US 20160135739A1

(19) **United States**

(12) **Patent Application Publication**

Bowers et al.

(10) **Pub. No.: US 2016/0135739 A1**

(43) **Pub. Date: May 19, 2016**

(54) **DETERMINING TREATMENT COMPLIANCE USING COMBINED PERFORMANCE INDICATORS**

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(73) Assignee: **Elwha LLC, a limited liability company of the State of Delaware**

(21) Appl. No.: **14/939,143**

(22) Filed: **Nov. 12, 2015**

Related U.S. Application Data

(63) Continuation-in-part of application No. 14/543,030, filed on Nov. 17, 2014, Continuation-in-part of application No. 14/543,066, filed on Nov. 17, 2014, Continuation-in-part of application No. 14/729,278, filed on Jun. 3, 2015, Continuation-in-part of application No. 14/729,322, filed on Jun. 3, 2015.

Publication Classification

(51) **Int. Cl.**

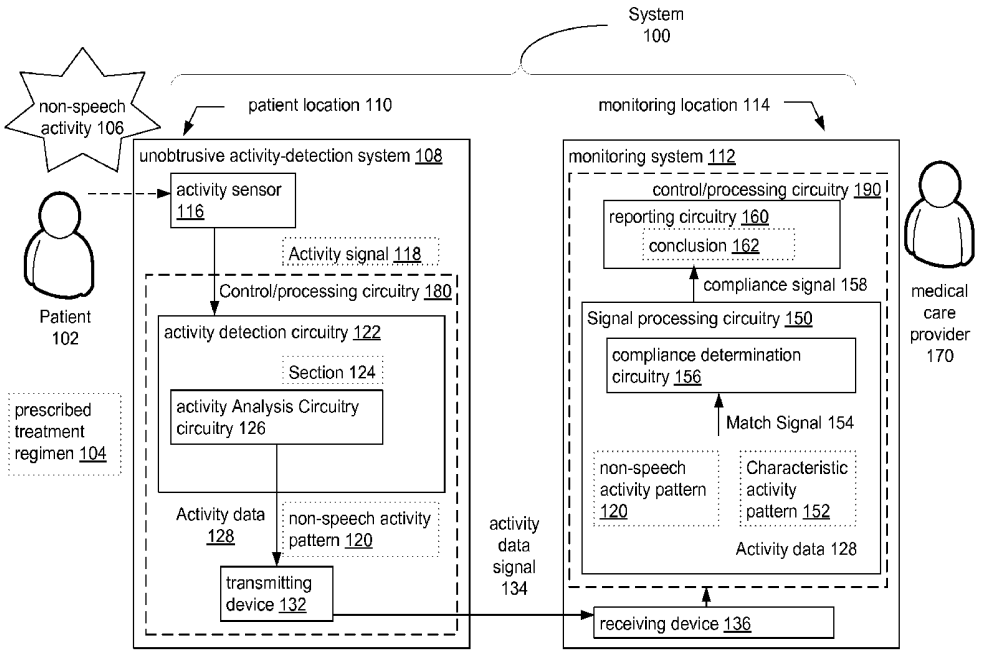
A61B 5/00	(2006.01)
A61B 5/16	(2006.01)
A61B 5/1171	(2006.01)
A61B 5/0205	(2006.01)
A61B 7/00	(2006.01)

(52) **U.S. Cl.**

CPC ***A61B 5/4833*** (2013.01); ***A61B 5/0205*** (2013.01); ***A61B 5/4803*** (2013.01); ***A61B 7/00*** (2013.01); ***A61B 5/1176*** (2013.01); ***A61B 5/72*** (2013.01); ***A61B 5/746*** (2013.01); ***A61B 5/0002*** (2013.01); ***A61B 5/7405*** (2013.01); ***A61B 5/167*** (2013.01); ***A61B 5/4082*** (2013.01); ***A61B 5/4088*** (2013.01); ***A61B 5/165*** (2013.01)

(57) **ABSTRACT**

Methods and systems for monitoring compliance of a patient with a prescribed treatment regimen are described. Patient activity is detected unobtrusively with an activity sensor at the patient location, and activity data is transmitted to a monitoring location. Patient speech detected during use of a communication system such as a mobile telephone by the patient may also be used as an activity signal. Patient activity and/or speech is processed at the patient location or monitoring location to identify activity parameters or patterns that indicate whether the patient has complied with the prescribed treatment regimen. The activity sensor and other components at the patient location may be incorporated into, or associated with, a cell phone, computing system, game system, or vehicle system, for example. The system may provide a report to an interested party, for example a medical care provider or insurance company, regarding patient compliance with the prescribed treatment regimen.



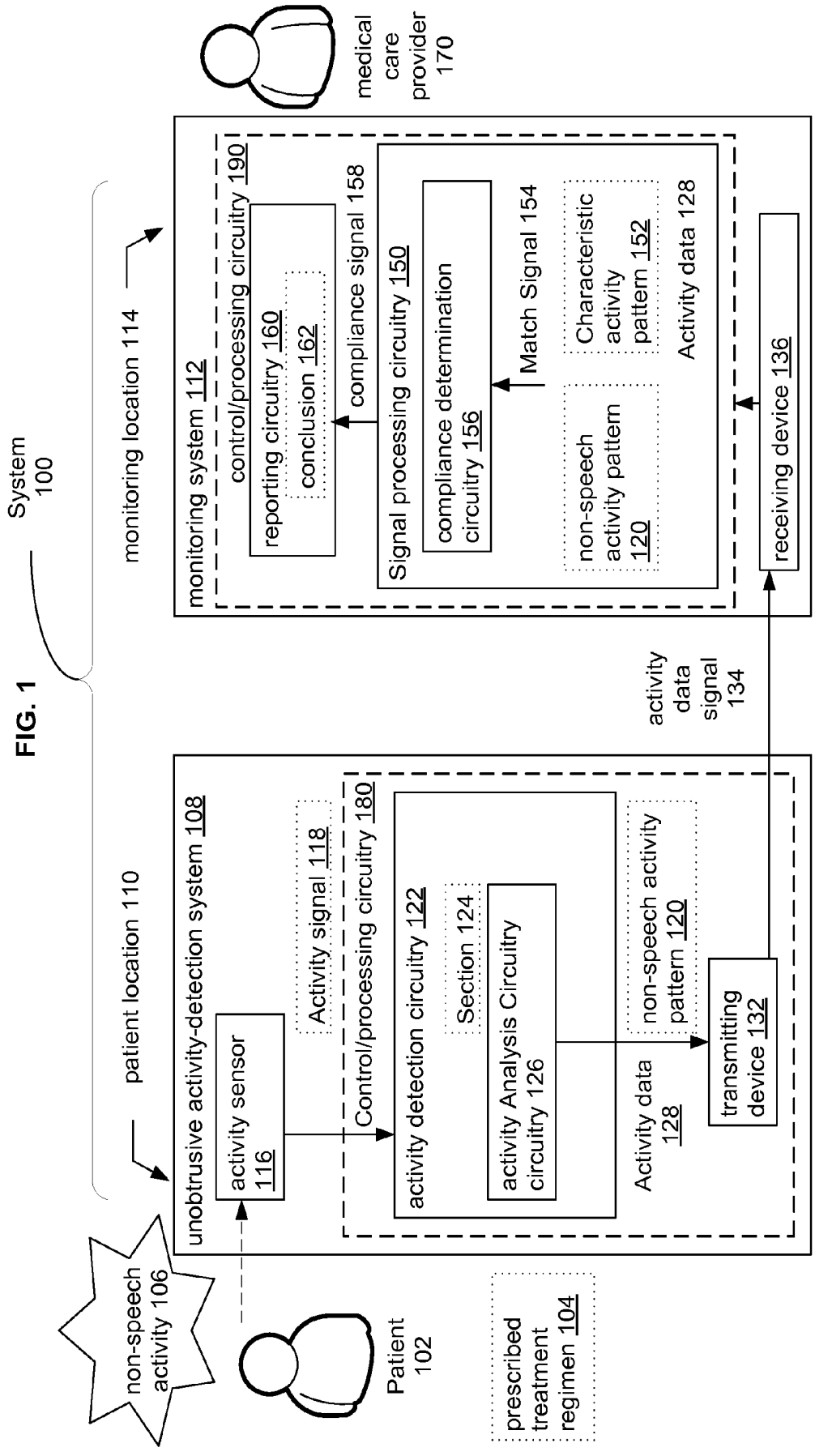

System 100
monitoring location 114
patient location 110
medical care provider 170
monitoring system 112
control/processing circuitry 190
reporting circuitry 160
conclusion 162
compliance signal 158
Signal processing circuitry 150
compliance determination circuitry 156
Match Signal 154
Characteristic activity pattern 152
non-speech activity pattern 120
Activity data 128
receiving device 136
activity data signal 134
unobtrusive activity-detection system 108
activity sensor 116
Activity signal 118
Control/processing circuitry 180
activity detection circuitry 122
Section 124
activity Analysis Circuitry circuitry 126
Activity data 128
non-speech activity pattern 120
transmitting device 132
non-speech activity 106
Patient 102
prescribed treatment regimen 104

FIG. 1

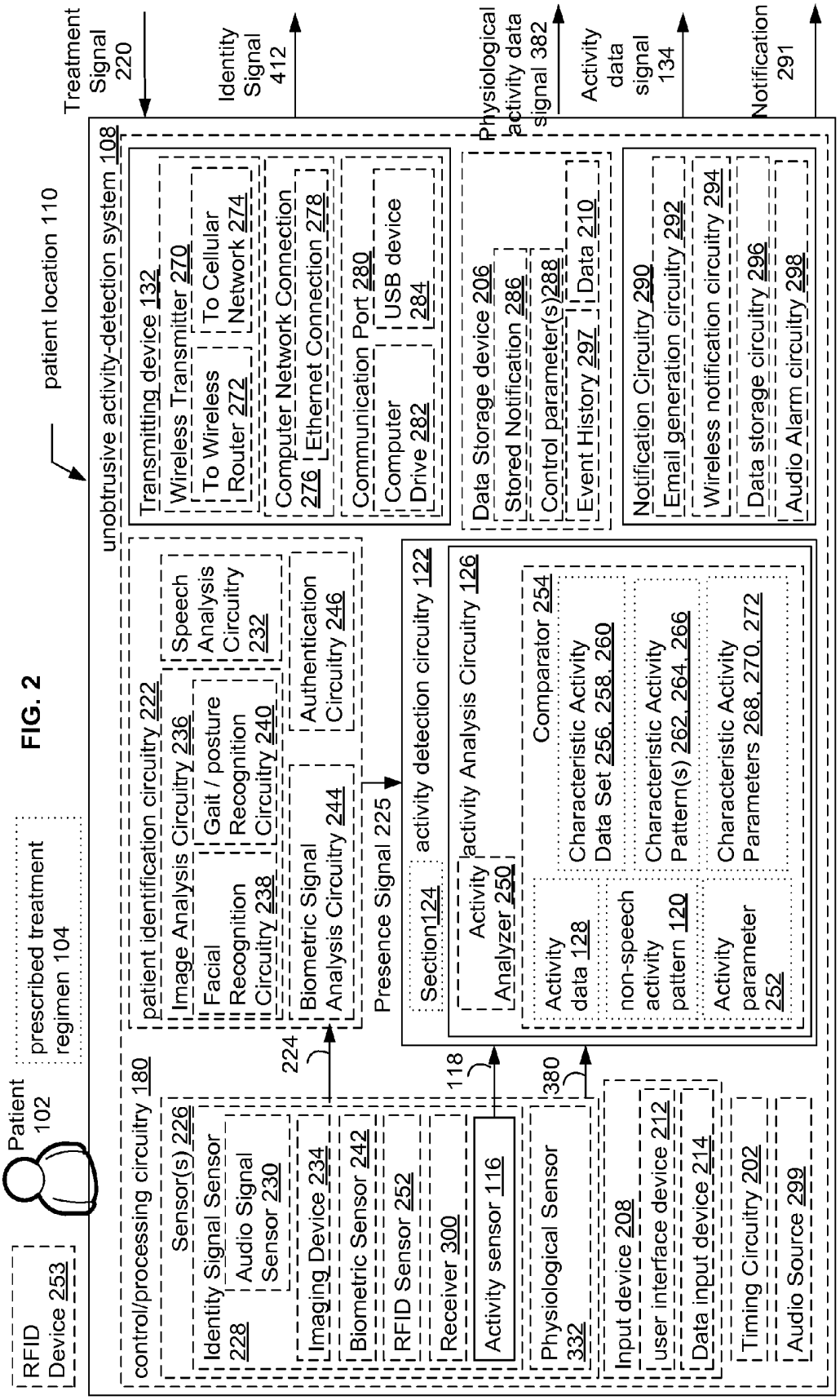
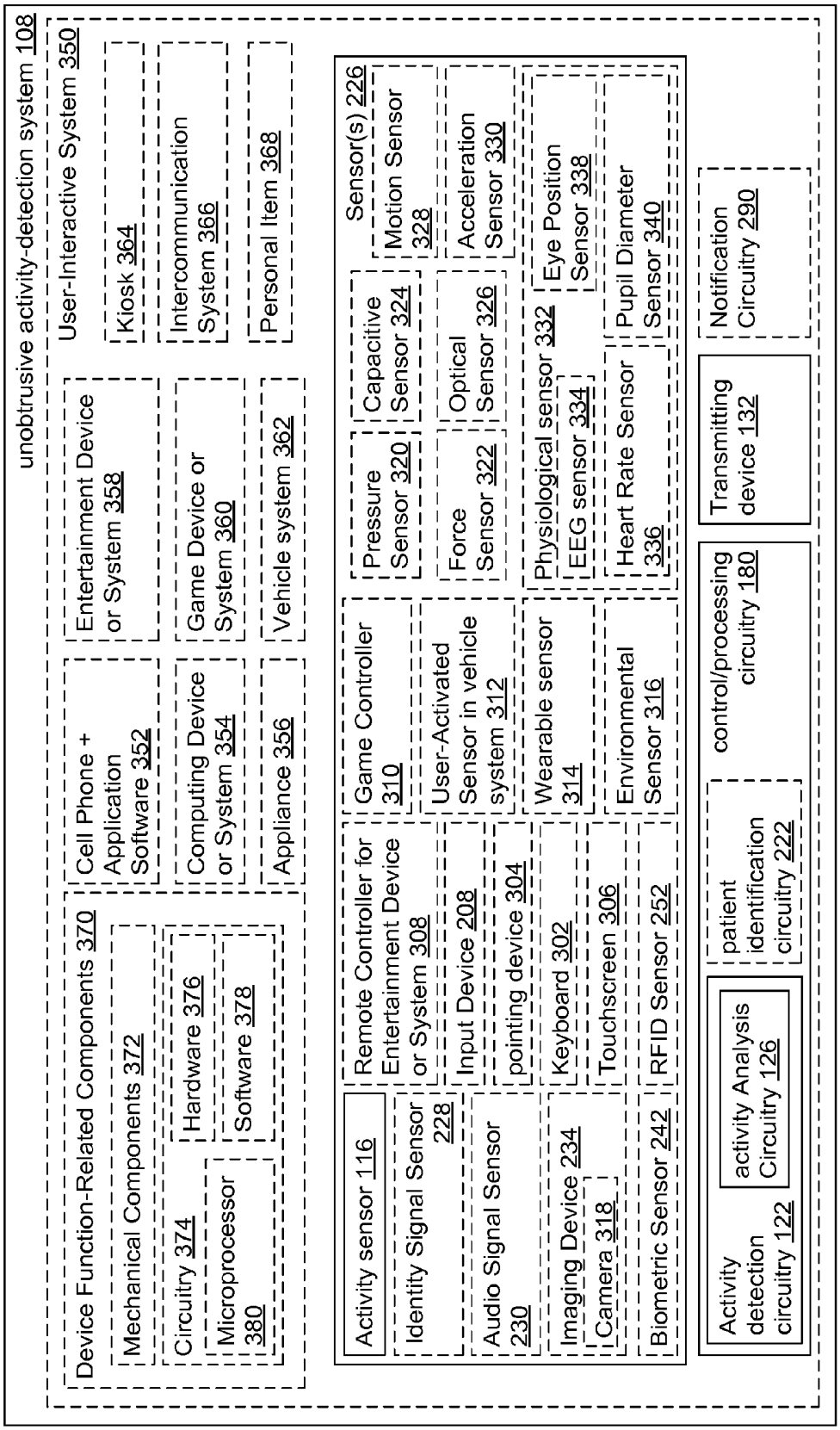

RFID Device 253
Patient 102
prescribed treatment regimen 104
patient location 110
unobtrusive activity-detection system 108
Treatment Signal 220
Identity Signal 412
Physiological activity data signal 382
Activity data signal 134
Notification 291
control/processing circuitry 180
Sensor(s) 226
Identity Signal Sensor 228
Audio Signal Sensor 230
Imaging Device 234
Biometric Sensor 242
RFID Sensor 252
Receiver 300
Activity sensor 116
Physiological Sensor 332
Input device 208
user interface device 212
Data input device 214
Timing Circuitry 202
Audio Source 299
224
118
380
patient identification circuitry 222
Image Analysis Circuitry 236
Facial Recognition Circuitry 238
Gait / posture Recognition Circuitry 240
Speech Analysis Circuitry 232
Biometric Signal Analysis Circuitry 244
Authentication Circuitry 246
Presence Signal 225
activity detection circuitry 122
Section124
activity Analysis Circuitry 126
Activity Analyzer 250
Activity data 128
Comparator 254
Characteristic Activity Data Set 256, 258, 260
non-speech activity pattern 120
Characteristic Activity Pattern(s) 262, 264, 266
Activity parameter 252
Characteristic Activity Parameters 268, 270, 272
Transmitting device 132
Wireless Transmitter 270
To Wireless Router 272
To Cellular Network 274
Computer Network Connection 276
Ethernet Connection 278
Communication Port 280
Computer Drive 282
USB device 284
Data Storage device 206
Stored Notification 286
Control parameter(s)288
Event History 297
Data 210
Notification Circuitry 290
Email generation circuitry 292
Wireless notification circuitry 294
Data storage circuitry 296
Audio Alarm circuitry 298

FIG. 2

FIG. 3


unobtrusive activity-detection system 108
Device Function-Related Components 370
Mechanical Components 372
Circuitry 374
Hardware 376
Microprocessor 380
Software 378
Cell Phone + Application Software 352
Computing Device or System 354
Appliance 356
Entertainment Device or System 358
Game Device or System 360
Vehicle system 362
User-Interactive System 350
Kiosk 364
Intercommunication System 366
Personal Item 368
Activity sensor 116
Identity Signal Sensor 228
Audio Signal Sensor 230
Imaging Device 234
Camera 318
Biometric Sensor 242
Remote Controller for Entertainment Device or System 308
Input Device 208
pointing device 304
Keyboard 302
Touchscreen 306
RFID Sensor 252
Game Controller 310
User-Activated Sensor in vehicle system 312
Wearable sensor 314
Environmental Sensor 316
Pressure Sensor 320
Force Sensor 322
Physiological sensor 332
EEG sensor 334
Heart Rate Sensor 336
Capacitive Sensor 324
Optical Sensor 326
Sensor(s) 226
Motion Sensor 328
Acceleration Sensor 330
Eye Position Sensor 338
Pupil Diameter Sensor 340
Activity detection circuitry 122
activity Analysis Circuitry 126
patient identification circuitry 222
control/processing circuitry 180
Transmitting device 132
Notification Circuitry 290

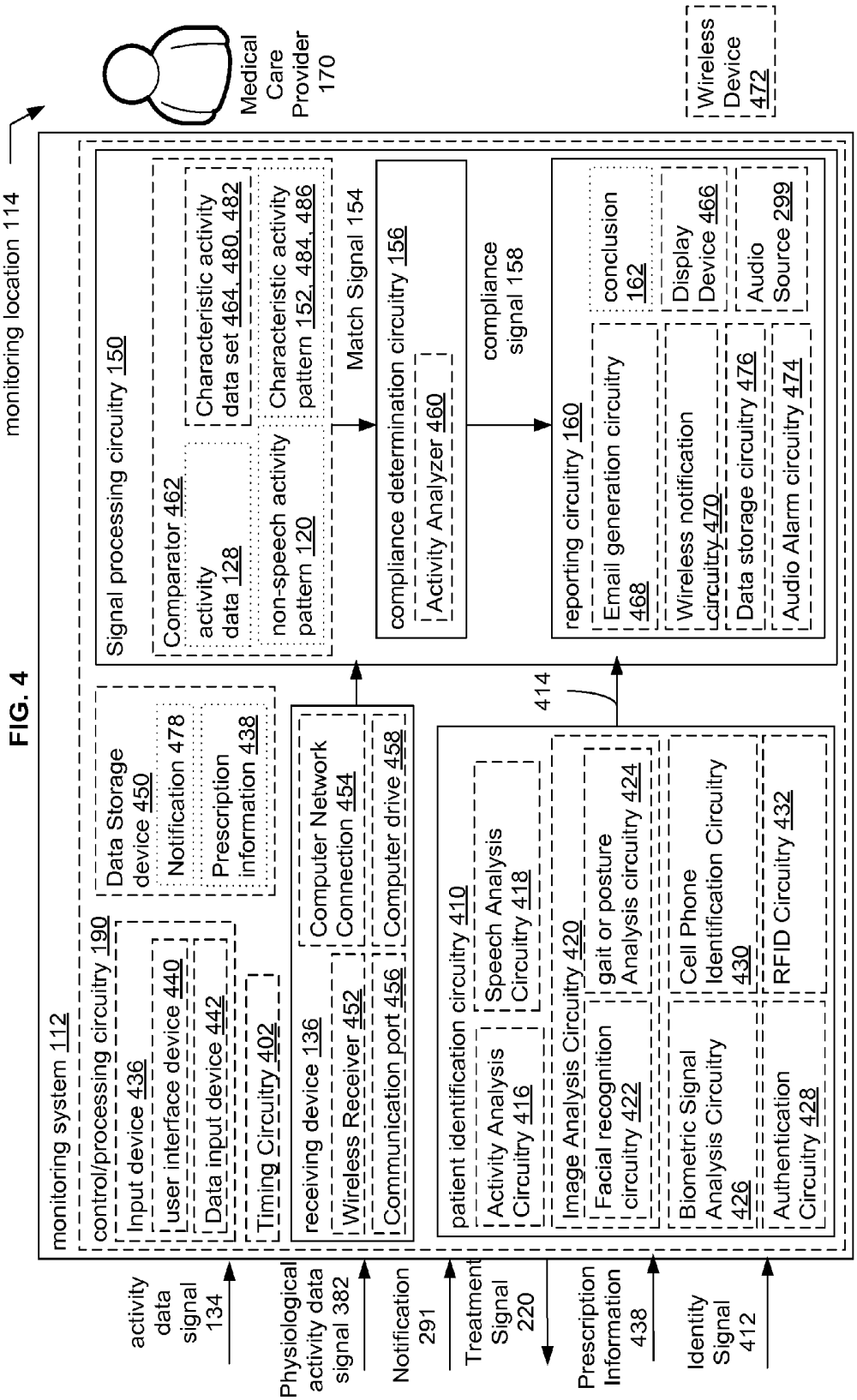
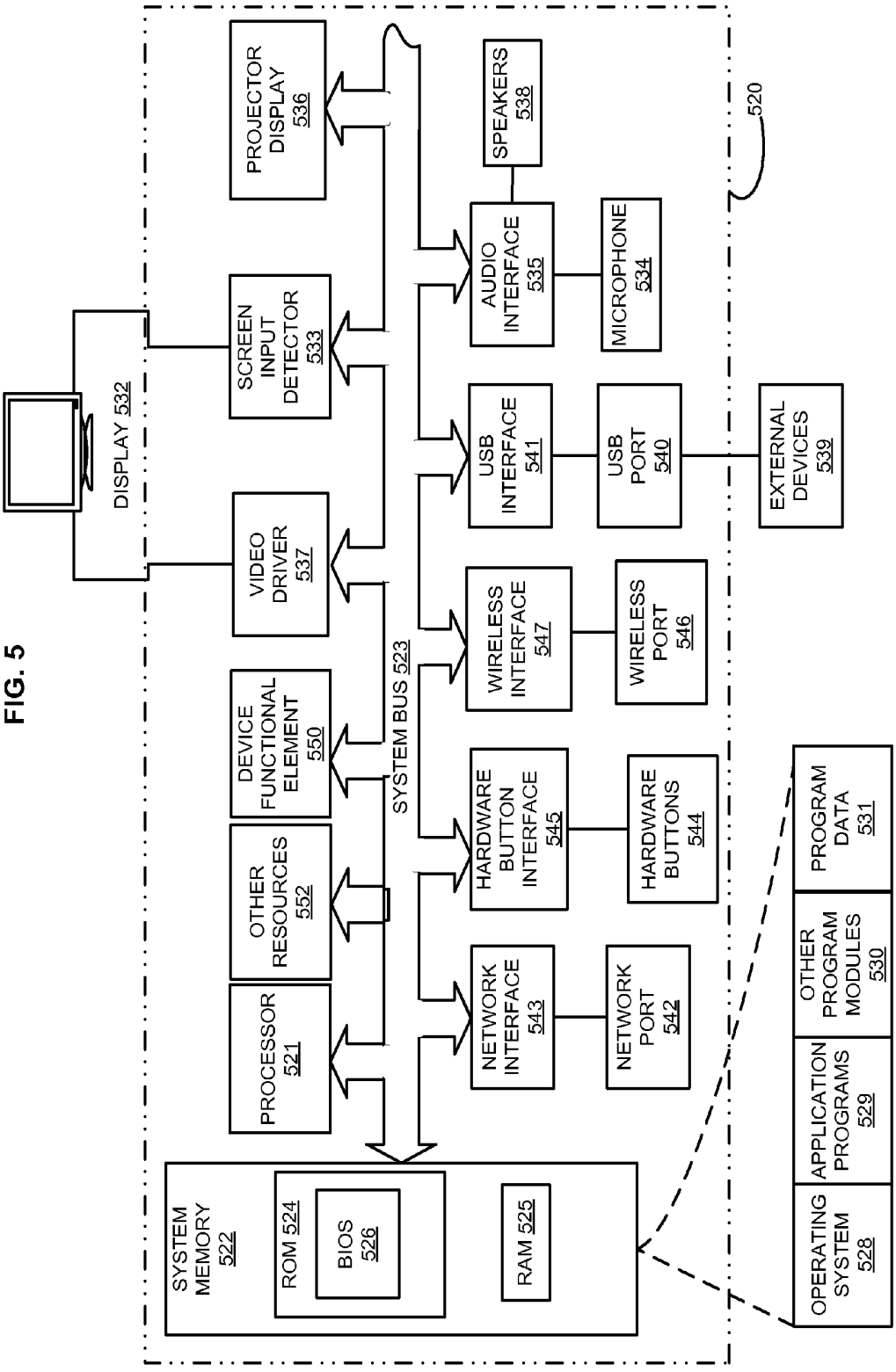

monitoring location 114
monitoring system 112
control/processing circuitry 190
Input device 436
user interface device 440
Data input device 442
Timing Circuitry 402
Data Storage device 450
Notification 478
Prescription information 438
receiving device 136
Wireless Receiver 452
Computer Network Connection 454
Communication port 456
Computer drive 458
patient identification circuitry 410
Activity Analysis Circuitry 416
Speech Analysis Circuitry 418
Image Analysis Circuitry 420
Facial recognition circuitry 422
gait or posture Analysis circuitry 424
Biometric Signal Analysis Circuitry 426
Cell Phone Identification Circuitry 430
Authentication Circuitry 428
RFID Circuitry 432
Signal processing circuitry 150
Comparator 462
activity data 128
non-speech activity pattern 120
Characteristic activity data set 464, 480, 482
Characteristic activity pattern 152, 484, 486
Match Signal 154
compliance determination circuitry 156
Activity Analyzer 460
compliance signal 158
reporting circuitry 160
Email generation circuitry 468
conclusion 162
Wireless notification circuitry 470
Data storage circuitry 476
Audio Alarm circuitry 474
Display Device 466
Audio Source 299
414
Medical Care Provider 170
Wireless Device 472
activity data signal 134
Physiological activity data signal 382
Notification 291
Treatment Signal 220
Prescription Information 438
Identity Signal 412

FIG. 4

FIG. 5


520
SYSTEM BUS 523
SYSTEM MEMORY 522
ROM 524
BIOS 526
RAM 525
PROCESSOR 521
OTHER RESOURCES 552
DEVICE FUNCTIONAL ELEMENT 550
VIDEO DRIVER 537
SCREEN INPUT DETECTOR 533
PROJECTOR DISPLAY 536
DISPLAY 532
NETWORK INTERFACE 543
NETWORK PORT 542
HARDWARE BUTTON INTERFACE 545
HARDWARE BUTTONS 544
WIRELESS INTERFACE 547
WIRELESS PORT 546
USB INTERFACE 541
USB PORT 540
EXTERNAL DEVICES 539
AUDIO INTERFACE 535
MICROPHONE 534
SPEAKERS 538
OPERATING SYSTEM 528
APPLICATION PROGRAMS 529
OTHER PROGRAM MODULES 530
PROGRAM DATA 531

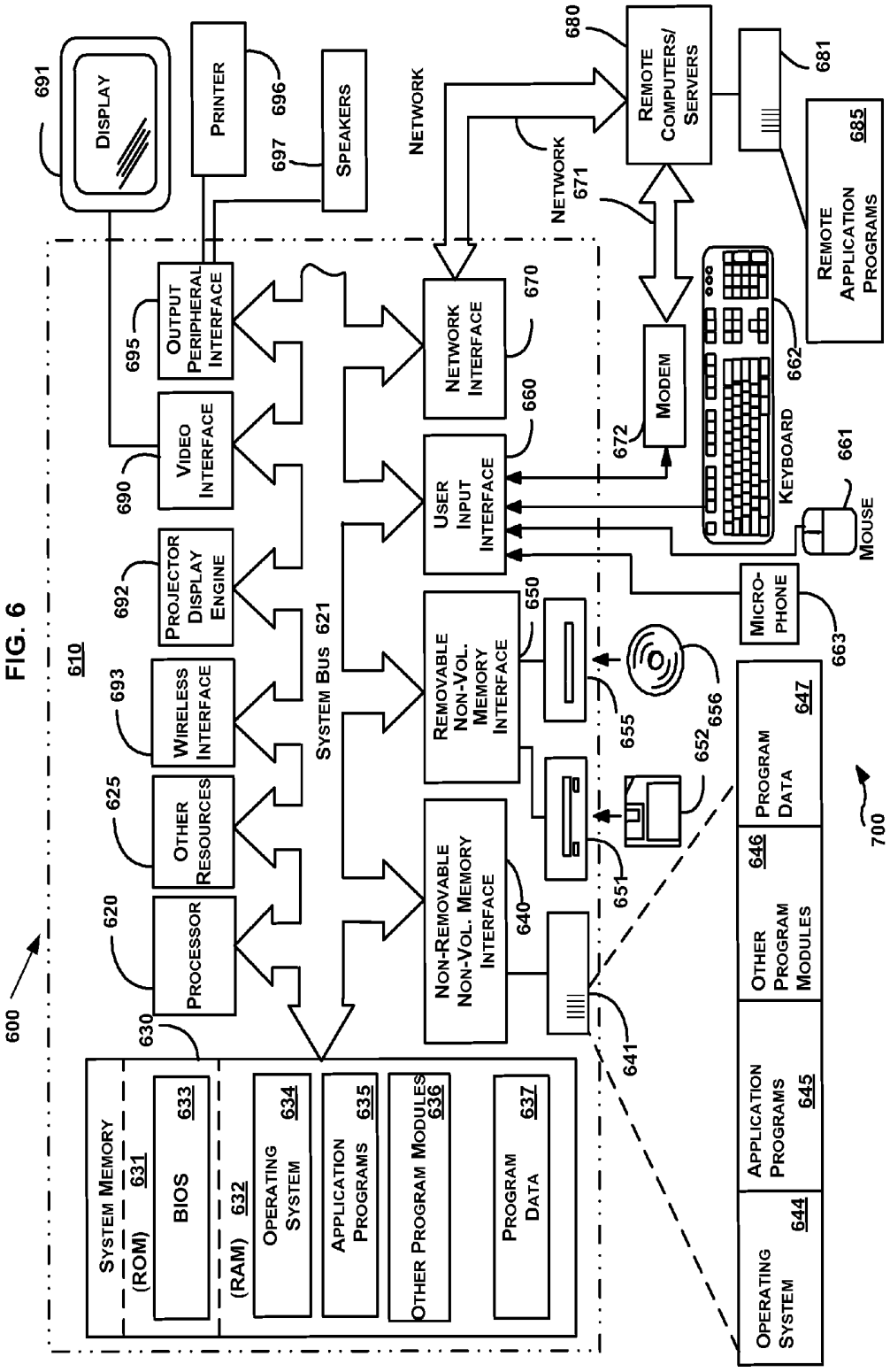


FIG. 6
600
610
691
DISPLAY
PRINTER
696
697
SPEAKERS
NETWORK
680
REMOTE COMPUTERS/ SERVERS
681
NETWORK 671
REMOTE APPLICATION PROGRAMS
685
695
OUTPUT PERIPHERAL INTERFACE
NETWORK INTERFACE
670
690
VIDEO INTERFACE
660
USER INPUT INTERFACE
672
MODEM
662
KEYBOARD
661
MOUSE
692
PROJECTOR DISPLAY ENGINE
693
WIRELESS INTERFACE
SYSTEM BUS 621
REMOVABLE NON-VOL. MEMORY INTERFACE
650
MICRO-PHONE
663
625
OTHER RESOURCES
620
PROCESSOR
630
NON-REMOVABLE NON-VOL. MEMORY INTERFACE
640
655
656
652
651
641
647
PROGRAM DATA
646
OTHER PROGRAM MODULES
645
APPLICATION PROGRAMS
644
OPERATING SYSTEM
700
SYSTEM MEMORY
(ROM) 631
BIOS 633
(RAM) 632
OPERATING SYSTEM 634
APPLICATION PROGRAMS 635
OTHER PROGRAM MODULES 636
PROGRAM DATA 637

FIG. 7

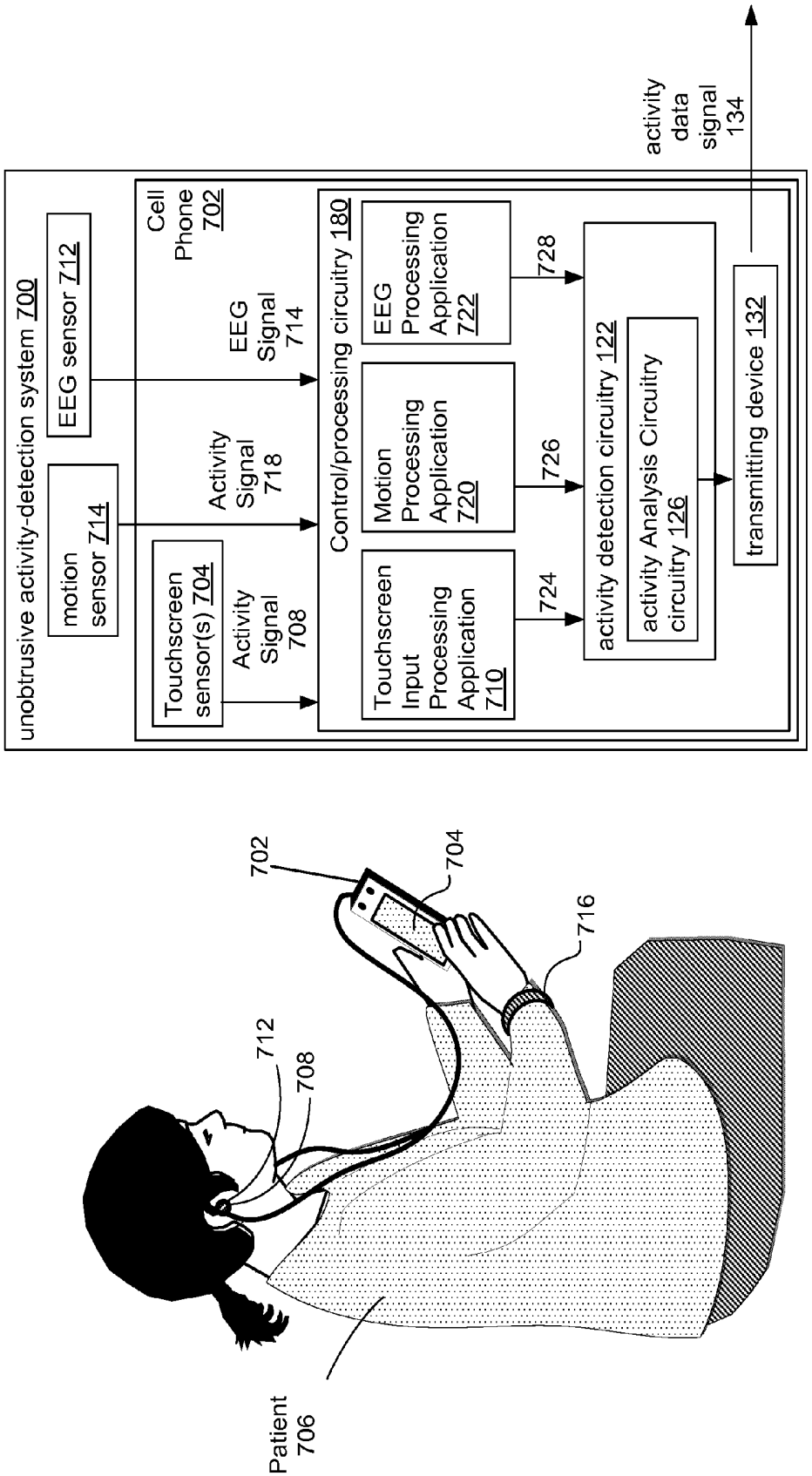

unobtrusive activity-detection system 700
motion sensor 714
EEG sensor 712
Cell Phone 702
Touchscreen sensor(s) 704
Activity Signal 708
Activity Signal 718
EEG Signal 714
Control/processing circuitry 180
Touchscreen Input Processing Application 710
Motion Processing Application 720
EEG Processing Application 722
724
726
728
activity detection circuitry 122
activity Analysis Circuitry circuitry 126
transmitting device 132
activity data signal 134
702
704
716
712
708
Patient 706

FIG. 8

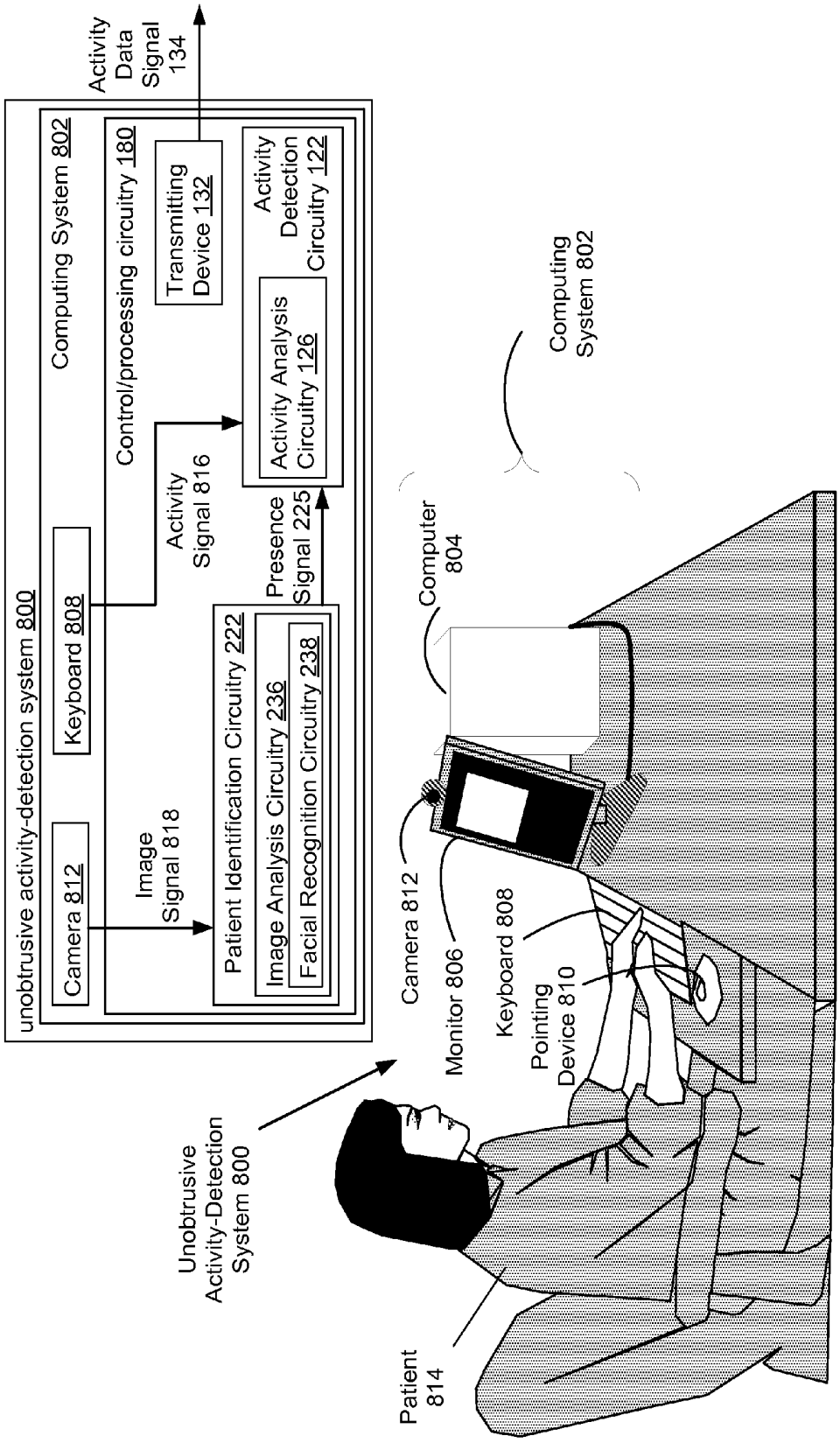

unobtrusive activity-detection system 800
Computing System 802
Control/processing circuitry 180
Camera 812
Keyboard 808
Transmitting Device 132
Activity Data Signal 134
Image Signal 818
Activity Signal 816
Patient Identification Circuitry 222
Image Analysis Circuitry 236
Facial Recognition Circuitry 238
Presence Signal 225
Activity Analysis Circuitry 126
Activity Detection Circuitry 122
Computing System 802
Computer 804
Camera 812
Monitor 806
Keyboard 808
Pointing Device 810
Unobtrusive Activity-Detection System 800
Patient 814

FIG. 9

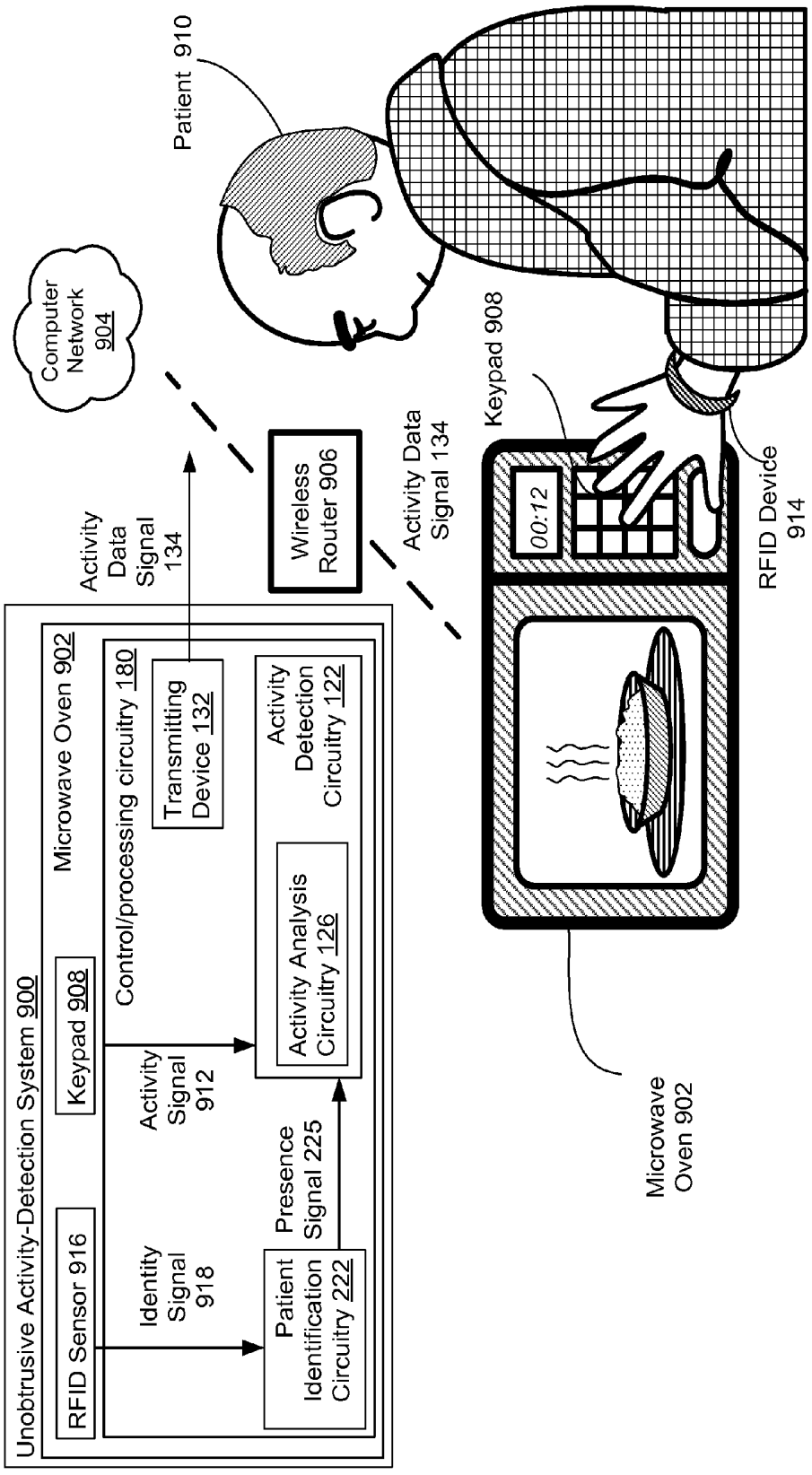
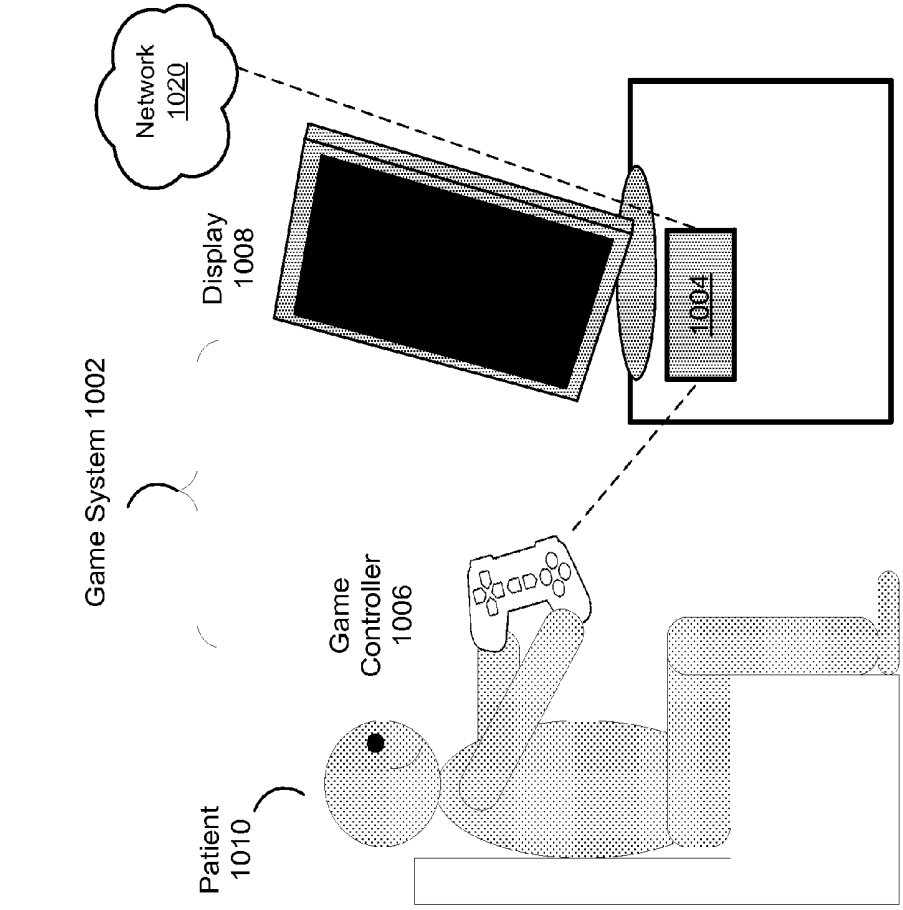

Unobtrusive Activity-Detection System 900
Microwave Oven 902
RFID Sensor 916
Keypad 908
Control/processing circuitry 180
Transmitting Device 132
Activity Detection Circuitry 122
Activity Analysis Circuitry 126
Patient Identification Circuitry 222
Identity Signal 918
Activity Signal 912
Presence Signal 225
Activity Data Signal 134
Computer Network 904
Wireless Router 906
Activity Data Signal 134
Patient 910
Keypad 908
00:12
RFID Device 914
Microwave Oven 902

FIG. 10


Network
1020
Display
1008
1004
Game System 1002
Game
Controller
1006
Patient
1010

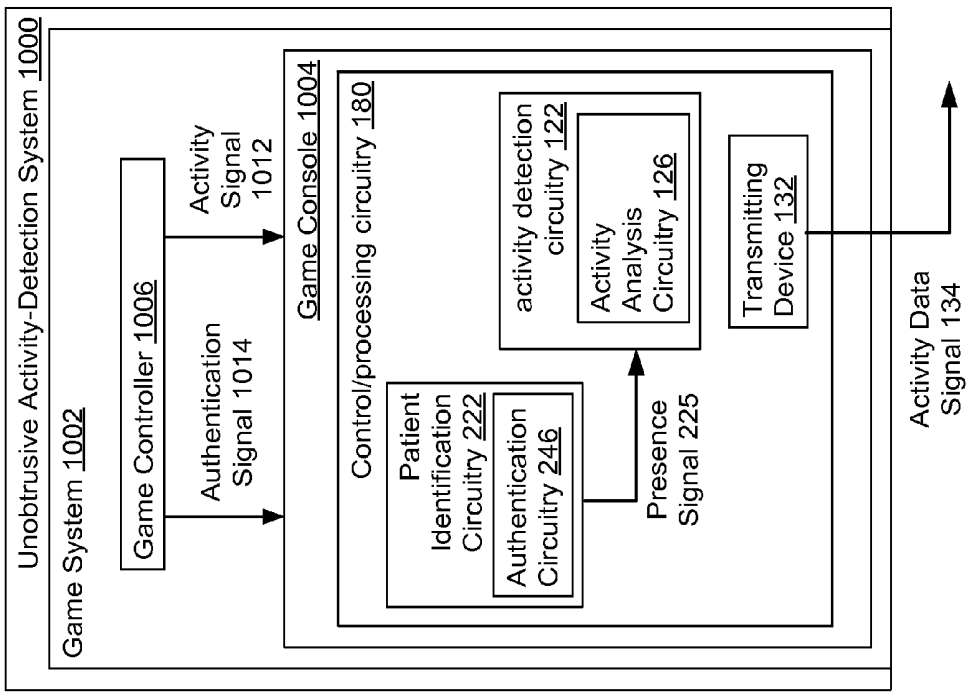

Unobtrusive Activity-Detection System 1000
Game System 1002
Game Controller 1006
Activity
Signal
1012
Authentication
Signal 1014
Game Console 1004
Control/processing circuitry 180
Patient
Identification
Circuitry 222
Authentication
Circuitry 246
activity detection
circuitry 122
Activity
Analysis
Circuitry 126
Presence
Signal 225
Transmitting
Device 132
Activity Data
Signal 134

FIG. 11

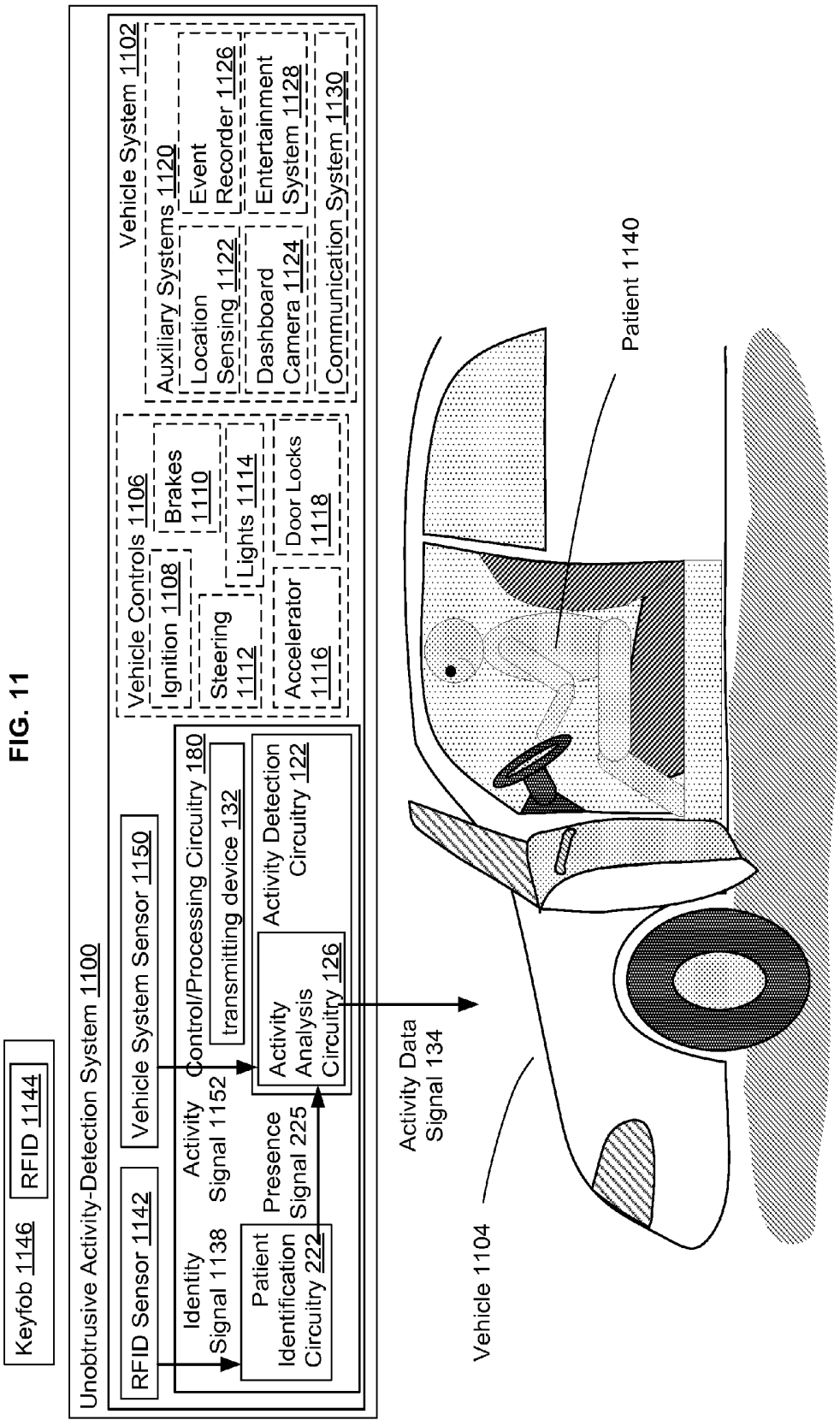
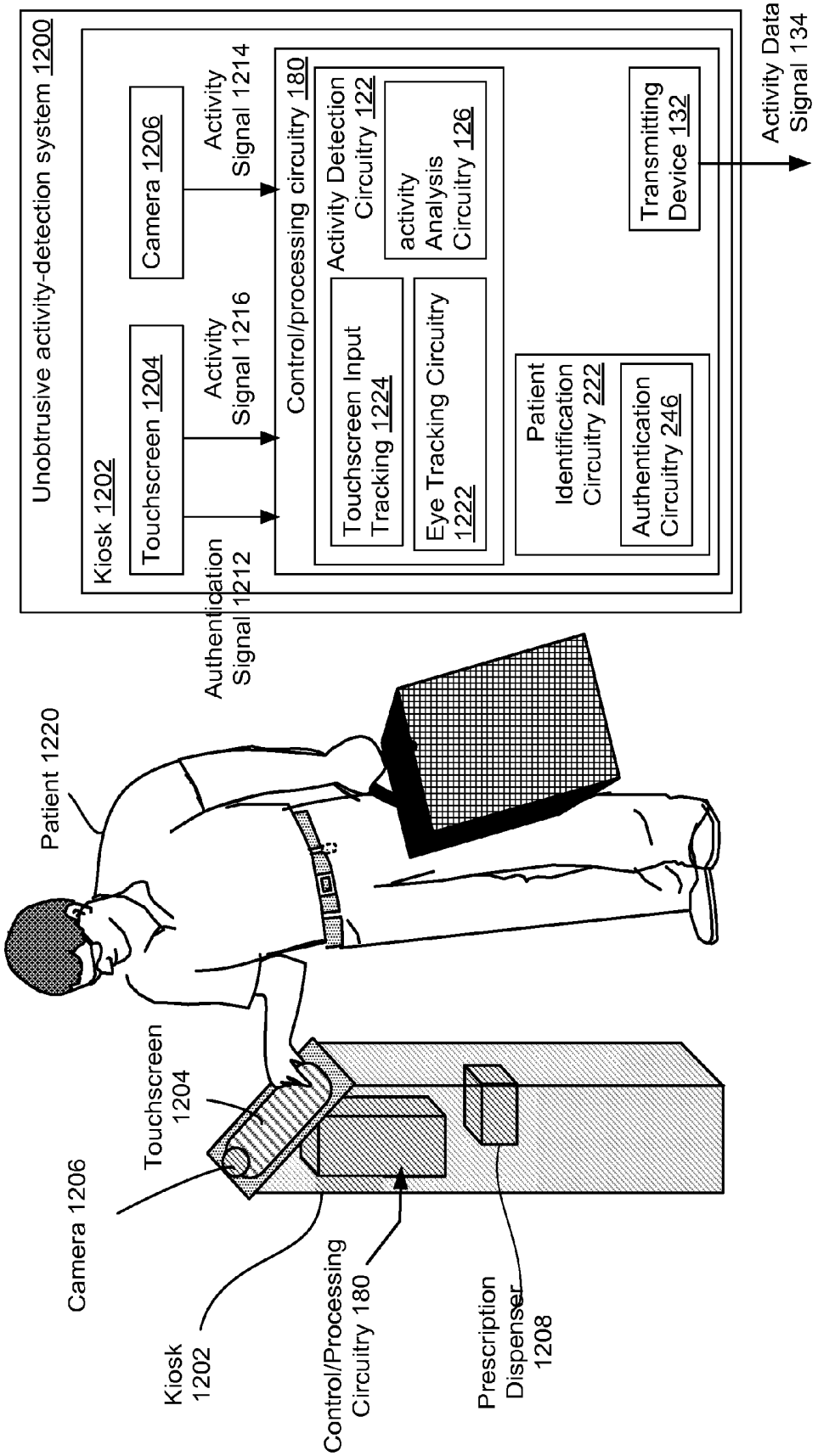

Keyfob 1146
RFID 1144
Unobtrusive Activity-Detection System 1100
RFID Sensor 1142
Vehicle System Sensor 1150
Identity Signal 1138
Activity Signal 1152
Control/Processing Circuitry 180
transmitting device 132
Patient Identification Circuitry 222
Presence Signal 225
Activity Detection Circuitry 122
Activity Analysis Circuitry 126
Vehicle Controls 1106
Ignition 1108
Brakes 1110
Steering 1112
Lights 1114
Accelerator 1116
Door Locks 1118
Vehicle System 1102
Auxiliary Systems 1120
Location Sensing 1122
Event Recorder 1126
Dashboard Camera 1124
Entertainment System 1128
Communication System 1130
Activity Data Signal 134
Vehicle 1104
Patient 1140

FIG. 12


Unobtrusive activity-detection system 1200
Kiosk 1202
Touchscreen 1204
Camera 1206
Activity Signal 1214
Activity Signal 1216
Authentication Signal 1212
Control/processing circuitry 180
Activity Detection Circuitry 122
Touchscreen Input Tracking 1224
Eye Tracking Circuitry 1222
activity Analysis Circuitry 126
Patient Identification Circuitry 222
Authentication Circuitry 246
Transmitting Device 132
Activity Data Signal 134
Patient 1220
Touchscreen 1204
Camera 1206
Kiosk 1202
Control/Processing Circuitry 180
Prescription Dispenser 1208

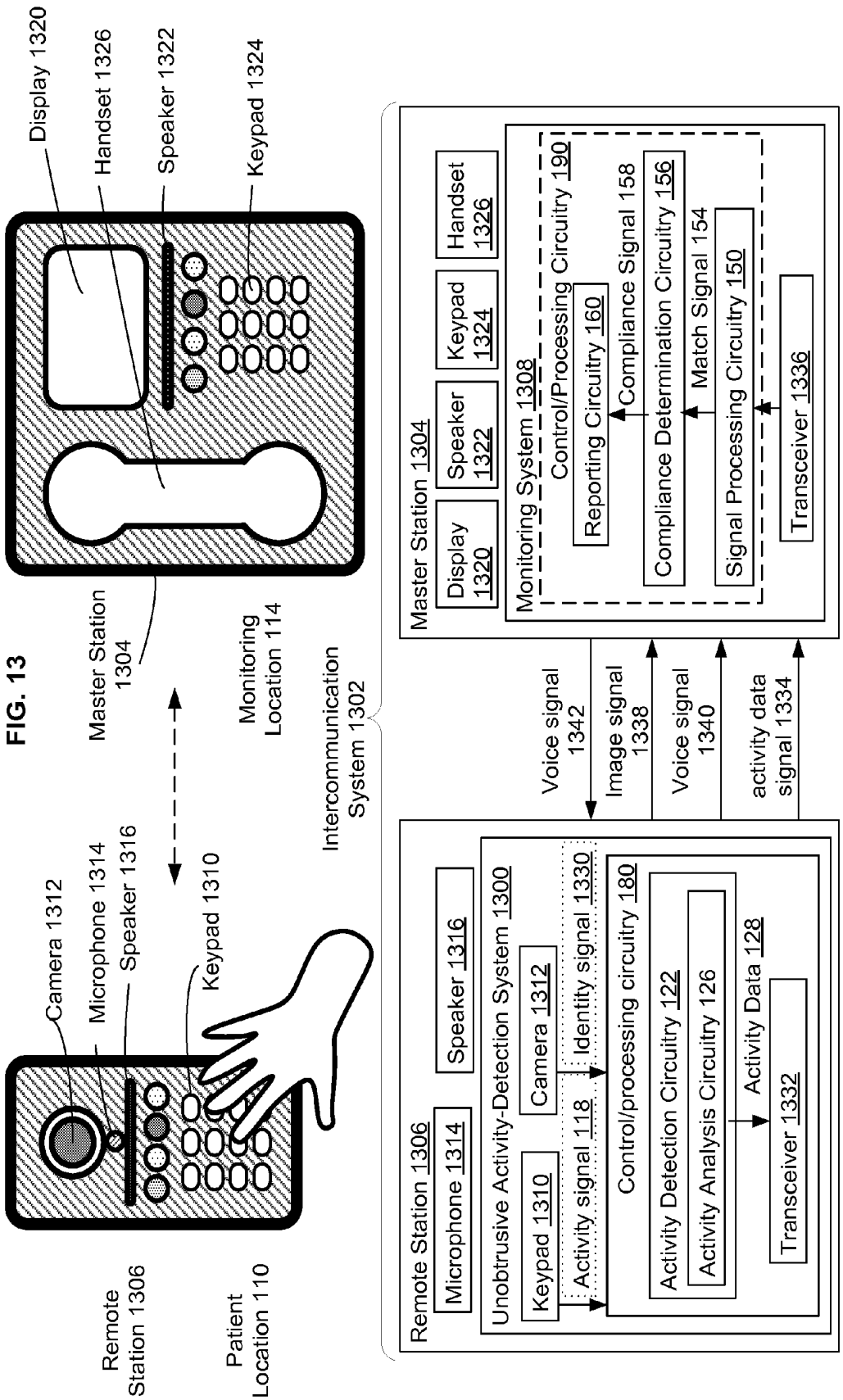

Display 1320
Handset 1326
Speaker 1322
Keypad 1324
Master Station 1304
Monitoring Location 114
Intercommunication System 1302
Camera 1312
Microphone 1314
Speaker 1316
Keypad 1310
Remote Station 1306
Patient Location 110
Master Station 1304
Display 1320
Speaker 1322
Keypad 1324
Handset 1326
Monitoring System 1308
Control/Processing Circuitry 190
Reporting Circuitry 160
Compliance Signal 158
Compliance Determination Circuitry 156
Match Signal 154
Signal Processing Circuitry 150
Transceiver 1336
Voice signal 1342
Image signal 1338
Voice signal 1340
activity data signal 1334
Remote Station 1306
Microphone 1314
Speaker 1316
Unobtrusive Activity-Detection System 1300
Keypad 1310
Camera 1312
Activity signal 118
Identity signal 1330
Control/processing circuitry 180
Activity Detection Circuitry 122
Activity Analysis Circuitry 126
Activity Data 128
Transceiver 1332

FIG. 13

FIG. 14

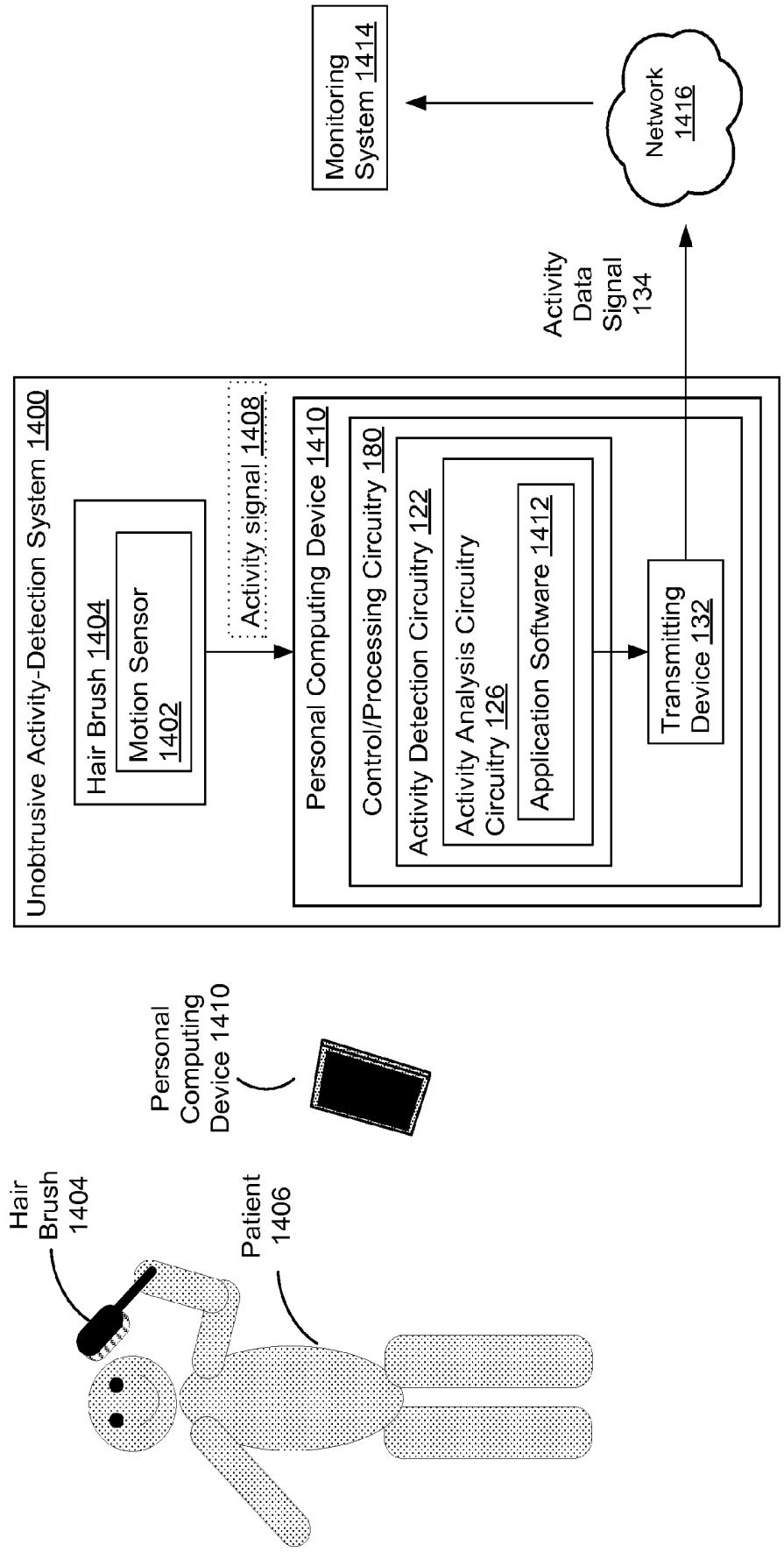

Monitoring System 1414
Network 1416
Activity Data Signal 134
Unobtrusive Activity-Detection System 1400
Hair Brush 1404
Motion Sensor 1402
Activity signal 1408
Personal Computing Device 1410
Control/Processing Circuitry 180
Activity Detection Circuitry 122
Activity Analysis Circuitry Circuitry 126
Application Software 1412
Transmitting Device 132
Personal Computing Device 1410
Hair Brush 1404
Patient 1406

FIG. 15

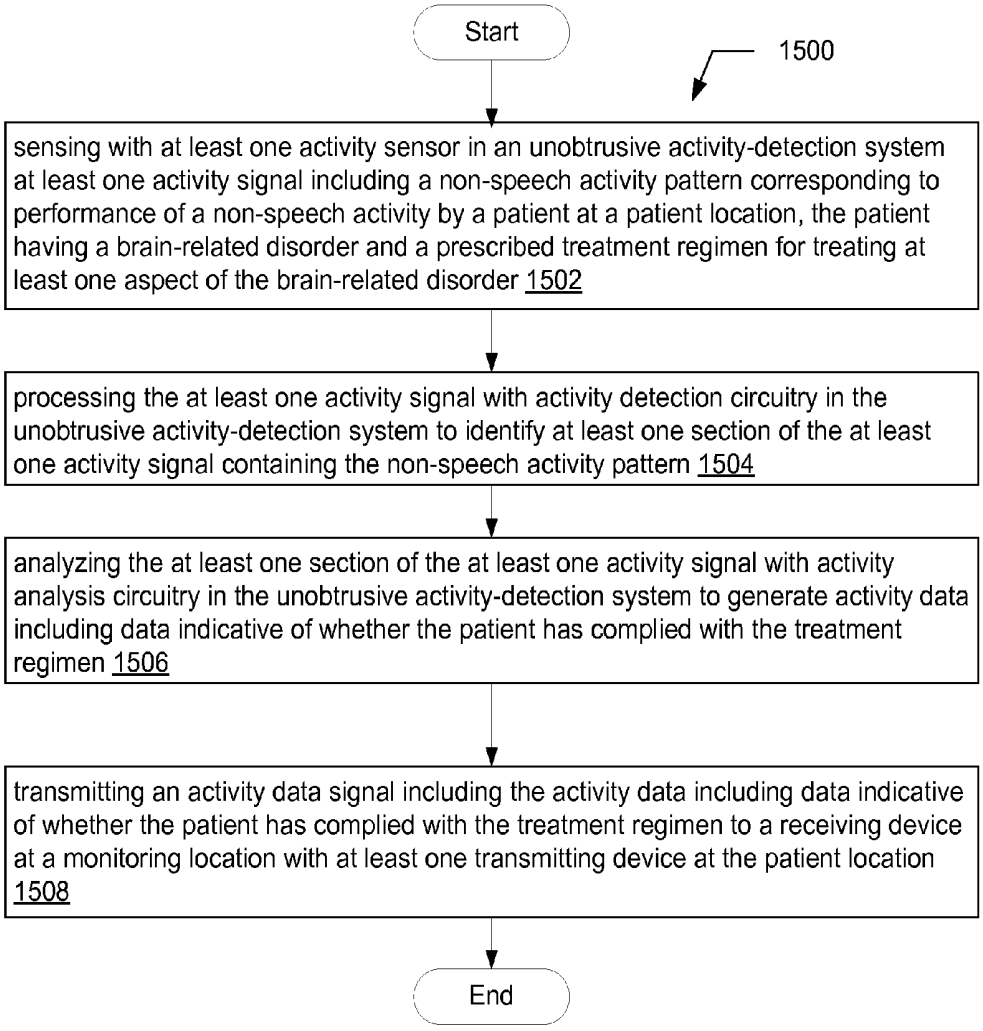

Start
1500
sensing with at least one activity sensor in an unobtrusive activity-detection system at least one activity signal including a non-speech activity pattern corresponding to performance of a non-speech activity by a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder 1502
processing the at least one activity signal with activity detection circuitry in the unobtrusive activity-detection system to identify at least one section of the at least one activity signal containing the non-speech activity pattern 1504
analyzing the at least one section of the at least one activity signal with activity analysis circuitry in the unobtrusive activity-detection system to generate activity data including data indicative of whether the patient has complied with the treatment regimen 1506
transmitting an activity data signal including the activity data including data indicative of whether the patient has complied with the treatment regimen to a receiving device at a monitoring location with at least one transmitting device at the patient location 1508
End

FIG. 16

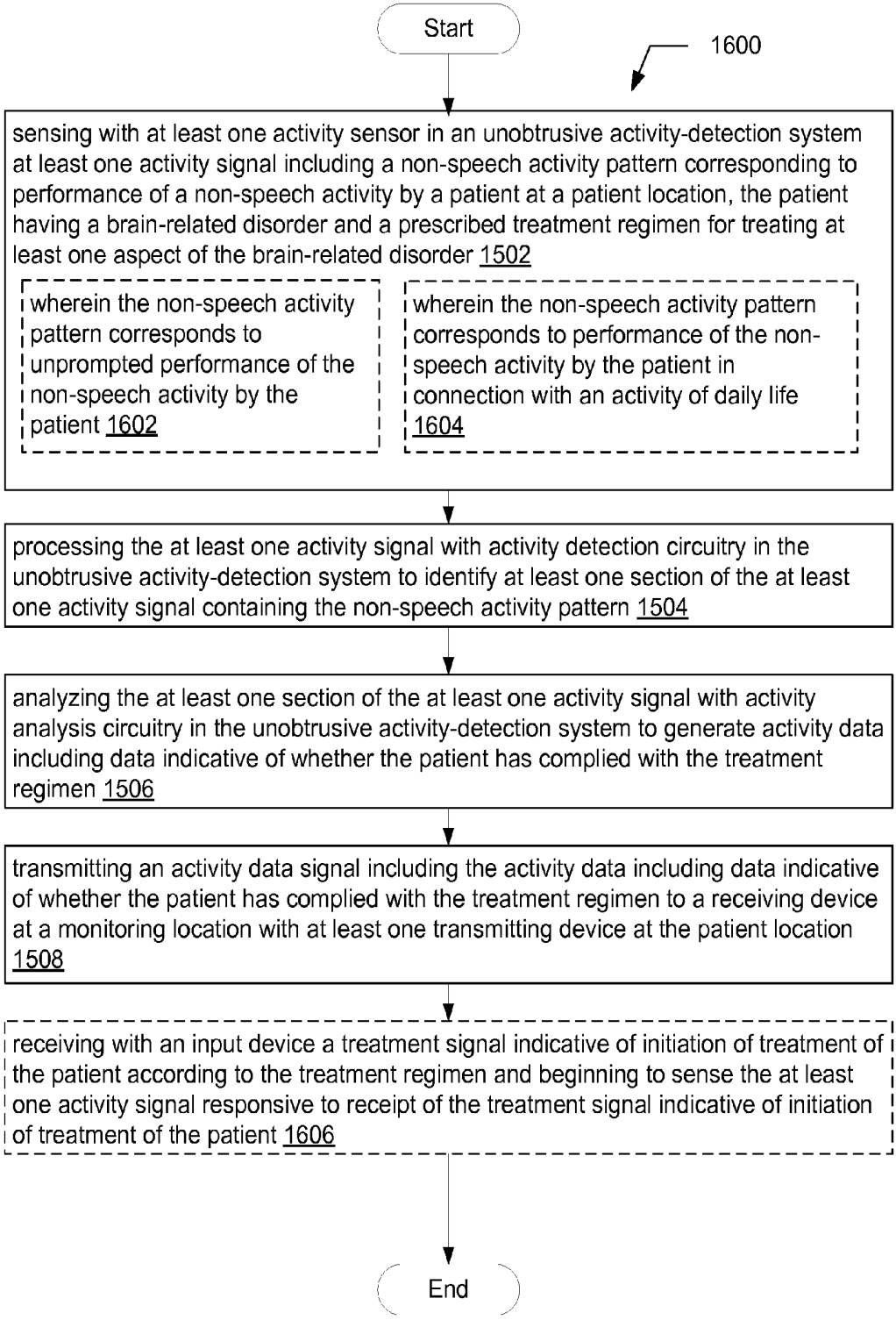

Start
1600
sensing with at least one activity sensor in an unobtrusive activity-detection system at least one activity signal including a non-speech activity pattern corresponding to performance of a non-speech activity by a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder 1502
wherein the non-speech activity pattern corresponds to unprompted performance of the non-speech activity by the patient 1602
wherein the non-speech activity pattern corresponds to performance of the non-speech activity by the patient in connection with an activity of daily life 1604
processing the at least one activity signal with activity detection circuitry in the unobtrusive activity-detection system to identify at least one section of the at least one activity signal containing the non-speech activity pattern 1504
analyzing the at least one section of the at least one activity signal with activity analysis circuitry in the unobtrusive activity-detection system to generate activity data including data indicative of whether the patient has complied with the treatment regimen 1506
transmitting an activity data signal including the activity data including data indicative of whether the patient has complied with the treatment regimen to a receiving device at a monitoring location with at least one transmitting device at the patient location 1508
receiving with an input device a treatment signal indicative of initiation of treatment of the patient according to the treatment regimen and beginning to sense the at least one activity signal responsive to receipt of the treatment signal indicative of initiation of treatment of the patient 1606
End

FIG. 17

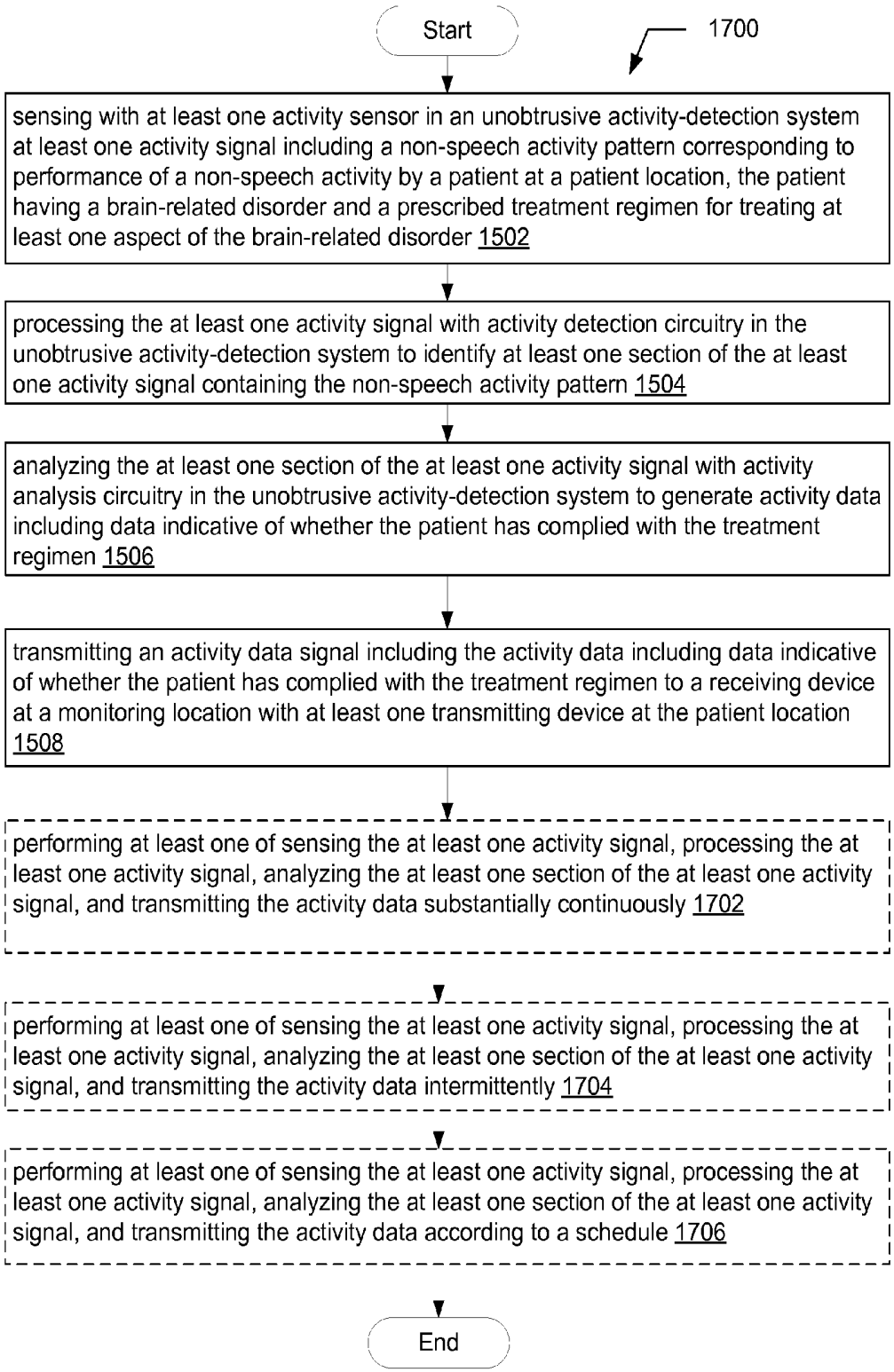

Start
1700
sensing with at least one activity sensor in an unobtrusive activity-detection system at least one activity signal including a non-speech activity pattern corresponding to performance of a non-speech activity by a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder 1502
processing the at least one activity signal with activity detection circuitry in the unobtrusive activity-detection system to identify at least one section of the at least one activity signal containing the non-speech activity pattern 1504
analyzing the at least one section of the at least one activity signal with activity analysis circuitry in the unobtrusive activity-detection system to generate activity data including data indicative of whether the patient has complied with the treatment regimen 1506
transmitting an activity data signal including the activity data including data indicative of whether the patient has complied with the treatment regimen to a receiving device at a monitoring location with at least one transmitting device at the patient location 1508
performing at least one of sensing the at least one activity signal, processing the at least one activity signal, analyzing the at least one section of the at least one activity signal, and transmitting the activity data substantially continuously 1702
performing at least one of sensing the at least one activity signal, processing the at least one activity signal, analyzing the at least one section of the at least one activity signal, and transmitting the activity data intermittently 1704
performing at least one of sensing the at least one activity signal, processing the at least one activity signal, analyzing the at least one section of the at least one activity signal, and transmitting the activity data according to a schedule 1706
End

FIG. 18

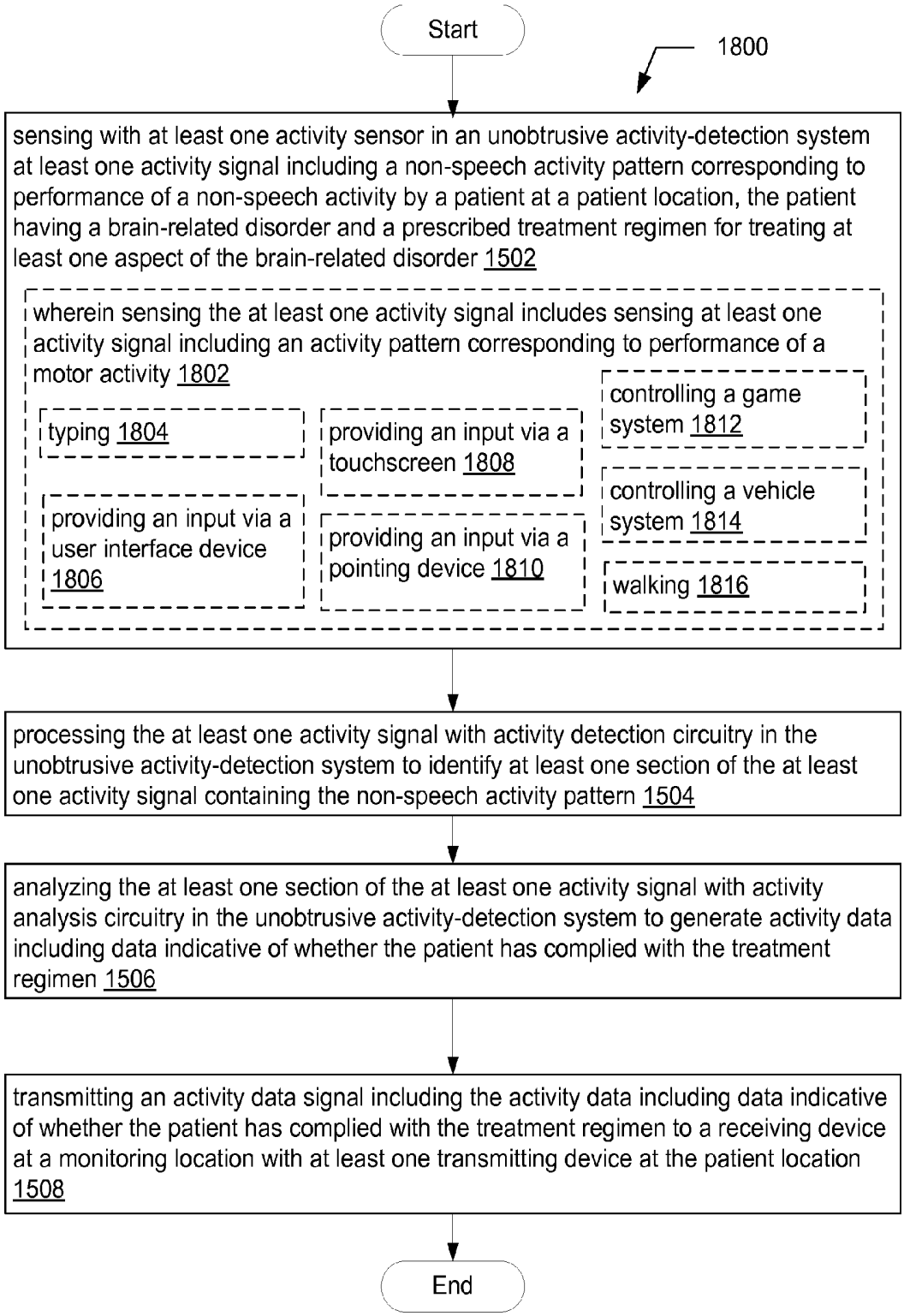

Start
1800
sensing with at least one activity sensor in an unobtrusive activity-detection system at least one activity signal including a non-speech activity pattern corresponding to performance of a non-speech activity by a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder 1502
wherein sensing the at least one activity signal includes sensing at least one activity signal including an activity pattern corresponding to performance of a motor activity 1802
typing 1804
providing an input via a user interface device 1806
providing an input via a touchscreen 1808
providing an input via a pointing device 1810
controlling a game system 1812
controlling a vehicle system 1814
walking 1816
processing the at least one activity signal with activity detection circuitry in the unobtrusive activity-detection system to identify at least one section of the at least one activity signal containing the non-speech activity pattern 1504
analyzing the at least one section of the at least one activity signal with activity analysis circuitry in the unobtrusive activity-detection system to generate activity data including data indicative of whether the patient has complied with the treatment regimen 1506
transmitting an activity data signal including the activity data including data indicative of whether the patient has complied with the treatment regimen to a receiving device at a monitoring location with at least one transmitting device at the patient location 1508
End

FIG. 19

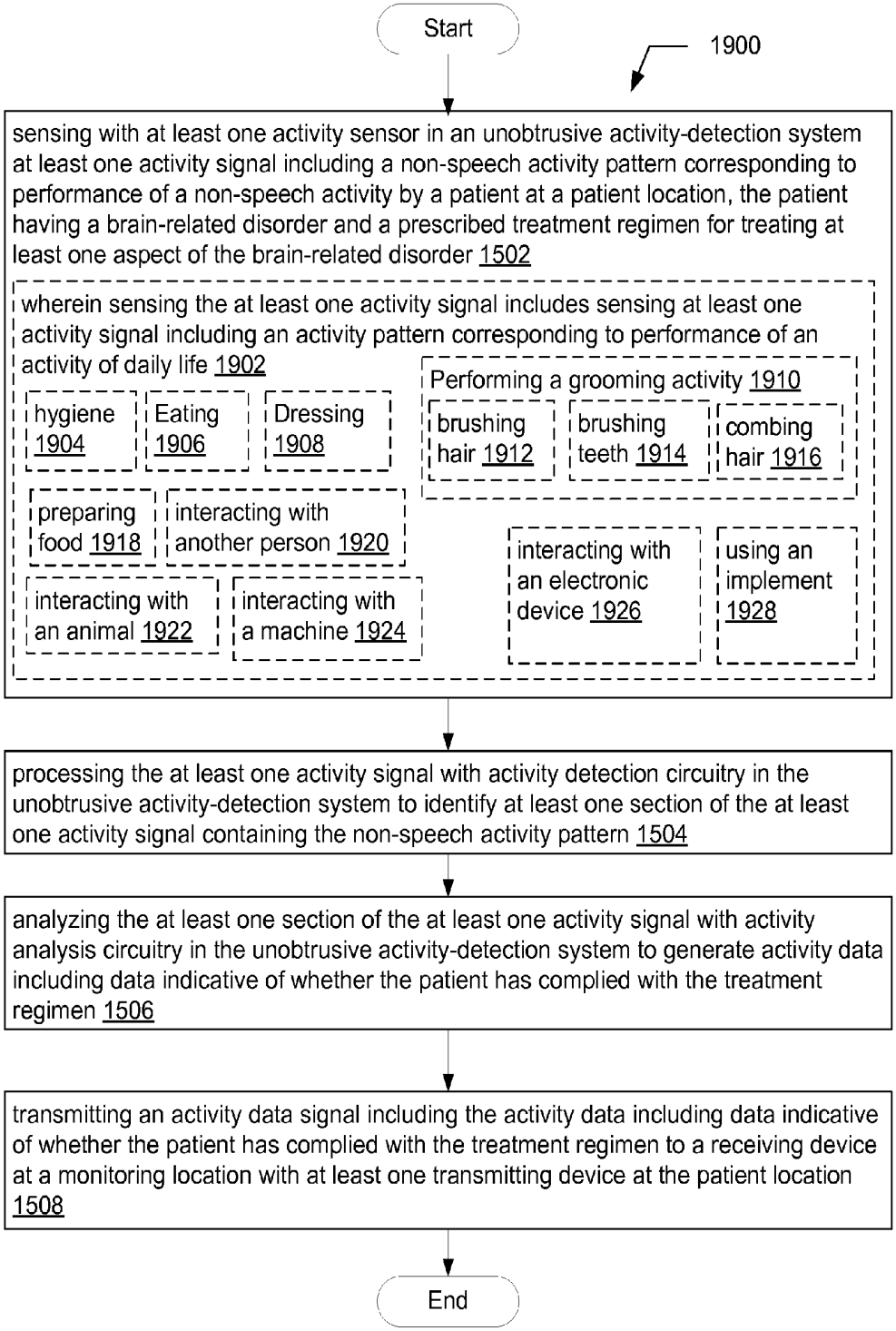

Start
1900
sensing with at least one activity sensor in an unobtrusive activity-detection system at least one activity signal including a non-speech activity pattern corresponding to performance of a non-speech activity by a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder 1502
wherein sensing the at least one activity signal includes sensing at least one activity signal including an activity pattern corresponding to performance of an activity of daily life 1902
hygiene 1904
Eating 1906
Dressing 1908
Performing a grooming activity 1910
brushing hair 1912
brushing teeth 1914
combing hair 1916
preparing food 1918
interacting with another person 1920
interacting with an animal 1922
interacting with a machine 1924
interacting with an electronic device 1926
using an implement 1928
processing the at least one activity signal with activity detection circuitry in the unobtrusive activity-detection system to identify at least one section of the at least one activity signal containing the non-speech activity pattern 1504
analyzing the at least one section of the at least one activity signal with activity analysis circuitry in the unobtrusive activity-detection system to generate activity data including data indicative of whether the patient has complied with the treatment regimen 1506
transmitting an activity data signal including the activity data including data indicative of whether the patient has complied with the treatment regimen to a receiving device at a monitoring location with at least one transmitting device at the patient location 1508
End

FIG. 20

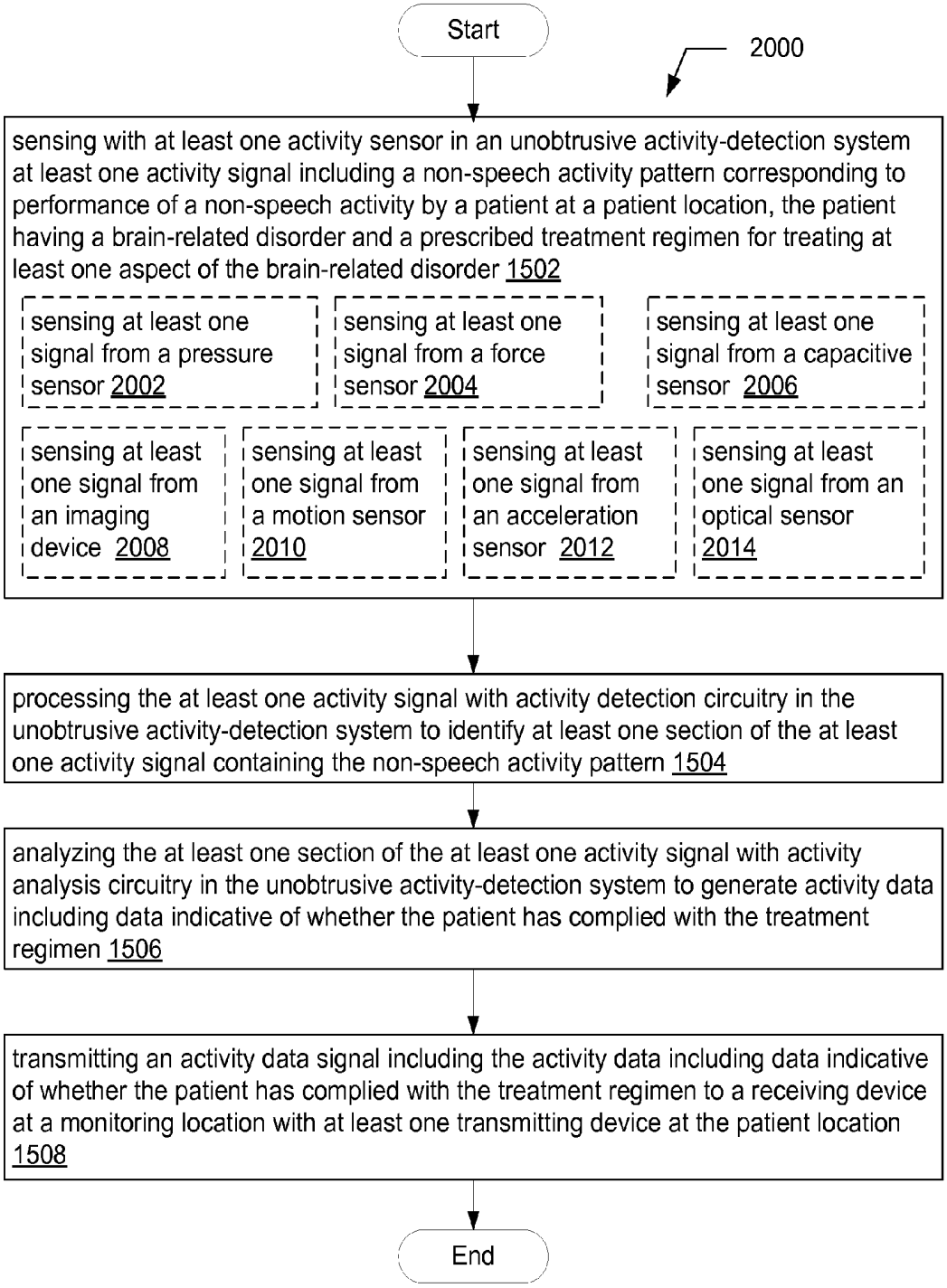

Start
2000
sensing with at least one activity sensor in an unobtrusive activity-detection system at least one activity signal including a non-speech activity pattern corresponding to performance of a non-speech activity by a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder 1502
sensing at least one signal from a pressure sensor 2002
sensing at least one signal from a force sensor 2004
sensing at least one signal from a capacitive sensor 2006
sensing at least one signal from an imaging device 2008
sensing at least one signal from a motion sensor 2010
sensing at least one signal from an acceleration sensor 2012
sensing at least one signal from an optical sensor 2014
processing the at least one activity signal with activity detection circuitry in the unobtrusive activity-detection system to identify at least one section of the at least one activity signal containing the non-speech activity pattern 1504
analyzing the at least one section of the at least one activity signal with activity analysis circuitry in the unobtrusive activity-detection system to generate activity data including data indicative of whether the patient has complied with the treatment regimen 1506
transmitting an activity data signal including the activity data including data indicative of whether the patient has complied with the treatment regimen to a receiving device at a monitoring location with at least one transmitting device at the patient location 1508
End

FIG. 21

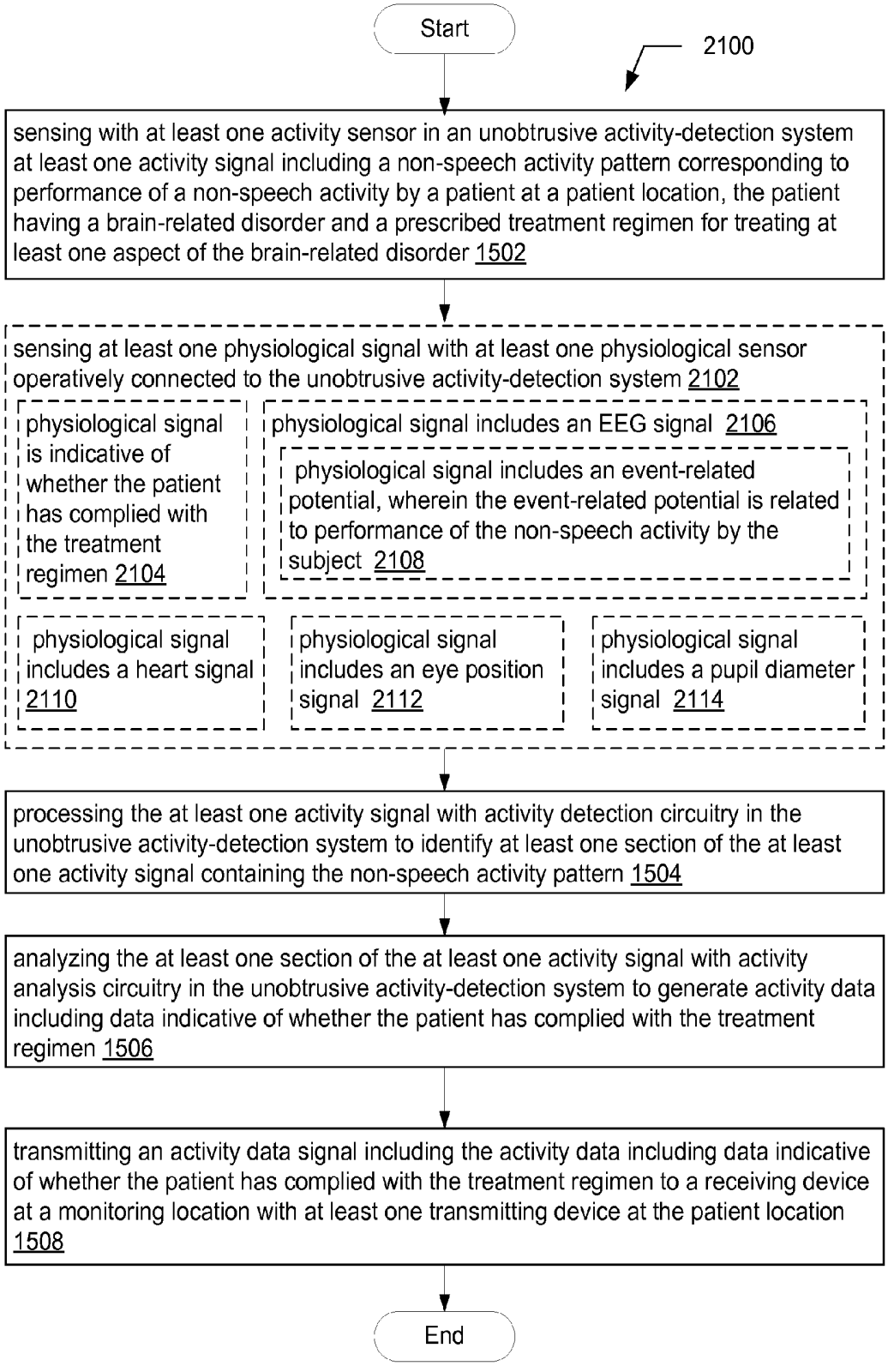

Start
2100
sensing with at least one activity sensor in an unobtrusive activity-detection system at least one activity signal including a non-speech activity pattern corresponding to performance of a non-speech activity by a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder 1502
sensing at least one physiological signal with at least one physiological sensor operatively connected to the unobtrusive activity-detection system 2102
physiological signal is indicative of whether the patient has complied with the treatment regimen 2104
physiological signal includes an EEG signal 2106
physiological signal includes an event-related potential, wherein the event-related potential is related to performance of the non-speech activity by the subject 2108
physiological signal includes a heart signal 2110
physiological signal includes an eye position signal 2112
physiological signal includes a pupil diameter signal 2114
processing the at least one activity signal with activity detection circuitry in the unobtrusive activity-detection system to identify at least one section of the at least one activity signal containing the non-speech activity pattern 1504
analyzing the at least one section of the at least one activity signal with activity analysis circuitry in the unobtrusive activity-detection system to generate activity data including data indicative of whether the patient has complied with the treatment regimen 1506
transmitting an activity data signal including the activity data including data indicative of whether the patient has complied with the treatment regimen to a receiving device at a monitoring location with at least one transmitting device at the patient location 1508
End

FIG. 22

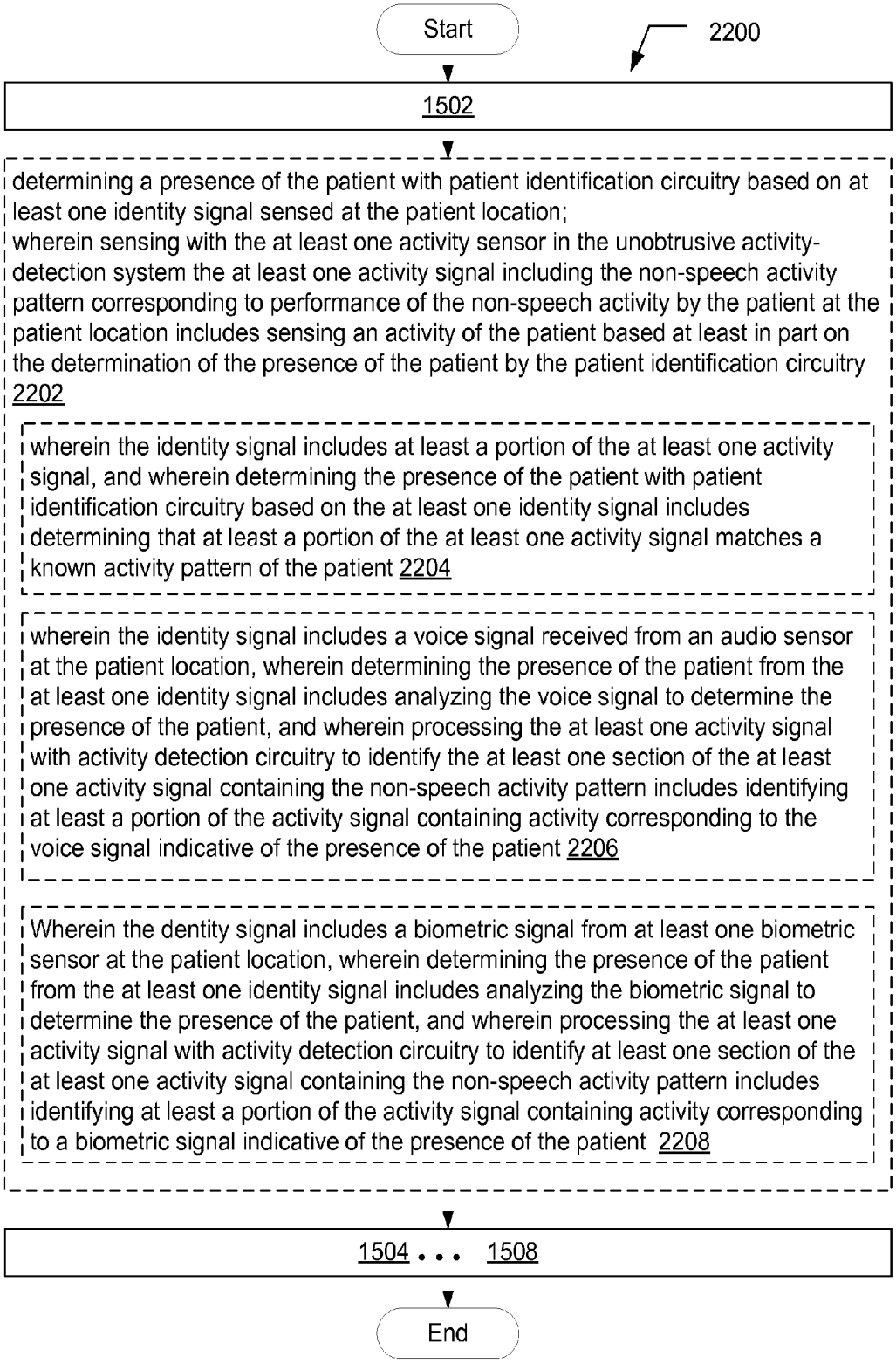

Start
2200
1502
determining a presence of the patient with patient identification circuitry based on at least one identity signal sensed at the patient location;
wherein sensing with the at least one activity sensor in the unobtrusive activity-detection system the at least one activity signal including the non-speech activity pattern corresponding to performance of the non-speech activity by the patient at the patient location includes sensing an activity of the patient based at least in part on the determination of the presence of the patient by the patient identification circuitry 2202
wherein the identity signal includes at least a portion of the at least one activity signal, and wherein determining the presence of the patient with patient identification circuitry based on the at least one identity signal includes determining that at least a portion of the at least one activity signal matches a known activity pattern of the patient 2204
wherein the identity signal includes a voice signal received from an audio sensor at the patient location, wherein determining the presence of the patient from the at least one identity signal includes analyzing the voice signal to determine the presence of the patient, and wherein processing the at least one activity signal with activity detection circuitry to identify the at least one section of the at least one activity signal containing the non-speech activity pattern includes identifying at least a portion of the activity signal containing activity corresponding to the voice signal indicative of the presence of the patient 2206
Wherein the dentity signal includes a biometric signal from at least one biometric sensor at the patient location, wherein determining the presence of the patient from the at least one identity signal includes analyzing the biometric signal to determine the presence of the patient, and wherein processing the at least one activity signal with activity detection circuitry to identify at least one section of the at least one activity signal containing the non-speech activity pattern includes identifying at least a portion of the activity signal containing activity corresponding to a biometric signal indicative of the presence of the patient 2208
1504 . . . 1508
End

FIG. 23

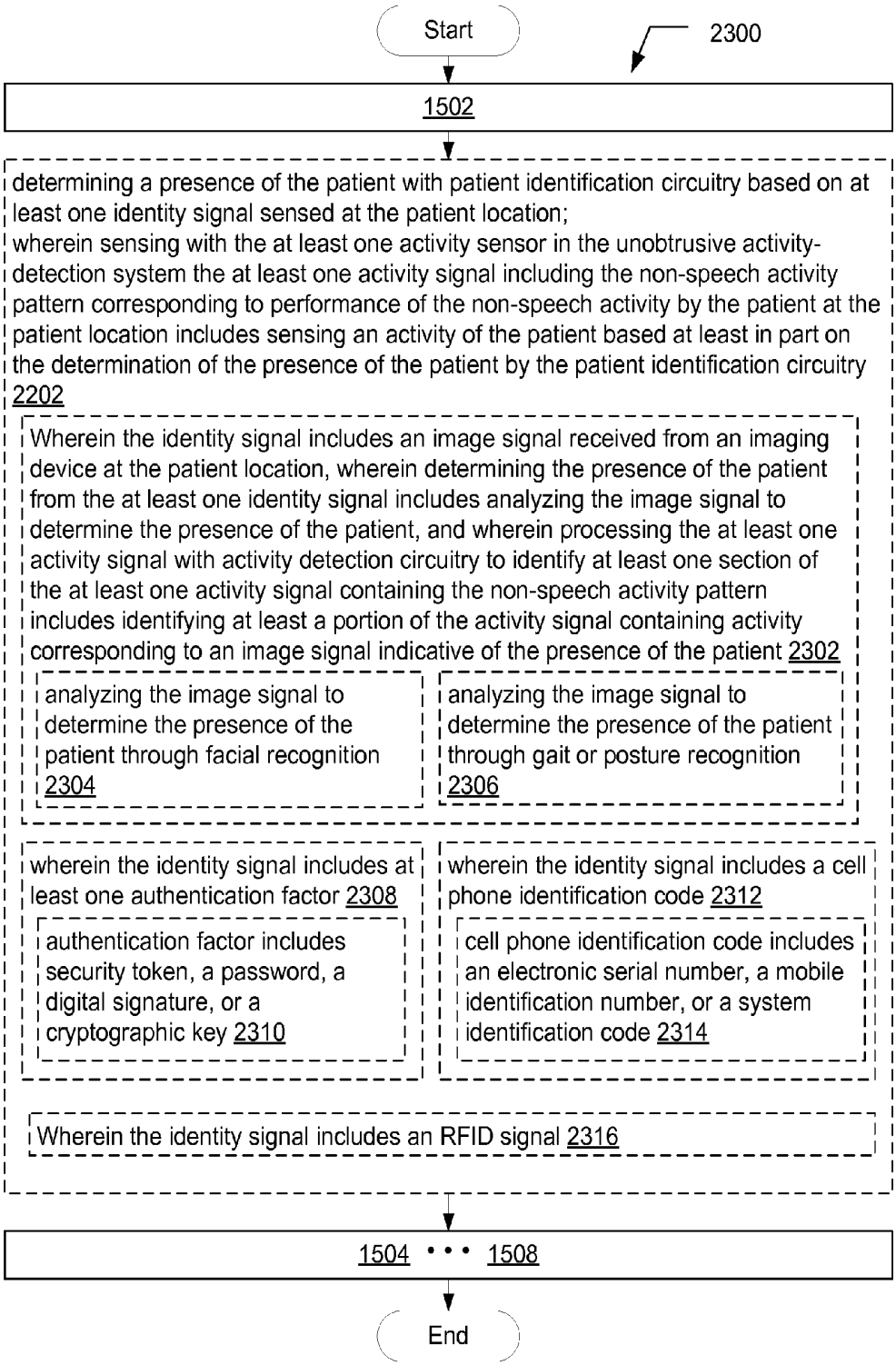

Start
2300
1502
determining a presence of the patient with patient identification circuitry based on at least one identity signal sensed at the patient location;
wherein sensing with the at least one activity sensor in the unobtrusive activity-detection system the at least one activity signal including the non-speech activity pattern corresponding to performance of the non-speech activity by the patient at the patient location includes sensing an activity of the patient based at least in part on the determination of the presence of the patient by the patient identification circuitry 2202
Wherein the identity signal includes an image signal received from an imaging device at the patient location, wherein determining the presence of the patient from the at least one identity signal includes analyzing the image signal to determine the presence of the patient, and wherein processing the at least one activity signal with activity detection circuitry to identify at least one section of the at least one activity signal containing the non-speech activity pattern includes identifying at least a portion of the activity signal containing activity corresponding to an image signal indicative of the presence of the patient 2302
analyzing the image signal to determine the presence of the patient through facial recognition 2304
analyzing the image signal to determine the presence of the patient through gait or posture recognition 2306
wherein the identity signal includes at least one authentication factor 2308
authentication factor includes security token, a password, a digital signature, or a cryptographic key 2310
wherein the identity signal includes a cell phone identification code 2312
cell phone identification code includes an electronic serial number, a mobile identification number, or a system identification code 2314
Wherein the identity signal includes an RFID signal 2316
1504 • • • 1508
End

FIG. 24

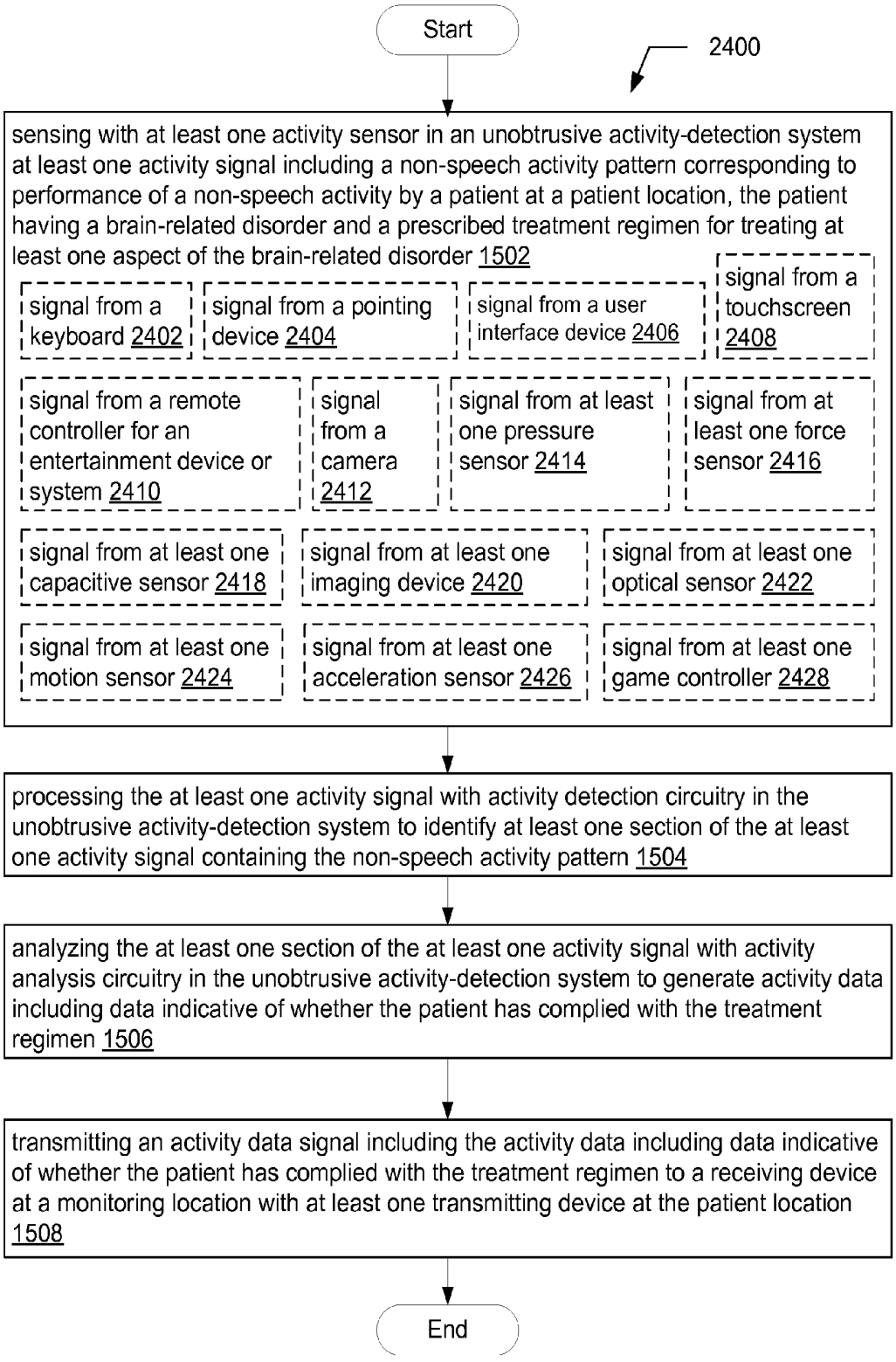

Start
2400
sensing with at least one activity sensor in an unobtrusive activity-detection system at least one activity signal including a non-speech activity pattern corresponding to performance of a non-speech activity by a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder 1502
signal from a keyboard 2402
signal from a pointing device 2404
signal from a user interface device 2406
signal from a touchscreen 2408
signal from a remote controller for an entertainment device or system 2410
signal from a camera 2412
signal from at least one pressure sensor 2414
signal from at least one force sensor 2416
signal from at least one capacitive sensor 2418
signal from at least one imaging device 2420
signal from at least one optical sensor 2422
signal from at least one motion sensor 2424
signal from at least one acceleration sensor 2426
signal from at least one game controller 2428
processing the at least one activity signal with activity detection circuitry in the unobtrusive activity-detection system to identify at least one section of the at least one activity signal containing the non-speech activity pattern 1504
analyzing the at least one section of the at least one activity signal with activity analysis circuitry in the unobtrusive activity-detection system to generate activity data including data indicative of whether the patient has complied with the treatment regimen 1506
transmitting an activity data signal including the activity data including data indicative of whether the patient has complied with the treatment regimen to a receiving device at a monitoring location with at least one transmitting device at the patient location 1508
End

FIG. 25

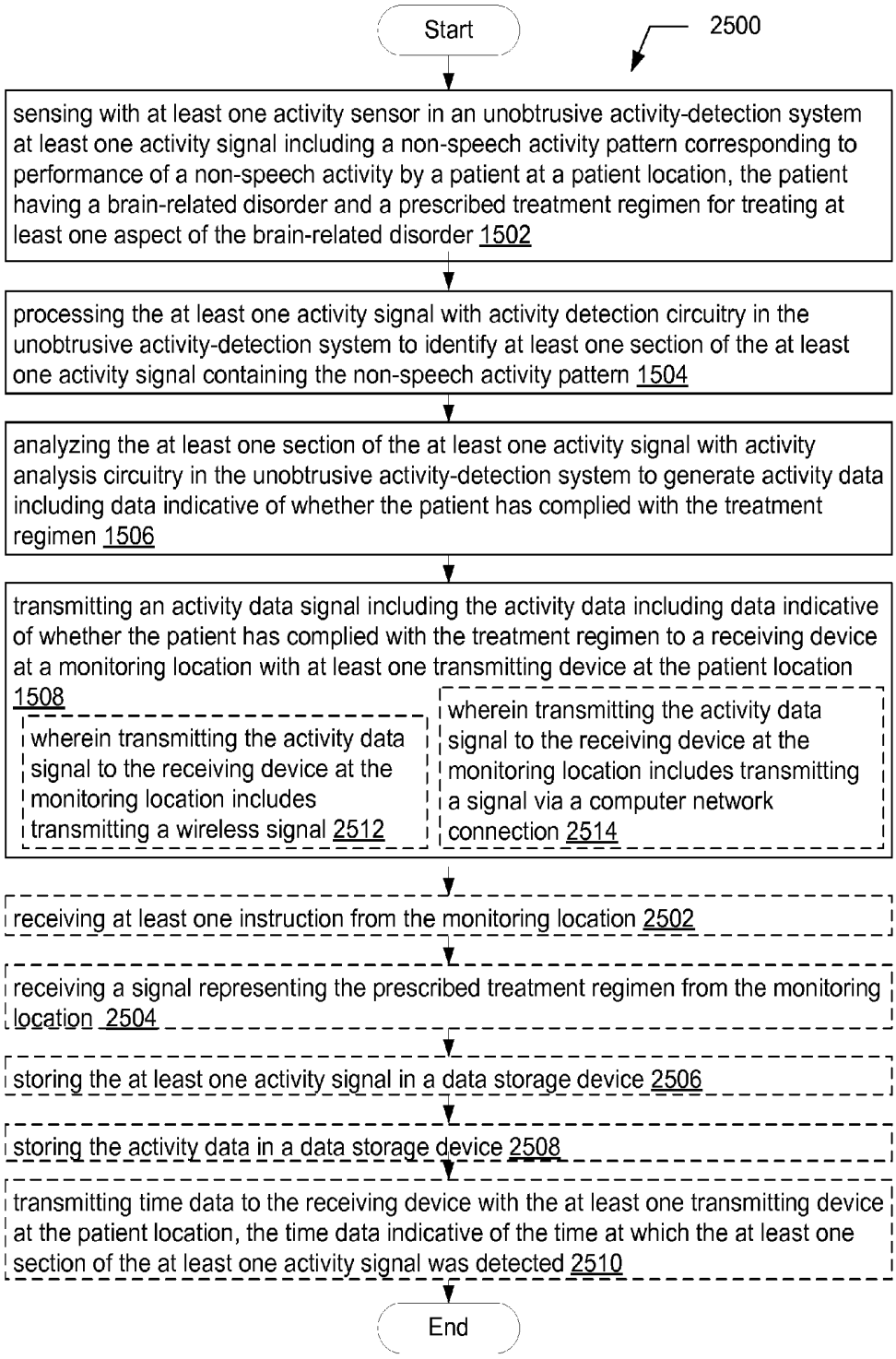

Start
2500
sensing with at least one activity sensor in an unobtrusive activity-detection system at least one activity signal including a non-speech activity pattern corresponding to performance of a non-speech activity by a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder 1502
processing the at least one activity signal with activity detection circuitry in the unobtrusive activity-detection system to identify at least one section of the at least one activity signal containing the non-speech activity pattern 1504
analyzing the at least one section of the at least one activity signal with activity analysis circuitry in the unobtrusive activity-detection system to generate activity data including data indicative of whether the patient has complied with the treatment regimen 1506
transmitting an activity data signal including the activity data including data indicative of whether the patient has complied with the treatment regimen to a receiving device at a monitoring location with at least one transmitting device at the patient location 1508
wherein transmitting the activity data signal to the receiving device at the monitoring location includes transmitting a wireless signal 2512
wherein transmitting the activity data signal to the receiving device at the monitoring location includes transmitting a signal via a computer network connection 2514
receiving at least one instruction from the monitoring location 2502
receiving a signal representing the prescribed treatment regimen from the monitoring location 2504
storing the at least one activity signal in a data storage device 2506
storing the activity data in a data storage device 2508
transmitting time data to the receiving device with the at least one transmitting device at the patient location, the time data indicative of the time at which the at least one section of the at least one activity signal was detected 2510
End

FIG. 26

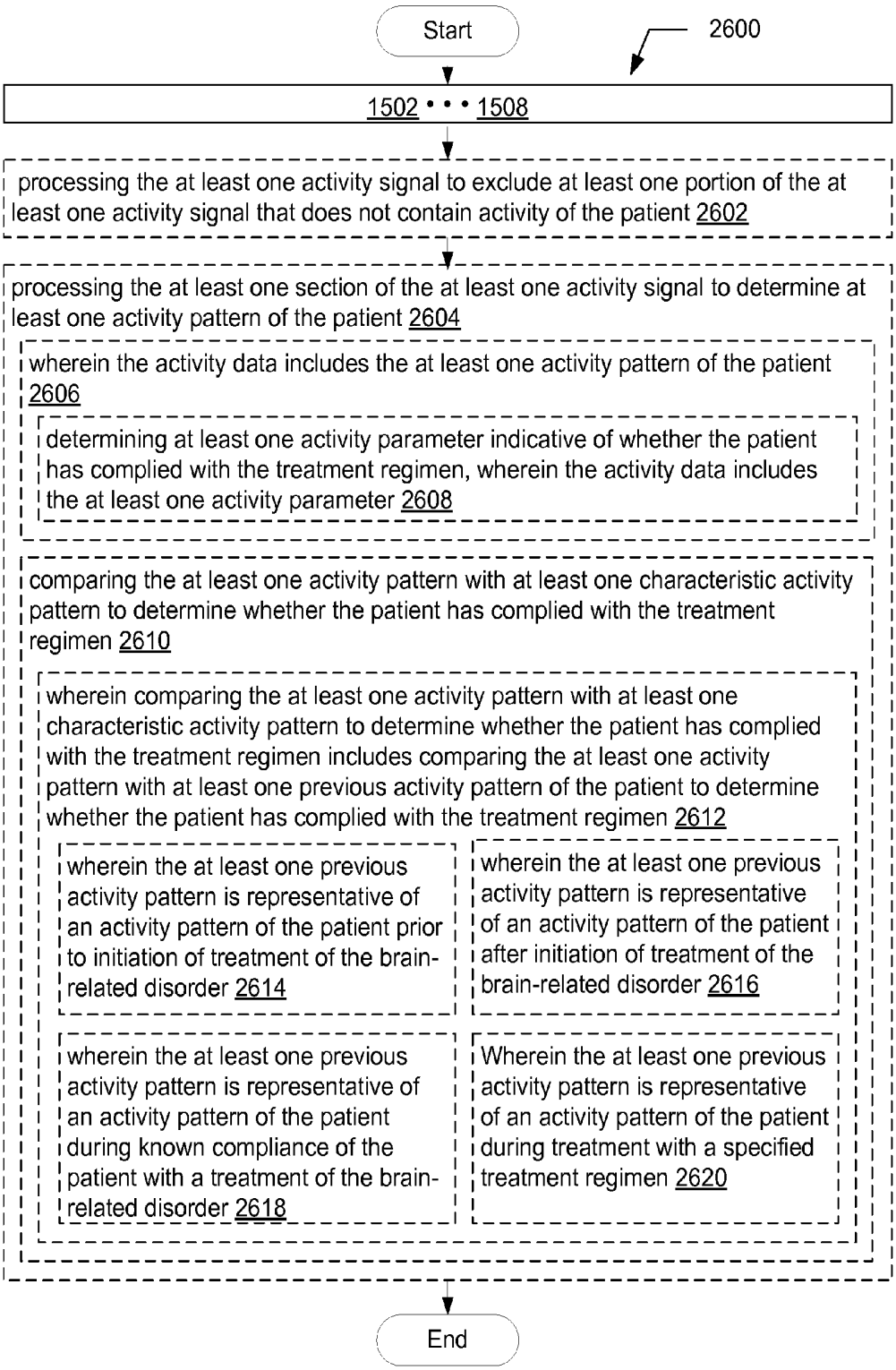

Start
2600
1502 • • • 1508
processing the at least one activity signal to exclude at least one portion of the at least one activity signal that does not contain activity of the patient 2602
processing the at least one section of the at least one activity signal to determine at least one activity pattern of the patient 2604
wherein the activity data includes the at least one activity pattern of the patient 2606
determining at least one activity parameter indicative of whether the patient has complied with the treatment regimen, wherein the activity data includes the at least one activity parameter 2608
comparing the at least one activity pattern with at least one characteristic activity pattern to determine whether the patient has complied with the treatment regimen 2610
wherein comparing the at least one activity pattern with at least one characteristic activity pattern to determine whether the patient has complied with the treatment regimen includes comparing the at least one activity pattern with at least one previous activity pattern of the patient to determine whether the patient has complied with the treatment regimen 2612
wherein the at least one previous activity pattern is representative of an activity pattern of the patient prior to initiation of treatment of the brain-related disorder 2614
wherein the at least one previous activity pattern is representative of an activity pattern of the patient after initiation of treatment of the brain-related disorder 2616
wherein the at least one previous activity pattern is representative of an activity pattern of the patient during known compliance of the patient with a treatment of the brain-related disorder 2618
Wherein the at least one previous activity pattern is representative of an activity pattern of the patient during treatment with a specified treatment regimen 2620
End

FIG. 27

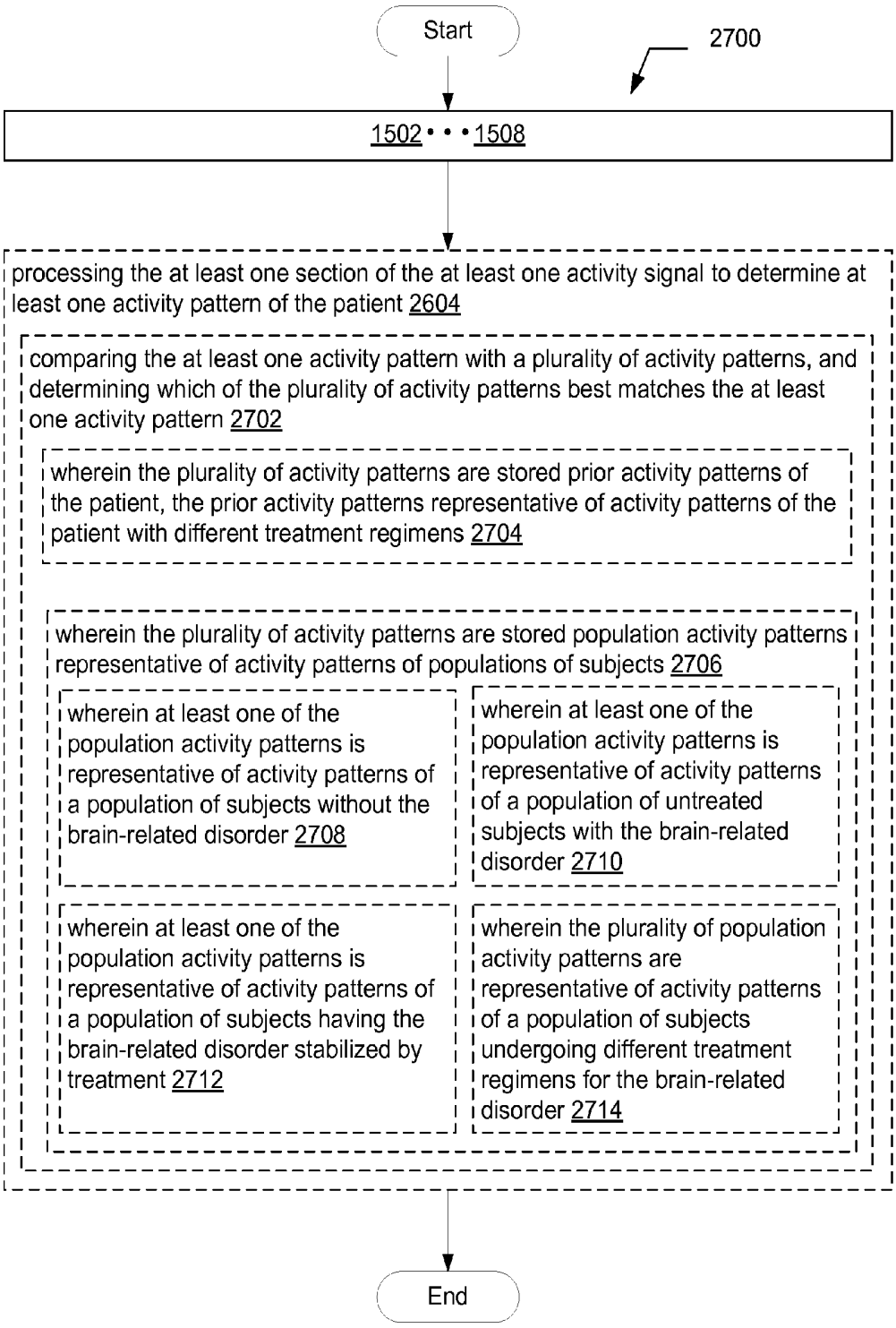

Start
2700
1502 • • • 1508
processing the at least one section of the at least one activity signal to determine at least one activity pattern of the patient 2604
comparing the at least one activity pattern with a plurality of activity patterns, and determining which of the plurality of activity patterns best matches the at least one activity pattern 2702
wherein the plurality of activity patterns are stored prior activity patterns of the patient, the prior activity patterns representative of activity patterns of the patient with different treatment regimens 2704
wherein the plurality of activity patterns are stored population activity patterns representative of activity patterns of populations of subjects 2706
wherein at least one of the population activity patterns is representative of activity patterns of a population of subjects without the brain-related disorder 2708
wherein at least one of the population activity patterns is representative of activity patterns of a population of untreated subjects with the brain-related disorder 2710
wherein at least one of the population activity patterns is representative of activity patterns of a population of subjects having the brain-related disorder stabilized by treatment 2712
wherein the plurality of population activity patterns are representative of activity patterns of a population of subjects undergoing different treatment regimens for the brain-related disorder 2714
End

FIG. 28

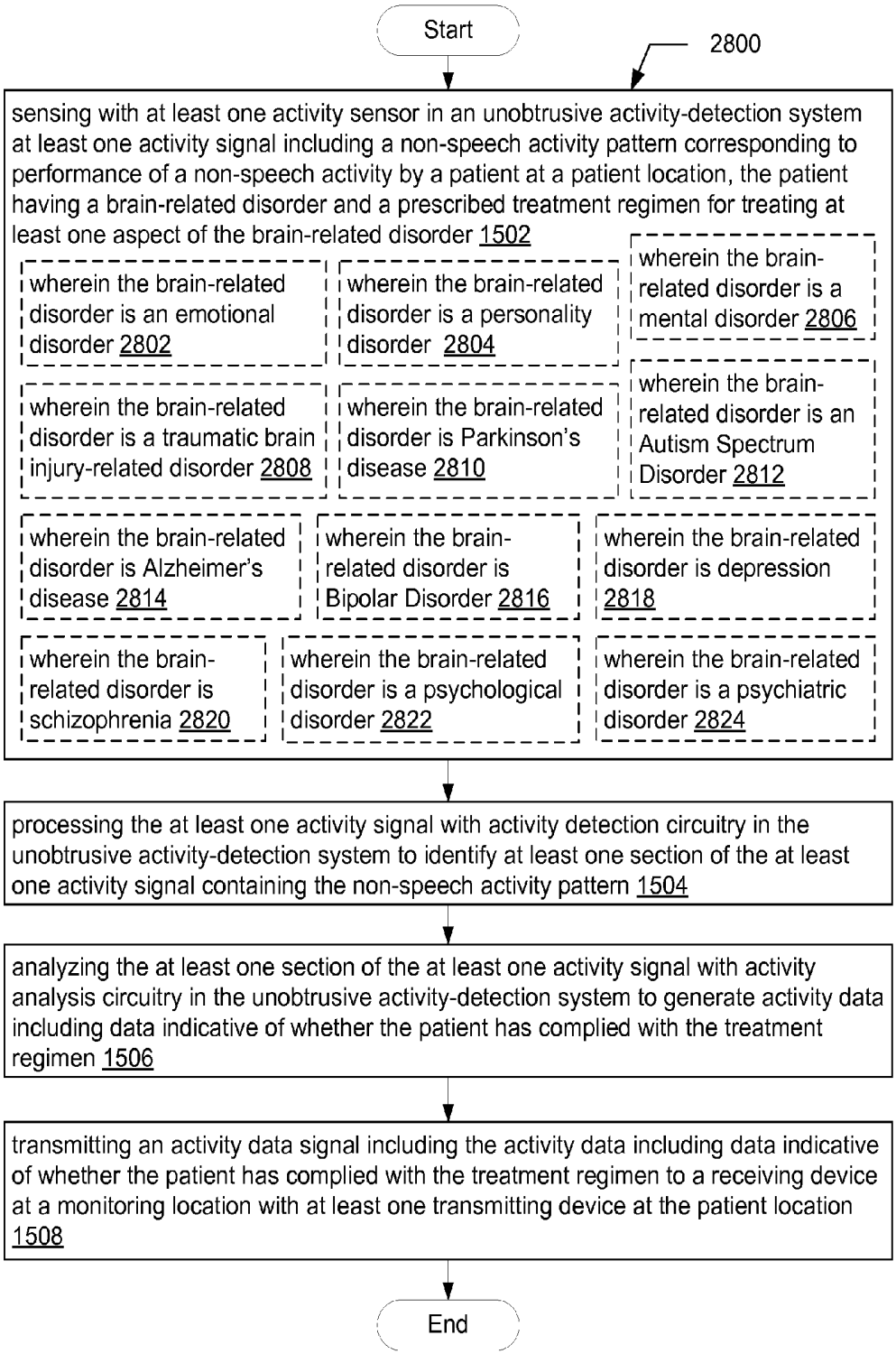

Start
2800
sensing with at least one activity sensor in an unobtrusive activity-detection system at least one activity signal including a non-speech activity pattern corresponding to performance of a non-speech activity by a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder 1502
wherein the brain-related disorder is an emotional disorder 2802
wherein the brain-related disorder is a personality disorder 2804
wherein the brain-related disorder is a mental disorder 2806
wherein the brain-related disorder is a traumatic brain injury-related disorder 2808
wherein the brain-related disorder is Parkinson's disease 2810
wherein the brain-related disorder is an Autism Spectrum Disorder 2812
wherein the brain-related disorder is Alzheimer's disease 2814
wherein the brain-related disorder is Bipolar Disorder 2816
wherein the brain-related disorder is depression 2818
wherein the brain-related disorder is schizophrenia 2820
wherein the brain-related disorder is a psychological disorder 2822
wherein the brain-related disorder is a psychiatric disorder 2824
processing the at least one activity signal with activity detection circuitry in the unobtrusive activity-detection system to identify at least one section of the at least one activity signal containing the non-speech activity pattern 1504
analyzing the at least one section of the at least one activity signal with activity analysis circuitry in the unobtrusive activity-detection system to generate activity data including data indicative of whether the patient has complied with the treatment regimen 1506
transmitting an activity data signal including the activity data including data indicative of whether the patient has complied with the treatment regimen to a receiving device at a monitoring location with at least one transmitting device at the patient location 1508
End

FIG. 29

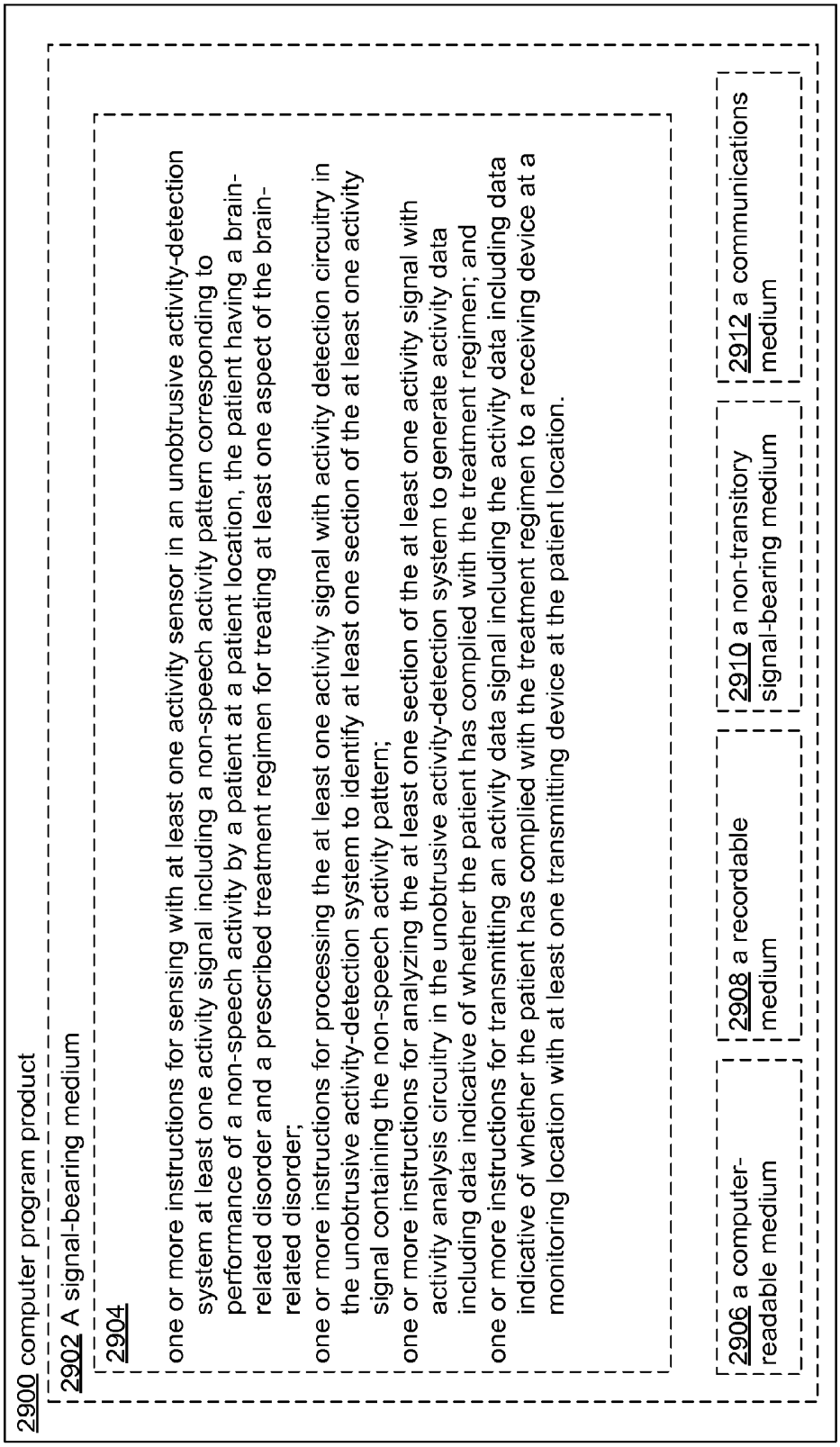

2900 computer program product
2902 A signal-bearing medium
2904
one or more instructions for sensing with at least one activity sensor in an unobtrusive activity-detection system at least one activity signal including a non-speech activity pattern corresponding to performance of a non-speech activity by a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder;
one or more instructions for processing the at least one activity signal with activity detection circuitry in the unobtrusive activity-detection system to identify at least one section of the at least one activity signal containing the non-speech activity pattern;
one or more instructions for analyzing the at least one section of the at least one activity signal with activity analysis circuitry in the unobtrusive activity-detection system to generate activity data including data indicative of whether the patient has complied with the treatment regimen; and
one or more instructions for transmitting an activity data signal including the activity data including data indicative of whether the patient has complied with the treatment regimen to a receiving device at a monitoring location with at least one transmitting device at the patient location.
2906 a computer-readable medium
2908 a recordable medium
2910 a non-transitory signal-bearing medium
2912 a communications medium

FIG. 30

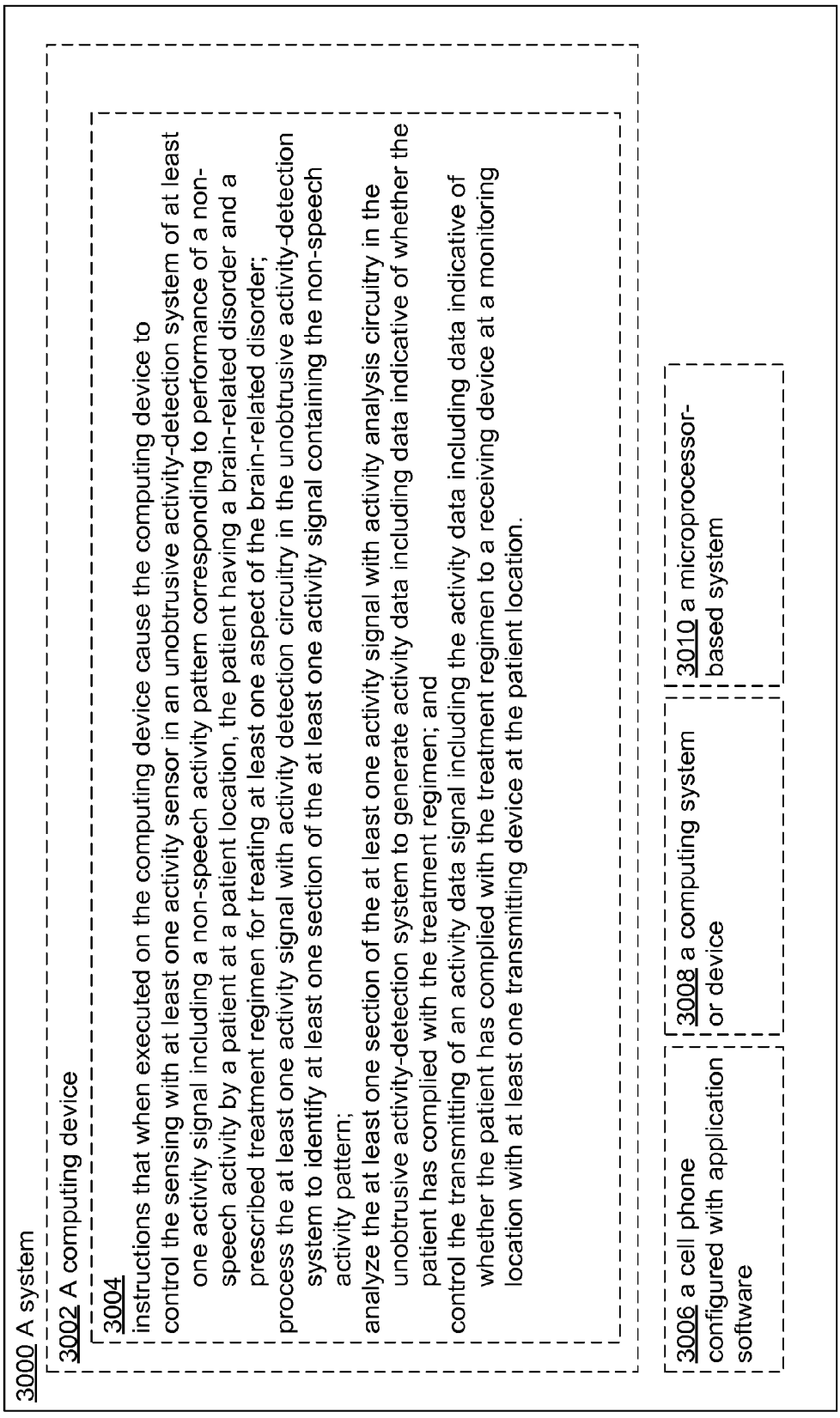

3000 A system
3002 A computing device
3004
instructions that when executed on the computing device cause the computing device to
control the sensing with at least one activity sensor in an unobtrusive activity-detection system of at least one activity signal including a non-speech activity pattern corresponding to performance of a non-speech activity by a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder;
process the at least one activity signal with activity detection circuitry in the unobtrusive activity-detection system to identify at least one section of the at least one activity signal containing the non-speech activity pattern;
analyze the at least one section of the at least one activity signal with activity analysis circuitry in the unobtrusive activity-detection system to generate activity data including data indicative of whether the patient has complied with the treatment regimen; and
control the transmitting of an activity data signal including the activity data including data indicative of whether the patient has complied with the treatment regimen to a receiving device at a monitoring location with at least one transmitting device at the patient location.
3006 a cell phone configured with application software
3008 a computing system or device
3010 a microprocessor-based system

FIG. 31

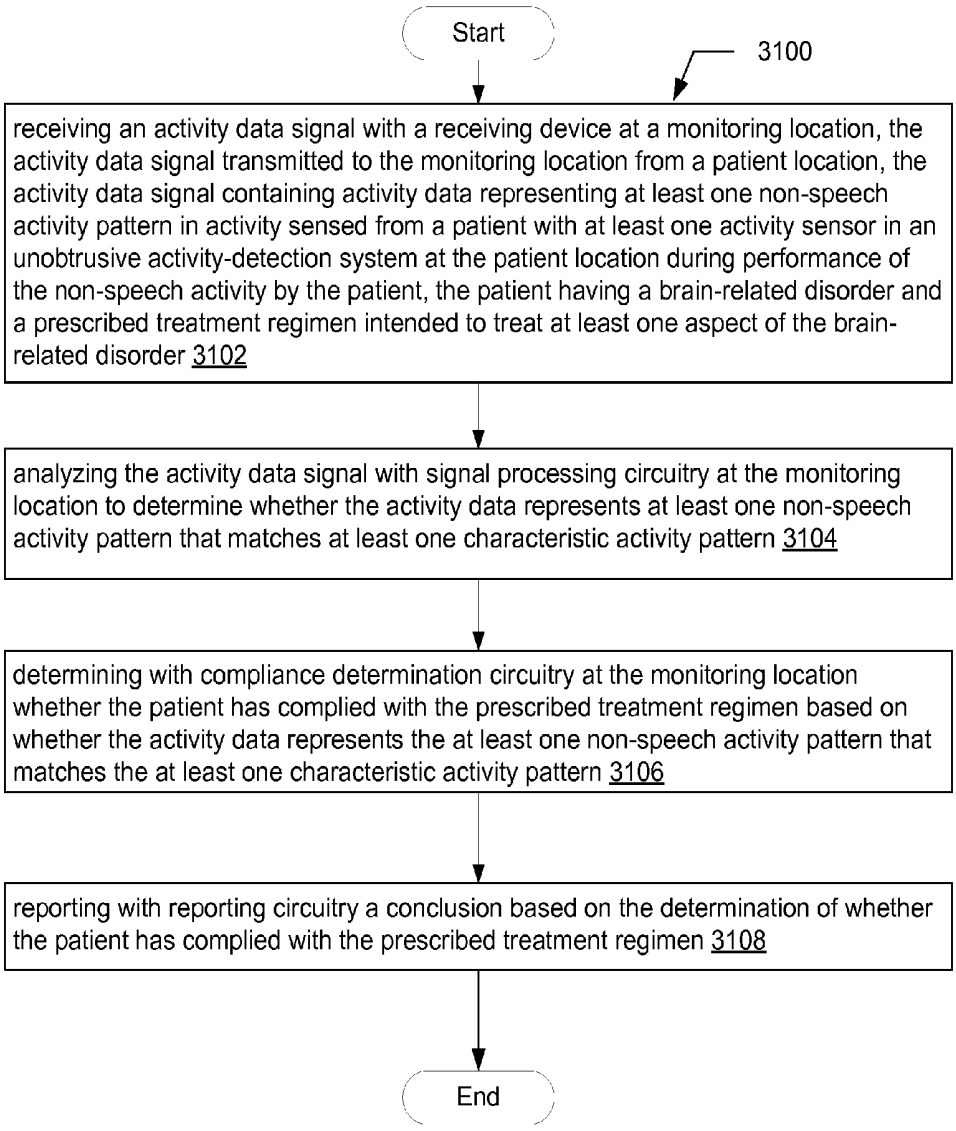

Start
3100
receiving an activity data signal with a receiving device at a monitoring location, the activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during performance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen intended to treat at least one aspect of the brain-related disorder 3102
analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern 3104
determining with compliance determination circuitry at the monitoring location whether the patient has complied with the prescribed treatment regimen based on whether the activity data represents the at least one non-speech activity pattern that matches the at least one characteristic activity pattern 3106
reporting with reporting circuitry a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen 3108
End

FIG. 32

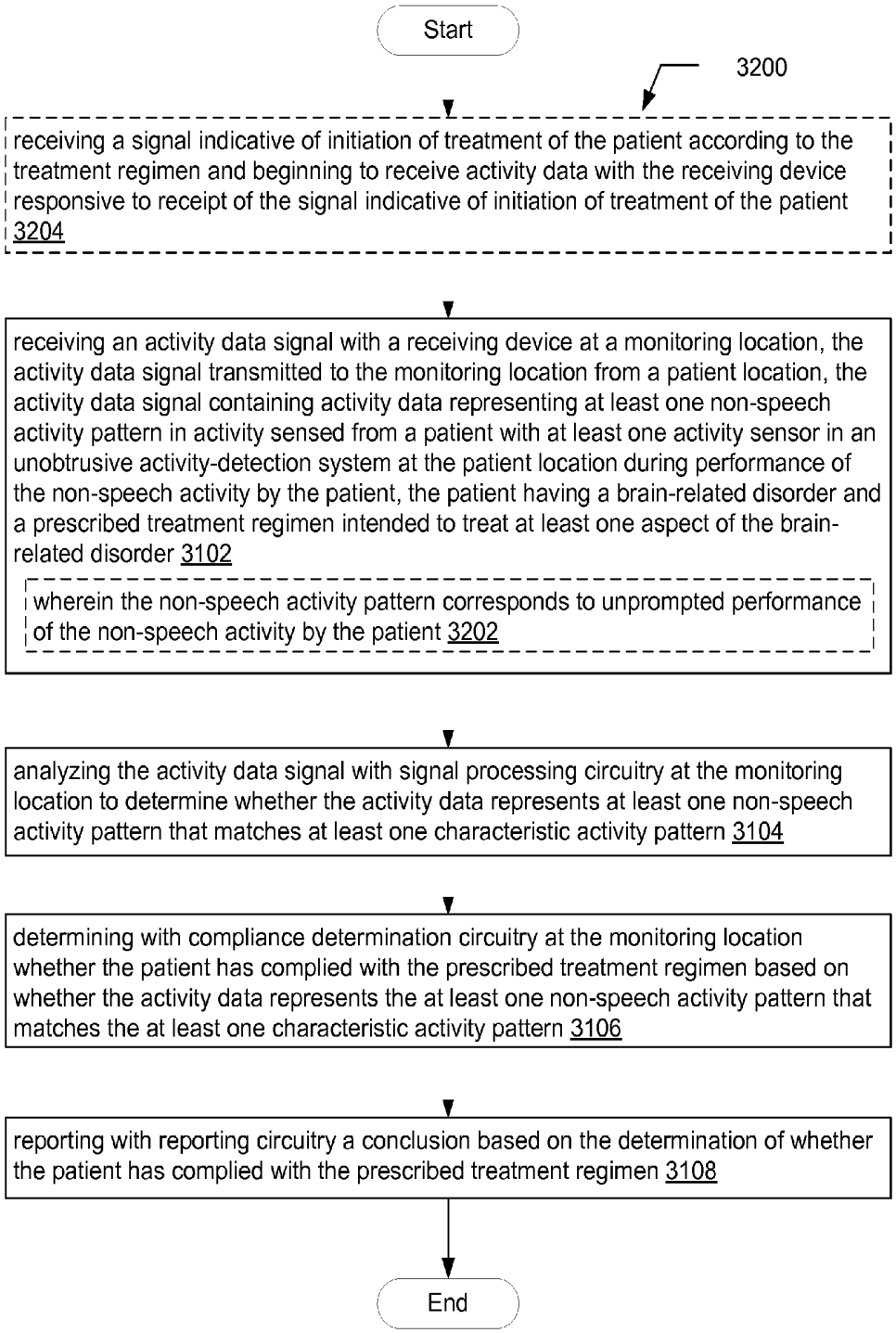

Start
3200
receiving a signal indicative of initiation of treatment of the patient according to the treatment regimen and beginning to receive activity data with the receiving device responsive to receipt of the signal indicative of initiation of treatment of the patient 3204
receiving an activity data signal with a receiving device at a monitoring location, the activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during performance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen intended to treat at least one aspect of the brain-related disorder 3102
wherein the non-speech activity pattern corresponds to unprompted performance of the non-speech activity by the patient 3202
analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern 3104
determining with compliance determination circuitry at the monitoring location whether the patient has complied with the prescribed treatment regimen based on whether the activity data represents the at least one non-speech activity pattern that matches the at least one characteristic activity pattern 3106
reporting with reporting circuitry a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen 3108
End

FIG. 33

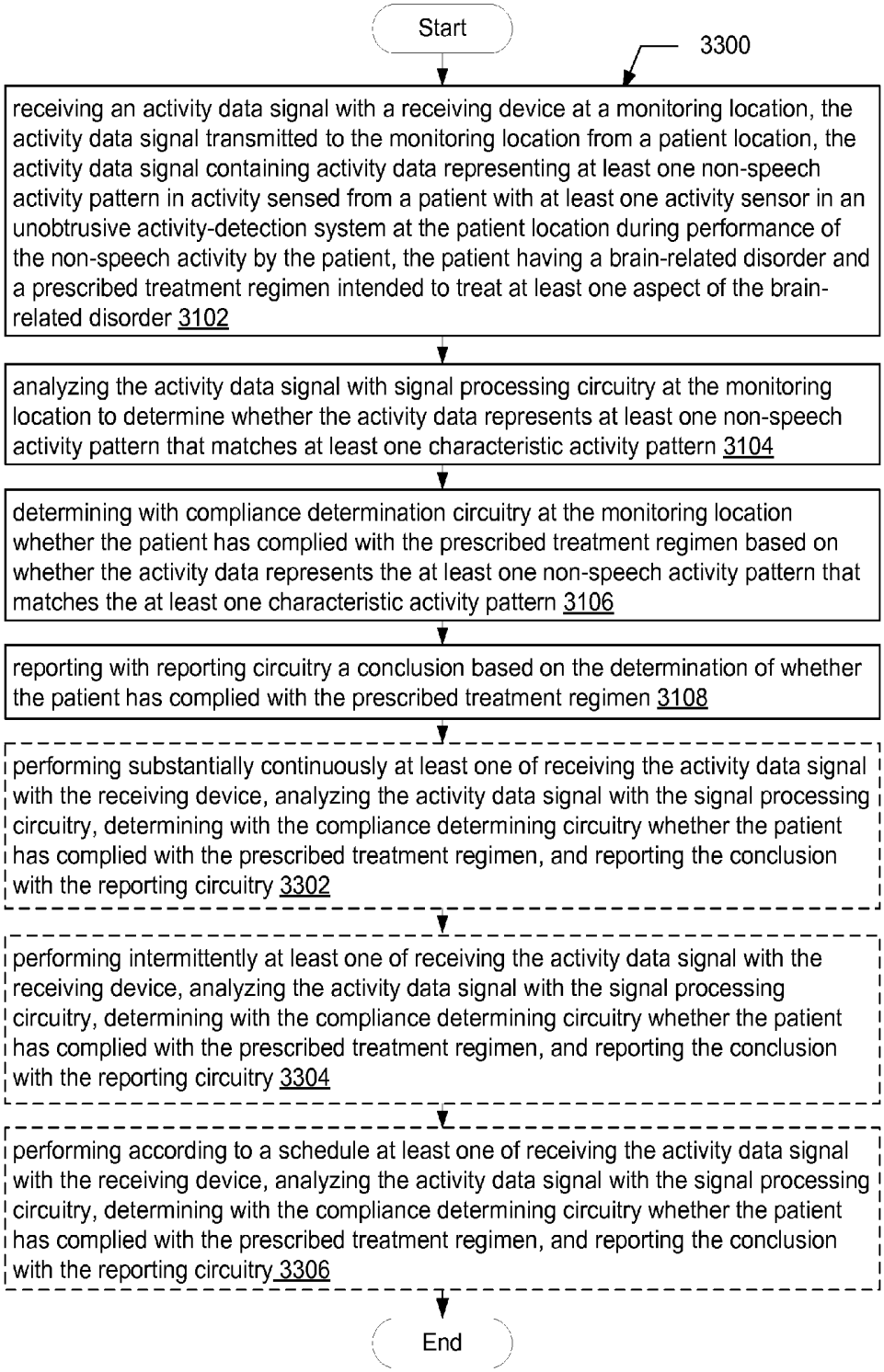

Start
3300
receiving an activity data signal with a receiving device at a monitoring location, the activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during performance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen intended to treat at least one aspect of the brain-related disorder 3102
analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern 3104
determining with compliance determination circuitry at the monitoring location whether the patient has complied with the prescribed treatment regimen based on whether the activity data represents the at least one non-speech activity pattern that matches the at least one characteristic activity pattern 3106
reporting with reporting circuitry a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen 3108
performing substantially continuously at least one of receiving the activity data signal with the receiving device, analyzing the activity data signal with the signal processing circuitry, determining with the compliance determining circuitry whether the patient has complied with the prescribed treatment regimen, and reporting the conclusion with the reporting circuitry 3302
performing intermittently at least one of receiving the activity data signal with the receiving device, analyzing the activity data signal with the signal processing circuitry, determining with the compliance determining circuitry whether the patient has complied with the prescribed treatment regimen, and reporting the conclusion with the reporting circuitry 3304
performing according to a schedule at least one of receiving the activity data signal with the receiving device, analyzing the activity data signal with the signal processing circuitry, determining with the compliance determining circuitry whether the patient has complied with the prescribed treatment regimen, and reporting the conclusion with the reporting circuitry 3306
End

FIG. 34

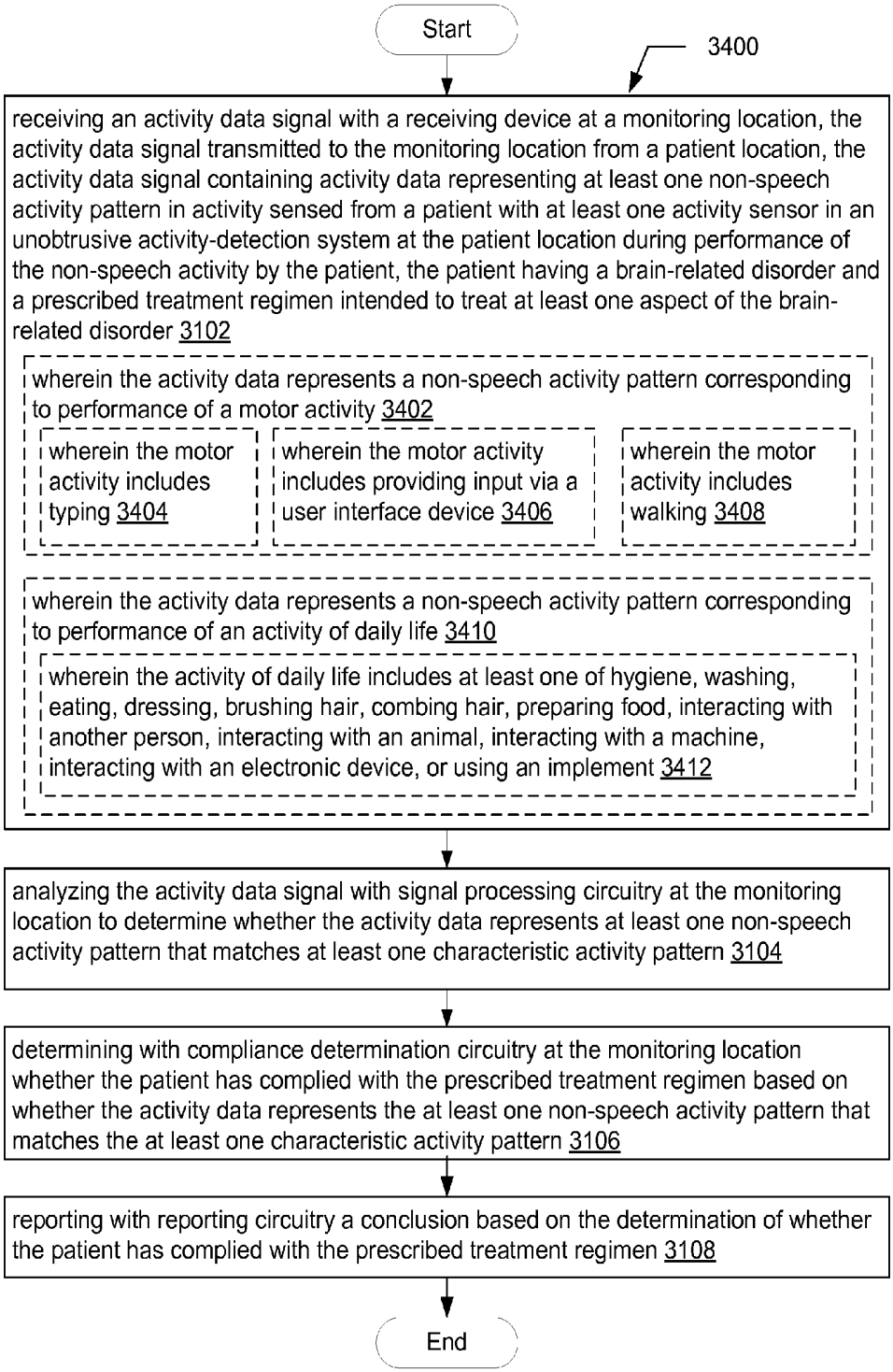

Start
3400
receiving an activity data signal with a receiving device at a monitoring location, the activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during performance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen intended to treat at least one aspect of the brain-related disorder 3102
wherein the activity data represents a non-speech activity pattern corresponding to performance of a motor activity 3402
wherein the motor activity includes typing 3404
wherein the motor activity includes providing input via a user interface device 3406
wherein the motor activity includes walking 3408
wherein the activity data represents a non-speech activity pattern corresponding to performance of an activity of daily life 3410
wherein the activity of daily life includes at least one of hygiene, washing, eating, dressing, brushing hair, combing hair, preparing food, interacting with another person, interacting with an animal, interacting with a machine, interacting with an electronic device, or using an implement 3412
analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern 3104
determining with compliance determination circuitry at the monitoring location whether the patient has complied with the prescribed treatment regimen based on whether the activity data represents the at least one non-speech activity pattern that matches the at least one characteristic activity pattern 3106
reporting with reporting circuitry a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen 3108
End

FIG. 35

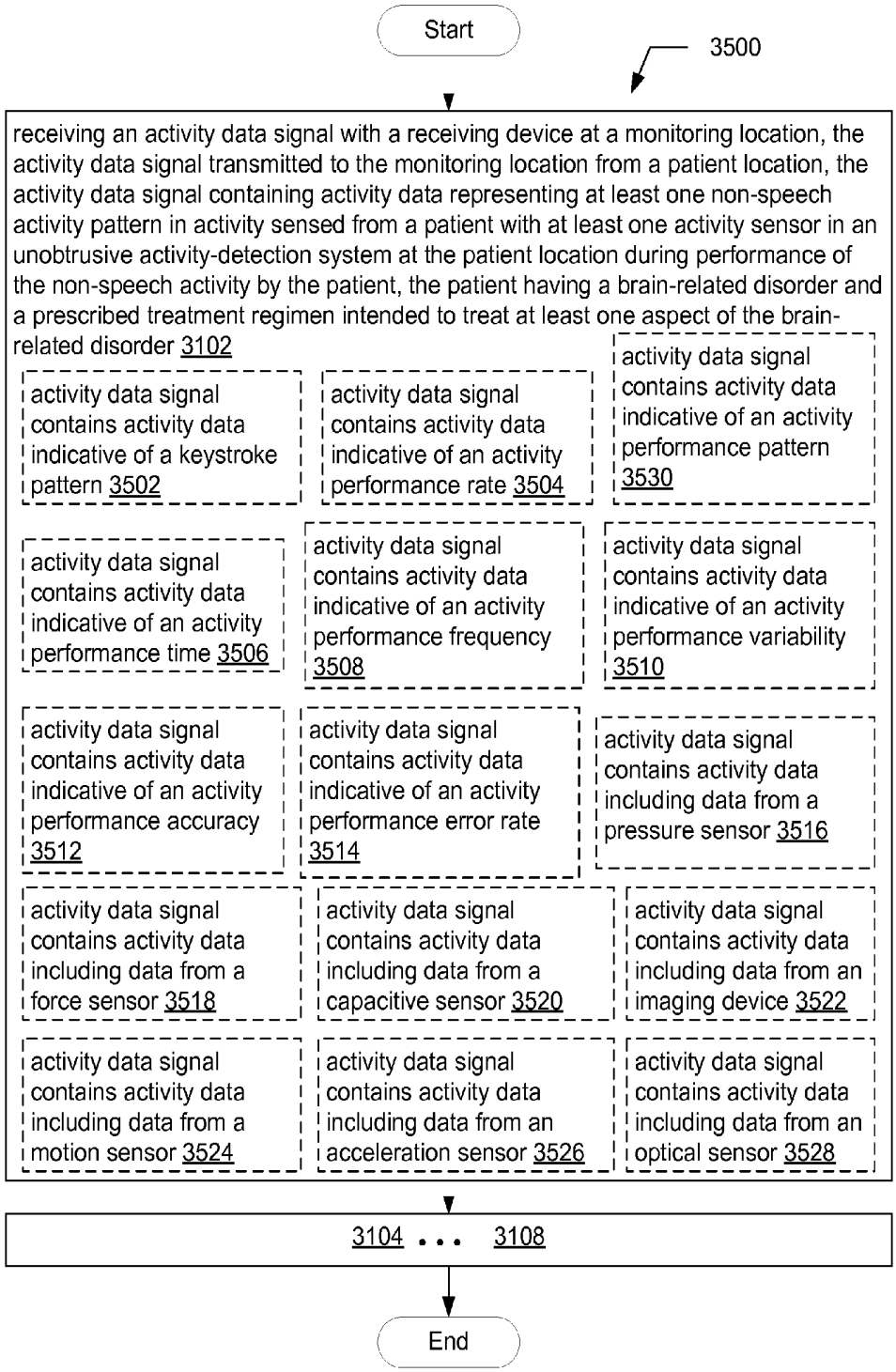

Start
3500
receiving an activity data signal with a receiving device at a monitoring location, the activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during performance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen intended to treat at least one aspect of the brain-related disorder 3102
activity data signal contains activity data indicative of a keystroke pattern 3502
activity data signal contains activity data indicative of an activity performance rate 3504
activity data signal contains activity data indicative of an activity performance pattern 3530
activity data signal contains activity data indicative of an activity performance time 3506
activity data signal contains activity data indicative of an activity performance frequency 3508
activity data signal contains activity data indicative of an activity performance variability 3510
activity data signal contains activity data indicative of an activity performance accuracy 3512
activity data signal contains activity data indicative of an activity performance error rate 3514
activity data signal contains activity data including data from a pressure sensor 3516
activity data signal contains activity data including data from a force sensor 3518
activity data signal contains activity data including data from a capacitive sensor 3520
activity data signal contains activity data including data from an imaging device 3522
activity data signal contains activity data including data from a motion sensor 3524
activity data signal contains activity data including data from an acceleration sensor 3526
activity data signal contains activity data including data from an optical sensor 3528
3104 ... 3108
End

FIG. 36

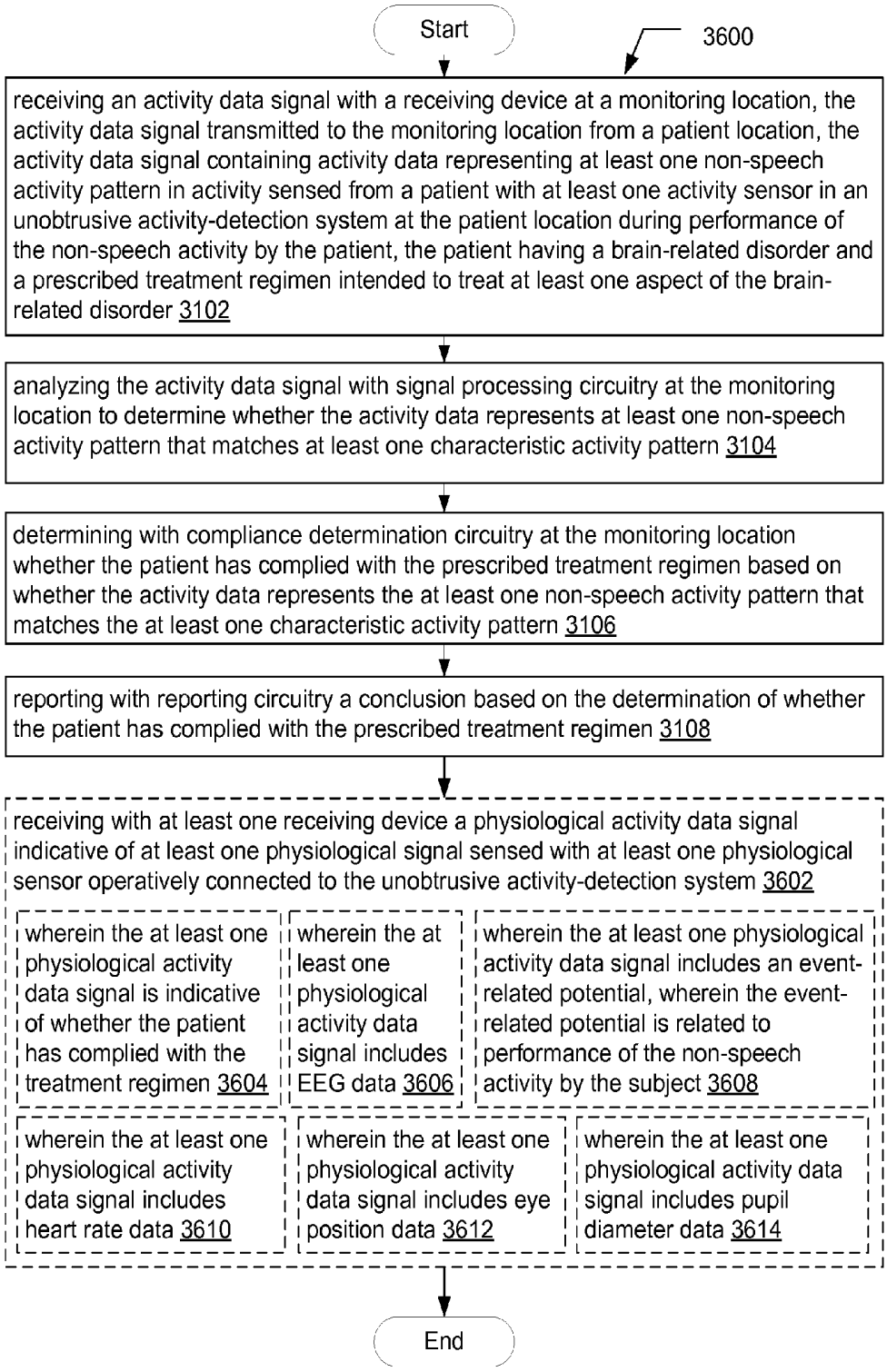

Start
3600
receiving an activity data signal with a receiving device at a monitoring location, the activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during performance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen intended to treat at least one aspect of the brain-related disorder 3102
analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern 3104
determining with compliance determination circuitry at the monitoring location whether the patient has complied with the prescribed treatment regimen based on whether the activity data represents the at least one non-speech activity pattern that matches the at least one characteristic activity pattern 3106
reporting with reporting circuitry a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen 3108
receiving with at least one receiving device a physiological activity data signal indicative of at least one physiological signal sensed with at least one physiological sensor operatively connected to the unobtrusive activity-detection system 3602
wherein the at least one physiological activity data signal is indicative of whether the patient has complied with the treatment regimen 3604
wherein the at least one physiological activity data signal includes EEG data 3606
wherein the at least one physiological activity data signal includes an event-related potential, wherein the event-related potential is related to performance of the non-speech activity by the subject 3608
wherein the at least one physiological activity data signal includes heart rate data 3610
wherein the at least one physiological activity data signal includes eye position data 3612
wherein the at least one physiological activity data signal includes pupil diameter data 3614
End

FIG. 37

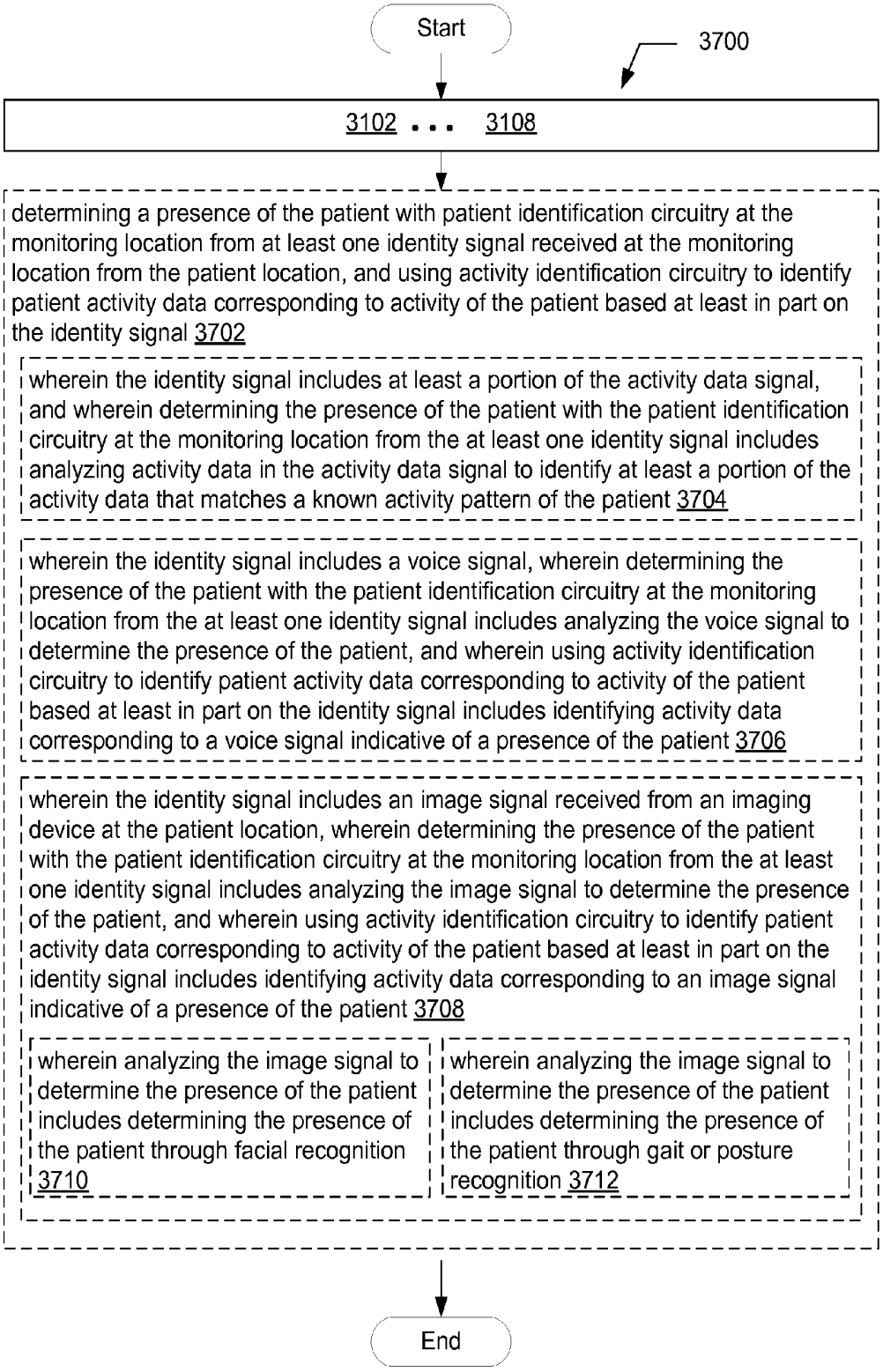

Start
3700
3102 . . . 3108
determining a presence of the patient with patient identification circuitry at the monitoring location from at least one identity signal received at the monitoring location from the patient location, and using activity identification circuitry to identify patient activity data corresponding to activity of the patient based at least in part on the identity signal 3702
wherein the identity signal includes at least a portion of the activity data signal, and wherein determining the presence of the patient with the patient identification circuitry at the monitoring location from the at least one identity signal includes analyzing activity data in the activity data signal to identify at least a portion of the activity data that matches a known activity pattern of the patient 3704
wherein the identity signal includes a voice signal, wherein determining the presence of the patient with the patient identification circuitry at the monitoring location from the at least one identity signal includes analyzing the voice signal to determine the presence of the patient, and wherein using activity identification circuitry to identify patient activity data corresponding to activity of the patient based at least in part on the identity signal includes identifying activity data corresponding to a voice signal indicative of a presence of the patient 3706
wherein the identity signal includes an image signal received from an imaging device at the patient location, wherein determining the presence of the patient with the patient identification circuitry at the monitoring location from the at least one identity signal includes analyzing the image signal to determine the presence of the patient, and wherein using activity identification circuitry to identify patient activity data corresponding to activity of the patient based at least in part on the identity signal includes identifying activity data corresponding to an image signal indicative of a presence of the patient 3708
wherein analyzing the image signal to determine the presence of the patient includes determining the presence of the patient through facial recognition 3710
wherein analyzing the image signal to determine the presence of the patient includes determining the presence of the patient through gait or posture recognition 3712
End

FIG. 38

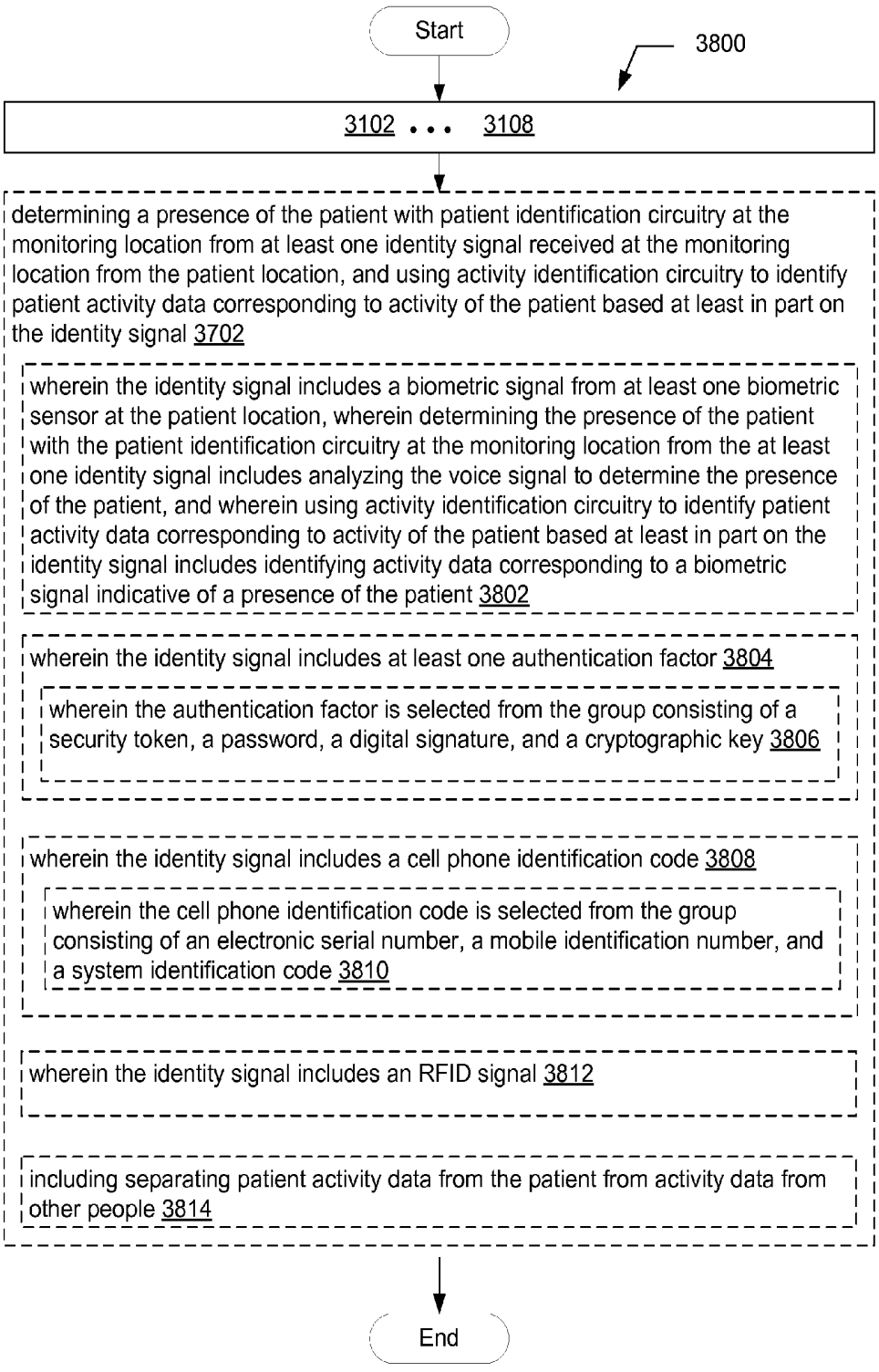

Start
3800
3102 • • • 3108
determining a presence of the patient with patient identification circuitry at the monitoring location from at least one identity signal received at the monitoring location from the patient location, and using activity identification circuitry to identify patient activity data corresponding to activity of the patient based at least in part on the identity signal 3702
wherein the identity signal includes a biometric signal from at least one biometric sensor at the patient location, wherein determining the presence of the patient with the patient identification circuitry at the monitoring location from the at least one identity signal includes analyzing the voice signal to determine the presence of the patient, and wherein using activity identification circuitry to identify patient activity data corresponding to activity of the patient based at least in part on the identity signal includes identifying activity data corresponding to a biometric signal indicative of a presence of the patient 3802
wherein the identity signal includes at least one authentication factor 3804
wherein the authentication factor is selected from the group consisting of a security token, a password, a digital signature, and a cryptographic key 3806
wherein the identity signal includes a cell phone identification code 3808
wherein the cell phone identification code is selected from the group consisting of an electronic serial number, a mobile identification number, and a system identification code 3810
wherein the identity signal includes an RFID signal 3812
including separating patient activity data from the patient from activity data from other people 3814
End

FIG. 39

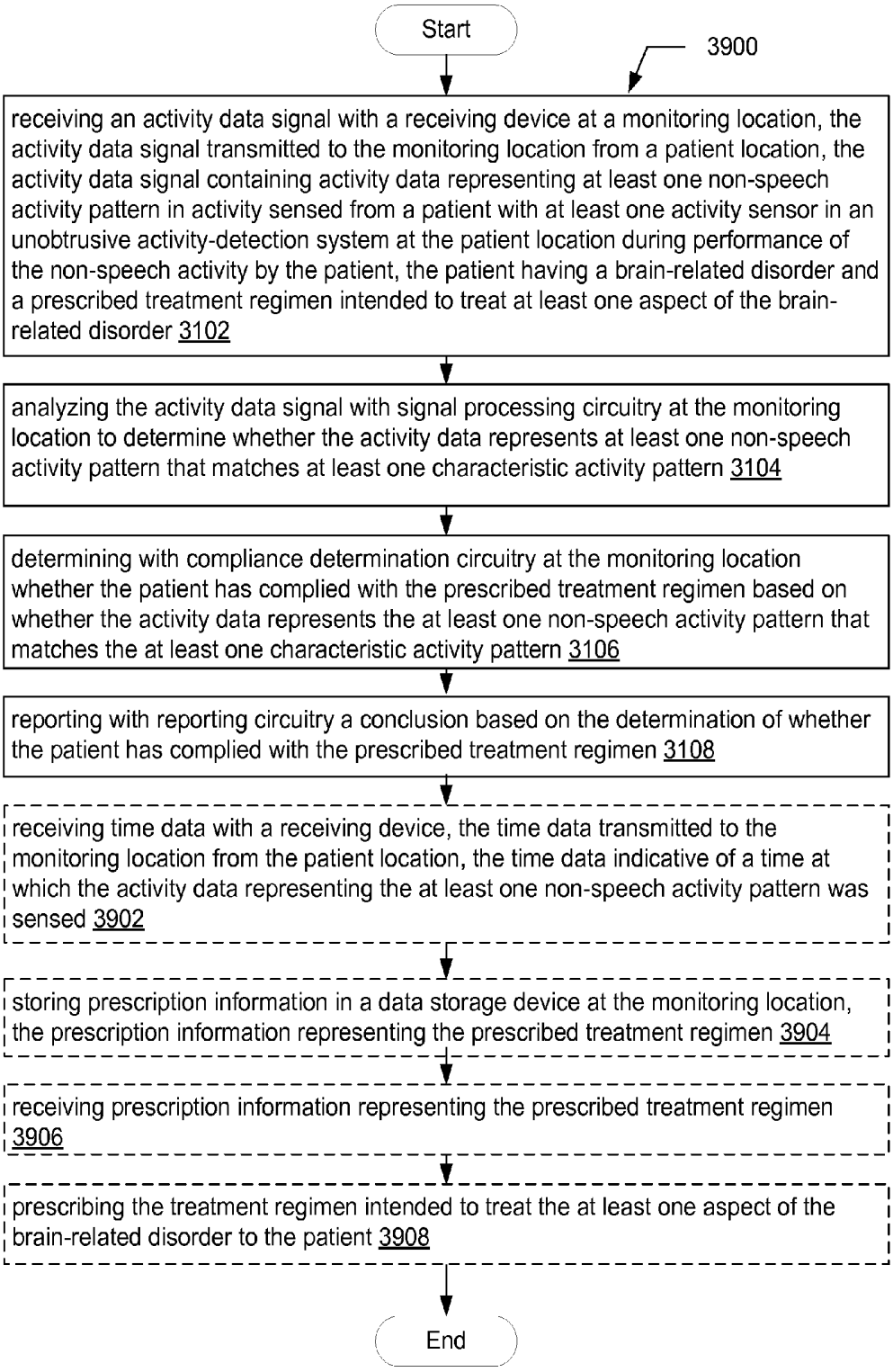

Start
3900
receiving an activity data signal with a receiving device at a monitoring location, the activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during performance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen intended to treat at least one aspect of the brain-related disorder 3102
analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern 3104
determining with compliance determination circuitry at the monitoring location whether the patient has complied with the prescribed treatment regimen based on whether the activity data represents the at least one non-speech activity pattern that matches the at least one characteristic activity pattern 3106
reporting with reporting circuitry a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen 3108
receiving time data with a receiving device, the time data transmitted to the monitoring location from the patient location, the time data indicative of a time at which the activity data representing the at least one non-speech activity pattern was sensed 3902
storing prescription information in a data storage device at the monitoring location, the prescription information representing the prescribed treatment regimen 3904
receiving prescription information representing the prescribed treatment regimen 3906
prescribing the treatment regimen intended to treat the at least one aspect of the brain-related disorder to the patient 3908
End

FIG. 40

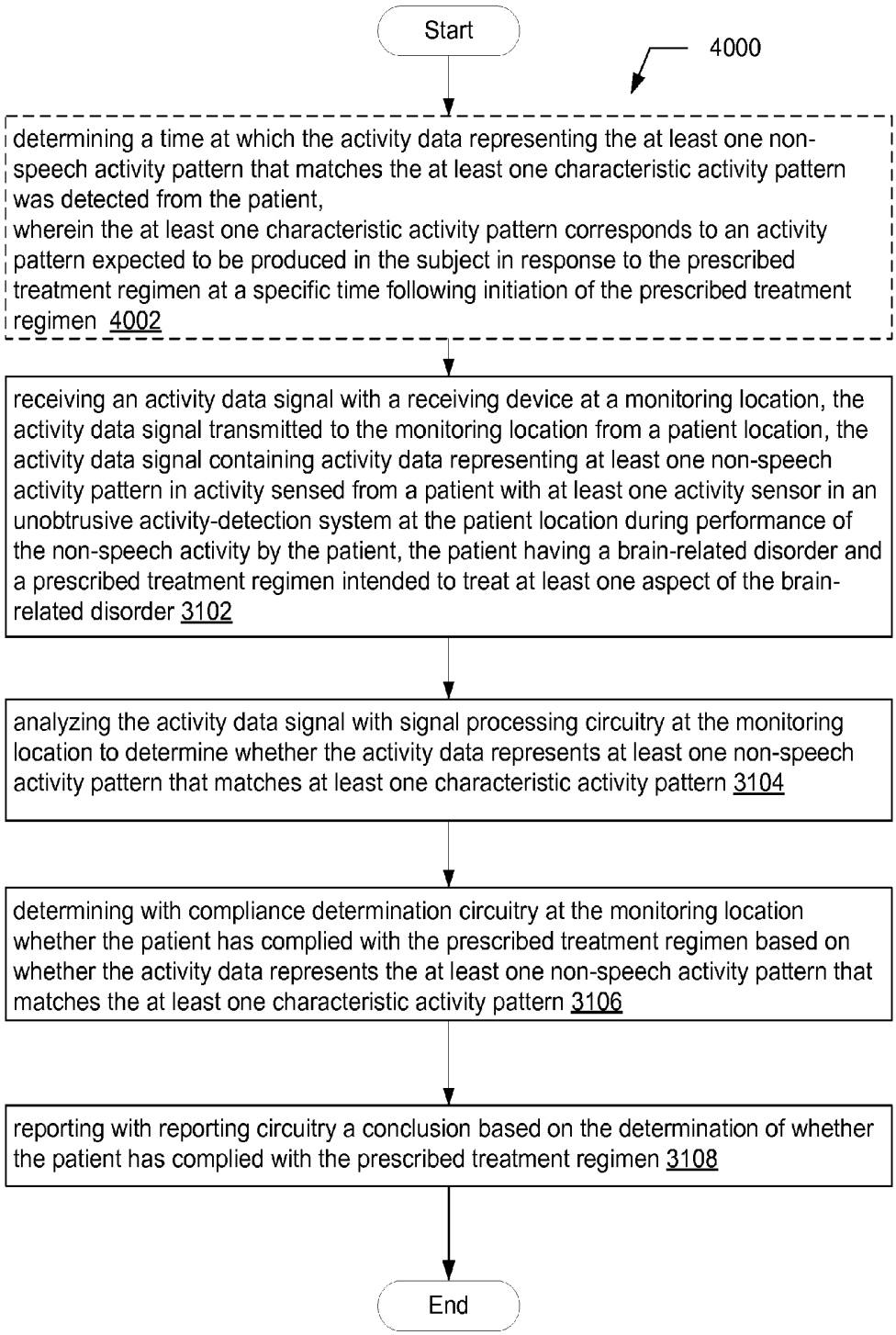

Start
4000
determining a time at which the activity data representing the at least one non-speech activity pattern that matches the at least one characteristic activity pattern was detected from the patient, wherein the at least one characteristic activity pattern corresponds to an activity pattern expected to be produced in the subject in response to the prescribed treatment regimen at a specific time following initiation of the prescribed treatment regimen 4002
receiving an activity data signal with a receiving device at a monitoring location, the activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during performance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen intended to treat at least one aspect of the brain-related disorder 3102
analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern 3104
determining with compliance determination circuitry at the monitoring location whether the patient has complied with the prescribed treatment regimen based on whether the activity data represents the at least one non-speech activity pattern that matches the at least one characteristic activity pattern 3106
reporting with reporting circuitry a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen 3108
End

FIG. 41

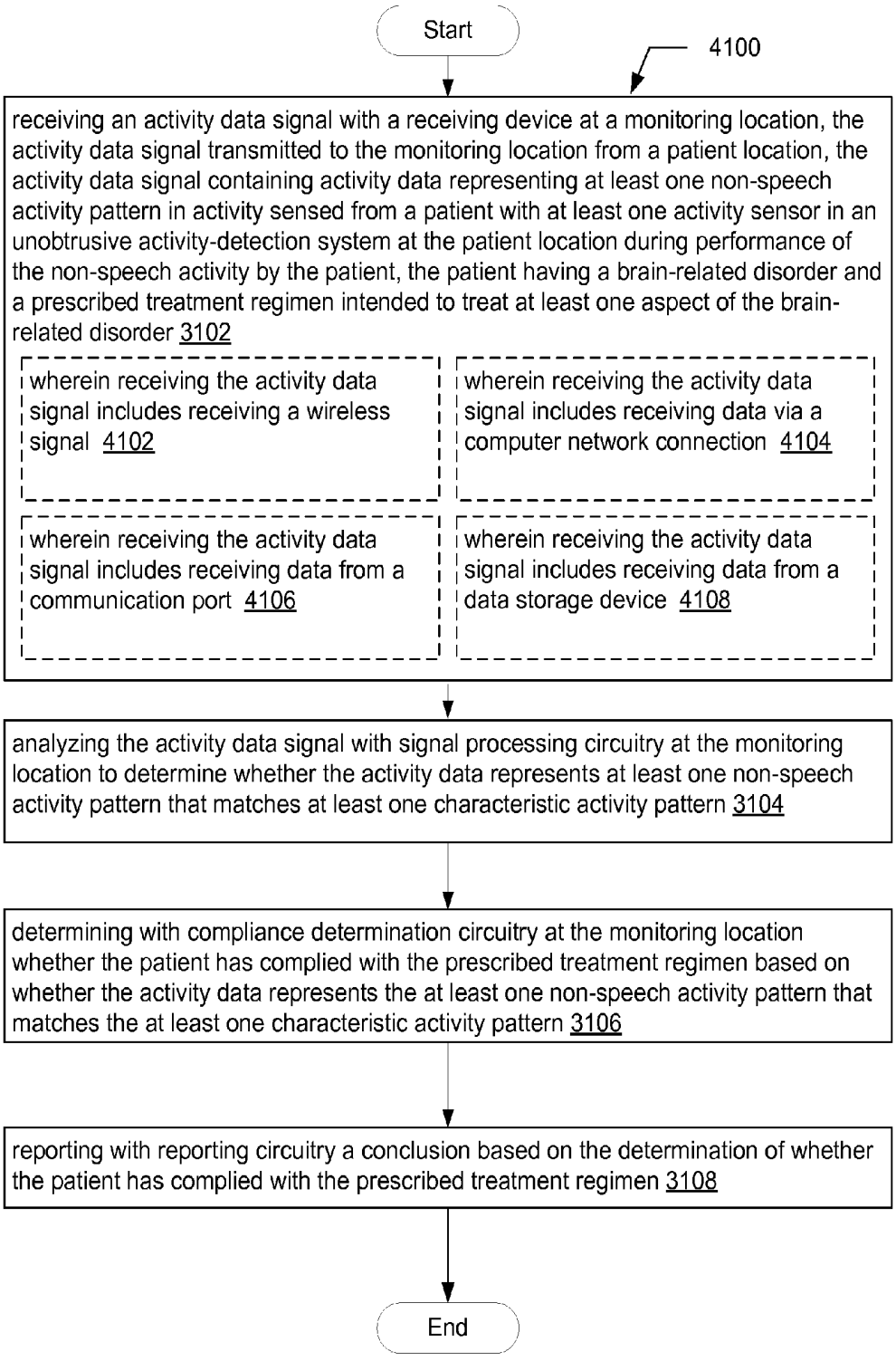

Start
4100
receiving an activity data signal with a receiving device at a monitoring location, the activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during performance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen intended to treat at least one aspect of the brain-related disorder 3102
wherein receiving the activity data signal includes receiving a wireless signal 4102
wherein receiving the activity data signal includes receiving data via a computer network connection 4104
wherein receiving the activity data signal includes receiving data from a communication port 4106
wherein receiving the activity data signal includes receiving data from a data storage device 4108
analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern 3104
determining with compliance determination circuitry at the monitoring location whether the patient has complied with the prescribed treatment regimen based on whether the activity data represents the at least one non-speech activity pattern that matches the at least one characteristic activity pattern 3106
reporting with reporting circuitry a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen 3108
End

FIG. 42

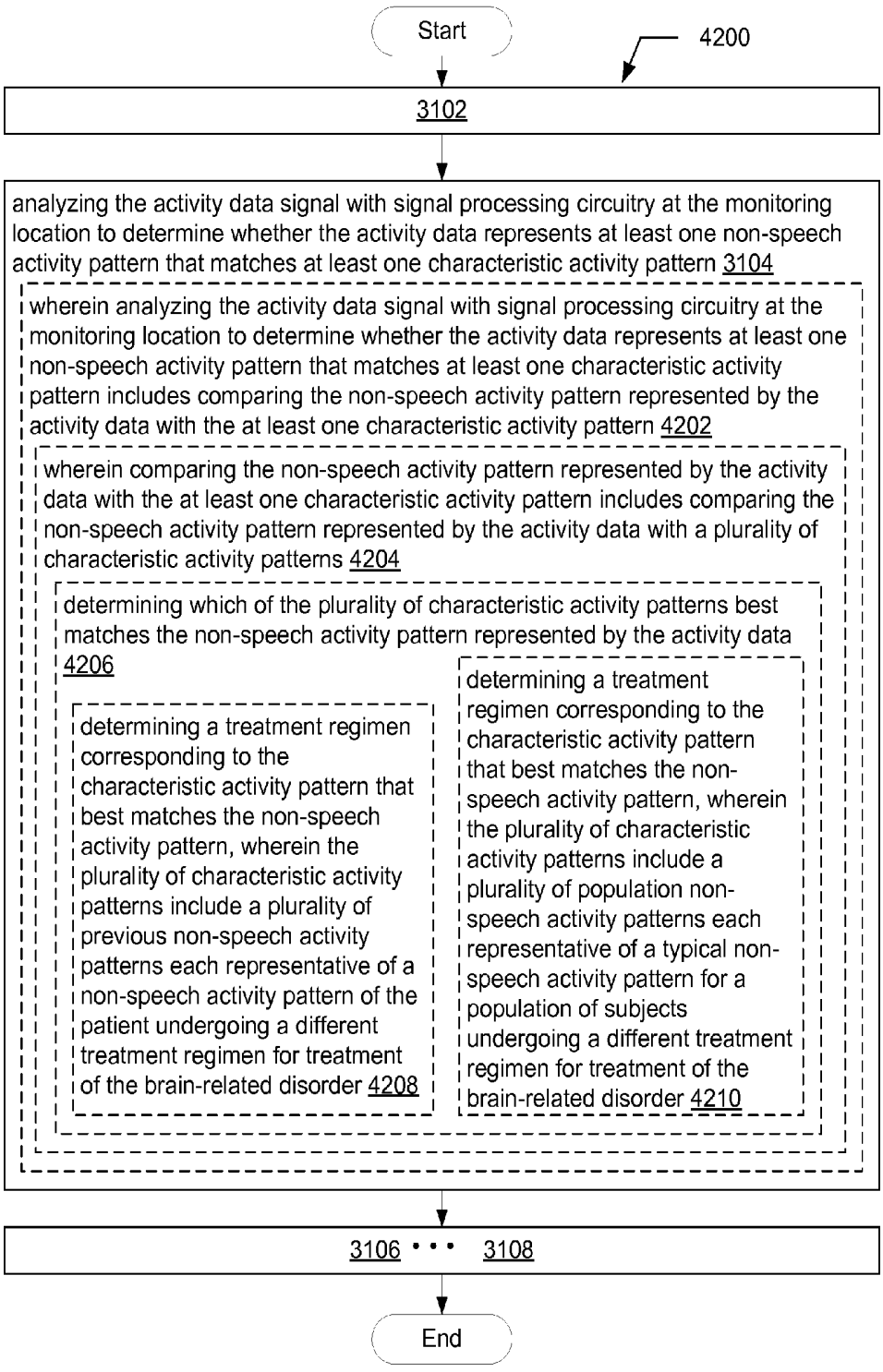

Start
4200
3102
analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern 3104
wherein analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern includes comparing the non-speech activity pattern represented by the activity data with the at least one characteristic activity pattern 4202
wherein comparing the non-speech activity pattern represented by the activity data with the at least one characteristic activity pattern includes comparing the non-speech activity pattern represented by the activity data with a plurality of characteristic activity patterns 4204
determining which of the plurality of characteristic activity patterns best matches the non-speech activity pattern represented by the activity data 4206
determining a treatment regimen corresponding to the characteristic activity pattern that best matches the non-speech activity pattern, wherein the plurality of characteristic activity patterns include a plurality of previous non-speech activity patterns each representative of a non-speech activity pattern of the patient undergoing a different treatment regimen for treatment of the brain-related disorder 4208
determining a treatment regimen corresponding to the characteristic activity pattern that best matches the non-speech activity pattern, wherein the plurality of characteristic activity patterns include a plurality of population non-speech activity patterns each representative of a typical non-speech activity pattern for a population of subjects undergoing a different treatment regimen for treatment of the brain-related disorder 4210
3106 • • • 3108
End

FIG. 43

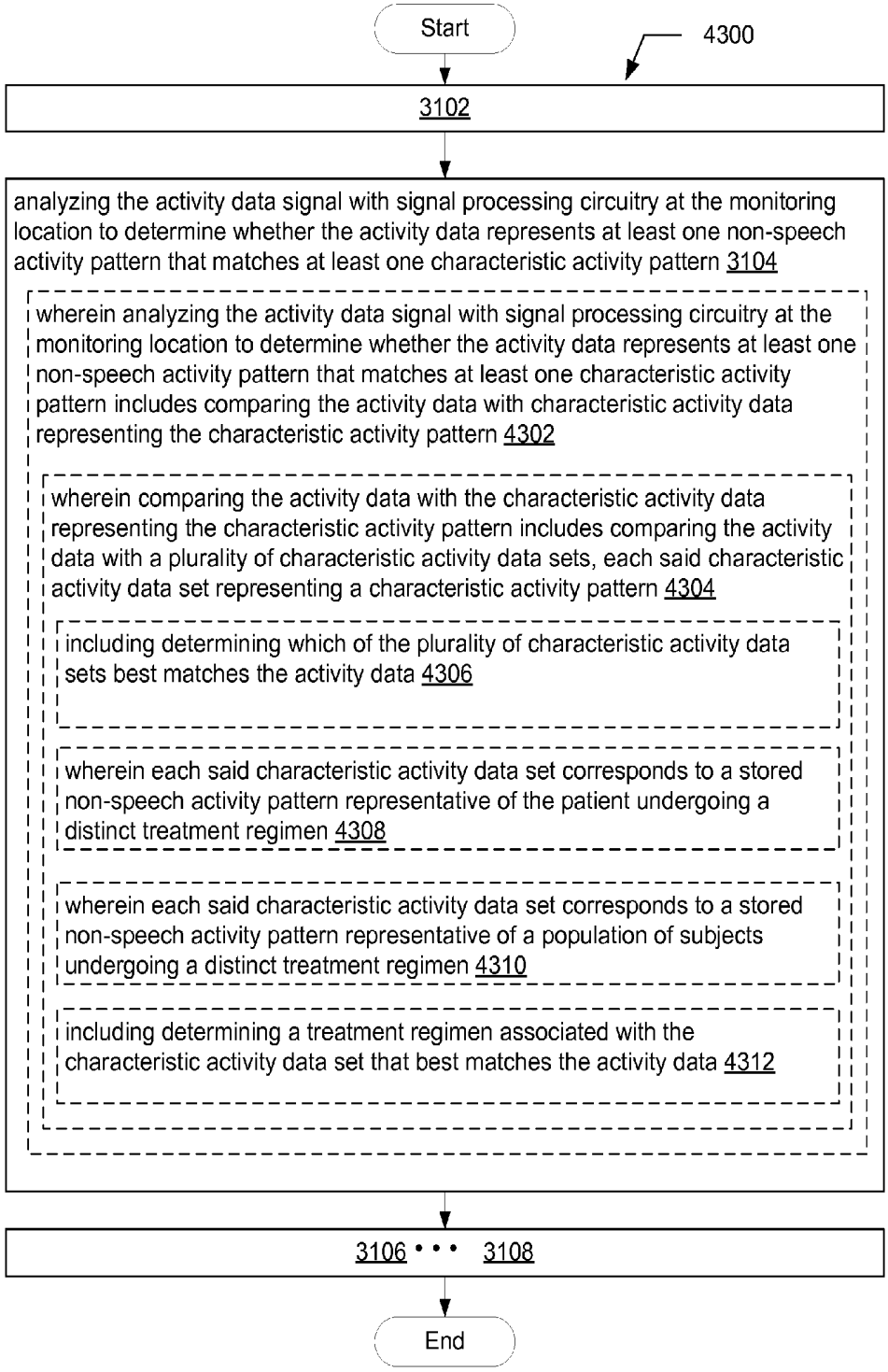

Start
4300
3102
analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern 3104
wherein analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern includes comparing the activity data with characteristic activity data representing the characteristic activity pattern 4302
wherein comparing the activity data with the characteristic activity data representing the characteristic activity pattern includes comparing the activity data with a plurality of characteristic activity data sets, each said characteristic activity data set representing a characteristic activity pattern 4304
including determining which of the plurality of characteristic activity data sets best matches the activity data 4306
wherein each said characteristic activity data set corresponds to a stored non-speech activity pattern representative of the patient undergoing a distinct treatment regimen 4308
wherein each said characteristic activity data set corresponds to a stored non-speech activity pattern representative of a population of subjects undergoing a distinct treatment regimen 4310
including determining a treatment regimen associated with the characteristic activity data set that best matches the activity data 4312
3106 • • • 3108
End

FIG. 44

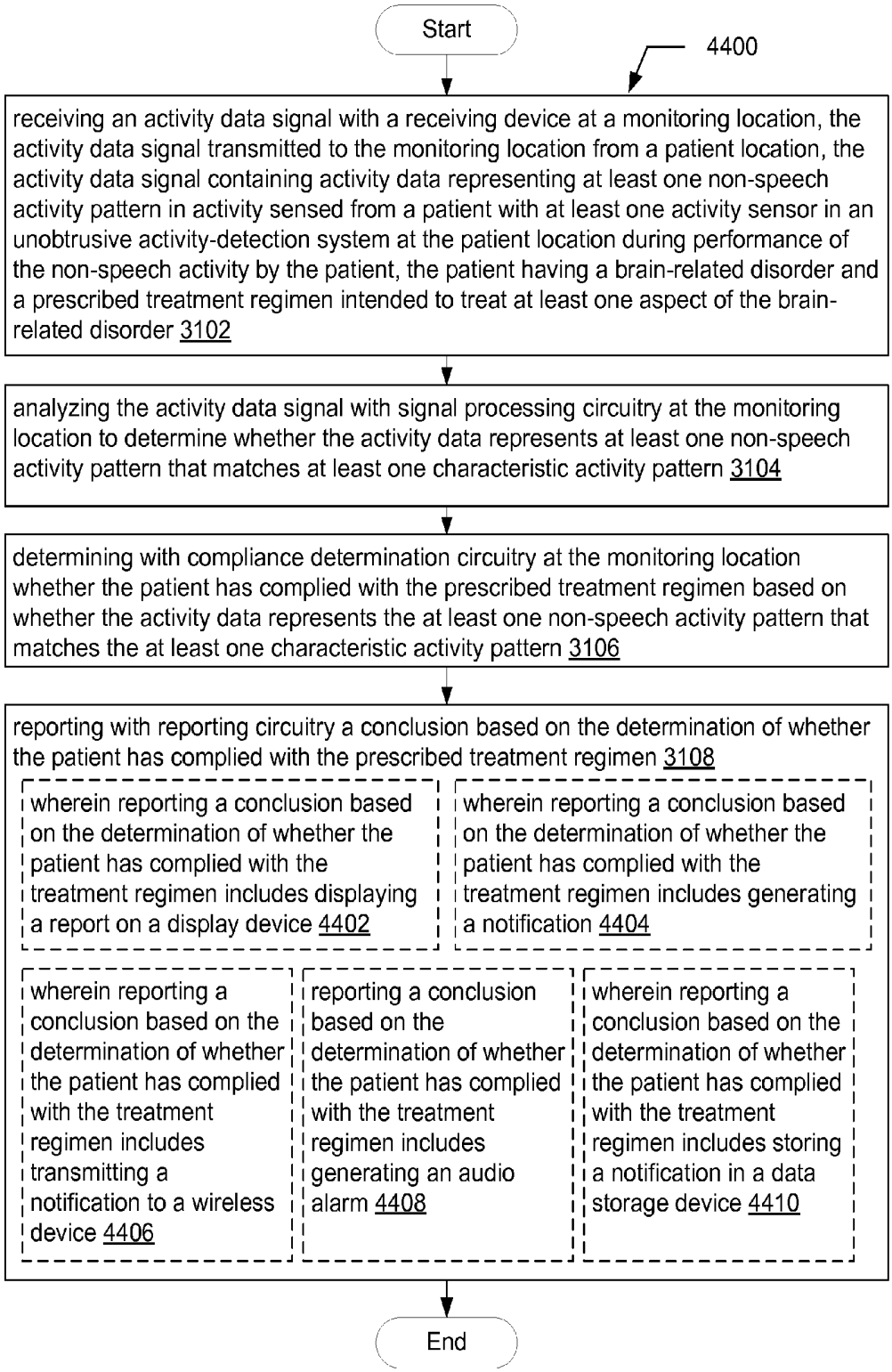

Start
4400
receiving an activity data signal with a receiving device at a monitoring location, the activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during performance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen intended to treat at least one aspect of the brain-related disorder 3102
analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern 3104
determining with compliance determination circuitry at the monitoring location whether the patient has complied with the prescribed treatment regimen based on whether the activity data represents the at least one non-speech activity pattern that matches the at least one characteristic activity pattern 3106
reporting with reporting circuitry a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen 3108
wherein reporting a conclusion based on the determination of whether the patient has complied with the treatment regimen includes displaying a report on a display device 4402
wherein reporting a conclusion based on the determination of whether the patient has complied with the treatment regimen includes generating a notification 4404
wherein reporting a conclusion based on the determination of whether the patient has complied with the treatment regimen includes transmitting a notification to a wireless device 4406
reporting a conclusion based on the determination of whether the patient has complied with the treatment regimen includes generating an audio alarm 4408
wherein reporting a conclusion based on the determination of whether the patient has complied with the treatment regimen includes storing a notification in a data storage device 4410
End

FIG. 45

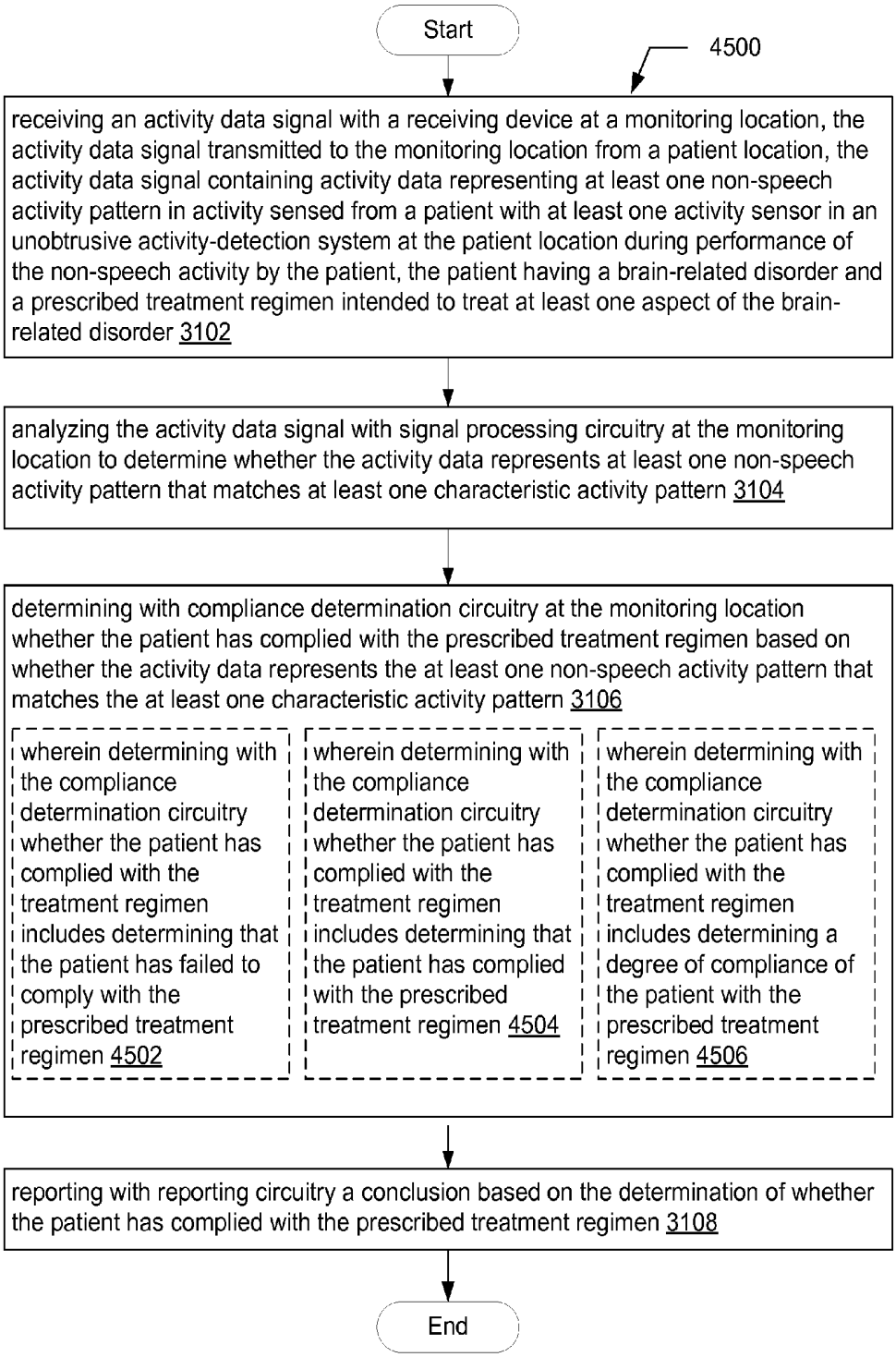

Start
4500
receiving an activity data signal with a receiving device at a monitoring location, the activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during performance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen intended to treat at least one aspect of the brain-related disorder 3102
analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern 3104
determining with compliance determination circuitry at the monitoring location whether the patient has complied with the prescribed treatment regimen based on whether the activity data represents the at least one non-speech activity pattern that matches the at least one characteristic activity pattern 3106
wherein determining with the compliance determination circuitry whether the patient has complied with the treatment regimen includes determining that the patient has failed to comply with the prescribed treatment regimen 4502
wherein determining with the compliance determination circuitry whether the patient has complied with the treatment regimen includes determining that the patient has complied with the prescribed treatment regimen 4504
wherein determining with the compliance determination circuitry whether the patient has complied with the treatment regimen includes determining a degree of compliance of the patient with the prescribed treatment regimen 4506
reporting with reporting circuitry a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen 3108
End

FIG. 46

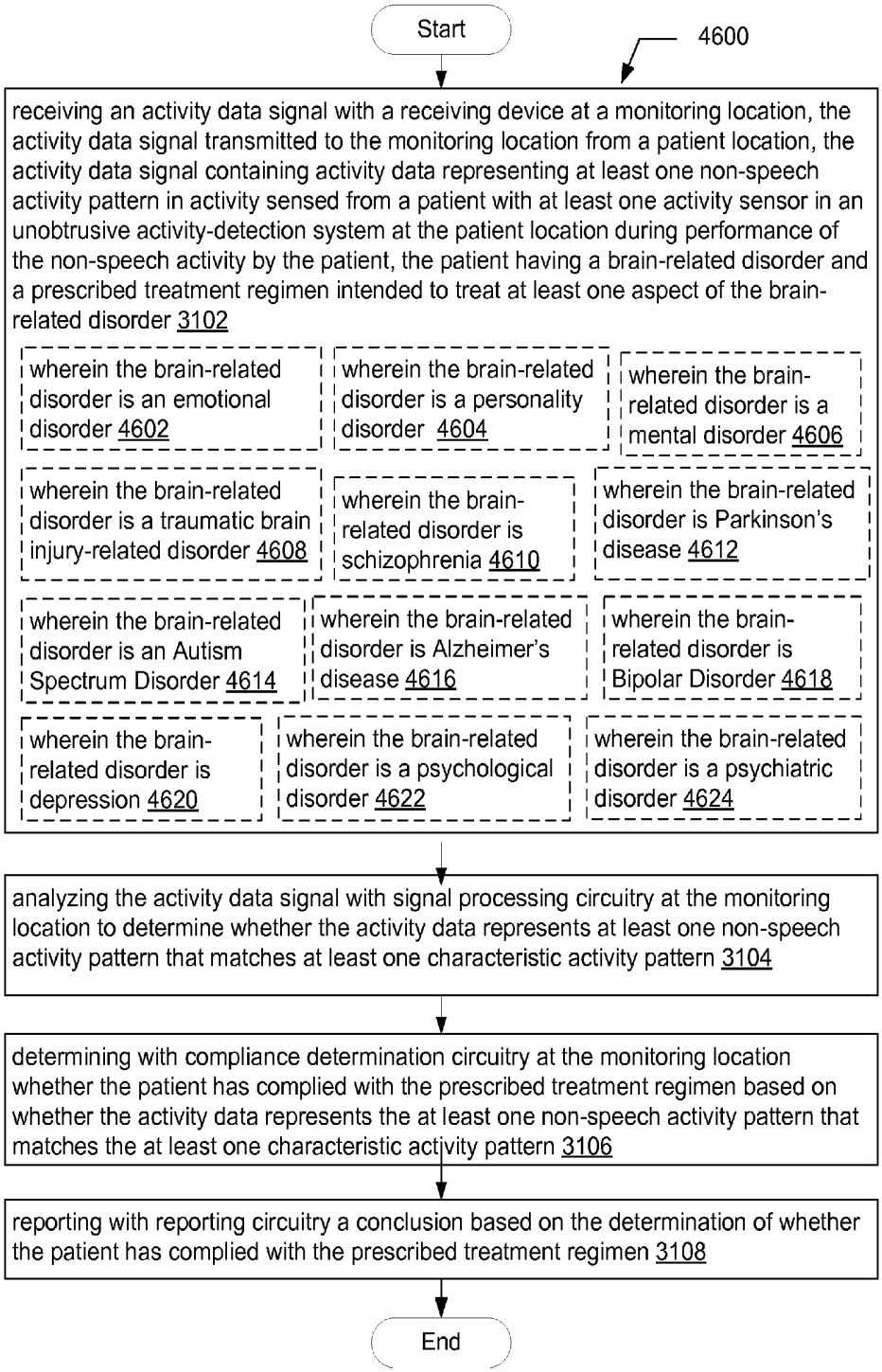

Start
4600
receiving an activity data signal with a receiving device at a monitoring location, the activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during performance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen intended to treat at least one aspect of the brain-related disorder 3102
wherein the brain-related disorder is an emotional disorder 4602
wherein the brain-related disorder is a personality disorder 4604
wherein the brain-related disorder is a mental disorder 4606
wherein the brain-related disorder is a traumatic brain injury-related disorder 4608
wherein the brain-related disorder is schizophrenia 4610
wherein the brain-related disorder is Parkinson's disease 4612
wherein the brain-related disorder is an Autism Spectrum Disorder 4614
wherein the brain-related disorder is Alzheimer's disease 4616
wherein the brain-related disorder is Bipolar Disorder 4618
wherein the brain-related disorder is depression 4620
wherein the brain-related disorder is a psychological disorder 4622
wherein the brain-related disorder is a psychiatric disorder 4624
analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern 3104
determining with compliance determination circuitry at the monitoring location whether the patient has complied with the prescribed treatment regimen based on whether the activity data represents the at least one non-speech activity pattern that matches the at least one characteristic activity pattern 3106
reporting with reporting circuitry a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen 3108
End

FIG. 47

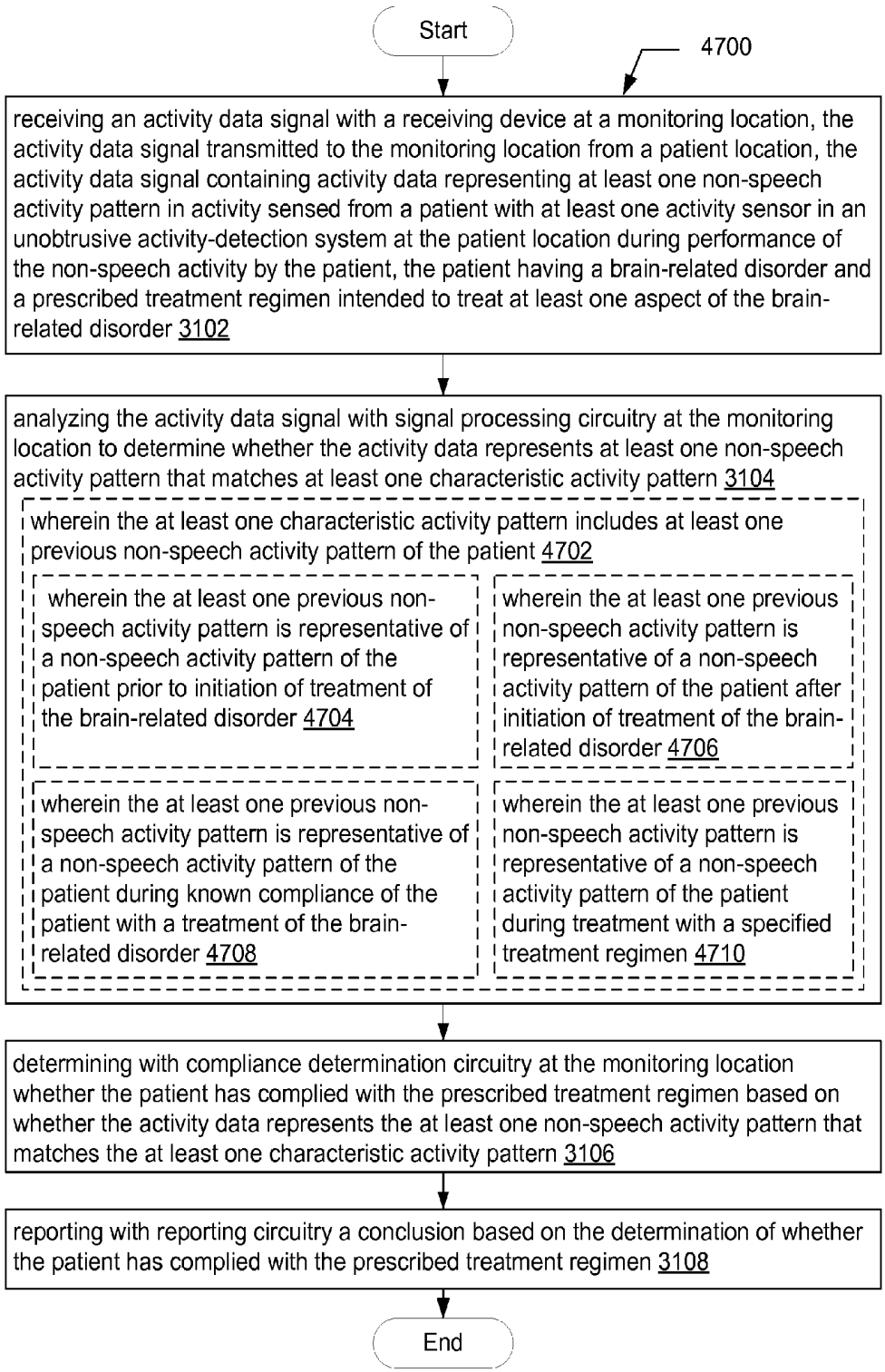

Start
4700
receiving an activity data signal with a receiving device at a monitoring location, the activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during performance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen intended to treat at least one aspect of the brain-related disorder 3102
analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern 3104
wherein the at least one characteristic activity pattern includes at least one previous non-speech activity pattern of the patient 4702
wherein the at least one previous non-speech activity pattern is representative of a non-speech activity pattern of the patient prior to initiation of treatment of the brain-related disorder 4704
wherein the at least one previous non-speech activity pattern is representative of a non-speech activity pattern of the patient after initiation of treatment of the brain-related disorder 4706
wherein the at least one previous non-speech activity pattern is representative of a non-speech activity pattern of the patient during known compliance of the patient with a treatment of the brain-related disorder 4708
wherein the at least one previous non-speech activity pattern is representative of a non-speech activity pattern of the patient during treatment with a specified treatment regimen 4710
determining with compliance determination circuitry at the monitoring location whether the patient has complied with the prescribed treatment regimen based on whether the activity data represents the at least one non-speech activity pattern that matches the at least one characteristic activity pattern 3106
reporting with reporting circuitry a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen 3108
End

FIG. 48

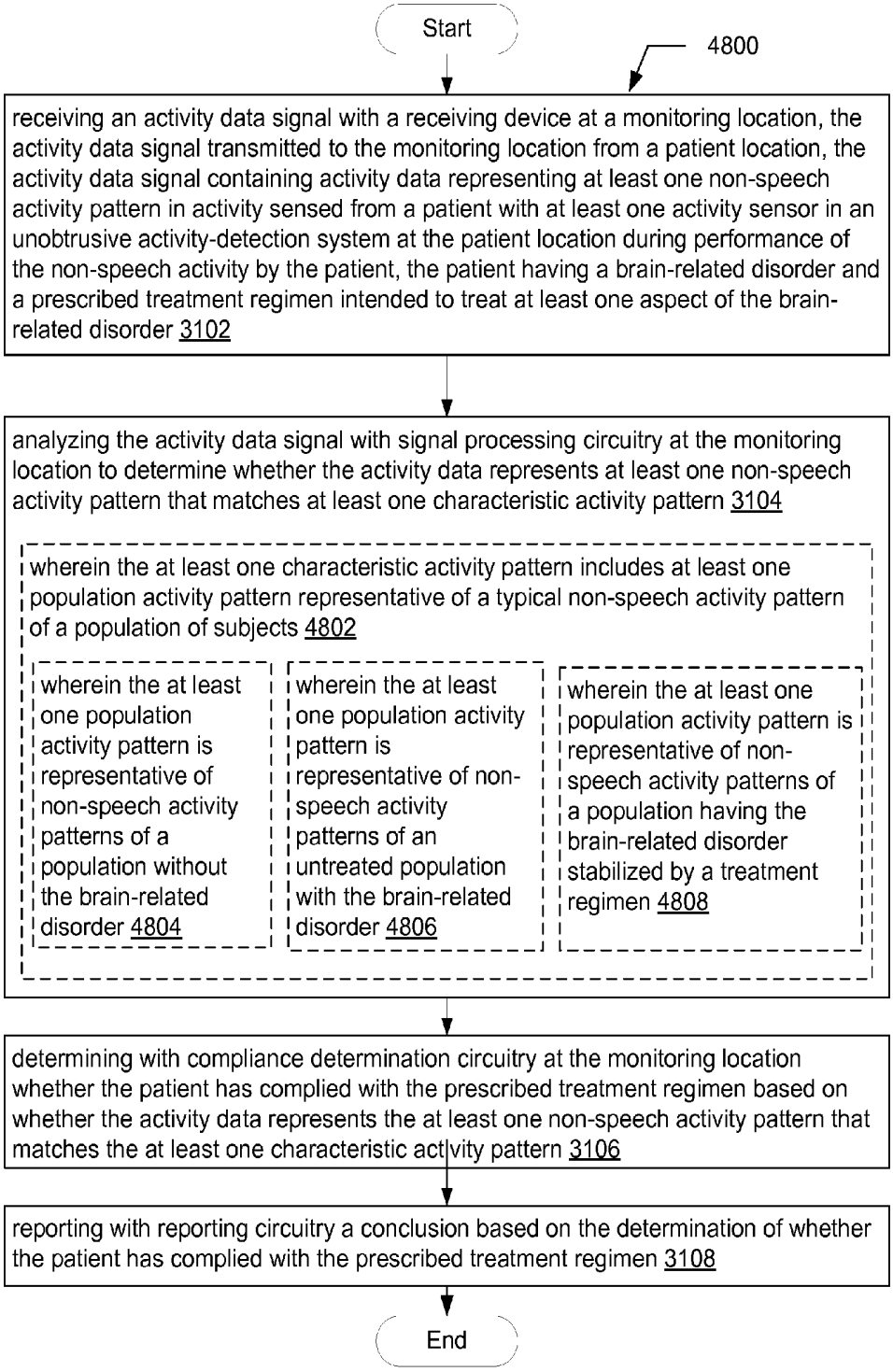

Start
4800
receiving an activity data signal with a receiving device at a monitoring location, the activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during performance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen intended to treat at least one aspect of the brain-related disorder 3102
analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern 3104
wherein the at least one characteristic activity pattern includes at least one population activity pattern representative of a typical non-speech activity pattern of a population of subjects 4802
wherein the at least one population activity pattern is representative of non-speech activity patterns of a population without the brain-related disorder 4804
wherein the at least one population activity pattern is representative of non-speech activity patterns of an untreated population with the brain-related disorder 4806
wherein the at least one population activity pattern is representative of non-speech activity patterns of a population having the brain-related disorder stabilized by a treatment regimen 4808
determining with compliance determination circuitry at the monitoring location whether the patient has complied with the prescribed treatment regimen based on whether the activity data represents the at least one non-speech activity pattern that matches the at least one characteristic activity pattern 3106
reporting with reporting circuitry a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen 3108
End

FIG. 49

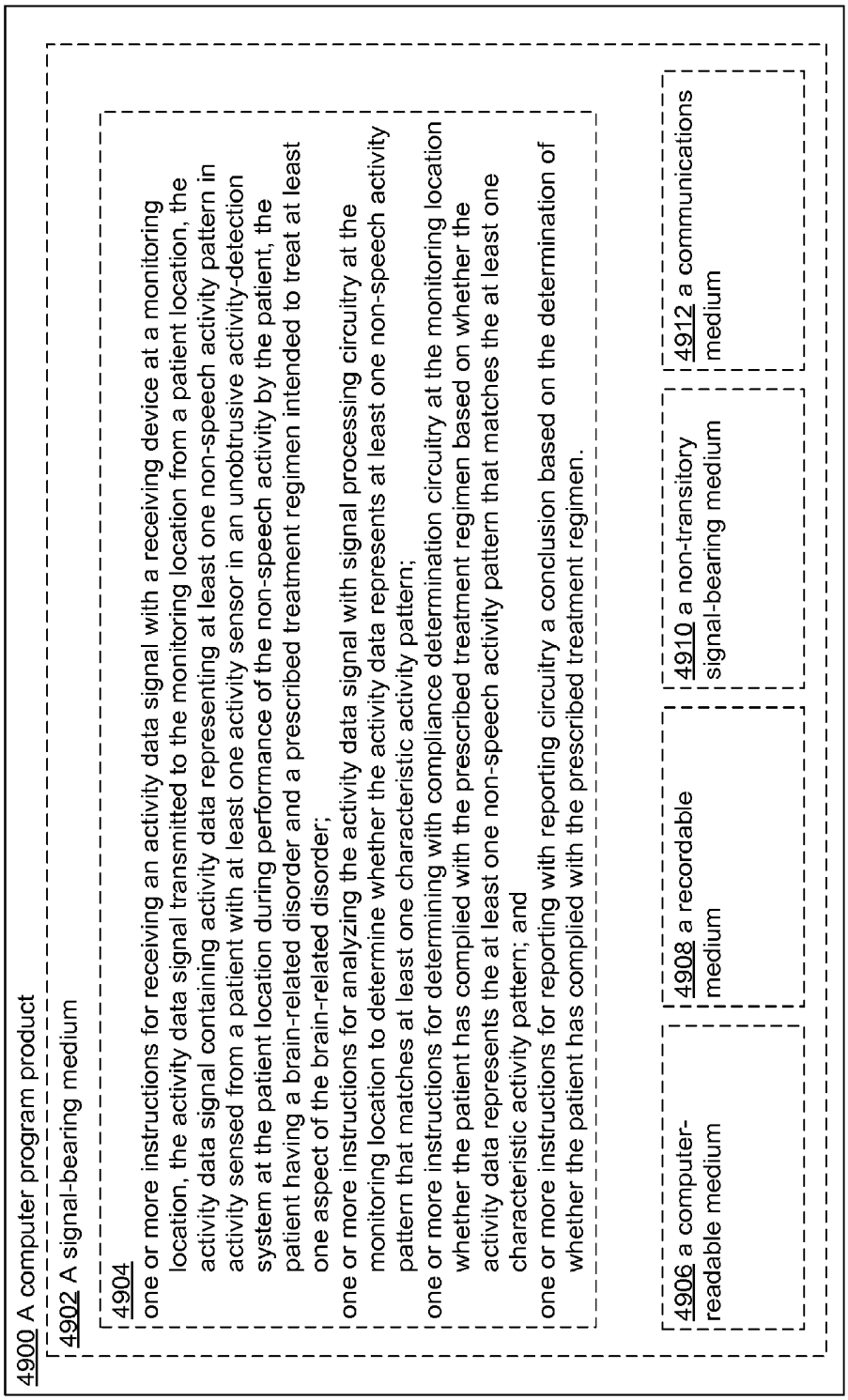

4900 A computer program product
4902 A signal-bearing medium
4904
one or more instructions for receiving an activity data signal with a receiving device at a monitoring location, the activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during performance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen intended to treat at least one aspect of the brain-related disorder;
one or more instructions for analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern;
one or more instructions for determining with compliance determination circuitry at the monitoring location whether the patient has complied with the prescribed treatment regimen based on whether the activity data represents the at least one non-speech activity pattern that matches the at least one characteristic activity pattern; and
one or more instructions for reporting with reporting circuitry a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen.
4906 a computer-readable medium
4908 a recordable medium
4910 a non-transitory signal-bearing medium
4912 a communications medium

FIG. 50

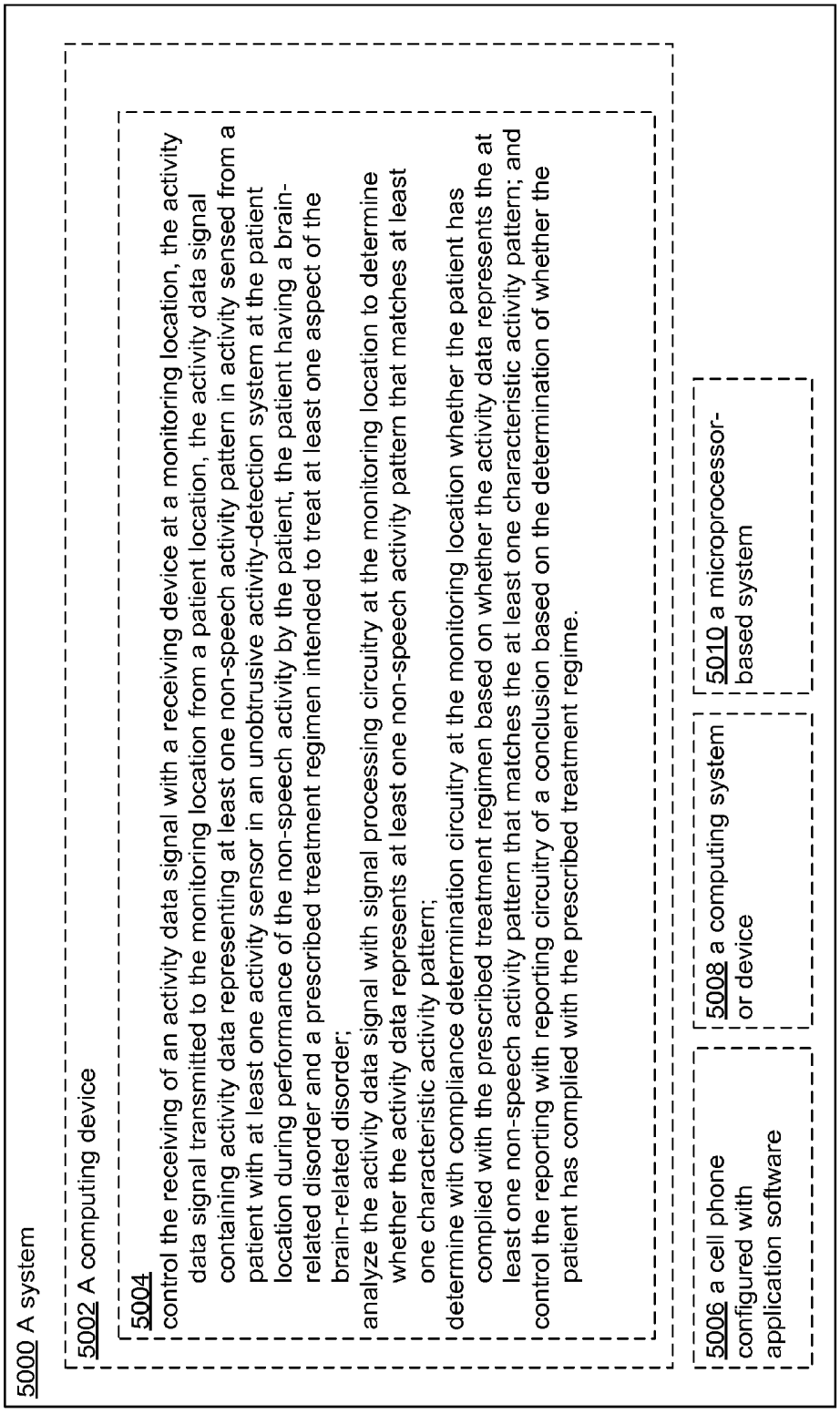

5000 A system
5002 A computing device
5004
control the receiving of an activity data signal with a receiving device at a monitoring location, the activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during performance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen intended to treat at least one aspect of the brain-related disorder;
analyze the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern;
determine with compliance determination circuitry at the monitoring location whether the patient has complied with the prescribed treatment regimen based on whether the activity data represents the at least one non-speech activity pattern that matches the at least one characteristic activity pattern; and
control the reporting with reporting circuitry of a conclusion based on the determination of whether the patient has complied with the prescribed treatment regime.
5006 a cell phone configured with application software
5008 a computing system or device
5010 a microprocessor-based system

FIG. 51

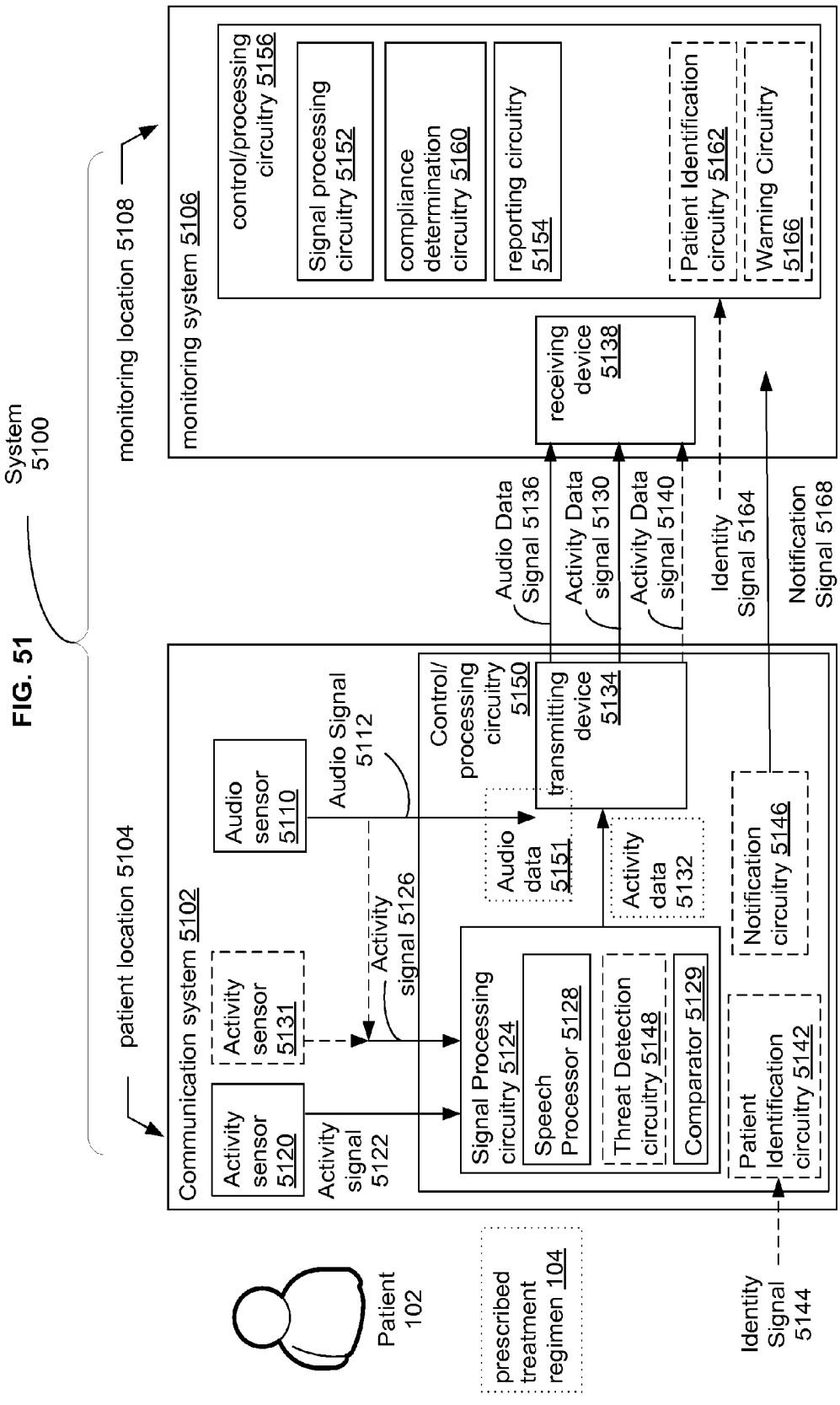

System 5100
patient location 5104
monitoring location 5108
Communication system 5102
Activity sensor 5120
Activity signal 5122
Activity sensor 5131
Audio sensor 5110
Audio Signal 5112
Activity signal 5126
Signal Processing circuitry 5124
Speech Processor 5128
Threat Detection circuitry 5148
Comparator 5129
Patient Identification circuitry 5142
Notification circuitry 5146
Control/ processing circuitry 5150
Audio data 5151
Activity data 5132
transmitting device 5134
Audio Data Signal 5136
Activity Data signal 5130
Activity Data signal 5140
monitoring system 5106
control/processing circuitry 5156
Signal processing circuitry 5152
compliance determination circuitry 5160
reporting circuitry 5154
receiving device 5138
Patient Identification circuitry 5162
Warning Circuitry 5166
Identity Signal 5164
Notification Signal 5168
Patient 102
prescribed treatment regimen 104
Identity Signal 5144

FIG. 52

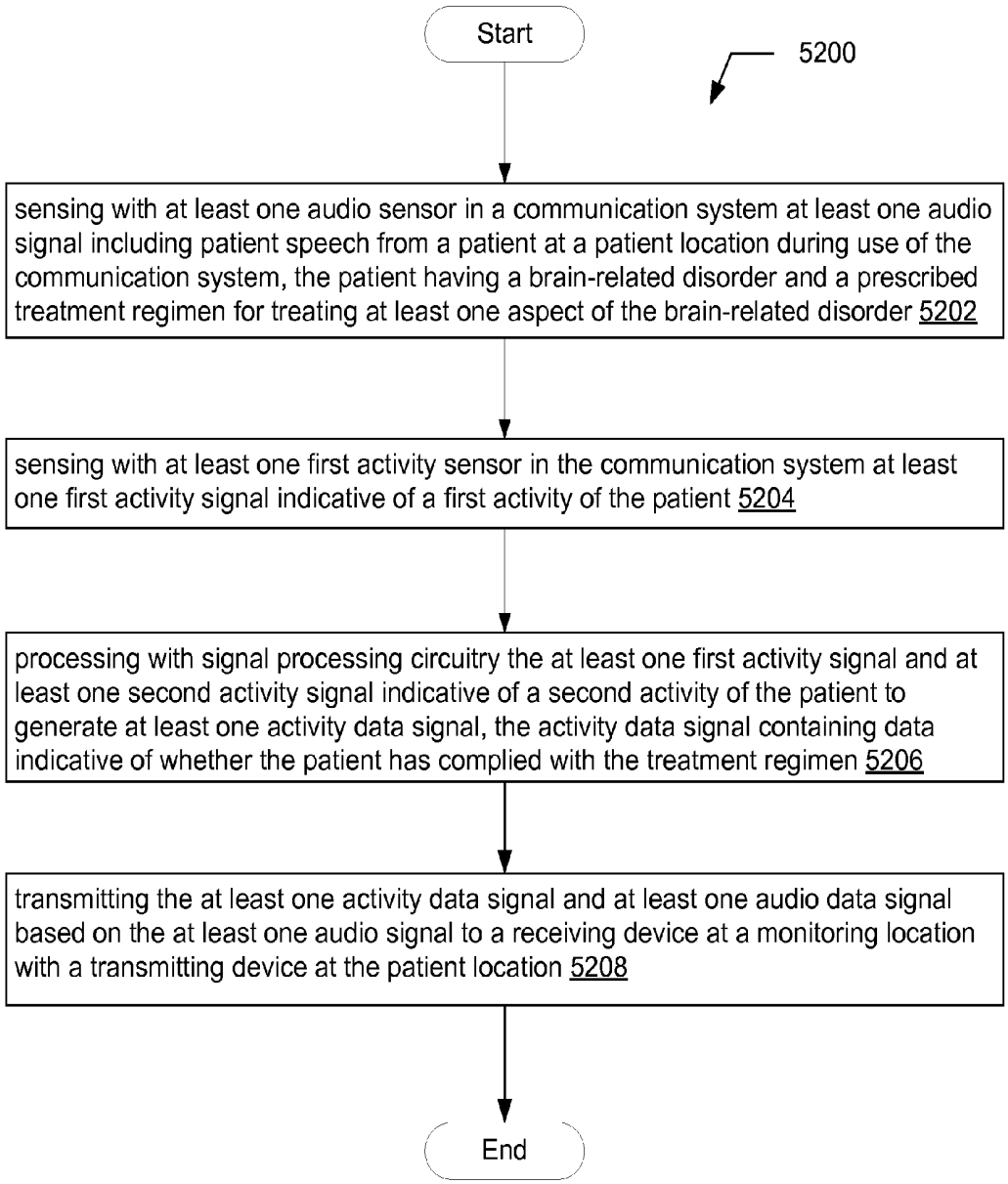

Start
5200
sensing with at least one audio sensor in a communication system at least one audio signal including patient speech from a patient at a patient location during use of the communication system, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder 5202
sensing with at least one first activity sensor in the communication system at least one first activity signal indicative of a first activity of the patient 5204
processing with signal processing circuitry the at least one first activity signal and at least one second activity signal indicative of a second activity of the patient to generate at least one activity data signal, the activity data signal containing data indicative of whether the patient has complied with the treatment regimen 5206
transmitting the at least one activity data signal and at least one audio data signal based on the at least one audio signal to a receiving device at a monitoring location with a transmitting device at the patient location 5208
End

FIG. 53

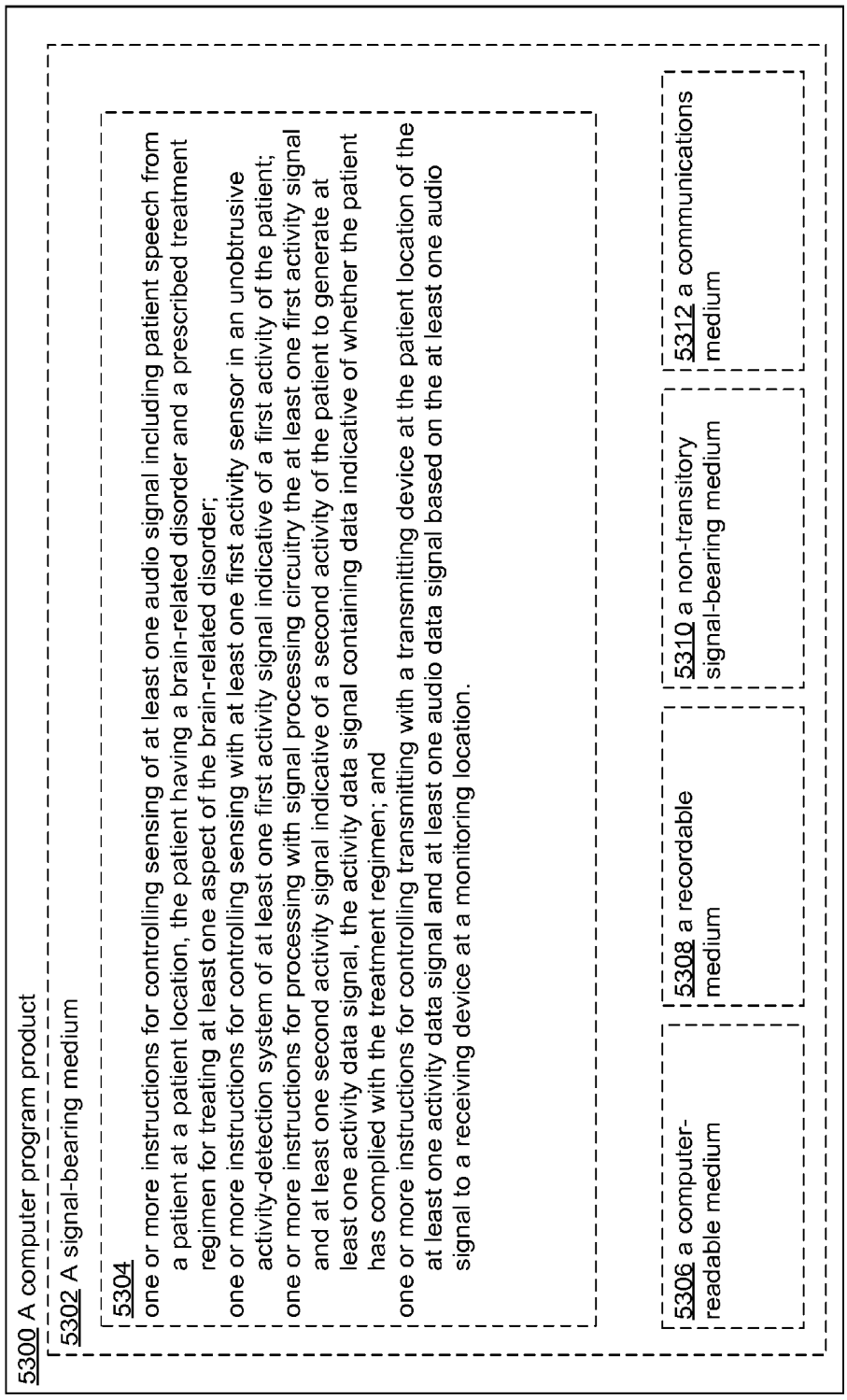

5300 A computer program product
5302 A signal-bearing medium
5304
one or more instructions for controlling sensing of at least one audio signal including patient speech from a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder;
one or more instructions for controlling sensing with at least one first activity sensor in an unobtrusive activity-detection system of at least one first activity signal indicative of a first activity of the patient;
one or more instructions for processing with signal processing circuitry the at least one first activity signal and at least one second activity signal indicative of a second activity of the patient to generate at least one activity data signal, the activity data signal containing data indicative of whether the patient has complied with the treatment regimen; and
one or more instructions for controlling transmitting with a transmitting device at the patient location of the at least one activity data signal and at least one audio data signal based on the at least one audio signal to a receiving device at a monitoring location.
5306 a computer-readable medium
5308 a recordable medium
5310 a non-transitory signal-bearing medium
5312 a communications medium

FIG. 54

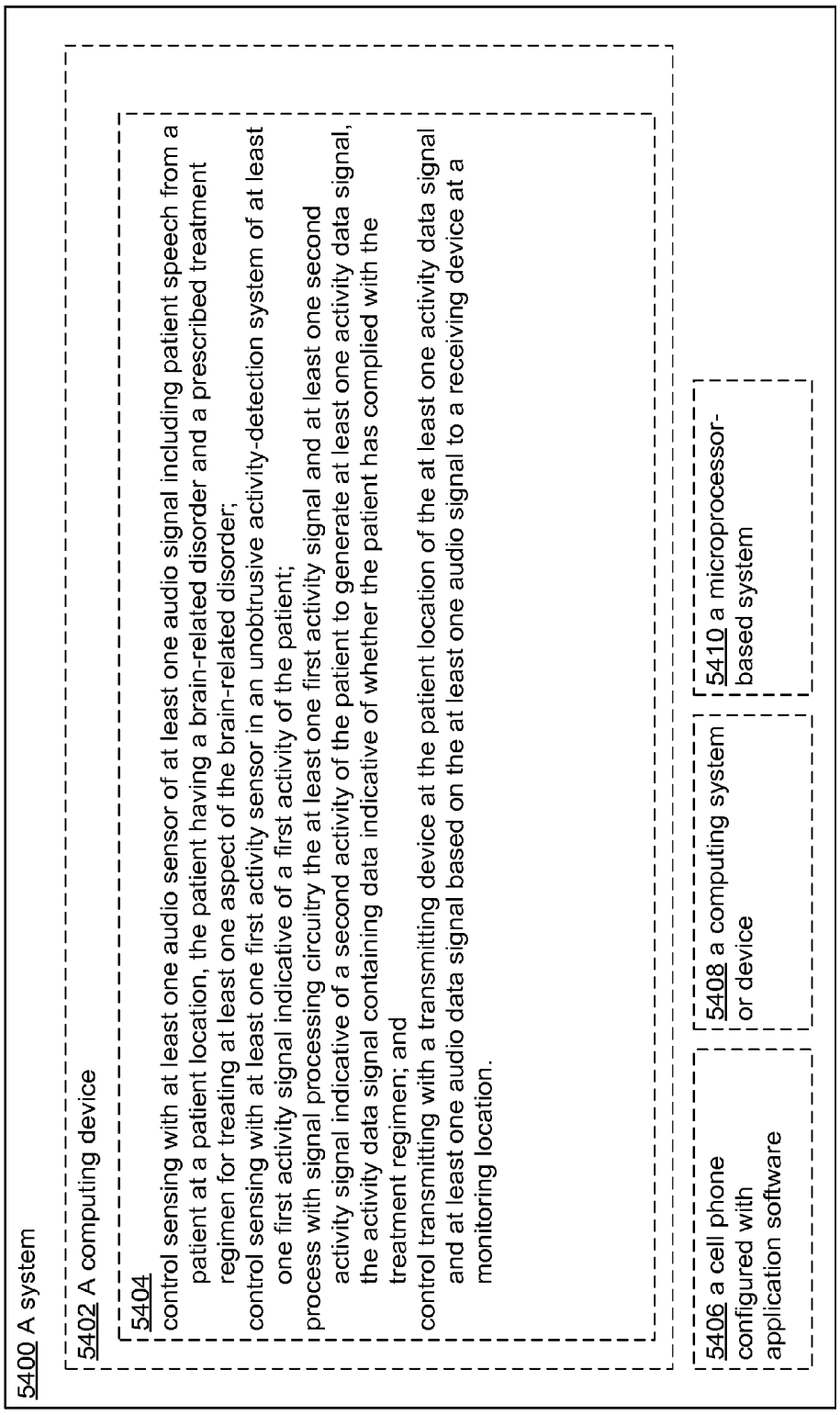

5400 A system
5402 A computing device
5404
control sensing with at least one audio sensor of at least one audio signal including patient speech from a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder;
control sensing with at least one first activity sensor in an unobtrusive activity-detection system of at least one first activity signal indicative of a first activity of the patient;
process with signal processing circuitry the at least one first activity signal and at least one second activity signal indicative of a second activity of the patient to generate at least one activity data signal, the activity data signal containing data indicative of whether the patient has complied with the treatment regimen; and
control transmitting with a transmitting device at the patient location of the at least one activity data signal and at least one audio data signal based on the at least one audio signal to a receiving device at a monitoring location.
5406 a cell phone configured with application software
5408 a computing system or device
5410 a microprocessor-based system

FIG. 55

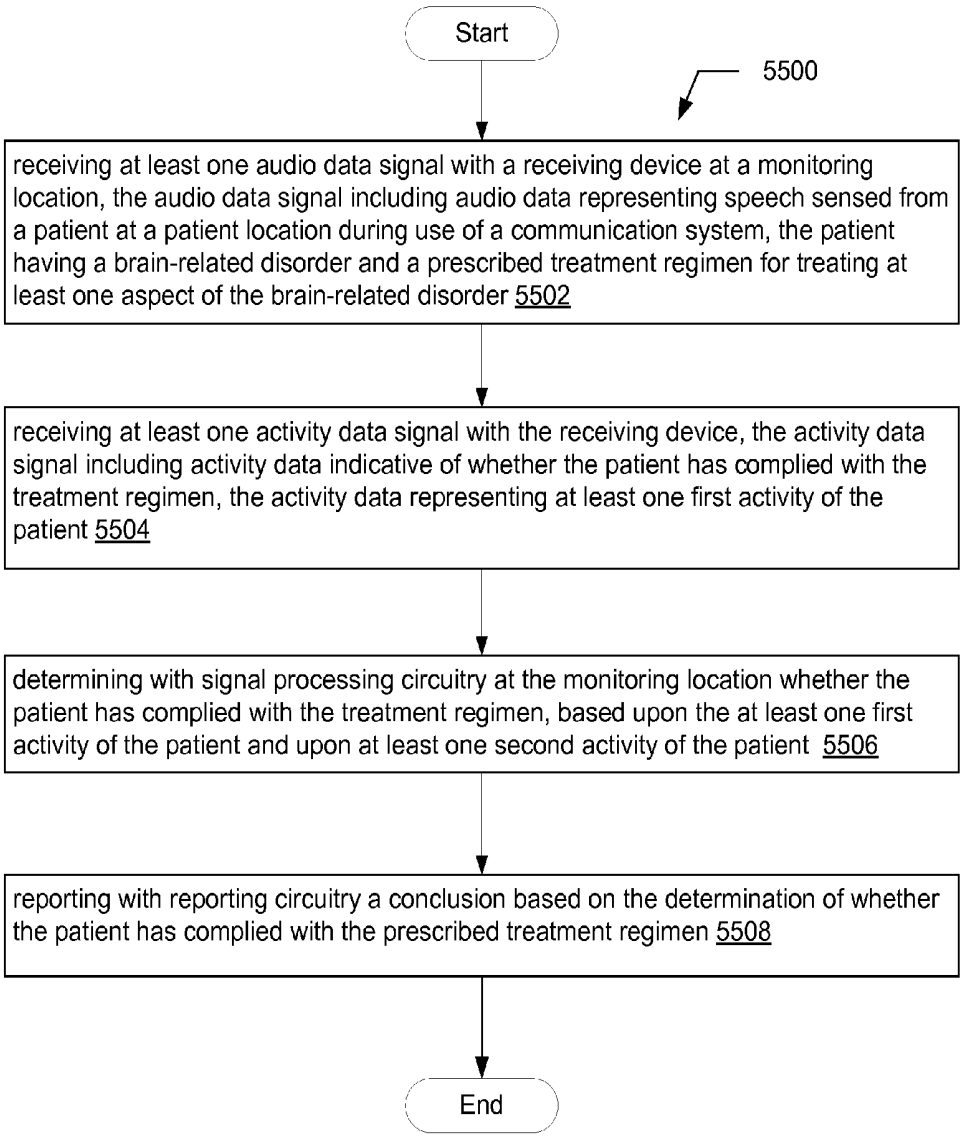

Start
5500
receiving at least one audio data signal with a receiving device at a monitoring location, the audio data signal including audio data representing speech sensed from a patient at a patient location during use of a communication system, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder 5502
receiving at least one activity data signal with the receiving device, the activity data signal including activity data indicative of whether the patient has complied with the treatment regimen, the activity data representing at least one first activity of the patient 5504
determining with signal processing circuitry at the monitoring location whether the patient has complied with the treatment regimen, based upon the at least one first activity of the patient and upon at least one second activity of the patient 5506
reporting with reporting circuitry a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen 5508
End

FIG. 56

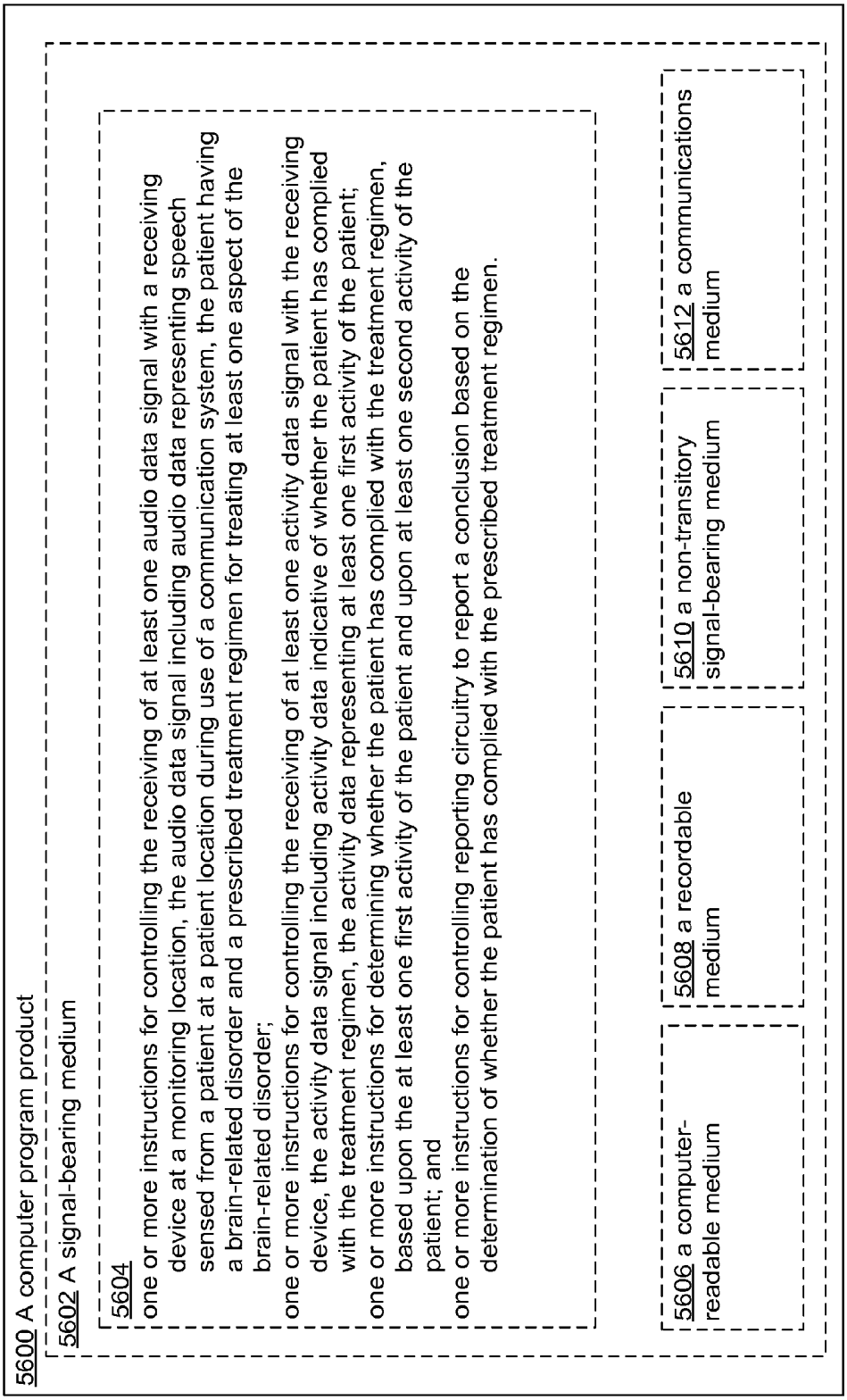
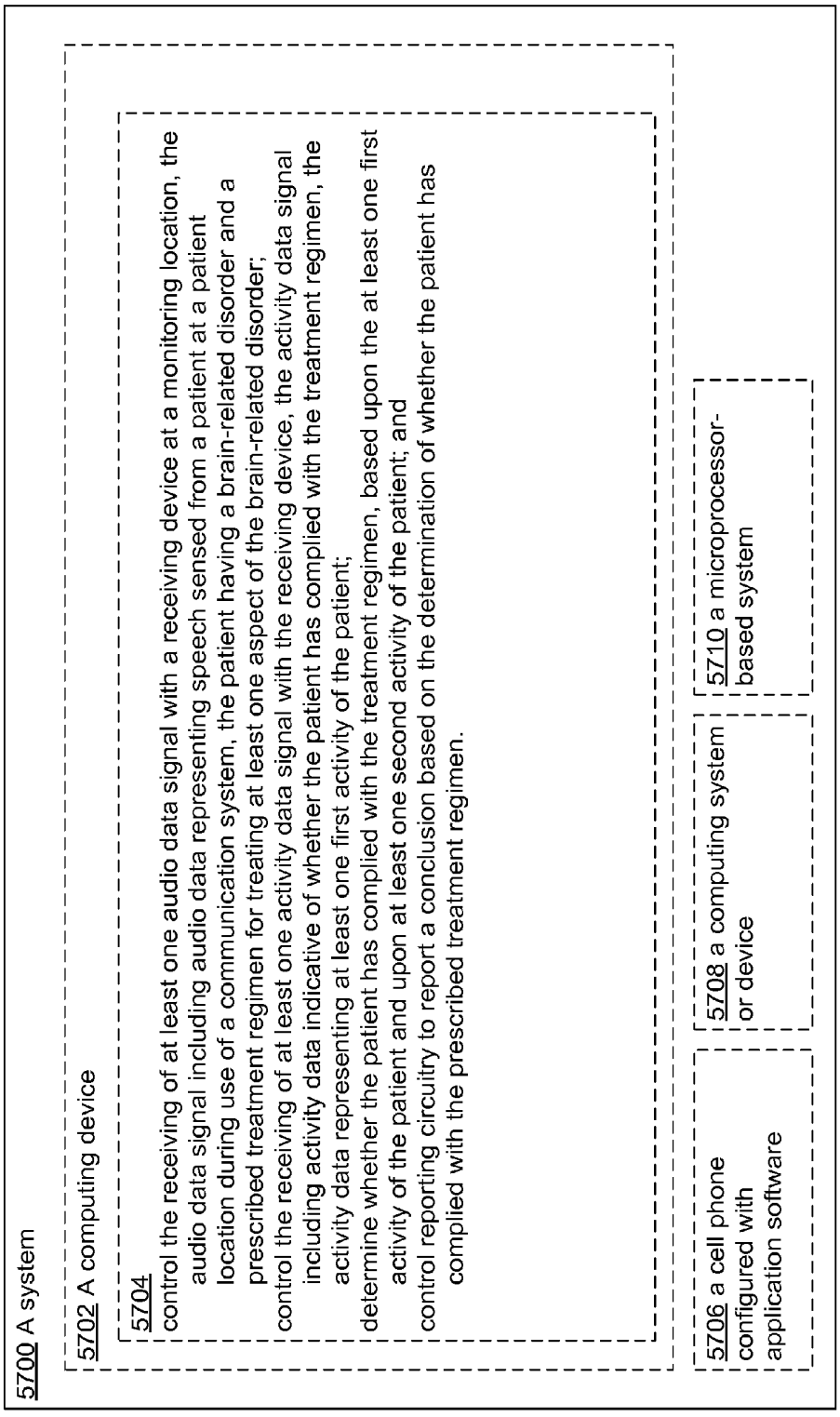

5600 A computer program product
5602 A signal-bearing medium
5604
one or more instructions for controlling the receiving of at least one audio data signal with a receiving device at a monitoring location, the audio data signal including audio data representing speech sensed from a patient at a patient location during use of a communication system, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder;
one or more instructions for controlling the receiving of at least one activity data signal with the receiving device, the activity data signal including activity data indicative of whether the patient has complied with the treatment regimen, the activity data representing at least one first activity of the patient;
one or more instructions for determining whether the patient has complied with the treatment regimen, based upon the at least one first activity of the patient and upon at least one second activity of the patient; and
one or more instructions for controlling reporting circuitry to report a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen.
5606 a computer-readable medium
5608 a recordable medium
5610 a non-transitory signal-bearing medium
5612 a communications medium

FIG. 57


5700 A system
5702 A computing device
5704
control the receiving of at least one audio data signal with a receiving device at a monitoring location, the audio data signal including audio data representing speech sensed from a patient at a patient location during use of a communication system, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder;
control the receiving of at least one activity data signal with the receiving device, the activity data signal including activity data indicative of whether the patient has complied with the treatment regimen, the activity data representing at least one first activity of the patient;
determine whether the patient has complied with the treatment regimen, based upon the at least one first activity of the patient and upon at least one second activity of the patient; and
control reporting circuitry to report a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen.
5706 a cell phone configured with application software
5708 a computing system or device
5710 a microprocessor-based system

DETERMINING TREATMENT COMPLIANCE USING COMBINED PERFORMANCE INDICATORS

[0001] If an Application Data Sheet (ADS) has been filed on the filing date of this application, it is incorporated by reference herein. Any applications claimed on the ADS for priority under 35 U.S.C. §§119, 120, 121, or 365(c), and any and all parent, grandparent, great-grandparent, etc. applications of such applications, are also incorporated by reference, including any priority claims made in those applications and any material incorporated by reference, to the extent such subject matter is not inconsistent herewith.

CROSS-REFERENCE TO RELATED APPLICATIONS

[0002] The present application claims the benefit of the earliest available effective filing date(s) from the following listed application(s) (the "Priority Applications"), if any, listed below (e.g., claims earliest available priority dates for other than provisional patent applications or claims benefits under 35 USC §119(e) for provisional patent applications, for any and all parent, grandparent, great-grandparent, etc. applications of the Priority Application(s)).

PRIORITY APPLICATIONS

[0003] The present application constitutes a continuation-in-part of U.S. patent application Ser. No. 14/543,030, entitled MONITORING TREATMENT COMPLIANCE USING SPEECH PATTERNS PASSIVELY CAPTURED FROM A PATIENT ENVIRONMENT, naming Jeffrey A. Bowers, Paul Duesterhoft, Daniel Hawkins, Roderick A. Hyde, Edward K. Y. Jung, Jordin T. Kare, Eric C. Leuthardt, Nathan P. Myhrvold, Michael A. Smith, Elizabeth A. Sweeney, Clarence T. Tegreene, and Lowell L. Wood, Jr. as inventors, filed 17 Nov. 2014 with attorney docket no. 0810-004-006-000000, which is currently co-pending or is an application of which a currently co-pending application is entitled to the benefit of the filing date.

[0004] The present application constitutes a continuation-in-part of U.S. patent application Ser. No. 14/543,066, entitled DETERMINING TREATMENT COMPLIANCE USING SPEECH PATTERNS PASSIVELY CAPTURED FROM A PATIENT ENVIRONMENT, naming Jeffrey A. Bowers, Paul Duesterhoft, Daniel Hawkins, Roderick A. Hyde, Edward K. Y. Jung, Jordin T. Kare, Eric C. Leuthardt, Nathan P. Myhrvold, Michael A. Smith, Elizabeth A. Sweeney, Clarence T. Tegreene, and Lowell L. Wood, Jr. as inventors, filed 17 Nov. 2014 with attorney docket no. 0810-004-007-000000, which is currently co-pending or is an application of which a currently co-pending application is entitled to the benefit of the filing date.

[0005] The present application constitutes a continuation-in-part of U.S. patent application Ser. No. 14/729,278, entitled MONITORING TREATMENT COMPLIANCE USING SPEECH PATTERNS CAPTURED DURING USE OF A COMMUNICATION SYSTEM, naming Jeffrey A. Bowers, Paul Duesterhoft, Daniel Hawkins, Roderick A. Hyde, Edward K. Y. Jung, Jordin T. Kare, Eric C. Leuthardt, Nathan P. Myhrvold, Michael A. Smith, Elizabeth A. Sweeney, Clarence T. Tegreene, and Lowell L. Wood, Jr. as inventors, filed 3 Jun. 2015 with attorney docket no. 0810-004-008-000000, which is currently co-pending or is an application of which a currently co-pending application is entitled to the benefit of the filing date.

[0006] The present application constitutes a continuation-in-part of U.S. patent application Ser. No. 14/729,322, entitled DETERMINING TREATMENT COMPLIANCE USING SPEECH PATTERNS CAPTURED DURING USE OF A COMMUNICATION SYSTEM, naming Jeffrey A. Bowers, Paul Duesterhoft, Daniel Hawkins, Roderick A. Hyde, Edward K. Y. Jung, Jordin T. Kare, Eric C. Leuthardt, Nathan P. Myhrvold, Michael A. Smith, Elizabeth A. Sweeney, Clarence T. Tegreene, and Lowell L. Wood, Jr. as inventors, filed 3 Jun. 2015 with attorney docket no. 0810-004-009-000000, which is currently co-pending or is an application of which a currently co-pending application is entitled to the benefit of the filing date.

[0007] If the listings of applications provided above are inconsistent with the listings provided via an ADS, it is the intent of the Applicant to claim priority to each application that appears in the Domestic Benefit/National Stage Information section of the ADS and to each application that appears in the Priority Applications section of this application.

[0008] All subject matter of the Priority Applications and of any and all applications related to the Priority Applications by priority claims (directly or indirectly), including any priority claims made and subject matter incorporated by reference therein as of the filing date of the instant application, is incorporated herein by reference to the extent such subject matter is not inconsistent herewith.

SUMMARY

[0009] In an aspect, a system includes, but is not limited to, at least one receiving device for use at a monitoring location for receiving an activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during performance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder, signal processing circuitry configured to analyze the activity data signal to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern, compliance determination circuitry configured to determine whether the patient has complied with the prescribed treatment regimen based upon whether the activity data represents the non-speech activity pattern that matches the at least one characteristic activity pattern, and reporting circuitry configured to report a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen. In addition to the foregoing, other system aspects are described in the claims, drawings, and text forming a part of the disclosure set forth herein.

[0010] In an aspect, a method of monitoring compliance of a patient with a prescribed treatment regimen includes, but is not limited to, receiving an activity data signal with a receiving device at a monitoring location, the activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during per-

formance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen intended to treat at least one aspect of the brain-related disorder, analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern, determining with compliance determination circuitry at the monitoring location whether the patient has complied with the prescribed treatment regimen based on whether the activity data represents the at least one non-speech activity pattern that matches the at least one characteristic activity pattern, and reporting with reporting circuitry a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen. In addition to the foregoing, other method aspects are described in the claims, drawings, and text forming a part of the disclosure set forth herein.

[0011] In an aspect, a computer program product includes, but is not limited to, a non-transitory signal-bearing medium bearing one or more instructions for receiving an activity data signal with a receiving device at a monitoring location, the activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during performance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen intended to treat at least one aspect of the brain-related disorder, one or more instructions for analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern, one or more instructions for determining with compliance determination circuitry at the monitoring location whether the patient has complied with the prescribed treatment regimen based on whether the activity data represents the at least one non-speech activity pattern that matches the at least one characteristic activity pattern, and one or more instructions for reporting with reporting circuitry a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen. In addition to the foregoing, other aspects of a computer program product including one or more non-transitory machine-readable data storage media bearing one or more instructions are described in the claims, drawings, and text forming a part of the disclosure set forth herein.

[0012] In an aspect, a system includes, but is not limited to a computing device, and instructions that when executed on the computing device cause the computing device to control the receiving of an activity data signal with a receiving device at a monitoring location, the activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during performance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen intended to treat at least one aspect of the brain-related disorder, analyze the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern, determine with compliance determination circuitry at the monitoring location whether the patient has complied with the prescribed treatment regimen based on whether the activity data represents the at least one non-speech activity pattern that matches the at least one characteristic activity pattern, and control the reporting with reporting circuitry of a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen. In addition to the foregoing, other system aspects are described in the claims, drawings, and text forming a part of the disclosure set forth herein.

[0013] In an aspect, an unobtrusive activity-detection system includes, but is not limited to, at least one activity sensor for sensing at least one activity signal including a non-speech activity pattern corresponding to performance of a non-speech activity by a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder, activity detection circuitry configured to identify at least one section of the at least one activity signal containing the non-speech activity pattern, activity analysis circuitry for processing the at least one section of the at least one activity signal to generate activity data including data indicative of whether the patient has complied with the treatment regimen, and at least one transmitting device for transmitting an activity data signal including the activity data including data indicative of whether the patient has complied with the treatment regimen from the patient location to a receiving device at a monitoring location. In addition to the foregoing, other system aspects are described in the claims, drawings, and text forming a part of the disclosure set forth herein.

[0014] In an aspect, a method includes, but is not limited to, sensing with at least one activity sensor in an unobtrusive activity-detection system at least one activity signal including a non-speech activity pattern corresponding to performance of a non-speech activity by a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder, processing the at least one activity signal with activity detection circuitry in the unobtrusive activity-detection system to identify at least one section of the at least one activity signal containing the non-speech activity pattern, analyzing the at least one section of the at least one activity signal with activity analysis circuitry in the unobtrusive activity-detection system to generate activity data including data indicative of whether the patient has complied with the treatment regimen, and transmitting an activity data signal including the activity data including data indicative of whether the patient has complied with the treatment regimen to a receiving device at a monitoring location with at least one transmitting device at the patient location. In addition to the foregoing, other method aspects are described in the claims, drawings, and text forming a part of the disclosure set forth herein.

[0015] In an aspect, a computer program product includes, but is not limited to, a non-transitory signal-bearing medium bearing one or more instructions for sensing with at least one activity sensor in an unobtrusive activity-detection system at least one activity signal including a non-speech activity pattern corresponding to performance of a non-speech activity by a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treat-

ing at least one aspect of the brain-related disorder, one or more instructions for processing the at least one activity signal with activity detection circuitry in the unobtrusive activity-detection system to identify at least one section of the at least one activity signal containing the non-speech activity pattern, one or more instructions for analyzing the at least one section of the at least one activity signal with activity analysis circuitry in the unobtrusive activity-detection system to generate activity data including data indicative of whether the patient has complied with the treatment regimen, and one or more instructions for transmitting an activity data signal including the activity data including data indicative of whether the patient has complied with the treatment regimen to a receiving device at a monitoring location with at least one transmitting device at the patient location. In addition to the foregoing, other aspects of a computer program product including one or more non-transitory machine-readable data storage media bearing one or more instructions are described in the claims, drawings, and text forming a part of the disclosure set forth herein.

[0016] In an aspect, a system includes, but is not limited to, a computing device and instructions that when executed on the computing device cause the computing device to control the sensing with at least one activity sensor in an unobtrusive activity-detection system of at least one activity signal including a non-speech activity pattern corresponding to performance of a non-speech activity by a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder, process the at least one activity signal with activity detection circuitry in the unobtrusive activity-detection system to identify at least one section of the at least one activity signal containing the non-speech activity pattern, analyze the at least one section of the at least one activity signal with activity analysis circuitry in the unobtrusive activity-detection system to generate activity data including data indicative of whether the patient has complied with the treatment regimen, and control the transmitting of an activity data signal including the activity data including data indicative of whether the patient has complied with the treatment regimen to a receiving device at a monitoring location with at least one transmitting device at the patient location. In addition to the foregoing, other system aspects are described in the claims, drawings, and text forming a part of the disclosure set forth herein.

[0017] In an aspect, a system includes, but is not limited to, at least one receiving device for use at a monitoring location for receiving at least one activity data signal and at least one audio data signal from a communication system, the at least one audio data signal including audio data representing speech from a patient at a patient location sensed with at least one audio sensor at the patient location during use of the communication system and transmitted to the monitoring location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder, the at least one activity data signal including activity data indicative of whether the patient has complied with the prescribed treatment regimen, the activity data representing at least one first activity of the patient, signal processing circuitry configured to process the at least one activity data signal to determine based upon the at least one first activity of the patient and at least one second activity of the patient whether the patient has complied with the prescribed treatment regimen, and reporting circuitry configured to report a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen. In addition to the foregoing, other system aspects are described in the claims, drawings, and text forming a part of the disclosure set forth herein.

[0018] In an aspect, a method of monitoring compliance of a patient with a treatment regimen includes, but is not limited to receiving at least one audio data signal with a receiving device at a monitoring location, the audio data signal including audio data representing speech sensed from a patient at a patient location during use of a communication system, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder, receiving at least one activity data signal with the receiving device, the activity data signal including activity data indicative of whether the patient has complied with the treatment regimen, the activity data representing at least one first activity of the patient, determining with signal processing circuitry at the monitoring location whether the patient has complied with the treatment regimen, based upon the at least one first activity of the patient and upon at least one second activity of the patient, and reporting with reporting circuitry a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen. In addition to the foregoing, other method aspects are described in the claims, drawings, and text forming a part of the disclosure set forth herein.

[0019] In an aspect, a computer program product includes, but is not limited to, a non-transitory signal-bearing medium bearing one or more instructions for controlling the receiving of at least one audio data signal with a receiving device at a monitoring location, the audio data signal including audio data representing speech sensed from a patient at a patient location during use of a communication system, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder, one or more instructions for controlling the receiving of at least one activity data signal with the receiving device, the activity data signal including activity data indicative of whether the patient has complied with the treatment regimen, the activity data representing at least one first activity of the patient, one or more instructions for determining whether the patient has complied with the treatment regimen, based upon the at least one first activity of the patient and upon at least one second activity of the patient, and one or more instructions for controlling reporting circuitry to report a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen. In addition to the foregoing, other aspects of a computer program product including one or more non-transitory machine-readable data storage media bearing one or more instructions are described in the claims, drawings, and text forming a part of the disclosure set forth herein.

[0020] In an aspect, a system includes, but is not limited to, a computing device, and instructions that when executed on the computing device cause the computing device to control the receiving of at least one audio data signal with a receiving device at a monitoring location, the audio data signal including audio data representing speech sensed from a patient at a patient location during use of a communication system, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder, control the receiving of at least one activity data signal with the receiving device, the activity data signal

including activity data indicative of whether the patient has complied with the treatment regimen, the activity data representing at least one first activity of the patient, determining whether the patient has complied with the treatment regimen, based upon the at least one first activity of the patient and upon at least one second activity of the patient, and controlling reporting circuitry to report a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen. In addition to the foregoing, other system aspects are described in the claims, drawings, and text forming a part of the disclosure set forth herein.

[0021] In an aspect, a system includes, but is not limited to, at least one audio sensor in a communication system for sensing at least one audio signal including patient speech from a patient at a patient location during use of the communication system, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder, at least one first activity sensor for sensing at least one first activity signal indicative of a first activity of the patient, signal processing circuitry configured to process the at least one first activity signal and at least one second activity signal indicative of a second activity of the patient to generate at least one activity data signal, the activity data signal containing activity data indicative of whether the patient has complied with the treatment regimen, and at least one transmitting device at the patient location for transmitting the at least one activity data signal and at least one audio data signal based on the at least one audio signal to a receiving device at a monitoring location. In addition to the foregoing, other system aspects are described in the claims, drawings, and text forming a part of the disclosure set forth herein.

[0022] In an aspect, a method includes, but is not limited to, sensing with at least one audio sensor in a communication system at least one audio signal including patient speech from a patient at a patient location during use of the communication system, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder, sensing with at least one first activity sensor in the communication system at least one first activity signal indicative of a first activity of the patient, processing with signal processing circuitry the at least one first activity signal and at least one second activity signal indicative of a second activity of the patient to generate at least one activity data signal, the activity data signal containing data indicative of whether the patient has complied with the treatment regimen, and transmitting the at least one activity data signal and at least one audio data signal based on the at least one audio signal to a receiving device at a monitoring location with a transmitting device at the patient location. In addition to the foregoing, other method aspects are described in the claims, drawings, and text forming a part of the disclosure set forth herein.

[0023] In an aspect, a system includes, but is not limited to, a computing device and instructions that when executed on the computing device cause the computing device to control sensing with at least one audio sensor of at least one audio signal including patient speech from a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder, control sensing with at least one first activity sensor in an unobtrusive activity-detection system of at least one first activity signal indicative of a first activity of the patient, process with signal processing circuitry the at least one first activity signal and at least one second activity signal indicative of a second activity of the patient to generate at least one activity data signal, the activity data signal containing data indicative of whether the patient has complied with the treatment regimen, and control transmitting with a transmitting device at the patient location of the at least one activity data signal and at least one audio data signal based on the at least one audio signal to a receiving device at a monitoring location. In addition to the foregoing, other system aspects are described in the claims, drawings, and text forming a part of the disclosure set forth herein.

[0024] In an aspect, a computer program product includes, but is not limited to a non-transitory signal-bearing medium bearing one or more instructions for controlling sensing of at least one audio signal including patient speech from a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder, one or more instructions for controlling sensing with at least one first activity sensor in an unobtrusive activity-detection system of at least one first activity signal indicative of a first activity of the patient, one or more instructions for processing with signal processing circuitry the at least one first activity signal and at least one second activity signal indicative of a second activity of the patient to generate at least one activity data signal, the activity data signal containing data indicative of whether the patient has complied with the treatment regimen, and one or more instructions for controlling transmitting with a transmitting device at the patient location of the at least one activity data signal and at least one audio data signal based on the at least one audio signal to a receiving device at a monitoring location. In addition to the foregoing, other aspects of a computer program product including one or more non-transitory machine-readable data storage media bearing one or more instructions are described in the claims, drawings, and text forming a part of the disclosure set forth herein.

[0025] The foregoing summary is illustrative only and is not intended to be in any way limiting. In addition to the illustrative aspects, embodiments, and features described above, further aspects, embodiments, and features will become apparent by reference to the drawings and the following detailed description.

BRIEF DESCRIPTION OF THE FIGURES

[0026] FIG. **1** is a block diagram of a system for monitoring compliance of a patient with a treatment regimen.

[0027] FIG. **2** is a block diagram of an unobtrusive activity-detection system.

[0028] FIG. **3** is a block diagram showing further details of the unobtrusive activity-detection system of FIG. **2**.

[0029] FIG. **4** is a block diagram of a monitoring system.

[0030] FIG. **5** illustrates an example embodiment of a thin computing device in which embodiments may be implemented.

[0031] FIG. **6** illustrates an example embodiment of a computing system in which embodiments may be implemented.

[0032] FIG. **7** is an illustration of an unobtrusive activity detection system implemented in a cell phone.

[0033] FIG. **8** is an illustration of an unobtrusive activity detection system implemented in a computing system.

[0034] FIG. **9** is an illustration of an unobtrusive activity detection system implemented in a microwave oven.

[0035] FIG. **10** is an illustration of an unobtrusive activity detection system implemented in a game system.

[0036] FIG. **11** is an illustration of an unobtrusive activity detection system implemented in a vehicle system.
[0037] FIG. **12** is an illustration of an unobtrusive activity detection system implemented in a kiosk.
[0038] FIG. **13** is an illustration of an unobtrusive activity detection system implemented in an intercommunication system.
[0039] FIG. **14** is an illustration of an unobtrusive activity detection system implemented in connection with a hair brush.
[0040] FIG. **15** is a flow diagram of a method relating to monitoring compliance of a patient with a prescribed treatment regimen.
[0041] FIG. **16** is a flow diagram of further aspects of the method of FIG. **15**.
[0042] FIG. **17** is a flow diagram of further aspects of the method of FIG. **15**.
[0043] FIG. **18** is a flow diagram of further aspects of the method of FIG. **15**.
[0044] FIG. **19** is a flow diagram of further aspects of the method of FIG. **15**.
[0045] FIG. **20** is a flow diagram of further aspects of the method of FIG. **15**.
[0046] FIG. **21** is a flow diagram of further aspects of the method of FIG. **15**.
[0047] FIG. **22** is a flow diagram of further aspects of the method of FIG. **15**.
[0048] FIG. **23** is a flow diagram of further aspects of the method of FIG. **15**.
[0049] FIG. **24** is a flow diagram of further aspects of the method of FIG. **15**.
[0050] FIG. **25** is a flow diagram of further aspects of the method of FIG. **15**.
[0051] FIG. **26** is a flow diagram of further aspects of the method of FIG. **15**.
[0052] FIG. **27** is a flow diagram of further aspects of the method of FIG. **15**.
[0053] FIG. **28** is a flow diagram of further aspects of the method of FIG. **15**.
[0054] FIG. **29** is a block diagram of a computer program product including a signal-bearing medium.
[0055] FIG. **30** is a block diagram of a system including a computing device.
[0056] FIG. **31** is a flow diagram of a method of monitoring compliance of a patient with a prescribed treatment regimen.
[0057] FIG. **32** is a flow diagram of further aspects of the method of FIG. **31**.
[0058] FIG. **33** is a flow diagram of further aspects of the method of FIG. **31**.
[0059] FIG. **34** is a flow diagram of further aspects of the method of FIG. **31**.
[0060] FIG. **35** is a flow diagram of further aspects of the method of FIG. **31**.
[0061] FIG. **36** is a flow diagram of further aspects of the method of FIG. **31**.
[0062] FIG. **37** is a flow diagram of further aspects of the method of FIG. **31**.
[0063] FIG. **38** is a flow diagram of further aspects of the method of FIG. **31**.
[0064] FIG. **39** is a flow diagram of further aspects of the method of FIG. **31**.
[0065] FIG. **40** is a flow diagram of further aspects of the method of FIG. **31**.
[0066] FIG. **41** is a flow diagram of further aspects of the method of FIG. **31**.
[0067] FIG. **42** is a flow diagram of further aspects of the method of FIG. **31**.
[0068] FIG. **43** is a flow diagram of further aspects of the method of FIG. **31**.
[0069] FIG. **44** is a flow diagram of further aspects of the method of FIG. **31**.
[0070] FIG. **45** is a flow diagram of further aspects of the method of FIG. **31**.
[0071] FIG. **46** is a flow diagram of further aspects of the method of FIG. **31**.
[0072] FIG. **47** is a flow diagram of further aspects of the method of FIG. **31**.
[0073] FIG. **48** is a flow diagram of further aspects of the method of FIG. **31**.
[0074] FIG. **49** is a block diagram of a computer program product including a signal-bearing medium.
[0075] FIG. **50** is a block diagram of a system including a computing device.
[0076] FIG. **51** is a block diagram system for monitoring compliance of a patient with a treatment regimen.
[0077] FIG. **52** is a flow diagram of a method is a flow diagram of a method of monitoring compliance of a patient with a prescribed treatment regimen.
[0078] FIG. **53** is a block diagram of a computer program product including a signal-bearing medium.
[0079] FIG. **54** is a block diagram of a system including a computing device.
[0080] FIG. **55** is a flow diagram of a method of monitoring compliance of a patient with a treatment regimen.
[0081] FIG. **56** is a block diagram of a computer program product including a signal-bearing medium.
[0082] FIG. **57** is a block diagram of a system including a computing device.

DETAILED DESCRIPTION

[0083] In the following detailed description, reference is made to the accompanying drawings, which form a part hereof. In the drawings, similar symbols typically identify similar components, unless context dictates otherwise. The illustrative embodiments described in the detailed description, drawings, and claims are not meant to be limiting. Other embodiments may be utilized, and other changes may be made, without departing from the spirit or scope of the subject matter presented here.
[0084] In an aspect, a patient **102** has a brain-related disorder, and treatment of the patient according to a prescribed treatment regimen **104** results in detectable changes in the patient's performance of one or more non-speech activities, relative to the patient's activity performance while in an untreated or partially treated state. In an aspect, failure of the patient to comply with a prescribed treatment regimen can be detected by monitoring the patient's activity-related activity patterns, and steps can be taken to address the patient's lack of compliance. FIG. **1** illustrates in block diagram form a system **100** for monitoring compliance of a patient **102** with a prescribed treatment regimen **104** based upon unobtrusive detection of a non-verbal activity of the patient, where the non-verbal activity corresponds to performance of non-speech activity **106** by the patient. System **100** includes unobtrusive activity-detection system **108** at patient location **110**, which is used to detect non-verbal activity of the patient, and monitoring system **112** at monitoring location **114**, which allows

remote monitoring of patient compliance with prescribed treatment regimen **104** by a medical care provider **170** or other interested party or entity, e.g., a family member, an insurance company, etc.

[0085] In FIG. **1**, and in other figures herein, in general, unless context dictates otherwise, solid lines are used to indicate standard components or steps, and dashed lines are used to represent optional components or steps. Unless context indicates otherwise, dotted lines are used to indicate data or information. Dashed lines may also be used to indicate signals.

[0086] System **100** monitors compliance of patient **102** with prescribed treatment regimen **104** by detecting and analyzing activity of patient **102** corresponding to performance of a non-speech activity **106**.

[0087] Unobtrusive activity-detection system **108** includes at least one activity sensor **116** for sensing at least one activity signal **118** including a non-speech activity pattern **120** corresponding to performance of non-speech activity **106** by patient **102** at patient location **110**. Unobtrusive activity-detection system **108** also includes activity detection circuitry **122**, which is configured to identify at least one section **124** of the at least one activity signal **118** containing the non-speech activity pattern **120**, and activity analysis circuitry **126** for processing the at least one section **124** of the at least one activity signal **118** to generate activity data **128** including data indicative of whether the patient has complied with the treatment regimen. In addition, unobtrusive activity-detection system **108** includes at least one transmitting device **132** for transmitting activity data signal **134** including activity data **128** including data indicative of whether the patient has complied with the treatment regimen. Transmitting device **132** transmits activity data signal **134** from patient location **110** to receiving device **136** at monitoring location **114**.

[0088] Monitoring system **112** at monitoring location **114** includes at least one receiving device **136** for use at a monitoring location **114** for receiving an activity data signal **134** transmitted to the monitoring location **114** from patient location **110**. Activity data signal **134** contains activity data **128** representing at least one non-speech activity pattern **120** in activity sensed from patient **102** with at least one activity sensor **116** in unobtrusive activity-detection system **108** at patient location **110** during performance of non-speech activity **106** by patient **102**. Monitoring system **112** also includes signal processing circuitry **150**, which is configured to analyze activity data signal **134** to determine whether activity data **128** represents at least one non-speech activity pattern **120** that matches at least one characteristic activity pattern **152**. Signal processing circuitry **150** generates match signal **154** indicating a determination that non-speech activity pattern **120** matches a characteristic activity pattern **152**. Monitoring system **112** also includes compliance determination circuitry **156**, which is configured to determine whether patient **102** has complied with prescribed treatment regimen **104** based upon whether activity data **128** represents a non-speech activity pattern **120** that matches at least one characteristic activity pattern **152**. Compliance determination circuitry **156** generates compliance signal **158**. Monitoring system **112** also includes reporting circuitry **160**, which is configured to report a conclusion **162** (regarding patient's compliance or lack thereof) based on the determination of whether the patient has complied with the prescribed treatment regimen **104**, as indicated by compliance signal **158**.

[0089] Both unobtrusive activity-detection system **108** and monitoring system **112** include control/processing circuitry, e.g., control/processing circuitry **180** in unobtrusive activity-detection system **108** and control/processing circuitry **190** in monitoring system **112**, which includes the circuitry components specifically described herein and other circuitry components used to control operation of unobtrusive activity-detection system **108** and monitoring system **112**, respectively.

[0090] In different embodiments, examples of which are described elsewhere here, different levels of signal processing take place in unobtrusive activity-detection system **108** at patient location **110** versus at monitoring system **112** at monitoring location **114**. The location at which different signal processing aspects are performed may depend on availability of data storage space; speed, reliability and/or power consumption of data transmission between patient location **110** and monitoring location **114**; and privacy concerns relating to storage and transmittal of patient data, among other considerations. As will be discussed in greater detail herein below, activity data signal **134** may contain raw activity data, information obtained from processed activity data, or both.

[0091] In an aspect, patient **102** has a brain-related disorder, and prescribed treatment regimen **104** is a treatment regimen prescribed to patient **102** for treating at least one aspect of the brain-related disorder. Brain-related disorders include, for example, mental disorders, psychological disorders, psychiatric disorders, traumatic disorders, lesion-related disorders, and/or neurological disorders, as discussed in greater detail elsewhere herein. Prescribed treatment regimen **104** may include a prescription for one or more therapeutic treatments, including medications, pharmaceuticals, nutraceuticals, therapeutic activities, diet, sleep, exercise, counseling, etc., to be used individually or in combination. In various aspects, prescribed treatment regimen **104** specifies type, quantity, and time course of any or all such therapeutic treatments.

[0092] Monitoring system **112** at monitoring location **114** allows medical care provider **170** or another interested individual or entity to remotely monitor compliance of patient **102** with prescribed treatment regimen **104**. Monitoring location **114** may be, for example, a hospital, clinic, data center, or doctor's office. Monitoring location **114** may be a short distance away from patient location **110** (e.g., in another room of the same building, or even within the same room as patient location **110**) or it may be in a separate building, a few miles away, or many miles away.

[0093] Systems as described herein can be used, for example, to monitor patient compliance with prescribed treatment regimen **104** at the request of or with the cooperation and/or authorization of patient **102**, e.g., in the situation that the patient and/or the patient's caregiver wish to track the patient's compliance with the prescribed treatment regimen. In some cases, monitoring of patient compliance with a prescribed treatment regimen can be implemented at the request or requirement of a caregiver, insurance company, or other individual or entity, for example, as a condition of living in a group home, mental health care facility, or other institution, or as a condition of insurance reimbursement for treatment. In some cases, monitoring of compliance can be implemented without knowledge and/or authorization of the patient, e.g., in situations in which the patient is not capable of making decisions for his or her self or to fulfill a legal requirement.

[0094] FIG. **2** illustrates components of unobtrusive activity-detection system **108** at patient location **110**. As discussed

above, unobtrusive activity-detection system **108** includes at least one activity sensor **116**, activity detection circuitry **122**, activity analysis circuitry **126**, and at least one transmitting device **132**. Activity detection circuitry **122**, activity analysis circuitry **126**, and other circuitry components as described herein include or form a part of control/processing circuitry **180**.

[0095] Non-speech activity detected by unobtrusive activity-detection system **108** corresponds to one or more non-speech activity **106** performed by patient **102** (as shown in FIG. **1**). For example, such activities may include various activities of daily life, or other activities or tasks performed routinely by patient **102**, including, but not limited to, hygiene, washing, eating, dressing, brushing teeth, brushing hair, combing hair, preparing food, interacting with another person (e.g., in the same location or via an electronic device), interacting with an animal, interacting with a machine, interacting with an electronic device, or using an implement. In an aspect, such activities are performed by the patient **102** without prompting by unobtrusive activity-detection system **108**. In an aspect, detection of non-speech activity-related activity is accomplished in a manner that is not noticeable to the patient, and does not interfere with the patient's daily routine. Unprompted activity refers to activity that is performed independent of any prompt by unobtrusive activity-detection system **108**. Such activity can be considered "passively captured" in that capture of such activity is not predicated on the delivery of a prompt to the patient from unobtrusive activity-detection system **108**. It should be noted, however, that, as used herein, unprompted activity in some cases includes activity produced by the patient in response to prompts or queries by another person, e.g., in the course of interaction with the person. In addition, activity produced by the patient that is not dependent on prior interaction with another person is also considered "spontaneous activity."

[0096] Unobtrusive activity-detection system **108** may include various types of sensors **226**, including various types of activity sensor(s) **116** for detecting activities that provide information regarding the patient's brain-related state. The patient's movements may be detected directly or indirectly with various types of sensors (including, but not limited to, pressure, force, capacitance, optical, motion, and acceleration sensors). Imaging sensors (e.g., cameras) can provide images of the patient that can be used to determine various aspects of motion of the patient. The patient's interaction with devices may be detected with user interface and input devices (e.g., keyboard, pointing device, or touchscreen) and/or device controls (including, but not limited to, controllers for game or entertainment devices or systems, appliances, vehicles, medical equipment, etc.). Interaction of the patient with other individuals, pets, or other animals, can be detected through image analysis, or through the use of proximity sensors to detect proximity of the patient to the individual or animal (with proximity assumed to correlate with interaction). Activity sensor **116** may be worn or carried by the patient, built into or attached to a device with which the patient interacts, or located in the patient's environment (e.g., a video camera in the patient's home).

[0097] In an aspect, activity detection circuitry **122** is configured to identity the at least one section **124** of the at least one activity signal containing non-speech activity pattern **120** from an activity signal **118** corresponding to unprompted performance of the non-speech activity by the patient.

[0098] In an aspect, unobtrusive activity-detection system **108** includes timing circuitry **202** configured to control timing of operation of at least a portion of unobtrusive activity-detection system **108** to perform substantially continuously sensing the at least one activity signal **118** with the at least one activity sensor **116**. In an aspect, timing circuitry **202** includes a clock or timer device. For example, timing circuitry **202** may be configured to cause sensing to be performed substantially continuously by causing samples to be collected from the activity sensor **116** (e.g., via an A/D converter, not shown) at a fixed sampling rate that is sufficiently high to capture any meaningful variations in the activity sensed by the sensor (e.g., at least the Nyquist rate). The sampling rate may be determined by hardware or software, and may be factory pre-set or controllable by the user (e.g., the sampling rate may be determined by one or more control parameters **288** stored in data storage device **206**, which may be set during manufacture of unobtrusive activity-detection system **108**, or entered by a user of the system via input device **208**.) For example, in an aspect, control/processing circuitry **180** includes an A/D converter, with the sampling rate of the A/D converter controlled by timing circuitry **202**.

[0099] In another aspect, timing circuitry **202** is configured to control timing of operation of at least a portion of the system to perform intermittently at least one of sensing the at least one activity signal **118** with the at least one activity sensor **116**, identifying the at least one section **124** of the at least one activity signal containing the non-speech activity pattern with the activity detection circuitry **122**, processing the at least one section of the at least one activity signal to generate activity data **128** including data indicative of whether the patient has complied with the treatment regimen with the activity analysis circuitry **126**, and transmitting an activity data signal **134** including the activity data **128** including data indicative of whether the patient has complied with the treatment regimen from the patient location **110** to a receiving device at a monitoring location with the at least one transmitting device **132**. For example, in an aspect, intermittent sensing of the at least one activity signal **118** is controlled by using software to determine sampling rate and times at which sampling is performed, with appropriately selected control parameters **288** stored in data storage device **206**. Alternatively, in an aspect, activity is sensed substantially continuously with activity sensor **116**, but either activity detection circuitry **122** and/or activity analysis circuitry **126** is configured to process the activity signal **118** and/or section **124** intermittently rather than continuously. In another aspect, activity signal **118** is sampled on a substantially continuous basis, but transmitting device **132** is configured (with hardware or software) to transmit activity data signal **134** to the monitoring location only intermittently (once an hour, once a day, etc.). Intermittent performance of sampling, data transmission, and/or other system functions include performance at uniform intervals, any sort of non-uniform intermittent pattern (e.g., at a high frequency during some parts of the day and lower frequency during other parts of the day), or at random or quasi-random intervals (e.g., as determined by a random number generator). In an aspect, timing of system functions is controlled in part by timing circuitry **202** and in part in response to some other sensed parameter or other inputs; for example, a basic schedule may be determined by timing circuitry **202** but if it is determined that the subject is asleep or is not present, or if the data cannot be transmitted due to low signal strength, low battery power, etc., the sched-

uled function may be delayed until suitable conditions are obtained. Data storage device **206** is used to store data **210** that includes any or all of activity signal **118**, section **124** of activity signal, and activity data **128**, as such data are obtained. Data thus stored can be retrieved from data storage device **206** for transmission with transmitting device **132** intermittently. Data storage device **206** may be any of various types of data storage and/or memory devices.

[0100] In an aspect, timing circuitry **202** is configured to control timing of operation of at least a portion of the system to perform according to a schedule at least one of sensing the at least one activity signal with the at least one activity sensor **116**, identifying the at least one section **124** of the at least one activity signal containing the non-speech activity pattern **120** with the activity detection circuitry **122**, processing the at least one section **124** of the at least one activity signal to generate activity data **128** including data indicative of whether the patient has complied with the treatment regimen the activity analysis circuitry, and transmitting an activity data signal **134** including the activity data including data indicative of whether the patient has complied with the treatment regimen from the patient location to a receiving device at a monitoring location with the at least one transmitting device **132**. Performance of the aforementioned steps according to a schedule can be controlled by timing circuitry **202** configured by hardware and software, using control parameters **288**, including sampling rate and times at which sampling, processing of activity signal **118** and/or section **124**, and transmission of activity data signal **134** are to be performed. The timing of these steps can be determined by control parameters **288**, which may be set or selected by a user, or preset during manufacture of the device, as described above. Unobtrusive activity-detection system **108** may include one or more power sources (not shown), e.g., a battery, a plug for connecting to an electrical outlet or communication port, e.g., a USB port, or any of various other types of power sources.

[0101] As noted above, in an aspect, unobtrusive activity-detection system **108** includes an input device **208**. In various aspects, input device **208** includes one or more of a user interface device **212**, which may be any of various types of user interface devices, or data input device **214**, which is a data input device adapted to receive data from a computing device or other electrical circuitry. Such data may be received by a wired connection or wireless connection. In an aspect, input device **208** is used for receiving a treatment signal **220** indicative of initiation of treatment of the patient according to the treatment regimen. In an aspect, treatment signal **220** is received from a user (either the patient or a caregiver of the patient) via a user interface device **212**. In another aspect, treatment signal **220** is received via data input device **214**.

[0102] In an aspect, unobtrusive activity-detection system **108** includes patient identification circuitry **222**, which is configured to determine a presence of the patient from at least one identity signal **224** sensed at the patient location, and to generate presence signal **225** which is provided to activity detection circuitry **122**. In an aspect, an identity signal **412** is transmitted from unobtrusive activity-detection system **108** to a monitoring system at the monitoring location. Identity signal **412** may be the same as identity signal **224**, or may be a processed version of identity signal **224**. In implementations in which unobtrusive activity-detection system **108** does not include patient identification circuitry **222**, identity signal **412** may be transmitted to the monitoring location and processed by circuitry there to determine identity/presence of the patient. In implementations in which unobtrusive activity-detection system **108** include patient identification circuitry **222**, identity signal **412** transmitted to the monitoring location so that the presence/identity of the patient may be determined from either the patient location or the monitoring location, or both, or the identity signal may be used for other purposes.

[0103] As noted previously, unobtrusive activity-detection system **108** includes activity sensor **116**. In some aspects, activity signal **118** sensed by activity sensor **116** functions not only as a source of information regarding one or more activities performed by patient **102**, but also as an identity signal **224** which is used to determine the identity of patient **102**. In an aspect, patient identification circuitry **222** is configured to identify the at least one section **124** of the at least one activity signal containing the non-speech activity pattern based at least in part on a determination of the presence of the patient **102** by patient identification circuitry **222**. In an aspect the at least one identity signal **224** includes at least a portion of the at least one activity signal **118**, and patient identification circuitry **222** is configured to analyze the activity signal **118** to identify at least a portion of the at least one activity signal that resembles a known activity pattern of the patient. Accordingly, in this example activity sensor **116** is also identity signal sensor **228**.

[0104] In order to use activity signal **118** as identity signal **224**, it may be necessary to process activity signal **118** to determine the presence of the patient and simultaneously or subsequently process activity signal **118** with activity detection circuitry **122** to generate activity data **128**. This can be accomplished by parallel processing of activity signal **118** by patient identification circuitry **222** and activity detection circuitry **122**, or by processing activity signal **118** first with patient identification circuitry **222** and subsequently with activity detection circuitry **122**. If the latter approach is used, generation of activity data signal **134** may not take place strictly in real time. Activity data signal **134** can be identified through the use of other types of identity signal, as well, as described herein below.

[0105] In some aspects, identity signal sensor **228** is distinct from activity sensor **116**. In an aspect, unobtrusive activity-detection system **108** includes an audio signal sensor **230** for sensing an audio signal including speech from patient **102** at the patient location, and patient identification circuitry **222** includes speech analysis circuitry **232** for identifying at least a portion of the audio signal that resembles known speech of the patient. In an aspect, activity detection circuitry **122** is configured to identify the at least one section of the at least one activity signal **118** by activity in activity signal **118** that corresponds (e.g., spatially and/or temporally) to the presence of patient **102** detected by speech analysis circuitry **232**. For example, a continuous speech system may be used for identifying the speaker, as described in Chandra, E. and Sunitha, C., "A Review on Speech and Speaker Authentication System using Voice Signal Feature Selection and Extraction," IEEE International Advance Computing Conference, 2009. IACC 2009, Page(s): 1341-1346, 2009 (DOI: 10.1109/IADCC.2009.4809211), which is incorporated herein by reference. In an aspect, patient identification circuitry **222** is configured to analyze identity signal **224** to determine the presence of the patient based on frequency analysis of the audio identity signal. Magnitude or phase spectral analysis may be used, as described in McCowan, I.; Dean, D.;

McLaren, M.; Vogt, R.; and Sridharan, S.; "The Delta-Phase Spectrum With Application to Voice Activity Detection and Speaker Recognition," IEEE Transactions on Audio, Speech, and Language Processing, 2011, Volume: 19, Issue: 7, Page (s): 2026-2038 (DOI: 10.1109/TASL.2011.2109379), which is incorporated herein by reference.

[0106] In an aspect, unobtrusive activity-detection system **108** includes an imaging device **234** for sensing an image at the patient location, wherein the patient identification circuitry **222** includes image analysis circuitry **236** for identifying a presence of the patient in the image. For example, in an aspect image analysis circuitry **236** includes facial recognition circuitry **238**, configured to analyze the image to determine the presence of the patient through facial recognition. For example, in an aspect facial recognition circuitry **238** uses approaches as described in Wheeler, Frederick W.; Weiss, R. L.; and Tu, Peter H., "Face Recognition at a Distance System for Surveillance Applications," Fourth IEEE International Conference on Biometrics: Theory Applications and Systems (BTAS), 2010 Page(s): 1-8 (DOI: 10.1109/BTAS.2010.5634523), and Moi Hoon Yap; Ugail, H.; Zwiggelaar, R.; Rajoub, B.; Doherty, V.; Appleyard, S.; and Hurdy, G., "A Short Review of Methods for Face Detection and Multifractal Analysis," International Conference on CyberWorlds, 2009. CW '09, Page(s): 231-236 (DOI: 10.1109/CW.2009.47), both of which are incorporated herein by reference.

[0107] In an aspect, image analysis circuitry **236** includes gait/posture recognition circuitry **240**, which is configured to analyze the image to determine the presence of the patient through gait or posture recognition. Identification of the patient based on gait analysis can be performed, for example, by methods as described in U.S. Pat. No. 7,330,566, issued Feb. 12, 2008 to Cutler, and Gaba, I. and Kaur P., "Biometric Identification on The Basis of BPNN Classifier with Other Novel Techniques Used For Gait Analysis," Intl. J. of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Vol. 2, issue 4, Sep. 2013, pp. 137-142, both of which are incorporated herein by reference.

[0108] In an aspect, unobtrusive activity-detection system **108** includes a biometric sensor **242** for sensing a biometric signal from the patient, wherein the patient identification circuitry **222** includes biometric signal analysis circuitry **244** for analyzing the biometric signal to determine the presence of the patient. Biometric identification can include face and gait recognition, as described elsewhere herein, and recognition based on a variety of other physiological or behavioral characteristics, such as fingerprints, voice, iris, retina, hand geometry, handwriting, keystroke pattern, etc., e.g., as described in Kataria, A. N.; Adhyaru, D. M.; Sharma, A. K.; and Zaveri, T. H., "A Survey of Automated Biometric Authentication Techniques" Nirma University International Conference on Engineering (NUiCONE), 2013, Page(s): 1-6 (DOI: 10.1109/NUiCONE.2013.6780190), which is incorporated herein by reference. U.S. Pat. No. 8,229,178 issued Jul. 24, 2012 to Zhang et al., which is incorporated herein by reference, describes a method for acquiring a palm vein image with visible and infrared light and extracting features from the image for authentication of individual identity. Biometric identification can be based on imaging of the retina or iris, as described in U.S. Pat. No. 5,572,596 issued to Wildes et al. on Nov. 5, 1996 and U.S. Pat. No. 4,641,349 issued to Flom et al. on Feb. 3, 1987, each of which is incorporated herein by reference. Combinations of several types of identity signals can also be used (e.g., speech and video, as described in Aleksic, P. S. and Katsaggelos, A. K. "Audio-Visual Biometrics," Proceedings of the IEEE Volume: 94, Issue: 11, Page(s): 2025-2044, 2006 (DOI: 10.1109/JPROC.2006.886017), which is incorporated herein by reference).

[0109] In an aspect, user interface device **212** is used for receiving an input indicative of at least one authentication factor from the user, and patient identification circuitry **222** includes authentication circuitry **246** for determining the presence of the patient based on the at least one authentication factor. The at least one authentication factor may include, for example, a security token, a password, a digital signature, and a cryptographic key. In an aspect, an authentication factor is received by unobtrusive activity-detection system via a user interface device **212**. User interface device **212** can include various types of user interface devices or controls as are well known to those of ordinary skill in the art, including, but not limited to, keyboards, touchpads, touchscreens, pointing devices, (e.g., a mouse), joysticks, tracking balls, graphic interfaces, styluses, microphones or other voice interfaces, motion tracking interfaces, gesture interfaces (e.g., via a Kinect® or the like), brain-computer interfaces, buttons, or switches. User interface device **212** can be integral to a communication device, e.g., a key pad of a cell phone. One or more user interface device **212** in unobtrusive activity-detection system **108** can be used to receive various types of user interfaces relating to operation of unobtrusive activity-detection system **108**, not limited to entry of an authentication factor. In an aspect, data input device **214** is used to receive a data signal, which is used as the identity signal, and patient identification circuitry **222** is configured to determine the presence of the patient based on the data signal.

[0110] In an aspect, unobtrusive activity-detection system **108** includes a receiver **300** for receiving a cell phone identification code, wherein the identity signal **224** is a cell phone identification code, and wherein the patient identification circuitry **222** is configured to determine the presence of the patient based on the cell phone identification code. The cell phone identification code may be, for example, an electronic serial number, a mobile identification number, and a system identification code.

[0111] In an aspect, unobtrusive activity-detection system **108** includes a radio frequency identification (RFID) sensor **252** for receiving an RFID signal from an RFID device **253** carried by or otherwise associated with patient **102**, wherein the identity signal **224** is an RFID signal, and wherein the patient identification circuitry **222** is configured to determine the presence of the patient based on the RFID signal. In an aspect, RFID device **253** is a passive RFID in a tag or chip associated with the patient. In an aspect, RFID sensor **252** is an active RFID reader.

[0112] In an aspect, patient identification circuitry **222** is configured to distinguish the presence of patient **102** from the presence of another individual. In the event that the activity of another individual is detected by unobtrusive activity-detection system **108**, activity detected from the other individual should not be used to determine the compliance of patient **102** with prescribed treatment regimen **104**. Accordingly, in an aspect, patient identification circuitry **222** is configured to determine the presence of patient **102** by determining that information contained in the identity signal matches patient information associated with the patient. For some types of identity signal (e.g., a password or device identity code), an exact match can be obtained. In other cases, a match is obtained by using a windowing, thresholding, or distance

measurement to determine whether the identity signal (or information contained there) matches sufficiently closely patient information associated with the patient. In an aspect, patient identification circuitry **222** is configured to distinguish the presence of the patient from the absence of the patient.

[0113] In an aspect, patient identification circuitry **222** generates presence signal **225** to indicate presence and/or identity of patient **102**. In an aspect, presence signal **225** is provided as an input to activity detection circuitry **122**. Presence of patient **102** may be indicated by a value of presence signal **225**. For example, in some aspects, presence signal **225** is a binary signal; e.g., presence signal **225** has a high value if the patient is present or a low value if the patient is not present (or vice versa). In an aspect, activity data **128** is generated from activity signal **118** only when the value of presence signal **225** indicates that patient **102** is present. Alternatively, in some aspects presence signal **225** is a continuous valued signal that indicates the probability that the patient is present. For example, presence signal **225** has a value of 100 if there is 100 percent probability that the patient is present, a value of zero if there is zero percent probability that the patient is present, or an intermediate value if there is an intermediate probability that the patient is present. It will be appreciated that in some contexts, the determination of whether the patient is present or absent will be relatively straightforward, in which case a binary presence signal may be appropriate, whereas in others (e.g., in cases where the presence of the patient must be distinguished from the presence of other individuals, e.g., from a conference call) there is some likelihood of error in identifying the presence of the patient (with the likelihood of error potentially dependent upon the number and identity of the other individuals present), such that an indication of the probability that the patient is present may be more appropriate. In some aspects, various device functions (e.g., acquisition of activity data, performance of activity analysis, or transmission of activity data signal **134** to the monitoring location) are initiated in response to detection of the presence of patient **102**. In some aspects, presence of patient **102** is a necessary but not sufficient condition for performance of particular device functions. For example, data may be collected at certain times of day, contingent upon the presence of patient **102**. In another aspect, data is collected when patient **102** is present and initiates a particular activity.

[0114] In an aspect, activity detection circuitry **122** is configured to process the at least one activity signal to exclude at least one portion of the at least one activity signal that does not contain activity of patient **102**, e.g., by excluding portions of the signal that contain no activity, or that contain activity of someone other than patient **102**.

[0115] In an aspect, activity detection circuitry **122** is configured to identify at least one section **124** of the at least one activity signal containing an activity pattern corresponding to performance of an activity of daily life, for example, hygiene, washing, eating, dressing, brushing teeth, brushing hair, combing hair, preparing food, interacting with another person, interacting with an animal, interacting with a machine, interacting with an electronic device, or using an implement.

[0116] In an aspect, activity detection circuitry **122** is configured to identify at least one section of the at least one activity signal containing an activity pattern corresponding to performance of a motor activity. Examples of motor activities are typing, providing an input via an input device, providing an input via a keyboard, providing an input via a touchscreen, providing an input via a pointing device, controlling an entertainment device or system, controlling a game device or system, controlling a vehicle system, or walking.

[0117] In an aspect, unobtrusive activity-detection system **108** includes one or more physiological sensors **332**. In some aspects, physiological sensor **332** provides physiological activity signal **380** to activity detection circuitry **122**. In an aspect, information from physiological activity signal **380**, taken in combination with activity signal **118**, provides supplemental information that aids in determining compliance of patient **102** with prescribed treatment regimen **104**. In some aspects, physiological activity data signal **382**, including physiological activity data based on information from physiological activity signal **380** is transmitted to a monitoring system for further analysis.

[0118] In an aspect, activity analysis circuitry **126** is configured to process the at least one section **124** of the at least one activity signal to determine at least one non-speech activity pattern **120** of the patient. In an aspect, activity analysis circuitry **126** is configured to generate activity data **128** that includes the at least one non-speech activity pattern **120** of the patient. In addition, in an aspect, activity analysis circuitry **126** includes an activity analyzer **250** for assessing the at least one activity pattern to determine at least one activity parameter **252** indicative of whether the patient has complied with the treatment regimen, and wherein the activity analysis circuitry **126** is configured to generate activity data **128** that includes the at least one activity parameter. In various aspects, activity analysis circuitry **126** is configured to determine activity patterns or parameters. In an aspect, an activity pattern characterizes one or both of coarse and fine temporal patterns of activity (e.g., whether an activity occurs at a particular time of day, such as morning, afternoon, evening, or night; frequency of occurrence of the activity during a particular time window). In an aspect, an activity pattern characterizes amplitude or intensity of the activity (e.g., how forcefully the patient strikes a key on a keyboard, or magnitude of body movement). In an aspect, an activity pattern includes the location at which an activity is performed. In an aspect, an activity pattern includes details regarding the substance of the activity (e.g., if the activity is selecting a song on a music player, the activity pattern includes information regarding the specific song selected). Activity parameters may include, but are not limited to, activity performance error rate, activity performance rate, activity performance time, activity performance frequency (e.g., repetitions of an activity), activity performance variability (including amount of variability, or lack thereof), or activity performance accuracy.

[0119] In an aspect, activity analysis circuitry **126** includes a comparator **254** for comparing the at least one non-speech activity pattern **120** with at least one characteristic activity pattern **256** to determine whether the patient has complied with the treatment regimen. In an aspect, comparator **254** is configured to compare non-speech activity pattern **120** with a plurality of characteristic activity patterns **256**, **258**, and **260** (three characteristic activity patterns are provided as an example but the comparison is not limited to any specific number of characteristic activity patterns).

[0120] In an aspect, activity analysis circuitry **126** is configured to determine that the patient **102** has failed to comply with the treatment regimen. In an aspect, activity analysis circuitry **126** is configured to determine that the patient has complied with the treatment regimen.

[0121] In an aspect, activity analysis circuitry **126** is configured to determine whether the patient has complied with the treatment regimen based upon a determination of whether the activity data **128** represents at least one of a plurality of characteristic activity pattern(s) **262**, **264**, and **266**. (Again, three patterns are provided as examples but comparison can be made to any number of characteristic activity patterns).

[0122] The result of the comparison performed by comparator **254** is a determination that the activity data **128** (or non-speech activity pattern **120** or activity parameter **252** derived therefrom) either does, or does not, match one or more characteristic activity data sets **256**, **258**, **260**, patterns **262**, **264**, **266**, or parameters **268**, **270**, **272**. It will be appreciated that in various aspects, activity analysis circuitry **122** can be configured to determine both compliance and non-compliance, and additionally, or alternatively, level of compliance (either at specific levels or simply partial compliance). In an aspect, if there is a match, notification **291** is generated by notification circuitry **290** regarding whether the patient has complied with the prescribed treatment regimen. In practice, the comparison performed by comparator **254** (which may include thresholding, windowing, distance computation, for example, as discussed herein above) will result in production of a signal that indicates at least whether the patient has complied with the prescribed treatment regimen, and alternatively, or in addition, a level of compliance with the prescribed treatment regimen. In some cases, a medical care provider at the monitoring location (or another party or entity concerned with the patient's health and well-being, such as a parent, family member, caretaker, healthcare provider, insurance company, etc.) is notified only if the patient has failed to comply with the prescribed treatment regimen. Alternatively, in some aspects the medical care provider or other party/entity is notified when the patient is in compliance with the prescribed treatment regimen. In some aspects, notification can be provided by transmitting a notification **291** generated by notification circuitry **290** to the monitoring location with transmitting device **132**, or to a wireless device, e.g., a remote device at the patient location, using wireless notification circuitry **294**.

[0123] In an aspect, transmitting device **132** includes a wireless transmitter **270**, which may, for example, transmit a signal to a wireless router **272** or a cellular network **274**. In another aspect, transmitting device **132** includes a computer network connection **276**, e.g., an Ethernet connection **278**. In another aspect, transmitting device **132** includes a communication port **280**. Communication port **280** may provide for communication with a computer drive **282** or USB device **284**.

[0124] In an aspect, unobtrusive activity-detection system **108** includes notification circuitry **290** for generating a notification **291** indicative of whether the patient has complied with the treatment regimen. Notification circuitry **290** may include, for example, email generation circuitry **292** for generating an email notification, wireless notification circuitry **294** for generating a notification to be transmitted to a wireless device, data storage circuitry **296** for storing a notification in a data storage device, and audio alarm circuitry **298** for generating an audio notification to be delivered with audio source **299**.

[0125] Compliance or lack thereof can be represented by appropriate text or numerical value in a displayed report or email, e.g., reported by notification circuitry **290**, or represented by a binary value in data stored by data storage device **206**. Alternatively, or in addition, level of compliance can be represented by a continuous value (e.g., percent compliance) or a text descriptor selected from a number of text descriptors corresponding to different levels of compliance (e.g., "non-compliance," "low compliance," "intermediate compliance," "near-full compliance," "full compliance"). In an aspect, notification circuitry **290** provides for formatting data included in notification **291** appropriately (e.g., by including appropriate text to accompany numerical data values) and for deciding whether and how to report the conclusion, based upon user preferences. For example, who is notified (patient versus medical care provider versus family member) or how notification is provided (stored in an event record, via email, or via a text message to a cell phone) may depend on the patient's level of compliance and the specifics of the patient. In some aspects, notification circuitry **290** can generate different levels of notifications depending on how serious a problem non-compliance is likely to be for the patient. Generating a notification may include retrieving a stored notification **286** from data storage device **206**, e.g., selected from among one or more notifications **286** stored in data storage device **206**. Notifications may take the form of text or numerical codes, for example.

[0126] In an aspect, notification circuitry **290** includes audio alarm circuitry **298** for generating an audio alarm, e.g., a tone or voice alert to be delivered via an audio source (e.g., a speaker, bell, buzzer, beeper, or the like). In an aspect, notification circuitry **290** provides a notification to patient **102**, e.g., by generating an audio alarm via the audio source or causing a text message to be displayed on a display of unobtrusive activity-detection system **108**, or a device in communication therewith, e.g., a cell phone or computing system used by patient **102**. A notification to the patient could take the form of a reminder to take a medication or contact a medical care provider, for example. In another aspect, notification circuitry **290** uses wireless notification circuitry **294** to transmit a notification (e.g., via wireless transmitter **270**) to a wireless device such as a pager, cell phone, or other wireless device used by a medical care provider or family member interested in tracking the status of the patient. In another aspect, notification circuitry **290** includes data storage circuitry **296** for storing a notification in a data storage device **206**. For example, in an aspect, data storage device **206** provides for storage of a notification in event history **297** in conjunction with information regarding the time at which the notification was generated (obtained, for example from timing circuitry **202**). In an aspect, information stored in event history **297** becomes a part of the subject's electronic medical records, and may ultimately be transferred to the monitoring system or other location. In an aspect, timing circuitry **202** includes a clock and/or timer, for example.

[0127] FIG. **3** depicts details of unobtrusive activity-detection system **108**, showing additional details and additional and/or alternative components relative to what is shown in FIG. **2**. As discussed in connection with FIG. **2**, unobtrusive activity detection system **108** includes a variety of sensors **226**, including one or more activity sensor **116** and one of more identity signal sensor **228**. As discussed in connection with FIG. **2**, in some aspects activity sensor **116** is the same as identity signal sensor **228**, while in other aspects the activity and identity signal sensors are different sensors. Sensors **226** may include one or more identity signal sensor **228**, including, but not limited to, one or more audio signal sensor **230**, biometric sensor **242**, RFID sensor **252**, or imaging device

234. In an aspect, activity sensor **116** includes a camera **318** or other imaging device **234**, which, in combination with appropriate hardware and software, may form a motion capture device (e.g., a Kinect®- or PlayStation® 4 Camera-type controller) that detects movements and/or gestures. In various aspects, such devices include depth sensing and IR reflectance technology, built-in color camera, infrared (IR) emitter, and microphone array.

[0128] A motion capture device can be used to detect activity of the subject during gaming or during daily living activities. In various aspects, camera **318** includes 2D and 3D cameras. Activity sensor **116** includes one or more devices of one or more types capable of sensing activity of the patient. In various aspects, the at least one activity sensor **116** includes one or more input device **208** (as described in connection with FIG. **2** which may be, for example, a keyboard **302**, a pointing device **304** (e.g., a computer mouse), or a touchscreen **306**. In various aspects, the at least one activity sensor **116** includes one or more remote controller for an entertainment device or system **308**, or game controller **310**. In various aspects, the at least one activity sensor includes a user-activated sensor in a vehicle system **312**. In an aspect, activity sensor **116** is a wearable sensor **314** or an environmental sensor **316**. In an aspect, an environmental sensor **316** includes one or more optical sensor **326** or camera **318** or other imaging device **234**, in the environment of the subject. In an aspect, an environmental sensor includes a sensor in the environment of the subject that senses proximity of the patient to an object in the environment. In an aspect, an environmental sensor is a sensor attached to an animal or person in the environment. In an aspect, activity sensor **116** is attached to an item which the patient uses or interacts with, e.g., a comb, a toothbrush, an implement, a utensil, a tool, keys, etc. In an aspect, the at least one activity sensor **116** includes an imaging device **234**, which may be, for example, a camera **318**. In other aspect, activity sensor **116** includes one or more pressure sensor **320**, force sensor **322**, capacitive sensor **324**, optical sensor **326**, motion sensor **328**, or acceleration sensor **330**.

[0129] In an aspect, unobtrusive activity-detection system **108** includes at least one physiological sensor **332**, operatively connected to the unobtrusive activity-detection system and configured to detect a physiological signal indicative of whether the patient has complied with the treatment regimen. For example, in an aspect, physiological sensor **332** includes an EEG sensor **334**. In an aspect, EEG sensor **334** is configured to detect an event-related potential. Event-related potentials, or "ERPs" correspond to attention of a subject to an event (e.g., the event captures the subject's interest). ERPs normally occur at a fixed latency relative to the event of interest; thus, if the time of occurrence of the event of interest is known, ERGs can be detected based on their latency relative to the event of interest. In addition, it is also possible to detect ERPs in the EEG based on their characteristic shape, without information regarding when the event of interest occurred. Various ERP parameters, such as amplitude, latency, and/or topography are changed in patients with brain-related disorders. See, e.g., Hansenne, "Event-Related Brain Potentials in Psychopathology: Clinical and Cognitive Perspectives," Psychologica Belgica 2006, vol. 46, iss. 1-2, pp. 5-36, and Wise et al., "Event-Related Potential and Autonomic Signs of Maladaptive Information Processing During an Auditory Oddball Task in Panic Disorder," International Journal of Psychophysiology 74 (2009) 34-44, both of which are incorporated herein by reference. Moreover, in some cases treatment of brain-related disorder, e.g., with pharmaceuticals, at least partially restores the ERP parameters to values observed in individuals without the disorder, as described in Sumiyoshi et al., "Neural Basis for the Ability of Atypical Antipsychotic Drugs to Improve Cognition in Schizophrenia," Frontiers in Behavioral Neuroscience," 16 Oct. 2013, Volume 7, Article 140, which is incorporated herein by reference. In an aspect, the number and/or nature of ERPs detected in the patient's EEG provides additional or alternative information regarding compliance of the patient with the treatment regimen. In other aspects, physiological sensor **332** includes a heart rate sensor **336**, an eye position sensor **338**, or a pupil diameter sensor **340**. Heart rate can be sensed by various approaches, using sensors in a fitness band (for example, of the type described in U.S. Pat. No. 9,113,795, which is incorporated herein by reference), sensors attached to the skin, etc. using various methods known in the art. Eye position can be sensed using a method and system as described in U.S. Pat. No. 8,808,195 to Tseng et al., which is incorporated herein by reference, or by other methods described herein or known to those skilled in the relevant art. Eye position may include static or fixed eye position/gaze direction or dynamic eye position/eye movement. Pupil diameter can be measured, for example, by methods as described in U.S. Pat. No. 6,162,186 to Scinto et al., which is incorporated herein by reference. Abnormal pupillary function is observed, for example, in patients with Alzheimer's disease (As discussed in Fotiou et al., "Pupil Reaction to Light in Alzheimer's disease: Evaluation of Pupil Size Changes and Mobility", Aging Clin Exp Res 2007 October; 19(5):364-71 (Abstract), which is incorporated herein by reference.

[0130] Unobtrusive activity-detection system **108** can be constructed and implemented in a variety of embodiments in which different devices and/or device components provide the functionality described herein. In an aspect, unobtrusive activity-detection system **108** includes or is implemented on or in connection with various types of systems with which the patient interacts. In an aspect, unobtrusive activity-detection system **108** is built into such a user-interactive system **350**. In another aspect, unobtrusive activity-detection system **108** is constructed separately but used in combination with such a user-interactive system **350**. For example, unobtrusive activity-detection system **108** may be attached to user-interactive system **350**, or operatively connected to user-interactive system **350**. In various aspects, unobtrusive activity-detection system **108** can be constructed as a microprocessor-based system, either as a device that provides compliance monitoring in combination with some other functionality, or as a compliance monitoring system that is used independently, or as an add-on to a system which provides some other functionality.

[0131] In an aspect, activity sensor **116**, activity detection circuitry **122**, activity analysis circuitry **126**, and transmitting device **132** are components of a cell phone **352** configured with application software. In another aspect, activity sensor **116**, activity detection circuitry **122**, activity analysis circuitry **126**, and transmitting device **132** are components of a computing device or system **354**. In another aspect, activity sensor **116**, activity detection circuitry **122**, activity analysis circuitry **126**, and transmitting device **132** are components of an appliance **356** (e.g., a household appliance such as a microwave oven, a washing machine, or a coffee maker). In another aspect, activity sensor **116**, activity detection circuitry **122**,

activity analysis circuitry **126**, and transmitting device **132** are components of an entertainment device or system **358** (e.g., a TV, a DVD player, or a music player) or a game device or system **360**. In yet another aspect, activity sensor **116**, activity detection circuitry **122**, activity analysis circuitry **126**, and transmitting device **132** are components of a vehicle system **362**. In an aspect, activity sensor **116**, activity detection circuitry **122**, activity analysis circuitry **126**, and transmitting device **132** are components of a kiosk **364**. In particular, kiosk **364** may be a medical kiosk used to provide health-related information, perform medical monitoring (e.g., take a blood pressure reading), dispense medication, and the like. In another example, kiosk **364** may be an entertainment or gaming kiosk, for example, located in a public venue such as a shopping mall or airport. In another aspect, activity sensor **116**, activity detection circuitry **122**, activity analysis circuitry **126**, and transmitting device **132** are components of an intercommunication ("intercom") system **366**. In another aspect, activity sensor **116**, activity detection circuitry **122**, activity analysis circuitry **126**, and transmitting device **132** are components of a personal item **368**. For example, personal item **368** can be any of various types of personal items that are used by the patient in the course of carrying out activities of daily life, such that the patient's interaction with personal item **368** may indicate compliance of the patient with a prescribed treatment regimen. For example, personal item **368** may be a personal grooming article such as a comb, hair brush, or toothbrush; a tool or implement; a key or a key fob attached to one or more keys; a wearable item such as a wristwatch, an item of jewelry, eyeglasses, an article of clothing, footwear, hat, helmet, head covering, or hairband; or a wallet or purse. In an aspect, one or more of activity sensor **116**, activity detection circuitry **122**, activity analysis circuitry **126**, and transmitting device **132** are operatively connected to personal item **368**; e.g., one or more components may be packaged separately from personal item **368** but configured to be physically attached to personal item **368**. In some aspects, one or more components of unobtrusive activity detection system **108** are not attached to the personal item **368**, but communicate with at least one component attached to or built into personal item **368**.

[0132] In addition to activity sensor **116**, activity detection circuitry **122**, activity analysis circuitry **126**, and transmitting device **132** that form part of unobtrusive activity-detection system **108**, user-interactive system **350** includes device function-related components **370**, including, but not limited to, mechanical components **372** and/or circuitry **374**, which may include hardware **376**, software **378**, and/or microprocessor **380**.

[0133] FIG. **4** depicts aspects of monitoring system **112**. As described briefly in connection with FIG. **1**, monitoring system **112** includes at least one receiving device **136** for use at a monitoring location **114** for receiving an activity data signal **134** transmitted to monitoring location **114** from a patient location. Activity data signal **134** contains activity data **128** representing at least one non-speech activity pattern **120** in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system (e.g., unobtrusive activity-detection system **108** at patient location **110** as shown in FIG. **1**) during performance of the non-speech activity by the patient. Monitoring system **112** also includes signal processing circuitry **150**, which is configured to analyze activity data signal **134** to determine whether the activity data **128** represents at least one non-speech activity pattern **120** that matches at least one characteristic activity pattern **152**. In addition, monitoring system **112** includes compliance determination circuitry **156** configured to determine whether the patient has complied with the prescribed treatment regimen based upon whether the activity data **128** represents the non-speech activity pattern **120** that matches the at least one characteristic activity pattern **152**, and reporting circuitry **160** configured to report a conclusion **162** based on the determination of whether the patient has complied with the treatment regimen.

[0134] In an aspect, signal processing circuitry **150** is configured to analyze the activity data signal **134** to identify at least one non-speech activity pattern that corresponds to unprompted performance of the non-speech activity by the patient. For example, in an aspect, signal processing circuitry **150** identifies non-speech activity based upon detectable patterns in the activity data signal, without relying upon information regarding timing of activity relative to a prompt. Analysis of activity data and/or activity patterns is performed substantially as discussed in connection with activity analysis circuitry **126** in FIG. **2**.

[0135] In an aspect, monitoring system **112** includes timing circuitry **402**, which may include a clock or timer device, and function in a manner substantially similar to timing circuitry **202** in unobtrusive activity-detection system **108** as described in connection with FIG. **2**. In an aspect, timing circuitry **402** is configured to control timing of operation of at least a portion of the system to perform substantially continuously the operation of receiving the activity data signal **134** with the at least one receiving device **136**. Receiving activity data signal **134** substantially continuously includes receiving a signal substantially without interruption, or sampling activity data signal **134** at a rate that is sufficiently high to capture any meaningful variations in the activity sensed by the sensor, as discussed herein above in connection with timing circuitry **202**. In an aspect, timing circuitry **402** is configured to control timing of operation of at least a portion of monitoring system **112** to perform intermittently at least one of receiving the activity data signal **134** with the at least one receiving device **136**, analyzing the activity data signal **134** with signal processing circuitry **150**, determining with compliance determination circuitry **156** at monitoring location **114** whether the patient has complied with the treatment regimen, and reporting with reporting circuitry **160** a conclusion **162** based on the determination of whether the patient has complied with the prescribed treatment regimen.

[0136] In another aspect, timing circuitry **402** is configured to control timing of operation of at least a portion of the system to perform according to a schedule at least one of receiving the activity data signal **134** with the at least one receiving device **136**, analyzing the activity data signal **134** with signal processing circuitry **150**, determining with compliance determination circuitry **156** at the monitoring location **114** whether the patient has complied with the treatment regimen, and reporting with reporting circuitry **160** a conclusion **162** based on the determination of whether the patient has complied with the prescribed treatment regimen. Timing of operation of monitoring system **112** to form operations intermittently or according to a schedule can be controlled by timing circuitry **402** configured by hardware and software, using control parameters which may be set or selected by a user, or preset during manufacture of the device, as described above.

[0137] In some aspects, non-speech activity pattern **120** is an activity pattern corresponding to performance of a motor activity, which may include, for example, typing, providing an input via an input device, providing an input via a keyboard, providing an input via a touchscreen, providing an input via a pointing device, controlling a game device or system, controlling an entertainment device or system, controlling a vehicle system, or walking. In some aspects, non-speech activity pattern **120** is an activity pattern corresponding to performance of an activity of daily life, for example, hygiene, washing, eating, dressing, brushing teeth, brushing hair, combing hair, preparing food, interacting with another person, interacting with an animal, interacting with a machine, interacting with an electronic device, or using an implement.

[0138] In various aspects, activity data signal **134** contains activity data **128** including data from various types of sensors, as described in connection with FIG. **3**, e.g., a pressure sensor, a force sensor, a capacitive sensor, an imaging device, a motion sensor, a motion capture device, an acceleration sensor, an optical sensor, a camera. In various aspects, activity data **128** represents one or more of a keystroke pattern, an activity performance pattern, an activity performance rate, an activity performance time, an activity performance frequency, an activity performance variability, an activity performance accuracy, or an activity performance error rate.

[0139] In an aspect, monitoring system **112** includes patient identification circuitry **410**, which is configured to determine a presence of the patient from at least one identity signal **412** received by receiving device **136** at the monitoring location **114** from the patient location; in connection therewith signal processing circuitry **150** is configured to identify patient activity data corresponding to an activity of the patient based at least in part on the determination of the presence of the patient by the patient identification circuitry, as indicated by presence signal **414** generated by patient identification circuitry **410**. In general, identity signals and determination of the presence of the patient are as described herein above in connection with FIG. **2**.

[0140] In an aspect, identity signal **412** includes at least a portion of the activity data **128** in activity data signal **134**, wherein patient identification circuitry **410** includes activity analysis circuitry **416** configured to analyze the activity data **128** to identify at least a portion of the activity data signal **134** containing activity data representing an activity pattern that matches a known activity pattern of the patient.

[0141] In an aspect, identity signal **412** includes a voice signal received from an audio sensor at the patient location, patient identification circuitry **410** includes speech analysis circuitry **418** for identifying at least a portion of the audio signal that resembles known speech of the patient, and signal processing circuitry **150** is configured to identify activity data corresponding to an activity of the patient by identifying activity data corresponding to a portion of the audio signal that resembles known speech of the patient.

[0142] In an aspect, identity signal **412** includes an image signal received from an imaging device at the patient location, wherein the patient identification circuitry includes image analysis circuitry **420** configured to analyze the image signal to determine the presence of the patient, and wherein the signal processing circuitry **150** is configured to identify activity data corresponding to an activity of the patient by identifying activity data corresponding to an image signal indicative of the presence of the patient. Image analysis circuitry **420** may include facial recognition circuitry **422** configured to analyze the image signal to determine the presence of the patient through facial recognition, or gait or posture analysis circuitry **424** configured to analyze the image signal to determine the presence of the patient through gait or posture recognition.

[0143] In another aspect, identity signal **412** includes a biometric signal from at least one biometric sensor at the patient location, and the patient identification circuitry **410** includes biometric analysis circuitry **426** configured to analyze the biometric signal to determine the presence of the patient, and signal processing circuitry **150** is configured to identify activity data corresponding to an activity of the patient by identifying activity data corresponding to a biometric signal indicative of a presence of the patient.

[0144] In another aspect, identity signal **412** include includes at least one authentication factor (e.g., one or more of a security token, a password, a digital signature, and a cryptographic key), and patient identification circuitry **410** includes authentication circuitry **428**.

[0145] In another aspect, identity signal **412** includes a device identification code, which identifies unobtrusive activity-detection system **108**, a component thereof, or an associated device. In an aspect, identity signal **412** includes a cell phone identification code (e.g., an electronic serial number, a mobile identification number, and a system identification code) and patient identification circuitry **410** includes cell phone identification circuitry **430**. In some aspects, identity signal **412** includes a device identification code that identifies a computing system or device, a stand-alone microprocessor-based system, or a component thereof. A device identification code can serve to identify a patient (e.g., patient **102** in FIG. **1** and FIG. **2**) providing the device thus identified is consistently used only by the patient. Identifying the patient based on device identification code may be done, for example, if some or all components of unobtrusive activity-detection system **108** are shared by multiple users but the device or component associated with the device identification code is used consistently by the patient. In an aspect, identity signal **412** includes an RFID signal, and patient identification circuitry **410** includes RFID circuitry **432**.

[0146] In an aspect, monitoring system **112** includes input device **436**, which is used, for example, for receiving prescription information **438** indicative of the treatment regimen prescribed to the patient. In an aspect, input device **436** includes a user interface device **440**, for receiving information from a user (e.g., medical care provider **170**). In another aspect, input device **436** includes a data input device **442**, for receiving information from a computing device or other electrical circuitry (e.g., like data input device **214** described in connection with FIG. **2**).

[0147] In an aspect, monitoring system **112** includes at least one data storage device **450**, which may be used, for example, for storing prescription information **438** indicative of the treatment regimen prescribed to the patient.

[0148] In various aspects, receiving device **136** includes, for example, a wireless receiver **452**, computer network connection **454**, communication port **456**, or computer drive **458**.

[0149] In an aspect, compliance determination circuitry **156** includes an activity analyzer **460** for analyzing activity data **128** to determine the non-speech activity pattern **120**, and a comparator **462** for comparing the non-speech activity pattern **120** represented by the activity data with the at least one characteristic activity pattern **152**. In some aspects, com-

parator **462** is configured to compare the non-speech activity pattern **120** represented by activity data **128** with a plurality of characteristic activity patterns **152**, **484**, and **486** (three are depicted in FIG. **4**, but comparison can be made with any number of characteristic activity patterns).

[0150] In another aspect, compliance determination circuitry **156** includes a comparator **462** for comparing the activity data **128** with at least one characteristic activity data set **464** representing at least one characteristic activity pattern **152**. In an aspect, comparator **462** is configured to compare activity data **128** with a plurality of characteristic activity data sets **464**, **480**, and **482**, each said characteristic activity data set representing a characteristic activity pattern (three are depicted in FIG. **4**, but comparison can be made with any number of characteristic activity data sets). For example, in some aspects compliance determination circuitry **156** is configured to determine whether the patient has complied with the treatment regimen based upon a determination of whether the received activity data signal **134** represents at least one of a plurality of characteristic activity patterns **152**.

[0151] In an aspect, compliance determination circuitry **156** is configured to determine that the patient has failed to comply with the treatment regimen. In another aspect, compliance determination circuitry **156** is configured to determine that the patient has complied with the treatment regimen.

[0152] In various aspects, reporting circuitry **160** includes a display device **466**, email generation circuitry **468** for generating an email notification, wireless notification circuitry **470** for transmitting a notification to a wireless device **472** (which may be, for example, a cell phone used by medical care provider **170**), audio alarm circuitry **474** for generating an audio alarm, or data storage circuitry **476** for storing a notification **478** in data storage device **450**.

[0153] In an aspect, the at least one receiving device **136** is adapted to receive a physiological activity data signal **382** indicative of at least one physiological signal sensed with at least one physiological sensor operatively connected to the unobtrusive activity-detection system at the patient location. In an aspect, physiological activity data signal **382** is indicative of whether the patient has complied with the treatment regimen. In various aspects, physiological activity data signal **382** includes one or more of EEG data (including, for example, an event-related potential, wherein the event-related potential is related to performance of the non-speech activity by the subject), heart rate data, eye position data, or pupil diameter data.

[0154] FIGS. **5** and **6** provide brief, general descriptions of environments in which embodiments may be implemented. FIG. **5** illustrates an example system that includes a thin computing device **520**, which may be included in an electronic device that also includes one or more device functional element **550**. For example, the electronic device may include any item having electrical or electronic components playing a role in a functionality of the item, such as a limited resource computing device, a wireless communication device, a mobile wireless communication device, an electronic pen, a handheld electronic writing device, a digital camera, a scanner, an ultrasound device, an x-ray machine, a non-invasive imaging device, a cell phone, a PDA, a Blackberry® device, a printer, a refrigerator, a car, and an airplane. In another example, the thin computing device may be included in a medical apparatus or device. In a further example, the thin computing device may be operable to communicate with a medical apparatus.

[0155] The thin computing device **520** includes a processor **521**, a system memory **522**, and a system bus **523** that couples various system components including the system memory **522** to the processor **521**. The system bus **523** may be any of several types of bus structures including a memory bus or memory controller, a peripheral bus, and a local bus using any of a variety of bus architectures. In an aspect, the system memory includes read-only memory (ROM) **524** and random access memory (RAM) **525**. A basic input/output system (BIOS) **526**, containing the basic routines that help to transfer information between sub-components within the thin computing device **520**, such as during start-up, is stored in the ROM **524**. A number of program modules may be stored in the ROM **524** or RAM **525**, including an operating system **528**, one or more application programs **529**, other program modules **530** and program data **531**.

[0156] A user may enter commands and information into the computing device **520** through input devices, such as a number of switches and buttons, illustrated as hardware buttons **544**, connected to the system via a suitable hardware button interface **545**. Input devices may further include a touch-sensitive display with suitable input detection circuitry, illustrated as a display **532** and screen input detector **533**. The output circuitry of the touch-sensitive display **532** is connected to the system bus **523** via a video driver **537**. Other input devices may include a microphone **534** connected through a suitable audio interface **535**, and a physical hardware keyboard (not shown). Output devices may include at least one display **532** and at least one speaker **538**.

[0157] In addition to the display **532**, the computing device **520** may include other peripheral output devices, such as a projector display **536**. Other external devices **539** may be connected to the processor **521** through a USB port **540** and USB port interface **541**, to the system bus **523**. Alternatively, the other external devices **539** may be connected by other interfaces, such as a parallel port, game port or other port. External devices **539** include external input or output devices, e.g., a joystick, game pad, satellite dish, scanner, various types of sensors or actuators. Output signals include device control signals. The computing device **520** may further include or be capable of connecting to a flash card memory (not shown) through an appropriate connection port (not shown). The computing device **520** may further include or be capable of connecting with a network through a network port **542** and network interface **543**, and through wireless port **546** and corresponding wireless interface **547** may be provided to facilitate communication with other peripheral devices, including other computers, printers, and so on (not shown). It will be appreciated that the various components and connections shown are examples and other components and means of establishing communication links may be used.

[0158] The computing device **520** may be primarily designed to include a user interface. The user interface may include a character, a key-based, or another user data input via the touch sensitive display **532**. The user interface may include using a stylus (not shown). Moreover, the user interface is not limited to a touch-sensitive panel arranged for directly receiving input, but may alternatively or in addition respond to another input device such as the microphone **534**. For example, spoken words may be received at the microphone **534** and recognized. Alternatively, the computing

device **520** may be designed to include a user interface having a physical keyboard (not shown).

[0159] The device functional elements **550** are typically application specific and related to a function of the electronic device, and is coupled with the system bus **523** through an interface (not shown). The functional elements may typically perform a single well-defined activity with little or no user configuration or setup, such as a cell phone connecting with an appropriate tower and transceiving voice or data information, or communicating with an implantable medical apparatus, or a camera capturing and saving an image.

[0160] In certain instances, one or more elements of the thin computing device **520** may be deemed not necessary and omitted. In other instances, one or more other elements (e.g., other resources **552**) may be deemed necessary and added to the thin computing device.

[0161] FIG. **6** illustrates an example embodiment of a computing system in which embodiments may be implemented, shown as a computing system environment **600**. Components of the computing system environment **600** may include, but are not limited to, a computing device **610** having a processor **620**, a system memory **630**, and a system bus **621** that couples various system components including the system memory to the processor **620**. The system bus **621** may be any of several types of bus structures including a memory bus or memory controller, a peripheral bus, and a local bus using any of a variety of bus architectures. By way of example, and not limitation, such architectures include Industry Standard Architecture (ISA) bus, Micro Channel Architecture (MCA) bus, Enhanced ISA (EISA) bus, Video Electronics Standards Association (VESA) local bus, and Peripheral Component Interconnect (PCI) bus, also known as Mezzanine bus.

[0162] The computing system environment **600** typically includes a variety of computer-readable media products. Computer-readable media may include any media that can be accessed by the computing device **610** and include both volatile and non-volatile media, removable and non-removable media. By way of example, and not of limitation, computer-readable media may include computer storage media. By way of further example, and not of limitation, computer-readable media may include a communication media.

[0163] Computer storage media includes volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules, or other data. Computer storage media includes, but is not limited to, random-access memory (RAM), read-only memory (ROM), electrically erasable programmable read-only memory (EEPROM), flash memory, or other memory technology, CD-ROM, digital versatile disks (DVD), or other optical disk storage, magnetic cassettes, magnetic tape, magnetic disk storage, or other magnetic storage devices, or any other medium which can be used to store the desired information and which can be accessed by the computing device **610**. In a further embodiment, a computer storage media may include a group of computer storage media devices. In another embodiment, a computer storage media may include an information store. In another embodiment, an information store may include a quantum memory, a photonic quantum memory, or atomic quantum memory. Combinations of any of the above may also be included within the scope of computer-readable media.

[0164] Communication media may typically embody computer-readable instructions, data structures, program modules, or other data in a modulated data signal such as a carrier wave or other transport mechanism and include any information delivery media. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media include wired media, such as a wired network and a direct-wired connection, and wireless media such as acoustic, RF, optical, and infrared media.

[0165] The system memory **630** includes computer storage media in the form of volatile and non-volatile memory such as ROM **631** and RAM **632**. A RAM may include at least one of a DRAM, an EDO DRAM, a SDRAM, a RDRAM, a VRAM, or a DDR DRAM. A basic input/output system (BIOS) **633**, containing the basic routines that help to transfer information between elements within the computing device **610**, such as during start-up, is typically stored in ROM **631**. RAM **632** typically contains data and program modules that are immediately accessible to or presently being operated on by processor **620**. By way of example, and not limitation, FIG. **6** illustrates an operating system **634**, application programs **635**, other program modules **636**, and program data **637**. Often, the operating system **634** offers services to applications programs **635** by way of one or more application programming interfaces (APIs) (not shown). Because the operating system **634** incorporates these services, developers of applications programs **635** need not redevelop code to use the services. Examples of APIs provided by operating systems such as Microsoft's "WINDOWS" are well known in the art.

[0166] The computing device **610** may also include other removable/non-removable, volatile/non-volatile computer storage media products. By way of example only, FIG. **6** illustrates a non-removable non-volatile memory interface (hard disk interface) **640** that reads from and writes for example to non-removable, non-volatile magnetic media. FIG. **6** also illustrates a removable non-volatile memory interface **650** that, for example, is coupled to a magnetic disk drive **651** that reads from and writes to a removable, non-volatile magnetic disk **652**, or is coupled to an optical disk drive **655** that reads from and writes to a removable, non-volatile optical disk **656**, such as a CD ROM. Other removable/nonremovable, volatile/non-volatile computer storage media that can be used in the example operating environment include, but are not limited to, magnetic tape cassettes, memory cards, flash memory cards, DVDs, digital video tape, solid state RAM, and solid state ROM. The hard disk drive **641** is typically connected to the system bus **621** through a non-removable memory interface, such as the interface **640**, and magnetic disk drive **651** and optical disk drive **655** are typically connected to the system bus **621** by a removable non-volatile memory interface, such as interface **650**.

[0167] The drives and their associated computer storage media discussed above and illustrated in FIG. **6** provide storage of computer-readable instructions, data structures, program modules, and other data for the computing device **610**. In FIG. **6**, for example, hard disk drive **641** is illustrated as storing an operating system **644**, application programs **645**, other program modules **646**, and program data **647**. Note that these components can either be the same as or different from the operating system **634**, application programs **635**, other program modules **636**, and program data **637**. The operating system **644**, application programs **645**, other program modules **646**, and program data **647** are given different numbers here to illustrate that, at a minimum, they are different copies.

[0168] A user may enter commands and information into the computing device **610** through input devices such as a microphone **663**, keyboard **62**, and pointing device **661**, commonly referred to as a mouse, trackball, or touch pad. Other input devices (not shown) may include at least one of a touch sensitive display, joystick, game pad, satellite dish, and scanner. These and other input devices are often connected to the processor **620** through a user interface **660** that is coupled to the system bus, but may be connected by other interface and bus structures, such as a parallel port, game port, or a universal serial bus (USB). Other devices that can be coupled to the system bus via other interface and bus structures include sensors of various types, for example.

[0169] A display **691**, such as a monitor or other type of display device or surface may be connected to the system bus **621** via an interface, such as a video interface **690**. A projector display engine **692** that includes a projecting element may be coupled to the system bus. In addition to the display, the computing device **610** may also include other peripheral output devices such as speakers **697** and printer **696**, which may be connected through an output peripheral interface **695**. Outputs may be sent to a variety of other types of devices, and are not limited to the example output devices identified here.

[0170] The computing system environment **600** may operate in a networked environment using logical connections to one or more remote computers, such as a remote computer **680**. The remote computer **680** may be a personal computer, a server, a router, a network PC, a peer device, or other common network node, and typically includes many or all of the elements described above relative to the computing device **610**, although only a memory storage device **681** has been illustrated in FIG. **6**. The network logical connections depicted in FIG. **6** include a local area network (LAN) and a wide area network (WAN), and may also include other networks such as a personal area network (PAN) (not shown). Such networking environments are commonplace in offices, enterprise-wide computer networks, intranets, and the Internet.

[0171] When used in a networking environment, the computing system environment **600** is connected to the network **671** through a network interface, such as the network interface **670**, the modem **672**, or the wireless interface **693**. The network may include a LAN network environment, or a WAN network environment, such as the Internet. In a networked environment, program modules depicted relative to the computing device **610**, or portions thereof, may be stored in a remote memory storage device. By way of example, and not limitation, FIG. **6** illustrates remote application programs **685** as residing on computer medium **681**. It will be appreciated that the network connections shown are examples and other means of establishing a communication link between the computers may be used.

[0172] In certain instances, one or more elements of the computing device **610** may be deemed not necessary and omitted. In other instances, one or more other elements (e.g., other resources **625**) may be deemed necessary and added to the computing device.

[0173] FIGS. **5** and **6** illustrate generalized forms of circuitry-based systems, in which systems as depicted in FIGS. **1-4** may be implemented. Although specific embodiments are described herein, those skilled in the art will appreciate that methods and systems as described herein can be implemented in various ways. Reference is made herein to various circuitry systems/subsystems (e.g., patient identification circuitry **222**, activity detection circuitry **122**, notification circuitry **290** in FIG. **2**, and patient identification circuitry **410**, reporting circuitry **160**, and signal processing circuitry **150** in FIG. **4**) which may be considered to be control/processing circuitry, and/or components thereof. In general, control/processing circuitry (e.g., control/processing circuitry **180** and control/processing circuitry **190** in FIG. **1**) includes any or all of digital and/or analog components, one or more processor (e.g., a microprocessor), and includes memory and additional components as described in connection with FIGS. **5** and **6**.

[0174] In a general sense, those skilled in the art will recognize that the various embodiments described herein can be implemented, individually and/or collectively, by various types of electrical circuitry having a wide range of electrical components such as hardware, software, firmware, and/or virtually any combination thereof. Electrical circuitry includes electrical circuitry having at least one discrete electrical circuit, electrical circuitry having at least one integrated circuit, electrical circuitry having at least one application specific integrated circuit, electrical circuitry forming a computing device configured by a computer program (e.g., a computer configured by a computer program which at least partially carries out processes and/or devices described herein, or a microprocessor configured by a computer program which at least partially carries out processes and/or devices described herein), electrical circuitry forming a memory device, which may include various types of memory (e.g., random access, flash, read only, etc.), electrical circuitry forming a communications device (e.g., a modem, communications switch, optical-electrical equipment, etc.), and/or any non-electrical analog thereto, such as optical or other analogs (e.g., graphene based circuitry). In an embodiment, the system is integrated in such a manner that the system operates as a unique system configured specifically for the function of monitoring treatment compliance, and any associated computing devices of the system operate as specific use computers for purposes of the claimed system, and not general use computers. In an embodiment, at least one of the associated computing devices of the system is hardwired with a specific ROM to instruct the at least one computing device. In a general sense, those skilled in the art will recognize that the various aspects described herein which can be implemented, individually and/or collectively, by a wide range of hardware, software, firmware, and/or any combination thereof can be viewed as being composed of various types of "electrical circuitry."

[0175] At least a portion of the devices and/or processes described herein can be integrated into a data processing system. A data processing system generally includes one or more of a system unit housing, a video display, memory such as volatile or non-volatile memory, processors such as microprocessors or digital signal processors, computational entities such as operating systems, drivers, graphical user interfaces, and applications programs, one or more interaction devices (e.g., a touch pad, a touch screen, an antenna, etc.), and/or control systems including feedback loops and control motors (e.g., feedback for sensing position and/or velocity; control motors for moving and/or adjusting components and/or quantities). A data processing system may be implemented utilizing suitable commercially available components, such as those typically found in data computing/communication and/or network computing/communication systems.

[0176] As discussed in connection with FIG. **1**, transmitting device **132** in unobtrusive activity-detection system **108**

and receiving device **136** in monitoring system **112** are configured to provide a communication link between the two locations. In various aspects, transmitting device **132** and receiving device **136** provide a wireless communication link. A wireless communication link may also be established between monitoring system **112** and wireless device **472**, as shown in FIG. **4**. In various aspects, a wireless communication link includes at least one of a radio frequency, wireless network, cellular network, satellite, WiFi, BlueTooth, Wide Area Network (WAN), Local Area Network (LAN), or Body Area Network (BAN) communication link. Various types of communication links are suitable for providing communication between two remote locations. Communication between locations remote from each other may take place over telecommunications networks, for example public or private Wide Area Network (WAN). In general, communication between remote locations is not considered to be suitably handled by technologies geared towards physically localized networks, e.g., Local Area Network (LAN) technologies operation at Layer 1/2 (such as the forms of Ethernet or WiFi). However, it will be appreciated that portions (but not the entirety) of communication networks used in remote communications may include technologies suitable for use in physically localized network, such as Ethernet or WiFi. In an aspect, system components are considered "remote" from each other if they are not within the same room, building, or campus. In an aspect, a remote system may include components separated by a few miles or more. Conversely, system components may be considered "local" to each other if they are located within the same room, building, or campus.

[0177] FIG. **7** illustrates an embodiment of an unobtrusive activity-detection system **700** that is based on a cell phone **702**. In this example, activity detection circuitry **122**, activity analysis circuitry **126**, and transmitting device **132** are components of a cell phone **702**, formed from standard cell phone hardware configured with application software. One or more touchscreen sensors **704**, which are used for receiving instructions for controlling phone **702** entered by patient **706**, serve as activity sensors. One or more activity signal **708** from touchscreen sensors **704** is processed by touchscreen input processing application **710**. Activity signal **708** represents the motion of the patient's finger on the touchscreen, as sensed by touchscreen sensors **704**. Touchscreen input processing application **710** determines the timing of entry of instructions by the patient. In an aspect, it is not necessary to determine the specific instructions entered by the patient, but only to determine how often the patient is using the phone, and/or how quickly the patient is entering instructions into the phone. However, in other aspects, the specific instructions can be detected, e.g., to determine whether the patient is choosing to listen to music, play a game, send or read email, receive a phone call, or place a phone call. An EEG (electroencephalogram) sensor **712** serves as a physiological sensor for providing further information relating to the brain-related functioning of patient **706**. EEG sensor **712** includes electrodes built into earbuds (which are used by the patient **706** for listening to phone calls, music, or other audio outputs provided by cell phone **702**). Sensed EEG signal **714** is processed by EEG processing application **722**. Sensing of EEG signals with sensors that fit into the ear canal is described, for example, in U.S. Patent Publication 2003/0195588 to Fischell et al., and U.S. Patent Publication 2006/0094974 to Cain, both of which are incorporated herein by reference. See also Bleichner, et al., "Exploring Miniaturized EEG Electrodes for Brain-Computer Interfaces. An EEG You Do Not See?" Physiological Reports 2015, Vol. 3, Iss. 4, e12362, doi:10.14814/phy2.12363, which is incorporated herein by reference. In an aspect, EEG sensor **712** is used for detecting event-related potentials (ERPs) associated with a detectable event associated with operation of cell phone **702**. In an aspect, the detectable event is an event that can be detected by control/processing circuitry **180** in cell phone **702**. For example, in various aspects, the detectable event includes providing notification of the arrival of an incoming call to patient **706** (e.g., by ringing or vibration of cell phone **702**), providing notification of the arrival of an email message or impending calendared event with an audible tone or a pop-up message. As used herein, a "detectable" event is an event that results in a detectable change in control/processing circuitry **180** of cell phone **702**. In principle, the "detectable" event is also expected to be detectable by patient **706**, at least at a sub-conscious level, with such detection of the event by the patient resulting in generation of an event-related potential that can be sensed with EEG sensor **712**. Because changes in amplitude, latency, and/or topography of event-related potentials have been observed in subjects with various brain-related disorders (Hansenne, "Event-Related Brain Potentials in Psychopathology: Clinical and Cognitive Perspectives," Psychologica Belgica 2006, vol. 46, iss. 1-2, pp. 5-36, which is incorporated herein by reference), changes in event-related potential production in response to a detectable event, or absence of an event-related potential in response to a detectable event provide information regarding the mental function of the patient, and hence whether the patient has complied with a prescribed treatment regimen. Motion sensor **714** in wristband **716** generates second activity signal **718** representing motion of patient **706**. Second activity signal **718** is processed by motion processing application **720**. Activity detection circuitry **122** receives signals **724**, **726**, and **728** from touchscreen input processing application **710**, motion processing application **720**, and EEG processing application **722**, respectively, which are received by activity detection circuitry **122** and processed to generate activity data signal **134**. Signal **724** from touchscreen input processing application **710** supplies to activity detection circuitry information regarding how often the patient **706** uses phone **702** (summarizing the patient's entry of instructions by category, e.g., by providing the number of times the person placed a phone call, the number of times the patient looked at email, and the number of hours per day spent listening to music). Signal **726** from motion processing application **720** provides information regarding the patient's activity level (sensed by motion sensor **714** in wristband **716**), and signal **728** from EEG processing application **722** provides information regarding how attentive the patient is to a the detectable event (e.g., percent of the time that an ERP was produced in response to a notification regarding the arrival of an email). ERP information and activity patterns relating to patient motion and touchscreen activity are processed in combination to determine compliance of patient **706** with a prescribed treatment regimen.

[0178] FIG. **8** depicts an embodiment of an unobtrusive activity-detection system **800**, implemented in a computing system **802**. Computing system **802** includes computer **804**, monitor **806**, keyboard **808**, pointing device **810**, and camera **812**, which is built into monitor **806** in the present example. Computing system **802** is used by patient **814** to perform personal or work-related activities, such as (for example, and

without limitation) creating and editing documents using word-processing software. In this example, keyboard **808** serves as an activity sensor, providing activity signal **816** to activity detection circuitry **122**. Other components of unobtrusive activity-detection monitoring system **800** (e.g., activity analysis circuitry **126**, and transmitting device **132**) are components of a computing system **802**. In addition, camera **812** provides an identify signal (image signal **818**) to patient identification circuitry **222**, where it is processed by facial recognition circuitry **238** in image analysis circuitry **236** to determine the identity/presence of patient **814** to generate presence signal **225**. It will be appreciated that it may also be possible to determine the identity/presence of patient **814** by utilizing login/password information provided when patient **814** logs onto computer **804** (or logs into a specific piece of program or online accounts) for authentication. Activity signal **816** contains information regarding the patient's typing pattern, which is analyzed by activity analysis circuitry **126**, to generate activity data signal **134**, which is transmitted to a monitoring location by transmitting device **132**. Activity analysis circuitry **126** may analyze typing patterns using, for example, techniques as described in U.S. Pat. No. 6,231,344 to Merzenich et al., U.S. Published Patent Application 2005/0084832 to Janssen et al., each of which is incorporated herein by reference

[0179] FIG. **9** depicts an embodiment of an unobtrusive activity-detection system **900** that is implemented in connection with a microwave oven **902**. Microwave oven **902** is a "smart" oven that includes a circuitry that allows it to send data to and receive data from a computing network, for example, as described in, e.g., U.S. Pat. No. 8,631,063 to Helal et al., U.S. Pat. No. 9,113,795 to Hong et al., U.S. Pat. No. 8,667,112 to Roth et al., each of which is incorporated herein by reference. Microwave oven **902** includes control/processing circuitry **180** and communication circuitry (including transmitting device **132**), allowing it to connect to the computer network **904** via a wireless router **906** or other wireless communication device (e.g., a cell phone or laptop computer). Activity detection circuitry **122**, activity analysis circuitry **126**, and transmitting device **132** are components of microwave oven **902**. Keypad **908** of microwave oven **902** is used as an activity sensor, providing an activity signal **912** to activity detection circuitry **122**. When patient **910** uses keypad **908** to operate microwave oven **902**, activity signal **912** is sent to activity detection circuitry **122**. In an aspect, the pattern of use of microwave oven, as indicated by activation of keypad **908** (e.g., time of day that it is used, frequency of use during the day) may be indicative of the brain-related functioning of the patient. For example, a depressed patient may be less likely to make the effort to prepare food, and will use the microwave oven less than usual. In other cases the patient may use the microwave more often than is typical for that patient, or at unusual times of the day or night. A patient that is showing symptoms of dementia may have difficulty pressing the keys on the keypad in the appropriate sequence in order to heat food. Accordingly, accuracy of operation of the microwave oven (e.g., whether the patient presses keys in the proper sequence to select cooking time and temperature and turns on the oven, and how many attempts it takes to operate the oven properly) may be indicative of the patient's alertness or coordination. Identity of patient **910** is determined by sensing an RFID signal from RFID device **914**, using RFID sensor **916**. Identity signal **918** from RFID sensor **916** is provided to patient identity circuitry **222**, which generates presence signal **225**, as discussed herein above. It is contemplated that RFID device **914** is a passive RFID device, but in other embodiments an active RFID could be used. RFID device **914** is depicted as taking the form of a wristband worn by patient **910**, but it could be embodied in a necklace, a key fob, an implant, clothing, or other form. As an alternative, patient **910** could be identified by sensing an identification signal from a cell phone or smart watch carried by patient **910**.

[0180] FIG. **10** depicts an example of an unobtrusive activity-detection system **1000** that is incorporated into a game system **1002**. Game system **1002** includes a game console **1004**, game controller **1006** for providing control signals to game console **1004**, and display **1008** driven by video output from game console **1004**. Game controller **1006** functions as an activity sensor; as patient **1010** plays the game, signals from game controller **1006** are used as activity signal **1012**, which is processed by activity detection circuitry **122** and activity analysis circuitry **126** in game console **1004**. Sensing and processing of game controller signals, e.g., to determine reaction times, may be substantially as described in U.S. Pat. No. 5,913,310 to Brown, or U.S. Pat. No. 6,186,145 to Brown, both of which are incorporated herein by reference. It will be appreciated that while Brown describes a video game designed primarily for health care-related teaching purposes, the video game may be for entertainment purposes, and need not include an educational or medical component. Activity detection circuitry **122** and activity analysis circuitry **126** include special-purpose hardware and/or software incorporated into game console **1004** (in the form of an add-on card or software). Username/password information entered into game controller **1006** by patient **1010** is used as an authentication signal **1014** processed by authentication circuitry **246** in patient identification circuitry **222** to generate presence signal **225** that indicates presence of the patient. Game console **1004** also includes transmitting device **132**, which is used for communicating with network **1020**, including transmitting activity data signal **134** to a monitoring location for processing as described elsewhere herein.

[0181] FIG. **11** depicts an example of an unobtrusive activity-detection system **1100** that is incorporated into a vehicle system **1102**. Vehicle system **1102** includes one or more components of vehicle **1104**, which are built into vehicle **1104** during manufacture or subsequently installed in vehicle **1104**. Vehicle system components include vehicle controls **1106** (including, but not limited to ignition **1108**, brakes **1110**, steering **1112**, lights **1114**, accelerator **1116**, or door locks **1118**) and auxiliary systems **1120** (including, but not limited to, location sensing **1122**, dashboard camera **1124**, event recorder or "black box" **1126** used for tracking vehicle acceleration, deceleration, etc., entertainment system **1128**, or communication system **1130**). Communication system **1130** may include, for example, a telephone or radio system. The presence and/or identity of patient **1140** in vehicle **1104** is sensed by RFID sensor **1142**, which detects RFID **1144** in key fob **1146** carried by patient **1140**. Activity of patient **1140** is sensed by one or more vehicle system sensor **1150**, including one or more sensors associated with vehicle controls **1106** or auxiliary systems **1120**. A wide variety of types of patient activity can be sensed by vehicle system sensor **1150** to provide information regarding the patient's brain-related function. For example, in various aspects patient activity sensed by vehicle system sensor **1150** includes, but is not limited to acceleration, deceleration or steering of vehicle **1104**, choice of music, activation/deactivation of lights or

door locks, coordination (determined through analysis of video from dashboard cam), choice of location as assessed by location sensing (e.g., GPS) system, etc. In various aspects, rate, frequency, and consistency of sensor activation provide information regarding the patient's mental state. Activity signal **1152** from vehicle system sensor **1150** is provided to activity detection circuitry **122** and activity analysis circuitry **126**, which are components of vehicle system **1102**, and activity data signal **134** from activity detection circuitry **122** is transmitted by transmitting device **132**, which is also a component of a vehicle system **1102**.

[0182] FIG. **12** depicts an example of an unobtrusive activity-detection system **1200** in which activity detection circuitry **122**, activity analysis circuitry **126**, and transmitting device **132** for transmitting activity data signal **134** to a monitoring location are components of a kiosk **1202** (e.g., as described generally in U.S. Pat. No. 9,135,403 to Tolmosoff, and U.S. Pat. No. 8,996,392 to Cashman et al., both of which are incorporated herein by reference). Kiosk **1202** is a medical kiosk used to provide health-related information, perform medical monitoring (e.g., take a blood pressure reading), dispense medication, and the like. Kiosk **1202** includes a touchscreen **1204**, camera **1206**, and prescription dispenser **1208**. Operation of kiosk **1202** is controlled by control/processing circuitry **180**. Patient **1220** signs in to a personal healthcare account via kiosk **1202** by entering a login name and password via touchscreen **1204**, by scanning an identification card, or by some other authentication method. Inputs from touchscreen **1204** are processed by touchscreen input tracking **1224**. Authentication signal **1212** from touchscreen **1204** (or alternatively, from a card scanner) is provided to authentication circuitry **246** in patient identification circuitry **222**. After signing into a personal healthcare account via kiosk **1202**, patient **1220** is able to pick up a prescription via prescription dispenser **1208**, or perform other healthcare-related activities. While patient **1220** interacts with kiosk **1202** via touchscreen **1204**, camera **1206** captures an image of the patient's face, which is provided to control/processing circuitry **180** as a first activity signal **1214**. Eye movement has been shown to be indicative of brain-related state, and eye tracking circuitry **1222** is used to track the patient's eye position/direction of gaze and determine the patient's eye movement pattern to assess brain-related state, for example using an approach as described in U.S. Pat. No. 8,808,195 to Tseng et al., which is incorporated herein by reference.

[0183] In an aspect, camera **1206** is a smart camera which captures images of the eyes of patient **1202**. Image data may include results of visual spectrum imaging, infrared imaging, ultrasound imaging. Smart cameras are commercially available (e.g., Hamamatsu's Intelligent Vision System; http://jp.hamamatsu.com/en/product_info/index.html). Such image capture systems may include dedicated processing elements for each pixel image sensor. Other possible camera systems may include, for example, a pair of infrared charge coupled device cameras to continuously monitor pupil diameter and position. This can be done as the eye follows a moving visual target, and can provide real-time data relating to pupil accommodation relative to objects on a display (e.g., http://jp.hamamatsu.com/en/rd/publication/scientific_american/common/pdf/scientific_06 08.pdf).

[0184] Eye movement and/or pupil movement may also be measured by video-based eye tracking circuitry. In these systems, a camera **1206** built into kiosk **1202** focuses on one or both eyes and records eye movement as the viewer looks at a stimulus. Contrast may be used to locate the center of the pupil, and infrared and near-infrared non-collimated light may be used to create a corneal reflection. The vector between these two features can be used to compute gaze intersection with a surface after a calibration for a subject.

[0185] Two types of eye tracking techniques include bright pupil eye tracking and dark pupil eye tracking Their difference is based on the location of the illumination source with respect to the optical system. If the illumination is coaxial with the optical path, then the eye acts as a retroreflector as the light reflects off the retina, creating a bright pupil effect similar to red eye. If the illumination source is offset from the optical path, then the pupil appears dark. Thus, in some embodiments, the gaze tracking stimulus source and the gaze response signal sensor are co-aligned. Alternatively, the gaze tracking stimulus source and the gaze response signal sensor may be separately aligned and located.

[0186] Bright Pupil tracking creates greater iris/pupil contrast allowing for more robust eye tracking that is less dependent upon iris pigmentation and greatly reduces interference caused by eyelashes and other obscuring features. It also allows for tracking in lighting conditions ranging from total darkness to very bright light. However, bright pupil techniques are not recommended for tracking outdoors as extraneous infrared (IR) sources may interfere with monitoring.

[0187] Most eye tracking systems use a sampling rate of at least 30 Hz. Although 50/60 Hz is most common, many video-based eye tracking systems run at 240, 350 or even 1000/1250 Hz, which is recommended in order to capture the detail of the very rapid eye movements during reading, for example.

[0188] Eye movements are typically divided into fixations, when the eye gaze pauses in a certain position, and saccades, when the eye gaze moves to another position. A series of fixations and saccades is called a scanpath. Most information from the eye is made available during a fixation, not during a saccade. The central one or two degrees of the visual angle (the fovea) provide the bulk of visual information; input from larger eccentricities (the periphery) generally is less informative. Therefore the locations of fixations along a scanpath indicate what information loci on the stimulus were processed during an eye tracking session. On average, fixations last for around 200 milliseconds during the reading of linguistic text, and 350 milliseconds during the viewing of a scene. Preparing a saccade towards a new goal takes around 200 milliseconds. Scanpaths are useful for analyzing cognitive intent, interest, and salience. Other biological factors (some as simple as gender) may affect the scanpath as well. Eye tracking in human-computer interaction typically investigates the scanpath for usability purposes, or as a method of input in gaze-contingent displays, also known as gaze-based interfaces.

[0189] Commercial eye tracking software packages can analyze eye tracking and show the relative probability of eye fixation at particular locations. This allows for a broad analysis of which locations received attention and which ones were ignored. Other behaviors such as blinks, saccades, and cognitive engagement can be reported by commercial software packages. A gaze tracking system for monitoring eye position is available from Seeing Machines Inc., Tucson, Ariz. (see e.g., the Specification Sheet: "faceLAB™ 5 Specifications" which is incorporated herein by reference). Eye position, eye rotation, eye gaze position against screen, pupil diameter and eye vergence distance may be monitored. Eye rotation mea-

surements of up to +/−45 degrees around the y-axis and +/−22 degrees around the x-axis are possible. Typical static accuracy of gaze direction measurement is 0.5-1 degree rotational error.

[0190] In addition, in some aspects an image obtained with camera **1206** can be used to determine movement or coordination of the patient. In an aspect, control/processing circuitry **180** includes image processing hardware and/or software used to determine an activity or posture of the subject from an image obtained from camera **1206**. Such image processing hardware and/or software may, for example, include or generate a model of the background of the image, segment the image, identify the subject in the image, and analyze the image to determine activity or posture of the subject, e.g., based on parameters such as the angle of the torso relative to the hips, or angle of the shoulders relative to the hips. Processing of an image to determine position or posture-related information may be, for example, as described in U.S. Pat. No. 7,616,779 issued Nov. 10, 2009 to Liau et al., U.S. Pat. No. 8,396,283, issued Mar. 12, 2013 to Iihoshi et al., U.S. Pat. No. 7,330,566, issued Feb. 12, 2008 to Cutler, or U.S. Pat. No. 7,728,839 issued Jun. 1, 2010 to Yang et al., each of which is incorporated herein by reference. In addition, the signal from touchscreen **1204**, representing entry of data and instructions via touchscreen **1204** by patient **1220** is used as a second activity signal **1216**. Rate, timing, type, and consistency of data entry as assessed through analysis of second activity signal **1216** also provide information regarding the patient's brain-related state. Activity Analysis circuitry **126** combines information from activity signal **1214** and activity signal **1216** to determine compliance of patient **1220** with a prescribed treatment regimen.

[0191] FIG. **13** depicts an example of an unobtrusive activity-detection system **1300** that is incorporated into an intercommunication ("intercom") system **1302**, for example, of the type used with an access control system to control entry of individuals to an apartment building or office building. In an aspect, intercommunication system **1302** includes master station **1304** and at least one remote station **1306**. In an aspect, remote station **1306** is an example of a system **108** depicted in FIG. **2**, and master station **1304** is an example of a system **112**, as depicted in FIG. **4**. Master station **1304** is used, for example, at a monitoring location **114** such as the reception desk of the building, where it is monitored by a member of the building staff, for example. Remote station **1306** is used at an entrance to a building to grant access to regular occupants or visitors to the building. This location is considered to be patient location **110** in the situation that remote station **1306** is used to control access of the patient to the building. Remote station **1306** includes keypad **1310**, camera **1312**, microphone **1314**, and speaker **1316**. In order to request access to the building, the patient typically presses one or more buttons on keypad **1310**. An image of the patient is detected with camera **1312**; the patient's voice is sensed with microphone **1314** and speaker **1316** provides for delivery of recorded messages, other notification sounds, or verbal instructions from a building staff person at master station **1304**. Master station **1304** includes display **1320** for displaying an image of the patient, speaker **1322** for presenting a voice signal detected with microphone **1314**, keypad **1324**, and handset **1326** which includes a microphone for sensing a voice signal from the building staff person at master station **1304** to deliver to the patient via speaker **1316**. The pattern of entry of an access code, detected via keypad **1310**, serves as activity signal **118**. Camera **1312** detects an image of the iris of the patient, which serves as identity signal **1330** (i.e., camera **1312** serves as a biometric sensor). Detection of patient presence/identity through biometric analysis can be performed by any of the various approaches described herein above. Activity signal **118** and identity signal **1330** are processed by control/processing circuitry **180**, activity detection circuitry **122**, activity analysis circuitry **126** to generate activity data **128**. Transceiver **1332** transmits activity data signal **1334** to transceiver **1336** in monitoring system **1308**. In addition, transceiver **1332** transmits image signal **1338** from camera **1312** and voice signal **1340** from microphone **1314**, and receives voice signal **1342**, sensed via handset **1326**, from master station **1304**. Activity data signal **1334** is processed by control/processing circuitry **190**, and signal processing circuitry **150**, compliance determination circuitry **156** and reporting circuitry **160** as described in connection with FIGS. **1** and **4**. Additional data signals and instructions relating to operation of intercommunication system **1302** are sent between remote station **1306** and master station **1304** via transceivers **1332** and **1336**, respectively, but are not depicted in FIG. **13**.

[0192] FIG. **14** depicts an example of an unobtrusive activity-detection system **1400** that includes a motion sensor **1402** built into (or, alternatively, attached to) a hair brush **1404** used by patient **1406**. In an aspect, motion sensor **1402** is a tri-axial accelerometer. Motion associated with the use of hair brush **1404** is sensed with motion sensor **1402**, and an activity signal **1408** is transmitted to personal computing device **1410**. (Here, personal computing device **1410** is a tablet computer, but it could alternatively be a cell phone, laptop computer, desktop computer, for example.) Personal computing device **1410** includes control/processing circuitry **180**, including activity detection circuitry **122**, activity analysis circuitry **126**, and transmitting device **132**. Application software **1412** configures hardware of personal computing device **1410** to perform functions of activity detection circuitry **122** and activity analysis circuitry **126**. Transmitting device **132** transmits activity data signal **134** to monitoring system **1414** via network **1416**. In an aspect, activity data signal **134** includes information regarding the time of day at which hair brush **1404** was used and how long it was used for. In many cases, this will provide sufficient information regarding use of hair brush **1404** by patient **1406**. However, information relating to the nature of movement sensed—e.g., was the movement weak or vigorous, erratic or regular, was any tremor detected, etc. may also be sensed and may provide additional information regarding the brain-related functioning of patient **1406**. In another aspect, motion sensor **1402** or other activity sensor, activity detection circuitry **122**, activity analysis circuitry **126**, and transmitting device **132** are all components of a personal item such as hair brush **1404**.

[0193] FIG. **15** is a flow diagram of a method **1500** relating to monitoring compliance of a patient with a prescribed treatment regimen. Method **1500** includes sensing with at least one activity sensor in an unobtrusive activity-detection system at least one activity signal including a non-speech activity pattern corresponding to performance of a non-speech activity by a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder, as indicated at **1502**; processing the at least one activity signal with activity detection circuitry in the unobtrusive activity-detection system to identify at least one section of the at least

one activity signal containing the non-speech activity pattern, as indicated at **1504**; analyzing the at least one section of the at least one activity signal with activity analysis circuitry in the unobtrusive activity-detection system to generate activity data including data indicative of whether the patient has complied with the treatment regimen, as indicated at **1506**; and transmitting an activity data signal including the activity data including data indicative of whether the patient has complied with the treatment regimen to a receiving device at a monitoring location with at least one transmitting device at the patient location, as indicated at **1508**. In various aspects, method **1500** is carried out with unobtrusive activity detection system **108** as depicted in FIGS. **1**, **2** and **3**, for example.

[0194] FIGS. **16-28** depict variations and expansions of method **1500** as shown in FIG. **15**. In the methods depicted in FIGS. **16-28**, steps **1502-1508** are as described generally in connection with FIG. **15**. Here and elsewhere, method steps outlined with dashed lines represent steps that are included in some, but not all method aspects, and combinations of steps other than those specifically depicted in the figures are possible as would be known by those having ordinary skill in the relevant art.

[0195] FIG. **16** depicts method **1600**, which includes steps **1502-1508** as described above. As indicated at **1602**, in an aspect the non-speech activity pattern corresponds to unprompted performance of the non-speech activity by the patient. As indicated at **1604**, in another aspect, the non-speech activity pattern corresponds to performance of the non-speech activity by the patient in connection with an activity of daily life. Examples of "activities of daily life" are listed herein above.

[0196] In an aspect, method **1600** includes receiving with an input device a treatment signal indicative of initiation of treatment of the patient according to the treatment regimen and beginning to sense the at least one activity signal responsive to receipt of the treatment signal indicative of initiation of treatment of the patient, as indicated at **1606**. See, e.g., treatment signal **220** in FIG. **2**.

[0197] FIG. **17** depicts method **1700**, which includes steps **1502-1508** as described in connection with FIG. **15**. In an aspect, method **1700** includes performing at least one of sensing the at least one activity signal, processing the at least one activity signal, analyzing the at least one section of the at least one activity signal, and transmitting the activity data substantially continuously, as indicated at **1702**. In another aspect, method **1700** includes performing at least one of sensing the at least one activity signal, processing the at least one activity signal, analyzing the at least one section of the at least one activity signal, and transmitting the activity data intermittently, as indicated at **1704**. In another aspect, method **1700** includes performing at least one of sensing the at least one activity signal, processing the at least one activity signal, analyzing the at least one section of the at least one activity signal, and transmitting the activity data according to a schedule, as indicated at **1706**.

[0198] FIG. **18** depicts method **1800**, wherein sensing the at least one activity signal includes sensing at least one activity signal including an activity pattern corresponding to performance of a motor activity, as indicated at **1802**. In various aspects, the motor activity includes typing, as indicated at **1804**; providing an input via a user interface device, as indicated at **1806**; providing an input via a touchscreen, as indicated at **1808**; providing an input via a pointing device, as indicated at **1810**; controlling a game system, as indicated at **1812**; controlling a vehicle system, as indicated at **1814**; or walking, as indicated at **1816**.

[0199] FIG. **19** depicts a method **1900**, wherein sensing the at least one activity signal includes sensing at least one activity signal including an activity pattern corresponding to performance of an activity of daily life, as indicated at **1902**. In various aspects, the activity of daily life includes at least one of hygiene, as indicated at **1904**; eating, as indicated at **1906**; dressing, as indicated at **1908**; performing a grooming activity, as indicated at **1910** (e.g., brushing hair, as indicated at **1912**; brushing teeth, as indicated at **1914**; or combing hair, as indicated at **1916**); preparing food, as indicated at **1918**; interacting with another person, as indicated at **1920**; interacting with an animal, as indicated at **1922**; interacting with a machine, as indicated at **1924**; interacting with an electronic device, as indicated at **1926**; or using an implement, as indicated at **1928**.

[0200] FIG. **20** depicts a method **2000**, wherein, in various aspects, sensing the at least one activity signal includes sensing at least one signal from a pressure sensor, as indicated at **2002**; a force sensor, as indicated at **2004**; a capacitive sensor, as indicated at **2006**; an imaging device, as indicated at **2008**; a motion sensor, as indicated at **2010**; an acceleration sensor, as indicated at **2012**; or an optical sensor, as indicated at **2014**.

[0201] FIG. **21** depicts a method **2100**, which includes sensing at least one physiological signal with at least one physiological sensor operatively connected to the unobtrusive activity-detection system, as indicated at **2102**. For example, in an aspect the at least one physiological signal is indicative of whether the patient has complied with the treatment regimen, as indicated at **2104**. In an aspect, the at least one physiological signal includes an EEG signal, as indicated at **2106**. For example, in an aspect the at least one physiological signal includes an event-related potential, wherein the event-related potential is related to performance of the non-speech activity by the subject, as indicated at **2108**. In other aspects, the at least one physiological signal includes one or more of a heart signal, as indicated at **1220**; an eye position signal, as indicated at **2112**; or a pupil diameter signal, as indicated at **2114**.

[0202] FIG. **22** depicts a method **2200**, which includes determining a presence of the patient with patient identification circuitry based on at least one identity signal sensed at the patient location, wherein sensing with the at least one activity sensor in the unobtrusive activity-detection system the at least one activity signal including the non-speech activity pattern corresponding to performance of the non-speech activity by the patient at the patient location includes sensing an activity of the patient based at least in part on the determination of the presence of the patient by the patient identification circuitry, as indicated **2202**. In an aspect, the identity signal includes at least a portion of the at least one activity signal, and determining the presence of the patient with patient identification circuitry based on the at least one identity signal includes determining that at least a portion of the at least one activity signal matches a known activity pattern of the patient, as indicated at **2204**. In another aspect, the identity signal includes a voice signal received from an audio sensor at the patient location, and determining the presence of the patient from the at least one identity signal includes analyzing the voice signal to determine the presence of the patient, and wherein processing the at least one activity signal with activity detection circuitry to identify the at least one section of the

at least one activity signal containing the non-speech activity pattern includes identifying at least a portion of the activity signal containing activity corresponding to the voice signal indicative of the presence of the patient, as indicated at **2206**.

[0203] In another aspect, as indicated at **2208**, the identity signal includes a biometric signal from at least one biometric sensor at the patient location, wherein determining the presence of the patient from the at least one identity signal includes analyzing the biometric signal to determine the presence of the patient, and wherein processing the at least one activity signal with activity detection circuitry to identify at least one section of the at least one activity signal containing the non-speech activity pattern includes identifying at least a portion of the activity signal containing activity corresponding to a biometric signal indicative of the presence of the patient.

[0204] FIG. **23** is a flow diagram showing further aspects of the method shown in FIG. **22**. Method **2300**, shown in FIG. **23**, includes step **1502-1508**, as described herein above, as well as step **2202**, which is described in connection with FIG. **22**. In addition, in method **2300**, the identity signal includes an image signal received from an imaging device at the patient location, wherein determining the presence of the patient from the at least one identity signal includes analyzing the image signal to determine the presence of the patient, and wherein processing the at least one activity signal with activity detection circuitry to identify at least one section of the at least one activity signal containing the non-speech activity pattern includes identifying at least a portion of the activity signal containing activity corresponding to an image signal indicative of the presence of the patient, as indicated at **2302**. Method **2300** includes analyzing the image signal to determine the presence of the patient through facial recognition, as indicated at **2304**, or analyzing the image signal to determine the presence of the patient through gait or posture recognition, as indicated at **2306**.

[0205] In other aspects, the identity signal includes at least one authentication factor, as indicated at **2308** (for example, a security token, a password, a digital signature, or a cryptographic key, as indicated at **2310**), or a cell phone identification code, as indicated at **2312** (for example, an electronic serial number, a mobile identification number, or system identification code, as indicated at **2314**). In yet other aspects, the identity signal includes an RFID signal, as indicated at **2316**.

[0206] FIG. **24** depicts further aspects of a method **2400** relating to sensing of the activity signal. For example, in various aspects, the at least one activity signal includes a signal from a keyboard, as indicated at **2402**; a signal from a pointing device, as indicated at **2404**; a signal from a user interface device, as indicated at **2406**; a signal from a touchscreen, as indicated at **2408**; a signal from a remote controller for an entertainment device or system, as indicated at **2410**; a signal from a camera, as indicated at **2412**; a signal from at least one pressure sensor, as indicated at **2414**; a signal from at least one force sensor, as indicated at **2416**; a signal from at least one capacitive sensor, as indicated at **2418**; a signal from at least one imaging device, as indicated at **2420**; a signal from at least one optical sensor, as indicated at **2422**; a signal from at least one motion sensor, as indicated at **2424**; a signal from at least one acceleration sensor, as indicated at **2426**; or a signal from at least one game controller, as indicated at **2428**.

[0207] FIG. **25** shows various other method aspects. For example, in an aspect, a method **2500** includes receiving at least one instruction from the monitoring location, as indicated at **2502**; receiving a signal representing the prescribed treatment regimen from the monitoring location, as indicated at **2504**; storing the at least one activity signal in a data storage device, as indicated at **2506**; storing the activity data in a data storage device, as indicated at **2508**; or transmitting time data to the receiving device with the at least one transmitting device at the patient location, the time data indicative of the time at which the at least one section of the at least one activity signal was detected, as indicated at **2510**. In an aspect, transmitting the activity data signal to the receiving device at the monitoring location includes transmitting a wireless signal, as indicated at **2512**. In another aspect, transmitting the activity data signal to the receiving device at the monitoring location includes transmitting a signal via a computer network connection, as indicated at **2514**.

[0208] FIG. **26** depicts a method **2600**. In an aspect, method **2600** includes processing the at least one activity signal to exclude at least one portion of the at least one activity signal that does not contain activity of the patient, as indicated at **2602**. In another aspect, method **2600** includes processing the at least one section of the at least one activity signal to determine at least one activity pattern of the patient, as indicated at **2604**. In an aspect, the activity data includes the at least one activity pattern of the patient, as indicated at **2606**. For example, in an aspect method **2600** includes determining at least one activity parameter indicative of whether the patient has complied with the treatment regimen, wherein the activity data includes the at least one activity parameter, as indicated at **2608**.

[0209] In some aspects, method **2600** includes comparing the at least one activity pattern with at least one characteristic activity pattern to determine whether the patient has complied with the treatment regimen, as indicated at **2610**. For example, in an aspect comparing the at least one activity pattern with at least one characteristic activity pattern to determine whether the patient has complied with the treatment regimen includes comparing the at least one activity pattern with at least one previous activity pattern of the patient to determine whether the patient has complied with the treatment regimen, as indicated at **2612**. For example, in various aspects, the at least one previous activity pattern is representative of an activity pattern of the patient prior to initiation of treatment of the brain-related disorder, as indicated at **2614**; an activity pattern of the patient after initiation of treatment of the brain-related disorder, as indicated at **2616**; an activity pattern of the patient during known compliance of the patient with a treatment of the brain-related disorder, as indicated at **2618**; and an activity pattern of the patient during treatment with a specified treatment regimen, as indicated at **2620**.

[0210] FIG. **27** depicts aspects of a method **2700**, showing further aspects of step **2604** as shown in FIG. **26**. In an aspect, method **2700** includes comparing the at least one activity pattern with a plurality of activity patterns, and determining which of the plurality of activity patterns best matches the at least one activity pattern, as indicated at **2702**. In an aspect, the plurality of activity patterns are stored prior activity patterns of the patient, and the prior activity patterns are representative of activity patterns of the patient with different treatment regimens, as indicated at **2704**. In another aspect, the plurality of activity patterns are stored population activity patterns representative of activity patterns of populations of

subjects, as indicated at **2706**. For example, in various aspects, at least one of the population activity patterns is representative of activity patterns of a population of subjects without the brain-related disorder, as indicated at **2708**; activity patterns of a population of untreated subjects with the brain-related disorder, as indicated at **2710**; activity patterns of a population of subjects having the brain-related disorder stabilized by treatment, as indicated at **2712**; or activity patterns of a population of subjects undergoing different treatment regimens for the brain-related disorder, as indicated at **2714**.

[0211] FIG. **28** depicts a method **2800**. In various aspects, the brain-related disorder is an emotional disorder, as indicated at **2802**; a personality disorder, as indicated at **2804**; a mental disorder, as indicated at **2806**; a traumatic brain injury-related disorder, as indicated at **2808**; Parkinson's disease, as indicated at **2810**; an Autism Spectrum Disorder, as indicated at **2812**; Alzheimer's disease, as indicated at **2814**; Bipolar Disorder, as indicated at **2816**; depression, as indicated at **2828**; schizophrenia, as indicated at **2820**; a psychological disorder, as indicated at **2822**; or a psychiatric disorder, as indicated at **2824**.

[0212] As noted above, in some aspects, a brain-related disorder is a mental disorder, psychological disorder, or psychiatric disorder. A mental disorder, psychological disorder, or psychiatric disorder can include, for example, a psychological pathology, psychopathology, psychosocial pathology, social pathology, or psychobiology disorder. A mental disorder, psychological disorder, or psychiatric disorder can be any disorder categorized in any Diagnostic and Statistical Manual (DSM) or International Statistical Classification of Diseases (ICD) Classification of Mental and Behavioural Disorders text, and may be, for example and without limitation, a neurodevelopmental disorder (e.g., autism spectrum disorder or attention-deficit/hyperactivity disorder), a psychotic disorder (e.g., schizophrenia), a mood disorder, a bipolar disorder, a depressive disorder, an anxiety disorder, an obsessive-compulsive disorder, a trauma- or stressor-related disorder, a dissociative disorder, a somatic symptom disorder, an eating disorder, an impulse-control disorder, a substance-related or addictive disorder, a personality disorder (e.g., narcissistic personality disorder or antisocial personality disorder), a neurocognitive disorder, a major or mild neurocognitive disorder (e.g., one due to Alzheimer's disease, traumatic brain injury, HIV infection, prion disease, Parkinson's disease, Huntington's disease, or substance/medication). A mental disorder, psychological disorder, or psychiatric disorder can be any disorder described by the NIH National Institute of Mental Health (NIMH) Research Domain Criteria Project and may include a biological disorder involving brain circuits that implicate specific domains of cognition, emotion, or behavior. In an aspect, a brain-related disorder includes a serious mental illness or serious emotional disturbance.

[0213] In various aspects, a brain-related disorder includes a serious mental illness or serious emotional disturbance, a mental disorder, psychological disorder, or psychiatric disorder.

[0214] In an aspect, a brain disorder is a traumatic disorder, such as a traumatic brain injury. Traumatic brain injury-induced disorders may present with dysfunction in cognition, communication, behavior, depression, anxiety, personality changes, aggression, acting out, or social inappropriateness. See, e.g., Jeffrey Nicholl and W. Curt LaFrance, Jr., "Neuropsychiatric Sequelae of Traumatic Brain Injury," Semin Neurol. 2009, 29(3):247-255.

[0215] In an aspect, a brain-related disorder is a lesion-related disorder. A brain lesion can include, for example and without limitation, a tumor, an aneurysm, ischemic damage (e.g., from stroke), an abscess, a malformation, inflammation, or any damage due to trauma, disease, or infection. An example of a lesion-related disorder is a disorder associated with a right-hemisphere lesion.

[0216] In an aspect, a brain disorder is a neurological disorder. A neurological disorder may be, for example and without limitation, Alzheimer's disease, a brain tumor, a developmental disorder, epilepsy, a neurogenetic disorder, Parkinson's disease, Huntington's disease, a neurodegenerative disorder, stroke, traumatic brain injury or a neurological consequence of AIDS. Neurological disorders are described on the website of the National Institutes of Health (NIH) National Institute of Neurological Disorders and Stroke (NINDS).

[0217] In various embodiments, methods as described herein may be performed according to instructions implementable in hardware, software, and/or firmware. Such instructions may be stored in non-transitory machine-readable data storage media, for example. Those having skill in the art will recognize that the state of the art has progressed to the point where there is little distinction left between hardware, software, and/or firmware implementations of aspects of systems; the use of hardware, software, and/or firmware is generally (but not always, in that in certain contexts the choice between hardware and software can become significant) a design choice representing cost vs. efficiency tradeoffs. Those having skill in the art will appreciate that there are various vehicles by which processes and/or systems and/or other technologies described herein can be effected (e.g., hardware, software, and/or firmware), and that the preferred vehicle will vary with the context in which the processes and/or systems and/or other technologies are deployed. For example, if an implementer determines that speed and accuracy are paramount, the implementer may opt for a mainly hardware and/or firmware vehicle; alternatively, if flexibility is paramount, the implementer may opt for a mainly software implementation; or, yet again alternatively, the implementer may opt for some combination of hardware, software, and/or firmware in one or more machines, compositions of matter, and articles of manufacture. Hence, there are several possible vehicles by which the processes and/or devices and/or other technologies described herein may be effected, none of which is inherently superior to the other in that any vehicle to be utilized is a choice dependent upon the context in which the vehicle will be deployed and the specific concerns (e.g., speed, flexibility, or predictability) of the implementer, any of which may vary. Those skilled in the art will recognize that optical aspects of implementations will typically employ optically oriented hardware, software, and or firmware.

[0218] In some implementations described herein, logic and similar implementations may include software or other control structures. Electrical circuitry, for example, may have one or more paths of electrical current constructed and arranged to implement various functions as described herein. In some implementations, one or more media may be configured to bear a device-detectable implementation when such media hold or transmit device detectable instructions oper-

able to perform as described herein. In some variants, for example, implementations may include an update or modification of existing software or firmware, or of gate arrays or programmable hardware, such as by performing a reception of or a transmission of one or more instructions in relation to one or more operations described herein. Alternatively or additionally, in some variants, an implementation may include special-purpose hardware, software, firmware components, and/or general-purpose components executing or otherwise invoking special-purpose components.

[0219] Implementations may include executing a special-purpose instruction sequence or invoking circuitry for enabling, triggering, coordinating, requesting, or otherwise causing one or more occurrences of virtually any functional operations described herein. In some variants, operational or other logical descriptions herein may be expressed as source code and compiled or otherwise invoked as an executable instruction sequence. In some contexts, for example, implementations may be provided, in whole or in part, by source code, such as C++, or other code sequences. In other implementations, source or other code implementation, using commercially available and/or techniques in the art, may be compiled/implemented/translated/converted into a high-level descriptor language (e.g., initially implementing described technologies in C or C++ programming language and thereafter converting the programming language implementation into a logic-synthesizable language implementation, a hardware description language implementation, a hardware design simulation implementation, and/or other such similar mode(s) of expression). For example, some or all of a logical expression (e.g., computer programming language implementation) may be manifested as a Verilog-type hardware description (e.g., via Hardware Description Language (HDL) and/or Very High Speed Integrated Circuit Hardware Descriptor Language (VHDL)) or other circuitry model which may then be used to create a physical implementation having hardware (e.g., an Application Specific Integrated Circuit). Those skilled in the art will recognize how to obtain, configure, and optimize suitable transmission or computational elements, material supplies, actuators, or other structures in light of these teachings.

[0220] This detailed description sets forth various embodiments of devices and/or processes via the use of block diagrams, flowcharts, and/or examples. Insofar as such block diagrams, flowcharts, and/or examples contain one or more functions and/or operations, it will be understood by those within the art that each function and/or operation within such block diagrams, flowcharts, or examples can be implemented, individually and/or collectively, by a wide range of hardware, software, firmware, or virtually any combination thereof. In an embodiment, several portions of the subject matter described herein may be implemented via Application Specific Integrated Circuits (ASICs), Field Programmable Gate Arrays (FPGAs), digital signal processors (DSPs), or other integrated formats. However, those skilled in the art will recognize that some aspects of the embodiments disclosed herein, in whole or in part, can be equivalently implemented in integrated circuits, as one or more computer programs running on one or more computers (e.g., as one or more programs running on one or more computer systems), as one or more programs running on one or more processors (e.g., as one or more programs running on one or more microprocessors), as firmware, or as virtually any combination thereof, and that designing the circuitry and/or writing the code for the software and or firmware would be well within the skill of one having skill in the art in light of this disclosure. In addition, those skilled in the art will appreciate that the mechanisms of the subject matter described herein are capable of being distributed as a program product in a variety of forms, and that an illustrative embodiment of the subject matter described herein applies regardless of the particular type of signal bearing medium used to actually carry out the distribution. Examples of a signal bearing medium include, but are not limited to non-transitory machine-readable data storage media such as a recordable type medium such as a floppy disk, a hard disk drive, a Compact Disc (CD), a Digital Video Disk (DVD), a digital tape, a computer memory, etc. A signal bearing medium may also include transmission type medium such as a digital and/or an analog communication medium (e.g., a fiber optic cable, a waveguide, a wired communications link, a wireless communication link (e.g., transmitter, receiver, transmission logic, reception logic, etc.) and so forth).

[0221] FIG. **29** is a block diagram of a computer program product **2900** for implementing a method as described in connection with FIG. **15**. Computer program product **2900** includes a signal-bearing medium **2902** bearing one or more instructions for sensing with at least one activity sensor in an unobtrusive activity-detection system at least one activity signal including a non-speech activity pattern corresponding to performance of a non-speech activity by a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder; one or more instructions for processing the at least one activity signal with activity detection circuitry in the unobtrusive activity-detection system to identify at least one section of the at least one activity signal containing the non-speech activity pattern; one or more instructions for analyzing the at least one section of the at least one activity signal with activity analysis circuitry in the unobtrusive activity-detection system to generate activity data including data indicative of whether the patient has complied with the treatment regimen; and one or more instructions for transmitting an activity data signal including the activity data including data indicative of whether the patient has complied with the treatment regimen to a receiving device at a monitoring location with at least one transmitting device at the patient location, as indicated at **2904**. Signal-bearing medium **2902** may be, for example, a computer-readable medium **2906**, a recordable medium **2908**, a non-transitory signal-bearing medium **2910**, or a communications medium **2912**, examples of which are described herein above.

[0222] FIG. **30** is a block diagram of a system **3000** for implementing a method as described in connection with FIG. **15**. System **3000** includes a computing device **3002** and instructions that when executed on the computing device cause the computing device to control the sensing with at least one activity sensor in an unobtrusive activity-detection system of at least one activity signal including a non-speech activity pattern corresponding to performance of a non-speech activity by a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder; process the at least one activity signal with activity detection circuitry in the unobtrusive activity-detection system to identify at least one section of the at least one activity signal containing the non-speech activity pattern; analyze the at least one section of the at least one activity signal with

activity analysis circuitry in the unobtrusive activity-detection system to generate activity data including data indicative of whether the patient has complied with the treatment regimen; and control the transmitting an activity data signal including the activity data including data indicative of whether the patient has complied with the treatment regimen to a receiving device at a monitoring location with at least one transmitting device at the patient location, as indicated at **3004**. System **3000** may be, for example, a cell phone configured with application software **3006**, a computing system or device **3008**, or a microprocessor-based system **3010** or various other systems as described herein. Furthermore, the system may include sensors, input devices, and output devices, e.g., as depicted FIGS. **2**, **5**, and **7** for example.

[0223] FIG. **31** is a flow diagram of a method **3100** relating to monitoring compliance of a patient with a prescribed treatment regimen. Method **3100** includes receiving an activity data signal with a receiving device at a monitoring location, the activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during performance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen intended to treat at least one aspect of the brain-related disorder, as indicated at **3102**; analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern, as indicated at **3104**; determining with compliance determination circuitry at the monitoring location whether the patient has complied with the prescribed treatment regimen based on whether the activity data represents the at least one non-speech activity pattern that matches the at least one characteristic activity pattern, as indicated at **3106**; and reporting with reporting circuitry a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen, as indicated at **3108**. In various aspects, method **3100** is carried out with monitoring system **118** as depicted in FIGS. **1** and **4**, for example.

[0224] FIGS. **32-48** depict variations and expansions of method **3100** as shown in FIG. **31**. In the methods depicted in FIGS. **32-48**, steps **3102-3108** are as described generally in connection with FIG. **31**. Here and elsewhere, method steps outlined with dashed lines represent steps that are included in some, but not all method aspects, and combinations of steps other than those specifically depicted in the figures are possible as would be known by those having ordinary skill in the relevant art.

[0225] FIG. **32** depicts a method **3200**, wherein the non-speech activity pattern corresponds to unprompted performance of the non-speech activity by the patient, as indicated at **3202**. In an aspect, method **3200** includes receiving a signal indicative of initiation of treatment of the patient according to the treatment regimen and beginning to receive activity data with the receiving device responsive to receipt of the signal indicative of initiation of treatment of the patient, as indicated at **3204**.

[0226] FIG. **33** depicts a method **3300**. In an aspect, method **3300** includes performing substantially continuously at least one of receiving the activity data signal with the receiving device, analyzing the activity data signal with the signal processing circuitry, determining with the compliance determining circuitry whether the patient has complied with the prescribed treatment regimen, and reporting the conclusion with the reporting circuitry, as indicated at **3302**. In another aspect, method **3300** includes performing intermittently at least one of receiving the activity data signal with the receiving device, analyzing the activity data signal with the signal processing circuitry, determining with the compliance determining circuitry whether the patient has complied with the prescribed treatment regimen, and reporting the conclusion with the reporting circuitry, as indicated at **3304**. In another aspect, method **3300** includes performing according to a schedule at least one of receiving the activity data signal with the receiving device, analyzing the activity data signal with the signal processing circuitry, determining with the compliance determining circuitry whether the patient has complied with the prescribed treatment regimen, and reporting the conclusion with the reporting circuitry, as indicated at **3306**.

[0227] Aspects of a method **3400** are shown in FIG. **34**. In one aspect, the activity data represents a non-speech activity pattern corresponding to performance of a motor activity, as indicated at **3402**, which in various aspects includes typing, as indicated at **3404**; providing input via a user interface device, as indicated at **3406**; or walking, as indicated at **3408**.

[0228] In another aspect, the activity data represents a non-speech activity pattern corresponding to performance of an activity of daily life, as indicated at **3410**. For example, in various aspects the activity of daily life includes at least one of hygiene, washing, eating, dressing, brushing hair, combing hair, preparing food, interacting with another person, interacting with an animal, interacting with a machine, interacting with an electronic device, or using an implement, as indicated at **3412**.

[0229] Further aspects relating to receipt of the activity data signal are shown in method **3500** depicted in FIG. **35**. In various aspects, the activity data signal contains activity data indicative of a keystroke pattern, as indicated at **3502**; activity data indicative of an activity performance pattern, as indicated at **3530**; activity data indicative of an activity performance rate, as indicated at **3504**; activity data indicative of an activity performance time, as indicated at **3506**; activity data indicative of an activity performance frequency, as indicated at **3508**; activity data indicative of an activity performance variability, as indicated at **3510**; activity data indicative of an activity performance accuracy, as indicated at **3512**; activity data indicative of an activity performance error rate, as indicated at **3514**; activity data including data from a pressure sensor, as indicated at **3516**; activity data including data from a force sensor, as indicated at **3518**; activity data including data from a capacitive sensor, as indicated at **3520**; activity data including data from an imaging device, as indicated at **3522**; activity data including data from a motion sensor, as indicated at **3524**; activity data including data from an acceleration sensor, as indicated at **3526**; and activity data including data from an optical sensor, as indicated at **3528**.

[0230] FIG. **36** depicts aspects of a method **3600**, which includes receiving with at least one receiving device a physiological activity data signal indicative of at least one physiological signal sensed with at least one physiological sensor operatively connected to the unobtrusive activity-detection system, as indicated at **3602**. In an aspect, the at least one physiological activity data signal is indicative of whether the patient has complied with the treatment regimen, as indicated at **3604**. In various aspects, the at least one physiological

activity data signal includes EEG data, as indicated at **3606**; an event-related potential, wherein the event-related potential is related to performance of the non-speech activity by the subject, as indicated at **3608**; heart rate data, as indicated at **3610**; eye position data, as indicated at **3612**; or pupil diameter data, as indicated at **3614**.

[0231] FIG. **37** depicts aspect of method **3700**, which includes determining a presence of the patient with patient identification circuitry at the monitoring location from at least one identity signal received at the monitoring location from the patient location, and using activity identification circuitry to identify patient activity data corresponding to activity of the patient based at least in part on the identity signal, as indicated at **3702**. In an aspect, the identity signal includes at least a portion of the activity data signal, and wherein determining the presence of the patient with the patient identification circuitry at the monitoring location from the at least one identity signal includes analyzing activity data in the activity data signal to identify at least a portion of the activity data that matches a known activity pattern of the patient, as indicated at **3704**. In an aspect, the identity signal includes a voice signal, wherein determining the presence of the patient with the patient identification circuitry at the monitoring location from the at least one identity signal includes analyzing the voice signal to determine the presence of the patient, and wherein using activity identification circuitry to identify patient activity data corresponding to activity of the patient based at least in part on the identity signal includes identifying activity data corresponding to a voice signal indicative of a presence of the patient, as indicated at **3706**. In an aspect, the identity signal includes an image signal received from an imaging device at the patient location, wherein determining the presence of the patient with the patient identification circuitry at the monitoring location from the at least one identity signal includes analyzing the image signal to determine the presence of the patient, and wherein using activity identification circuitry to identify patient activity data corresponding to activity of the patient based at least in part on the identity signal includes identifying activity data corresponding to an image signal indicative of a presence of the patient, as indicated at **3708**. For example, in an aspect, analyzing the image signal to determine the presence of the patient includes determining the presence of the patient through facial recognition, as indicated at **3710**. In another aspect, analyzing the image signal to determine the presence of the patient includes determining the presence of the patient through gait or posture recognition, as indicated at **3712**.

[0232] FIG. **38** depicts a method **3800**, showing further aspects relating to determination of the presence of the patient with patient identification circuitry at **3702**, which is as described in connection with FIG. **37**. As indicated at **3802**, in an aspect the identity signal includes a biometric signal from at least one biometric sensor at the patient location, wherein determining the presence of the patient with the patient identification circuitry at the monitoring location from the at least one identity signal includes analyzing the voice signal to determine the presence of the patient, and wherein using activity identification circuitry to identify patient activity data corresponding to activity of the patient based at least in part on the identity signal includes identifying activity data corresponding to a biometric signal indicative of a presence of the patient.

[0233] In another aspect, the identity signal includes at least one authentication factor, as indicated at **3804**. For example, in various aspects the authentication factor is selected from the group consisting of a security token, a password, a digital signature, and a cryptographic key, as indicated at **3806**. In another aspect, the identity signal includes a cell phone identification code, as indicated at **3808**, for example, an electronic serial number, a mobile identification number, and a system identification code, as indicated at **3810**. In another aspect, the identity signal includes an RFID signal, as indicated at **3812**. In yet another aspect, method **3800** includes separating patient activity data from the patient from activity data from other people, as indicated at **3814**.

[0234] FIG. **39** depicts method **3900**, which includes, in various aspects, receiving time data with a receiving device, the time data transmitted to the monitoring location from the patient location, the time data indicative of a time at which the activity data representing the at least one non-speech activity pattern was sensed, as indicated at **3902**; storing prescription information in a data storage device at the monitoring location, the prescription information representing the prescribed treatment regimen, as indicated at **3904**; receiving prescription information representing the prescribed treatment regimen, as indicated at **3906**; prescribing the treatment regimen intended to treat the at least one aspect of the brain-related disorder to the patient, as indicated at **3908**.

[0235] FIG. **40** depicts a method **4000**, which includes determining a time at which the activity data representing the at least one non-speech activity pattern that matches the at least one characteristic activity pattern was detected from the patient, wherein the at least one characteristic activity pattern corresponds to an activity pattern expected to be produced in the subject in response to the prescribed treatment regimen at a specific time following initiation of the prescribed treatment regimen, as indicated **4002**.

[0236] FIG. **41** depicts method **4100** illustrating further aspects relating to receiving an activity data signal at **3102**. In various aspects of method **4100**, receiving the activity data signal includes at least one of receiving a wireless signal, as indicated at **4102**; receiving data via a computer network connection, as indicated at **4104**; receiving data from a communication port, as indicated at **4106**; and receiving data from a data storage device, as indicated at **4108**.

[0237] FIG. **42** depicts method **4200**, illustrating further aspects relating to analyzing the activity data signal at **3104**. In an aspect, analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern includes comparing the non-speech activity pattern represented by the activity data with the at least one characteristic activity pattern, as indicated at **4202**. In an aspect, comparing the non-speech activity pattern represented by the activity data with the at least one characteristic activity pattern includes comparing the non-speech activity pattern represented by the activity data with a plurality of characteristic activity patterns, as indicated at **4204**. In connection therewith, method **4200** includes determining which of the plurality of characteristic activity patterns best matches the non-speech activity pattern represented by the activity data, as indicated at **4206**. For example, in an aspect method **4200** includes determining a treatment regimen corresponding to the characteristic activity pattern that best matches the non-speech activity pattern, wherein the plurality of characteristic activity patterns include a plurality of previous non-speech activity patterns each representative of a non-speech

activity pattern of the patient undergoing a different treatment regimen for treatment of the brain-related disorder, as indicated at **4208**. In another aspect, method **4200** includes determining a treatment regimen corresponding to the characteristic activity pattern that best matches the non-speech activity pattern, wherein the plurality of characteristic activity patterns include a plurality of population non-speech activity patterns each representative of a typical non-speech activity pattern for a population of subjects undergoing a different treatment regimen for treatment of the brain-related disorder, as indicated at **4210**.

[0238] FIG. **43** depicts a method **4300**, wherein analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern includes comparing the activity data with characteristic activity data representing the characteristic activity pattern, as indicated at **4302**. In an aspect, comparing the activity data with the characteristic activity data representing the characteristic activity pattern includes comparing the activity data with a plurality of characteristic activity data sets, each said characteristic activity data set representing a characteristic activity pattern, as indicated at **4304**. The method may also include determining which of the plurality of characteristic activity data sets best matches the activity data, as indicated at **4306**. In an aspect, each said characteristic activity data set corresponds to a stored non-speech activity pattern representative of the patient undergoing a distinct treatment regimen, as indicated at **4308**. In an aspect, each said characteristic activity data set corresponds to a stored non-speech activity pattern representative of a population of subjects undergoing a distinct treatment regimen, as indicated at **4310**. The method may include determining a treatment regimen associated with the characteristic activity data set that best matches the activity data, as indicated at **4312**.

[0239] FIG. **44** depicts aspects of a method **4400** relating to reporting with reporting circuitry a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen, as shown at **3108**. In an aspect, reporting a conclusion based on the determination of whether the patient has complied with the treatment regimen includes displaying a report on a display device, as indicated at **4402**.

[0240] In another aspect, reporting a conclusion based on the determination of whether the patient has complied with the treatment regimen includes generating a notification, as indicated at **4404**. In other aspects, reporting a conclusion based on the determination of whether the patient has complied with the treatment regimen includes one or more of transmitting a notification to a wireless device, as indicated at **4406**; generating an audio alarm, as indicated at **4408**; or storing a notification in a data storage device, as indicated at **4410**.

[0241] FIG. **45** depicts method **4500**, showing method aspects relating to determining whether the patient has complied with the prescribed treatment regimen, at **3106**. In an aspect, determining with the compliance determination circuitry whether the patient has complied with the treatment regimen includes determining that the patient has failed to comply with the prescribed treatment regimen, as indicated at **4502**. In another aspect, wherein determining with the compliance determination circuitry whether the patient has complied with the treatment regimen includes determining that the patient has complied with the prescribed treatment regimen, as indicated at **4504**. In another aspect, determining with the compliance determination circuitry whether the patient has complied with the treatment regimen includes determining a degree of compliance of the patient with the prescribed treatment regimen, as indicated at **4506**.

[0242] FIG. **46** depicts a method **4600**, in which, in various aspects, the brain-related disorder is an emotional disorder, as indicated at **4602**; a personality disorder, as indicated at **4604**; a mental disorder, as indicated at **4606**; a traumatic brain injury-related disorder, as indicated at **4608**; schizophrenia, as indicated at **4610**; Parkinson's disease, as indicated at **4612**; an Autism Spectrum Disorder, as indicated at **4614**; Alzheimer's disease, as indicated at **4616**; Biopolar Disorder, as indicated at **4618**; depression, as indicated at **4620**; a psychological disorder, as indicated at **4622**; or a psychiatric disorder, as indicated at **4624**.

[0243] FIG. **47** depicts a method **4700**, wherein the at least one characteristic activity pattern includes at least one previous non-speech activity pattern of the patient, as indicated at **4702**. In various aspects, the at least one previous non-speech activity pattern is representative of a non-speech activity pattern of the patient prior to initiation of treatment of the brain-related disorder, as indicated at **4704**; a non-speech activity pattern of the patient after initiation of treatment of the brain-related disorder, as indicated at **4706**; a non-speech activity pattern of the patient during known compliance of the patient with a treatment of the brain-related disorder, as indicated at **4708**; or a non-speech activity pattern of the patient during treatment with a specified treatment regimen, as indicated at **4710**.

[0244] FIG. **48** depicts a method **4800**, wherein the at least one characteristic activity pattern includes at least one population activity pattern representative of a typical non-speech activity pattern of a population of subjects, as indicated at **4802**. In various aspects, the at least one population activity pattern is representative of non-speech activity patterns of a population without the brain-related disorder, as indicated at **4804**; an untreated population with the brain-related disorder, as indicated at **4806**; or a population having the brain-related disorder stabilized by a treatment regimen, as indicated at **4808**.

[0245] FIG. **49** is a block diagram of a computer program product **4900** for implementing a method as described in connection with FIG. **31**. Computer program product **4900** includes a signal-bearing medium **4902** bearing one or more instructions for receiving an activity data signal with a receiving device at a monitoring location, the activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during performance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen intended to treat at least one aspect of the brain-related disorder, one or more instructions for analyzing the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern, one or more instructions for determining with compliance determination circuitry at the monitoring location whether the patient has complied with the prescribed treatment regimen based on whether the activity data represents the at least one non-

speech activity pattern that matches the at least one characteristic activity pattern, and one or more instructions for reporting with reporting circuitry a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen, as indicated at **4904**. Signal-bearing medium **4902** may be, for example, a computer-readable medium **4906**, a recordable medium **4908**, a non-transitory signal-bearing medium **4910**, or a communications medium **4912**, examples of which are described herein above.

[0246] FIG. **50** is a block diagram of a system **5000** for implementing a method as described in connection with FIG. **31**. System **5000** includes a computing device **5002** and instructions that when executed on the computing device cause the computing device to control the receiving of an activity data signal with a receiving device at a monitoring location, the activity data signal transmitted to the monitoring location from a patient location, the activity data signal containing activity data representing at least one non-speech activity pattern in activity sensed from a patient with at least one activity sensor in an unobtrusive activity-detection system at the patient location during performance of the non-speech activity by the patient, the patient having a brain-related disorder and a prescribed treatment regimen intended to treat at least one aspect of the brain-related disorder; analyze the activity data signal with signal processing circuitry at the monitoring location to determine whether the activity data represents at least one non-speech activity pattern that matches at least one characteristic activity pattern; determine with compliance determination circuitry at the monitoring location whether the patient has complied with the prescribed treatment regimen based on whether the activity data represents the at least one non-speech activity pattern that matches the at least one characteristic activity pattern; and control the reporting with reporting circuitry of a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen, as indicated at **5004**. System **5000** may be, for example, a cell phone configured with application software **5006**, a computing system or device **5008**, or a microprocessor-based system **5010**.

[0247] In other aspects, systems may be constructed which utilizes two or more activity signals detected from the patient in order to determine whether the patient has complied with a prescribed treatment regimen. Such systems may utilize various combinations of activity signals as described herein, or utilize one or more activity signals as described herein in combination with an audio signal including speech from the patient. Information regarding compliance with a treatment regimen can be based in part upon analysis of patient speech.

[0248] FIG. **51** is a block diagram of a system **5100** for monitoring compliance of a patient with a treatment regimen based upon two or more sensed signals. System **5100** includes communication system **5102** at patient location **5104** and monitoring system **5106** at monitoring location **5108**. In general, communication system **5102** includes components shown in unobtrusive activity detection system **108** in FIG. **2**, as well as any additional components required for perform communication system functions. Communication system **5102** includes at least one audio sensor **5110** for sensing at least one audio signal **5112**, which includes patient speech from patient **102** at a patient location **5104** during use of communication system **5102**. In an aspect, communication system **5102** includes a telephone (e.g., as depicted in FIG. **7**), an intercommunication system (e.g., as depicted in FIG. **13**), or a radio communication system, and audio sensor is a microphone or other audio sensing device as known by those of ordinary skill in the art. Patient **102** has a brain-related disorder and a prescribed treatment regimen **104** for treating at least one aspect of the brain-related disorder. Communication system **5102** includes at least one first activity sensor **5120** for sensing at least one first activity signal **5122** indicative of a first activity of the patient. Communication system **5102** includes signal processing circuitry **5124**, which is configured to process the at least one first activity signal **5122** and at least one second activity signal **5126**, which indicative of a second activity of the patient, to generate at least one activity data signal **5130**, the activity data signal **5130** containing activity data **5132** indicative of whether the patient has complied with the treatment regimen. Communication system **5102** also includes at least one transmitting device **5134** at the patient location for transmitting the at least one activity data signal **5130** and at least one audio data signal **5136** based on the at least one audio signal **5112** to a receiving device **5138** at monitoring location **5108**. In an aspect, activity signal **5126** includes audio signal **5112** from audio sensor **5110**, which can supply information regarding speech or vocal activity of patient **102**. In an aspect, signal processing circuitry **5124** includes speech processor **5128**. In an aspect, speech processor **5128** is configured to process the at least one audio signal **5112** to identify at least one portion of the at least one audio signal **5112** containing spontaneous speech of the patient. In an aspect, speech processor **5128** is configured to process at least one audio signal **5112** to exclude at least one portion of at least one audio signal **5112** that does not contain spontaneous speech of the patient. In an aspect, activity data **5132** includes the at least one section of the at least one audio signal **5112** containing spontaneous speech of the patient.

[0249] In an aspect, speech processor **5128** is configured to process at least one audio signal **5112** to determine at least one speech pattern of the patient. In an aspect, activity data **5132** includes the at least one speech pattern. A speech pattern can be defined as a consistent, characteristic form, style, or method of speech comprising a distribution or arrangement of repeated or corresponding parts composed of qualities, acts, or tendencies. In an embodiment a speech pattern can include one or more qualities of diction, elocution, inflection, and/or intonation. In an embodiment a speech pattern can include aspects of language at the lexical level, sentential level, or discourse level. In an embodiment, a speech pattern may conform to the Thought, Language, and Communication Scale and/or Thought and Language Index. Reviews describing speech patterns and linguistic levels and the tools used to study them include Covington M. A., et al. "Schizophrenia and the structure of language: The linguist's view," Schizophrenia Research 77: 85-98, 2005, and Kuperberg and Caplan (2003 Book Chapter: Language Dysfunction in Schizophrenia), which are both incorporated herein by reference.

[0250] In an embodiment, a speech pattern includes a linguistic pattern determined at the lexical level. A speech pattern may include a frequency of, for example, pauses, words, or phrases. For example, a speech pattern may include a frequency of pauses. A higher frequency of pauses or reduced verbal fluency can be indicative of alogia associated with a brain disorder, e.g., bipolar disorder, depression, or schizophrenia. For example, a speech pattern may include a frequency of dysfluencies ("uhs" and "ums"). A higher than average frequency of dysfluencies may indicate a slowed speech, the inability to think clearly, or a deliberate attempt to appear unaffected by illness, all of which have been associ-

ated with psychological pathologies. For example, a speech pattern may include a distribution of pauses and dysfluencies. A high frequency and particular distribution of pauses and dysfluencies may be indicative of anomia associated with schizophrenia or with an aphasia due to brain injury. For example, a speech pattern may include a frequency of neologisms and/or word approximations, or glossomania. Higher than average frequencies of neologisms and/or word approximations, or glossomania, have been associated with disorders such as schizophrenia, schizoaffective disorder, or mania. For example, a speech pattern may include a frequency of word production. A frequency of word production lower than the norm may be indicative of a brain disorder such as schizophrenia. An excessive speed during speech, as in pressured speech, may be indicative of a brain disorder such as the mania of bipolar disorder, while reduced speed may be indicative of depression or a depressive episode. For example, a pattern may include a type:token ratio (i.e., number of different words (types) in relation to the total number of words spoken (tokens)). A type:token ratio that is generally lower than the norm can be indicative of schizophrenia. For example, a speech pattern may include a frequency of specific words. Quantitative word counts have been used as a tool in the identification and examination of abnormal psychological processes including major depression, paranoia, and somatization disorder. A high frequency of negative emotion words or death-related words may be indicative of depression. Psychologically relevant words can include those listed in one or more dictionaries of the Linguistic Inquiry and Word Count (LIWC) program (see Tausczik and Pennebaker, "The Psychological Meaning of Words: LIWC and Computerized Text Analysis Methods," Journal of Language and Social Psychology 29(1): 24-54, 2010, which is incorporated herein by reference). Words interpreted as carrying normative emotional qualities are found in dictionaries of two programs, *Affective Norms for English Words* (*ANEW*) and *Dictionary of Affect in Language* (*DAL*) (see Whissell C., "A comparison of two lists providing emotional norms for English words (ANEW and the DAL)," Psychol Rep., 102(2):597-600, 2008, which is incorporated herein by reference).

[0251] In an embodiment, a speech pattern includes a linguistic pattern determined at the sentential level or discourse level. For example, a speech pattern can include a consistent grammatical style. A pattern comprising a style that is grammatically deviant from the norm might include the overuse of the past tense, indicating detachment from the subject being discussed. A pattern comprising a style that is grammatically deviant from the norm, e.g., as reflected by a higher percentage of simple sentences and, in compound sentences, fewer dependent clauses may be indicative of schizophrenia. For example, a speech pattern may include a ratio of syntactic complexity (number of clauses and proportion of relative: total clauses). An abnormal ratio may indicate a brain disorder. For example, a speech pattern may include a frequency of subordinate clauses. An increase in subordinate clauses has been observed in the speech of psychopaths (see, e.g., Hancock et al., "Hungry like the wolf: A word-pattern analysis of the language of psychopaths," Legal and Criminological Psychology, 2011; DOI: 10.1111/j.2044-8333.2011.02025.x, which is incorporated herein by reference). For example, a speech pattern may include a relatedness of lexical content such as semantic or sentential priming. A speech pattern of abnormal priming may indicate a brain disorder such as schizophrenia. For example, a speech pattern may include a frequency of one or more use of cohesive ties, e.g., as demonstrated by references, conjunctions, or lexical cohesion. A low frequency of reference ties has been observed in patients suffering from schizophrenia. For example, a speech pattern may include an hierarchical structure within a discourse, e.g., a systematic structure in which propositions branch out from a central proposition. A speech pattern lacking a systematic structure may be indicative of schizophrenia.

[0252] For example, a speech pattern including a linguistic pattern determined at the sentential level or discourse level may include a representation of content of thought (what the patient is talking about). For example, a speech pattern may include a representation of form of thought (the way ideas, sentences, and words are put together). A speech pattern containing representations of content or form of thought that differ from those expected (e.g., as determined from population patterns) may indicate a psychological disorder such as schizophrenia. Examples of representations of content or form of thought observed in schizophrenia include derailment, loss of goal, perseveration, and tangentiality. For example, a speech pattern may include aspects of linguistic pragmatics (e.g., cohesion or coherence). Abnormal patterns in pragmatics may be indicative of a brain disorder such as schizophrenia or mania. Examples of speech patterns and content of thought are discussed by Covington, et al., idem, and by Kuperberg and Caplan idem. A program for classifying parts of speech (e.g., noun, verb, adjective, etc.) based on the surrounding context and analysis of semantic content has been developed and is available under the Wmatrix interface (http://ucrel.lancs.ac.uk/wmatrix/) and has been used to analyze the speech of psychopaths (see Hancock, idem).

[0253] In an embodiment, a speech pattern includes an acoustic quality. In an embodiment a speech pattern includes volume. For example, excessive or reduced volume may be indicative of a symptom of a brain disorder. In an embodiment a speech pattern includes prosody (the rhythm, stress, and intonation of speech). For example, aprosody or flattened intonation can be indicative of schizophrenia. In an embodiment, a speech pattern includes a voice quality of phonation. In an embodiment, a speech pattern includes pitch or timbre. For example, abnormalities in pitch have been observed in schizophrenics. For example, a strained quality, choking voice, or creaking voice (laryngealisation) may be indicative of a psychological disorder. Voice qualities and volume in linguistics are discussed by Covington, idem.

[0254] For example, the at least one speech pattern may be represented in activity data **5132** in numerical or categorical form. For example, a speech pattern represented in numerical form may include one or more numerical values representing one or more speech parameters. Particular speech parameters represented in a speech pattern may be selected for the purpose of evaluating/monitoring particular brain-related disorders. For example, in an aspect a speech pattern for evaluating/monitoring depression includes values representing the following parameters: speech volume, frequency of word production, frequency of pauses, and frequency of negative value words. In another aspect, a speech pattern for evaluating/monitoring schizophrenia includes values representing frequency of word production, frequency of pauses, frequency of disfluencies, type:token ratio, and speech volume. A speech parameter or pattern may be represented in activity data **5132** in categorical form; for example, frequency of word production may be categorized as low, medium, or high rather than represented by a specific numerical value.

[0255] In an aspect, signal processing circuitry **5124** includes a comparator **5129** for comparing speech patterns or parameters of patient **102** with characteristic speech patterns or parameters, in an approach similar to that described above in connection with comparator **254** in FIG. **2**, to determine whether the patient has complied with the prescribed treatment regimen. In an aspect, comparator **5129** is configured to compare at least one speech pattern of the patient with a plurality of characteristic speech patterns. In an aspect, the result of such a comparison is either "patient has complied" or "patient has not complied." In an aspect, signal processing circuitry **5124** is configured to determine that patient **102** has failed to comply with the prescribed treatment regimen. In an aspect, signal processing circuitry **5124** is configured to determine that patient **102** has complied with prescribed treatment regimen **104**. Determination of compliance may be accomplished by a thresholding, windowing, or distance computation of one or multiple parameters relative to characteristic threshold or range values for the parameter, and combining results for the multiple parameters. For example, for a given parameter (relating to activity sensed with one or more activity sensor or audio sensor), a patient parameter value higher than a characteristic threshold value may indicate compliance of the patient with the prescribed treatment regimen, while a patient parameter value equal to or lower than the threshold value may indicate non-compliance. As another example, a patient parameter value that lies within a range of characteristic values for the parameter may indicate compliance, while a patient parameter value outside the range of characteristic values indicates non-compliance. Comparator **5129** may utilize various types of distance computations to determine whether patient parameter values are within a threshold distance or distance range from characteristic values. Distance computations based on one or more parameters or data values are known (including, but not limited to, least-squares calculations). Different activity parameters or audio signal parameters may be given different weights depending on how strongly indicative the parameter is of the patient compliance. In an aspect, signal processing circuitry **5124** is configured to determine whether the patient has complied with the prescribed treatment regimen based upon a determination of whether the speech corresponds to at least one of a plurality of characteristic speech patterns. For example, the plurality of characteristic speech patterns can include multiple characteristic speech patterns, each corresponding to a patient speech pattern obtained at a different treatment regimen, for example, different doses of a drug. By identifying which characteristic speech pattern the patient speech pattern matches or is closest to, the drug dose taken by the patient can be determined. For example, the patient may have taken the drug, but at a lesser dose or less often than was prescribed. Accordingly, the patient's speech pattern matches the characteristic speech pattern associated with the lesser dose of drug, indicating partial, but not full, compliance of the patient with the prescribed treatment regimen.

[0256] In an aspect, speech processor **5128** is configured to process at least one audio signal **5112** to determine at least one speech parameter indicative of whether the patient has complied with the prescribed treatment regimen. Speech parameters include, but are not limited to, measures of prosody, rhythm, stress, intonation, variance, intensity/volume, pitch, length of phonemic syllabic segments, and length of rising segments, for example. In an aspect, audio data includes at least one speech parameter, which may include, for example, one or more of prosody, rhythm, stress, intonation, variance, intensity/volume, pitch, length of phonemic syllabic segments, and length of rising segments. In an aspect, signal processing circuitry **5124** includes comparator **5129** for comparing at least one speech parameter of the patient with at least one characteristic speech parameter to determine whether the patient has complied with the prescribed treatment regimen. In an aspect, comparator **5129** is configured to compare at least one speech parameter of the patient with a plurality of characteristic speech parameters to determine whether the patient has complied with the prescribed treatment regimen. For example, in an aspect, the result of such a comparison is either "patient has complied" or "patient has not complied." In an aspect, comparator **5129** determines a level of compliance of the patient with the prescribed treatment regimen. Determination of compliance, non-compliance, or level of compliance may be performed with comparator **5129** using thresholding, windowing, or distance measurements, for example, as described herein above. Similarly, determination of compliance or non-compliance of patient **102** with a prescribed treatment regimen may be accomplished with the use of comparator **5129** using approaches as described herein above.

[0257] In an aspect, activity signal **5126** includes a signal from one or more additional activity sensor(s) **5131**. In various aspects, first activity sensor **5120** and any additional activity sensor(s) **5131** include any of the various types of activity sensor **116** described herein above, e.g., as in connection with FIG. **3**. In an aspect, signal processing circuitry **5124** processes at least one first activity signal **5122** and at least one second activity signal **5126** using signal processing approaches as described herein above (e.g., as described in connection with activity detection circuitry **122**/activity analysis circuitry **126** in FIG. **1**), to generate activity data **5132**, which is included in activity data signal **5130**. In some aspects, more than one activity data signal is generated (e.g., activity data signal **5130** and activity signal **5140**). In some aspects, activity data from different activity sensors is transmitted in separate activity data signals. In other aspects, activity data from multiple activity sensors is transmitted in a single activity data signal. In an aspect, audio data signal **5136** is a radio frequency signal containing telecommunication data. In some aspects, audio data signal **5136** is combined with activity data signal **5130**. In some aspects, communication system **5102** includes patient identification circuitry **5142**, which is used to determine the presence of patient **102** based on identity signal **5144**, using an approach as described herein above, e.g., in connection with patient identification circuitry **222** in FIG. **2**. In some aspects, communication system **5102** includes notification circuitry **5146**, which functions in the same manner as notification circuitry **290** in FIG. **2**. In an aspect, communication system **5102** includes threat detection circuitry **5148** in signal processing circuitry **5124**. Threat detection circuitry **5148** is used for determining, based upon at least one of the at least one first activity signal and the at least one second activity signal, whether the patient poses a threat. Threat can be determined using approaches as described, for example, in U.S. Patent Application 2006/0190419 dated Aug. 24, 2016 to Bunn et al., and U.S. Patent Application 2006/00208556 dated Feb. 9, 2006 to Bunn et al., both of which are incorporated herein by reference. If it is determined that that patient poses a threat, a notification indicative of the threat is generated with notification circuitry **5146**, and the notification is delivered to the threatened party

via warning circuitry **5166** in monitoring system **5106**. Alternatively, or in addition, warning circuitry may be located separately from monitoring system **5106**. Signal processing circuitry **5124**, patient identification circuitry **5142**, notification circuitry **5146**, threat detection circuitry **5148**, and transmitting device **5134** are components of control/processing circuitry **5150**.

[0258] Monitoring system **5106** includes at least one receiving device **5138** for use at a monitoring location **5108** for receiving at least one activity data signal **5130** and at least one audio data signal **5136** (and, optionally one or more additional activity data signal **5140**) from communication system **5102** and is similar to receiving device **136** in FIGS. **1** and **4**. Audio data signal **5136** includes audio data **5151** representing speech from patient **102** sensed with at least one audio sensor **5110** at the patient location **5104** during use of communication system **5102**, and transmitted to the monitoring location **5108**. Activity data signal **5130** includes activity data **5132** indicative of whether patient **102** has complied with the prescribed treatment regimen **104**. Activity data **5132** represents at least one first activity of the patient. Monitoring system **5106** includes signal processing circuitry **5152**, which is configured to process the at least one activity data signal **5130** to determine, based upon the at least one first activity of the patient and at least one second activity of the patient, whether the patient has complied with the prescribed treatment regimen, and reporting circuitry **5154** configured to report a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen. Signal processing circuitry **5152** is substantially similar to signal processing circuitry **150** as discussed in connection with FIGS. **1** and **4**. Reporting circuitry **5154** is substantially the same as reporting circuitry **160** as discussed in connection with FIGS. **1** and **4**. Signal processing circuitry **5152** and reporting circuitry **5154** are components of control/processing circuitry **5156** in monitoring system **5106**. In an aspect, control/processing circuitry **5156** includes compliance determination circuitry **5160**, which functions in the same manner as compliance determination circuitry **156** in FIGS. **1** and **4**, as discussed herein above. In an aspect control/processing circuitry **5156** includes patient identification circuitry **5162**, which determines a presence of patient **102** at patient location **5104** based on identity signal **5164**, in the same manner as patient identification circuitry **410** depicted in FIG. **4** and described herein above. In an aspect, control/processing circuitry **5156** includes warning circuitry **5166**, which delivers a warning to a threatened party in response to a notification. The notification is received from the patient location, e.g., in the form of notification signal **5168** from transmitting device **5134**, as described herein above. Delivering a warning to a threatened party may include, for example, displaying a warning message, playing a recorded warning message, or generating an audible alarm tone. The warning may be delivered in the same general manner as conclusion **162** is reported by reporting circuitry **160**, as described herein above, in connection with FIG. **4**.

[0259] FIG. **52** is a flow diagram of a method **5200** relating to monitoring compliance of a patient with a prescribed treatment regimen using a system such as system **5102** in FIG. **51** according to principles as described herein above. Method **5200** includes sensing with at least one audio sensor in a communication system at least one audio signal including patient speech from a patient at a patient location during use of the communication system, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder, as indicated at **5202**; sensing with at least one first activity sensor in the communication system at least one first activity signal indicative of a first activity of the patient, as indicated at **5204**; processing with signal processing circuitry the at least one first activity signal and at least one second activity signal indicative of a second activity of the patient to generate at least one activity data signal, the activity data signal containing data indicative of whether the patient has complied with the treatment regimen, as indicated at **5206**; and transmitting the at least one activity data signal and at least one audio data signal based on the at least one audio signal to a receiving device at a monitoring location with a transmitting device at the patient location, as indicated at **5208**.

[0260] FIG. **53** is a block diagram of a computer program product **5300** for implementing a method **5200** as described in connection with FIG. **52**. Computer program product **5300** includes a signal-bearing medium **5302** bearing one or more instructions for controlling sensing of at least one audio signal including patient speech from a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder; one or more instructions for controlling sensing with at least one first activity sensor in an unobtrusive activity-detection system of at least one first activity signal indicative of a first activity of the patient; one or more instructions for processing with signal processing circuitry the at least one first activity signal and at least one second activity signal indicative of a second activity of the patient to generate at least one activity data signal, the activity data signal containing data indicative of whether the patient has complied with the treatment regimen; and one or more instructions for controlling transmitting with a transmitting device at the patient location of the at least one activity data signal and at least one audio data signal based on the at least one audio signal to a receiving device at a monitoring location, as indicated at **5304**. Signal-bearing medium **5302** may be, for example, a computer-readable medium **5306**, a recordable medium **5308**, a non-transitory signal-bearing medium **5310**, or a communications medium **5312**, examples of which are described herein above.

[0261] FIG. **54** is a block diagram of a system **5400** for implementing a method as described in connection with FIG. **52**. System **5400** includes a computing device **5402** and instructions that when executed on the computing device cause the computing device to control sensing with at least one audio sensor of at least one audio signal including patient speech from a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder; control sensing with at least one first activity sensor in an unobtrusive activity-detection system of at least one first activity signal indicative of a first activity of the patient; process with signal processing circuitry the at least one first activity signal and at least one second activity signal indicative of a second activity of the patient to generate at least one activity data signal, the activity data signal containing data indicative of whether the patient has complied with the treatment regimen; and control transmitting with a transmitting device at the patient location of the at least one activity data signal and at least one audio data signal based on the at least one audio signal to a receiving device at a monitoring location, as indicated at **5404**. System **5400** may be, for example,

a cell phone configured with application software **5406**, a computing system or device **5408**, or a microprocessor-based system **5410**.

[0262] FIG. **55** is a flow diagram of a method **5500** of monitoring compliance of a patient with a treatment regimen, using a system such as monitoring system **5106** in FIG. **51**. In an aspect, method **5500** includes receiving at least one audio data signal with a receiving device at a monitoring location, the audio data signal including audio data representing speech sensed from a patient at a patient location during use of a communication system, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder, as indicated at **5502**; receiving at least one activity data signal with the receiving device, the activity data signal including activity data indicative of whether the patient has complied with the treatment regimen, the activity data representing at least one first activity of the patient, as indicated at **5504**; determining with signal processing circuitry at the monitoring location whether the patient has complied with the treatment regimen, based upon the at least one first activity of the patient and upon at least one second activity of the patient, as indicated at **5506**; and reporting with reporting circuitry a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen, as indicated at **5508**.

[0263] FIG. **56** is a block diagram of a computer program product **5600** for implementing a method **5500** as described in connection with FIG. **55**. Computer program product **5600** includes a signal-bearing medium **5602** bearing one or more instructions for controlling the receiving of at least one audio data signal with a receiving device at a monitoring location, the audio data signal including audio data representing speech sensed from a patient at a patient location during use of a communication system, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder; one or more instructions for controlling the receiving of at least one activity data signal with the receiving device, the activity data signal including activity data indicative of whether the patient has complied with the treatment regimen, the activity data representing at least one first activity of the patient; one or more instructions for determining whether the patient has complied with the treatment regimen, based upon the at least one first activity of the patient and upon at least one second activity of the patient; and one or more instructions for controlling reporting circuitry to report a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen, as indicated at **5604**. Signal-bearing medium **5602** may be, for example, a computer-readable medium **5606**, a recordable medium **5608**, a non-transitory signal-bearing medium **5610**, or a communications medium **5612**, examples of which are described herein above.

[0264] FIG. **57** is a block diagram of a system **5700** for implementing a method as described in connection with FIG. **52**. System **5700** includes a computing device **5702** and instructions that when executed on the computing device cause the computing device to control the receiving of at least one audio data signal with a receiving device at a monitoring location, the audio data signal including audio data representing speech sensed from a patient at a patient location during use of a communication system, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder; control the receiving of at least one activity data signal with the receiving device, the activity data signal including activity data indicative of whether the patient has complied with the treatment regimen, the activity data representing at least one first activity of the patient; determine whether the patient has complied with the treatment regimen, based upon the at least one first activity of the patient and upon at least one second activity of the patient; and control reporting circuitry to report a conclusion based on the determination of whether the patient has complied with the prescribed treatment regimen, as indicated at **5704**. System **5700** may be, for example, a cell phone configured with application software **5706**, a computing system or device **5708**, or a microprocessor-based system **5710**.

[0265] The herein described subject matter sometimes illustrates different components contained within, or connected with, different other components. It is to be understood that such depicted architectures are merely exemplary, and that in fact many other architectures may be implemented which achieve the same functionality. In a conceptual sense, any arrangement of components to achieve the same functionality is effectively "associated" such that the desired functionality is achieved. Hence, any two components herein combined to achieve a particular functionality can be seen as "associated with" each other such that the desired functionality is achieved, irrespective of architectures or intermedial components. Likewise, any two components so associated can also be viewed as being "operably connected", or "operably coupled," to each other to achieve the desired functionality, and any two components capable of being so associated can also be viewed as being "operably couplable," to each other to achieve the desired functionality. Specific examples of operably couplable include but are not limited to physically mateable and/or physically interacting components, and/or wirelessly interactable, and/or wirelessly interacting components, and/or logically interacting, and/or logically interactable components.

[0266] In some instances, one or more components may be referred to herein as "configured to," "configured by," "configurable to," "operable/operative to," "adapted/adaptable," "able to," "conformable/conformed to," etc. Those skilled in the art will recognize that such terms (e.g., "configured to") generally encompass active-state components and/or inactive-state components and/or standby-state components, unless context requires otherwise.

[0267] While particular aspects of the present subject matter described herein have been shown and described, it will be apparent to those skilled in the art that, based upon the teachings herein, changes and modifications may be made without departing from the subject matter described herein and its broader aspects and, therefore, the appended claims are to encompass within their scope all such changes and modifications as are within the true spirit and scope of the subject matter described herein. It will be understood by those within the art that, in general, terms used herein, and especially in the appended claims (e.g., bodies of the appended claims) are generally intended as "open" terms (e.g., the term "including" should be interpreted as "including but not limited to," the term "having" should be interpreted as "having at least," the term "includes" should be interpreted as "includes but is not limited to," etc.). It will be further understood by those within the art that if a specific number of an introduced claim recitation is intended, such an intent will be explicitly recited in the claim, and in the absence of such recitation no such intent

is present. For example, as an aid to understanding, the following appended claims may contain usage of the introductory phrases "at least one" and "one or more" to introduce claim recitations. However, the use of such phrases should not be construed to imply that the introduction of a claim recitation by the indefinite articles "a" or "an" limits any particular claim containing such introduced claim recitation to claims containing only one such recitation, even when the same claim includes the introductory phrases "one or more" or "at least one" and indefinite articles such as "a" or "an" (e.g., "a" and/or "an" should typically be interpreted to mean "at least one" or "one or more"); the same holds true for the use of definite articles used to introduce claim recitations. In addition, even if a specific number of an introduced claim recitation is explicitly recited, those skilled in the art will recognize that such recitation should typically be interpreted to mean at least the recited number (e.g., the bare recitation of "two recitations," without other modifiers, typically means at least two recitations, or two or more recitations). Furthermore, in those instances where a convention analogous to "at least one of A, B, and C, etc." is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system having at least one of A, B, and C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). In those instances where a convention analogous to "at least one of A, B, or C, etc." is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system having at least one of A, B, or C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). It will be further understood by those within the art that typically a disjunctive word and/or phrase presenting two or more alternative terms, whether in the description, claims, or drawings, should be understood to contemplate the possibilities of including one of the terms, either of the terms, or both terms unless context dictates otherwise. For example, the phrase "A or B" will be typically understood to include the possibilities of "A" or "B" or "A and B."

[0268] With respect to the appended claims, those skilled in the art will appreciate that recited operations therein may generally be performed in any order. Also, although various operational flows are presented in a sequence(s), it should be understood that the various operations may be performed in other orders than those which are illustrated, or may be performed concurrently. Examples of such alternate orderings may include overlapping, interleaved, interrupted, reordered, incremental, preparatory, supplemental, simultaneous, reverse, or other variant orderings, unless context dictates otherwise. Furthermore, terms like "responsive to," "related to," or other past-tense adjectives are generally not intended to exclude such variants, unless context dictates otherwise.

[0269] While various aspects and embodiments have been disclosed herein, other aspects and embodiments will be apparent to those skilled in the art. The various aspects and embodiments disclosed herein are for purposes of illustration and are not intended to be limiting, with the true scope and spirit being indicated by the following claims.

I/We claim:

1. A system comprising:

at least one audio sensor in a communication system for sensing at least one audio signal including patient speech from a patient at a patient location during use of the communication system, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder;

at least one first activity sensor for sensing at least one first activity signal indicative of a first activity of the patient;

signal processing circuitry configured to process the at least one first activity signal and at least one second activity signal indicative of a second activity of the patient to generate at least one activity data signal, the activity data signal containing activity data indicative of whether the patient has complied with the treatment regimen; and

at least one transmitting device at the patient location for transmitting the at least one activity data signal and at least one audio data signal based on the at least one audio signal to a receiving device at a monitoring location.

2. The system of claim **1**, including at least one second activity sensor for sensing the at least one second activity signal indicative of the second activity of the patient.

3.-**26**. (canceled)

27. The system of claim **1**, wherein the at least one first activity sensor is configured to transduce an activity signal associated with performance of a non-speech activity.

28.-**33**. (canceled)

34. The system of claim **1**, wherein the first activity of the patient and the second activity of the patient are both non-speech activities.

35.-**36**. (canceled)

37. The system of claim **1**, including

patient identification circuitry configured to determine a presence of the patient from at least one identity signal sensed at the patient location;

wherein the signal processing circuitry is configured to detect an activity of the patient based at least in part on the determination of the presence of the patient by the patient identification circuitry.

38.-**55**. (canceled)

56. The system of claim **1**, wherein the signal processing circuitry includes activity analysis circuitry for processing the at least one first activity signal and the at least one second activity signal to determine at least one activity pattern of the patient.

57.-**65**. (canceled)

66. The system of claim **1**, including notification circuitry for generating a notification indicative of whether the patient has complied with the treatment regimen.

67.-**70**. (canceled)

71. The system of claim **66**, including

threat detection circuitry for determining based upon at least one of the at least one first activity signal and the at least one second activity signal that the patient poses a threat;

wherein the notification circuitry is configured to generate a notification indicative of the threat.

72. A method comprising:

sensing with at least one audio sensor in a communication system at least one audio signal including patient speech from a patient at a patient location during use of the communication system, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder;

sensing with at least one first activity sensor in the communication system at least one first activity signal indicative of a first activity of the patient;

processing with signal processing circuitry the at least one first activity signal and at least one second activity signal indicative of a second activity of the patient to generate at least one activity data signal, the activity data signal containing data indicative of whether the patient has complied with the treatment regimen; and

transmitting the at least one activity data signal and at least one audio data signal based on the at least one audio signal to a receiving device at a monitoring location with a transmitting device at the patient location.

73. The method of claim **72**, including sensing the at least one second activity signal with at least one second activity sensor.

74. The method of claim **72**, wherein the at least one second activity signal is the at least one audio signal.

75.-**106**. (canceled)

107. The method of claim **72**, including

determining, with patient identification circuitry, a presence of the patient from at least one identity signal sensed at the patient location; and

detecting, with the signal processing circuitry, at least one of speech of the patient in the at least one audio signal and activity of the patient in the at least one activity signal, based at least in part on the determination of the presence of the patient by the patient identification circuitry.

108.-**120**. (canceled)

121. The method of claim **72**, including

determining whether the patient has complied with the treatment regimen by comparing at least one of the at least one first activity signal and the at least one second activity signal with at least one characteristic activity signal;

generating the at least one activity data signal based upon the determination of whether the patient has complied with the treatment regimen.

122.-**129**. (canceled)

130. The method of claim **72**, wherein processing with signal processing circuitry the at least one first activity signal and the at least one second activity signal includes processing at least one of the at least one first activity signal and the at least one second activity signal with pattern detection circuitry to identify at least one section of the at least one first activity signal and the at least one second activity signal containing at least one activity pattern.

131. The method of claim **130**, including

including the at least one section of the at least one first activity signal and the at least one second activity signal containing at least one activity pattern in the activity data signal.

132. The method of claim **130**, including

analyzing the at least one activity pattern with pattern analysis circuitry to determine at least one activity parameter for the patient.

133. The method of claim **132**, including

including the at least one activity parameter in the activity data signal.

134.-**140**. (canceled)

141. The method of claim **130**, including

comparing the at least one activity pattern with a plurality of activity patterns; and

determining which of the plurality of activity patterns best matches the at least one activity pattern.

142.-**157**. (canceled)

158. The method of claim **72**, including

determining with threat detection circuitry in the signal processing circuitry, based upon the at least one first activity signal and the at least one second activity signal, that the patient poses a threat;

generating a notification indicative of the threat with notification circuitry; and

delivering the notification to warning circuitry configured to deliver a warning to a threatened party.

159. A system comprising:

a computing device; and

instructions that when executed on the computing device cause the computing device to:

control sensing with at least one audio sensor of at least one audio signal including patient speech from a patient at a patient location, the patient having a brain-related disorder and a prescribed treatment regimen for treating at least one aspect of the brain-related disorder;

control sensing with at least one first activity sensor in an unobtrusive activity-detection system of at least one first activity signal indicative of a first activity of the patient;

process with signal processing circuitry the at least one first activity signal and at least one second activity signal indicative of a second activity of the patient to generate at least one activity data signal, the activity data signal containing data indicative of whether the patient has complied with the treatment regimen; and

control transmitting with a transmitting device at the patient location of the at least one activity data signal and at least one audio data signal based on the at least one audio signal to a receiving device at a monitoring location.

160.-**183**. (canceled)

184. The system of claim **1**, wherein the at least one first activity sensor includes at least one of a physiological sensor, an eye position sensor, an EEG sensor, an EEG sensor configured to detect an event-related potential, a heart rate sensor, a pupil diameter sensor, an imaging device, an entertainment device or system, a game controller, an input device, a pointing device, a touchscreen, an RFID sensor, a vehicle system, a wearable sensor, an environmental sensor, a pressure sensor, a force sensor, a capacitive sensor, an optical sensor, a motion sensor, a motion capture device, and an acceleration sensor.

185. The system of claim **37**, wherein the identity signal includes an image signal from an imaging device at the patient location, and wherein the patient identification circuitry is configured to analyze the image signal to determine the identity of the patient through at least one of facial recognition and gait recognition.

186. The system of claim **37**, wherein the identity signal includes at least one of a portion of the first activity signal, a portion of the at least one second activity signal, an audio signal from the audio sensor at the patient location, an image signal from an imaging device at the patient location, a biometric signal from at least one biometric sensor at the patient location, an authentication factor, a security token, a password, a digital signature, a cryptographic key, a cell phone identification code, an electronic serial number, a mobile identification number, and a system identification code, and an RFID signal.

187. The system of claim **1**, wherein the at least one audio sensor, the at least one first activity sensor, the signal processing circuitry, and the at least one transmitting device are components of at least one of an unobtrusive activity detection system, a communication system, a cell phone configured with application software, a computing system or device, and an intercommunication device.

188. The system of claim **56**, wherein the activity analysis circuitry includes at least one of an activity analyzer for assessing the at least one activity pattern to determine at least one activity parameter indicative of whether the patient has complied with the treatment regimen, wherein the activity data signal includes the at least one activity parameter; and a comparator for comparing the at least one activity pattern with at least one characteristic activity pattern to determine whether the patient has complied with the treatment regimen.

189. The system of claim **1**, wherein the transmitting device includes a wireless transmitter, a network connection, or a communication port.

190. The system of claim **66**, wherein the notification circuitry includes at least one of circuitry for generating an email notification, circuitry for generating a notification to be transmitted to a wireless device, circuitry for storing a notification in a data storage device, and circuitry for generating an audio notification.

191. The method of claim **72**, including

performing at least one of sensing with the at least one audio sensor, sensing with the at least one first activity sensor, processing with the signal processing circuitry, and transmitting the at least one activity data signal and the at least one audio data signal substantially continuously, intermittently, or according to a schedule.

192. The method of claim **72**, wherein sensing the at least one activity signal includes sensing an activity signal corresponding to performance of a motor activity and sensing at least one activity signal corresponding to performance of an activity of daily life.

193. The method of claim **72**, wherein sensing the at least one activity signal includes sensing an activity signal corresponding to performance of a motor activity, wherein the motor activity includes at least one of typing, providing an input via a user interface device, providing an input via a touchscreen, providing an input via a pointing device, controlling a game system, controlling a vehicle system, and walking.

194. The method of claim **72**, wherein sensing the at least one activity signal includes sensing at least one activity signal corresponding to performance of an activity of daily life, wherein the activity of daily life includes at least one of hygiene, washing, eating, dressing, brushing hair, brushing hair, combing hair, preparing food, interacting with another person, interacting with an animal, interacting with a machine, interacting with an electronic device, using an implement, and a grooming activity.

195. The method of claim **72**, wherein sensing the at least one activity signal includes sensing at least one signal from at least one of a pressure sensor, a force sensor, a capacitive sensor, an imaging device, a motion sensor, a motion capture device, an acceleration sensor, an optical sensor, and a physiological sensor.

196. The method of claim **72**, including sensing at least one physiological signal with at least one physiological sensor, wherein the at least one physiological signal includes an EEG signal, a heart rate signal, an eye position signal, or a pupil diameter signal.

197. The method of claim **107**, wherein the identity signal includes an image signal received from an imaging device at the patient location, and wherein determining the presence of the patient includes analyzing the image signal to determine the presence of the patient through at least one of facial recognition and gait recognition.

198. The method of claim **107**, wherein the identity signal includes at least a portion of at least one of the first activity signal, the second activity signal, the at least one audio signal, an image signal received from an imaging device at the patient location, a biometric signal from at least one biometric sensor at the patient location; and wherein determining the presence of the patient includes at least one of determining that at least a portion of the at least one of the at least one first activity signal and the at least one second activity signal matches a known activity pattern of the patient, determining that at least a portion of the at least one audio signal matches a known speech pattern of the patient, analyzing the image signal to determine the presence of the patient, and analyzing the biometric signal to determine the presence of the patient.

199. The method of claim **107**, wherein the identity signal includes at least one of an authentication factor, a security token, a password, a digital signature, a cryptographic key, a cell phone identification code, an electronic serial number, a mobile identification number, a system identification code, and an RFID signal.

200. The method of claim **72**, including at least one of receiving at least one instruction from the monitoring location and receiving prescription information indicative of the prescribed treatment regimen, and transmitting time data to the receiving device, the time data indicative of the time at which at least one of the at least one first activity signal and the at least one second activity signal was detected.

201. The method of claim **72**, wherein transmitting the at least one activity data signal and the at least one audio data signal to the receiving device at the monitoring location includes at least one of transmitting a wireless signal, transmitting a signal via a computer network connection, and storing the at least one activity data signal and the at least one audio data signal in a data storage device.

202. The method of claim **130**, including at least one of comparing the at least one activity pattern with at least one characteristic activity pattern to determine whether the patient has complied with the treatment regimen and comparing the at least one activity pattern with at least one previous activity pattern of the patient to determine whether the patient has complied with the treatment regimen.

203. The method of claim **130**, including

comparing the at least one activity pattern with at least one previous activity pattern of the patient to determine whether the patient has complied with the treatment regimen;

wherein the at least one previous activity pattern is representative of at least one of an activity pattern of the patient prior to initiation of treatment of the brain-related disorder, an activity pattern of the patient after initiation of treatment of the brain-related disorder, an activity pattern of the patient during known compliance of the patient with a treatment of the brain-related disorder, and an activity pattern of the patient during treatment with a specified treatment regimen.

204. The method of claim **141**, wherein the plurality of activity patterns include at least one of stored prior activity patterns of the patient, the prior activity patterns representative of activity patterns of the patient with different treatment regimens, and stored population activity patterns representative of activity patterns of populations of subjects.

205. The method of claim **141**, wherein the plurality of activity patterns are stored population activity patterns representative of activity patterns of populations of subjects, including at least one of activity patterns of a population of subjects without the brain-related disorder, activity patterns of a population of untreated subjects having the brain-related disorder, activity patterns of a population of subjects having the brain-related disorder stabilized by treatment, and activity patterns of a population of subjects undergoing different treatment regimens for the brain-related disorder.

206. The method of claim **72**, wherein the brain-related disorder includes at least one of an emotional disorder, a personality disorder, a mental disorder, a traumatic brain-injury-related disorder, schizophrenia, Parkinson's disease, an Autism Spectrum Disorder, Alzheimer's disease, Bipolar Disorder, and depression.

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专利名称(译)	使用综合绩效指标确定治疗依从性		
公开(公告)号	US20160135739A1	公开(公告)日	2016-05-19
申请号	US14/939143	申请日	2015-11-12
[标]申请(专利权)人(译)	埃尔瓦有限公司		
申请(专利权)人(译)	ELWHA LLC		
当前申请(专利权)人(译)	ELWHA有限责任公司，特拉华州的有限责任公司		
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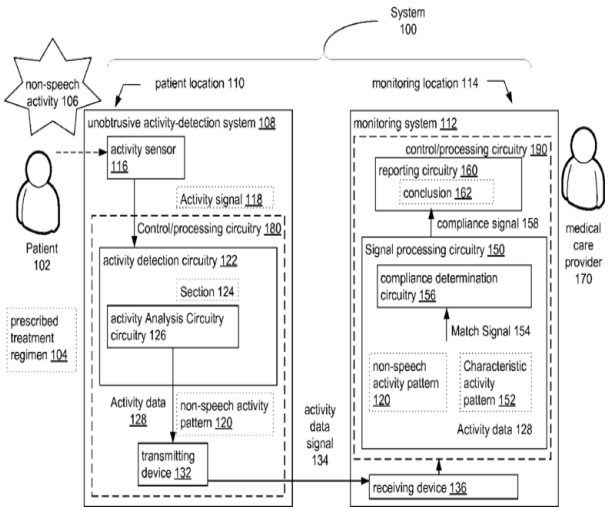
IPC分类号	A61B5/00 A61B5/16 A61B5/1171 A61B5/0205 A61B7/00		
CPC分类号	A61B5/4833 A61B5/0205 A61B5/4803 A61B7/00 A61B5/1176 A61B5/72 A61B5/165 A61B5/0002 A61B5/7405 A61B5/167 A61B5/4082 A61B5/4088 A61B5/746 A61B5/1118 A61B5/163		
外部链接	Espacenet USPTO		

摘要(译)

描述了用规定的治疗方案监测患者依从性的方法和系统。用患者位置处的活动传感器不显眼地检测患者活动，并且将活动数据发送到监测位置。在患者使用诸如移动电话的通信系统期间检测到的患者语音也可以用作活动信号。在患者位置或监测位置处理患者活动和/或言语以识别指示患者是否已遵守规定治疗方案的活动参数或模式。例如，患者位置处的活动传感器和其他组件可以合并到手机，计算系统，游戏系统或车辆系统中或与之相关联。该系统可以向感兴趣的一方（例如医疗护理提供者或保险公司）提供关于患者对规定的治疗方案的依从性的报告。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