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(54) **WEARABLE DEVICE HEALTHCARE SYSTEM**

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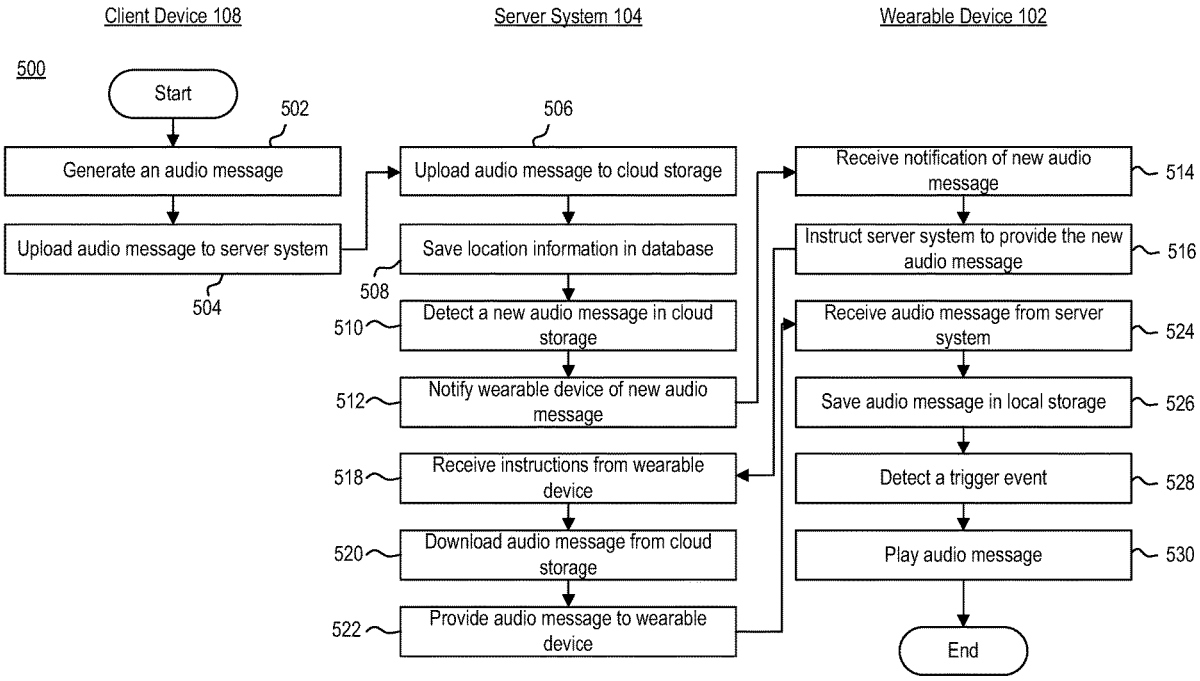
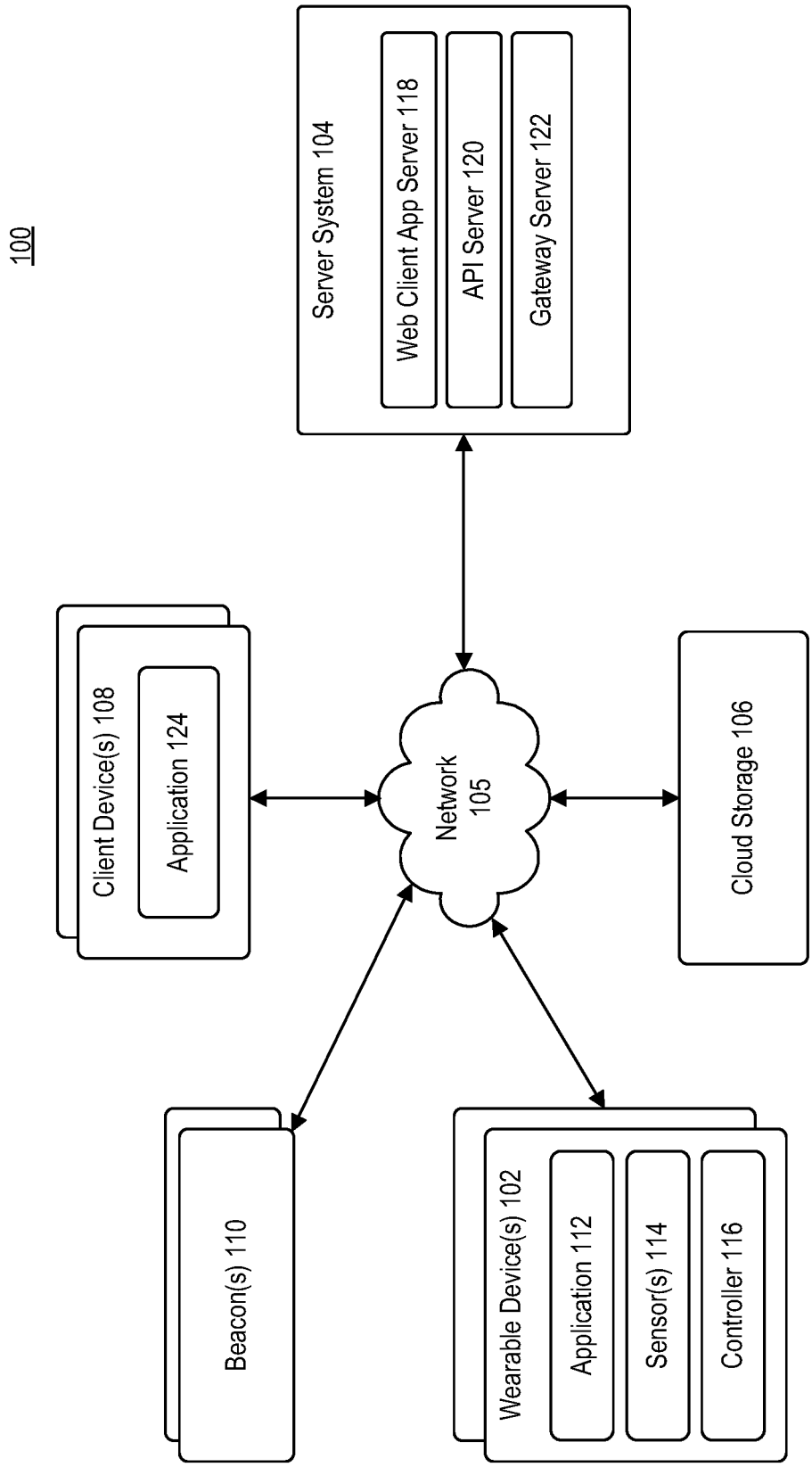
(57) **ABSTRACT**

In some embodiments, a wearable device detects a trigger event. The trigger event indicates a type of measurement to take. Based on the trigger event, the wearable device selects an instruction audio message corresponding to the type of measurement to be taken. The instruction audio message includes instructions for how to conduct the type of measurement. The wearable device connects to an appropriate measuring apparatus based on the type of measurement to be taken and the instruction audio message. The wearable device plays the instruction audio message to a patient of the wearable device. The wearable device receives measurements from the appropriate measuring apparatus.

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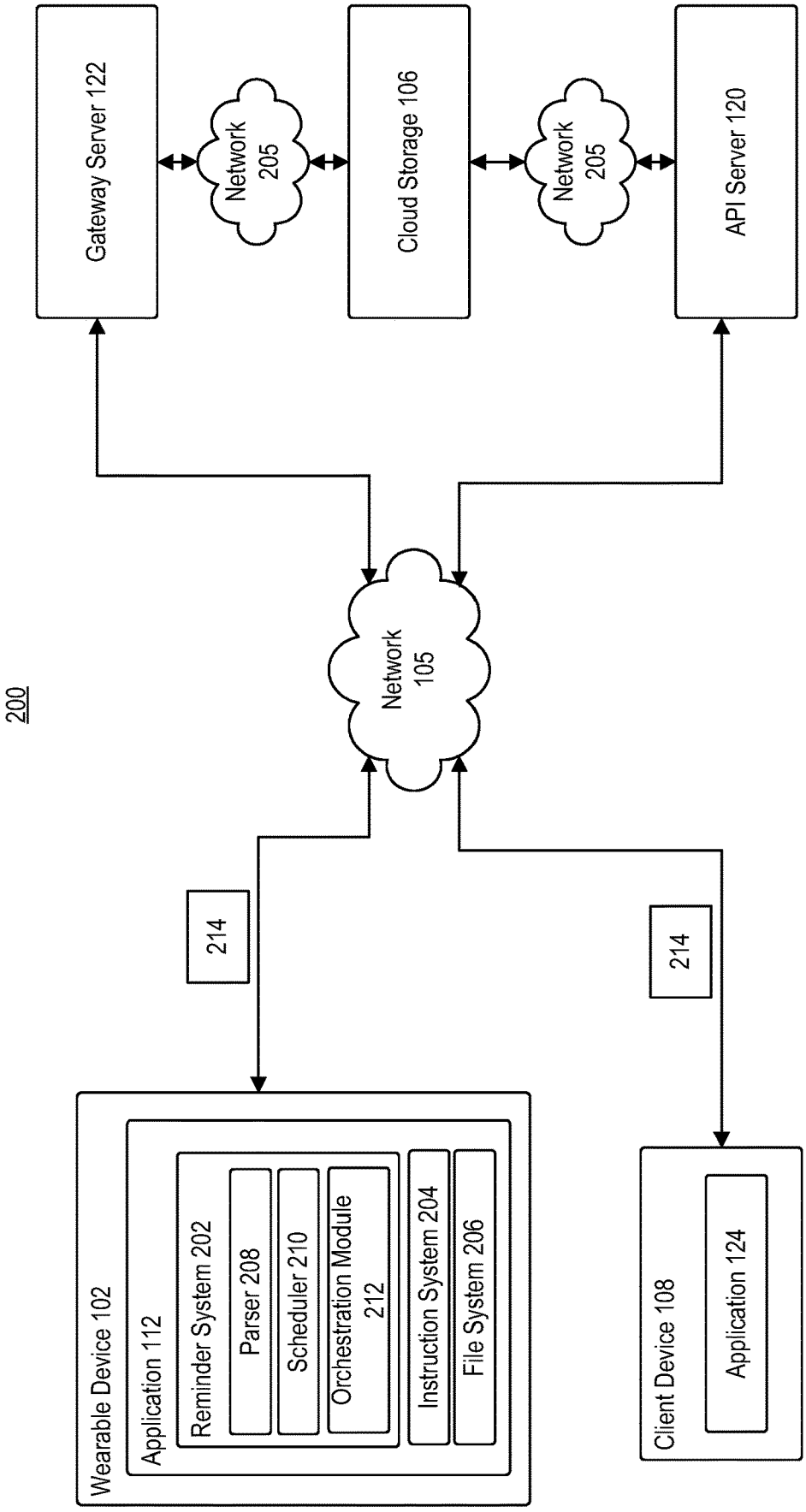
Server System 104
Web Client App Server 118
API Server 120
Gateway Server 122
Client Device(s) 108
Application 124
Network 105
Cloud Storage 106
Beacon(s) 110
Wearable Device(s) 102
Application 112
Sensor(s) 114
Controller 116

FIG. 1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Gateway Server 122
Network 205
Cloud Storage 106
Network 205
API Server 120
Network 105
214
214
Wearable Device 102
Application 112
Reminder System 202
Parser 208
Scheduler 210
Orchestration Module 212
Instruction System 204
File System 206
Client Device 108
Application 124

FIG. 2

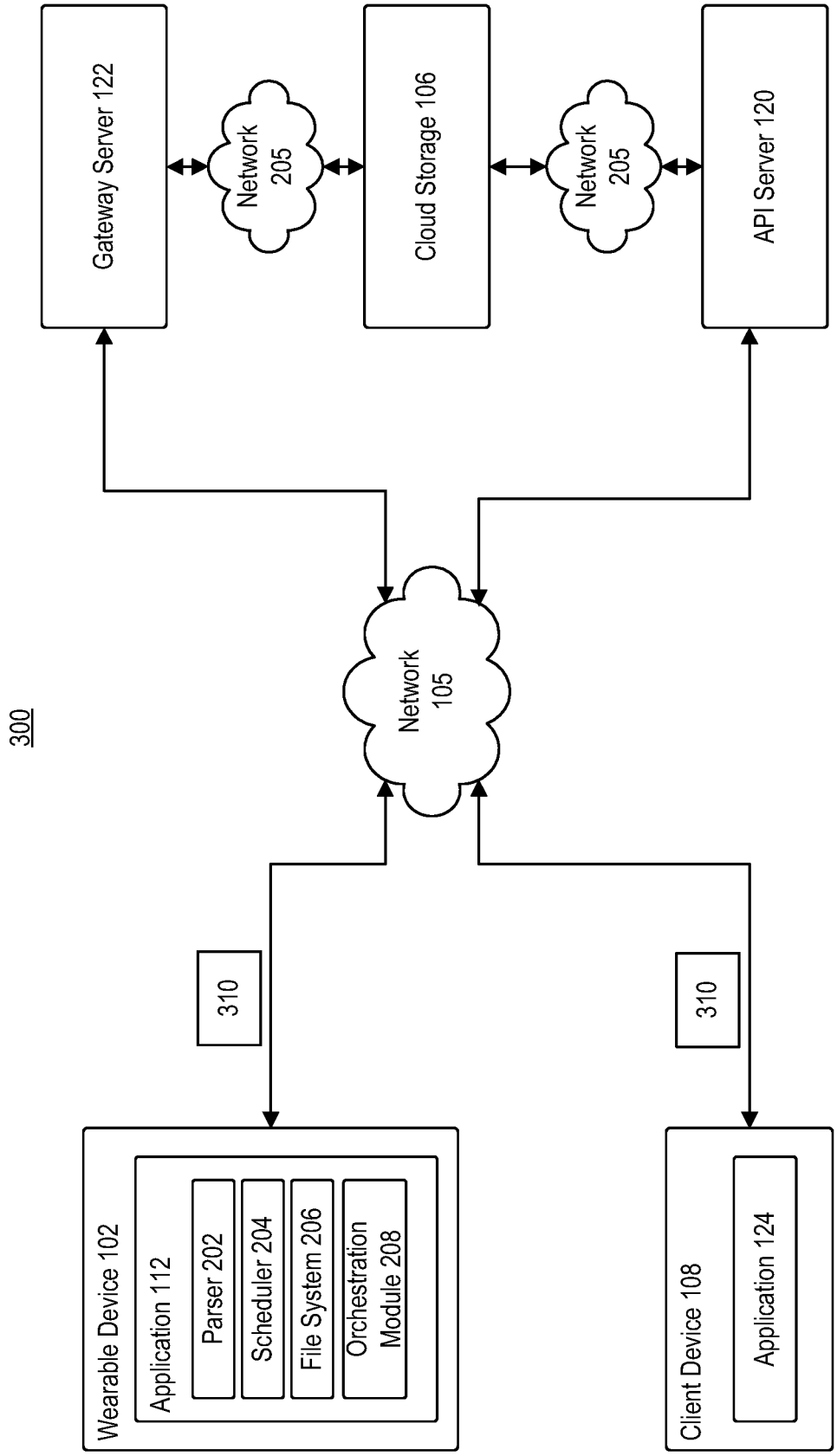
300
Gateway Server 122
Network 205
Cloud Storage 106
Network 205
API Server 120
Network 105
310
310
Wearable Device 102
Application 112
Parser 202
Scheduler 204
File System 206
Orchestration Module 208
Client Device 108
Application 124

FIG. 3

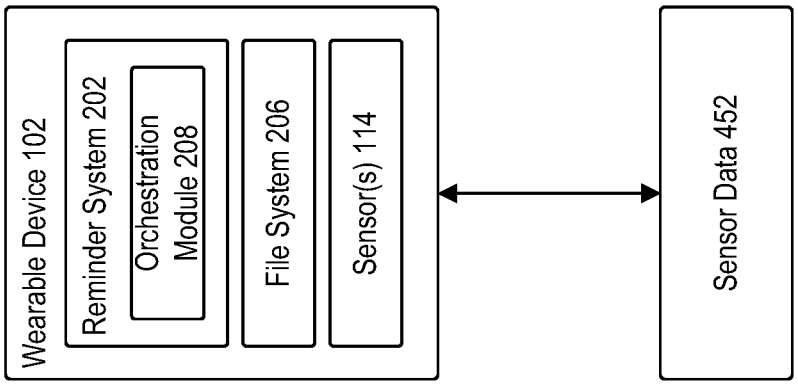
450
Wearable Device 102
Reminder System 202
Orchestration Module 208
File System 206
Sensor(s) 114
Sensor Data 452

FIG. 4B

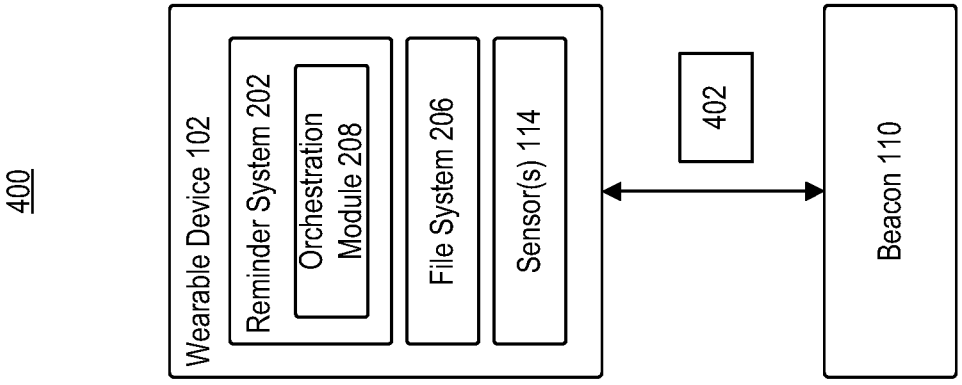
400
Wearable Device 102
Reminder System 202
Orchestration Module 208
File System 206
Sensor(s) 114
402
Beacon 110

FIG. 4A

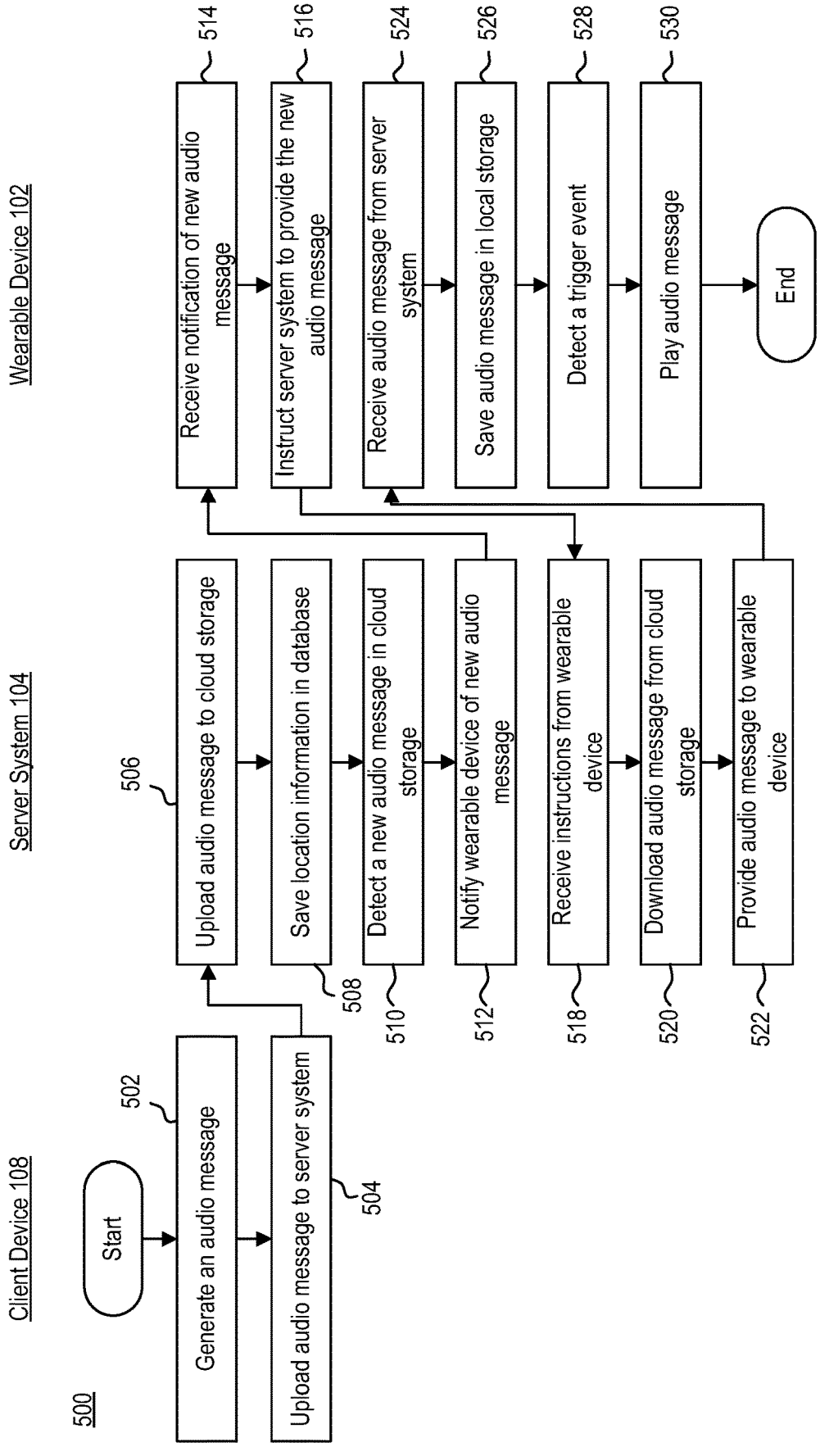
500
Client Device 108
Server System 104
Wearable Device 102
Start
Generate an audio message
Upload audio message to server system
Upload audio message to cloud storage
Save location information in database
Detect a new audio message in cloud storage
Notify wearable device of new audio message
Receive instructions from wearable device
Download audio message from cloud storage
Provide audio message to wearable device
Receive notification of new audio message
Instruct server system to provide the new audio message
Receive audio message from server system
Save audio message in local storage
Detect a trigger event
Play audio message
End
502
504
506
508
510
512
514
516
518
520
522
524
526
528
530

FIG. 5

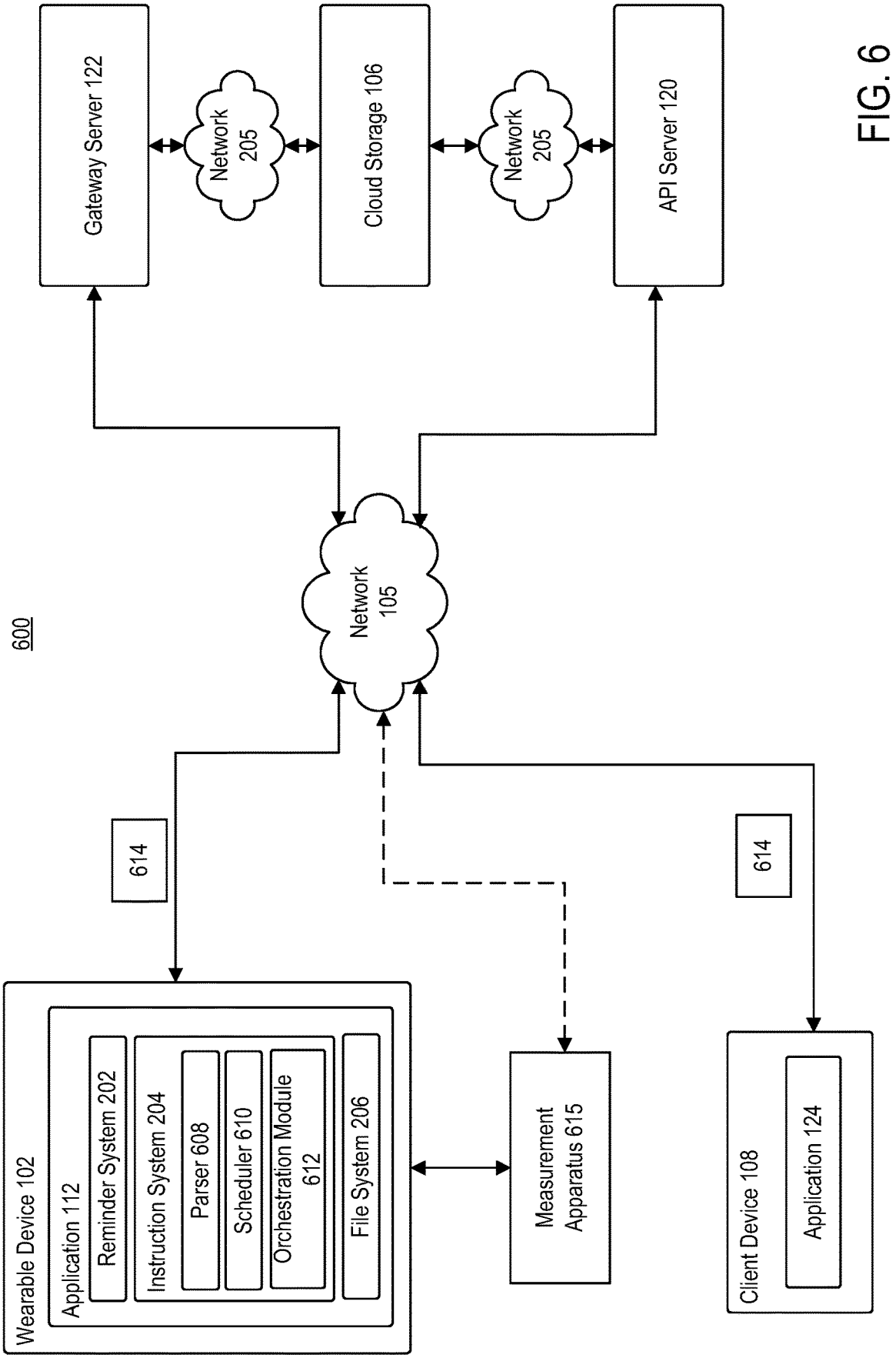
600
Gateway Server 122
Network 205
Cloud Storage 106
Network 205
API Server 120
Network 105
614
614
Wearable Device 102
Application 112
Reminder System 202
Instruction System 204
Parser 608
Scheduler 610
Orchestration Module 612
File System 206
Measurement Apparatus 615
Client Device 108
Application 124

FIG. 6

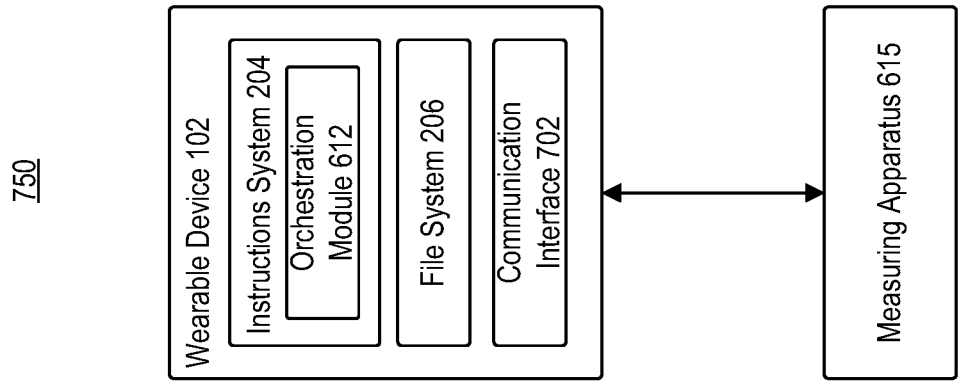
750
Wearable Device 102
Instructions System 204
Orchestration Module 612
File System 206
Communication Interface 702
Measuring Apparatus 615

FIG. 7B

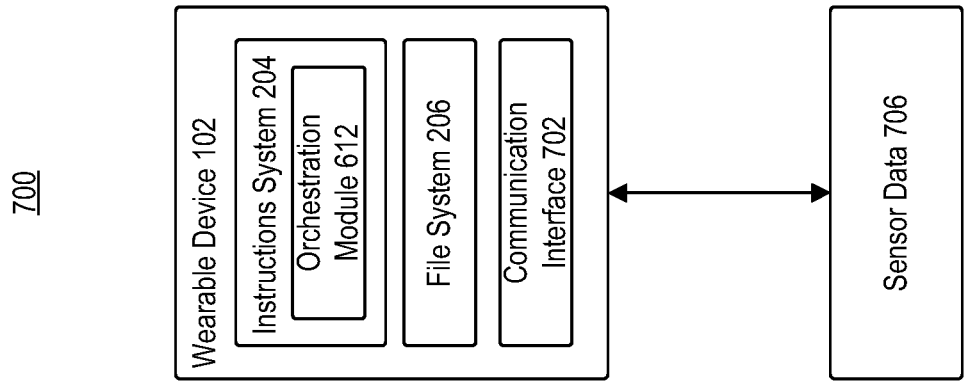
700
Wearable Device 102
Instructions System 204
Orchestration Module 612
File System 206
Communication Interface 702
Sensor Data 706

FIG. 7A

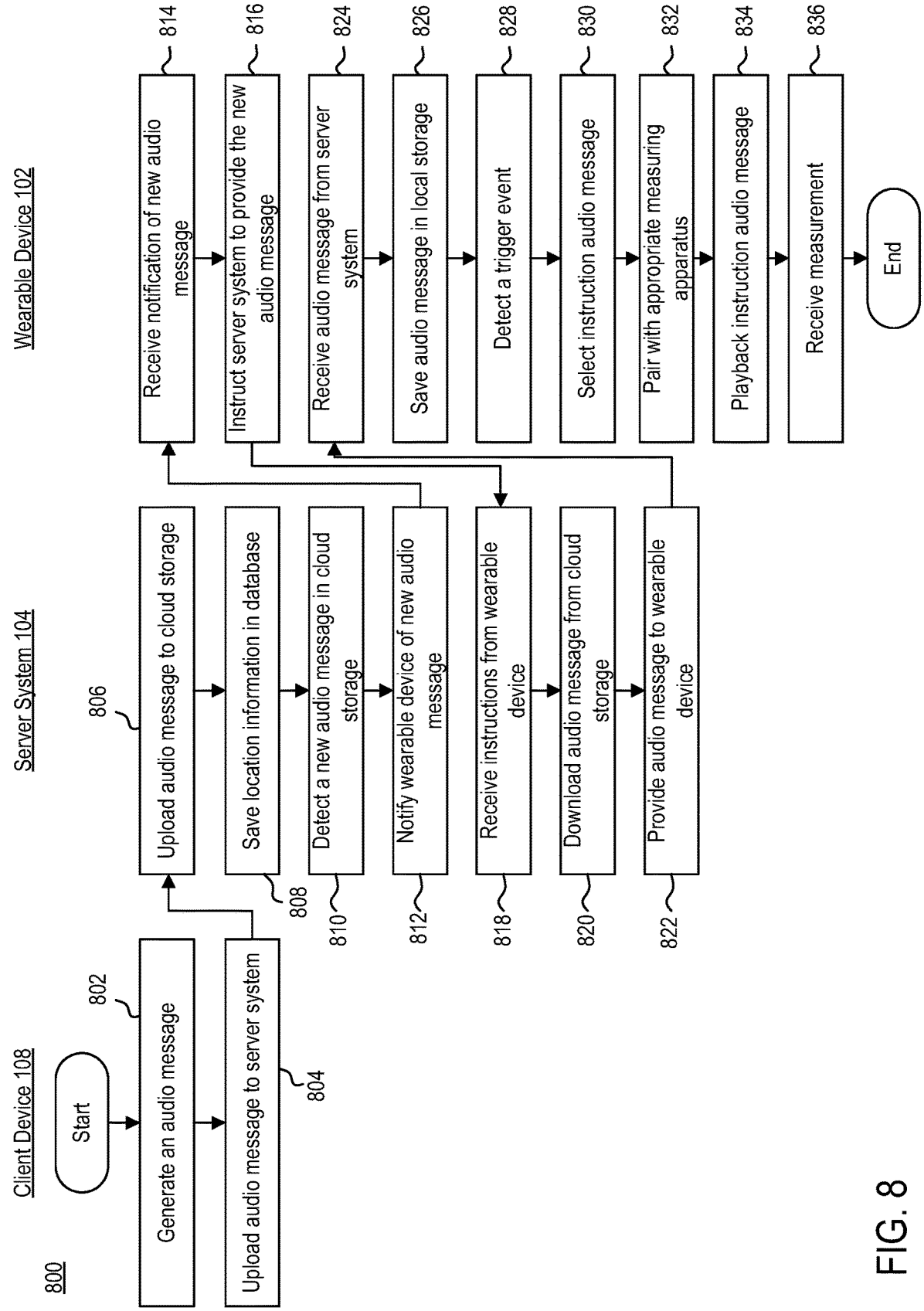
800
Client Device 108
Server System 104
Wearable Device 102
Start
802
Generate an audio message
Upload audio message to server system
804
806
Upload audio message to cloud storage
Save location information in database
808
Detect a new audio message in cloud storage
810
Notify wearable device of new audio message
812
Receive instructions from wearable device
818
Download audio message from cloud storage
820
Provide audio message to wearable device
822
814
Receive notification of new audio message
816
Instruct server system to provide the new audio message
824
Receive audio message from server system
826
Save audio message in local storage
828
Detect a trigger event
830
Select instruction audio message
832
Pair with appropriate measuring apparatus
834
Playback instruction audio message
836
Receive measurement
End

FIG. 8

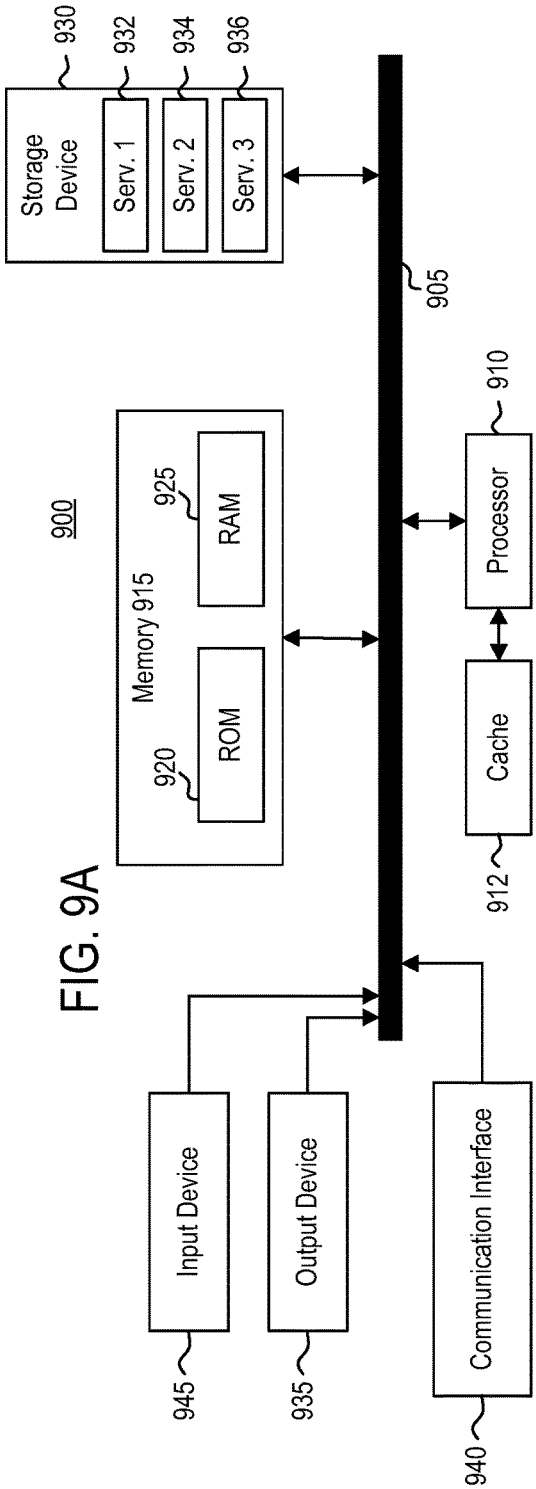
900
Storage Device
930
Serv. 1
932
Serv. 2
934
Serv. 3
936
905
Memory 915
RAM
925
ROM
920
Processor
910
Cache
912
Input Device
945
Output Device
935
Communication Interface
940

FIG. 9A

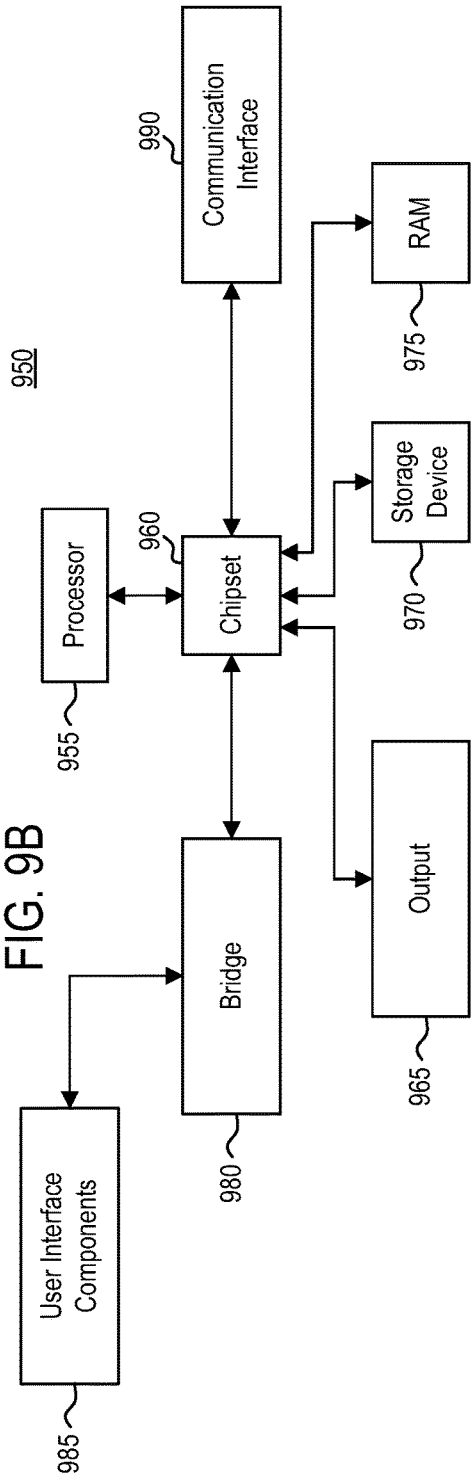
950
Communication Interface
990
RAM
975
Processor
955
Chipset
960
Storage Device
970
Bridge
980
Output
965
User Interface Components
985

FIG. 9B

WEARABLE DEVICE HEALTHCARE SYSTEM

FIELD OF THE DISCLOSURE

[0001] The present disclosure generally relates to a wearable device for use in a healthcare system and, more specifically, a wearable device configured to deliver customized reminders and messages to patients.

BACKGROUND

[0002] Wearables are ubiquitous now in personal health. Wearables typically include sensors that include accelerometers, gyros, inclinometers, and magnetometers, among others. Such sensors can detect certain trigger events, such as location-based trigger events, or activities, such as walking, running, sleeping, sitting, falling, and rolling among other functional states of a wearer.

SUMMARY

[0003] In some embodiments, a wearable device detects a trigger event. The trigger event indicates a type of measurement to take. Based on the trigger event, the wearable device selects an instruction audio message corresponding to the type of measurement to be taken. The instruction audio message includes instructions for how to conduct the type of measurement. The wearable device connects to an appropriate measuring apparatus based on the type of measurement to be taken and the instruction audio message. The wearable device plays the instruction audio message to a patient of the wearable device. The wearable device receives measurements from the appropriate measuring apparatus.

[0004] In some embodiments, a non-transitory computer readable medium is disclosed herein. The non-transitory computer readable medium includes one or more sequences of instructions, which, when executed by one or more processors, causes a wearable device to perform operations. The operations include detecting, by a wearable device, a trigger event. The trigger event indicates a type of measurement to take. The operations further include, based on the trigger event, selecting, by the wearable device, an instruction audio message corresponding to the type of measurement to be taken. The instruction audio message includes instructions for how to conduct the type of measurement. The operations further include connecting, by the wearable device, to an appropriate measuring apparatus based on the type of measurement to be taken and the instruction audio message. The operations further include playing, by the wearable device, the instruction audio message to a patient of the wearable device. The operations further include receiving, by the wearable device, measurements from the appropriate measuring apparatus.

[0005] In some embodiments, a system is disclosed herein. The system includes a processor and a memory. The memory has programming instructions stored thereon, which, when executed by the processor, causes the system to perform operations. The operations include detecting a trigger event. The trigger event indicates a type of measurement to take. The operations include, based on the trigger event, selecting an instruction audio message corresponding to the type of measurement to be taken. The instruction audio message includes instructions for how to conduct the type of measurement. The operations include connecting to an appropriate measuring apparatus based on the type of measurement to be taken and the instruction audio message. The operations include playing the instruction audio message to a patient associated with the system. The operations include receiving measurements from the appropriate measuring apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] So that the manner in which the above recited features of the present disclosure can be understood in detail, a more particular description of the disclosure, briefly summarized above, may be had by reference to embodiments, some of which are illustrated in the appended drawings. It is to be noted, however, that the appended drawings illustrated only typical embodiments of this disclosure and are therefore not to be considered limiting of its scope, for the disclosure may admit to other equally effective embodiments.

[0007] FIG. **1** is a block diagram illustrating a computing environment, according to example embodiments.

[0008] FIG. **2** is a block diagram illustrating a computing environment, according to example embodiments.

[0009] FIG. **3** is a block diagram illustrating a computing environment, according to example embodiments.

[0010] FIG. **4**A is a block diagram illustrating a computing environment, according to example embodiments.

[0011] FIG. **4**B is a block diagram illustrating a computing environment, according to example embodiments.

[0012] FIG. **5** is a flow diagram illustrating a method of playing back a reminder audio message to a user of wearable device, according to example embodiments.

[0013] FIG. **6** is a block diagram illustrating a computing environment, according to example embodiments.

[0014] FIG. **7**A is a block diagram illustrating a computing environment, according to example embodiments.

[0015] FIG. **7**B is a block diagram illustrating a computing environment, according to example embodiments.

[0016] FIG. **8** is a flow diagram illustrating a method of playing back an instruction audio message to a user of wearable device, according to example embodiments.

[0017] FIG. **9**A is a block diagram illustrating a computing device, according to example embodiments.

[0018] FIG. **9**B is a block diagram illustrating a computing device, according to example embodiments.

[0019] To facilitate understanding, identical reference numerals have been used, where possible, to designate identical elements that are common to the figures. It is contemplated that elements disclosed in one embodiment may be beneficially utilized on other embodiments without specific recitation.

DETAILED DESCRIPTION

[0020] As people age, their memory deficits may increase. An aging person typically needs constant reminders for vital health behaviors, as well as for routine everyday tasks. For example, elderly individuals frequently need reminders to take medications, to attend upcoming events and appointments, to perform certain tasks (e.g., check in with family, order groceries, make an appointment with the doctor, etc.), to drink water (dehydration is a leading cause of falls and hospitalizations in elderly men), to eat timely meals, and to be given a health nudge (e.g., reminders to stand, to stretch if too much sitting, to get extra steps in before day ends, or to get more on-feet time to reduce chronic obstructive

pulmonary disease (COPD) exacerbation). As memory deficits continue to increase, an aging person needs reminders for basic hygiene tasks of daily living (e.g., to get up from bed, to go to the bathroom, to brush teeth, to get dressed, etc.)

[0021] As people age, their social interaction also declines. To avoid the cognitive declines associated with decreased social interaction, an aging person needs stimulation from familiar social contacts to encourage interaction. For example, a familiar voice greeting at the start and end of a day, a familiar voice helping to remember events, names and people, and a familiar voice notifying you of how you compare to people in your social group (e.g., "gamify" wellness—Susie cooked meals for 5 days straight, and you only cooked twice, etc.). In addition, as a person ages, their diminishing interests and abilities are often opaque to them. A familiar voice speaking quantified data can help an aging person be more motivated to engage in their own health and to slow down their age-related declines. For example: "Grandma you used to cook every day and now you are only cooking two days a week—you used to love cooking, can you cook more please?" or "Grandma you used to walk 300 steps every day and now you are only walking 200 steps—please try and get back to 300 steps by the time I come to visit you for thanksgiving."

[0022] While reminder-based technology exists, conventional approaches to reminder-based technology with aging individuals is limited. For example, with person-based reminders, such systems are typically subjective, unreliable, and may not be timely. Many aged people need multiple reminders and relying on a person to deliver reminders cannot be provided with consistency. With fixed device systems, such systems are often devices fixed in one location of a home and do not know whether a target person is present in earshot, awake, or aware of when a reminder is played. Such fixed systems are also unable to collect an acknowledgment of receipt of reminder. With existing wearable devices, they often rely on screen-based reminders and/or require an aged person to feel the haptic feedback, look at the screen, and comprehend the small text for a particular reminder. Such small screens often restrict the amount of text in the reminder. Further, the haptic feedback preamble to reminders is often not felt. These conventional device-based systems generally are impersonal and have no emotional or social connection to the aged person to trigger a compliant response.

[0023] Further, conventional device-based systems fail to consider a person's current state (e.g., awake, sitting, sleeping, in the bathroom, cooking, etc.) when finding an appropriate time to play the reminder. Such conventional systems also fail to consider a person's current context to adaptively decide to play or not play a reminder, or to play or not play a message based on the occurrence or non-occurrence of a particular event. For example, if a senior is suddenly going to the bathroom too frequently, the senior may be prompted with a message asking whether a family member should be notified. Similarly, if a fall is detected, the senior may be prompted with a message asking whether assistance is required.

[0024] Further, conventional device-based systems fail to provide feedback to the person who initiated the reminder. For example, such systems do not provide any information to the person who initiated the reminder regarding whether the reminder was played at the designated time or whether the reminder was not played for some intervening reason (e.g., the senior was detected to be sleeping or the wearable was not powered on, etc.). Conventional systems are further unable to provide a method for the senior to confirm back to the initiator of the reminder that the reminder was heard by the senior.

[0025] One or more techniques described herein improve upon conventional systems by delivering context-aware notifications to individuals. In some embodiments, one or more techniques provided herein further deliver confirmation of receipt by the senior back to the initiator of the reminder. For example, the present system may understand or identify the context of the individual (e.g., their room location, their activity state (e.g., sleeping, sitting, standing cooking, etc.), and may deliver notifications to the individual based on their current context. Such system may deliver such reminders to the user using voice notifications with a preamble sound or tone that sensitizes the individual to the message about to follow. Further, one or more techniques provided herein may allow individuals associated with the aging person to record reminders using their own voice to be replayed at any recurrent pattern.

[0026] Further, clinical monitoring often consists of measuring certain physiological signals at specific periodic intervals and analyzing the data to identify the current state of a disease condition. For example, a patient with hypertension disease may be monitored for high blood pressure several times a day and as the condition changes, medications and other therapies are modulated to keep the disease in check.

[0027] Before the widespread availability of physiological measuring apparatus directly to consumers, such measurements took place in clinical settings: physician offices, hospitals, clinics, emergency rooms and nursing homes.

[0028] As patients age and their mobility decreases, it becomes important for the person to take their own measurements at their own places of residence. The availability of measuring apparatus off the shelf and at affordable prices meant that a person can take their own measurements at home and then relay that information to a clinician. However, the process of communicating the measurements timely and accurately has become a challenge, as self-reporting of data is unreliable as patients age.

[0029] As a result, a new industry was born, coined Remote Patient Monitoring (RPM), wherein the measurements would be communicated electronically to a clinician for evaluation automatically. The clinician, upon review of the data, would then orchestrate the right intervention if needed.

[0030] RPM typically consists of a variety of FDA approved apparatus to measure weight, temperature, blood pressure, glucose or blood sugar, heart rate, pulse oximetry, spirometry to name just a few. These apparatuses may be connected to a computer kiosk of some form that would have a method to communicate electronically to a clinician all the values measured. Such systems could support multiple apparatus to each measure specific signals for as many chronic conditions as need to be managed.

[0031] With the advent of mobile devices, modern RPM systems began to use a smart tablet or a smartphone to collect the signals from measuring apparatus via some form of wireless communication.

[0032] As RPM has proliferated massively due to the start of reimbursement coverage by healthcare systems (espe-

cially in the US through Medicare), some failings have become apparent: patients often fail to take measurements timely; patients often fail to take measurements accurately; and patients are challenged to connect a measuring apparatus with a smart device.

[0033] The failings occur because as patients age, they become more cognitively impaired, especially around memory, recall and executive function in performing tasks. Patients may require timely repetition of instructions to successfully perform a task so that they can be guided with specific instructions in taking their measurement consistently each time. Further, using off the shelf devices requires a patient to install specific applications on their smart device and perform the technical process of pairing the measuring device to the smart device. Such process can result in errors as smart devices continue to advance in their technology, thus exceeding the technical proficiency levels of an elderly patient.

[0034] Current approaches to remote patient monitoring are limited to a fixed kiosk or a device that is not in immediate proximity to the patient, thus any reminders or guidance becomes improbable. Instead, any reminder function is limited to, at most, a notification on a smart device or on a fixed kiosk. Further, no conventional approach takes into account the patient's state when the notification arrives. For example, the notifications do not account for whether the patient is proximal, asleep, or engaged in an activity that precludes use of a measuring apparatus at that instant. In other words, current approaches fail to take into account a person's current state to find the appropriate time to play the reminder or guidance.

[0035] One or more techniques described herein further provide an improvement over conventional system by delivering to patients guidance or instructions for taking their remote measurements. Such guidance or instructions may be delivered to patients via a wearable device, such that the patients are no longer required to be present in a certain room in order to hear the message. By providing patients with instructions via their wearable device, measurement consistency can be achieved. For example, the reminder and instructions can say: "It's time to take your blood pressure. Make sure you are sitting down comfortably, place your arm on the table and relax it, place the cuff with the arrow on your inner elbow, press the silver button on the blood pressure monitor to take the measurement, wait for the beep before moving your arm."

[0036] FIG. **1** is a block diagram illustrating a computing environment **100**, according to example embodiments. Computing environment **100** may include wearable devices **102**, server system **104**, cloud storage **106**, and client devices **108** communicating via network **105**.

[0037] Network **105** may be of any suitable type, including individual connections via the Internet, such as cellular or Wi-Fi networks. In some embodiments, network **105** may connect terminals, services, and mobile devices using direct connections, such as radio frequency identification (RFID), near-field communication (NFC), Bluetooth™, low-energy Bluetooth™ (BLE), Wi-Fi™ ZigBee™, ambient backscatter communication (ABC) protocols, Long Range Wide area networks (LoRAWAN), USB, WAN, or LAN. Because the information transmitted may be personal or confidential, security concerns may dictate one or more of these types of connection be encrypted or otherwise secured. In some embodiments, however, the information being transmitted may be less personal, and therefore, the network connections may be selected for convenience over security.

[0038] Network **105** may include any type of computer networking arrangement used to exchange data or information. For example, network **105** may be the Internet, a private data network, virtual private network using a public network and/or other suitable connection(s) that enables components in computing environment **100** to send and receive information between the components of environment **100**.

[0039] Wearable device **102** may be representative of an electronic device that is worn by a user. For example, wearable device **102** may be representative of an electronic device having a microcontroller or microprocessor. In some embodiments, wearable device **102** may be representative of any wearable device to be worn by the user that may be configured to deliver voice-based notifications to the wearer.

[0040] As shown, wearable device **102** may include application **112**, one or more sensors **114**, and a controller **116**. Application **112** may be representative of a health notification application associated with server system **104**. In some embodiments, application **112** may be a standalone application associated with server system **104**. Wearable device **102** may communicate over network **105** to request or receive audio messages from web client application server **118** of server system **104**. For example, wearable device **102** may communicate with web client application server **118** over network **105** to receive an audio message to be played to a wearer of wearable device **102** at a predefined time period. In some embodiments, audio message may be representative of a customized voice message generated by the user of client device **108**. In some embodiments, audio message may be representative of a sound, tone, or other notification that alerts the wearer of wearable device **102**.

[0041] Sensors **114** may be representative of one or more sensors associated with wearable device **102**. Some non-exhaustive list of sensors may include, but are not limited to, humidity sensors, pressure sensors, ambient temperature sensors, core body temperature sensors, skin temperature sensors, ultraviolet levels sensors, infrared sensors, ambient light sensors, gyroscope, accelerometer, EKG/ECG, magnetometer, sound level sensor (e.g., microphone), heart rate sensor, pulse oximetry sensor, hall effect sensor (e.g., magnetic field), respiration rate sensor, and galvanic skin sensor.

[0042] In some embodiments, sensors **114** may be configured to detect information transmitted by one or more beacons **110**. For example, sensors **114** may be configured to receive and unpack a message transmitted by a beacon **110** to determine a relative position of wearable device **102**.

[0043] Controller **116** may be configured to control operations of wearable device **102**. For example, controller **116** may be configured to selectively deliver audio messages to the individual based on detected trigger conditions. Using a specific example, based on sensors **114** detecting the user falling, controller **116** may selectively identify a locally stored audio message that is relevant to the detected event, and may playback the audio message for the user.

[0044] Server system **104** may be configured to manage voice reminders for end users. As shown, server system **104** may include web client application server **118**, application programming interface (API) server **120**, and gateway server **122**. Each of API server **120** and gateway server **122** may be comprised of one or more software modules. The one or more software modules are collections of code or

instructions stored on a media (e.g., memory of server system **104**) that represent a series of machine instructions (e.g., program code) that implements one or more algorithmic steps. Such machine instructions may be the actual computer code the processor of server system **104** interprets to implement the instructions or, alternatively, may be a higher level of coding of the instructions that are interpreted to obtain the actual computer code. The one or more software modules may also include one or more hardware components. One or more aspects of an example algorithm may be performed by the hardware components (e.g., circuitry) itself, rather than as a result of the instructions.

[0045] API server **120** may be configured to handle audio messages generated by an end user (e.g., user of client device **108**) for upload to wearable device **102**. For example, API server **120** may receive an audio message generated by client device **108**. In some embodiments, the audio message may be received in base64 audio format. In such embodiments, API server **120** may be configured to decode the base64 audio message and may convert the decoded messages into a 16-bit or 16 KHz raw audio format (e.g., .wav format). In the converted format, API server **120** may upload the converted audio file to cloud storage **106**. In some embodiments, cloud storage **106** may be representative of an Amazon Web Services® 53° bucket. In some embodiments, in addition to uploading the audio message in a converted format, API server **120** may be configured to upload the audio message in its original format, as a backup to the converted format in case the converted format becomes lost or corrupted.

[0046] In some embodiments, the uploading of the audio message to the converted format may generate a unique identifier and file path associated with the unique identifier. In some embodiments, the unique identifier and file path associated with the unique identifier can be saved in a separate storage location. For example, the unique identifier and file path associated with the unique identifier can be stored in a MYSQL database, accessible to gateway server **122** and/or client device **108** via a representational state transfer (REST) API. In some embodiments, API server **120** may provide the REST APIs to application **124** executing on client device **108** and/or application **112** executing on wearable device **102**. In some embodiments, a REST API, customized for the application **124** on client device **108**, may be dynamically generated by API server **120**. In some embodiments, the REST API may be generated specifically for the use by a particular client device. In some embodiments, the REST API may be dynamically used by the client to access its own specialized data, such as specific messages and associated constraint data.

[0047] Gateway server **122** may be configured to communicate with wearable device **102** and/or cloud storage **106**. Gateway server **122** may be configured to monitor cloud storage **106** and/or MYSQL database to determine when there is a new audio message or a modified audio message for each wearable device **102**. Upon determining that a new audio message or a modified audio message is available, gateway server **122** may notify wearable device **102**. Wearable device **102** may instruct gateway server **122** to download the new audio message or modified message from cloud storage **106**. In some embodiments, gateway server **122** may format the retrieved audio message. For example, gateway server **122** may trim or reduce the audio message to a pre-set length (e.g., one minute or less). Gateway server **122** may then provide the audio message to wearable device **102**.

[0048] Cloud storage **106** may be representative of one or more cloud service providers. Generally, cloud storage **106** may be representative of a cloud storage offering that is able to scale to the needs of server system **104**.

[0049] Client device **108** may be in communication with server system **104** via network **105**. Client device **108** may be operated by a user. For example, client device **108** may be a mobile device, a tablet, a desktop computer, or any computing system capable of recording or generating an audio message to be uploaded to server system **104** and/or provided to wearable device **102** for playback. Users may include, but are not limited to, individuals such as, for example, family members, clinicians, friends, and the like associated with a user of wearable device **102**.

[0050] Client device **108** may include at least application **124**. Application **124** may be representative of an application through which a user can record or generate an audio message for playback to a user of wearable device **102**. In some embodiments, an audio message may be representative of a reminder. In some embodiments, an audio message may be representative of guidance or instructions for taking a physiological measurement (e.g., blood pressure, heart rate, glucose levels, and the like). In some embodiments, application **124** may be a standalone application associated with server system **104**. In some embodiments, application **124** may be representative of a web-browser configured to communicate with server system **104**. In some embodiments, client device **108** may communicate over network **105** to request a webpage, for example, from web client application server **118** of server system **104**. For example, client device **108** may be configured to execute application **124** to generate or record an audio message. In some embodiments, client device **108** may define constraints associated with the audio message. Exemplary constraints may include, but are not limited to, an indication of the target recipient (e.g., user or patient identifier), a trigger condition associated with playback of the audio message, times to not play the video message (e.g., during sleeping hours), and the like. The content that is displayed to client device **108** may be transmitted from web client application server **118** to client device **108**, and subsequently processed by application **124** for display through a graphical user interface (GUI) of client device **108**.

[0051] In some embodiments, client device **108** may receive a notification when the generated audio message is played at wearable device **102**. For example, for each audio message generated by client device **108**, application **124** may include a status identifier associated therewith. The status identifier of a given audio message may be updated to reflect a playing of the audio message at wearable device **102**. For example, in some embodiments, when wearable device **102** plays back the audio message, application **112** executing on wearable device **102** may send a notification to application **124** that the audio message was played. Application **124** may then update the status identifier associated with the played audio message.

[0052] Beacons **110** may be representative of a communication device configured to transmit or beacon a signal for receipt by one or more wearable devices **102**. For example, beacons **110** may be representative of low power infrared beacons. Generally, beacons **110** may be configured to transmit a unique identifier representing the area of a venue

in which they are affixed. Exemplary identifiers may include, but are not limited to, stove/kitchen, toilet/bathroom, bedroom, multi-purpose room, and the like. In some embodiments, beacons **110** may be self-installed devices that are fixed at a range of prescribed heights and operate on self-contained power or utility power.

[0053] FIG. **2** is a block diagram illustrating a computing environment **200**, according to example embodiments. Computing environment **200** may illustrate an exemplary process in which client device **108** generates a voice recording for a user of wearable device **102**.

[0054] As shown, client device **108** may generate a new reminder audio message **214** using application **124**. Application **124** may allow user of client device **108** to access functionality associated with server system **104**. For example, via application **124**, a user of client device **108** can record a message to be played to a user of wearable device **102** via wearable device **102**. In some embodiments, the message can be a reminder message. In some embodiments, the message may be an instructions message. In some embodiments, user of client device **108** can set constraints or parameters associated with the recording using application **124**. For example, client device **108** can dictate a trigger event for replaying the message. In some embodiments, the trigger event may be wearable device **102** detecting the user entered or approached a certain location. In some embodiments, the trigger event may be wearable device **102** detecting a certain user motion or activity. For example, the motion or activity may include, but is not limited to, eating, exercising, falling, brushing teeth, and the like. In some embodiments, the trigger event may be time based. For example, every night at 9:00 p.m., wearable device **102** may be instructed to play the message.

[0055] In some embodiments, application **112** of wearable device **102** may utilize a combination of sensors and algorithms to detect a location of the wearer (e.g., kitchen), an activity being performed by the wearer (e.g., cooking), and the like. In some embodiments, application **112** may utilize one or more kinematic algorithms trained to recognize a gesture (e.g., a fork lifting off a surface to the mouth, the repetition of which over certain times and certain locations to identify the event of eating). For example, the kinematic algorithms may be trained to track the position of the wrist in 3D space, its acceleration in x, y, and z axes (accelerometer), as well as the rotational vectors (gyroscope) to identify the movement of the hand from surface to mouth using an Inertial Measurement Unit (IMU) that may include a multi-axis accelerometer and a multi-axis gyroscope. In some embodiments, precision may be improved by using a multi-axis magnetometer and or an inclinometer or an orientation sensor.

[0056] In some embodiments, client device **108** may communicate with server system **104**, via application **124**, using one or more API calls. For example, when generating a new reminder audio message to be played to a user of wearable device **102**, client device **108** may utilize a POST/v1/schedule/audio API call. Such API call may generally be made by application **124** to create a new reminder audio message.

[0057] API server **120** may receive the API call from client device **108**. For example, API server **120** may receive the new reminder audio message and any constraints associated with the new reminder audio message. Upon receiving the new reminder audio message, API server **120** may upload the audio file to cloud storage **106**. In some embodiments, in addition to uploading the reminder audio message in a converted format, API server **120** may be configured to upload the reminder audio message in its original format, as a backup to the converted format in case the converted format becomes lost or corrupted.

[0058] In some embodiments, the uploading of the reminder audio message to the converted format may generate a unique identifier and file path associated with the unique identifier. In some embodiments, the unique identifier and file path associated with the unique identifier can be saved in a separate storage location. For example, the unique identifier and file path associated with the unique identifier can be stored in a MYSQL database, accessible to gateway server **122** and/or client device **108**.

[0059] In some embodiments, gateway server **122** may monitor cloud storage **106**. For example, gateway server **122** may monitor cloud storage **106** to determine when a new reminder audio message is uploaded. In some embodiments, gateway server **122** may monitor MYSQL database to determine when there is a new reminder audio message. In some embodiments, gateway server **122** may receive a notification that a new reminder audio message is available. Upon determining that a new reminder audio message is available, gateway server **122** may notify wearable device **102** over network **105**.

[0060] Wearable device **102** may instruct gateway server **122** to download new reminder audio message **214** from cloud storage **106**. In some embodiments, gateway server **122** may format the retrieved reminder audio message. For example, gateway server **122** may trim or reduce the reminder audio message to a pre-set length (e.g., one minute or less). Gateway server **122** may then provide the reminder audio message to wearable device **102**.

[0061] In some embodiments, gateway server **122**, API server **120**, and cloud storage **106** may communicate via a different network than network **105**, i.e., network **205**. By communicating via a separate network, client device **108** and/or wearable device **102** may not have direct access to cloud storage **106**. Network **205** may be of any suitable type, including individual connections via the Internet, such as cellular or Wi-Fi networks. In some embodiments, network **205** may connect terminals, services, and mobile devices using direct connections, such as radio frequency identification (RFID), near-field communication (NFC), Bluetooth™, low-energy Bluetooth™ (BLE), Wi-Fi™, ZigBee™, ambient backscatter communication (ABC) protocols, USB, Long Range Wide area networks (LoRAWAN), WAN, or LAN. Because the information transmitted may be personal or confidential, security concerns may dictate one or more of these types of connection be encrypted or otherwise secured. In some embodiments, however, the information being transmitted may be less personal, and therefore, the network connections may be selected for convenience over security.

[0062] Network **205** may include any type of computer networking arrangement used to exchange data or information. For example, network **105** may be the Internet, a private data network, virtual private network using a public network and/or other suitable connection(s) that enables components in computing environment **100** to send and receive information between the components of environment **100**.

[0063] As shown, application **112** of wearable device **102** may include reminder system **202**, instruction system **204**, and file system **206**. Reminder system **202** may be configured to manage reminder audio messages. Instruction system **204** may be configured to manage instruction audio messages. For ease of illustration, the details of only reminder system **202** are discussed in FIGS. **2-5**. The details of instruction system **204** may be found in more detail below, in conjunction with FIGS. **6-8**.

[0064] Reminder system **202** may include parser **208**, scheduler **210**, and orchestration module **212**. Each of parser **208**, scheduler **210**, and orchestration module **212** may be comprised of one or more software modules. The one or more software modules are collections of code or instructions stored on a media (e.g., memory of wearable device **102**) that represent a series of machine instructions (e.g., program code) that implements one or more algorithmic steps. Such machine instructions may be the actual computer code the processor of wearable device **102** interprets to implement the instructions or, alternatively, may be a higher level of coding of the instructions that are interpreted to obtain the actual computer code. The one or more software modules may also include one or more hardware components. One or more aspects of an example algorithm may be performed by the hardware components (e.g., circuitry) itself, rather than as a result of the instructions.

[0065] Parser **208** may be configured to parse reminder audio message **214**. For example, as previously discussed, gateway server **122** may provide the reminder audio message to wearable device **102** in the form of a JSON file. Parser **208** may be configured to parse the JSON file to obtain details regarding playback of the reminder audio message. For example, parser **208** may parse JSON file to identify the constraints or parameters for playback, as defined by client device **108**. Parser **208** may be configured to store the reminder audio message and/or associated constraints or parameters in file system **206**. File system **206** may be configured to organize the audio files associated with wearable device **102**.

[0066] Scheduler **210** may be configured to schedule reminder audio messages for playback. For example, scheduler **210** may monitor or check file system **206** to determine when to playback a reminder audio message. In some embodiments, scheduler **210** may be configured to playback a reminder audio message in accordance with time constraints set by user of client device **108**. For example, if client device **108** set a constraint that the reminder audio message should be played back at 9:00 p.m., scheduler **210** may schedule the reminder audio message to be played at 9:00 p.m.

[0067] Orchestration module **212** may be configured to monitor trigger events for determine when to play a reminder audio message. In some embodiments, orchestration module **212** may be configured to monitor communications from beacons **110** to determine if a location-based trigger occurs. In some embodiments, orchestration module **212** may be configured to monitor sensor data collected by sensors **114** to determine when whether an activity trigger has occurred. Based on the detected trigger events, orchestration module **212** may cause an appropriate or relevant reminder audio message to be played back to the user of wearable device **102**.

[0068] In some embodiments, orchestration module **212** may be configured to control a light of wearable device **102**. For example, in some embodiments, wearable device **102** may include an LED. Prior to a reminder audio message being played back, orchestration module **212** may cause LED to illuminate, to notify the user of wearable device **102** that a reminder audio message is about to be played. In some embodiments, rather than illuminate an LED or other light associated with wearable device **102**, orchestration module **212** may cause wearable device **102** to provide the user with haptic feedback to notify the user that a reminder audio message is about to be played.

[0069] FIG. **3** is a block diagram illustrating a computing environment **300**, according to example embodiments. Computing environment **200** may illustrate an exemplary process in which client device **108** generates an update to an existing voice recording for a user of wearable device **102**.

[0070] As shown, client device **108** may generate a modification **310** to an existing recording that has been uploaded to cloud storage **106** via application **124**. In some embodiments, modification **310** may be to the audio recording itself. For example, a user of client device **108** may wish to modify the existing audio recording with a new or modified message. In some embodiments, modification **310** may be to the parameters or constraints associated with the audio recording. For example, a user of client device **108** may wish to modify when an audio recording is played or the trigger event(s) associated with the audio recording. Using a specific example, a user of client device **108** may wish to modify the playback time for the reminder audio message from 9:00 p.m. to 8:00 p.m.

[0071] In some embodiments, client device **108** may communicate with server system **104**, via application **124**, using one or more API calls. For example, when a user generates modification **310**, client device **108** may utilize a PUT/v1/schedule/audio/{careVoiceId} API call. Such API call may generally be made by application **124** to update or modify an existing reminder audio message.

[0072] API server **120** may receive the API call from client device **108**. For example, API server **120** may receive modification **310**. Upon receiving modification, API server **120** may adjust the existing reminder audio message corresponding to modification **310**. In some embodiments, updating the existing reminder audio message may include writing over an existing reminder audio message with the new reminder audio message. In some embodiments, updating constraints or parameters associated with the existing reminder audio message may include API server **120** updating metadata associated with the existing reminder audio message.

[0073] In some embodiments, gateway server **122** may monitor cloud storage **106** for updates. For example, gateway server **122** may monitor cloud storage **106** to determine when a modification to an existing reminder audio message is uploaded. In some embodiments, gateway server **122** may monitor MYSQL database to determine when there is a modification. In some embodiments, gateway server **122** may receive a notification that there has been a modification to an existing reminder audio message. Upon determining that modification **310**, gateway server **122** may notify wearable device **102** over network **105**.

[0074] Wearable device **102** may instruct gateway server **122** to download modification **310** from cloud storage **106**. Gateway server **122** may provide modification **310** to wearable device **102**. In some embodiments, parser **208** of wearable device **102** may parse modification **310** to deter-

mine how to adjust or change a local version of the existing reminder audio message. In some embodiments, adjusting or changing the local version of the existing reminder audio message may include parser **208** overwriting the existing reminder audio message with modification **310**. In some embodiments, adjusting or changing the local version of the existing reminder audio message may include parser **208** changing or modifying constraints or parameters of the existing reminder audio message based on modification **310**.

[0075] FIG. **4**A is a block diagram illustrating a computing environment **400**, according to example embodiments. Computing environment **400** may illustrate an exemplary process in which wearable device **102** identifies a location-based trigger for playback of a reminder audio message.

[0076] As shown, wearable device **102** may receive a communication **402** from beacon **110**. Communication **402** may include information associated with the relative positioning of wearable device **102**. For example, when a wearable device **102** comes within range of beacon **110**, wearable device **102** may receive communication **402** from beacon **110**. Communication **402** includes information regarding the location of wearable device **102**. For example, communication **402** may specify that beacon **110** corresponds to "kitchen" and that the user is approaching the kitchen, since wearable device **102** is able to receive communications from beacon **110** (i.e., is within range).

[0077] In some embodiments, orchestration module **212** may be configured to parse communication **402** to determine an appropriate reminder audio message (if any) to playback to the user. For example, based on information contained in communication **402**, such as location information, orchestration module **212** may search file system **206** for a corresponding reminder audio message. Orchestration module **212** may then cause the corresponding reminder audio message to be played back to the user.

[0078] FIG. **4**B is a block diagram illustrating a computing environment **450**, according to example embodiments. Computing environment **450** may illustrate an exemplary process in which wearable device **102** identifies an activity-based trigger for playback of a reminder audio message.

[0079] As shown, wearable device **102** may receive a sensor data **452**. For example, sensors **114** may measure various attributes associated with the user. Exemplary sensor data **452** may include, but is not limited to, heart rate, blood pressure, speed, velocity, hydration levels, elevation, and the like. Orchestration module **212** may be configured to parse sensor data **452** to determine an appropriate reminder audio message (if any) to playback to the user. For example, based on information contained in sensor data **452**, such as an indication of a user falling, orchestration module **212** may search file system **206** for a corresponding reminder audio message. Orchestration module **212** may then cause the corresponding reminder audio message to be played back to the user.

[0080] FIG. **5** is a flow diagram illustrating a method **500** of playing back a reminder audio message to a user of wearable device **102**, according to example embodiments. Method **500** may begin at step **502**.

[0081] At step **502**, client device **108** may generate a new audio recording to be played back via wearable device **102**. In some embodiments, client device **108** may generate the new audio recording using application **124**. For example, via application **124**, a user of client device **108** can record a reminder audio message to be played to a user of wearable device **102** via wearable device **102**. In some embodiments, user of client device **108** can set constraints or parameters associated with the recording using application **124**. For example, client device **108** can dictate a trigger event for replaying the message. In some embodiments, the trigger event may be wearable device **102** detecting the user entered or approached a certain location. In some embodiments, the trigger event may be wearable device **102** detecting a certain user motion or activity. In some embodiments, the trigger event may be time based.

[0082] At **504**, client device **108** may upload the new reminder audio message to server system **104**. For example, via application **124**, client device **108** may upload the new reminder audio message to server system **104**. In some embodiments, client device **108** may communicate with server system **104** using one or more API calls. For example, client device **108** may utilize a POST/v1/schedule/audio API call.

[0083] At step **506**, API server **120** of server system **104** may upload the reminder audio message to cloud storage **106**. For example, API server **120** may receive an API call from client device **108**. The API call may include the new reminder audio message and any constraints or parameters associated with the new reminder audio message. In some embodiments, the reminder audio message may be received in base64 audio format. In such embodiments, API server **120** may decode the base64 reminder audio message and may convert the decoded messages into a 16-bit or 16 KHz raw audio format (e.g., .wav format). In the converted format, API server **120** may upload the converted audio file to cloud storage **106**. In some embodiments, in addition to uploading the reminder audio message in a converted format, API server **120** may upload the reminder audio message in its original format, as a backup to the converted format in case the converted format becomes lost or corrupted.

[0084] At step **508**, API server **120** may save a storage location of reminder audio message in cloud storage **106** in a database. In some embodiments, the uploading of the reminder audio message to the converted format may generate a unique identifier and file path associated with the unique identifier. In some embodiments, the unique identifier and file path associated with the unique identifier can be saved in a separate storage location.

[0085] At step **510**, gateway server **122** may detect the new reminder audio message in cloud storage **106**. For example, in some embodiments, gateway server **122** may monitor cloud storage **106** to determine when a new reminder audio message is uploaded. In some embodiments, gateway server **122** may monitor MYSQL database to determine when there is a new reminder audio message. In some embodiments, gateway server **122** may receive a notification that a new reminder audio message is available.

[0086] At step **512**, gateway server **122** may notify wearable device **102** that a new reminder audio message is available for download. At step **514**, wearable device **102** may receive notification of the new reminder audio message from gateway server **122**. At step **516**, wearable device **102** may instruct server system **104** to provide the new reminder audio message. For example, wearable device **102** may utilize one or more REST API calls to gateway server **122** to prompt gateway server **122** to provide wearable device **102** with the new reminder audio message.

[0087] At step **518**, gateway server **122** may receive the download instructions from wearable device **102**. At step

520, gateway server **122** may download the new reminder audio message from cloud storage **106**. For example, in order to provide wearable device **102** with the new reminder audio message, gateway server **122** may first retrieve the new reminder audio message from cloud storage **106**. Such retrieval may be necessary because, in some embodiments, wearable device **102** may not have direct access to cloud storage **106**. In some embodiments, gateway server **122** may format the retrieved reminder audio message. For example, gateway server **122** may trim or reduce the reminder audio message to a pre-set length (e.g., one minute or less). Gateway server **122** may then provide the reminder audio message to wearable device **102**.

[0088] At step **522**, gateway server **122** may provide the new reminder audio message to wearable device **102**. At step **524**, wearable device **102** may receive the new reminder audio message from server system **104**.

[0089] At step **526**, wearable device **102** may save the new reminder audio message in local storage. For example, wearable device **102** may parse the reminder audio message to obtain details regarding playback of the reminder audio message. For example, parser **208** of wearable device **102** may parse the file provided by gateway server **122** to identify constraints or parameters for playback, as defined by client device **108**. Wearable device **102** may store the reminder audio message and/or associated constraints or parameters in file system **206**.

[0090] At step **528**, wearable device **102** may detect a trigger event. In some embodiments, the trigger event may be wearable device **102** detecting the user entered or approached a certain location. In some embodiments, the trigger event may be wearable device **102** detecting a certain user motion or activity. For example, the motion or activity may include, but is not limited to, exercising, falling, brushing teeth, and the like. In some embodiments, the trigger event may be time based. For example, every night at 9:00 p.m., wearable device **102** may be instructed to play the message.

[0091] At step **530**, wearable device **102** may play the reminder audio message corresponding to the trigger event. For example, upon detecting the trigger event, orchestration module **212** of wearable device **102** may search file system **206** to identify a relevant reminder audio message. In some embodiments, the relevant reminder audio message may be the new reminder audio message. Responsive to identifying the relevant reminder audio message, orchestration module **212** may cause wearable device **102** to playback the new reminder audio message.

[0092] FIG. **6** is a block diagram illustrating a computing environment **600**, according to example embodiments. Computing environment **600** may illustrate an exemplary process in which client device **108** generates an instruction audio message for a user of wearable device **102**.

[0093] As discussed above, client device **108** can record a message to be played to a user of wearable device **102** via wearable device **102**. In some embodiments, the message may be an instructions message. In some embodiments, user of client device **108** can set constraints or parameters associated with the instructions message using application **124**. For example, client device **108** can dictate a trigger event (e.g., a time and/or date) for replaying the message.

[0094] In some embodiments, client device **108** may communicate with server system **104**, via application **124**, using one or more API calls. For example, when generating a new instruction audio message to be played to a user of wearable device **102**, client device **108** may utilize a POST/v1/schedule/audio API call. Such API call may generally be made by application **124** to create a new instruction audio message.

[0095] API server **120** may receive the API call from client device **108**. For example, API server **120** may receive the new instruction audio message and any constraints associated with the new instruction audio message. Upon receiving the new instruction audio message, API server **120** may upload the audio file to cloud storage **106**. In some embodiments, in addition to uploading the instruction audio message in a converted format, API server **120** may be configured to upload the instruction audio message in its original format, as a backup to the converted format in case the converted format becomes lost or corrupted.

[0096] In some embodiments, the uploading of the instruction audio message to the converted format may generate a unique identifier and file path associated with the unique identifier. In some embodiments, the unique identifier and file path associated with the unique identifier can be saved in a separate storage location. For example, the unique identifier and file path associated with the unique identifier can be stored in a MYSQL database, accessible to gateway server **122** and/or client device **108**.

[0097] In some embodiments, gateway server **122** may monitor cloud storage **106**. For example, gateway server **122** may monitor cloud storage **106** to determine when a new instruction audio message is uploaded. In some embodiments, gateway server **122** may monitor MYSQL database to determine when there is a new instruction audio message. In some embodiments, gateway server **122** may receive a notification that a new instruction audio message is available. Upon determining that a new instruction audio message is available, gateway server **122** may notify wearable device **102** over network **105**.

[0098] Wearable device **102** may instruct gateway server **122** to download new instruction audio message **614** from cloud storage **106**. In some embodiments, gateway server **122** may format the retrieved instruction audio message. For example, gateway server **122** may trim or reduce the instruction audio message to a pre-set length (e.g., one minute or less). Gateway server **122** may then provide the instruction audio message to wearable device **102**.

[0099] In some embodiments, gateway server **122**, API server **120**, and cloud storage **106** may communicate via a different network than network **105**, i.e., network **205**. By communicating via a separate network, client device **108** and/or wearable device **102** may not have direct access to cloud storage **106**. Network **205** may be of any suitable type, including individual connections via the Internet, such as cellular or Wi-Fi networks. In some embodiments, network **205** may connect terminals, services, and mobile devices using direct connections, such as radio frequency identification (RFID), near-field communication (NFC), Bluetooth™, low-energy Bluetooth™ (BLE), Wi-Fi™, ZigBee™, ambient backscatter communication (ABC) protocols, USB, Long Range Wide area networks (LoRAWAN), WAN, or LAN. Because the information transmitted may be personal or confidential, security concerns may dictate one or more of these types of connection be encrypted or otherwise secured. In some embodiments, however, the information being transmitted may be less

personal, and therefore, the network connections may be selected for convenience over security.

[0100] Network **205** may include any type of computer networking arrangement used to exchange data or information. For example, network **105** may be the Internet, a private data network, virtual private network using a public network and/or other suitable connection(s) that enables components in computing environment **100** to send and receive information between the components of environment **100**.

[0101] As shown, application **112** of wearable device **102** may include reminder system **202**, instruction system **204**, and file system **206**. The details of reminder system **202** has been discussed above in conjunction with FIGS. **2-5**.

[0102] Instruction system **204** may include parser **608**, scheduler **610**, and orchestration module **612**. Each of parser **608**, scheduler **610**, and orchestration module **612** may be comprised of one or more software modules. The one or more software modules are collections of code or instructions stored on a media (e.g., memory of wearable device **102**) that represent a series of machine instructions (e.g., program code) that implements one or more algorithmic steps. Such machine instructions may be the actual computer code the processor of wearable device **102** interprets to implement the instructions or, alternatively, may be a higher level of coding of the instructions that are interpreted to obtain the actual computer code. The one or more software modules may also include one or more hardware components. One or more aspects of an example algorithm may be performed by the hardware components (e.g., circuitry) itself, rather than as a result of the instructions.

[0103] Parser **608** may be configured to parse instruction audio message **614**. For example, as previously discussed, gateway server **122** may provide the instruction audio message to wearable device **102** in the form of a JSON file. Parser **608** may be configured to parse the JSON file to obtain details regarding playback of the audio message. For example, parser **608** may parse JSON file to identify the constraints or parameters for playback, as defined by client device **108**. Parser **608** may be configured to store the audio message and/or associated constraints or parameters in file system **206**. File system **206** may be configured to organize the audio files associated with wearable device **102**.

[0104] Scheduler **610** may be configured to schedule audio messages for playback. For example, scheduler **610** may monitor or check file system **206** to determine when to playback an audio message. In some embodiments, scheduler **610** may be configured to playback an audio message in accordance with time constraints set by user of client device **108**. For example, if client device **108** set a constraint that the audio message should be played back at 9:00 p.m., scheduler **610** may schedule the audio message to be played at 9:00 p.m.

[0105] Orchestration module **612** may be configured to manage the playback of the instruction audio message. For example, in some embodiments, a patient or creator of the instruction audio message can define one or more "quiet times." During quiet times, orchestration module **612** may defer reminders that are scheduled to fall within that time period.

[0106] In some embodiments, orchestration module **612** may be configured to take into account a patient's current context to adaptively decide to play or not play a reminder, or to play or not play a message based on the occurrence or non-occurrence of a particular event (e.g., prompt glucose measurement thirty minutes after eating was last detected).

[0107] In some embodiments, orchestration module **612** may further be configured connect to a measurement device when instruction audio message for taking a measurement is played. In some embodiments, orchestration module **612** may be configured to recognize, via Bluetooth or other local area communication protocols, measuring apparatus **615**. In some embodiments, orchestration module **612** may be configured to automatically pair with measuring apparatus **615**, to pair with measuring apparatus **615** using pre-configured identifiers, codes or passwords, and receive data from measuring apparatus **615** without further user intervention. Orchestration module **612** may then send the measurements to server system **104** for storage thereon. Server system **104** may then organize and display this measurement data to the user through a web and mobile application. Server system **104** can raise alerts to individuals based on their authorization and scope of interest and on certain levels or ranges of measurements.

[0108] In some embodiments, once the data is received from measuring apparatus **615**, orchestration module **612** may be configured to read back the measurements to the patient. In some embodiments, orchestration module **612** may utilize one or more pre-recorded audio files, which may be dynamically constructed from various segments of pre-recorded audio, to generate the playback message.

[0109] In some embodiments, orchestration module **612** may be configured to control a light of wearable device **102**. For example, in some embodiments, wearable device **102** may include an LED. Prior to an instruction audio message being played back, orchestration module **612** may cause LED to illuminate, to notify the user of wearable device **102** that an instruction audio message is about to be played. In some embodiments, rather than illuminate an LED or other light associated with wearable device **102**, orchestration module **612** may cause wearable device **102** to provide the user with haptic feedback to notify the user that an instruction audio message is about to be played.

[0110] FIG. **7**A is a block diagram illustrating a computing environment **700**, according to example embodiments. Computing environment **700** may illustrate an exemplary process in which wearable device **102** identifies a context-based trigger for playback of an audio message.

[0111] As shown, wearable device **102** may receive a sensor data **706**. For example, sensors **114** may measure various attributes associated with the user. Exemplary sensor data **706** may include, but is not limited to, heart rate, blood pressure, speed, velocity, hydration levels, elevation, and the like. Orchestration module **612** may be configured to parse sensor data **706** to determine an appropriate instruction message (if any) to playback to the user. For example, based on information contained in sensor data **706**, orchestration module **612** may determine that the user should take a physiological measurement and may search file system **206** for a corresponding instruction audio message. Orchestration module **612** may then cause the corresponding audio message to be played back to the user.

[0112] FIG. **7**B is a block diagram illustrating a computing environment **750**, according to example embodiments. Computing environment **750** may illustrate an exemplary process in which wearable device **102** plays back an instruction audio message and connects to an appropriate measuring apparatus **615**.

[0113] As shown, wearable device **102** may select an instruction audio message to be played back to the user based on sensor data **706**. For example, orchestration module **612** may determine that the patient should take a glucose reading thirty minutes after they ate. Based on the selected instruction audio message, orchestration module **612** may instruct communication interface **702** to pair or connect with an appropriate measuring apparatus **615**. Continuing with the above example, orchestration module **612** may instruct communication interface to pair or connect with a glucose measuring apparatus. Once connected, wearable device **102** may playback instructions to the patient regarding how to take a measurement using measuring apparatus **615**.

[0114] FIG. **8** is a flow diagram illustrating a method **800** of playing back an instruction audio message to a user of wearable device **102**, according to example embodiments. Method **800** may begin at step **802**.

[0115] At step **802**, client device **108** may generate a new audio recording to be played back via wearable device **102**. In some embodiments, client device **108** may generate the new audio recording using application **124**. For example, via application **124**, a user of client device **108** can record an instruction audio message to be played to a user of wearable device **102** via wearable device **102**. In some embodiments, user of client device **108** can set constraints or parameters associated with the recording using application **124**. For example, client device **108** can dictate a trigger event for replaying the message. In some embodiments, the trigger event may be wearable device **102** detecting the user entered or approached a certain location. In some embodiments, the trigger event may be wearable device **102** detecting a certain user motion or activity. In some embodiments, the trigger event may be time based.

[0116] At **804**, client device **108** may upload the new instruction audio message to server system **104**. For example, via application **124**, client device **108** may upload the new instruction audio message to server system **104**. In some embodiments, client device **108** may communicate with server system **104** using one or more API calls. For example, client device **108** may utilize a POST/v1/schedule/audio API call.

[0117] At step **806**, API server **120** of server system **104** may upload the instruction audio message to cloud storage **106**. For example, API server **120** may receive an API call from client device **108**. The API call may include the new instruction audio message and any constraints or parameters associated with the new instruction audio message. In some embodiments, the instruction audio message may be received in base64 audio format. In such embodiments, API server **120** may decode the base64 instruction audio message and may convert the decoded messages into a 16-bit or 16 KHz raw audio format (e.g., .wav format). In the converted format, API server **120** may upload the converted audio file to cloud storage **106**. In some embodiments, in addition to uploading the instruction audio message in a converted format, API server **120** may upload the instruction audio message in its original format, as a backup to the converted format in case the converted format becomes lost or corrupted.

[0118] At step **808**, API server **120** may save a storage location of instruction audio message in cloud storage **106** in a database. In some embodiments, the uploading of the instruction audio message to the converted format may generate a unique identifier and file path associated with the unique identifier. In some embodiments, the unique identifier and file path associated with the unique identifier can be saved in a separate storage location.

[0119] At step **810**, gateway server **122** may detect the new instruction audio message in cloud storage **106**. For example, in some embodiments, gateway server **122** may monitor cloud storage **106** to determine when a new instruction audio message is uploaded. In some embodiments, gateway server **122** may monitor MYSQL database to determine when there is a new instruction audio message. In some embodiments, gateway server **122** may receive a notification that a new instruction audio message is available.

[0120] At step **812**, gateway server **122** may notify wearable device **102** that a new instruction audio message is available for download. At step **814**, wearable device **102** may receive notification of the new instruction audio message from gateway server **122**. At step **816**, wearable device **102** may instruct server system **104** to provide the new instruction audio message. For example, wearable device **102** may utilize one or more REST API calls to gateway server **122** to prompt gateway server **122** to provide wearable device **102** with the new instruction audio mes sage.

[0121] At step **818**, gateway server **122** may receive the download instructions from wearable device **102**. At step **820**, gateway server **122** may download the new instruction audio message from cloud storage **106**. For example, in order to provide wearable device **102** with the new instruction audio message, gateway server **122** may first retrieve the new instruction audio message from cloud storage **106**. Such retrieval may be necessary because, in some embodiments, wearable device **102** may not have direct access to cloud storage **106**. In some embodiments, gateway server **122** may format the retrieved instruction audio message. For example, gateway server **122** may trim or reduce the instruction audio message to a pre-set length (e.g., one minute or less). Gateway server **122** may then provide the instruction audio message to wearable device **102**.

[0122] At step **822**, gateway server **122** may provide the new instruction audio message to wearable device **102**. At step **824**, wearable device **102** may receive the new instruction audio message from server system **104**.

[0123] At step **826**, wearable device **102** may save the new instruction audio message in local storage. For example, wearable device **102** may parse the instruction audio message to obtain details regarding playback of the instruction audio message. For example, parser **208** of wearable device **102** may parse the file provided by gateway server **122** to identify constraints or parameters for playback, as defined by client device **108**. Wearable device **102** may store the instruction audio message and/or associated constraints or parameters in file system **206**.

[0124] At step **828**, wearable device **102** may detect a trigger event. In some embodiments, the trigger event may be wearable device **102** detecting the user entered or approached a certain location. In some embodiments, the trigger event may be wearable device **102** detecting a certain user motion or activity. For example, the motion or activity may include, but is not limited to, exercising, falling, brushing teeth, and the like. In some embodiments, the trigger event may be time based. For example, every night at 9:00 p.m., wearable device **102** may be instructed to play the message. In some embodiments, the trigger event may be manually actuated by the patient. For example, the patient

may request a blood pressure measurement using wearable device **102**. For example, in some embodiments, a user can press a button on wearable device **102**. Pressing the button on wearable device **102** may prompt wearable device **102** to read out a menu of options. The menu of options may include various physiological measurements the user can take. The user may select any of the options provided in the menu of options.

[0125] At step **830**, wearable device **102** may select an appropriate audio message based on the trigger event. In some embodiments, wearable device **102** may select an instruction audio message to be played back to the user based on sensor data. For example, orchestration module **612** may determine that the patient should take a glucose reading thirty minutes after they ate.

[0126] At step **832**, wearable device **102** may pair or connect with an appropriate measuring apparatus based on the selected audio message. In some embodiments, orchestration module **612** may instruct communication interface **702** to pair or connect with an appropriate measuring apparatus **615**. Continuing with the above example, orchestration module **612** may instruct communication interface to pair or connect with a glucose measuring apparatus. Once connected, wearable device **102** may playback instructions to the patient regarding how to take a measurement using measuring apparatus **615**.

[0127] At step **834**, wearable device **102** may play the instruction audio message corresponding to the trigger event. For example, once paired, orchestration module **612** may playback the instruction audio message. The instruction audio message may instruct the user on the steps required for obtaining a measurement using the connected measurement apparatus.

[0128] At step **836**, wearable device **102** may receive measurement data from the connected measurement apparatus.

[0129] FIG. **9**A illustrates an architecture of computing system **900**, according to example embodiments. System **900** may be representative of at least a portion of server system **104**. One or more components of system **900** may be in electrical communication with each other using a bus **905**. System **900** may include a processing unit (CPU or processor) **910** and a system bus **905** that couples various system components including the system memory **915**, such as read only memory (ROM) **920** and random access memory (RAM) **925**, to processor **910**. System **900** may include a cache of high-speed memory connected directly with, in close proximity to, or integrated as part of processor **910**. System **900** may copy data from memory **915** and/or storage device **930** to cache **912** for quick access by processor **910**. In this way, cache **912** may provide a performance boost that avoids processor **910** delays while waiting for data. These and other modules may control or be configured to control processor **910** to perform various actions. Other system memory **915** may be available for use as well. Memory **915** may include multiple different types of memory with different performance characteristics. Processor **910** may include any general purpose processor and a hardware module or software module, such as service **1 932**, service **2 934**, and service **3 936** stored in storage device **930**, configured to control processor **910** as well as a special-purpose processor where software instructions are incorporated into the actual processor design. Processor **910** may essentially be a completely self-contained computing system, containing multiple cores or processors, a bus, memory controller, cache, etc. A multi-core processor may be symmetric or asymmetric.

[0130] To enable user interaction with the computing system **900**, an input device **945** may represent any number of input mechanisms, such as a microphone for speech, a touch-sensitive screen for gesture or graphical input, keyboard, mouse, motion input, speech and so forth. An output device **935** (e.g., display) may also be one or more of a number of output mechanisms known to those of skill in the art. In some instances, multimodal systems may enable a user to provide multiple types of input to communicate with computing system **900**. Communications interface **940** may generally govern and manage the user input and system output. There is no restriction on operating on any particular hardware arrangement and therefore the basic features here may easily be substituted for improved hardware or firmware arrangements as they are developed.

[0131] Storage device **930** may be a non-volatile memory and may be a hard disk or other types of computer readable media which may store data that are accessible by a computer, such as magnetic cassettes, flash memory cards, solid state memory devices, digital versatile disks, cartridges, random access memories (RAMs) **925**, read only memory (ROM) **920**, and hybrids thereof.

[0132] Storage device **930** may include services **932**, **934**, and **936** for controlling the processor **910**. Other hardware or software modules are contemplated. Storage device **930** may be connected to system bus **905**. In one aspect, a hardware module that performs a particular function may include the software component stored in a computer-readable medium in connection with the necessary hardware components, such as processor **910**, bus **905**, output device **935**, and so forth, to carry out the function.

[0133] FIG. **9**B illustrates a computer system **950** having a chipset architecture that may represent at least a portion of server system **104**. Computer system **950** may be an example of computer hardware, software, and firmware that may be used to implement the disclosed technology. System **950** may include a processor **955**, representative of any number of physically and/or logically distinct resources capable of executing software, firmware, and hardware configured to perform identified computations. Processor **955** may communicate with a chipset **960** that may control input to and output from processor **955**. In this example, chipset **960** outputs information to output **965**, such as a display, and may read and write information to storage device **970**, which may include magnetic media, and solid-state media, for example. Chipset **960** may also read data from and write data to RAM **975**. A bridge **980** for interfacing with a variety of user interface components **985** may be provided for interfacing with chipset **960**. Such user interface components **985** may include a keyboard, a microphone, touch detection and processing circuitry, a pointing device, such as a mouse, and so on. In general, inputs to system **950** may come from any of a variety of sources, machine generated and/or human generated.

[0134] Chipset **960** may also interface with one or more communication interfaces **990** that may have different physical interfaces. Such communication interfaces may include interfaces for wired and wireless local area networks, for broadband wireless networks, as well as personal area networks. Some applications of the methods for generating, displaying, and using the GUI disclosed herein may include

receiving ordered datasets over the physical interface or be generated by the machine itself by processor **955** analyzing data stored in storage device **970** or RAM **975**. Further, the machine may receive inputs from a user through user interface components **985** and execute appropriate functions, such as browsing functions by interpreting these inputs using processor **955**.

[0135] It may be appreciated that example systems **900** and **950** may have more than one processor **910** or be part of a group or cluster of computing devices networked together to provide greater processing capability.

[0136] While the foregoing is directed to embodiments described herein, other and further embodiments may be devised without departing from the basic scope thereof. For example, aspects of the present disclosure may be implemented in hardware or software or a combination of hardware and software. One embodiment described herein may be implemented as a program product for use with a computer system. The program(s) of the program product define functions of the embodiments (including the methods described herein) and can be contained on a variety of computer-readable storage media. Illustrative computer-readable storage media include, but are not limited to: (i) non-writable storage media (e.g., read-only memory (ROM) devices within a computer, such as CD-ROM disks readably by a CD-ROM drive, flash memory, ROM chips, or any type of solid-state non-volatile memory) on which information is permanently stored; and (ii) writable storage media (e.g., floppy disks within a diskette drive or hard-disk drive or any type of solid state random-access memory) on which alterable information is stored. Such computer-readable storage media, when carrying computer-readable instructions that direct the functions of the disclosed embodiments, are embodiments of the present disclosure.

[0137] It will be appreciated to those skilled in the art that the preceding examples are exemplary and not limiting. It is intended that all permutations, enhancements, equivalents, and improvements thereto are apparent to those skilled in the art upon a reading of the specification and a study of the drawings are included within the true spirit and scope of the present disclosure. It is therefore intended that the following appended claims include all such modifications, permutations, and equivalents as fall within the true spirit and scope of these teachings.

What is claimed is:

1. A method, comprising:

detecting, by a wearable device, a trigger event, wherein the trigger event indicates a type of measurement to take;

based on the trigger event, selecting, by the wearable device, an instruction audio message corresponding to the type of measurement to be taken, the instruction audio message comprising instructions for how to conduct the type of measurement;

connecting, by the wearable device, to an appropriate measuring apparatus based on the type of measurement to be taken and the instruction audio message;

playing, by the wearable device, the instruction audio message to a patient of the wearable device; and

receiving, by the wearable device, measurements from the appropriate measuring apparatus.

2. The method of claim **1**, wherein connecting, by the wearable device, to the appropriate measuring apparatus based on the type of measurement to be taken and the instruction audio message comprises:

automatically pairing the wearable device with the appropriate measuring apparatus.

3. The method of claim **1**, wherein connecting, by the wearable device, to the appropriate measuring apparatus based on the type of measurement to be taken and the instruction audio message comprises:

applying one or more of pre-configured identifies, codes, or passwords to connect with the appropriate measuring apparatus.

4. The method of claim **1**, further comprising:

causing, by the wearable device, a visual or physical notification that indicates the instruction audio message is to be played.

5. The method of claim **1**, wherein detecting, by the wearable device, the trigger event, comprises:

receiving a prompt from the patient associated with the wearable device to record the type of measurement.

6. The method of claim **1**, wherein detecting, by the wearable device, the trigger event, comprises:

analyzing, via one or more sensors of the wearable device, patient activity data to detect the trigger event.

7. The method of claim **1**, wherein playing, by the wearable device, the instruction audio message to the patient of the wearable device comprises:

constructing the instruction audio message from a plurality of segments of pre-recorded audio.

8. A non-transitory computer readable medium comprising one or more sequences of instructions, which, when executed by one or more processors, causes a wearable device to perform operations comprising:

detecting, by the wearable device, a trigger event, wherein the trigger event indicates a type of measurement to take;

based on the trigger event, selecting, by the wearable device, an instruction audio message corresponding to the type of measurement to be taken, the instruction audio message comprising instructions for how to conduct the type of measurement;

connecting, by the wearable device, to an appropriate measuring apparatus based on the type of measurement to be taken and the instruction audio message;

playing, by the wearable device, the instruction audio message to a patient of the wearable device; and

receiving, by the wearable device, measurements from the appropriate measuring apparatus.

9. The non-transitory computer readable medium of claim **8**, wherein connecting, by the wearable device, to the appropriate measuring apparatus based on the type of measurement to be taken and the instruction audio message comprises:

automatically pairing the wearable device with the appropriate measuring apparatus.

10. The non-transitory computer readable medium of claim **8**, wherein connecting, by the wearable device, to the appropriate measuring apparatus based on the type of measurement to be taken and the instruction audio message comprises:

applying one or more of pre-configured identifies, codes, or passwords to connect with the appropriate measuring apparatus.

11. The non-transitory computer readable medium of claim **8**, further comprising:

causing, by the wearable device, a visual or physical notification that indicates the instruction audio message is to be played.

12. The non-transitory computer readable medium of claim **8**, wherein detecting, by the wearable device, the trigger event comprises:

receiving a prompt from the patient associated with the wearable device to record the type of measurement.

13. The non-transitory computer readable medium of claim **8**, wherein detecting, by the wearable device, the trigger event comprises:

analyzing, via one or more sensors of the wearable device, patient activity data to detect the trigger event.

14. The non-transitory computer readable medium of claim **8**, wherein playing, by the wearable device, the instruction audio message to the patient of the wearable device comprises:

constructing the instruction audio message from a plurality of segments of pre-recorded audio.

15. A system comprising:

a processor; and

a memory having programming instructions stored thereon, which, when executed by the processor, causes the system to perform operations comprising:

detecting a trigger event, wherein the trigger event indicates a type of measurement to take;

based on the trigger event, selecting an instruction audio message corresponding to the type of measurement to be taken, the instruction audio message comprising instructions for how to conduct the type of measurement;

connecting to an appropriate measuring apparatus based on the type of measurement to be taken and the instruction audio message;

playing the instruction audio message to a patient associated with the system; and

receiving measurements from the appropriate measuring apparatus.

16. The system of claim **15**, wherein connecting to the appropriate measuring apparatus based on the type of measurement to be taken and the instruction audio message comprises:

automatically pairing the system with the appropriate measuring apparatus.

17. The system of claim **15**, wherein connecting to the appropriate measuring apparatus based on the type of measurement to be taken and the instruction audio message comprises:

applying one or more of pre-configured identifies, codes, or passwords to connect with the appropriate measuring apparatus.

18. The system of claim **15**, wherein detecting the trigger event comprises:

receiving a prompt from the patient associated with the system to record the type of measurement.

19. The system of claim **15**, wherein detecting the trigger event comprises:

analyzing, via one or more sensors of the system, patient activity data to detect the trigger event.

20. The system of claim **15**, wherein playing the instruction audio message to the patient associated with the system comprises:

constructing the instruction audio message from a plurality of segments of pre-recorded audio.

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