture location of the tracked device is determined to be the retrieved fixture location of the identified fixture pair.

41. A system controller, comprising:

a communications circuit wherein the communications circuit is configured to communicate messages for controlling lighting control devices via a wireless communications network, and wherein the communication circuit is further configured to receive tracking data from the lighting control devices; and

a control circuit configured to:

transmit and receive messages for controlling one or more of the plurality of lighting loads via the wireless communication network;

receive tracking data for a tracked device from one or more of the plurality of lighting control devices, wherein each of the tracking data comprises a processed path loss value associated with the tracked device;

retrieve areas associated with each of the one or more of the lighting control devices from which tracking data for the tracked device is received;

calculate an average path loss for each of the retrieved areas;

determine an area of the retrieved areas with a lowest average path loss; and

determine an area location of the tracked device, wherein the area location of the tracked device is determined to be the area with the lowest average path loss.

42. The system controller of claim 41, wherein the control circuit is further configured to retrieve x-y coordinates for the tracked device based on the determined area location of the tracked device.

43. The system controller of claim 41, wherein the control circuit is further configured to:  
determine, based on the tracking data for the tracked device received over a period of time, an area location of the tracked device over the period of time;  
determine a most commonly determined area location of the tracked device over the period of time; and  
report the most commonly determined area location of the tracked device over the period of time.

44. The system controller of claim 41, wherein the control circuit is further configured to:  
generate, based on the received tracking data, a path loss table for the tracked device, wherein the path loss table includes path loss values associated with each of the one more of the plurality of lighting control devices from which tracking data is received;  
identify, based on the path loss table, a first lighting control device and a second lighting control device, wherein the first lighting control device and the second lighting control device are associated with the two lowest path loss values in the path loss table;  
determine a difference between a path loss value associated with the first lighting control device and a path loss value associated with the second lighting control device;  
determine whether the difference is greater than a threshold;  
based on a determination that the difference is greater than the threshold, retrieve an area of the first lighting control device; and  
determine the area location of the tracked device, wherein the area location of the tracked device is determined to be the retrieved area of the first lighting control device.

45. A system controller, comprising:

a communications circuit wherein the communications circuit is configured to communicate messages for controlling lighting control devices via a wireless communications network, and wherein the communication circuit is further configured to receive tracking data from the lighting control devices; and

a control circuit configured to:

transmit and receive messages for controlling one or more of the plurality of lighting loads via the wireless communication network;

receive tracking data for a tracked device from one or more of the plurality of lighting control devices, wherein each of the tracking data comprises a processed path loss value associated with the tracked device;

identify one or more fixture pairs from the one or more of the plurality of lighting control devices from which tracking data for the tracked device is received, wherein each of the one or more fixture pairs comprise adjacent lighting fixtures;

calculate a combined path loss for each of the one or more fixture pairs;

identify, from the one or more fixture pairs, a fixture pair with a lowest combine path loss; and

determine a fixture location of the tracked device, wherein the fixture location of the tracked device is determined to be the fixture pair with the lowest combine path loss.

46. The system controller of claim 45, wherein the control circuit is further configure to:

retrieve a floorplan for a space that includes the plurality of light control devices, wherein the floorplan includes coordinates for each of one or more fixture pairs; and

determine, based on the determined fixture location of the tracked device, coordinates for the tracked device.

47. The system controller of claim 45, wherein the control circuit is further configure to:

determine, based on tracking data received for the tracked device over a period of time, a fixture location of the tracked device over the period of time;



determine a most commonly determined fixture location of the tracked device over the period of time; and

report the most commonly determined fixture location of the tracked device over the period of time.

48. The system controller of claim 44, wherein the control circuit is further configured to:

generate, based on the received tracking data, a path loss table for the tracked device, wherein the path loss table includes path loss values associated with each of the one more of the plurality of lighting control devices from which tracking data is received;

identify, based on the path loss table, a first lighting control device and a second lighting control device, wherein the first lighting control device and the second lighting control device are associated with the two lowest path loss values in the path loss table;

determine a difference between a path loss value associated with the first lighting control device and a path loss value associated with the second lighting control device;

determine whether the difference is greater than a threshold;

based on a determination that the difference is greater than the threshold, retrieve an area of the first lighting control device; and

determine the area location of the tracked device, wherein the area location of the tracked device is determined to be the retrieved area of the first lighting control device.

49. A method for determining locations of tracked devices in a space, the method comprising:

receiving tracking data for a tracked device from one or more of the plurality of lighting control devices, wherein each of the tracking data comprises a processed path loss value associated with the tracked device;

retrieving areas associated with each of the one or more of the lighting control devices from which tracking data for the tracked device is received;

calculating an average path loss for each of the retrieved areas;

determining an area of the retrieved areas with a lowest average path loss; and

determining an area location of the tracked device, wherein the area location of the tracked device is determined to be the area with the lowest average path loss.

50. The method of claim 49, further comprising retrieving x-y coordinates for the tracked device based on the determined area location of the tracked device.

51. The method of claim 49, further comprising:  
determining, based on the tracking data received for the tracked device over a period of time, an area location of the tracked device over the period of time;  
determining a most commonly determined area location of the tracked device over the period of time; and  
reporting the most commonly determined area location of the tracked device over the period of time.

52. The method of claim 49, further comprising:  
generating, based on the received tracking data, a path loss table for the tracked device, wherein the path loss table includes path loss values associated with each of the one more of the plurality of lighting control devices from which tracking data is received;  
identifying, based on the path loss table, a first lighting control device and a second lighting control device, wherein the first lighting control device and the second lighting control device are associated with the two lowest path loss values in the path loss table;  
determining a difference between a path loss value associated with the first lighting control device and a path loss value associated with the second lighting control device;  
determining whether the difference is greater than a threshold;  
based on a determination that the difference is greater than the threshold, retrieving an area of the first lighting control device; and  
determine the area location of the tracked device, wherein the area location of the tracked device is determined to be the retrieved area of the first lighting control device.

53. A method for determining locations of tracked devices in a space, the method comprising:

receiving tracking data for a tracked device from one or more of the plurality of lighting control devices, wherein each of the tracking data comprises a processed path loss value associated with the tracked device;

identifying one or more fixture pairs from the one or more of the plurality of lighting control devices from which tracking data for the tracked device is received, wherein each of the one or more fixture pairs comprise adjacent lighting fixtures;

calculating a combined path loss for each of the one or more fixture pairs;

identifying, from the one or more fixture pairs, a fixture pair with a lowest combine path loss;  
and

determining a fixture location of the tracked device, wherein the fixture location of the tracked device is determined to be the fixture pair with the lowest combine path loss.

54. The method of claim 53, further comprising:

retrieving a floorplan for a space that includes the plurality of light control devices, wherein the floorplan includes coordinates for each of one or more fixture pairs; and

determining, based on the determined fixture location of the tracked device, coordinates for the tracked device.

55. The method of claim 53, further comprising:

determining, based on tracking data received for the tracked device over a period of time, a fixture location of the tracked device over the period of time;

determining a most commonly determined fixture location of the tracked device over the period of time; and

reporting the most commonly determined fixture location of the tracked device over the period of time.

56. The method of claim 53, further comprising:

generating, based on the received tracking data, a path loss table for the tracked device, wherein the path loss table includes path loss values associated with each of the one more of the plurality of lighting control devices from which tracking data is received;

identifying, based on the path loss table, a first lighting control device and a second lighting control device, wherein the first lighting control device and the second lighting control device are associated with the two lowest path loss values in the path loss table;

determining a difference between a path loss value associated with the first lighting control device and a path loss value associated with the second lighting control device;

determining whether the difference is greater than a threshold;

based on a determination that the difference is greater than the threshold, retrieving an area of the first lighting control device; and

determining the area location of the tracked device, wherein the area location of the tracked device is determined to be the retrieved area of the first lighting control device.

57. A device comprising:

a control circuit configured to:

receive tracking data for a tracked device from two or more lighting control devices, wherein each of the tracking data comprises a processed communication quality metric associated with the tracked device; and

determine a location for the tracked device based on the processed communication quality metric comprised within each of the tracking data, wherein the location of the tracked device comprises one of an area location of the tracked device or a fixture location of the tracked device.

58. The device of claim 57, wherein the control circuit is further configured to:

identify, based on the tracking data, two of the two or more lighting control devices that are closest to the tracked device, wherein the two lighting control devices comprises a first lighting control device and a second lighting control device; and

determine, based on the tracking data, that the first lighting control device is closer to the tracked device than the second lighting control device.

59. The device of claim 58, wherein the control circuit is further configured to:

generate, based on the received tracking data, a table for the tracked device, wherein the table includes communication quality metrics associated with each of the two or more lighting control devices from which tracking data is received, and wherein the two lighting control devices that are closest to the tracked device are identified based on the table for the tracked device.

60. The device of claim 59, wherein the tracked device is associated with a transmit power, and wherein the communication quality metrics included within the table are calculated based on the processed communication quality metric comprised within each of the tracking data and the transmit power associated with the tracked device.

61. The device of claim 59, wherein each of the tracking data further comprises a communication quality metric calculated by a respective lighting control device.

62. The device of claim 59, wherein the control circuit is further configured to:  
determine a difference between the communication quality metric measured by the first lighting control device and the communication quality metric measured by the second lighting control device;  
determine whether the difference is greater than a threshold; and  
based on a determination that the difference is greater than the threshold, retrieve an area of the first lighting control device, wherein the area location of the tracked device is determined to be the retrieved area of the first lighting control device.

63. The device of claim 62, wherein the control circuit is further configured to:  
based on a determination that the difference is not greater than the threshold, retrieve areas associated with each of the two or more lighting control devices from which tracking data for the tracked device is received;  
estimate a distance between the tracked device and each of the retrieved areas; and  
determine, based on the estimated distance between the tracked device and each of the retrieved areas, an area that is closest to the tracked device, wherein the area location of the tracked device is determined to be the area that is closest to the tracked device.

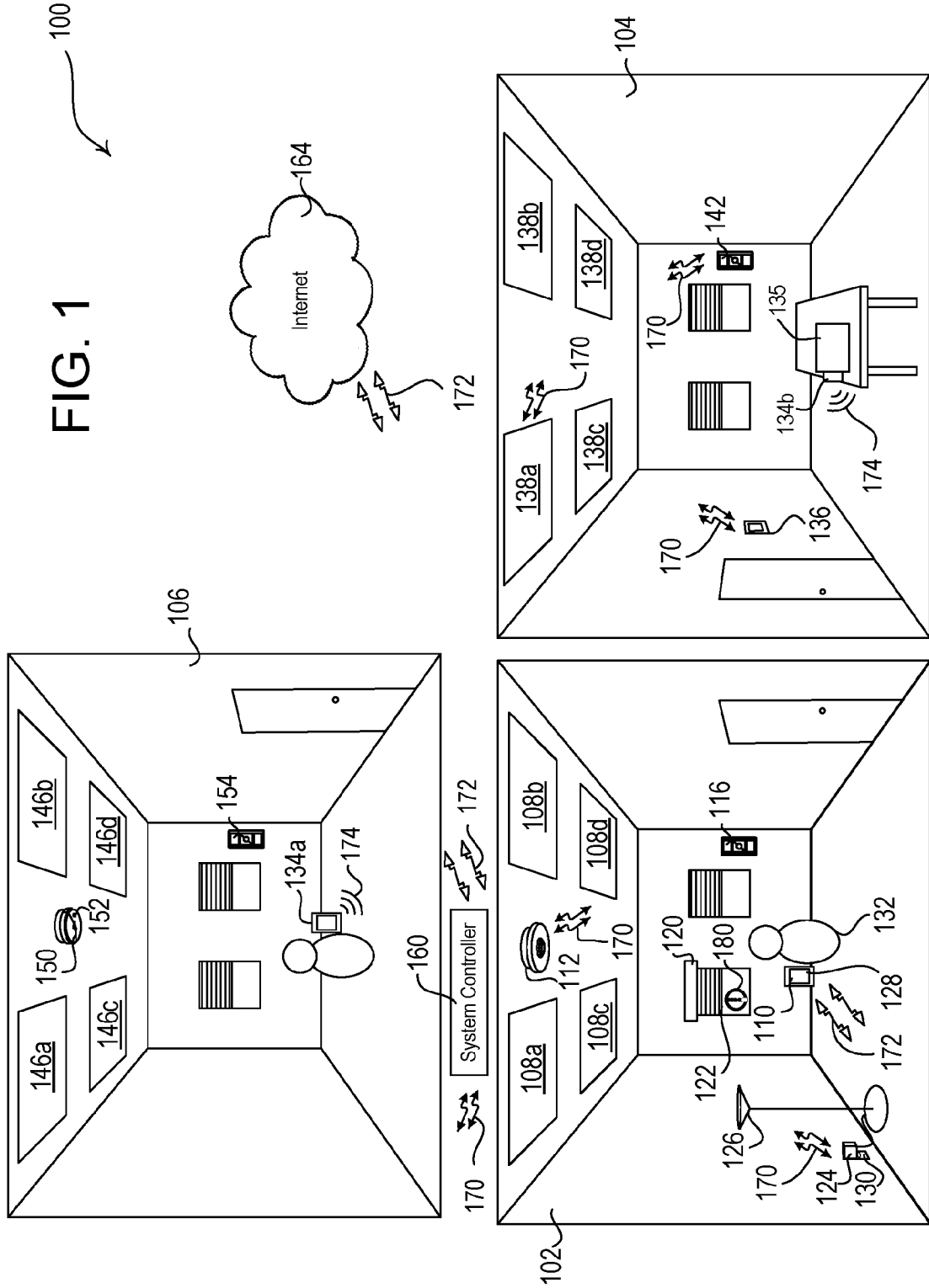
64. The device of claim 62, wherein the control circuit is further configured to, based on a determination that the difference is greater than the threshold, retrieve a fixture location of the first lighting control device, wherein the fixture location of the tracked device is determined to be the retrieved fixture location of the first lighting control device.

65. The device of claim 62, wherein each the two or more lighting control devices are configured to control a respective lighting load that is comprised within a lighting fixture, and wherein the control circuit is further configured to:

based on a determination that the difference is not greater than the threshold, identify one or more fixture pairs from the two or more lighting control devices from which tracking data for the tracked device is received, wherein each of the one or more fixture pairs comprise adjacent lighting fixtures;

identify a fixture pair of the one or more fixture pairs that is closest to the tracked device; and

retrieve a fixture location of the identified fixture pair, wherein the fixture location of the tracked device is determined to be the retrieved fixture location of the identified fixture pair.



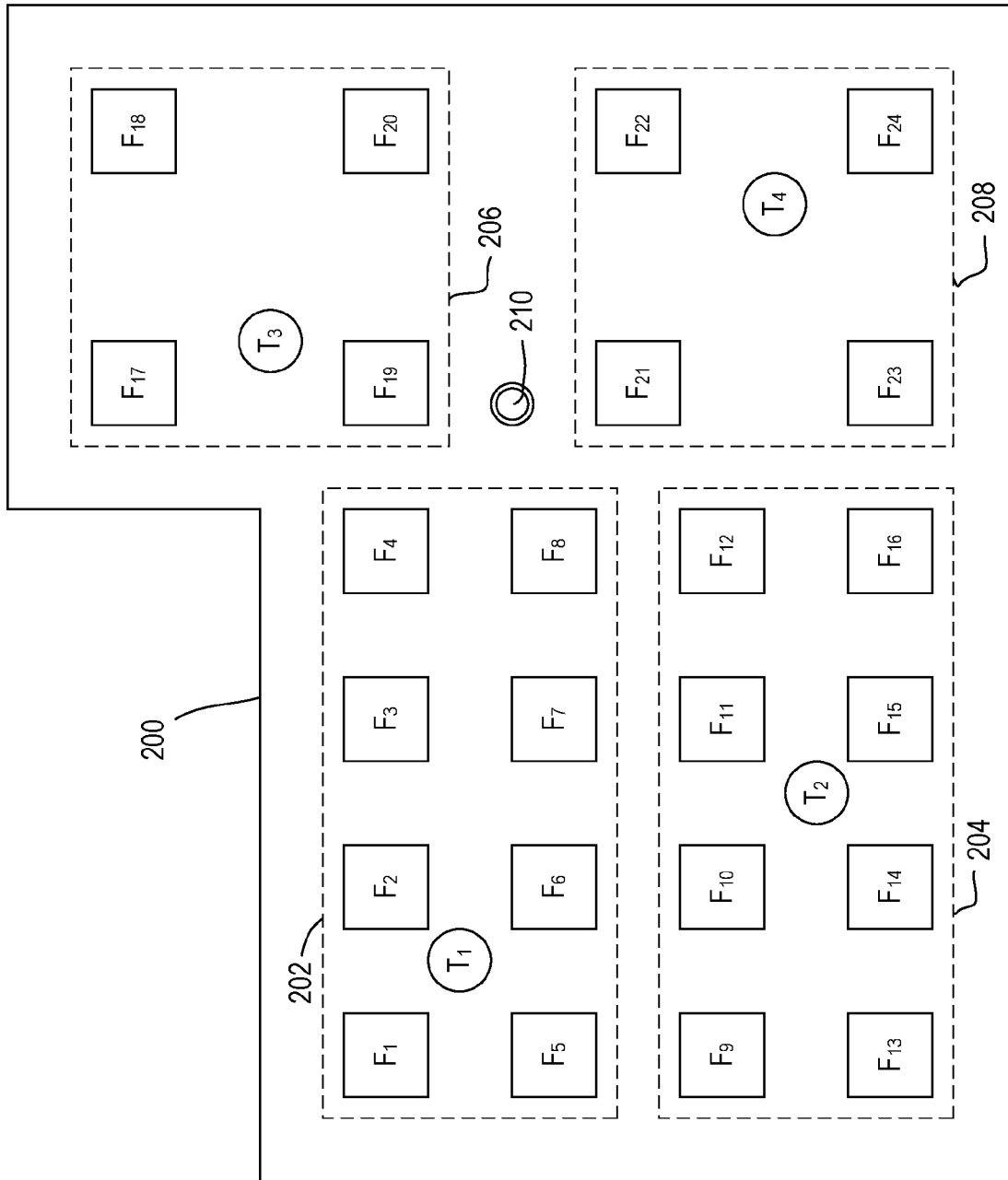


FIG. 2



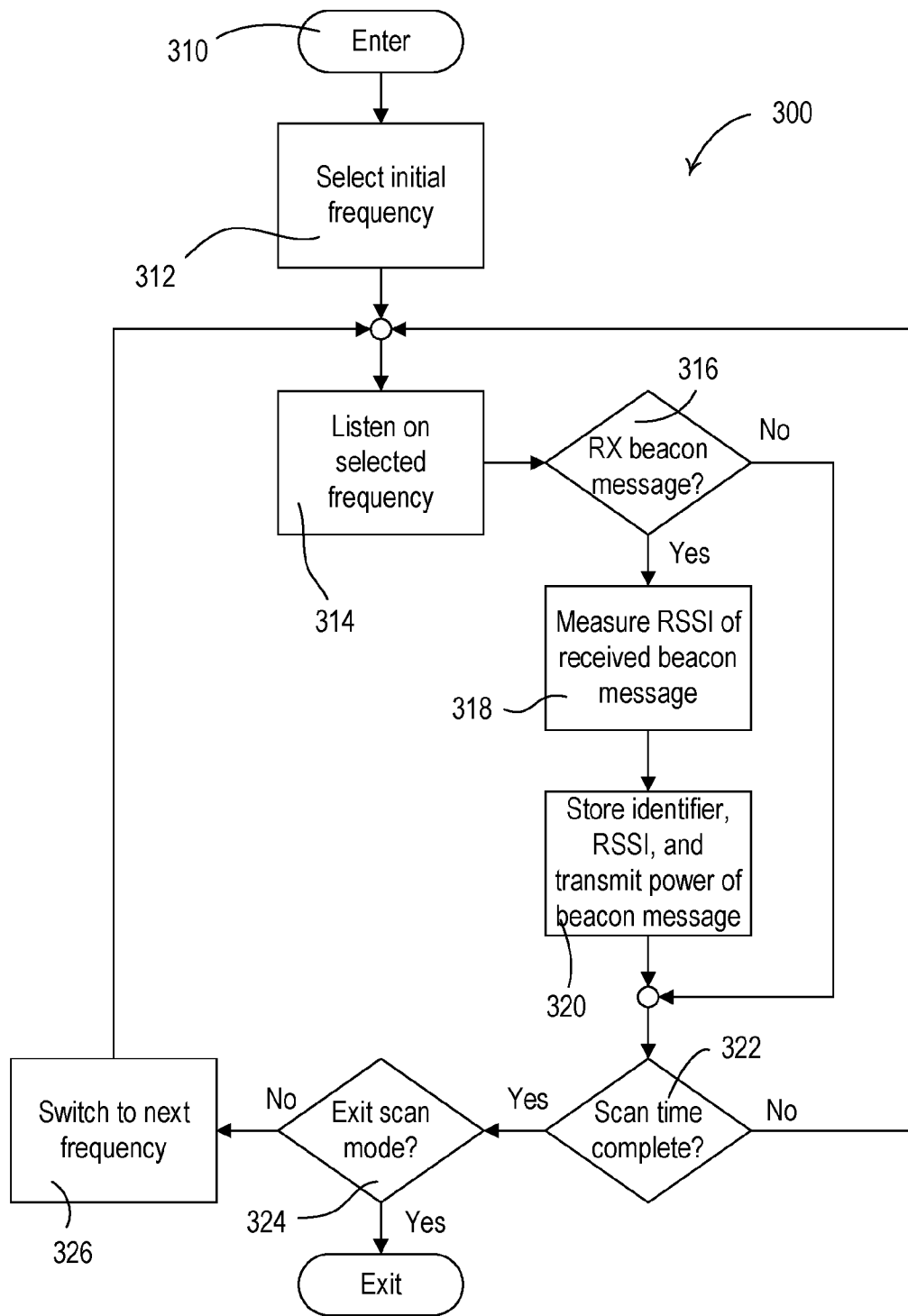


FIG. 3

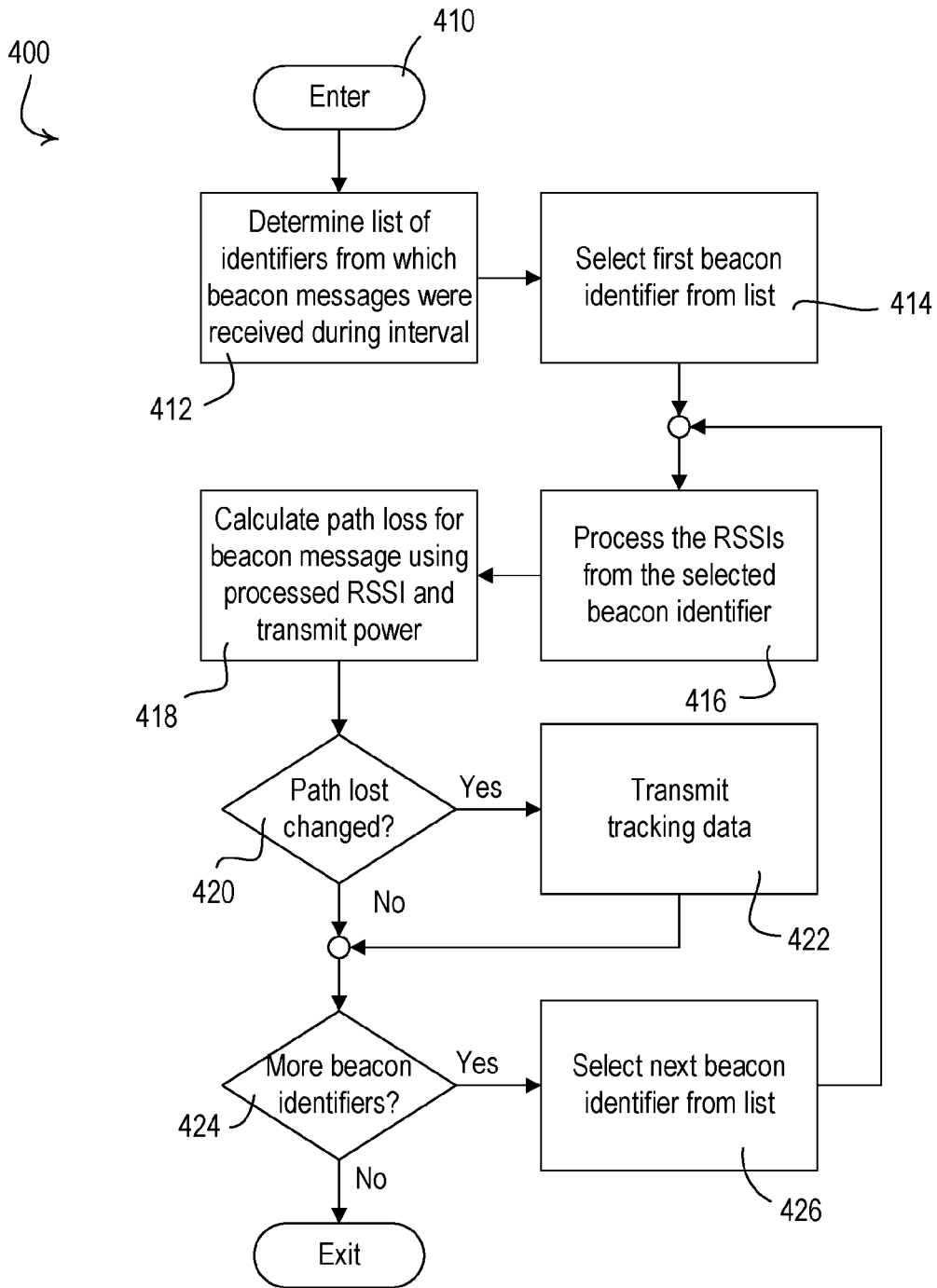


FIG. 4

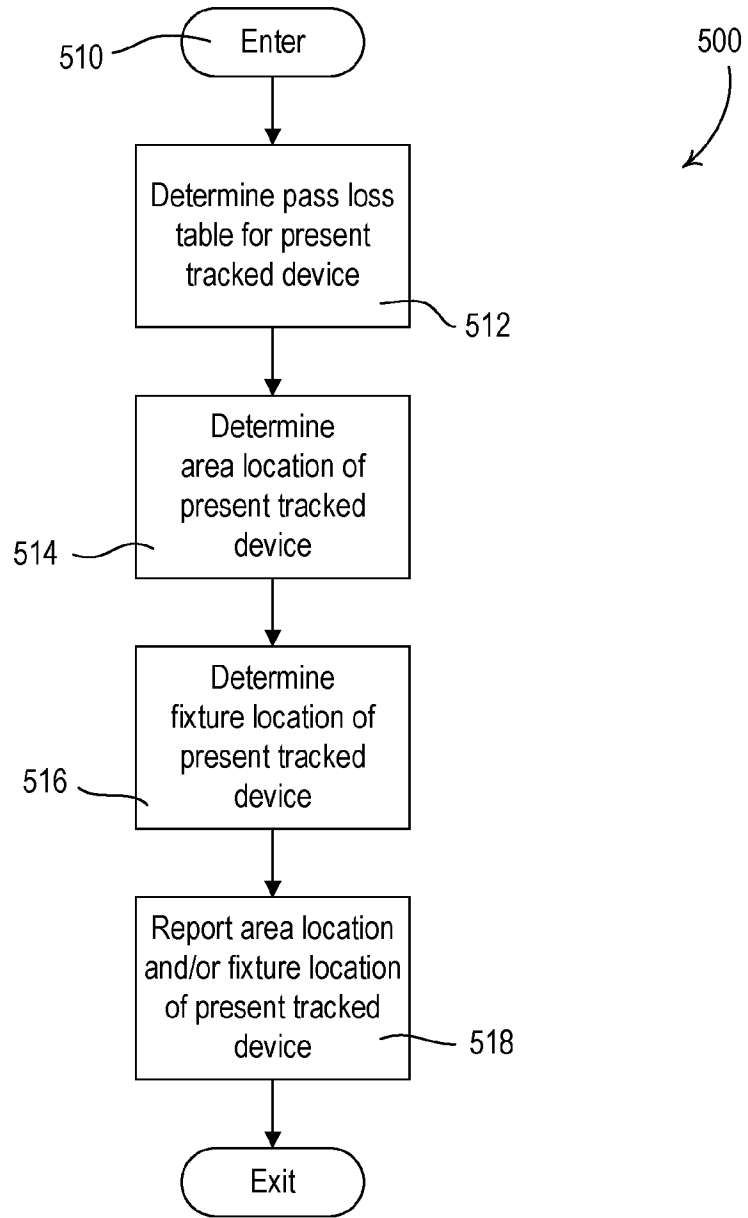


FIG. 5

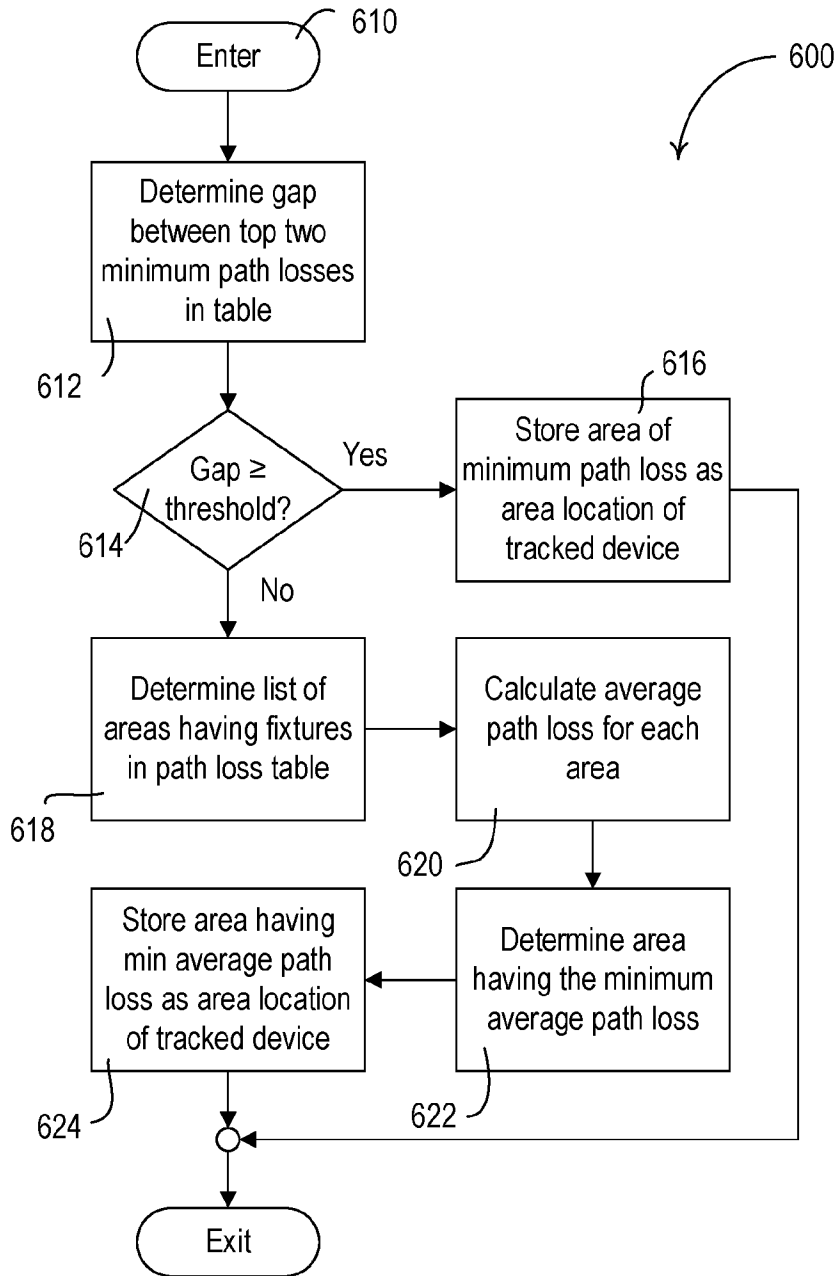


FIG. 6

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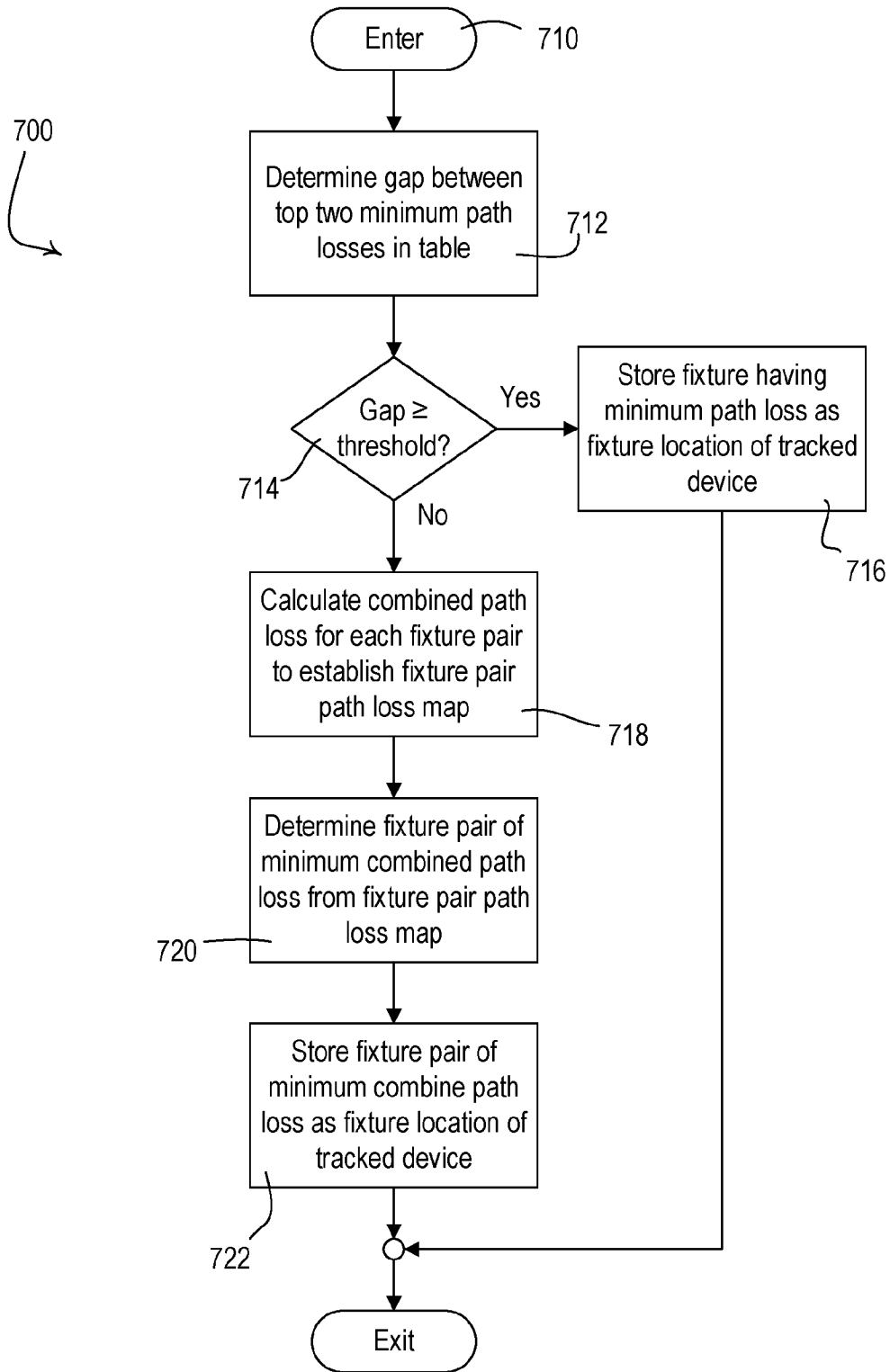


FIG. 7

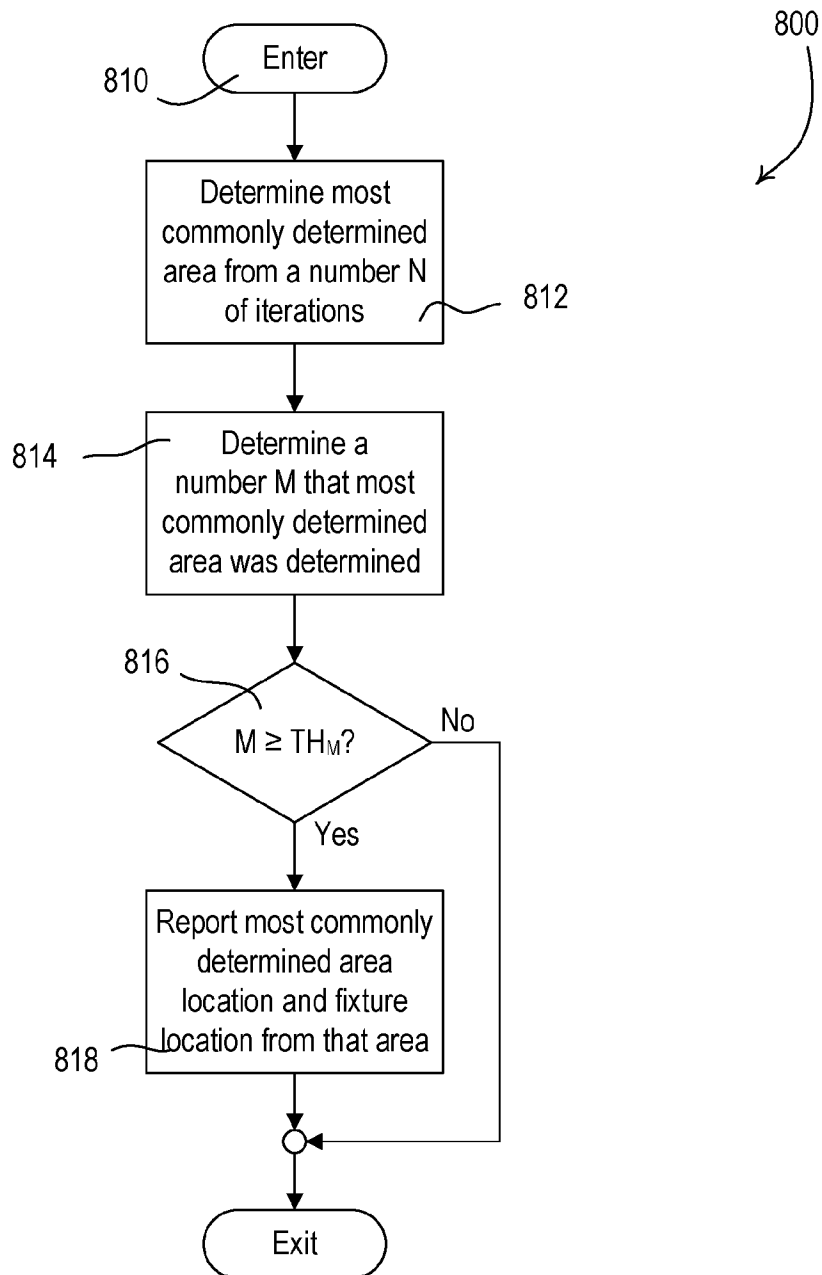


FIG. 8

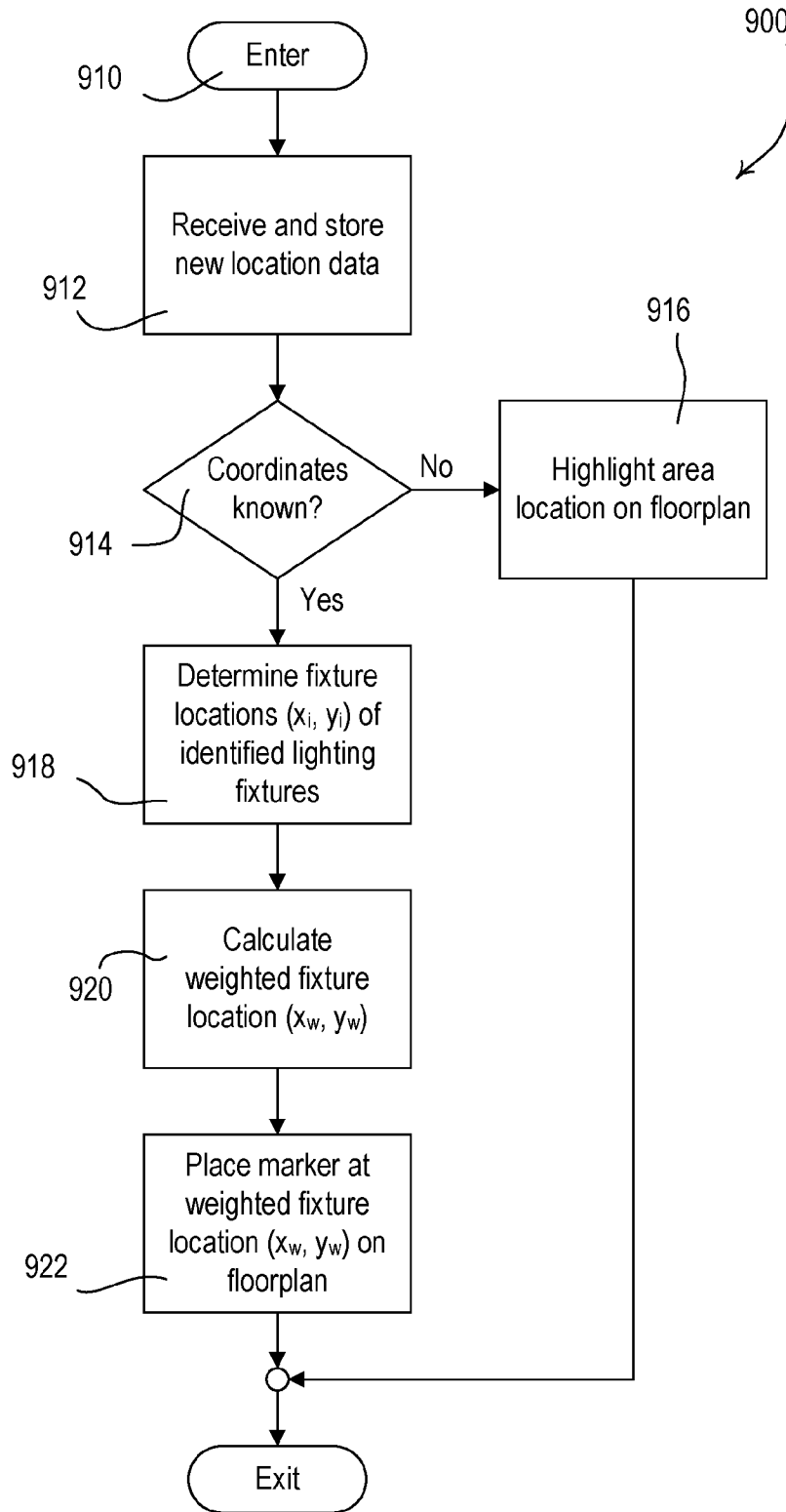


FIG. 9

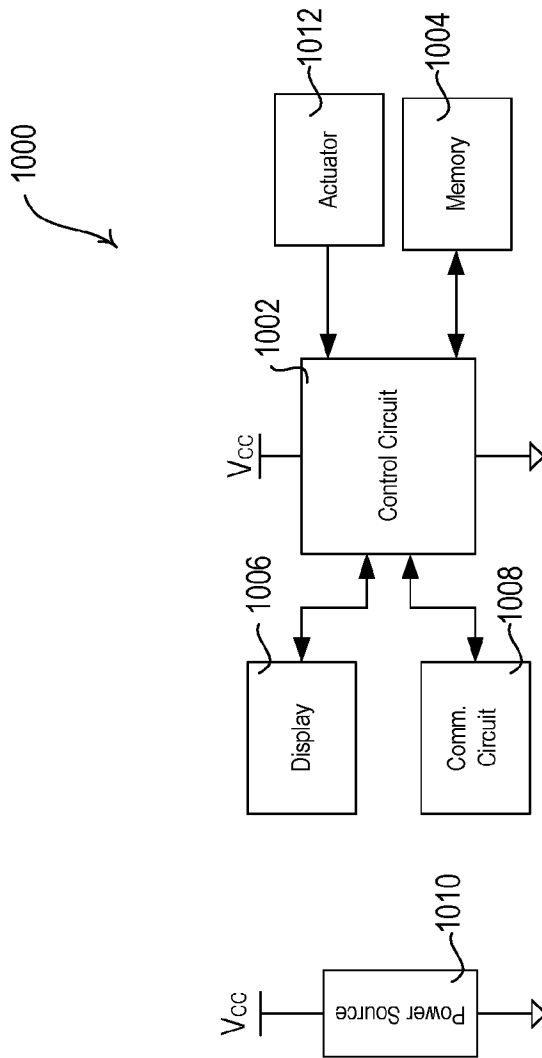


FIG. 10



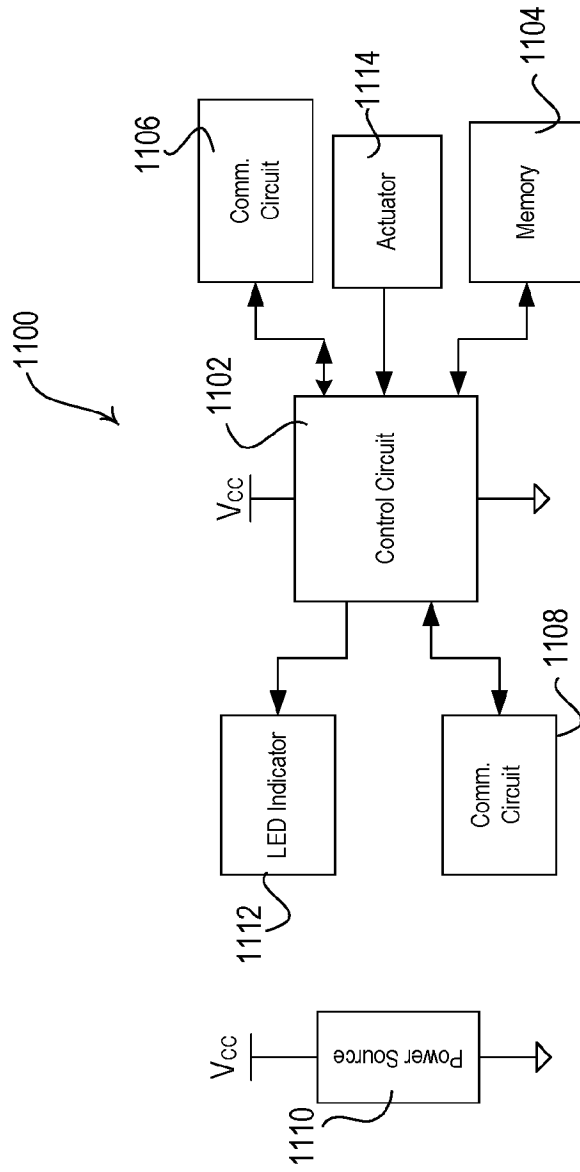


FIG. 11

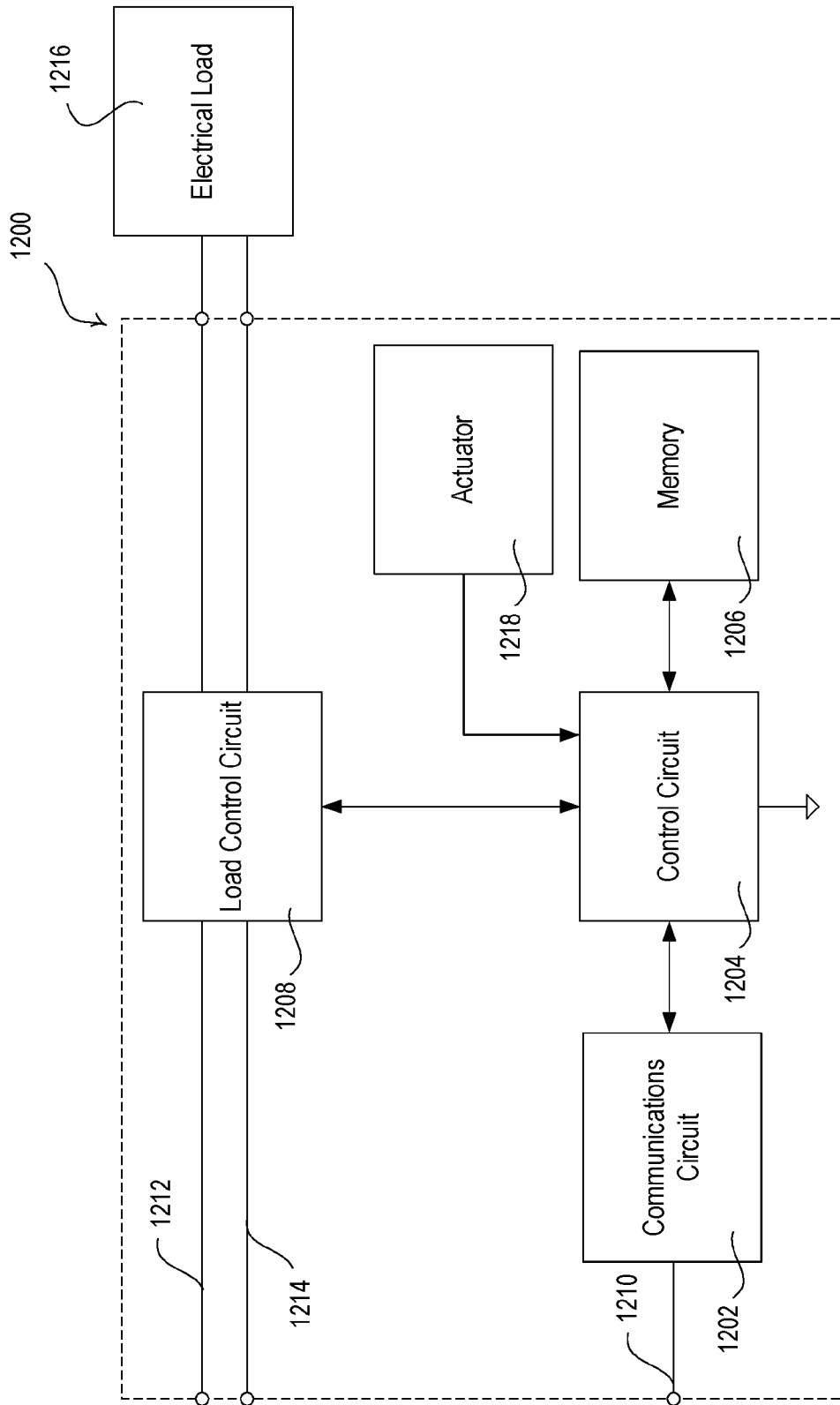


FIG. 12

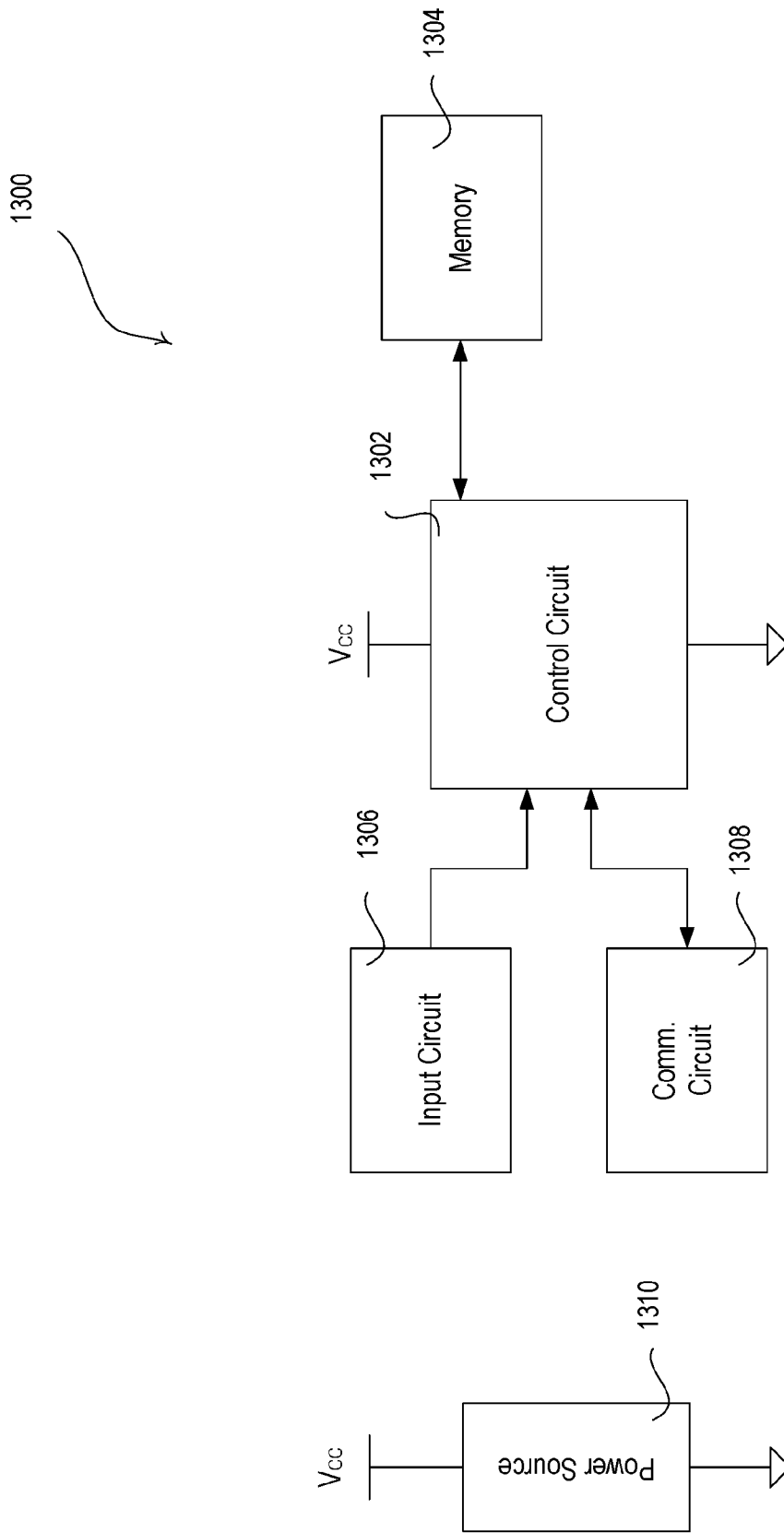


Fig. 13

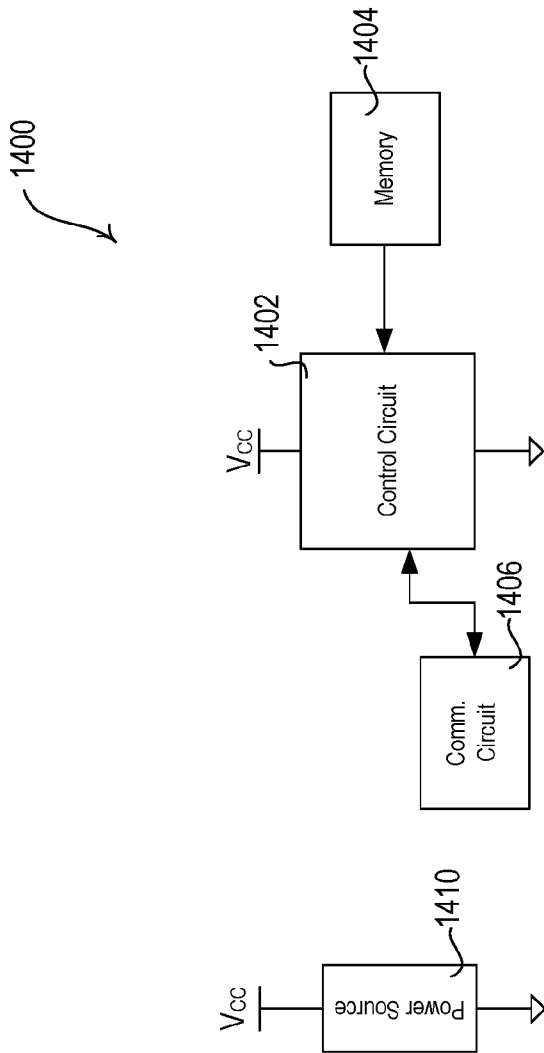


FIG. 14



## INTERNATIONAL SEARCH REPORT

International application No

PCT/US2021/061892

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A	<p>column 1, lines 23-25; figures 1-24  column 3, line 19 - column 56, line 3</p>	2-9, 12-16, 20, 22-29, 33-56, 58-65
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