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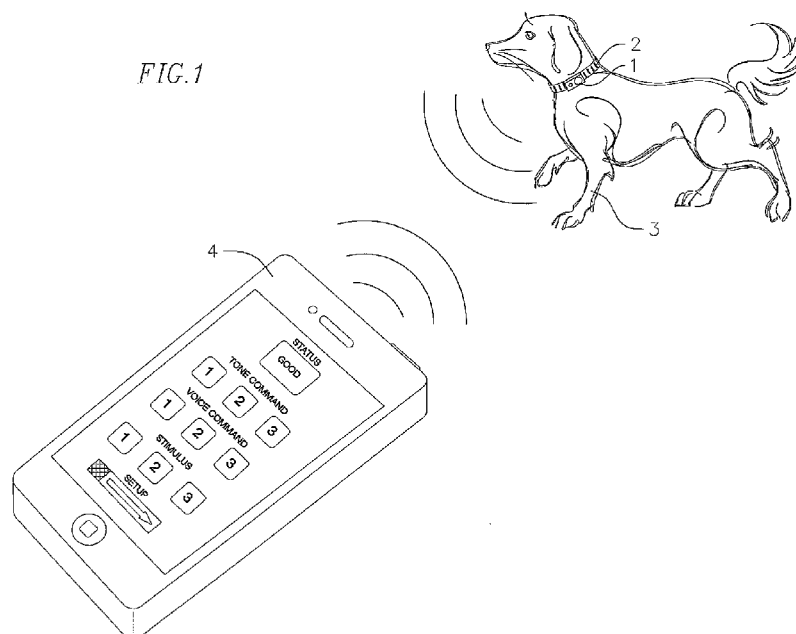
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(54) Title: WIRELESS ANIMAL TRAINING, MONITORING AND REMOTE CONTROL SYSTEM



(57) Abstract: An animal training and/or monitoring system and an animal -worn device that is capable of receiving and sending various inputs and outputs, respectively, from/to a wireless mobile device. The wireless mobile device has a software application that allows a human user to wirelessly communicate with the animal-worn transceiver via direct, networked or cellular wireless protocols. The animal-worn device interacts with the applications on the wireless mobile device to allow for a variety of functions, such as the transfer of commands or stimuli to the animal, the transfer of data regarding the animal or its environment to the wireless mobile device, and/or the transfer of instructions from the animal-worn device to an external device. The wireless mobile device may also transmit new firmware to the animal-worn device to modify its inputs and outputs.

# WIRELESS ANIMAL TRAINING, MONITORING AND REMOTE CONTROL SYSTEM

## BACKGROUND

[0001] Conventional wireless dog training systems, commonly known as electric fence systems, use a transmitter to transmit radio signals to a dog collar in order to determine the dog's location. These systems can apply various stimuli to the dog via the dog collar in order to train the dog to not leave the electric fence perimeter. Electric fence systems typically operate in the 28 to 433 MHz range as allowed by the FCC or the regulatory agency of the particular county or region in which the system is used. Such systems typically have a fixed set of controls at the transmitter and a fixed number of outputs at the collar with no means to monitor the behavior of the animal or record the effect of the collar's outputs on the animal. The receiver used by such dog collars systems have no capability to send data back to a human operator.

[0002] Unlike in the electric fence industry, in the field of wireless mobile device technology, external devices exist that have the capability to send data back to a human operator. External devices, such as heart rate monitors, are capable of providing information regarding the human using the external device back to a wireless mobile device. There are several commercially available protocols that link external devices to a wireless mobile device in real time to provide information regarding the human operator. Such available protocols may include networked, point-to-point and cellular protocols, the most commonly used wireless protocols being Bluetooth and Wi-Fi. For example, wireless mobile devices may be linked via a wireless protocol to external fitness devices that contain human fitness monitoring inputs. A software application in the wireless mobile device analyses the data from the fitness device and provides a human user with information regarding the fitness of the human user that may be useful in structuring an exercise routine.

[0003] However, systems involving external devices and wireless mobile devices that relay information regarding the state of an animal, such as a pet, to the human user are far more limited in capabilities and scope, focusing primarily on the location of the animal. One current system uses a smart phone to display the location of an animal-worn device. Location information is determined by a GPS locator in the device and that information is communicated to the smart phone via a cellular network. Another similar system, designed to locate an animal via GPS and display the location with a smart phone, also communicates limited information related to the animal's movements such as the speed and distance the animal has traveled during a certain period of time. Such information is collected at the collar presumably from an accelerometer and from the GPS data stored in the animal-worn device and then transmitted to the smart phone via a cellular network at some later point in time.

1 [0004] Another system, designed to contain an animal within a predetermined boundary,  
uses high frequency radio frequency coupling of a base transceiver and animal-worn device.  
Two-way communication between the transceivers is primarily for the purpose of ranging  
between the transceivers using chirp spread spectrum techniques to determine the time of  
5 flight of the signal and therefore, the distance between the two devices. When the animal-  
worn device is at a distance from the base transceiver greater than a predetermined value, the  
animal automatically receives a corrective stimulus generated by the animal-worn device.  
Information available to the human user is limited to what can be surmised by the ranging  
data, such as number of times the animal has breached the boundary.

10 [0005] Another system is a trackable sticker that can be adhered to an item, such as car  
keys or a pet, and tracked with a mobile device application. The sticker transmits a signal via  
Bluetooth technology to a mobile device for the purpose of locating said item via Received  
Signal Strength Indication (RSSI). The mobile device application allows the human user to  
set an alarm if the item leaves a selected range or comes within a selected range.

15 [0006] Finally, there exists a system, developed by the current inventor, that uses an  
animal-worn collar to control animal devices via an ultrasonic control signal. (*See* Bonge,  
U.S. Patent No. 5,872,516 and U.S. Patent No. RE41,629.) This system provides a one-way  
communication from an animal-worn collar to a remote device but does not allow for the  
flow of data from the collar to the human operator.

20 [0007] Although these systems can be used for locating animals, there is a need for a  
system that allows communication between an animal-worn device and a wireless mobile  
device to facilitate two-way communication between a wireless mobile device and an animal-  
worn device whereby the animal-worn device has inputs and outputs allowing a human to  
send real-time training stimuli to the animal and/or to collect useful data in real-time from the  
25 animal-worn device.

[0008] It is also desirable to create a system and method for a human to establish  
communication with the animal-worn device for the purpose of training and conditioning the  
health and fitness of the animal. It is further desirable for the system to allow the human to  
change and redefine commands or outputs as necessary and to input information pertaining to  
30 the specific characteristics of the animal, such as species, breed, size, weight, age and the  
like. It is further desirable to integrate into an animal-worn device a device to allow an animal  
wearing the transceiver to control other apparatuses in said animal's environment, for  
example, an automatic pet door.

## 35 SUMMARY

[0009] Embodiments of the current invention provide a powerful tool for remotely  
training animals and/or monitoring different aspects pertaining to an animal, such as its  
behavior, health, fitness and environment. Embodiments provide a multi-functional animal-

1 worn device capable of receiving and sending various inputs and outputs, respectively,  
from/to a wireless mobile device. For example, signals may be sent from the wireless mobile  
device to activate outputs at the animal-worn device and the animal-worn device may send  
back acknowledgement of signal receipt and confirmation that a certain function was  
5 successfully performed. The animal-worn device may also collect data pertaining to its  
inputs and wirelessly send it to the wireless mobile device. Embodiments of the animal-worn  
device may interact with software applications on the wireless mobile device to allow for a  
variety of functions, including, but not limited to, the transfer of commands or stimuli to the  
animal, the transfer of data regarding the animal or its environment to the wireless mobile  
10 device, and/or the transfer of instructions from the animal-worn device to an external device.  
The animal-worn device may include all or some of these various functions.

**[0010]** Commercially available wireless mobile devices used for the animal training  
and/or monitoring system may include a variety of known mobile devices that contain  
wireless communication functionality, such as smart phones and tablets. Commands, data  
15 and firmware may be sent to the animal-worn device from the wireless mobile device  
utilizing the mobile device's existing communication protocols. The communication  
protocol used may be, for example, point-to-point, networked or cellular communication  
protocols. Commonly used networked and point-to-point communication protocols include  
WiFi and Bluetooth, respectively. The most commonly used cellular communication protocol  
20 makes use of GSM (Global System for Mobile Communications) or CDMA (Code Division  
Multiple Access) protocols. Any of these protocols may facilitate one-way or two-way  
wireless communication between the human and the animal-worn device.

**[0011]** Making use of the wireless and application executing capabilities of commercially  
available wireless mobile devices and coupling such mobile devices to the animal-worn  
25 device, further embodiments provide an animal training and/or monitoring system that a  
human user may configure with incredible flexibility. Wireless mobile device applications  
may be specifically tailored to the needs of a particular individual or group, such as  
sportsmen, law enforcement or pet owners, and may be changed and updated by wirelessly  
modifying the animal-worn devices without the requirement of physical changes to the  
30 animal-worn devices. In some embodiments, wireless mobile device applications may be  
able to send alerts, such as via email, SMS, website postings (e.g., Facebook, Twitter, etc.) or  
instant messaging, alerting the user of the condition of the animal based on information  
received from the animal-worn device.

**[0012]** Some embodiments of the invention utilize the wireless capability of the animal-  
worn devices to allow the animal to control external devices. For example, some  
35 embodiments of the invention allow the animal to control remotely operated devices, such as  
pet doors or automatic feeders, via wireless communications protocols. Other embodiments  
may also (or alternatively) provide a system for animals to control remotely operated

1 apparatus such as electronic fences, barriers and the like. Accordingly, the animal-worn device may use signals emitted by various external devices as data inputs or to control its outputs.

5 [0013] Embodiments of the current invention may include one or more inputs at the animal-worn device, including, for example, a transceiver to receive inputs from the wireless mobile device, a vibration sensor, a temperature sensor, an accelerometer, a microphone, an audio recorder, a heart rate monitor, a magnetometer, a GPS locator, an auxiliary radio receiver, a photosensor, a conductivity sensor, a humidity sensor, a water sensor, a gyroscope and a camera. Embodiments of the current invention may include one or more outputs at the  
10 animal-worn device, including, for example, a transceiver to send inputs to the wireless mobile device, a shock generator, a spray module, an audio processor, a tone generator, a speaker, a lamp, a vibration generator and an auxiliary radio transmitter. Although certain embodiments detailed herein describe various uses for the various inputs and outputs, these are merely a representative few of the numerous applications that these inputs and outputs  
15 that can provide within the scope of the invention.

[0014] Some embodiments of the invention allow the human operating the wireless mobile device to activate training stimuli to train and condition the animal using some of the above inputs and outputs. For example, some embodiments allow the human operator to control an animal's behavior, such as unwanted barking, or create a boundary to limit the  
20 animal's movement. Such embodiments may also keep track of data related to the training, such as the number of times a dog has barked during a certain period or the number of times the animal has come into the field of a proximity sensor.

[0015] Further embodiments monitor the animal's behavior or health and fitness. For example, embodiments may monitor the speed at which an animal is moving and/or the  
25 animal's body temperature, heart rate and other vital signs. Other embodiments may also monitor environmental data, such as temperature and precipitation.

[0016] The specific inputs and outputs of the animal-worn device allow for the functionality of these different embodiments, and any of the different inputs and outputs may be combined in the animal-worn device depending on the needs of the human operator. For  
30 example, a pet owner desiring to train his pet may only require animal-worn device with inputs and outputs that provide such functionality, whereas another pet owner desiring to train her pet and to monitor the health and fitness of her animal may require the inputs and outputs related to training and to monitor health and fitness. On the other hand, a law enforcement officer in a K9 unit or a disabled person with a guide dog may require a different  
35 set of functionality. Some embodiments of the current invention provide a wide range of functionality based on the inclusion of multiple inputs and outputs, allowing the human operator to choose which functions he would like to use.

1 [0017] Further embodiments of the invention facilitate a real-time data link between the wireless mobile device and a remote server having the capacity of complex data analysis. The server may modify the wireless mobile device application and may also modify firmware at the animal-worn device. These modifications may update the way that the wireless mobile  
5 device manipulates the animal-worn device's inputs and outputs, thus modifying the way in which the animal is monitored and controlled.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0018] Further features and advantages of the embodiments of the invention will become  
10 apparent from the following description taken in conjunction with the accompanying drawings.

[0019] Figure 1 shows an embodiment of the invention wherein a wireless mobile device communicates with an animal-worn device via a point-to-point wireless connection.

[0020] Figure 2 shows an embodiment of the invention wherein a plurality of wireless  
15 computing devices communicates with the animal-worn device via wireless routers and the internet.

[0021] Figure 3 shows an embodiment of the invention wherein the animal-worn device communicates wirelessly with a personal computer which in turn communicates with the wireless mobile device via wireless routers and the internet.

20 [0022] Figure 4 shows an embodiment of the invention wherein the animal worn transceiver communicates wirelessly with the wireless mobile device which in turn communicates with the server and the personal computer via the internet.

[0023] Figure 5 shows an embodiment of the invention wherein the wireless mobile device communicates with the animal-worn device via a cellular network.

25 [0024] Figure 6 shows the animal-worn device in wireless communication with external apparatuses.

[0025] Figure 7 is a block diagram of the animal worn transceiver.

[0026] Figure 8 is a block diagram of a remote transceiver device.

[0027] Figure 9 is a perspective front view of the animal-worn device.

30 [0028] Figure 10 is a perspective rear view of the animal worn transceiver of Figure 9.

[0029] Figure 11 shows the wireless mobile device with a display screen displaying a list of pre-programmed applications on the wireless mobile device.

[0030] Figure 12 shows a first training graphical interface that may load when the "Training" application is selected on the wireless mobile device.

35 [0031] Figure 13 shows a second training graphical interface being displayed on the graphic display panel of the wireless mobile device as part of the "Training" application.

[0032] Figure 14 shows the third training graphical interface being displayed on the graphic display panel of the wireless mobile device as part of the "Training" application.

1 [0033] Figure 15 shows a human user using a speaker to provide a voice command to the animal according to this embodiment of the “Training” application.

[0034] Figure 16 shows a fourth training graphical interface that may be displayed when the human user is using the “Training” application according to Figure 15.

5 [0035] Figure 17 shows a first bark control graphical interface being displayed on the graphic display panel of the wireless mobile device that may load when the “Bark Control” application is selected on the wireless mobile device.

[0036] Figure 18 shows a second bark control graphical interface that may be displayed on the graphic display panel of the wireless mobile device as part of the “Bark Control” application.

10 [0037] Figure 19 shows an example of the human using the “Leash Control” application to tether the animal.

[0038] Figure 20 shows a first leash control graphical interface being displayed on the graphic display panel of the wireless mobile device that may load when the “Leash Control” application is selected on the wireless mobile device.

15 [0039] Figure 21 shows a second leash control graphical interface that may be displayed on the graphic display panel of the wireless mobile device as part of the “Leash Control” application.

[0040] Figure 22 is a representational diagram of an animal containment system that may be controlled by an “Electronic Fence” application on the wireless mobile device 4.

20 [0041] Figure 23 is a representational diagram of an animal containment system that may be controlled by a “Wireless Fence” application on the wireless mobile device 4.

[0042] Figure 24 shows a first fitness graphical interface being displayed on the graphic display panel of the wireless mobile device that may load when the “Fitness” application is selected on the wireless mobile device.

25 [0043] Figure 25 shows a second fitness graphical interface being displayed on the graphic display panel of the wireless mobile device as part of the “Fitness” application.

[0044] Figure 26 shows a third fitness graphical interface being displayed on the graphic display panel of the wireless mobile device as part of the “Fitness” application.

30 [0045] Figure 27 is a block diagram of a firmware upload from the wireless mobile device to the animal-worn device.

#### DETAILED DESCRIPTION

35 [0046] Figures 1-5 provide examples of different methods and protocols by which an animal-worn device 1 may communicate with a wireless mobile device 4. The wireless mobile device 4 may be capable of communicating with the animal-worn device 1 by any combination of the following methods and protocols.

1 [0047] Figure 1 shows the animal-worn device 1 wirelessly paired to the wireless mobile  
device 4 via a direct, point-to-point connection. The animal-worn device 1 may be affixed by  
means of flexible strap 2 to an animal 3. The wireless mobile device 4 wirelessly paired to  
the animal-worn device 1 may be a so-called smart phone or tablet with the capability of  
5 executing preprogramed applications. Currently, the predominant devices with this capability  
utilize the iOS operating system proprietary to Apple Corporation or the Android operating  
system proprietary to Google. Other currently available operating systems include Blackberry  
and Windows. The current embodiment requires that the wireless mobile device 4 be capable  
of executing a pre-programmed application and be capable of wirelessly communicating with  
10 an external device. Many commercially available wireless mobile devices incorporate  
ancillary radio transceivers, separate from that used for cellular communication, for the  
purpose of exchanging data over relatively short distances. Such transceivers typically  
operate in the 2.4 gigahertz range and communicate via Bluetooth or WiFi protocols.  
Referring again to Figure 1, the animal-worn device 1 includes a radio transceiver (*see, e.g.,*  
15 transceiver 15 of Figure 7, discussed below) using compatible frequencies and protocols to  
wirelessly communicate and exchange data with an ancillary transceiver of the wireless  
mobile device 4. For this purpose, the Bluetooth protocol is particularly useful because it is  
configured for direct one-to-one pairing. The Bluetooth Low Energy (BLE) protocol has the  
advantage of very low energy consumption per unit time while achieving practical ranges  
20 upward of 400 feet with future designs predicted to achieve working ranges upward of 2,500  
feet. WiFi has the advantage of being able to transmit and receive large amounts of data per  
unit of time making it practical for transmitting audio and video signals over approximately  
the same distance ranges as the Bluetooth devices with the disadvantage of higher energy  
consumption. In addition to WiFi and Bluetooth protocols, the radio transceiver of the  
25 animal-worn device 1 can be configured to wirelessly communicate and exchange data via  
other protocols at a variety of frequencies.

[0048] Figure 2 shows an example of data being exchanged with the animal-worn device  
1 via a wireless network. The network may include other programmable devices, such as  
personal computer 5. The animal-worn device 1 in this embodiment may also be capable of  
30 exchanging data via other methods, such as the previously discussed point-to-point  
connection. The animal-worn transceiver 1 may communicate with the personal computer 5  
and the wireless mobile device 4 via wireless routers 7 and 8 and the internet using a  
communication protocol, such as IEEE 802.11 Wi-Fi. This allows a human to monitor and  
control the animal 3 remotely via a wide choice of devices, including the wireless mobile  
35 device 4. Wireless linking of the animal-worn device 1 to a wireless network such as WiFi  
may also be used to monitor and control the animal 3 at a long range. The animal-worn  
device 1 sends and receives wireless signals via wireless routers 7 and 8 which may be linked



1 to the wireless mobile device 4. A human user may then, at considerable distance, communicate with the animal-worn device 1 via the internet 6.

[0049] Figure 3 shows an example of the animal-worn device 1 communicating with the personal computer 5 via a protocol such as Bluetooth. This is advantageous since many commercially available personal computing devices include wireless capability, such as Bluetooth. The personal computer 5 communicates with other devices such as the wireless mobile device 4 via routers 7 and 8 and the internet. It is common for computing devices to connect to the internet wirelessly using the WiFi protocol. In a further embodiment, the animal-worn device 1 may use a low energy communication protocol, such as Bluetooth low energy BLE, while devices such as the personal computer 5 and the wireless mobile device 4 may take advantage of higher data rates from a more energy consumptive communication protocol, such as WiFi.

[0050] Figure 4 shows an example of data from the animal-worn device 1 being sent to the wireless mobile device 4 and relayed via the internet to a remote server 106. The remote server 106 may contain dynamic software that may send push messages to the wireless mobile device 4 or even tailor new firmware to be downloaded by the animal-worn device 1 based on the input data received. Indeed, the animal-worn transceiver 1 may acquire new software or firmware including input/output and data analysis programs from the wireless mobile device 4. As illustrated in Figure 4, new firmware may be acquired wirelessly by the wireless mobile device 4 from the personal computer 5 or from the remote server 106 via the internet 6. In addition, connection to the internet 6 may allow the wireless mobile device 4 to send data collected at the animal-worn device 1 to the remote server 106, which may use more sophisticated programs to analyze the collected data and may send back useful messages to the wireless mobile device 4.

[0051] In the embodiment shown in Figure 5, the animal-worn device 1 includes a wireless telephone receiver (*see, e.g.*, antenna 14 of Figure 7, discussed below), which communicates with the wireless mobile device 4 over a cellular network 9 by way of cellular communication towers 10 and 11, effectively allowing a human to monitor and control the animal 3 from any point on Earth that has access to a wireless telephone network, such as GSM (Global System for Mobile Communications), CDMA (Code division multiple access) or others. Linking the animal-worn device 1 and the wireless mobile device 4 via the cellular network 9 may allow the human user to call up the animal-worn device 1 and establish direct communication for the purpose of long range monitoring of the inputs and activation of the outputs at the animal-worn device 1 from any location that has cellular access. In this embodiment, the animal-worn transceiver 1 contains a cellphone transceiver 143, which may be accessed over the cellular network 9 by the wireless mobile device 4 whenever a human wishes to activate outputs or monitor inputs at the animal-worn device 1. Accordingly, the animal-worn device 1 may initiate communication with the wireless mobile device 4 when a

1 particular input condition has occurred. For example, the animal-worn device 1 may initiate  
communication when a sensor (*see, e.g.*, microphone 22 and audio recorder 23 of Figure 7,  
discussed below) at the animal-worn device 1 detects that the animal 3 is barking excessively.  
The human user receiving the communication via the wireless mobile device 4 may then  
5 activate an output at the animal-worn device 1. For example, the human user may remotely  
trigger a training tone or electric shock stimulus, to correct the undesired behavior.  
Obviously, many other scenarios are encompassed by the current invention wherein outputs  
of the animal-worn device 1 may be monitored and controlled by the wireless mobile device  
4 over the cellular network 9.

10 [0052] Once data exchange is established between the animal-worn device 1 and the  
wireless mobile device 4, a pre-programmed application (or applications) on the wireless  
mobile device 4 is employed to operate inputs and outputs at the animal-worn device 1 for  
purposes including training, containing and monitoring the behavior, health, physical fitness  
of animal 3 and/or monitoring and controlling selected devices in animal's 3 environment.  
15 The pre-programmed applications may be installed on the wireless mobile device 4 and  
embodiments of such applications are described below with reference to Figures 11-26.

[0053] Figure 6 shows an embodiment wherein the animal-worn device 1 may  
communicate with at least one external apparatus for the purpose of remotely controlling that  
apparatus. For example, the animal-worn device 1 may control an automatic pet door 12,  
20 where the radio signal emitted by the animal-worn device 1 may cause the automatic pet door  
12 to open, allowing the animal 3 to pass through whenever the animal-worn device 1 is  
within a predetermined distance. The distance can be determined, for example, by using the  
received signal strength of the animal-worn device's 1 wireless signal. Alternatively, a  
remote transceiver 13 may communicate with the animal-worn device 1 and detect when the  
25 animal 3 is within a predetermined distance using the received signal strength of the animal-  
worn device's 1 wireless signal or other ranging or proximity sensing techniques. The  
remote transceiver device 13 may then send a signal to the animal-worn device 1 instructing  
it to activate selected outputs according to a set of pre-programmed instructions. For  
example, the remote transceiver device 13 may be used as an area restriction device wherein  
30 it instructs the animal-worn device 1 to activate a shock output whenever the animal 3 comes  
within a predetermined distance. Alternatively, the remote transceiver device 13 may be used  
as a wireless fence device wherein it instructs the animal-worn device 1 to activate a shock  
output whenever the animal 3 goes outside of a predetermined distance. Data may be stored  
in the animal-worn device 1, such as the number of times the animal 3 has come within or left  
35 the predetermined distance. The data may be sent to the wireless mobile device 4 in real-time  
or at a later time via one of the communication protocols previously described. A software  
application on the wireless mobile device 4 may allow the data to be displayed on the  
wireless mobile device 4. This same software application, or a different application, on the

1 wireless mobile device 4 may be used by the human operator to send inputs to the remote transceiver device 13. For example, the human user may input the predetermined distance in embodiments where the remote transceiver device 13 is used as an area restriction device or wireless fence.

5 [0054] The remote transceiver device 13 may also possess control device capably of controlling various appliances, such that those appliances may be switched on or off when the animal-worn device 1 is within a predetermined distance. The remote transceiver 13 may thereby, be pre-programmed to perform a plurality of useful tasks such as turning on the lights when the animal 3 enters the room, activating automated food or water dispensers and  
10 other useful apparatuses that may be used to automate the care and safety of the animal 3. Control of apparatuses may be digital, as in the case of turning lights off and on, or analog, for example setting the lights at a predetermined intensity level based upon the condition of certain of animal-worn transceiver 1's inputs. The remote transceiver device 13 may also communicate with the wireless mobile device 4 or the other wireless devices previously  
15 described for dynamic control of the animal's 3 environment. For example, the remote transceiver 13 may receive instructions in real time from the wireless mobile device 4 or other wireless devices instructing it to turn on sprinklers or air conditioning when the animal's 3 temperature rises above a predetermined set point. For another example, the remote transceiver 13 may be instructed to turn on soothing music when the animal 3 is  
20 whining. A wide variety of pre-programmed tasks are possible using external devices wirelessly in communication with the wireless mobile device 4 and the animal-worn transceiver 1.

[0055] Figure 7 shows a block diagram of the animal-worn transceiver 1 and components that may be included in it. The animal-worn device 1 includes an antenna 14 or the like to  
25 send signals to and receive signals from the wireless mobile device 4, the wireless router 5 and/or the cellular network 9 as previously described. The animal-worn device 1 includes a transceiver 15, which contains at least one radio transceiver and may include a processor to modulate and condition incoming and outgoing signals. For example, a wireless protocol processor 16 may be included to condition signals to conform to the particular wireless  
30 protocol being used, such as Bluetooth, WiFi or other wireless protocols. There are currently commercially available integrated circuits which perform the functions of the antenna 14, the transceiver 15 and the wireless protocol processor 16 in a single chip that may be used in place of separate components. Such integrated circuits typically employ Bluetooth or WiFi protocols.

35 [0056] The animal-worn device 1 may also include a decryption module 17, which may be necessary for communicating with an operating system of a wireless mobile device that encrypts its wireless signals, such as is the case with many such mobile devices currently. Specifically, the decryption module 17 may be necessary to decrypt some communication

1 modes of the Apple iOS operating system in order for the animal-worn device 1 to communicate with devices running that operating system.

[0057] The animal-worn device 1 includes a main processor 18 to control logic and input/output functions based upon pre-programmed instructions and external commands received from the wireless mobile device 4, the personal computer 5 and/or other external devices such as the remote transceiver device 13. The main processor 18 contains software allowing the animal-worn device 1 to communicate with one or more of the previously described wireless devices. It may also contain self-aware software that communicates directly with the previously described external devices and may activate outputs at the animal-worn device 1 according to pre-programmed instructions independent of or in tandem with an application contained in the wireless mobile device 4, the personal computer 5 and/or other wireless computing devices.

[0058] Reference numbers 19 – 29 and 107 - 110 are examples of input devices that may be included in the animal-worn device 1 to feed data to the main processor 18. The animal-worn device 1 may include one or more of these input devices. Information from an input device may be received by the main processor 18 and then output to the wireless mobile device 4, for example, via the wireless protocol processor 16. Reference numerals 33 - 40 are examples of output devices which may be integrated into the hardware of the animal-worn device 1 and controlled by the main processor 18. The animal-worn device 1 may include one or more of these output devices. Outputs may include information sent to these output devices from the main processor 18 and/or information sent from the main processor 18 to the wireless mobile device 4, for example, via the wireless protocol processor 16. It may not be necessary for all functions and inputs and/or outputs of the animal-worn device 1 to be operating at all times. When the animal 3 is at rest, for example, main processor 18 may shut down certain functions and/or input and output devices to reduce energy consumption.

[0059] Input devices that may be included in the animal-worn device 1 will now be discussed in detail with reference to Figure 7.

[0060] The animal-worn device 1 may include a vibration sensor 19 to detect an utterance, such as a dog bark, made by the animal 3 by directly detecting the motion of the animal's 3 vocal cords. Such detection may be done alone or in tandem with a microphone 22. The animal-worn device 1 may include a temperature sensor 20 capable of measuring an ambient environmental temperature and/or the animal's 3 body temperature.

[0061] The animal-worn device 1 may include an accelerometer 21 to detect changes in the animal's 3 speed or direction of motion. The accelerometer 21 may incorporate a multi-axis and gyroscopic architecture that may be used to automatically activate selected outputs based upon the animal's speed and direction of motion. In a further embodiment, the accelerometer 21 may be used in conjunction with a GPS locator 26 and a gyroscope 109 to determine the location of the animal-worn transceiver 1 to a high degree of accuracy,

1 especially when the main processor 18 is enhanced with software that uses data from the  
accelerometer 21 and the gyroscope 109 to compensate for GPS location error. Another  
embodiment uses the accelerometer 21 as a pedometer by detecting the movements of the  
animal-worn transceiver 1 along the vertical axis that are generated as the animal 3 takes  
5 steps. Each step creates a vertical oscillation that represents forward movement of the animal  
3 that, when multiplied by the distance of the animal's 3 gate, provides a precise  
measurement of the distance of the animal's 3 forward movement. When mathematically  
divided by the time between each step, a precise measurement of animal's 3 velocity may  
also be determined. Of course, there are numerous other embodiments in which an onboard  
10 accelerometer may be useful.

[0062] The animal-worn device 1 may include a microphone 22 to detect an animal's  
utterance as a noninvasive alternative to using vibration sensor 19. Detection of such  
utterances may be useful in order to control unwanted sounds, such as barking, from the  
animal 3. For the purposes of dog bark detection, software in the main processor 18 may be  
15 installed that compares incoming audio signals from the microphone 22 with the audio voice  
characteristics of a typical dog bark. These audio voice characteristics may include  
frequency, pulse duration and amplitude. Even more sophisticated bark detection may be  
achieved by feeding the signal from the microphone 22 to the audio recorder 23 to record the  
audio waveform of animal's 3 bark. The audio waveform may then be digitally stored in the  
20 processor 18. The audio waveform of any subsequent incoming bark may then be compared  
to the stored audio waveform. If the two waveforms are determined by predetermined  
criteria to be substantially similar, the processor 18 may initiate a behavioral correction  
sequence using one or more of output devices 33 - 40. This technique effectively tunes the  
bark detection to the specific voice of animal 3. The microphone 22 may also be capable of  
25 detecting sounds in the environment of the animal 3 for any of a variety of purposes,  
including determining the location of the animal 3, should it become lost, or recording an  
audio history of the animal's 3 comings and goings by feeding its audio signals to audio  
recorder 23 and storing an audio record in the processor 18. The microphone 22 may also be  
capable of recording human voice. Such voice recordings may be used, for example, to  
30 directly record verbal audio commands to be used as outputs.

[0063] The animal-worn device 1 may include a heart rate monitor 24 to aid in  
monitoring the health of the animal 3 and may be used to assist the human user in properly  
exercising the animal 3. The heart rate monitor 24 may be integrated into the animal-worn  
device 1 or may be a separate external device to be worn by the animal 3, for example, as a  
35 harness.

The animal-worn device 1 may include a magnetometer 25 to measure changes in the  
Earth's magnetic field. Heading information from magnetometer 25 may be combined with

1 roll and pitch data from the accelerometer 21 in the main processor 18 to calculate the exact orientation of animal-worn device 1 as it moves.

5 [0064] The animal-worn device 1 may include a GPS locator 25 to detect the position on the Earth of the animal-worn transceiver 1 using the Global Positioning System via communication with the GPS satellites. Alternate embodiments may use a GLONASS receiver to communicate with the GLONASS satellites in the same way. Such an input device is useful in tracking the whereabouts of animal-worn device 1 and accordingly the location of the animal 3. Combining data from the accelerometer 21, the magnetometer 25, the gyroscope 109 and the GPS locator 26 results in the ability to track and locate the animal-worn device 1 with a high degree of accuracy. Embodiments, such as the above, may be used to contain the animal 3 within certain boundaries or to track the general location of the animal 3.

10 [0065] The animal-worn device 1 may include an auxiliary radio receiver 26 such as a low frequency type radio receiver used to detect the position of the radio receiver relative to a wire loop boundary antenna for the purpose of animal containment. Alternatively, the auxiliary radio receiver 26 may be used to wirelessly generate an invisible boundary within which the animal 3 is to be contained.

15 [0066] The animal-worn device 1 may include a photo sensor 28 to detect the light level in the animal's 3 environment. In one embodiment, the main processor 18 may activate selected outputs in daylight and a different set of outputs at night based on the detected light levels from the photo sensor 28.

20 [0067] The animal-worn device 1 may include a conductivity sensor 29 to detect the electrical conductivity, impedance and/or capacitance between shock electrodes 43 and 44, as shown in Figures 9 and 10, in order to detect and insure that the electrodes 43 and 44 are making sufficient contact with the animal's 3 skin so that the animal 3 may receive the stimulus generated by a shock generator 33.

25 [0068] The animal-worn device 1 may include a humidity sensor 107 to detect ambient humidity for use in monitoring the animal's 3 environment. Data from the humidity sensor 107 may be incorporated into programs used in the wireless mobile device's applications related to the animal's 3 health and fitness. The animal-worn device 1 may also include a water sensor 108 to determine when the animal 3 is in a rainy environment or if animal 3 has immersed itself in water such as a pool, lake or ocean. This may be used in conjunction with the conductivity sensor 29 to determine if the animal is immersed in salt water.

30 [0069] As discussed above, the animal-worn device 1 may include the gyroscope 109 to detect the orientation of the animal-worn transceiver 1. The gyroscope 109 may be used to correctly interpret incoming wireless signals that may attenuate based upon the orientation of the animal-worn transmitter 1 relative to the axis of the emitted wireless signal waves. For example, the RSSI of a wireless signal typically varies greatly depending upon the relative

1 orientation of the device receiving the wireless signal. Attenuation of RSSI based upon  
device orientation may be corrected using a gyroscope to more accurately measure distance  
between the emission source and the device.

5 [0070] The animal-worn device 1 may include a camera 110. The camera 110 may be a  
still image or video recording device for use in locating the animal 3 should it become lost or  
for use in creating a still image or video history of the animal's 3 comings and goings.

[0071] The animal worn device may include cellular phone transceiver 143 for allowing  
two-way communication over a cellular telephone network in place of or in addition to the  
wireless transceiver 15.

10 [0072] Output devices that may be included in the animal-worn device 1 will now be  
discussed in detail with reference to Figure 7.

[0073] The animal-worn device 1 may include the shock generator 33, which generates  
electrical stimulus which may be used to get the attention of the animal 3 in order to correct  
undesirable behavior. The animal-worn device 1 may include a spray module 34 that may be  
15 used as an alternative corrective stimulus to spray a liquid or mist, such as citronella, which  
the animal 3 may find unpleasant but not painful. Alternatively, the spray module 34 may be  
used to create a positive reinforcing stimulus by spraying a mist that the animal 3 finds  
pleasant, for example steak aroma, when the animal 3 exhibits desirable behavior.

[0074] The animal-worn device 1 may include an audio processor 35 that receives audio-  
20 encoded electronic signals from the main processor 18 and translates the electronic signals  
into voice and music quality audio output for broadcast by a speaker 36. The animal-worn  
device 1 may include a tone generator 37 that receives audio-encoded electronic signals from  
the main processor 18 and translates the electronic signals into discrete audio tones for audio  
broadcast by the speaker 36. Alternatively, the tone generator 37 may activate a dedicated  
25 output device such as a piezoelectric transducer in place of the speaker 36. The audio tones  
generated by the tone generator 37 may be used by a person training the animal 3 to  
communicate specific commands to the animal 3. Each command may be associated with a  
discrete and unique audio tone.

[0075] The animal-worn device 1 may include a lamp 38 that provides light output used  
30 as a training stimulus, a status message to the human user, to illuminate the animal's 3 path at  
night or to locate the animal 3 in the dark. The animal-worn device 1 may include a vibration  
generator 39 that may consist of a small electric motor with an offset load at its rotation shaft  
to create vibratory stimulus to be used to train the animal 3. The animal-worn device 1 may  
include an auxiliary radio transmitter 40 that may be used for specialized purposes apart from  
35 the transceiver 15.

[0076] Figure 7 also shows that the animal-worn device 1 includes a battery array 29 to  
provide power to the animal-worn device 1. Typically, the operating voltage required by  
commercially available microprocessors, such as may be used as the main processor 18, is

1 lower than that required for other outputs employed by the animal-worn device 1. For  
example, the shock generator 33 may require significantly higher voltage than the main  
processor's 18 operating voltage. When operating both the main processor 18 and the shock  
generator 33 from a single battery, the voltage needed to operate the main processor 18 may  
5 need to be stepped down, resulting in energy loss and loss of practical battery life.  
Alternatively, operating the main processor 18 and the shock generator 33 from separate  
batteries is possible, but may be impractical if it requires the human user to replace two  
different batteries at different times, or if both batteries are contained in a single battery pack,  
it limits the useful battery life to that of the shortest lasting battery and wastes the energy of  
10 the unspent battery. To address this issue, the battery array 29 may include primary and  
secondary batteries 30, 31 and a switch 32. The primary battery 30 is sized to closely match  
the required processor operating voltage of the main processor 18, for example, 3 volts. The  
secondary battery 31 is sized so that when placed in series with the primary battery 30, the  
shock generator 33 is supplied with a higher, more optimum supply voltage. In this example,  
15 the secondary battery 31 is sized at 3 volts so that when in series with the primary battery 31,  
6 volts is delivered to the shock generator 33. In practice, selecting batteries of equal voltage  
is preferable for many battery types, such as lithium batteries, however, different voltage  
batteries may be used. The switch 32, which in this embodiment is a DPDT switch, is  
operated by a series/ parallel control signal provided by the main processor 18. With the  
20 switch 32 in its normal, non-activated, position, primary and secondary batteries 30, 31 are in  
parallel supplying 3 volts to both the low voltage and high voltage circuits, in this example,  
the main processor 18 and the shock generator 33. When the main processor 18 receives a  
command to activate the shock generator 33, it sends a control signal placing switch 32 in its  
activated position. This puts the primary and secondary batteries 30, 31 in series supplying 6  
25 volts to the shock generator 33 while taking the secondary battery 31 out of the circuit  
supplying voltage to the main processor 18. In this state, 3 volts is supplied to the low  
voltage circuits (the main processor 18) while simultaneously 6 volts is supplied to the high  
voltage circuits (the shock generator 33). When the switch 32 is returned to its non-activated  
position both the primary and secondary batteries 30, 31 are placed in parallel and any  
30 difference in voltage between the two batteries caused by unequal current drain will quickly  
equalize. This power circuit allows the normal operating voltage of the animal-worn device 1  
to be set at 3 volts with the ability to supply 6 volts as needed for momentary power to the  
high voltage circuits with zero losses typical of conventional step up - step down voltage  
techniques. This power circuit also facilitates the use of components, such as a shock output  
35 transformer, which may be smaller in size and operate more efficiently than lower voltage  
counterparts. While the primary and secondary batteries 30, 31 each supply a voltage of 3  
volts in this example, other voltages are possible based on the needs of the animal-worn  
device 1 and the main processor 18. Also, while this embodiment is discussed with reference



1 to the shock generator 33, similar power circuits can also be connected to other output devices or input devices where a higher or lower voltage is needed.

5 [0077] Figure 8 shows a block diagram of the remote transceiver 13. An antenna 114, a transceiver 115, a wireless protocol processor 116 and a decryption module 117 are similar to the antenna 14, the transceiver 15, the wireless protocol processor 16 and the decryption module 17 of the animal-worn device 1. Processor 111 may contain pre-programmed logic to execute programs when the animal-worn device 1 comes within a predetermined distance. These programs may activate outputs at the animal-worn device 1 or change the state of a remote transceiver switch 112 from open to closed and vice versa. The remote transceiver switch 112 may thereby control other selected apparatuses that may be switch controlled, such as electric lights, automatic food dispensers, radios and the like. For example, the remote transceiver may be part of a pet door such as the automatic pet door 12 to control the opening and closing of the pet door 12 when the animal 3 is within the predetermined distance. Alternatively, an analog control device may be used in place of the switch 112 to control analog apparatuses.

10 [0078] Figure 9 shows a perspective view of the animal-worn device 1 according to one embodiment. The animal-worn device 1 includes a casing 41 for housing the electronic components. A strap 2 is provided for attaching the device around the neck of the animal 3. In this embodiment, the shock electrodes 43 and 44 are provided for applying electrical stimulus generated by the shock generator 33 to the animal 3. The casing 41 may contain a decorative cut-out 42, which may be filled with a translucent material such as glass or clear plastic. The decorative cut-out 42 may be shaped in the form of a logo or other meaningful design. The lamp 38, as shown in Figure 7, may be placed inside the casing 41 such that the light it emits will shine through the cut-out 42 and be visible to the human user. Although in this embodiment the cut-out is decorative, it may also be a non-decorative, simple and/or functionally-shaped cut-out. In one embodiment, the animal-worn device's 1 main processor 18 can activate the lamp 38 whenever a command is received from the wireless mobile device 4 or other remote activating device.

15 [0079] The speaker 36 may be enclosed within the casing 41 and positioned in front of an opening such that acoustical emissions may be transmitted through the air. The speaker 36 may be of the commercially available waterproof variety and may be sealed to the casing 41 so as to prevent water leaking into the casing 41 should the animal 3 decide to immerse itself in a body of water.

20 [0080] Figure 10 shows a rear perspective view of the animal-worn device 1 of Figure 9. As shown in Figure 10, the animal-worn device 1 may include at least one temperature sensor 20 placed at the back side of the casing 41 to measure the animal's 3 body temperature. Additionally, at least one microphone 22 may be included to detect audible sounds uttered by the animal 3, by a human or other sounds from the environment. The heart rate monitor 24

1 may be included to detect the animal's 3 pulse rate by emitting light from a light source 47  
and detecting the backscattering with light detectors 45 and 46 using a known process  
whereby blood vessels that contain a higher volume of blood absorb more light of certain  
frequencies than do blood vessels containing less blood. As blood pulses through the veins of  
5 the animal 3, backscattered light of certain frequencies will be detected with varying  
amplitude, the rise or fall of amplitude following the pulse rate of the animal 3 yielding a  
pulse rate equal to the heart rate of the animal 3. The resulting heart rate may be transmitted  
to the wireless mobile device 4 or stored in the main processor 18 for transmission at a later  
time. The heart rate of the animal 3 may be used by the wireless mobile device 4 in  
10 executing applications relating to the health and fitness of the animal 3.

[0081] Figure 11 shows the wireless mobile device 4 with a display screen 48 displaying  
a list of pre-programmed applications that may be available for use when the wireless mobile  
device 4 is wirelessly paired to the animal worn device 1. The wireless mobile device 4 may  
include any number of applications such as these which work wirelessly with the animal-  
15 worn device 1. The listed applications, including "Training," "Bark Control," "Virtual  
Leash," "Electronic Fence," "Wireless Fence," and "Fitness," will be discussed in detail with  
respect to Figures 12-26 below. These and similar applications may also be subroutines that  
are all part of the same application on the wireless mobile device 4.

[0082] Figures 12-16 show graphical interfaces and a representational diagram of an  
20 embodiment of a "Training" application. The "Training" application uses point-to-point  
communication, via a protocol such as Bluetooth, between the wireless mobile device 4 and  
the animal-worn device 1 to allow the human user 68 to train and monitor the animal 3 in real  
time. The human user 68 may transmit training stimuli to the animal wearing animal-worn  
device 1 while observing the animal in real time. Outputs at the animal-worn device 1 may  
25 include positive stimulation to encourage certain desired behaviors or negative stimulation to  
deter undesired animal behavior.

[0083] Figure 12 shows a first training graphical interface 121 that may load when the  
"Training" application is selected on the wireless mobile device 4. The "training" application  
may be stored in the wireless mobile device's 4 internal memory and, when selected by the  
30 human user, may result in the first training graphical interface 121 being displayed on a  
graphic display panel 48 of the wireless mobile device 4. The first training graphical  
interface 121 may include a status indicator 50 that indicates the status of the connection  
between the wireless mobile device 4 and the animal-worn device 1. In one embodiment, a  
display of "GOOD" indicates that the wireless mobile device 4 is properly paired to the  
35 animal-worn device 1 and display of "FAIL" indicates that the two devices are not wirelessly  
communicating with each other. Other status messages may include "SENT" to indicate  
when a command is being sent from the wireless mobile device 4 and "ACKNOWLEDGE"  
to indicate that the command has been received by the animal-worn device 1 and that the

1 animal-worn device 1 has sent back a handshake signal to acknowledge receipt and execution of the command.

[0084] The first training graphical interface 121 may include a connected device indicator 51 that displays the name of the animal-worn device 1 with which the wireless mobile device 4 is paired. A tone button array 52 may also be included that includes virtual push buttons to activate unique audible command tones at the animal-worn device 1. Command tones may be discrete single frequency tones much like musical notes or may be more complex pre-programmed audio outputs, examples of which may include the various ring tones available on many commercially available cellular telephones. The use of more complex tones may be more easily identifiable and distinguishable to the animal 4. A voice button array 53 may include virtual push buttons that activate prerecorded voice commands at the animal-worn device 1. The prerecorded voice commands may be recorded at the wireless mobile device 4 and transmitted to the animal-worn device 1 for digital storage in the main processor 18 or the audio recorder 23. They may also be recorded directly into the animal-worn device 1 using the microphone 22. A stimulus button array 54 may be included on the first training graphical interface 121 that includes virtual push buttons that are used to activate electrical stimulus outputs at the electrodes 43 and 44 of the animal-worn device 1 that are generated by the shock generator 33. A battery level indicator 55 may also be included that graphically displays the battery charge level of the animal-worn device 1. Next, a screen slider 56 may be included to switch to additional graphical interfaces in the "Training" application, such as the second training graphical interface 122 shown in Figure 13.

[0085] Figure 13 shows a second training graphical interface 122 being displayed on the graphic display panel 48 of the wireless mobile device 4. The second training graphical interface 122 may provide information related to the status of animal-worn devices 1 within the detection range of the wireless mobile device 4. In this embodiment, multiple animal-worn devices 1 are displayed, although multiple animal-worn devices 1 are not required. The second training graphical interface 122 may include a stored device list 57 that displays the names of all previously connected animal-worn devices 1 (that have not been removed by the human user). For wireless mobile devices 4 where the graphic display panel 48 is a touchscreen, touching the name of one of the animal-worn devices 1 on the stored device list 57 selects that animal-worn device 1. A remove button 60 may be included on the second training graphical interface 122 to allow the human user to remove the selected animal-worn device 1 from stored device list 57. A rename button 61 may be included to allow the human user to rename the selected animal-worn device 1. Additional features and buttons may be included, such as a "Settings" button 62, which may advance the human user to a third training graphical interface 123 on which setting information for the selected animal-worn device 1 is provided. Although the second training graphical interface 122 is being described

1 as part of the "Training" application, it may also be a part of any other application or subroutine or its own separate application or subroutine.

[0086] The second training graphical interface 122 may also include an active status indicator 58 that indicates the wireless status of each animal-worn device 1. A "Not Found" indication on the status indicator 58 may indicate that the animal-worn device 1 is not  
5 detected. A "Found" indication may indicate that the animal-worn device 1 is detected but not paired with the wireless mobile device 4. A "Connected" status indication may indicate that the animal-worn device 1 is currently paired with the wireless mobile device. As an alternative to providing the status indicator 58 for all animal-worn devices 1 simultaneously,  
10 the second graphic interface may provide only the status indicator 58 for the selected animal-worn device 1.

[0087] Figure 14 shows the third training graphical interface 123 being displayed on the graphic display panel 48 of the wireless mobile device 4. The third training graphical interface 123 may provide "Settings" information regarding the animal-worn device 1  
15 selected on the second training graphical interface 122. The "Settings" graphical interface 123 may include the connected device indicator 51 to indicate the selected animal-worn device 1. "Settings" information may include buttons or the like to allow the human user to set several individually selectable stimulus levels and durations for the selected animal-worn device 1. For example, "Settings" graphical interface 123 may include intensity buttons 63 to  
20 allow the human user to select different intensity levels for the shock stimulus sent from the shock generator 33 to the electrodes 43, 44 that are used to correct animal behavior. As an alternative to or in addition to the intensity buttons 63, the "Settings" graphical interface 123 may include an intensity slider 65 that allows the human user to fine tune the level of intensity by sliding a digital dial along the intensity slider 65 to increase or decrease the level  
25 of intensity, which may be indicated by the percentage level of the intensity. The "Settings" graphical interface 123 may also include a duration slider 64 to allow the human user to select the length of the shock stimulus sent from the shock generator 33. The "Settings" graphical interface 123 may include "Record Command" options 66 to allow the human user to record commands that can be sent to the animal 3 via the audio processor 35 and speaker  
30 36 so that the human user can provide the animal 3 with a voice command at a later time. For example, this can be used when the animal 3 is at a distance to allow the human user to provide the voice command through the animal-worn device 1. The "Settings" graphical interface 123 may include a return button 67 to allow the human user to return to a previous graphical interface, such as the first training graphical interface 121 or the second training  
35 graphical interface 122. Although, in the above embodiments, specific interface features are described as being buttons or sliders, the graphical features described as buttons may be replaced with sliders and vice versa and either may be substituted with any other known graphical interface feature as would be known to a person of ordinary skill in the art.

1 [0088] Figure 15 shows the human user 68 using the speaker 36 to provide the voice  
command to the animal 3 according to this embodiment of the “Training” application. This  
embodiment allows the human 68 to communicate with the animal 3 via a walkie-talkie type  
arrangement using the voice receiving ability of the wireless mobile device 4. The  
5 “Training” application in the wireless mobile device 4 may allow the human 68 to speak  
voice commands into the wireless mobile device 4 and then wirelessly transmit the voice  
commands to the animal-worn device 1 via one of the communication protocols previously  
described. The animal-worn device 1 may receive the wireless transmission and relay the  
voice command via the audio processor 35 to the speaker 36. The animal-worn device 1 may  
10 then send an acknowledgement back to the wireless mobile device 4 indicating that the  
incoming signal was received and that the voice command was communicated by the speaker  
36.

[0089] Figure 16 shows a fourth training graphical interface 124 that may be displayed  
when the human 68 is using the “Training” application described in Figure 15. The fourth  
15 training graphical interface 124 may include the connected device indicator 51 to indicate the  
selected animal-worn device 1 that will receive the voice commands. The fourth training  
graphical interface 124 may include the status indicator 50 that indicates the status of the  
connection between the wireless mobile device 4 and the animal-worn device 1. The status  
indicator 50 may also indicate if the voice command has been successfully sent and played by  
20 the animal-worn device 1. The fourth training graphical interface 124 may also include “Tone  
Command” options 52 to allow the human 68 to transmit prerecorded tones and/ or audio  
outputs to the animal 3. The prerecorded tones may be, for example, tones imbedded in the  
“Training” application or tones uploaded or recorded by the human user. The fourth training  
graphical interface 124 may include “Stimulus” options 54 to allow the human 68 to transmit  
25 predetermined stimuli. The levels of the “Stimulus” options 54 may be determined by the  
human user’s selections on the third training graphical interface 123. The fourth training  
graphical interface 124 may also include a “Push-to-Talk” button 69, which is similar to a  
walkie-talkie feature, that allows the human 68 to transmit real-time voice commands to the  
animal 3. “Push-to-Talk” button 69 may be depressed immediately before the voice  
30 command is enunciated. Once spoken, the voice command is sent to the animal-worn device  
1. The fourth training graphical interface 124 may include the next screen slider 56 to switch  
to additional graphical interfaces in the “Training” application. The battery level indicator 55  
may also be included that graphically displays the battery charge level of the animal-worn  
device 1.

35 [0090] Figures 17-18 show graphical interfaces and a representational diagram of an  
embodiment of a “Bark Control” application. The “Bark Control” application may be used to  
train the animal 3 to refrain from certain types of unwanted barking and/or growling while  
allowing others.

1 [0091] Figure 17 shows a first bark control graphical interface 131 being displayed on the  
graphic display panel 48 of the wireless mobile device 4 that may load when the “Bark  
Control” application is selected on the wireless mobile device 4. The first bark control  
graphical interface 131 may be for controlling different types of barking by selecting the bark  
5 to be controlled and selecting the type of stimulus to be used to control that type of barking.  
A bark mode selector 70 may be included that allows the human user to select the type of  
barks that are to be controlled. For example, the human user may select an option on the bark  
mode selector 70 that focuses on controlling howling (e.g., “Anti-Howl”) or that focuses on  
controlling barking in general (e.g., “Anti-Bark”). The bark mode selector 70 may also  
10 include options to allow specific types of barking without receiving a stimulus (e.g., “Allow  
Excited Barking”). A stimulus mode selector 71 may be included that allows the human user  
to select the type of stimulus to be generated in response to the selected type of bark. For  
example, the human user may be able to select options such as “Shock Only,” “Tone Only”  
or “Tone and Shock” and other possible stimuli that can be selected to occur when the  
15 selected barking occurs. The first bark control graphical interface 131 may also include  
different buttons or sliders to control the level and intensity of a stimulus. For example, the  
interface 131 may include a progressive step slider 72, a maximum duration slider 73, and/or  
a maximum intensity slider 74 to control characteristics of a shock stimulus. The progressive  
step slider 72 may allow the human user to control the rate of increase in the level of the  
20 shock stimulus that occurs if the animal 3 continues to utter the selected bark. The maximum  
duration slider 73 may allow the human user to control the maximum length of time for  
which the shock stimulus persists. The maximum intensity slider 74 may allow the human  
user to control the maximum level of intensity of the shock stimulus that is given to the  
animal 3. These sliders or other sliders, buttons or the like may be included that allow the  
25 human user to control the characteristics of the stimulus or stimuli to be given to the animal  
3.

[0092] The first bark control graphical interface 131 may also include the connected  
device indicator 51 to indicate the animal-worn device 1 that has been selected, such as via  
the second training graphical interface 122 or similar graphical interface included in the  
30 “Bark Control” application. It may also include the status indicator 50 that indicates the  
status of the connection between the wireless mobile device 4 and the animal-worn device 1.  
The battery level indicator 55 may also be included that graphically displays the battery  
charge level of the animal-worn device 1. The first bark control graphical interface 131 may  
include the next screen slider 56 to switch to additional graphical interfaces in the “Bark  
35 Control” application.

[0093] Figure 18 shows a second bark control graphical interface 132 that may be  
displayed on the graphic display panel 48 of the wireless mobile device 4. The second bark  
control graphical interface 132 displays one embodiment of a graphical representation of the

1 bark history of the animal 3. Similar graphical representations including charts, tables or the  
like may be included in the “Bark Control” application to show the progress of the animal 3  
over the course of the bark control training. In this embodiment, the second bark control  
graphical interface 132 shows a line graph 75 representing the number of barks by the animal  
5 3 that have occurred on a daily basis throughout the month of January. Other similar graphs  
may be included, such as representing the number of barks over a different period of time,  
such as hourly, monthly or annually, or representing specific types of bark over time, or  
comparing different types of barks by the animal 3. The “Bark Control” application may also  
be able to send alerts, such as via email, SMS, website postings (e.g., Facebook, Twitter, etc.)  
10 or instant messaging, alerting the user that the animal is barking. These alerts may include  
information regarding the type of barking, such as whether the barking is excited, excessive  
or whether the animal is howling.

[0094] Figures 19-21 show graphical interfaces and representational diagrams of an  
embodiment of a “Leash Control” application. Using RSSI or other ranging techniques, the  
15 “Leash Control” application may alert the human user 68 when the animal 3 has strayed  
beyond a predetermined range of separation between the wireless mobile device 4 and the  
animal-worn device 1. Stimulus may be applied to the animal via outputs at the animal-worn  
device 1 to encourage the animal 3 to return to a position within the predetermined range.  
This may be especially useful when the human 68 is physically training with the animal 3, for  
20 example, when the human 68 and the animal 3 are running side by side or the animal 3 is  
running alongside the human 68 who is riding a bicycle. This “Leash” application along with  
the animal-worn device 1 avoids the need for a physical leash.

[0095] Figure 19 shows an example of the human 68 using the “Leash Control”  
application to tether the animal 3 while jogging. In this embodiment, the wireless mobile  
25 device 4 can emit a radio signal 76 and the “Leash Control” application uses the RSSI of the  
emitted radio signal 76 to determine a distance d of the wireless mobile device 4 from the  
animal-worn device 1. Although in this embodiment the wireless mobile device 4 is emitting  
the radio signal 76, an auxiliary transmitting device may also be used to emit the radio signal  
76. Using the RSSI, the “Leash Control” application allows human user to select a  
30 predetermined boundary 77 and if the animal-worn device 1 moves farther from the wireless  
mobile device 4 than the predetermined boundary 77, specific outputs can be triggered or  
deactivated. For example, if the animal-worn device 1 moves outside the predetermined  
boundary 77, the animal-worn device 1 may send a stimulus to the animal 3, such as a shock  
stimulus via the electrodes 43, 44. The radio signal 76 used to create the predetermined  
35 boundary 77 may use the same frequency as for data transmission or the boundary signal may  
be transmitted separately using a frequency conducive to the particular RSSI decoding  
technique employed. Although this embodiment is in effect while the human 68 is jogging,

1 the “Leash Control” application may also be used when the human 68 is performing any of a variety of activities, including walking, hiking or biking.

5 [0096] Figure 20 shows a first leash control graphical interface 141 that may be displayed on the graphic display panel 48 of the wireless mobile device 4. The first leash control graphical interface 141 may provide information regarding the relative position of the animal 3 to the predetermined boundary 77. For example, the first leash control graphical interface 141 may provide a pictorial representation of the animal 3 relative to the predetermined boundary 77 via a graphical representation of the predetermined boundary 77, in this example represented by the line 78, and a graphical representation of the animal-worn device 1, in this example represented by the dot 79. Although a line and a dot are used in this example, other symbols or shapes may be used, including, for example, a small animal cartoon to represent the animal 3. The first leash control graphical interface 141 may also include a boundary status indicator 80 to indicate whether the animal 3 is within or outside of the predetermined boundary 77, such as by using different colored textual statements.

15 [0097] The first leash control graphical interface 141 may include the status indicator 50 that indicates the status of the connection between the wireless mobile device 4 and the animal-worn device 1. The first leash control graphical interface 141 may include the connected device indicator 51 to indicate the animal-worn device 1 that has been selected, such as via the second training graphical interface 122 or similar graphical interface included in the “Leash Control” application. The battery level indicator 55 may also be included that graphically displays the battery charge level of the animal-worn device 1. The screen slider 56 may be included to switch to additional graphical interfaces in the “Leash Control” application.

25 [0098] Figure 21 shows a second leash control graphical interface 142 that may be displayed on the graphic display panel 48 of the wireless mobile device 4. The second leash control graphical interface 142 may include setup information to allow the human user to configure the settings of the “Virtual Leash” application. A distance slider 81 may be included to allow the human user to select the distance from the wireless mobile device 4 where the predetermined boundary 77 will exist. The duration slider 64 may be included to allow the human user to select the length of the shock stimulus or other stimulus sent from the shock generator 33, the tone generator 37, etc. The intensity slider 65 may be included to allow the human user to fine tune the level of intensity by sliding the digital dial along the intensity slider 65 to increase or decrease the level of intensity, which may be indicated by the percentage level of the intensity. The second leash control graphical interface 142 may also include the connected device indicator 51 to indicate the animal-worn device 1 that has been selected. The second leash control graphical interface 142 may include the return button 67 to allow the human user to return to a previous graphical interface, such as the first leash control graphical interface 141.



1 [0099] Figure 22 is a representational diagram of an animal containment system that may  
be controlled by an “Electronic Fence” application on the wireless mobile device 4. This  
embodiment uses a wire perimeter antenna 84 that may emit a low frequency radio field  
around the wire perimeter antenna 84 based on inputs from an RF transmitter 82. The RF  
5 transmitter 82 may be controlled by the wireless mobile device 4 via a wireless protocol  
transceiver 83 that communicates with the wireless mobile device 4. The wireless mobile  
device 4 may communicate with the wireless protocol transceiver 83 through any of the  
communication protocols discussed above, including Bluetooth and WiFi. Through the  
“Electronic Fence” application on the wireless mobile device 4, the human user 68 may  
10 instruct the animal-worn device 1 to activate a stimulus, such as a shock or tone output,  
whenever the animal 3 comes within the radio field of the perimeter antenna 84. The human  
user 68 may also be able to instruct the animal-worn device 1 to activate different stimuli  
based on the proximity of the animal 3 to the wire perimeter antenna 84 within the radio field.  
The “Electronic Fence” application may be capable of activating the RF transmitter 82,  
15 controlling the width of the radio field emitted by the wire perimeter antenna 84, and/or  
controlling the intensity, duration and other attributes of the stimulus to be given to the  
animal when it comes within the radio field of the perimeter antenna 84. The “Electronic  
Fence” application may also store information regarding the number of times the animal 3  
breached the radio field of the perimeter antenna 84 and display that information to the  
20 human user 68 on the wireless mobile device 4. The “Electronic Fence” application may also  
be able to send alerts, such as via email, SMS, website postings or instant messaging, alerting  
the user that the animal has breached the fence perimeter.

[00100] Figure 23 is a representational diagram of an animal containment system that may  
be controlled by a “Wireless Fence” application on the wireless mobile device 4. A wireless  
25 fence transmitter 86, 87, or 88 may emit a radio signal 76 and the “Wireless Fence”  
application uses the RSSI of the emitted radio signal 76 to determine a distance of the  
wireless mobile device 4 from the animal-worn device 1. Using the RSSI, the “Wireless  
Fence” application allows the human user to select a predetermined boundary 77 and if the  
animal-worn device 1 moves farther from the wireless mobile device 4 than the  
30 predetermined boundary 77, specific outputs can be triggered or deactivated. For example, if  
the animal-worn device 1 moves outside the predetermined boundary 77, the animal-worn  
device 1 may send a stimulus to the animal 3, such as a shock stimulus via the electrodes 43,  
44. Time of flight and other wireless localizing techniques may be employed to locate the  
animal-worn device 1 relative to the wireless fence transmitter 86, 87, or 88 and send the  
35 location data to the wireless mobile device 4. In the current embodiment, the wireless fence  
transmitter 86, 87, or 88 is installed at a house 85, however, the wireless fence transmitter 86,  
87, or 88 may be installed at any area where containment of the animal 3 is desired.

1 [00101] Figure 23 provides three alternative wireless fence transmitters that may emit the  
radio signal 76: a single antenna wireless fence transmitter 86, a dual antenna wireless fence  
transmitter 87 or a radial loop wireless fence transmitter 88. The single antenna wireless  
fence transmitter 86 has a single antenna and may emit the same type of radio signal as is  
5 used by the wireless mobile device 4. For example, the single antenna wireless fence  
transmitter 86 may emit a Bluetooth or WiFi signal as the radio signal 76. In addition, the  
single antenna wireless fence transmitter 86 may have RSSI built into the transmitter. Using  
the same radio signal for containment and communication provides numerous advantages  
including reducing the number of system components.

10 [00102] The dual antenna wireless fence transmitter 87 has two antennae and may emit the  
same type of radio signal as is used by the wireless mobile device 4. For example, the dual  
antenna wireless fence transmitter 87 may emit a Bluetooth or WiFi signal as the radio signal  
76. In addition, the dual antenna wireless fence transmitter 87 may have RSSI build into the  
transmitter. The two antennae of the dual antenna wireless fence transmitter 87 are spaced by  
15 at least half a wavelength, which can help increase the consistency of the containment system  
by preventing the occurrence of nodes which could create localized "holes" in the wireless  
fence. In a particular embodiment, the use of two antennae also allows for a reduction of the  
multipath effect. Multipath refers to the fact that a reflected signal will have a longer path  
getting from a transmitter to a receiver than would a direct signal. Depending on the  
20 frequency and the geometry of the situation, the two signals may be in phase and additive,  
producing a high RSSI, or may be out of phase and subtractive producing a low RSSI, or  
may be any phase between the two. For a given geometry there will be a frequency which  
is additive, and other frequency which is subtractive. The difference in these two  
frequencies becomes less as the distance of the direct signal becomes greater. In one  
25 particular communication protocol, Bluetooth BLE, frequency hops over a large enough  
range of frequencies that at least one additive and one subtractive channel are usually  
available for any geometry with a direct path distance longer than 50 feet. At shorter  
distances where signal strength is very high, accurate RSSI is not needed because the pet  
is well within the containment boundary.

30 [00103] The multipath effect of direct and reflected RF signals makes it difficult to  
estimate distance between a transmitter and receiver using just the magnitude of RSSI at  
the receiver. This is especially true in the 2.4GHz frequency band where a wavelength is  
only about 5 inches. However, using multiple antennae in addition to, in one embodiment,  
taking advantage of the frequency hopping property of BlueTooth Low Energy 4.0  
35 communications at 2.4GHz, helps to mitigate the phase cancellation effect by keeping a  
history of the reported signal strength for each band compared to the average of all bands,  
and predicting for each band the ratio of its signal strength versus the average. This  
allows the animal-worn transmitter 1 to operate as an RF containment system by sensing

the approximate distance from a central Bluetooth transmitter, such as the dual antenna wireless fence transmitter **87**. If the distance is too great, the collar may produce various stimuli which instruct the pet to return to an acceptable distance, thus implementing a containment system with a circular invisible fence centered at the Bluetooth transmitter.

**[00104]** The radial loop wireless fence transmitter **88** is a known type of transmitter in the field including three loop antennas each on a different axis. The radial loop wireless fence transmitter **88** uses a low frequency signal that may be lower than 100kHz, or even lower than 20 kHz. With such low frequencies, the radio signal **76** emitted by the radial loop wireless fence transmitter **88** can penetrate through most objects, such as the house **85**. In addition, using three loop antennae can increase the signal strength by summing the signal strengths along the three axes.

**[00105]** In a further embodiment, the radio signal **76** of any of the above described containment systems may act as a beacon to activate a GPS locator **26** in the animal-worn device **1** when the signal strength of the radio signal **76** decreases below a predetermined threshold.

**[00106]** Figures 24-26 show graphical interfaces and a representational diagram of an embodiment of a "Fitness" application. The "Fitness" application may allow the human **68** to conduct exercise sessions with the animal **3** wearing the animal-worn device **1** and to observe the fitness and vital signs of the animal as the session progresses. Software in the wireless mobile device **4** may analyze data generated at the animal-worn device **1** and advise the human when the training level needs adjustment in order to maintain a desired heart rate, calorie burn or other benchmark fitness criteria. The "Fitness" application may also allow the human user to physically train along with the animal and display data pertaining to the exercise level of both the animal **3** and the human **68**.

**[00107]** Figure 24 shows a first fitness graphical interface **151** being displayed on the graphic display panel **48** of the wireless mobile device **4** that may load when the "Fitness" application is selected on the wireless mobile device **4**. The first fitness graphical interface **151** may provide a fitness calculator to estimate the overall body mass index (BMI) of the animal **3** based on information input by the human user. The first fitness graphical interface **151** may include a name input field **90** where the human user may input the name of the animal **3**. A breed input field **91** may be included where the human user may choose the breed of the animal from a pull-down list. An age input field **92** may be included where the human user may input the age of the animal **3**. A weight input field **93** may be included where the human user may input the weight of the animal **3**. A gender selection field **94** may be included where the human user may select the gender of the animal **3**. A height input field **95** may be included where the human user may input the height of the animal **3**. The first fitness graphical interface **151** may include a "Calculate" button that when pressed after the human user has input the above information, will initiate instructions stored in the "Fitness"

1 application to calculate the BMI of the animal 3 and display the calculated BMI on the BMI  
display 97. The instruction stored in the "Fitness" application may calculate BMI based on  
all or some of the information input by the human user. Additional input fields may be  
included in order to more precisely calculate the BMI of the animal 3. The first fitness  
5 graphical interface 151 may also include a fitness level display 98, which provides a general  
statement of the animal's fitness based on the BMI or other input information. The fitness  
level display 98 may include statements such as "Overweight," "Healthy," or "Underweight"  
as a general assessment of the animal's overall health. The first fitness graphical interface  
151 may include the screen slider 56 that allows the human user to switch to additional  
10 graphical interfaces in the "Fitness" application.

[00108] Figure 25 shows a second fitness graphical interface 152 being displayed on the  
graphic display panel 48 of the wireless mobile device 4. The second fitness graphical  
interface 152 may monitor exercise information regarding the animal 3 in real-time when the  
animal 3 is performing an exercise routine. It may provide buttons such as a start/pause  
15 button 102 to allow the human user to begin or pause the exercise routine. It may also  
include a "done" button 103 that ends the exercise routine. During the animal's 3 exercise  
routine, the second fitness graphical interface 152 may provide statistics regarding the  
animal's 3 performance in an exercise data array 100. The exercise data array 100 may  
include statistics of the exercise routine, such as the animal's 3 heart rate, percentage of heart  
20 rate relative to maximum heart rate, internal temperature, current pace, average pace, distance  
traveled, time elapsed and calories burned. The second fitness graphical interface 152 may  
also include an exercise level indicator 101 that displays recommendations as to whether the  
animal's 3 exercise level should be increased or decreased based on some or all the statistics  
in the exercise data array 100 and/or the input fields from the first fitness graphical interface  
25 151 and outputs a recommendation to advise the human 68 as to when the training level  
needs adjustment in order to maintain a desired heart rate, calorie burn or other benchmark  
fitness criteria. For example, recommendations may be determined by comparing target  
training levels, which may be based on information input on the first graphical interface 151,  
to the animal's real-time activity level.

30 [00109] The second fitness graphical interface 152 may also include the connected device  
indicator 51 to indicate the animal-worn device 1 that has been selected. It may include the  
status indicator 50 that indicates the status of the connection between the wireless mobile  
device 4 and the animal-worn device 1. It may also include the battery level indicator 55 that  
graphically displays the battery charge level of the animal-worn device 1.

35 [00110] Figure 26 shows a third fitness graphical interface 153 being displayed on the  
graphic display panel 48 of the wireless mobile device 4. The third fitness graphical interface  
153 may monitor exercise information regarding both the human 68 and the animal 3 in real-  
time when both the animal 3 and the human 68 are performing a tandem exercise routine. It

1 may provide buttons such as a start/pause button **102** to allow the human **68** to begin or pause the tandem exercise routine. It may also include a “done” button **103** that ends the tandem exercise routine. During the animal’s **3** exercise routine, the third fitness graphical interface **153** may provide statistics regarding the animal’s **3** performance and the human’s **68** performance in a tandem exercise data array **104**. The tandem exercise data array **104** may include statistics and information regarding the tandem exercise routine, such as the time elapsed and the activity being performed (*e.g.*, running, biking, hiking or walking), the distance traveled, the current pace, the average pace, the heart rate, the percentage of heart rate relative to maximum heart rate, the calories burned and the exercise level for both the animal **3** and the human **68**. The third fitness graphical interface **153** may also include a message field **105** that may provide warnings or progress reports on either or both of the animal **3** or the human **68**. For example, messages in the message field **105** may include recommendations generated by software in the “Fitness” application that analyzes some or all the statistics in the tandem exercise data array **104** and/or the input fields from the first fitness graphical interface **151** and outputs a message to advise the human **68** as to when the training level needs adjustment in order to maintain a desired heart rate, calorie burn or other benchmark fitness criteria.

[00111] The third fitness graphical interface **153** may also include the connected device indicator **51** to indicate the animal-worn device **1** that has been selected. It may include the status indicator **50** that indicates the status of the connection between the wireless mobile device **4** and the animal-worn device **1**. It may also include the battery level indicator **55** that graphically displays the battery charge level of the animal-worn device **1**.

[00112] Figure **27** is a block diagram of a firmware upload from the wireless mobile device **4** to the animal-worn device **1**. The embodiments described above may use the approach described in Figure **27** to load and update firmware from the wireless mobile device **4** to the animal-worn device **1** to avoid potential firmware update issues that may occur when updating the animal-worn device **1** through the wireless mobile device **4**. When using a wireless protocol, such as Bluetooth low energy BLE, with its characteristically low data rate and limited range, using a conventional boot loader program to upgrade firmware wirelessly can be inconvenient and risky. The lengthy time required to slowly pass kilobytes of data by such conventional means could render the animal-worn receiver **1** unusable for a significant time. Additionally, signal loss or power loss could cause the firmware download to halt or be corrupted, requiring a restart of the entire firmware upgrade process. This problem can be addressed by maintaining two isolated sections of program memory in the animal-worn device’s **1** main processor, one for the current firmware which may continue to run throughout the upgrade process, and another in which the new firmware version is to be loaded. This allows the animal worn transceiver **1** to keep performing all its functions of running the current firmware while the new firmware is slowly transmitted over the wireless

1 link. When the download is complete, the animal worn transceiver's 1 processor overwrites  
startup and interrupt vectors to point to the new firmware. If ever the new firmware is  
unstable, boot loader software in the animal-worn device's 1 processor can be configured to  
detect the fault and switch back to the previous firmware version by rewriting the previous  
5 vectors. Multiple upgrades of the firmware may be accommodated by placing the succeeding  
version in a currently unused block of program memory, always preserving the latest versions  
of firmware.

[00113] As shown in Figure 27, data regarding the firmware is loaded on the wireless  
mobile device 4 (S2) and then individual packets of firmware are loaded (S3) and sent (S4) to  
10 the animal-worn device 1. Such packets may be transmitted, for example, using Bluetooth  
4.0 BLE. Each packet of data has a length (in this example the length is 20 bytes but other  
lengths are possible) and may include a message identifier code, a ROM address of the first  
byte of code in the packet, the number of firmware bytes in the packet - for example, from 1  
to 15 bytes - and the actual bytes of data. Boot loader software in the animal-worn device's  
15 processor 1A installs each packet of firmware (S5) into the processor's 1A internal Flash  
ROM starting at an included starting address. If every byte is successfully installed, the boot  
loader software sends an acknowledgement message requesting the next bytes (S6, S3). If  
not, it sends a message requesting the previous data (S6, S4). The boot loader software may  
specify any starting address for the next 15 firmware bytes, thus allowing for reprogramming of  
20 an entire block of ROM should an earlier written byte of data be erased, for example during a  
power failure. This robustness also allows for the fixing or adjusting of code errors to a great  
degree without sending an entire new firmware file.

[00114] Prior to starting the firmware download, a unique "start download" data packet is  
sent by the wireless mobile device 4 (S1) and received at the animal-worn device 1 indicating  
25 the start of the firmware upgrade. The "start download" packet specifies the total number of  
firmware bytes to be transferred and a checksum of all the bytes to be transferred.  
Subsequent to the last byte of firmware being downloaded, and when there are no additional  
packets to be transferred (S7), a unique "end download" packet is sent by the wireless mobile  
device 4 (S8) with the checksum again included. The animal-worn device's 1 processor  
30 compares the starting checksum to the ending checksum and the actual checksum of all the  
bytes loaded into ROM memory (S10). If all three checksums match, the upgrade is deemed  
successful and the vectors are rewritten to start execution of the new firmware (S11). The  
boot loader software may send a "success" (S12) or "failed" (S10, S1) message to the  
wireless mobile device 4. If successful, a "Install Successful" message can be displayed on  
35 the wireless mobile device's 4 display screen (S13). If the installation fails, the wireless  
mobile device 4 may repeat the upgrade process a predetermined number of times (S10, S1)  
before displaying a failed status message on the wireless mobile device's 4 display screen and  
halting the firmware upgrade process.

1    **[00115]** While the present invention has been described in connection with certain  
exemplary embodiments, it is to be understood that the invention is not limited to the  
disclosed embodiments, but is instead intended to cover various modifications and equivalent  
arrangements included within the spirit and scope of the of the appended claims, and  
5    equivalents thereof.

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1 WHAT IS CLAIMED IS:

1. A wireless system for controlling behavior of an animal by a wireless mobile device comprising:

5 a device for the animal comprising one or more outputs and a transceiver to communicate with the wireless mobile device via a wireless protocol; and

a pre-programmed computer application configured to run on the wireless mobile device, wherein said pre-programmed computer application is configured to allow a human to operate the one or more outputs of the device for the animal.

10 2. The wireless system of claim 1, wherein the one or more outputs of the device for the animal comprise at least one output selected from a group consisting of: a tone generator, an electrical stimulus generator, a light generator, a vibration generator, a liquid spray module configured to spray a liquid mist, a gas spray module configured to spray a gas, a speaker and a radio transmitter.

15 3. The wireless system of claim 1, wherein the device for the animal further comprises one or more inputs.

20 4. The wireless system of claim 3, wherein the one or more inputs of the device for the animal comprise at least one input selected from a group consisting of: a vibration sensor, a temperature sensor, an accelerometer, a microphone, an audio recorder, a heart rate monitor, a magnetometer, a GPS locator, a radio receiver, a photo sensor, a conductivity sensor, a humidity sensor, a water sensor, a gyroscope, a camera and a cellular phone transceiver.

25 5. The wireless system of claim 1, wherein the one or more outputs of the device for the animal comprises a speaker configured to audibly output voice recordings from the wireless mobile device.

30 6. The wireless system of claim 1, wherein the transceiver of the device for the animal comprises a radio transceiver configured to send wireless signals to an external device, and wherein the external device is configured to receive the wireless signals and perform functions in response to the wireless signals.

35 7. The wireless system of claim 1, wherein at least one output of the one or more outputs is a player of prerecorded spoken words.

8. The wireless system of claim 1, further comprising a wireless fence transmitter, wherein the device for the animal contains means to detect a distance of the device for the animal from the wireless fence transmitter and when the device for the animal



1 is greater than a predetermined distance from the wireless fence transmitter, at least one  
output of said one or more outputs produces a corrective stimulus.

5 9. The wireless system of claim 8, wherein the at least one output is an electrical  
stimulus generator and the corrective stimulus is an electrical shock.

10 10. The wireless system of claim 8, wherein the wireless fence transmitter emits a  
beacon and wherein the device for the animal includes a GPS locator that is activated when a  
signal strength of the beacon decreases below a predetermined threshold.

11. The wireless system of claim 1, further comprising a wireless mobile device  
comprising a display and a processor configured to execute the pre-programmed computer  
application.

15 12. The wireless system of claim 1 wherein the device for the animal includes a  
dual battery system comprising a primary battery, a secondary battery and a switch.

13. A wireless system for monitoring an animal by a wireless mobile device  
comprising:

20 an device for the animal comprising one or more inputs and a transceiver to  
communicate with the wireless mobile device via a wireless protocol; and

a pre-programmed computer application configured to run on the wireless  
mobile device, wherein said pre-programmed computer application is configured to receive  
data from at least one input of the one or more inputs of the device for the animal.

25 14. The wireless system of claim 13, wherein the one or more inputs of the device  
for the animal comprise at least two inputs selected from a group consisting of: a vibration  
sensor, a proximity sensor, a temperature sensor, an accelerometer, a microphone, an audio  
recorder, a heart rate monitor, a magnetometer, a GPS locator, an auxiliary radio receiver, a  
photo sensor, a conductivity sensor, a humidity sensor, a water sensor, a gyroscope, a camera  
and a cellular phone transceiver.

30 15. The wireless system of claim 13, further comprising:  
a wireless mobile device comprising a display and a processor configured to  
execute the pre-programmed computer application;

35 wherein the transceiver is configured to receive data from at least one input of  
the one or more inputs of the device for the animal and to wirelessly send the input data from  
the at least one input to the wireless mobile device via the wireless protocol; and

1            wherein the pre-programmed computer application includes at least one graphical interface configured to graphically represent the input data on the display of the wireless mobile device.

5            16.     The wireless system of claim 13, wherein the pre-programmed computer application is configured to receive data from at least one input of the one or more inputs of the device for the animal in real-time.

10           17.     The wireless system of claim 13, wherein the one or more inputs includes a means for detecting an utterance by an animal wearing the device for the animal.

            18.     The wireless system of claim 14, wherein the heart rate monitor includes a pressure sensor.

15           19.     The wireless system of claim 14, wherein the heart rate monitor includes an electrical current sensor.

            20.     The wireless system of claim 14, wherein the auxiliary radio transceiver is configured to send wireless signals to an external device configured to receive the wireless signals and perform functions in response to the wireless signals.

20           21.     The wireless system of claim 13, further comprising a remote server configured to receive and analyze input data from the one or more inputs of the device for the animal.

25           22.     The wireless system of claim 21, wherein the remote server is configured to send firmware updates to the device for the animal based on results from the analysis of the input data.

            23.     The wireless system of claim 1 wherein the device for the animal includes a dual battery system comprising a primary battery, a secondary battery and a switch.

30           24.     A wireless system for monitoring and controlling the behavior of an animal by a wireless mobile device comprising:

            a device for the animal comprising one or more outputs, one or more inputs and a transceiver to communicate with the wireless mobile device via a wireless protocol, and  
            a pre-programmed computer application configured to run on the wireless  
35     mobile device, wherein said pre-programmed computer application is configured to allow a human to monitor the one or more inputs and operate the one or more outputs of the device for the animal in real time.

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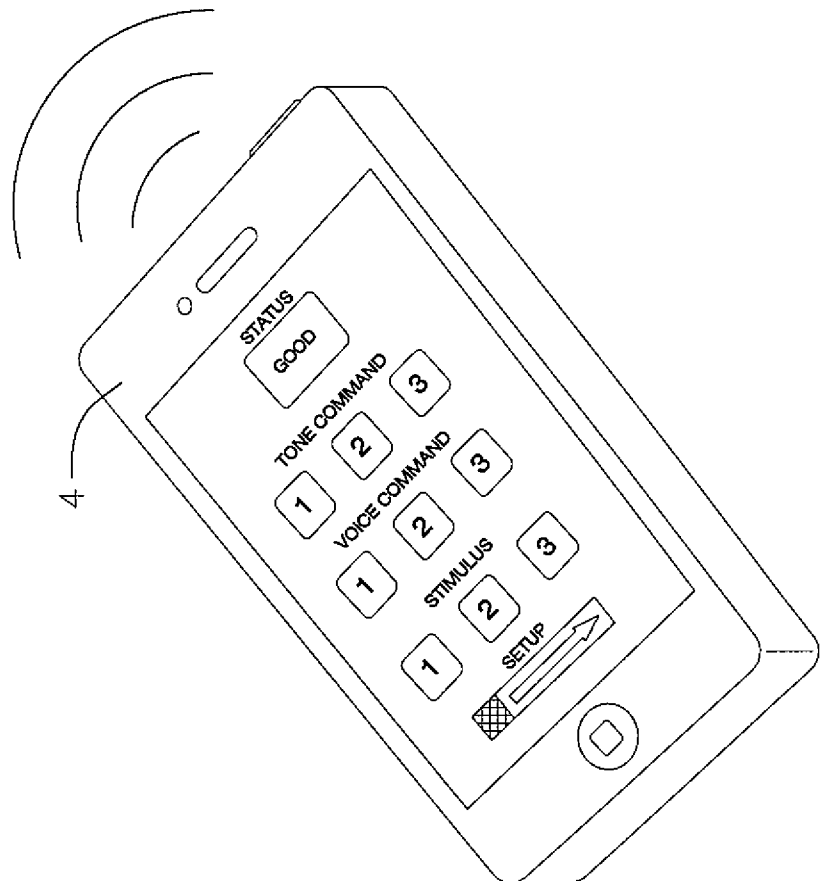
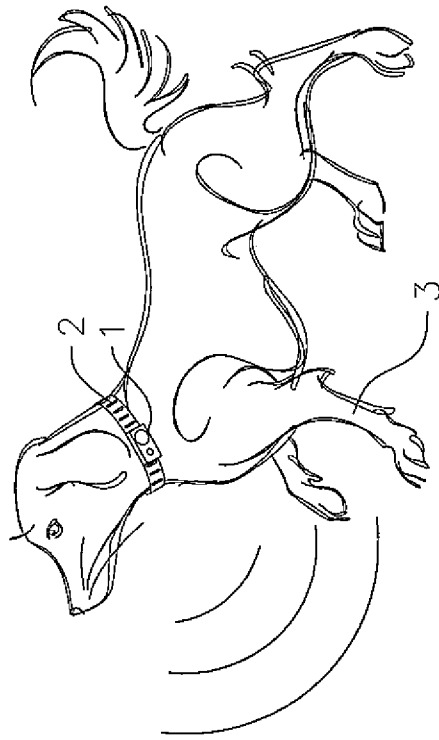
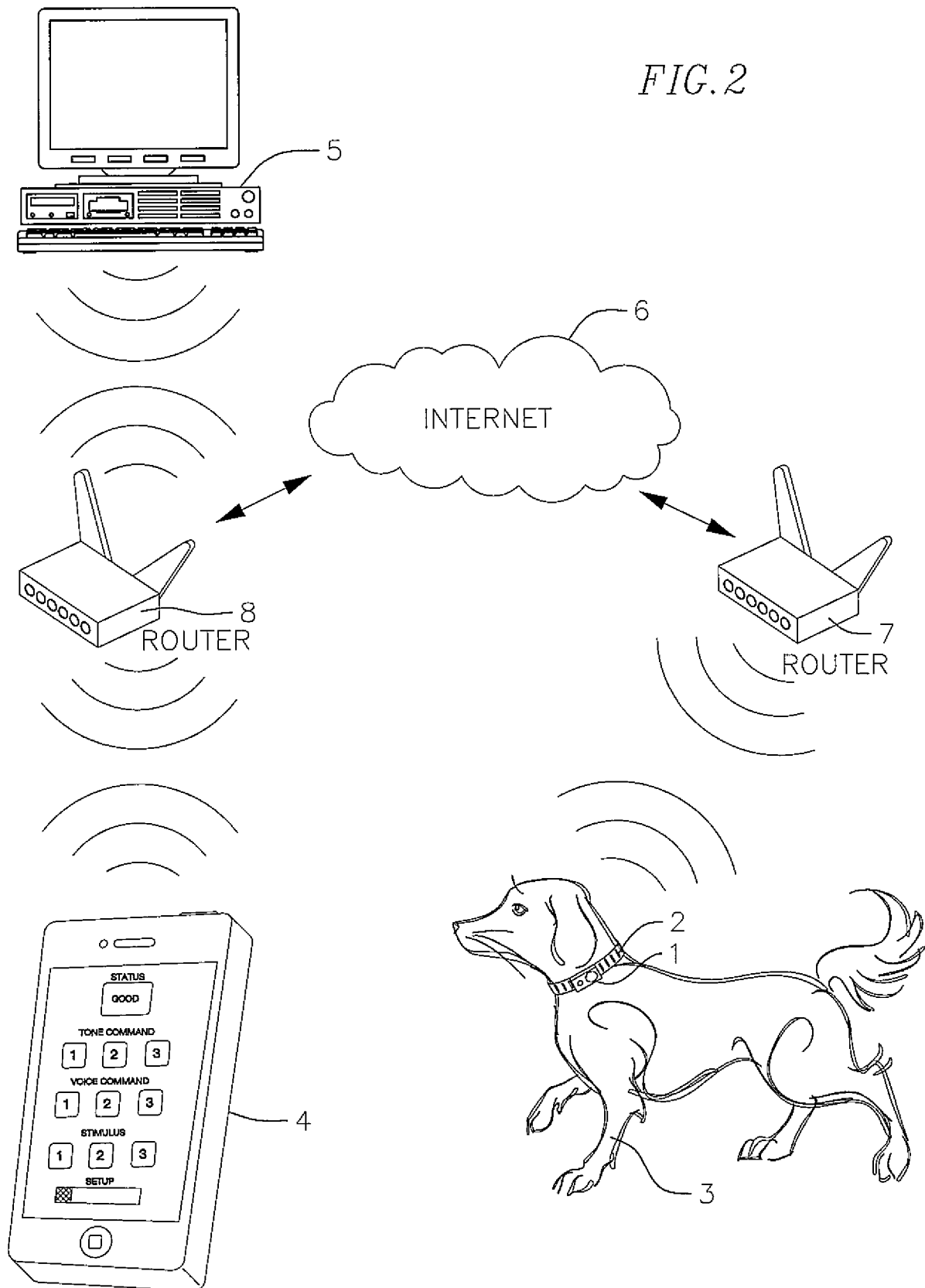
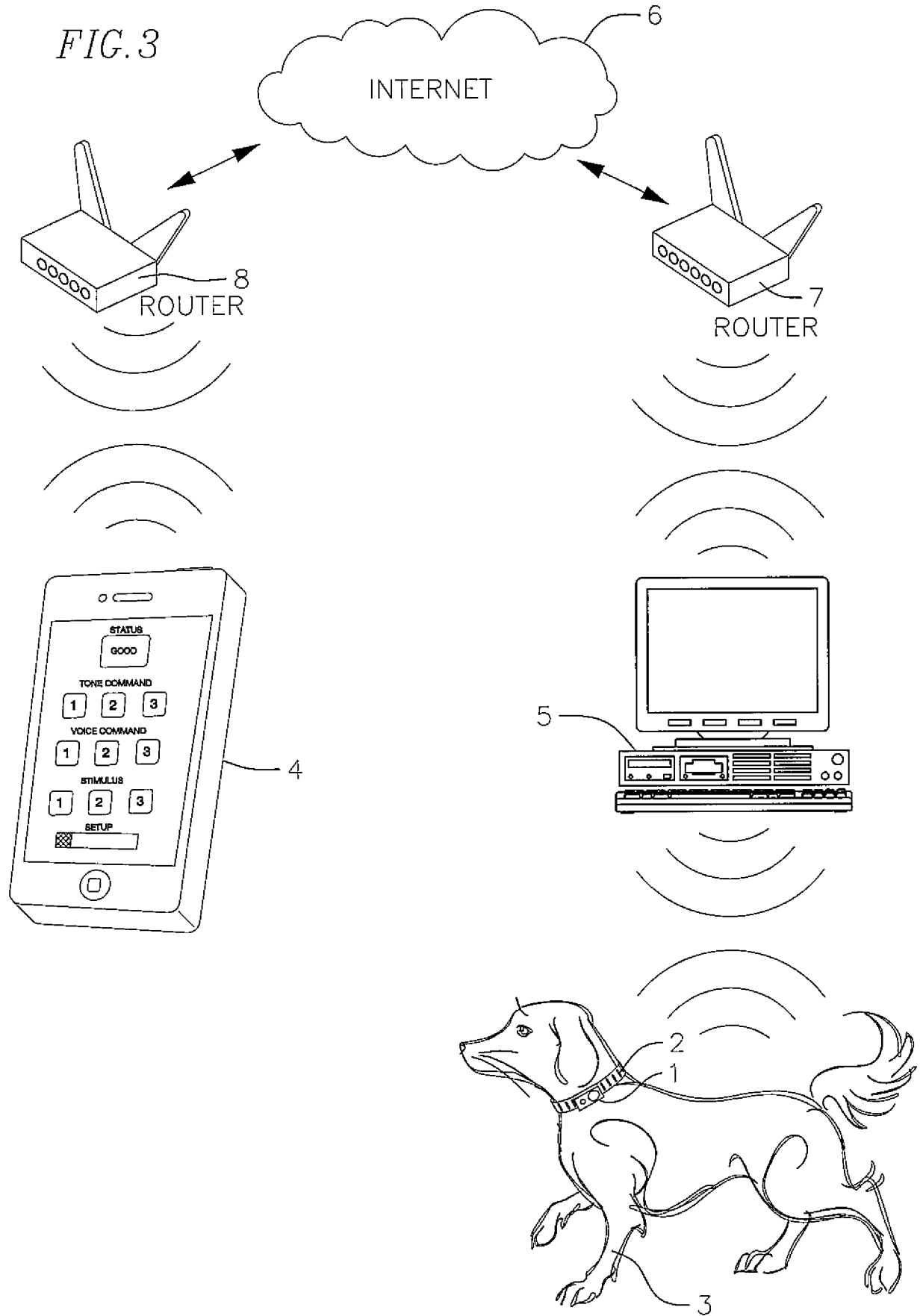


FIG. 1

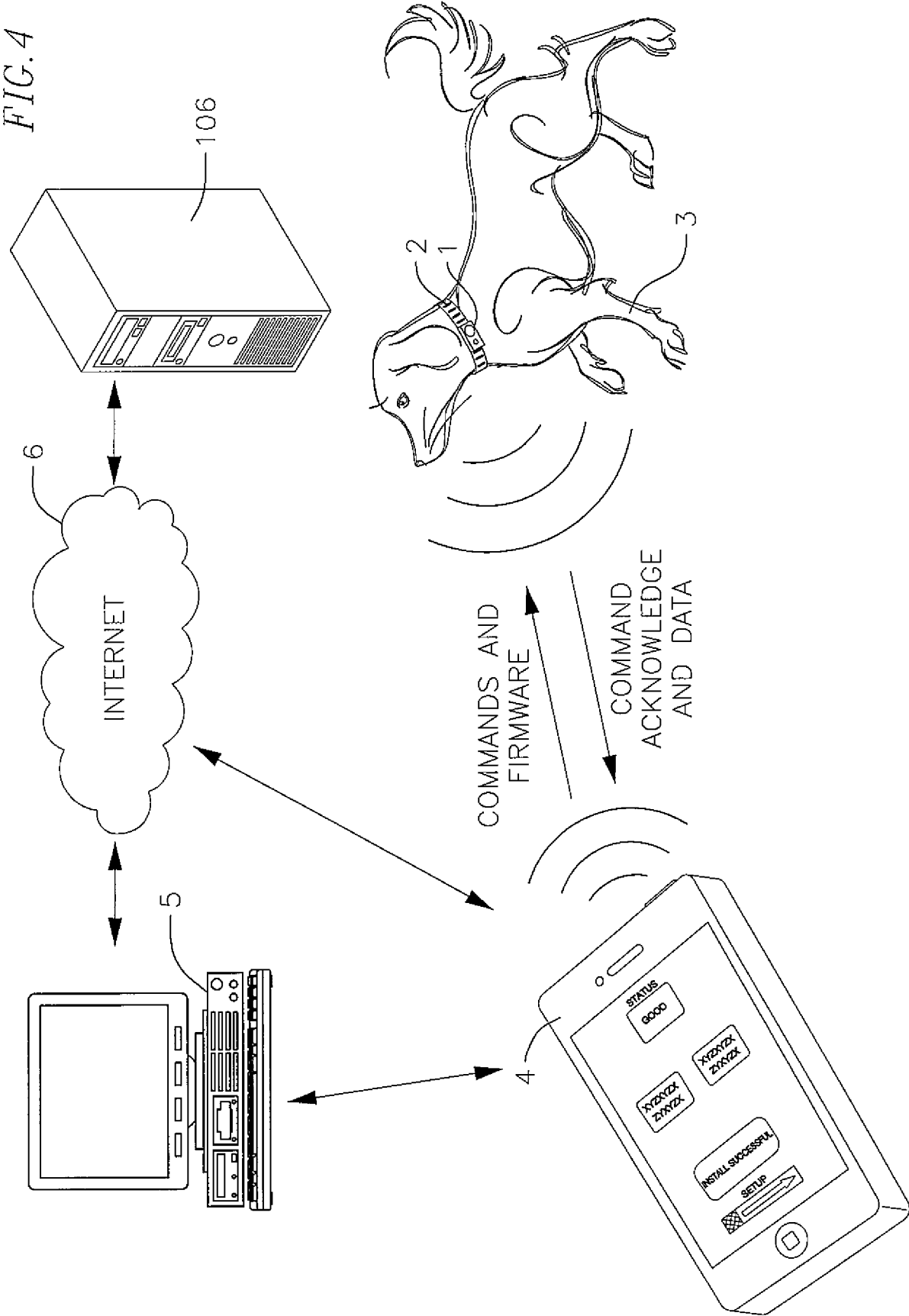
2/27



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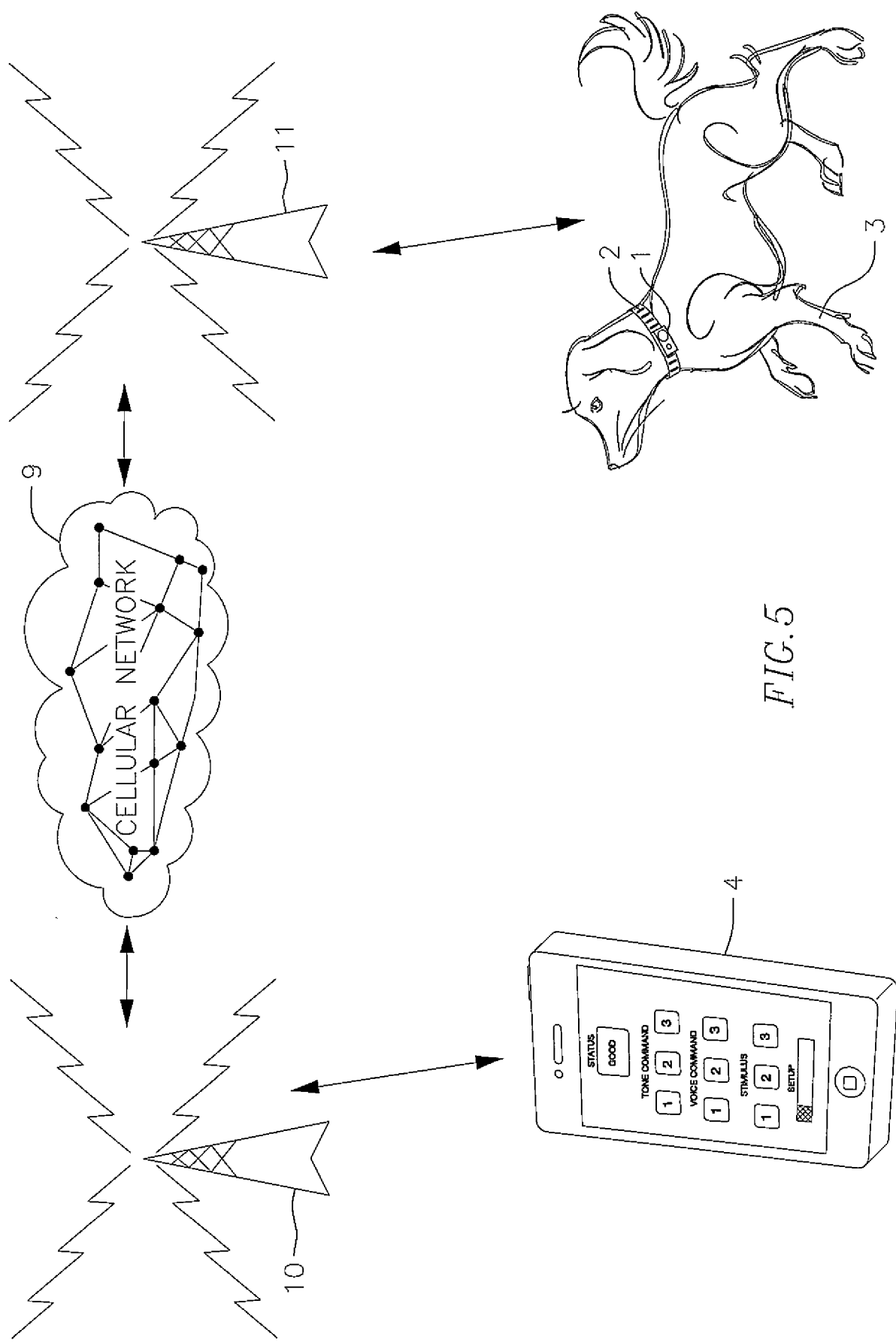
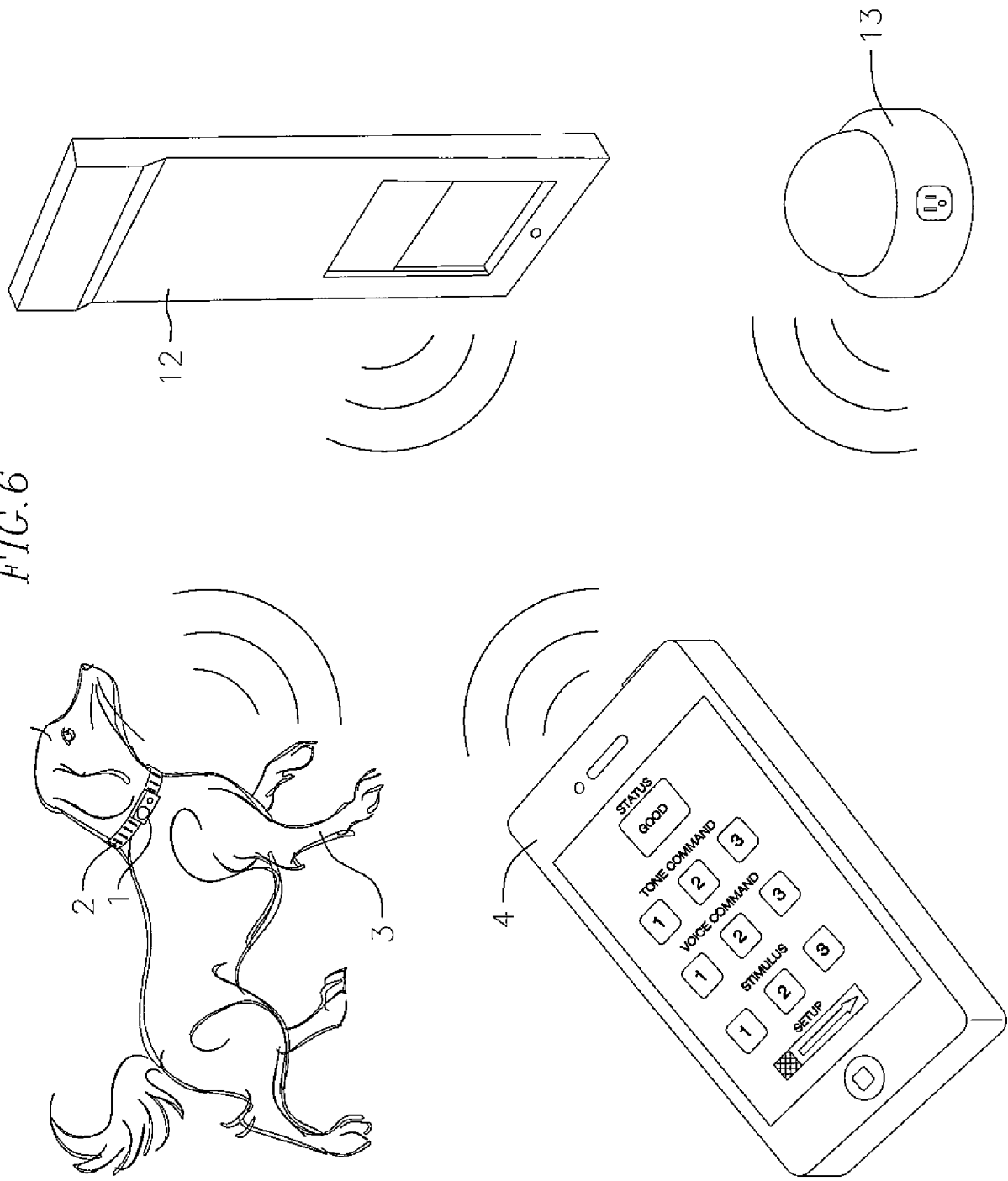


FIG. 5

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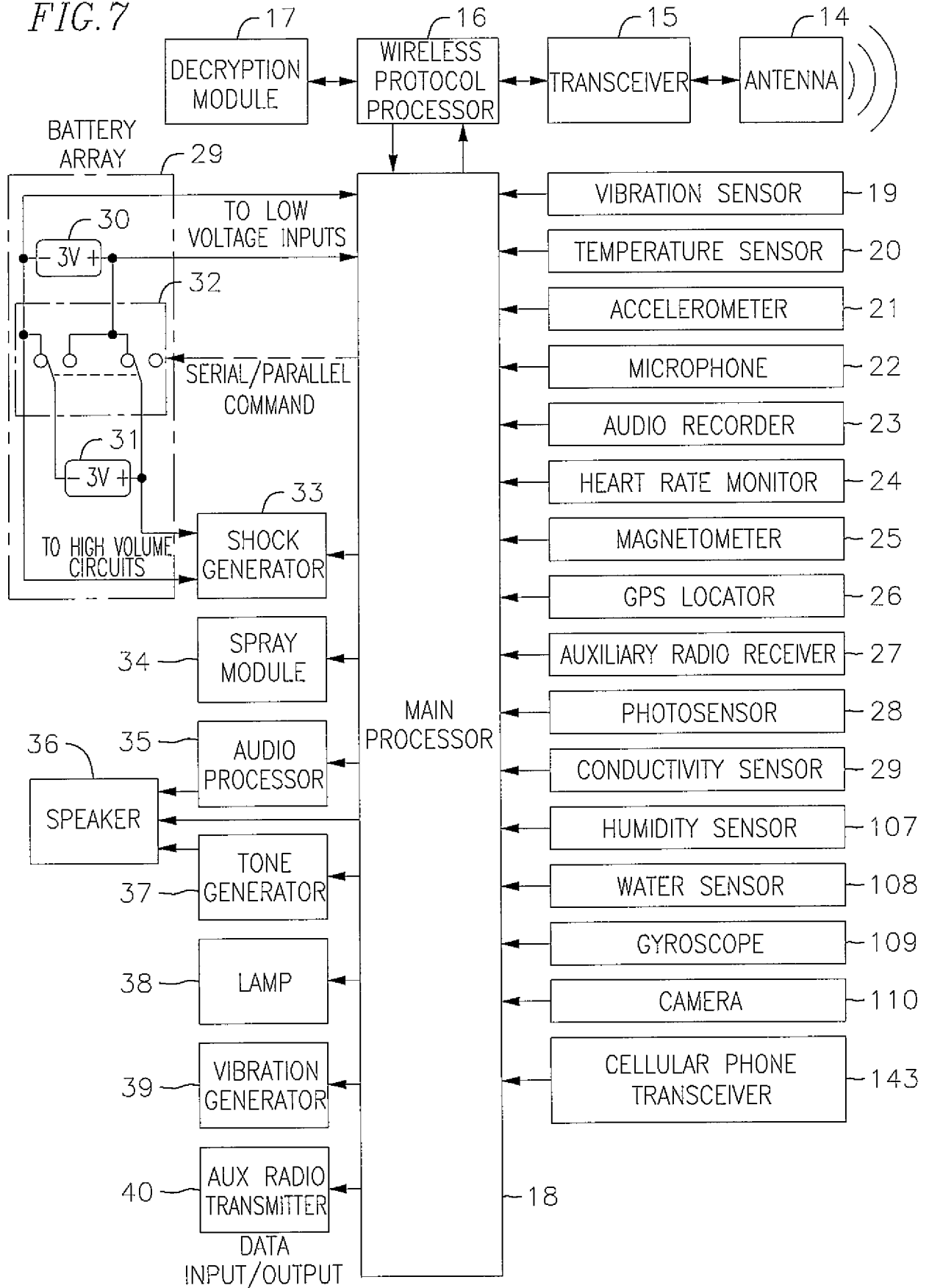
FIG. 6





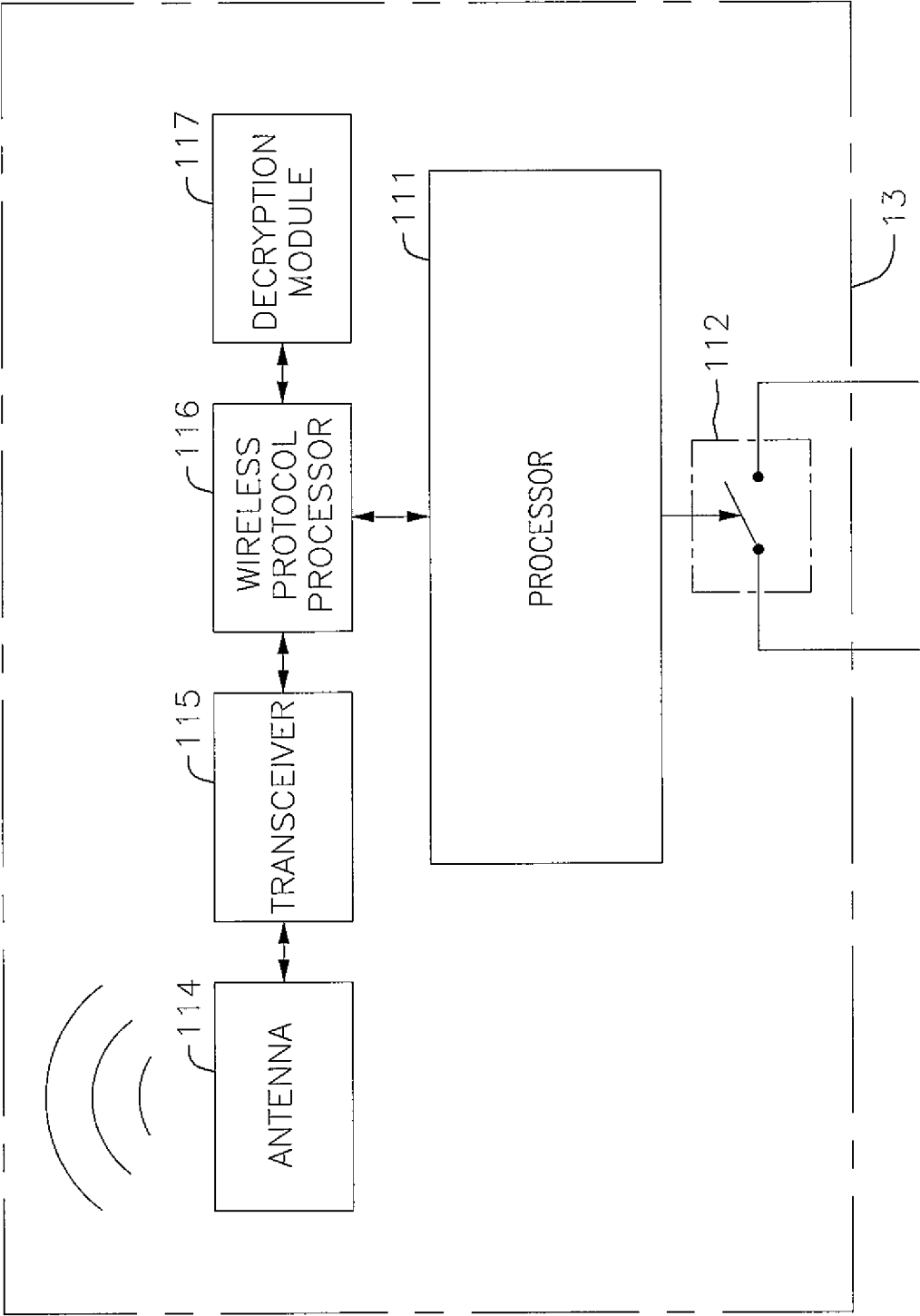
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FIG. 7



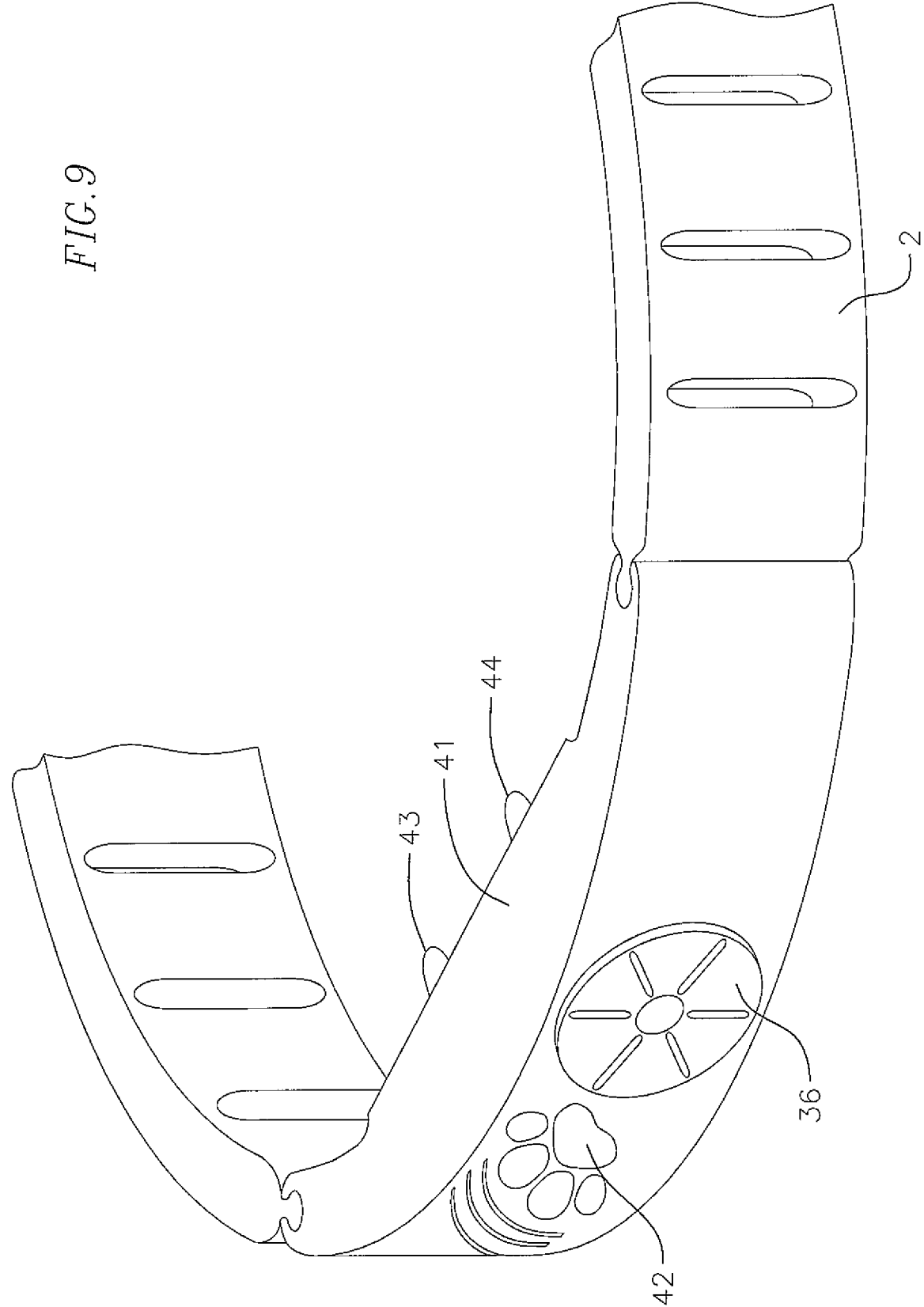
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FIG. 8

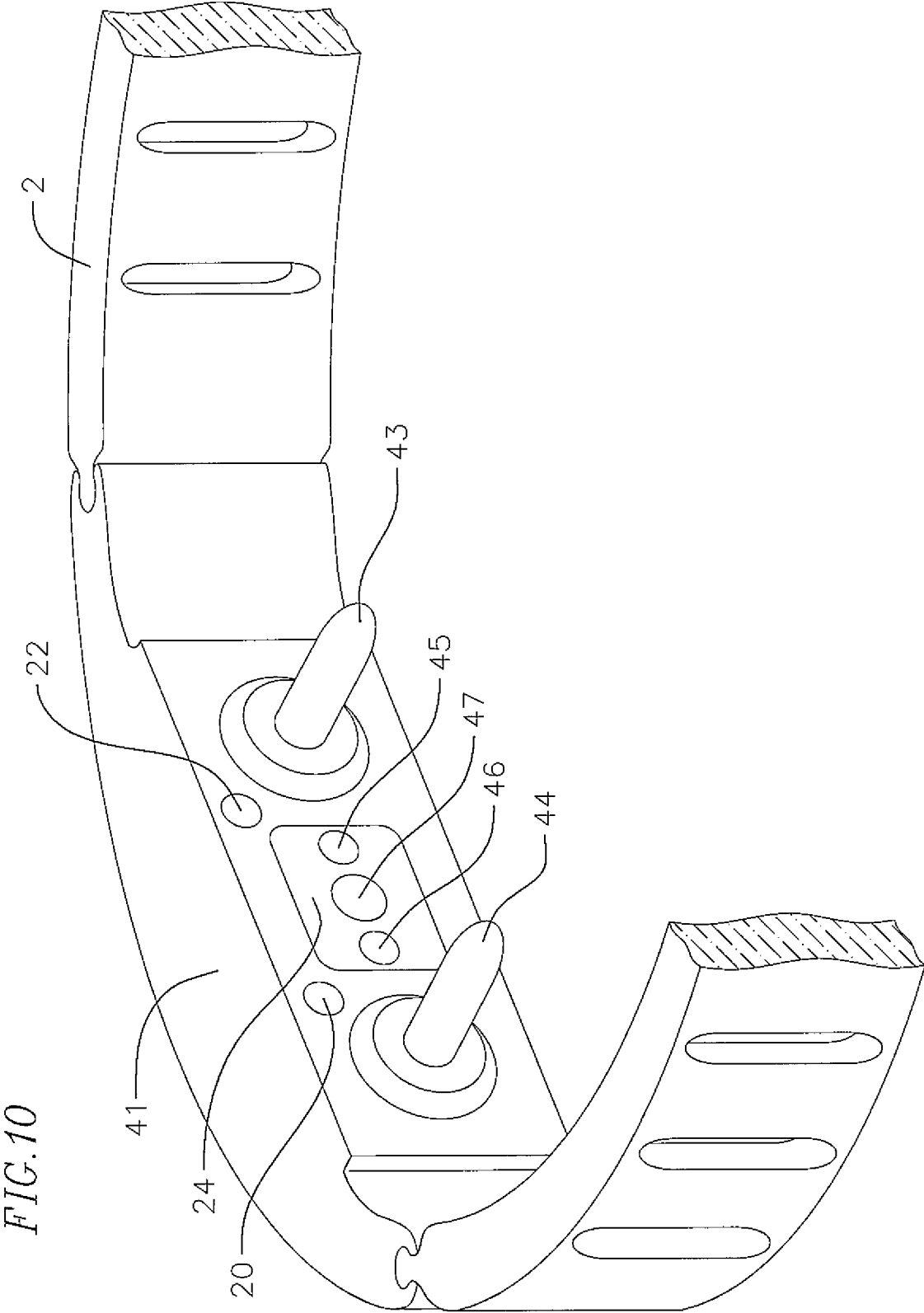


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FIG. 9

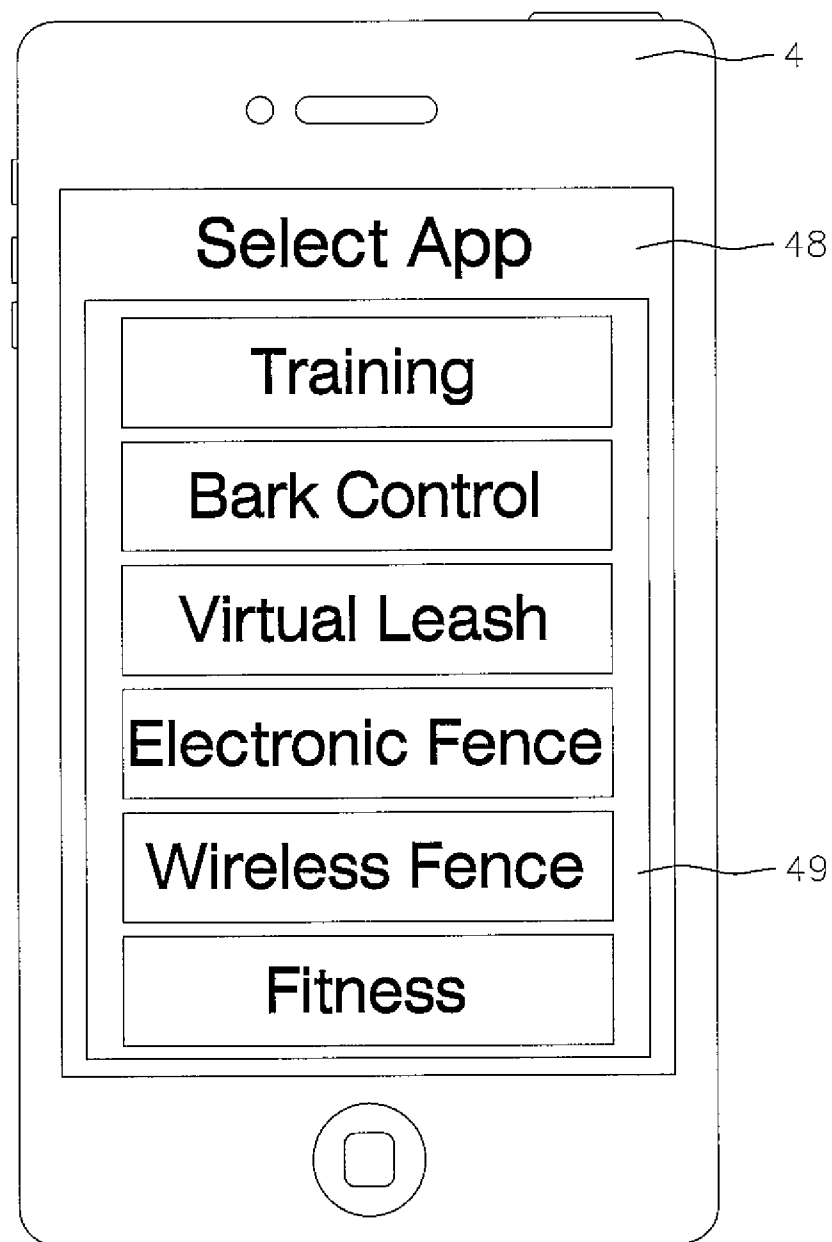


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*FIG. 11*



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FIG. 12

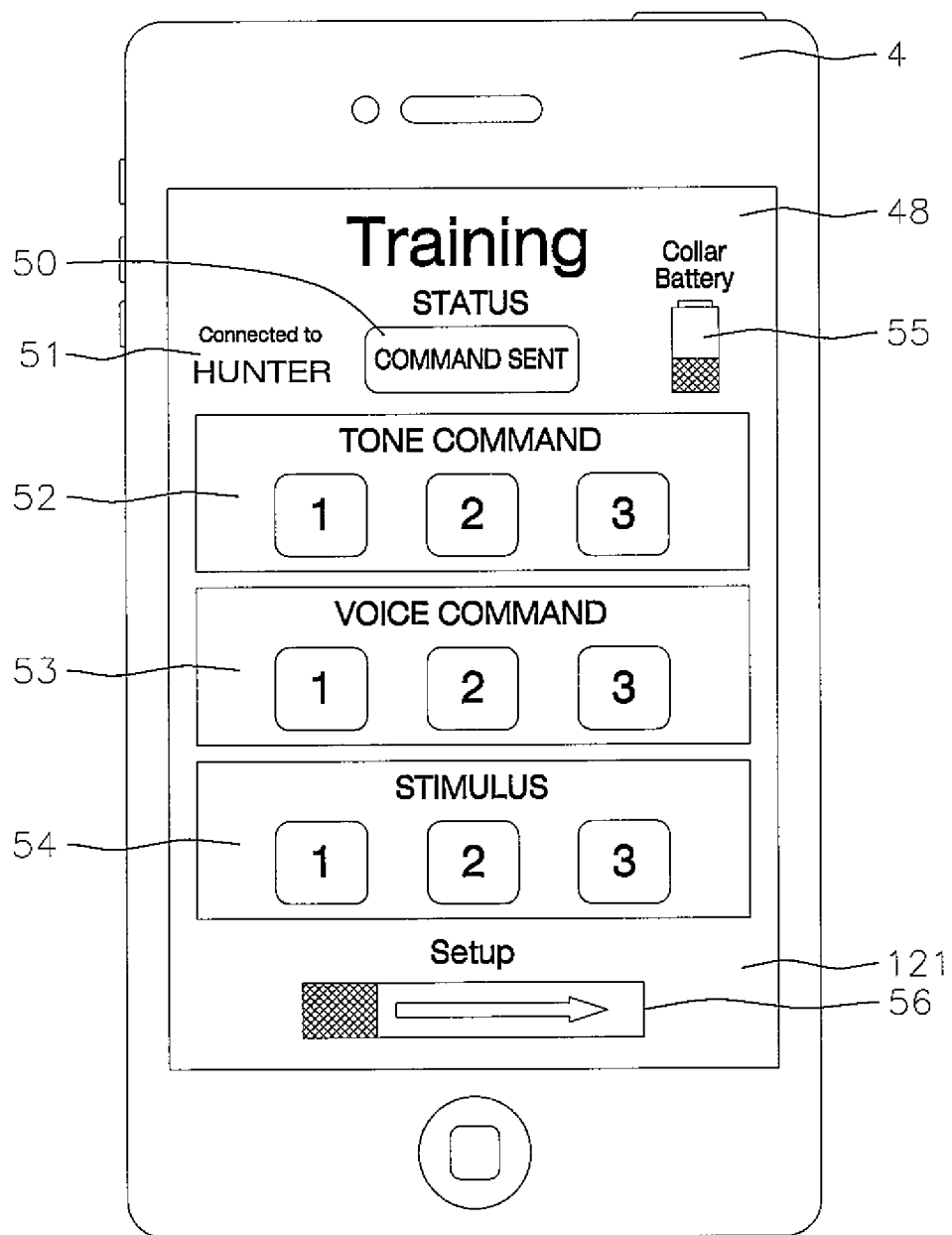
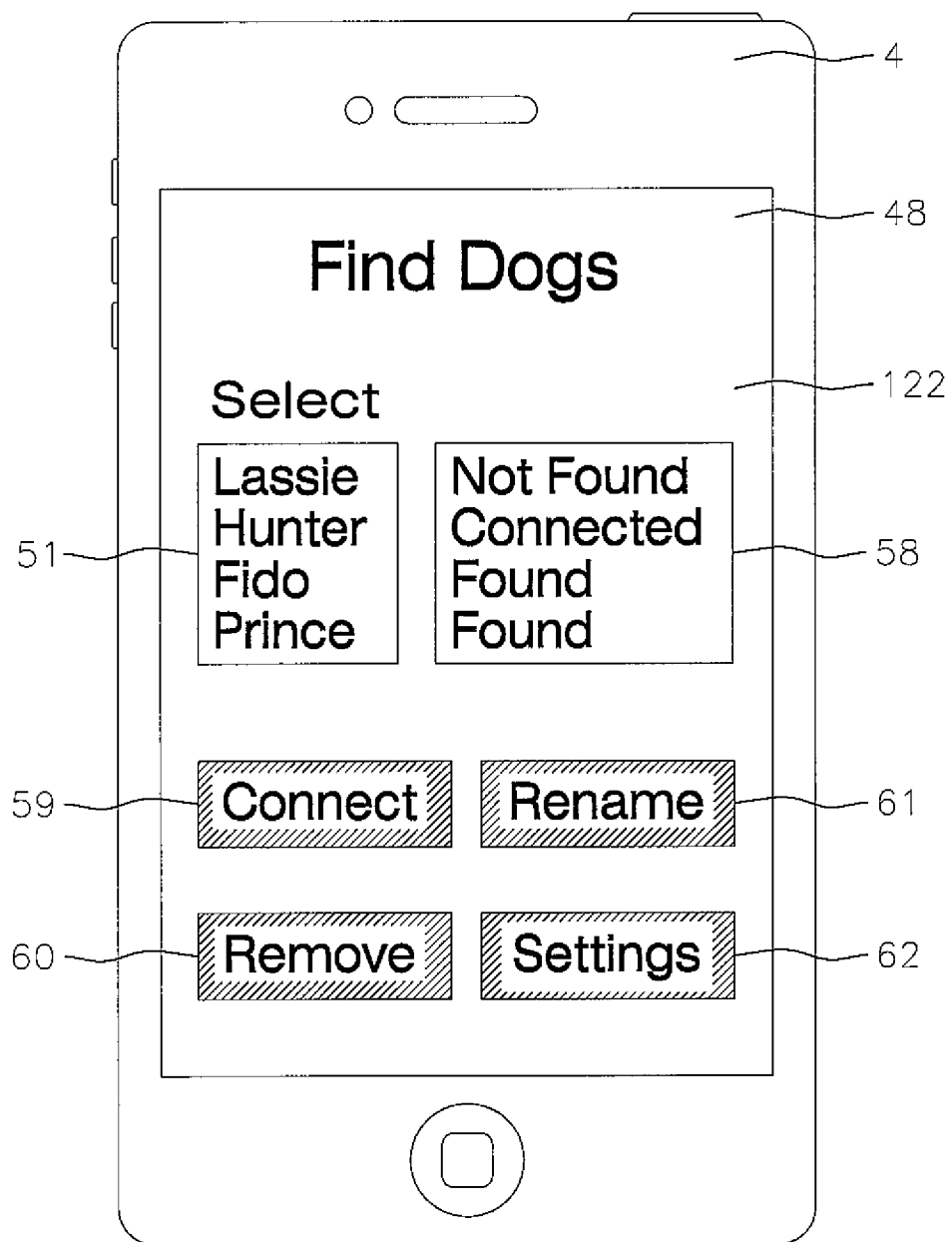


FIG. 13



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FIG. 14

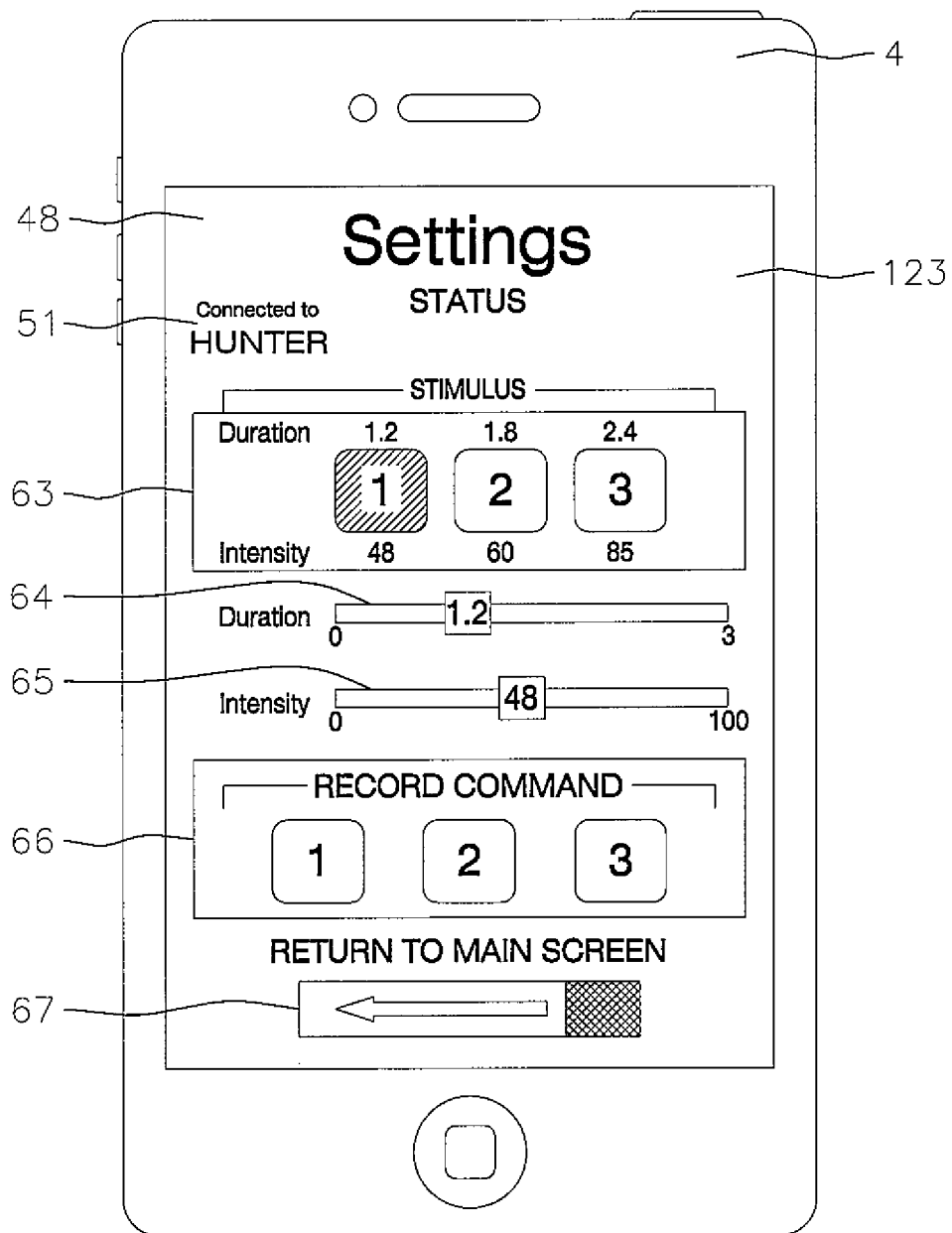
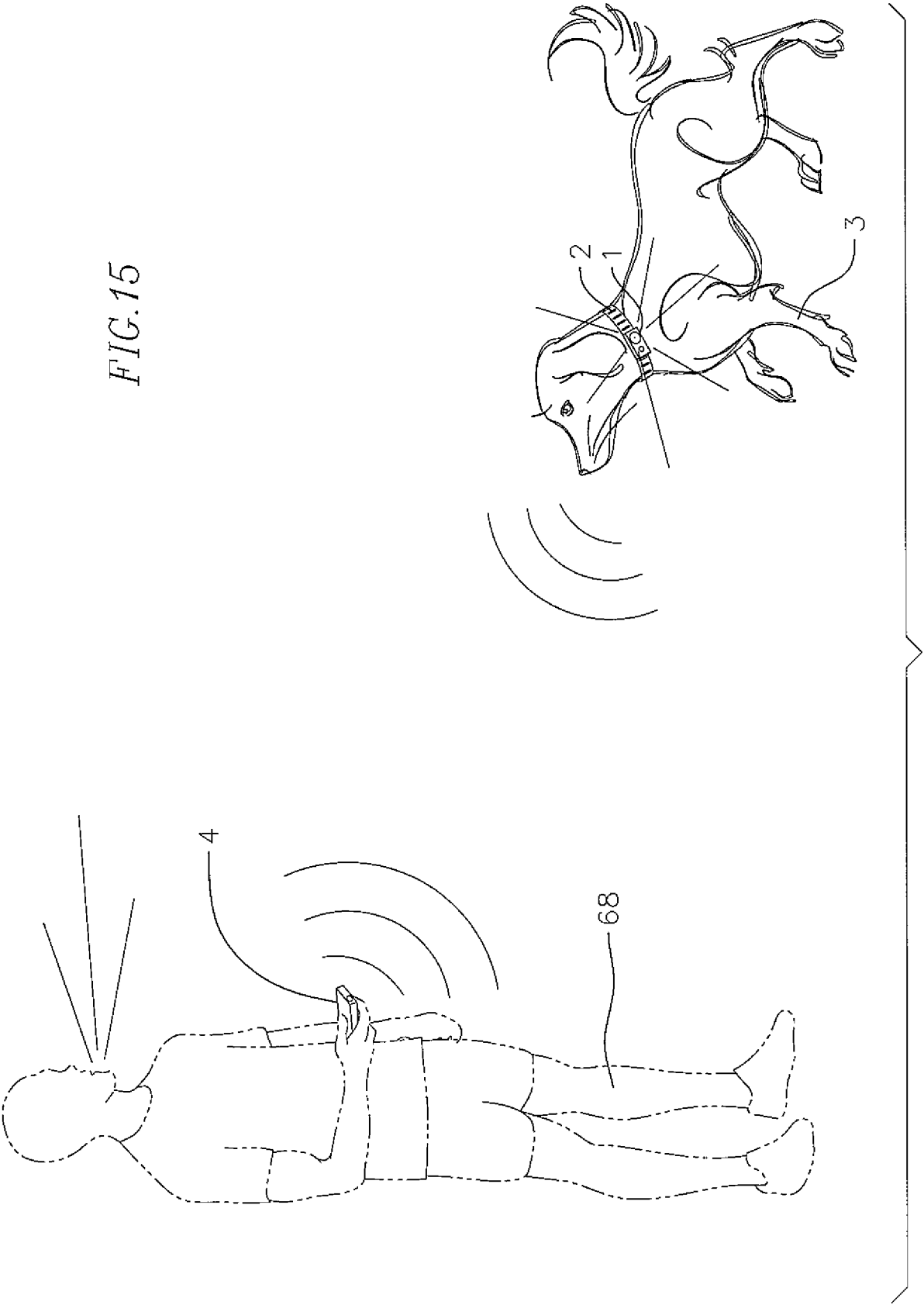


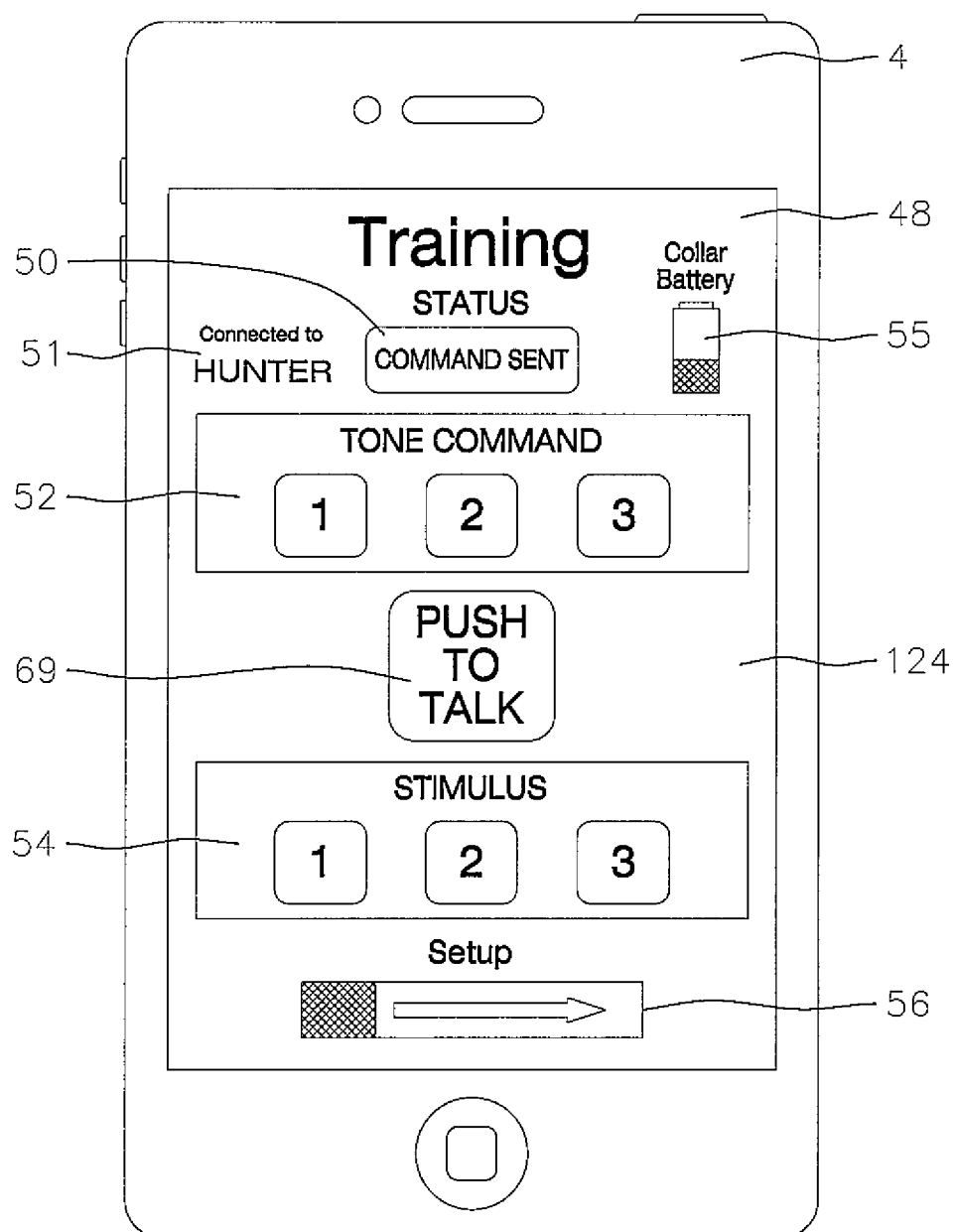


FIG. 15



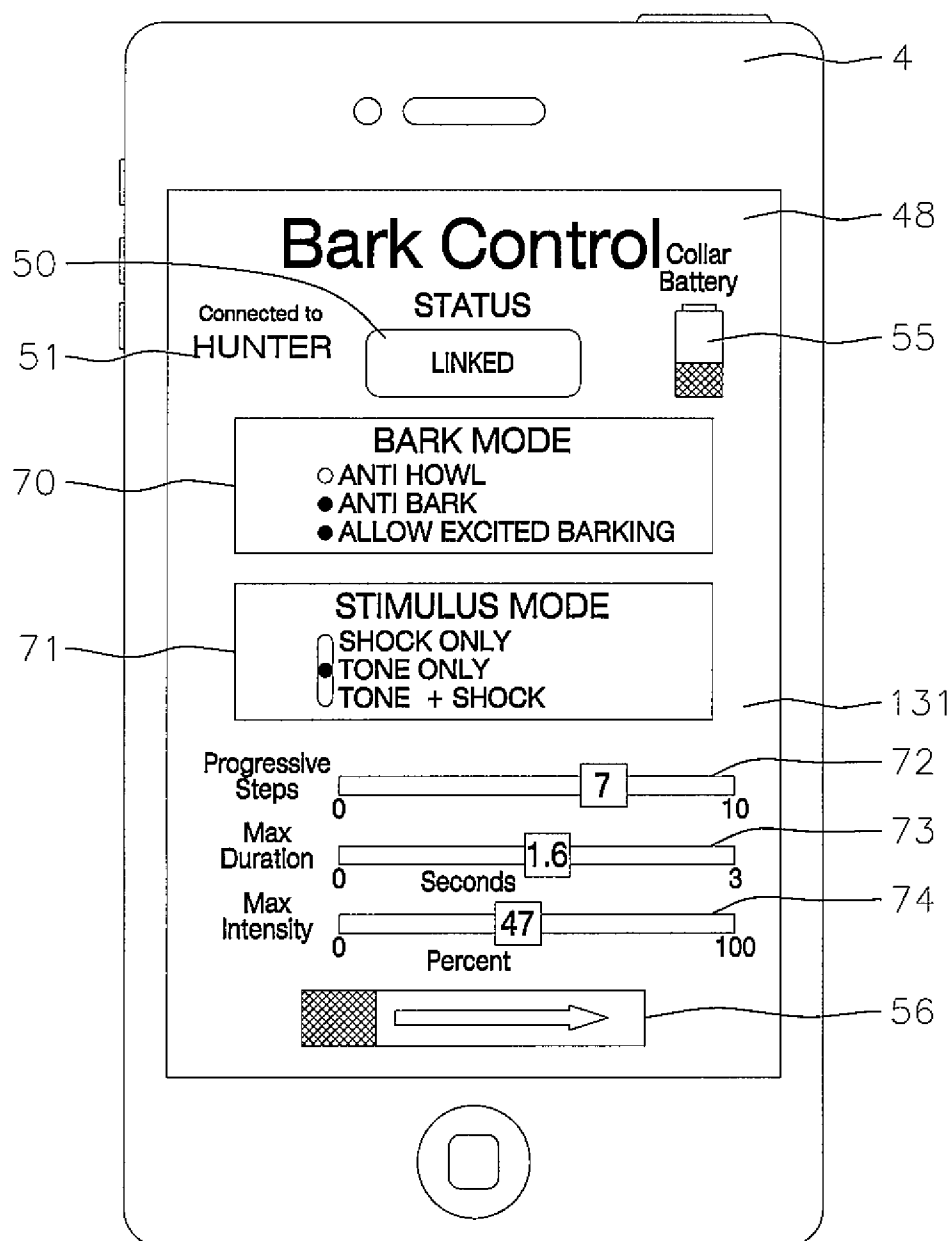
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FIG. 16



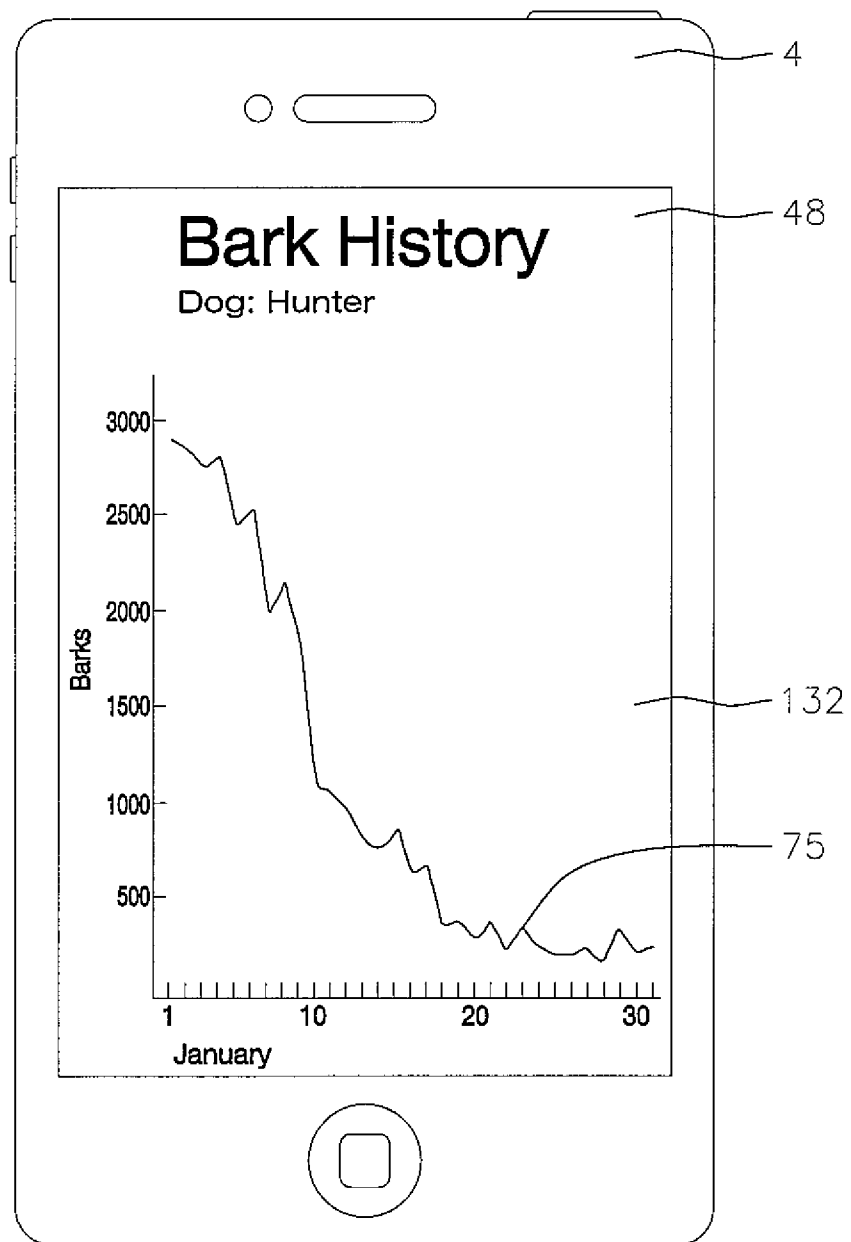
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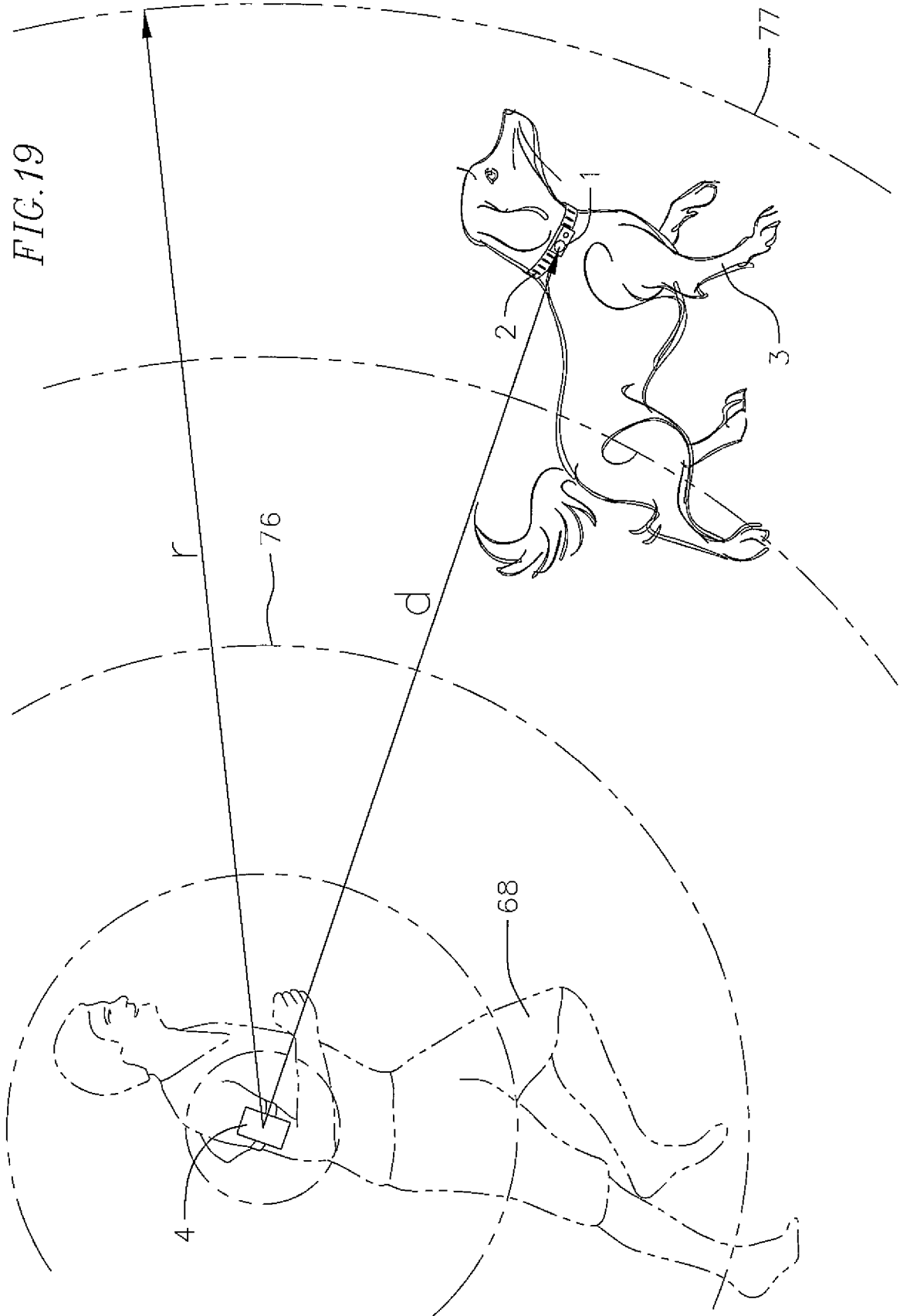
FIG. 17



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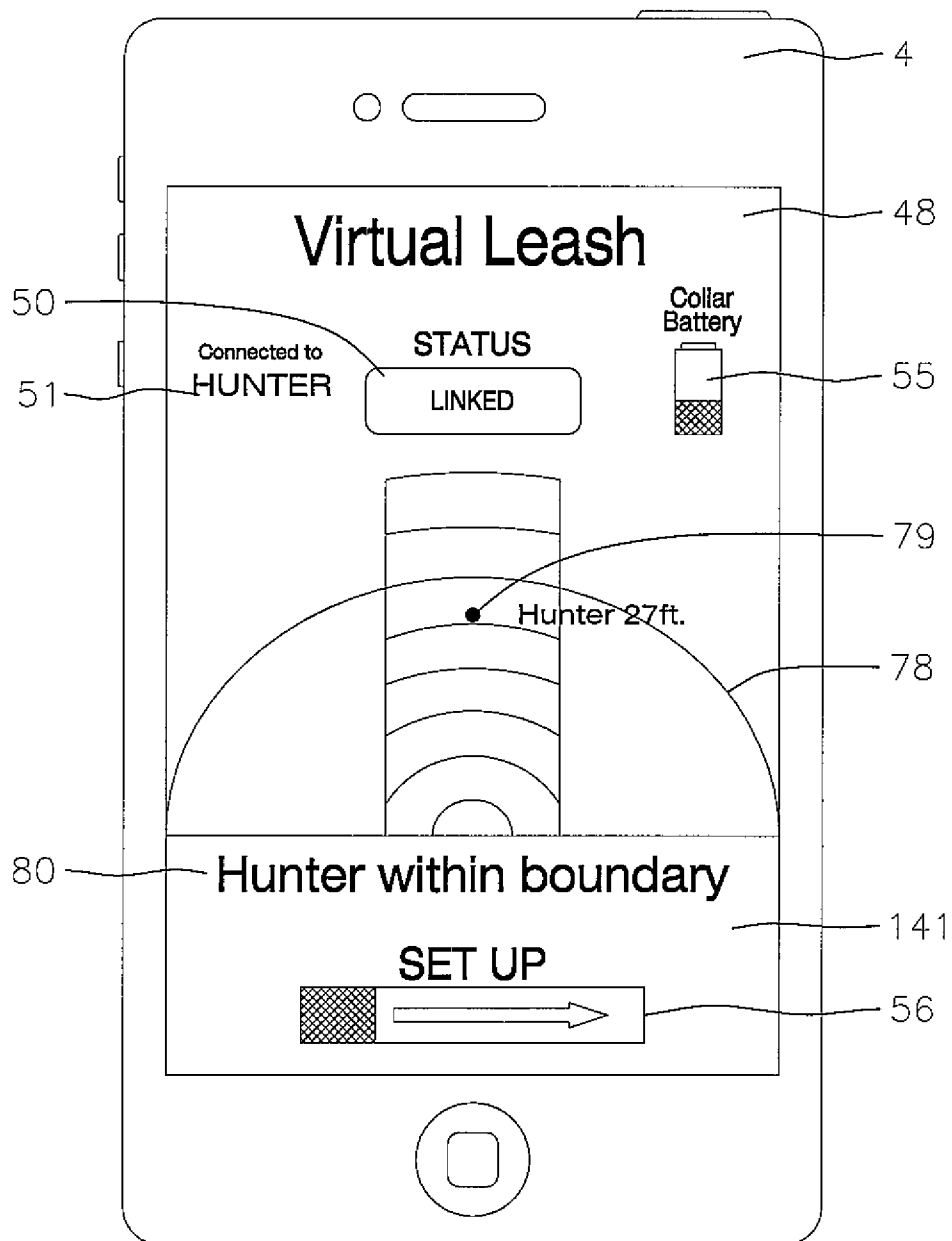
FIG. 18





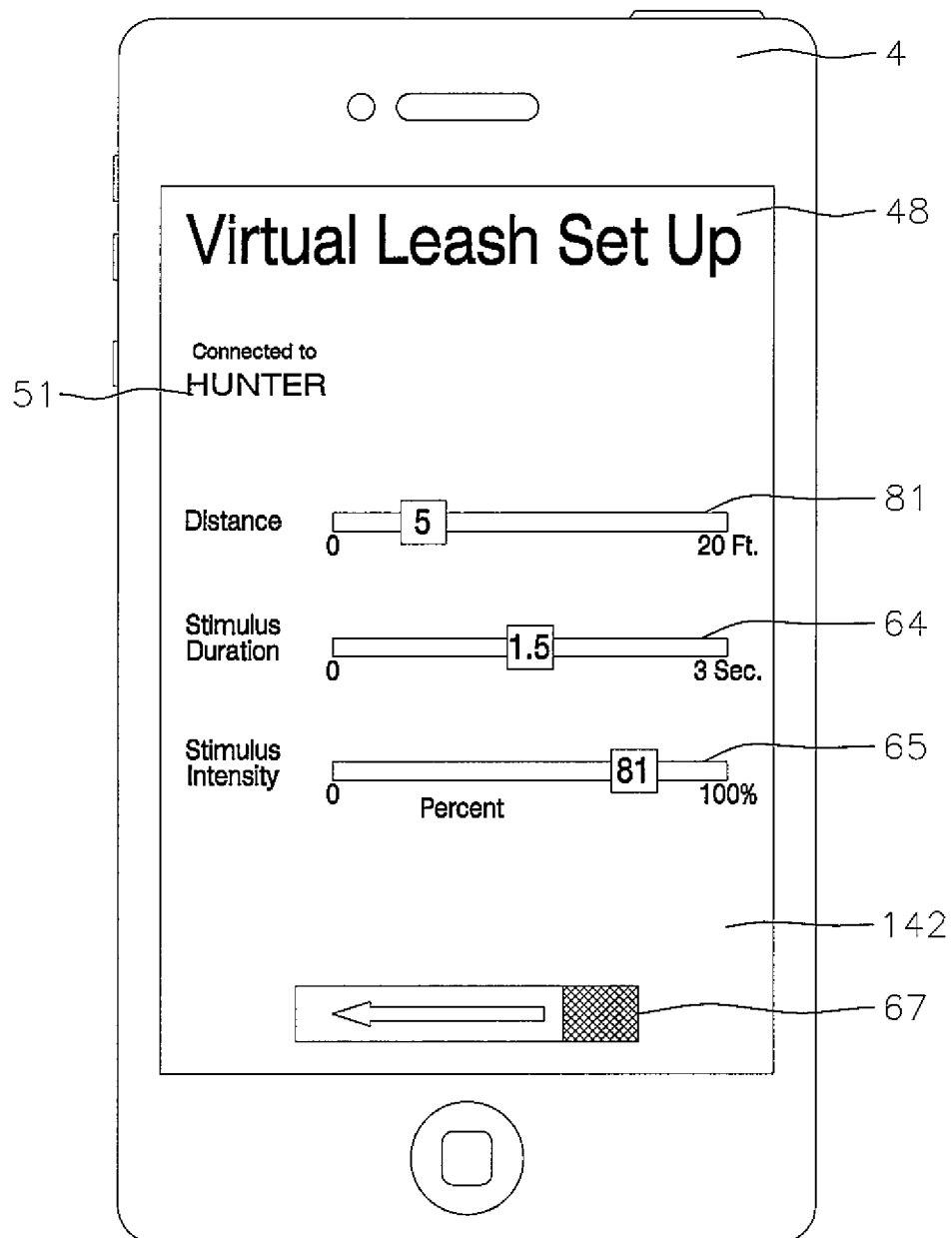
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FIG. 20



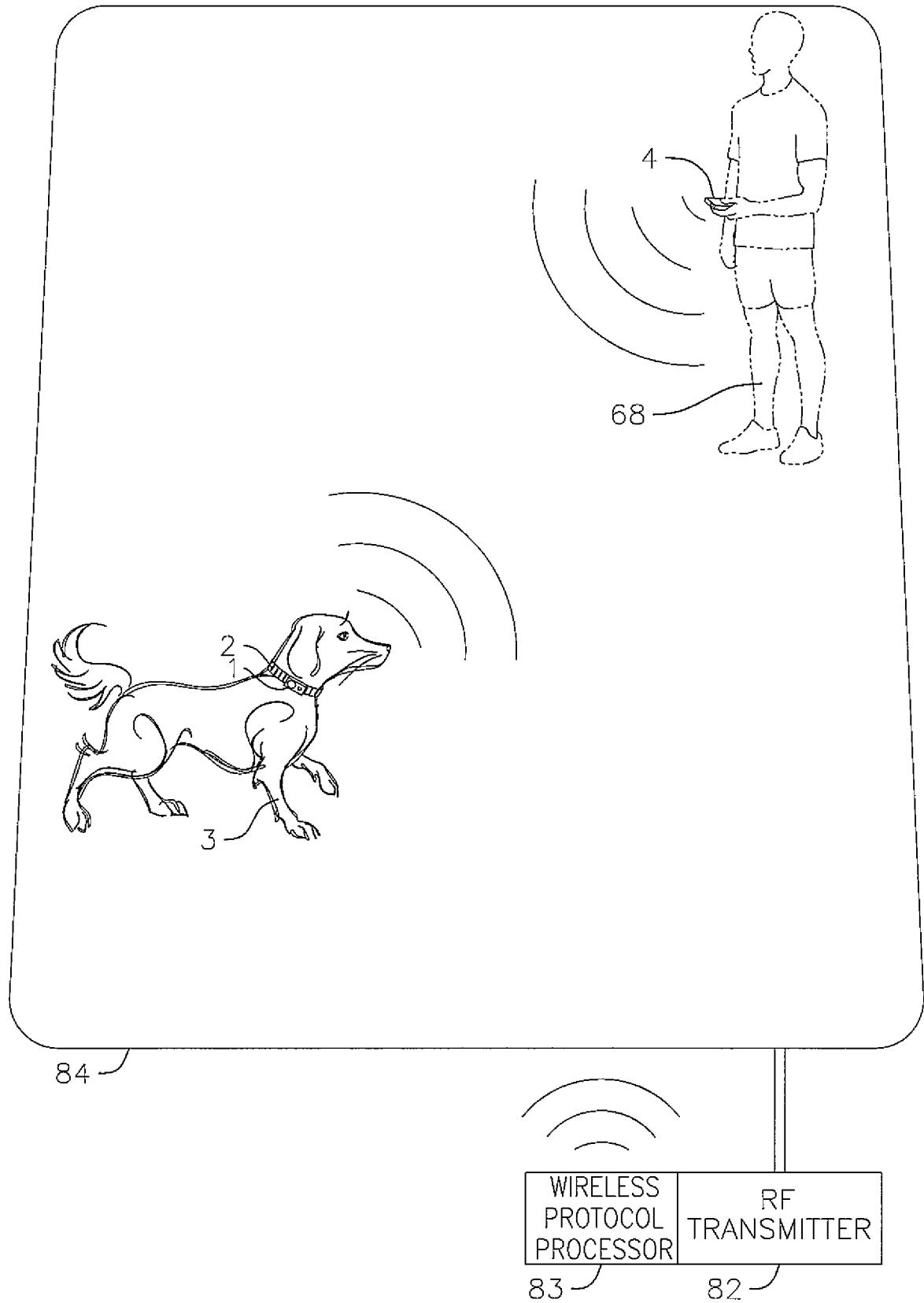
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FIG. 21

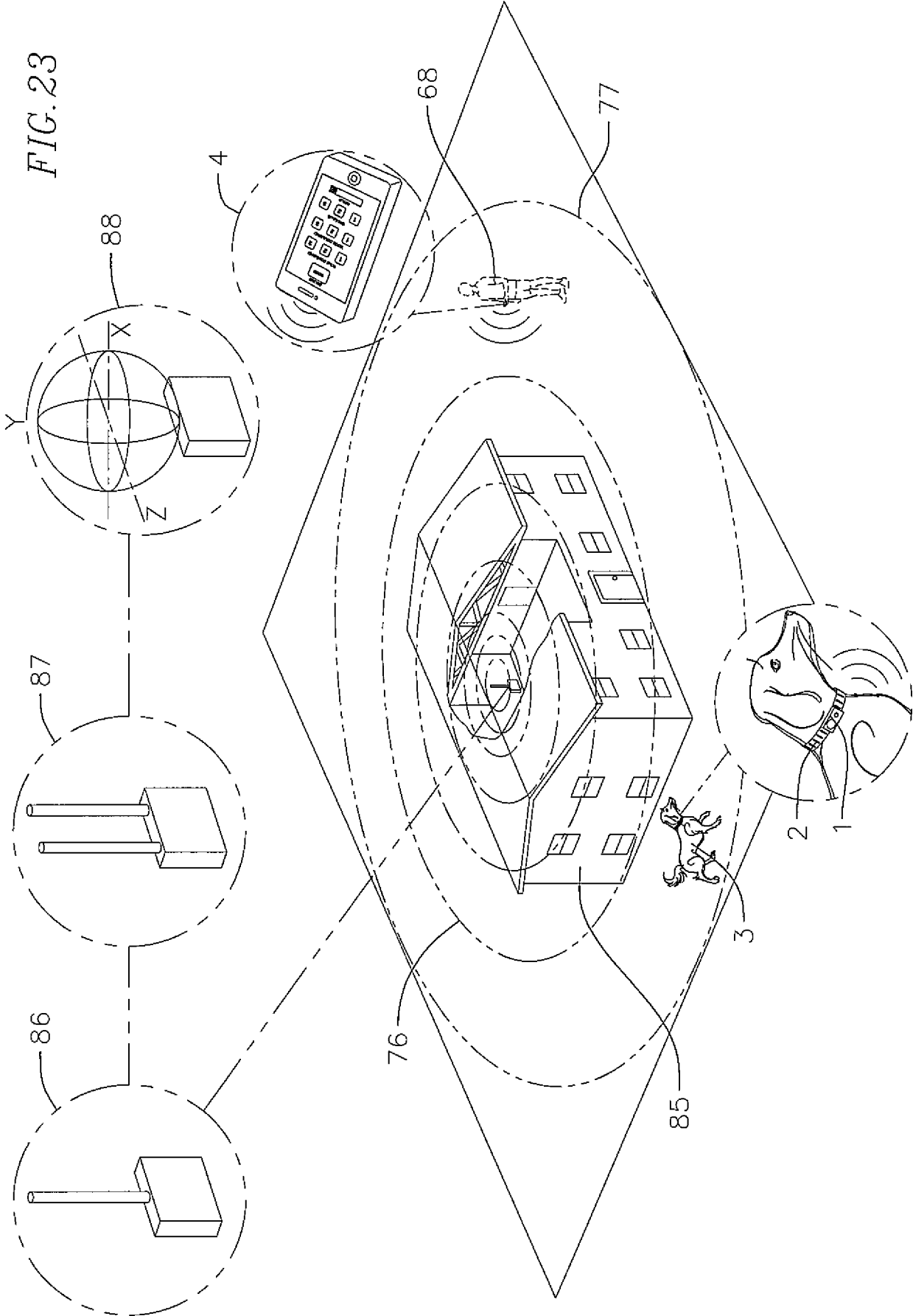


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FIG. 22







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FIG. 24

**Fitness Calculator**

Dog's Name

Breed  ▼

Age  Years  Months

Weight lbs.

Gender ☒ Male ☐ Female

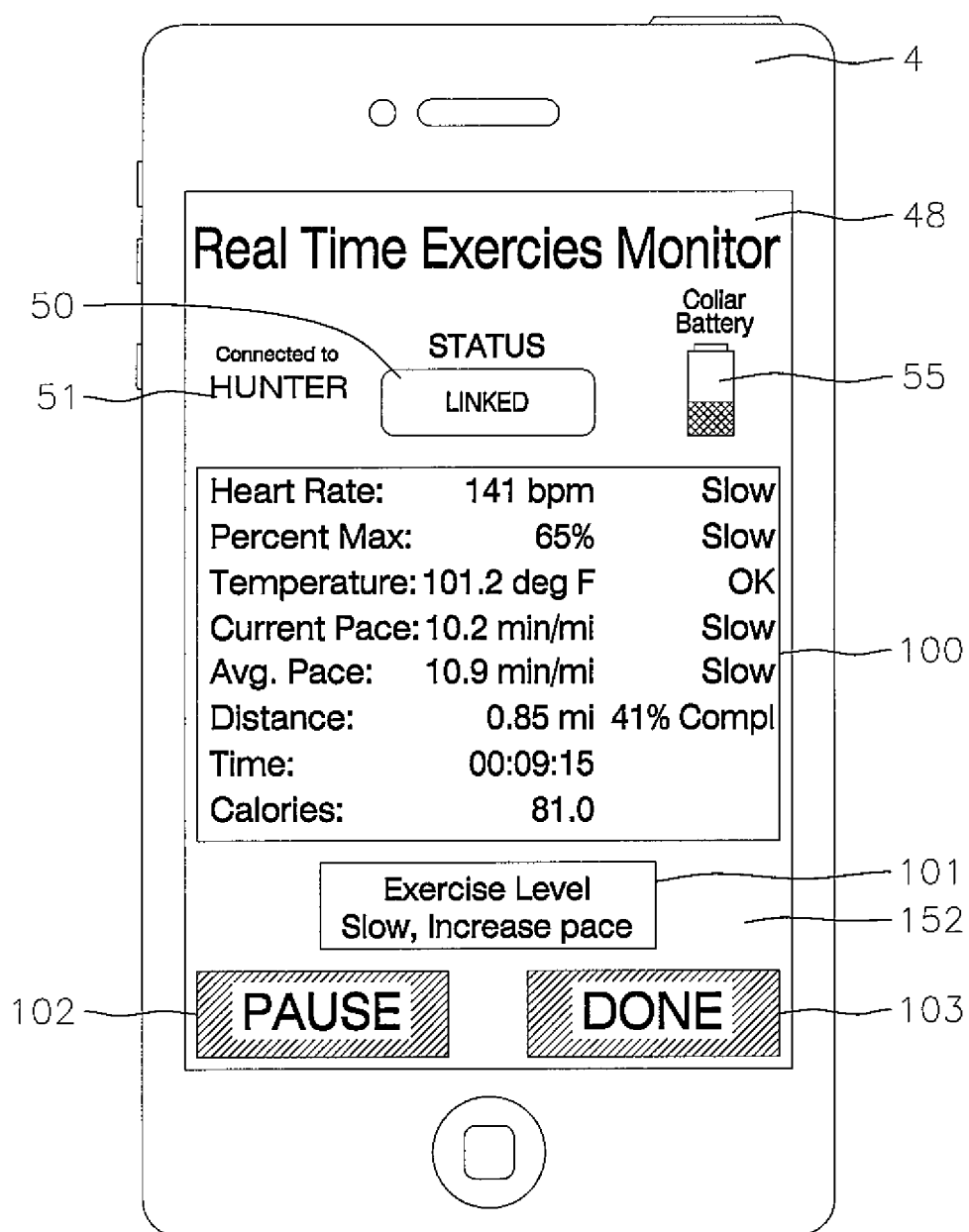
Height in. (To Shoulder)

**Calculate**

BMI  Fitness

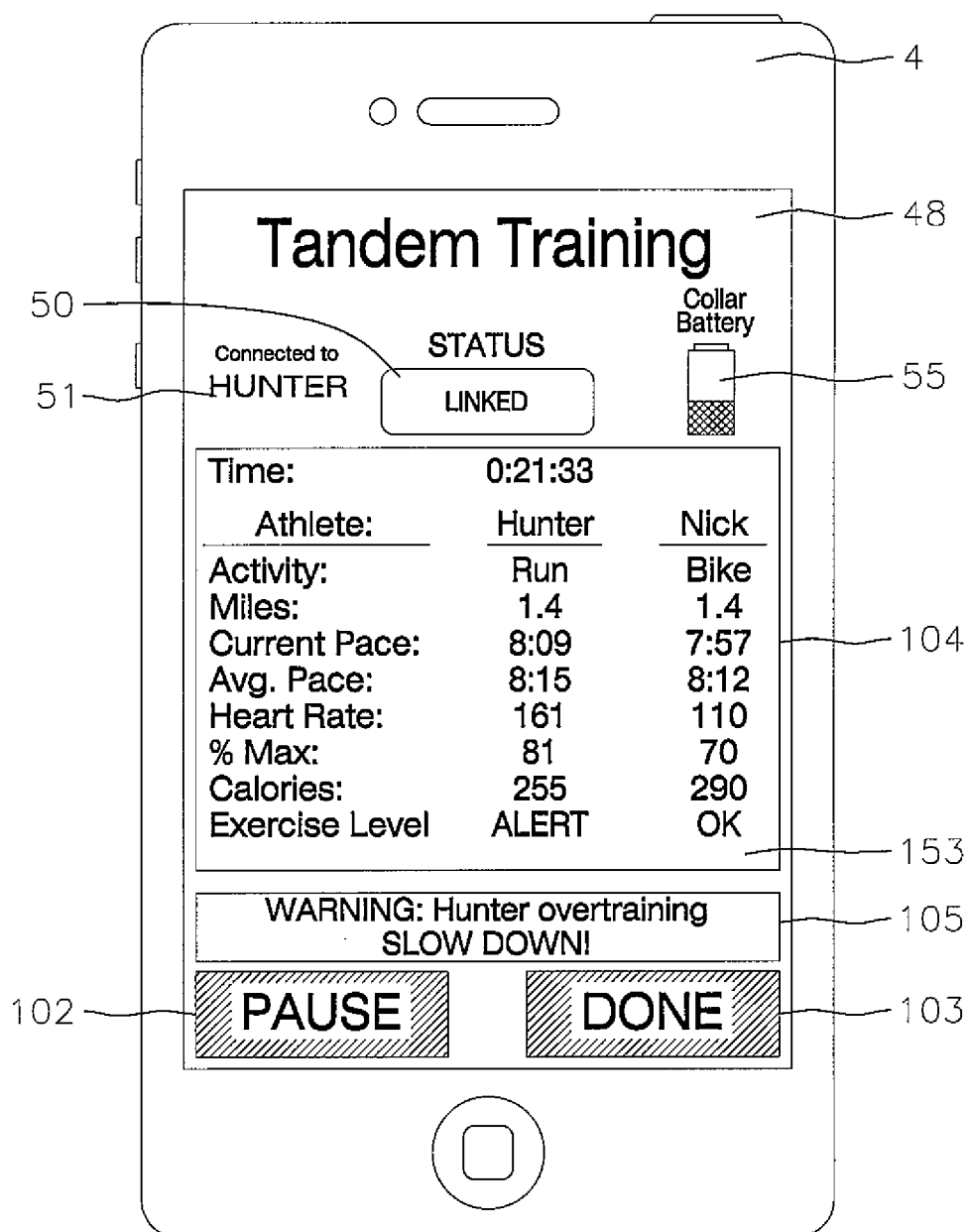
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FIG. 25



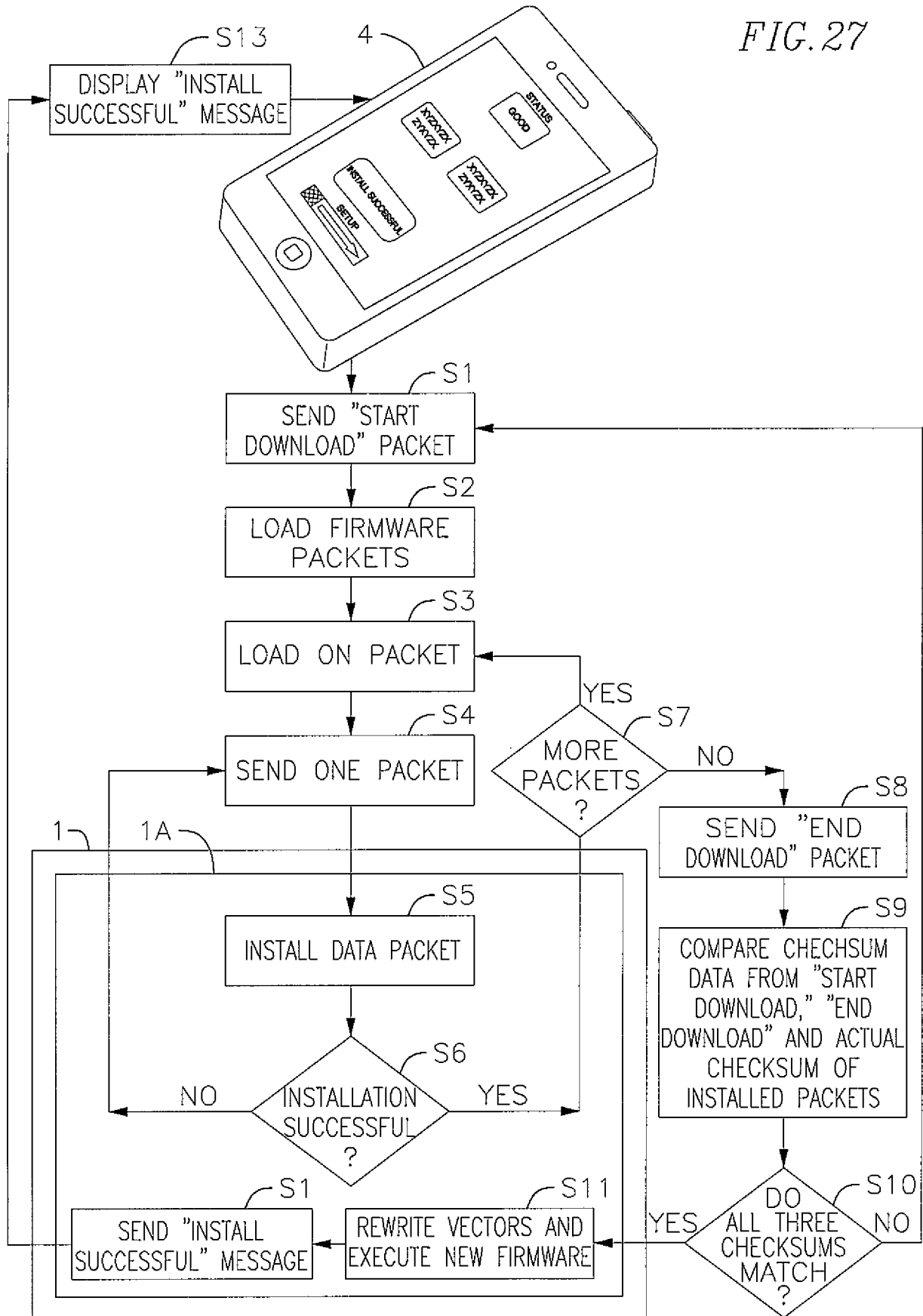
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FIG. 26



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FIG. 27



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US15/41193

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - H04W 24/00 (2015.01)

CPC - A01K 15/021, 27/006, 27/009

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

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8): H04W 24/00 (2015.01)

CPC: A01K 15/021, 27/006, 27/009

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

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

PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, Other Countries (INPADOC), RU, AT, CH, TH, BR, PH); Google Patents; Google; Google Scholar; EBSCO; PubMed/Medline; Search terms used: animal, dog, cat, canine, feline, train\*, behav\*, perform\*, obey, obed\*, collar, transceiver, wireless, smartphone, software, tone, light, spray, speaker, output, sensors, server

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/0252486 A1 (LOPEZ, D et al.) October 4, 2012; abstract; figure 4; paragraphs [0002], [0030]-[0031], [0034], [0036], [0042]	1-4, 13-14, 16, 24
Y		5-12, 15, 17-21, 23
Y		22
Y	US 2005/0257752 A1 (LANGER, S) November 24, 2005; paragraphs [0006], [0020], [0024]	5
Y	US 6874447 B1 (KOBETT, K) April 5, 2005; figure 3; column 3, lines 1-4; column 5, lines 64-67; column 6, lines 19-24; column 7, lines 10-11, 18-20; column 8, lines 42-51	6
Y	WO 2008/112065 A1 (WILBY, S) September 18, 2008; page 1, first paragraph; page 6, third paragraph; claims 1, 12; figure 4	7
Y	US 2007/0204804 A1 (SWANSON, SD et al.) September 6, 2007; abstract; figures 2, 3; paragraphs [0012]-[0013], [0034]-[0036], [0059]	8-10
Y	US 2012/0252430 A1 (IMES, KR et al.) October 4, 2012; figure 5A; paragraph [0150]-[0151]	11, 15
Y	US 2008/0246656 A1 (GHAZARIAN, OD) October 9, 2008; ; figure 6; paragraphs [0038], [0070], [0075]	12, 23
Y	US 5927233 A (MAININI, CE et al.) July 27, 1999; column 3, lines 44-49; column 4, lines 8-10, 21-26, 43-45	17



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

28 September 2015 (28.09.2015)

Date of mailing of the international search report

23 OCT 2015

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US15/41193

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y — A	US 2013/0014706 A1 (MENKES, A) January 17, 2013; abstract; paragraphs [0011], [0024], [0048]	18, 21 ----- 22
Y	US 2004/0019289 A1 (ROSS, C) January 29, 2004; paragraphs [0023], [0027]	19
Y	US 2007/0107668 A1 (EATON, ET et al.) May 17, 2007; figure 2; paragraphs [0002], [0006], [0019], [0024]-[0025], [0029]	20
A	US 2007/0184823 A1 (OKKONEN, H et al.) August 9, 2007; abstract; paragraph [0025]	22