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(54) Title: REMOTE MONITORING INTERFACE DEVICE AND MOBILE APPLICATION FOR MEDICAL DEVICES
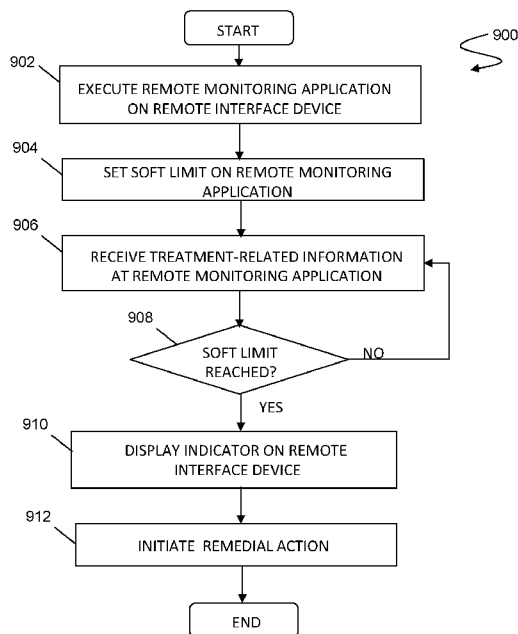
(57) Abstract: A remote monitoring mobile application may be installed and executed on a remote interface device. By streaming a log of the treatment data, attending HCPs may have continual access to the dialysis machine and patient data at the treatment center. In various embodiments, the data may be streamed to a server accessible by the remote interface device and/or directly to the remote interface device. The operator is able to log into the application on the remote interface device to access dialysis machine data and/or patient data during treatment. The HCP, through the application, is able to monitor the data at the treatment center and may set "soft" limits to warn the HCP of problems during the treatment before alarms or other treatment- disruptive actions occur at the dialysis machine. The remote monitoring mobile application may be software downloaded from a network and/or otherwise installed on the remote interface device.

FIG. 9

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REMOTE MONITORING INTERFACE DEVICE AND

MOBILE APPLICATION FOR MEDICAL DEVICES

TECHNICAL FIELD

5   This patent application is related to processing devices and interfaces in the medical device

area.

BACKGROUND OF THE INVENTION

Hemodialysis is a process which employs a machine that includes a dialyzer to aid patients

10   whose renal function has deteriorated to the point where their body cannot adequately rid itself of

toxins. The dialyzer may include a semi-permeable membrane, the membrane serving to divide the

dialyzer into two chambers. Blood is pumped through one chamber and a dialysis solution through

the second. As the blood flows by the dialysis fluid, impurities, such as urea and creatinine, diffuse

through the semi-permeable membrane into the dialysis solution. The electrolyte concentration of

15   the dialysis fluid may be set so as to maintain electrolytic balance within the patient.   Other

purification techniques and processes may additionally be used.   Hemodialysis may be generally

referred to herein as "dialysis," although it is noted that other types of dialysis exist, such a

peritoneal dialysis, and it is noted that the system described herein may be used in connection with

any appropriate dialysis system or similar treatment system.

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Since dialysis involves removing blood from and returning blood to a patient, performing a

dialysis procedure carries a degree of risk. Dialysis treatment requires monitoring of several patient

vital signs and dialysis parameters during the dialysis process in order to optimize the overall

efficacy of the dialysis procedure, to assess the condition of a fistula (the access to the patient's

25   blood) and to determine the actual purification achieved. Some examples of parameters monitored

and analyzed by a dialysis machine or equipment include the blood access flow rate or the rate at which blood flows out of the patient to the dialyzer, a critical parameter, and the ratio Kt/V to measure dialysis efficiency, where K is the clearance or dialysance (both terms representing the purification efficiency of the dialyzer), t is treatment time and V is the patient's total water value.

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A processing device coupled to the dialysis machine may be used to manage and oversee the functions of the dialysis process and to, for example, monitor, analyze and interpret patient vital signs and dialysis parameters during a dialysis procedure. The processing device may include a display that displays information concerning the dialysis procedure and include an interface that

10   enables configuration and control of the dialysis machine. A health care practitioner (HCP) such as a nurse or a patient care technician may oversee the dialysis treatment sessions. Data provided by the dialysis machine and the processing device may aid the health care practitioner in performing his or her duties.

15   For various descriptions of dialysis systems and components, reference is made, for example, to US Patent No. 8,110,104 B2 to Crnkovich et al., entitled "Dialysis Systems and Related Components," and US Patent No. 6,775,577 B2 to Crnkovich et al., entitled "Method and System for Controlling a Medical Device," which are incorporated herein by reference. For a description of a sensor system that may be used in connection with monitoring and issuing alerts during a dialysis

20   procedure, reference is made, for example, to US Patent No. 7,973,667 B2 to Crnkovich et al., entitled "Wetness Sensor," which is incorporated herein by reference. For various descriptions of interfaces for dialysis systems, reference is made, for example, to US Patent No. 8,323,503 B2 to Levin et al., entitled "User Interface Processing Device" and US Pub. No. 2007/0112603 A1 to Kauthen et al., entitled "Digital Data Entry Methods and Devices," which are incorporated herein by

25   reference.

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During a dialysis treatment, when thresholds or limits at the dialysis machine are reached and/or violated, such as in connection with patient variables including blood pressure, heart rate, monitored parameter levels, etc., alarms and/or other actions may be triggered at the dialysis machine. The result of this may cause the treatment to be suspended and/or prematurely stopped at the dialysis machine which may cause complications and problems during the dialysis treatment. Accordingly, it would be desirable to provide a system that facilitates the mitigation and/or avoidance of such problems or complications during a dialysis treatment.

SUMMARY OF THE INVENTION

According to the system described herein, a method for remotely monitoring a medical treatment includes executing a remote monitoring application on a remote interface device. The method further includes receiving data, using the remote monitoring application, concerning the medical treatment being performed with a medical device. A first limit is set using the remote monitoring application, wherein the first limit is a limit for a treatment parameter measuring during the medical treatment that is reached before a second limit set at the medical device for the treatment parameter is reached. An indicator is indicated on the remote interface device when the first limit is reached. In response to the indicator on the remote interface device, a remedial action is initiated in connection with the treatment parameter before the second limit is reached at the medical device. The medical treatment may be a dialysis treatment, and the medical device may be a dialysis machine. The second limit, when reached, may cause an alarm or a suspension of the medical treatment at the medical device. The remote interface device may be portable or wearable by a user, in particular, the remote interface device may be a smart phone or a tablet device and/or the remote interface device may be worn by the user. The first limit may be set on the remote monitoring application by a user according to a preference of the user. The data concerning the

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medical treatment may be streamed from the medical device directly to the remote interface device and/or the data concerning the medical treatment may be first stored on a server, and the remote interface device accesses the data via the server. The data may be encrypted. Executing the remote monitoring application on the remote interface device may include requiring authorized access credentials from a user to log into the remote monitoring application.

According further to the system described herein, a non-transitory computer-readable medium stores software for remotely monitoring a medical treatment. The software includes executable code for a remote monitoring application installed on a remote interface device. Executable code is provided that receives data, using the remote monitoring application, concerning the medical treatment being performed with a medical device. Executable code is provided that enables setting a first limit on the remote monitoring application, wherein the first limit is a limit for a treatment parameter measuring during the medical treatment that is reached before a second limit set at the medical device for the treatment parameter is reached. Executable code is provided that indicates with an indicator on the remote interface device when the first limit is reached. Executable code is provided that, in response to the indicator on the remote interface device, enables initiating of a remedial action in connection with the treatment parameter before the second limit is reached at the medical device. The medical treatment may be a dialysis treatment, and the medical device may be a dialysis machine. The second limit, when reached, may cause an alarm or a suspension of the medical treatment at the medical device. The remote interface device may be portable or wearable by a user, in particular, the remote interface device may be a smart phone or a tablet device and/or the remote interface device may be worn by the user. The first limit may be set on the remote monitoring application by a user according to a preference of the user. The data concerning the medical treatment may be streamed from the medical device directly to the remote interface device and/or the data concerning the medical treatment may first be stored on a server,

and wherein the remote interface device accesses the data via the server. The data may be encrypted. The executable code for the remote monitoring application on the remote interface device may include executable code that requires authorized access credentials from a user to log into the remote monitoring application.

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According further to the system described herein, a system for remote monitoring of a medical treatment includes a medical device and a remote interface device. A non-transitory computer-readable medium stores software for remotely monitoring the medical treatment. The software includes executable code for a remote monitoring application installed on a remote

10   interface device. Executable code is provided that receives data, using the remote monitoring application, concerning the medical treatment being performed with the medical device. Executable code is provided that enables setting a first limit on the remote monitoring application, wherein the first limit is a limit for a treatment parameter measuring during the medical treatment that is reached before a second limit set at the medical device for the treatment parameter is reached. Executable

15   code is provided that indicates with an indicator on the remote interface device when the first limit is reached. Executable code is provided that, in response to the indicator on the remote interface device, enables initiating of a remedial action in connection with the treatment parameter before the second limit is reached at the medical device. The medical treatment may be a dialysis treatment, and the medical device may be a dialysis machine. The second limit, when reached, may cause an

20   alarm or a suspension of the medical treatment at the medical device. The remote interface device may be portable or wearable by a user, in particular, the remote interface device may be a smart phone or a tablet device and/or the remote interface device may be worn by the user. The first limit may be set on the remote monitoring application by a user according to a preference of the user. The data concerning the medical treatment may be streamed from the medical device directly to the

25   remote interface device and/or the data concerning the medical treatment may first be stored on a

server, and wherein the remote interface device accesses the data via the server. The data may be encrypted. The executable code for the remote monitoring application on the remote interface device may include executable code that requires authorized access credentials from a user to log into the remote monitoring application.

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BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the system described herein are explained with reference to the several figures of the drawings, which are briefly described as follows.

10   FIG. 1 is a schematic illustration of an example of a patient care environment in which a patient seated in a chair receives medical treatment from a dialysis machine and which may be used in connection with an embodiment of the system described herein.

FIG. 2 is a schematic illustration of another example of a patient care environment that may
15   be used in connection with an embodiment of the system described herein.

FIG. 3 is schematic illustration of an example implementation of the dialysis machine that may be used in connection with an embodiment of the system described herein.

20   FIG. 4 is a schematic illustration of a more detailed implementation of the dialysis machine that may be used in connection with an embodiment of the system described herein.

FIG. 5 is a schematic illustration showing example information that may be displayed on the display of the dialysis machine in connection with an embodiment of the system described herein.

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FIG. 6 is a schematic illustration according to an embodiment of the system described herein showing the HCP using an interface device in connection with the monitoring and/or control of a dialysis machine in connection with a dialysis treatment being performed in the patient care environment.

FIG. 7 is a schematic illustration of a remote interface device on which an application may be executed that enables remotely receiving data from a dialysis machine according to an embodiment of the system described herein.

FIG. 8 is a schematic illustration of another embodiment for a remote interface device that may be configured as wearable device in accordance with an embodiment of the system described herein.

FIG. 9 is a flow diagram showing processing, using a remote monitoring application, for remote monitoring of a medical treatment being performed with a medical device according to an embodiment of the system described herein.

DETAILED DESCRIPTION OF VARIOUS EMBODIMENTS

FIG. 1 is a schematic illustration of an example of a patient care environment 10 in which a patient 4 seated in a chair 6 receives medical treatment from a treatment station 22 and which may be used in connection with an embodiment of the system described herein. The medical treatment is, for example, dialysis. The treatment station 22 may be a dialysis treatment station or dialysis machine. A tube or blood line 8 transports blood from the patient 4 to the dialysis machine 22 and back again to the patient 4 after processing and treatment in the dialysis machine 22. The dialysis machine 22 with display 20 may be connected via cabling 18 to a controller device 30 that may

include a processor 14 which controls a display 12. In various embodiments, the display 20 may display information corresponding to a dialysis treatment being performed by the dialysis machine 22. The display 12 may be mounted on a movable stand 16 of the controller device 30. The display 12 permits a health care practitioner (HCP), such as a nurse, a patient care technician (PCT), or even a patient, to interface with the display 12 to, for example, to monitor and/or control the dialysis machine 22 and/or to enter patient or other data, for example. In various embodiments, the display 12 may include touch screen display capability as well as be implemented in connection with non-contact or gesture based detection and control capability, among other possible interfacing features.

According to various embodiments of the system described herein, a transceiver device 40 may be coupled to the controller device 30 that may be used to control the dialysis machine 22, as further discussed in detail elsewhere herein. In an embodiment, the signal transceiver device 40 may include a sensor to detect control input by a user or HCP operating the dialysis machine 22, and may include touch based control input, such as a via touch screen, and/or non-contact input, such as by a gesture detection and recognition device. Further, the signal transceiver device 40 may also include wireless communication capability in connection with wireless coupling to one or more wireless interface devices that may be used by an HCP to monitor and/or control a dialysis treatment being performed by the dialysis machine 22, as further discussed elsewhere herein. Various embodiments for the one or more wireless interface devices and for the actions and functions of the signal transceiver device 40 in connection with control of the dialysis machine 22 are further discussed in detail elsewhere herein. It is noted that where reference is made herein to wireless coupling or communication, the system described herein may be used with any appropriate wireless communication technology, including, for example, IEEE 802.11b/g, 802.11b/g/n and/or Bluetooth, having appropriate security and encryption standards and used in conjunction with

appropriate wireless networks, having hardware and software components, that support such wireless communication technologies.

FIG. 2 is a schematic illustration of another example of a patient care environment 100 that
5   may be used in connection with an embodiment of the system described herein. In the patient care environment 100, the patient 4 is seated in the chair 6 and receives medical treatment from a treatment station, such as a dialysis machine 102. The tube or blood line 8 is used for transporting blood from the patient 4 to the dialysis machine 102 and back again to the patient 4 after processing and treatment of the blood in the dialysis machine 102. The dialysis machine 102 may be
10   configured to communicate with an external network 120, such as a local-area network or the Internet, via a wired or wireless connection 124. The network 120 may include one or more databases or other stores of information that securely contain medical information that may be accessed in connection with operation of the system described herein. It is noted that the system described herein may be used in connection with dialysis products produced by Fresenius Medical
15   Care North America of Waltham, Massachusetts, including, for example, one or more Fresenius hemodialysis systems (e.g., a 2008T system).

In an embodiment, the dialysis machine 102 may include a display 112. The dialysis machine 102 may centralize and consolidate dialysis functions and data entry functions in a single
20   device 102, without, e.g., the use of a separate, external display (e.g., display 12 of FIG. 1) or a separate, external processor (e.g., processor 14) with associated equipment (e.g., movable stand 16). In an embodiment, the dialysis machine 102 may include one or more processors 114, like the processor 14, that may be used in connection with interfacing with, and control of, the dialysis machine 102, for example, by an HCP during a dialysis treatment. Consolidation of functions in a
25   single dialysis machine 102 may advantageously reduce the amount of external cabling (e.g.,

cabling 18) to the device 102. The dialysis machine 102 may further reduce the amount of space needed for dialysis treatment and present less crowding of the patient care environment 100. An HCP may be able to focus solely on the dialysis machine 102, or the display 112 of the dialysis machine 102, without the HCP's attention being diverted to, e.g., another external display. The

5   dialysis machine 102 may reduce power consumption and cost as compared to other, non-centralized implementations.

In an embodiment, a signal transceiver device 140 may be coupled to the dialysis machine 102. The signal transceiver device 140 may have similar features and functionality as the signal

10   transceiver device 40 discussed elsewhere herein. As noted in connection with the signal transceiver device 40 of FIG. 1, and as discussed in detail elsewhere herein, the signal transceiver device 140 may also include wireless channel components that may be used in connection with receiving external or remote signals that may be used to control the dialysis machine 102 and/or may be transmit signals in connection with operation of the dialysis machine 102. In another

15   embodiment, a signal transceiver device 140 may be located separately or remotely from the dialysis machine 102 and coupled wirelessly thereto. Further, in an embodiment, the signal transceiver device 140 may also be wirelessly coupled to the network 120. Accordingly, in various embodiments, functions of the signal transceiver device 140 may include control of and/or information exchange with the dialysis machine 102 via direct communication therewith and/or the

20   signal transceiver device 140 may interface with the dialysis machine 102 via the network 120.

FIG. 3 is schematic illustration of an example implementation 200 of the dialysis machine 102 according to an embodiment of the system described herein. A user interface processing device (UIP) 206 may be configured to share user interface resources, i.e., user interface devices 208-1,

25   208-2, 208-3 . . . , 208-N, between a first processing device 202 and a second processing device

204. Both the first and the second processing devices 202, 204 may be connected to the UIP 206 via respective connections 210, 212, while the user interface devices 208-1, 208-2, 208-3 . . . , 208-N are connected to the UIP 206 via connections 214-1, 214-2, 214-3 . . . , 214-N. Although one UIP 206 is shown in FIG. 3, several user interface processing devices may be used to implement the

5   functionality of the UIP 206. The UIP 206 is connected to memory 216 via a connection 218. Other memory (not shown) may be connected to, and, used by, e.g., the first processing device 202 and/or the second processing device 204. The second processing device 204 of the device 200 may be configured to communicate with the external network 120, such as a local-area network or the Internet, via a wired or wireless connection 124 (and, e.g., via a network interface (not shown)). In

10   other implementations, other processing devices such as the UIP 206 or the first processing device 202 may communicate with an external network such as the external network 120.

        The user interface devices 208-1, 208-2, 208-3 . . . , 208-N may include any of a variety of user interface devices known in the art, such as an alphanumeric keyboard or a keypad, a pointing

15   device (e.g., a touchpad, a mouse, or a trackball) and/or a display with a touch screen, such a tablet, mobile phone and/or other portable processing and display device. Accordingly, in various implementations, one or more of the user interface devices 208-1, 208-2, 208-3. . . , 208-N may be directly disposed on or coupled to the device 200 and/or may be located external to the device 200 and coupled via wired and/or wireless connections to the device 200. Specifically, for example,

20   user interface device 208-3 is shown remotely located and wirelessly coupled, via wireless connection 214-3, to the device 200. Various embodiments for a user interface device, like that of the user interface device 208-3, that may be used to wirelessly monitor and/or control the dialysis machine 102 are further discussed in detail elsewhere herein and may include use of one or more portable processing or interfacing devices, such as a tablet or mobile phone, that are wirelessly

25   coupled to the dialysis machine 102 to provide and/or receive wireless signals to control and/or

monitor the display 112 and/or other information generated in connection with the dialysis machine 102.

As described herein, the UIP 206 may be configured to share the user interface devices 208-1, 208-2, 208-3 . . . , 208-N between the first processing device 202 and the second processing device 204. The UIP 206 may switch focus from the first processing device 202 to the second processing device 204. The UIP 206 may likewise switch focus from the second processing device 204 to the first processing device 202. Specifically, a processing device, such as the first or the second processing device 202, 204 of FIG. 3, may be said to have focus when the processing device has control of, and/or is controlled by, one or more user interface devices connected to, or communicating with, the processing device (e.g., via one or more user interface processing devices). That is, in this example, when a processing device has focus, a user interface device connected to, or communicating with, the processing device (e.g., via one or more user interface processing devices) will generally affect operation of the processing device, and thereby the dialysis machine 102. User interactions with a user interface device will likewise generally affect operation of the processing device in this instance. Likewise, in this example, when a processing device has focus, the processing device may control a user interface device (such as a video display) connected to, or communicating with, the processing device (e.g., via one or more user interface processing devices).

When a processing device, such as the first or the second processing device 202, 204 of FIG. 3, does not have focus, then, for example, the processing device may not have control of and/or be controlled by one or more user interface devices connected to, or communicating with, the processing device (e.g., via one or more user interface processing devices). Rather, another processing device may have been given focus. One or more user interface processing devices such

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as the UIP 206 may send protocol data to the processing device, even when the processing device does not presently have focus, so that the processing device may be configured to maintain connections with one or more user interface devices. That is, from the perspective of the processing device, even when the processing device does not have focus, the processing device may have a

5   connection maintained with a user interface device that the processing device does not control and/or that is not controlled by the processing device when the processing device does not have focus. The UIP 206 may therefore send protocol data related to the one or more user interface devices to the first and the second processing devices 202, 204, irrespective of which processing device 202, 204 has focus.

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When a processing device (such as the first processing device 202 or the second processing device 204) has focus, one or more user interface processing devices (such as the UIP 206) may manage communications between one or more user interface devices (such as the user interface devices 208-1, 208-2, 208-3 . . . , 208-N) and the processing device. The UIP 206 may, when the

15   processing device has focus, permit the user interface devices 208-1, 208-2, 208-3 . . . , 208-N to affect operation of the processing device. The UIP 206 may switch between modes. The modes may be exclusive of one another and may include a mode in which the first processing device 202 has focus, and a mode in which a second processing device 204 has focus.

20   FIG. 4 is a schematic illustration of a more detailed implementation 300 of the dialysis machine 102 according to an embodiment of the system described herein. A UIP 306 is configured to share user interface resources, such as a keyboard 308 and a pointing device 310 (such as a touchpad) between a first processing device 302 and a second processing device 304. Further user interface components, according to the system described herein, may include a display 312, like the

25   display 112 discussed herein, that may be coupled to or otherwise integrated with an input

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receiver/controller 313. In various embodiments, the display 312 may also further include touch screen input control features, such as touch screen controller 314. In other embodiments, the system described herein may operate in connection with use of a remote interface device 400 that may be wirelessly coupled to the dialysis machine 102 for control and/or monitoring of the display 112/312 thereof, as further discussed in detail herein. It is noted that the first processing device 302 may be a functional dialysis processing device (FHP) 302 that may be configured to monitor dialysis functions of the device 300. The second processing device 304 may be a microprocessor, such as a standard personal computer (PC) processor, embedded within the device 300, and may be referred to as an embedded processing device (EP) 304. The FHP 302 is connected to the UIP 306 via connections 322, 324, 326, 328, and the EP 304 is connected to the UIP 306 via connections 330, 332, 334, 336.

The keyboard 308 is connected to the UIP 306 via connection 338. The pointing device 310 is connected to the UIP 306 via connection 340. The display 312 may be connected to a digital video switch 316 via connection 342, which is in turn connected to the UIP 306, the FHP 302, and the EP 304 via respective connections 344, 346, 348. A touch screen controller 314 may be connected to the display 312 via connection 350, and to the UIP 306 via connection 352. Although one UIP 306 is shown in FIG. 4, several user interface processing devices may be used to implement the functionality of the UIP 306. The UIP 306 is connected to memory 358 via a connection 360. Other memory (not shown) may be connected to, and, used by, e.g., the FHP 302 and/or the EP 304. The EP 304, for example, may utilize a flash memory rather than a conventional hard drive. The device 300 also includes an audio device 362. The audio device 362 is connected to the EP 304 via connection 364 and the UIP 306 via connection 366. FIG. 4 is intended to show functional connections between devices of the device 300, so more or fewer connections may be used than are shown in FIG. 4.

As described above, the UIP 306 may switch focus from the FHP 302 to the EP 304. The UIP 306 may likewise switch focus from the EP 304 to the FHP 302. When the FHP 302 has focus, one or more of the keyboard 308, the pointing device 310, the display 312 with a touch screen will

5   generally affect operation of the FHP 302. When the EP 304 has focus, the keyboard 308, the pointing device 310, the display 312, and/or the remote interface device 400 may generally affect operation of the EP 304. User interactions with the devices 308, 310, 312, 400 will likewise generally affect operation of whichever processing device (the FHP 302 or the EP 304) has focus. The processing device that has focus (the FHP 302 or the EP 304) may control, e.g., the display 312

10   in certain circumstances.

In various implementations, one or more of the user interface devices may be located external to the device 300. In this example implementation, when the EP 304 has focus, the FHP 302 does not have focus, and the FHP 302 may not have control of and/or be controlled by the

15   devices 308, 310, 312, 400. When the FHP 302 has focus, the EP 304 does not have focus, and the EP 304 may not have control of and/or be controlled by the devices 308, 310, 312, 400. The UIP 306 may send protocol data relating to the devices 308, 310, 312 to the EP 304 and the FHP 302, even when one of these devices does not have focus, so that the EP 304 and the FHP 302 may maintain connections with the devices 308, 310, 312. That is, from the perspective of the processing

20   device (EP 304 or FHP 302) that does not have focus, a connection at least appears to be maintained with the devices 308, 310, 312, 400, even though these devices 308, 310, 312, 400 are not controlled by, and do not control, the processing device that does not have focus. The UIP 306 may therefore send protocol data related to the devices 308, 310, 312, 400 to the FHP 302 and the EP 304, irrespective of which processing device 302, 304 has focus. The UIP 306 may switch between

modes. The modes may be exclusive of one another and may include a mode in which the first processing device 302 has focus, and a mode in which the second processing device 304 has focus.

5   The interface device 400 may include one or more advisory indictors, such as lights, that may communicate a successful pairing of the interface device with the signal transceiver device 140 and/or the dialysis machine 102. The advisory indicators may further communicate other information, such as low battery and/or other information concerning the communication pathway between the interface device 400 and the dialysis machine 102.

10   FIG. 5 is a schematic illustration showing an embodiment of information 500 that may be displayed on the display 112 of the dialysis machine 102 in connection with an embodiment of the system described herein. The illustrated embodiment of the information 500 is presented by way of example only, and other information, particularly other operational functions and features for controlling and/or monitoring a dialysis treatment, may be displayed and/or controlled in

15   accordance with the system described herein. In various embodiments, the system described herein may be used in connection with generation and/or display of information corresponding to a medical device, medical treatment and/or patient related data. In the illustrated embodiment, the information 500 may include a treatment screen on the display 112 of the dialysis machine 102 that incorporates methods and systems for monitoring and/or controlling functions of the dialysis

20   machine 102 like that discussed elsewhere herein. It is noted that other appropriate treatment information may be provided and used in connection with monitoring and/or controlling a dialysis machine and/or other medical device in connection with the system described herein.

      Screen access buttons 502 (main access), 504 (trends), 506 (dialysate), 508 (test options),

25   510 (heparin), 512 (Kt/V), 514 (BTM), and 516 (blood pressure) may be used to access the various

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treatment screens in a manner that may be similar to that accessed at the display 112. For example, as illustrated, the main access button 502 has been activated revealing a main treatment access screen 501 that may be displayed on the display 112 of the dialysis machine. It is noted that, in other embodiments, different and/or summarized versions of the information displayed on the display 112 of the dialysis machine 102 may be displayed on the interface device 400. A different treatment access screen may be displayed, for example, by pressing the different screen access buttons. The main treatment access screen 501 provides a general overview of the status of the current treatment. Other treatment screens may offer a more in-depth view of specific aspects of the current treatment, though some treatment screens may have some of the same information displayed as found on other treatment screens.

A status box 518 appears at the top left corner of the treatment screen being displayed in the information 500. During normal operation it displays the operation mode of the machine, which in this case is "Dialysis." During alarm situations, a warning message may be displayed in the status box 518. The message displayed in the status box 518 may also prompt the operator for a specific action in situations when the treatment parameters are being set. During normal treatment, a box 520 displays the current time and the box 522 displays the time of the last blood pressure reading and the patient's blood pressure and pulse rate at that time. Arterial pressure in mmHg is displayed numerically in a meter box 524, and graphically in a bar graph 526. Similarly, venous pressure in mmHg is displayed numerically in a meter box 528 and graphically in a bar graph 530, and transmembrane pressure (TMP) in mmHg is displayed numerically in a meter box 532 and graphically in a bar graph 534.

A Tx clock button 536 may be activated start, or to pause or suspend, the treatment. The Tx clock button 536 controls multiple functions of the hemodialysis machine when it is activated. A

UF-goal button 538 displays the desired ultrafiltration (UF) in milliliters to be removed during the dialysis treatment. This is typically the difference between the patient's pre and dry weight plus saline or fluid intake during treatment. The UF-time button 540 acts as a countdown timer displaying the remaining time in hours and minutes that ultrafiltration will be performed. The timer stops during a blood alarm or whenever the UF pump is stopped. During treatment, A UF-rate button 542 displays the current rate of ultrafiltration in milliliters per hour. The rate ultrafiltration occurs is determined by the values entered in a UF-goal button 538 and a UF-time button 540 and the profile selected with a UF-profile button 546. A UF-removed button 544 keeps a running total in milliliters of the fluid drawn from the patient through ultrafiltration. When the value displayed in the UF-Removed button 544 is equal to the value entered in the UF-goal button 538, an alarm sounds and the message, "UF GOAL REACHED" is displayed in the status box 518. A UF-profile button 546 when touched brings up the UF Profile selection screen. Once a profile is selected, and the operator pushes the main access button 502, the profile selected is displayed in the UF-profile button 546.

A dialysate flow button 548 displays the current dialysate flow rate in milliliters per minute. A temperature button 550 displays the current temperature in degrees centigrade of the dialysate. Pressing the temperature button 550 allows the operator to set the desired temperature, and thereafter the actual temperature is displayed. If the temperature varies too far from the set point, an alarm sounds, a warning message is displayed in the status box 518, and the dialysate goes into bypass. A conductivity button 552 displays the current conductivity in millisiemens per centimeter of the dialysate. An RTD (Remaining Time of Dialysis) button 554 acts as a countdown timer displaying the amount of treatment time remaining. At the end of treatment (RTD=0:00) an alarm sounds and the message "RTD ZERO" is displayed in the status box 518. An SVS profile button 556 when touched brings up the Sodium Variation System (SVS) profile selection screen. Once a

profile is selected, and the operator pushes the main access button 502, the profile selected is displayed in the SVS profile button 556.

FIG. 6 is a schematic illustration 600 according to an embodiment of the system described herein showing an HCP 601 using an interface device 610 in connection with the monitoring and/or control of a dialysis machine in connection with a dialysis treatment being performed in the patient care environment 100. In this embodiment, the HCP 601 is shown in proximity to the interface device 610 which may be an implementation of the interface device 400. The interface device 610 enables the HCP 601 to monitor and/or control the dialysis machine 102 during the dialysis treatment in a non-contact manner without requiring the HCP to touch and/or otherwise contact the dialysis machine 102 or component thereof or be in direct line of sight with the dialysis machine.

Using the interface device 610, the HCP 601 may navigate through screens being displayed on the display of the interface device 610 and monitor portion of the information 500 being displayed on the dialysis machine 102. In other embodiments, the interface device 610 may be used to select or activate portions of the information 500 being displayed. In an embodiment, the interface device 610 may be wirelessly coupled to the dialysis machine 102, and specifically to the display 112 of the dialysis machine 102, in which content for display on the display 112 of the dialysis machine 102 is also, or instead, displayed on the display of the interface device 610. The wireless channel for wireless signal transmission and reception to/from the interface device 610 is shown schematically as wireless channel 611 of the interface device 610. It is noted that the information displayed on the interface device 610 may not necessarily be identical to the information displayed on the display 112, but instead may be summarized or condensed version thereof, for example.

Further shown schematically is wireless channel 141 that may be a wireless channel for transmission of signals from wireless channel components of the signal transceiver device. For example, over the wireless channel pairing signals and/or acknowledge signal may be communicated among the signal transceiver device 140 and the interface device 610, as well as information corresponding to the display of information, and control of the information, of the dialysis machine 102 in accordance with the embodiments discussed herein. It is noted that the wireless communication channel between the interface device 610 and the signal transceiver device 140 may include suitable relay components for relaying the signal via the network 120, that may be an internal network and/or an external network, such as the Internet, in connection with operation of the system for the described embodiment(s). Using the interface device 610, the HCP 601 may control the dialysis machine during the dialysis treatment without contacting the display 112 of the dialysis machine 102 and/or without necessarily contacting the interface device 610. In this way, the HCP 601 does not need to re-glove each time an action needs to be taken with respect to the dialysis machine 102, such as modifying a parameter thereof during the dialysis treatment. In various embodiments, the information used by the interface device 610 may be generated from patient data streamed directly to the interface device 610 and/or accessed from one or more servers 620 via the network 120. The patient data may be streamed and/or stored on the one or more servers 620 according to appropriate security and encryption protocols and standards and securely accessed by the interface device 610 according to the required input of authorized access credentials from the user when logging into a remote monitoring application installed and executing on the interface device 610, as further discussed elsewhere herein.

In various embodiments, the interface device 610 may be used to control functionality of the treatment screen being displayed as information 500 on the interface device 610. Accordingly, the mechanism of control of the treatment screen may deviate from control of the treatment screen that

20

is being displayed on the display 112 of the dialysis machine 102. For example, whereas the treatment screen displayed on the screen of the interface device 610 may be controlled, for example, by the command-based recognition that may be used to iterate through and/or highlight different buttons of the information 500 for the treatment screen that is being displayed on the display 112.

As discussed elsewhere herein, in other embodiments, the information 500 being displayed on the interface device 610 may present a treatment screen that is somewhat different from the treatment screen presented on the display 112 of the dialysis machine 102 in a manner that facilitates that command-based recognition control enabled by the interface device 610.

Dialysis machines may include sensors or other components for monitoring patient parameters and other treatment-related information during a dialysis treatment. The information may be transmitted from the dialysis machine to a storage device or monitoring device. For a discussion of detecting medical parameters and/or conditions of a patient receiving medical treatment, such as by sensing blood pressure, heart rate, weight, glucose level, hemoglobin level and/or blood potassium level, for example, and transmitting information regarding the parameters to a digital data processing system disposed remotely from the medical treatment apparatus, reference is made to US Pub. No. 2010/0137693 A1 to Porras et al, entitled "Methods and Systems for Patient Care," which is incorporated herein by reference. Reference is also made to US Pub. No. 2013/0018355 A1 to Brand et al., entitled "Method and Device for Remote Monitoring and Control of Medical Fluid Management Devices," and to US Pub. No. 2013/0211206 A1 to Sands et al., entitled "Patient Treatment and Monitoring Systems and Methods with Cause Inferencing," which are incorporated herein by reference.

According to the system described herein, a remote monitoring mobile application may be installed and executed on a remote interface device (e.g., smartphone, tablet, computer, etc.) that

may have features like the one or more of the interface devices discussed elsewhere herein. By streaming the treatment data and/or a log or summary of the treatment data, attending HCPs may have continual access to the dialysis machine and patient data at the treatment center. In various embodiments, the data may be streamed directly to the remote interface device and/or first

5 transmitted to a server that is accessible by the remote interface device. The operator is able to execute, or securely log into, the application on the remote interface device to access dialysis machine data, patient data and/or other treatment-related information during the treatment. The HCP, through the application, is then able to monitor the data of the treatment at the treatment center. The remote monitoring mobile application may be software downloaded from a network,

10 such as the Internet and/or an intranet, and/or otherwise installed on the remote interface device. The remote monitoring mobile application may include executable code that is executed to perform functions and having capabilities to interact with components of the remote interfacing device to receive data concerning a medical treatment being performed a different location by a medical device and to process and analyze that data to determine whether one or more soft limits, set at the

15 remote monitoring mobile application, has been reached.

FIG. 7 is a schematic illustration of a remote interface device 700 on which an application may execute that enables remotely receiving data in connection with a dialysis treatment at a dialysis machine according to an embodiment of the system described herein. In various

20 embodiments, the remote interface device 700 may have similar features as one or more of the interface devices discussed elsewhere herein, such as the remote interface device 610, and including a transceiver to receive wireless signals and/or to output wireless signals. In an embodiment, patient data and/or other treatment-related data may be transmitted to, and/or made accessible to, the remote interface device. In an embodiment, the data may be streamed to an accessible server

25 and/or directly to the remote interface device 700. In an embodiment, the remote monitoring

application executing on the remote interface device 700 may display information 710 concerning the dialysis machine and/or treatment that may be remotely viewed by an HCP using the remote interface device 700. In various embodiments, the information 710 received by the remote interface device 700 may be generated from data streamed and/or accessed by the remote interface device 700 that is transmitted and/or stored according to appropriate security and encryption protocols and standards in compliance with applicable laws and regulations concerning sensitive patient data and/or other medical information, as further discussed elsewhere herein.

In an embodiment, the application executing on the remote interface device 700 may have one or more input features 720 to enable setting "soft" thresholds or limits on patient-related variables, such as blood pressure, heart rate or other monitored blood parameter levels, and/or other treatment-related information. In an embodiment, the soft limits may be limits set only on the application, and thereby on the remote interface device 700, and not on the dialysis machine, such as the dialysis machine 102. When a soft limit input on the application via the input features 720 is reached and/or otherwise violated, an indicator 730 may be triggered on the remote interface device 700 that may inform the HCP that the soft limit has been reached or violated. The indicator 730 may be a warning symbol and/or other indicator disposed or displayed on the remote interface device 700 and may also include information as to which soft limit set by the HCP has been reached.

The soft limits may be configurable and customized by the HCP on the remote interface device 700 according to the specifications of the HCP, and customized to trigger the indicator to the HCP before other hard limits at dialysis machine are reached and/or violated. The hard limits at the dialysis machine may be limits set according to explicit regulations or guidelines, whereas the soft limits may be customized limits set individually by the HCP, for example, according to preference

of the HCP. The indicator 730 may also include timing information that may indicate how long before a hard limit at the dialysis machine is reached whereupon an alarm and/or other treatment-disruptive action would occur at the dialysis machine, as well as other appropriate or desirable information concerning the soft limit. Accordingly, the soft limits set by the HCP may be individually configured by the HCP based on location of the HCP, based on specific conditions of the patient known to the HCP, and/or based other variables that are designed to thereby give sufficient time for the HCP to address the problem during the treatment before the hard limit is reached at the dialysis machine.

Through these soft limits, the HCP may be notified about significant changes or rates of change in treatment parameters before the changes exceed the dialysis machine's set alarm limits. By addressing the issue before the dialysis machine alarm is triggered, and/or by alerting the HCP personally even when the HCP is remote from the dialysis machine, the application on the remote interface device 700 may facilitate the taking of preemptive action by the HCP and/or other practitioner before the occurrence of the treatment-halting alarms triggered at the dialysis machine, and particularly in the situation where the HCP is initially remote from the dialysis machine. In this way, the hemodialysis treatment may progress more smoothly and may thereby enable preemptive avoidance of unnecessary complications during the treatment.

The information and/or data concerning the treatment parameters received by the remote monitoring application at the remote interface device 700 may be streamed directly to the remote interface device 700 from one or more medical devices and/or may be accessed by the remote interface device 700 from one or more servers, e.g. server 620. In various embodiments, particularly for security purposes and appropriate protection of sensitive patient information under applicable laws and regulations, the application on the remote interface device 700 may require

secure log in by a user requiring user input of credentials to facilitate authorized access by appropriate HCPs to the patient information using the application. The credentials may include secure access credentials, including usernames, passwords, personal identification numbers (PINs), biometric credentials, appropriate near field communication (NFC) credentials, and/or other

5   appropriate access credentials. The data streamed to the remote interface device 700 and/or stored on the one or more servers, e.g., server 620, may be encrypted using appropriate encryption protocols and techniques, and subsequently decrypted using appropriate decryption protocols and techniques in connection with use thereof by the application on the remote interface device 700.

10   FIG. 8 is a schematic illustration of another embodiment for a remote interface device 800, that may have features like the remote interface devices discussed elsewhere herein, but configured as wearable device in accordance with an embodiment of the system described herein. The wearable device may be a head-mounted display that may include smart glasses, such as a Google Glass device, and/or other appropriate type of head-mounted display. Other implementations of

15   wearable devices may be appropriately used in connection with the system described herein, such as a smart watch implementation. The remote interface device 800 may be worn by a user, such as an HCP, in connection with remotely monitoring and/or controlling a dialysis machine or component during a dialysis treatment, as further discussed in detail elsewhere herein. In various other embodiments, the remote interface device 800 may be a display that is coupled to a different

20   portable processing device, such as a smart phone or tablet, and display information being transmitted from portable processing device.

The remote interface device 800 may include two screens or sides 805, 810 that may be used and function independently of each other. For example, in an embodiment, the side 805 may be

25   clear to enable a user to perform duties remote from the dialysis machine and unobstructed by any

visual display during use of the interface device 800, and the side 810 may display information 811, 812, 813 used in connection with monitoring and/or controlling the dialysis machine 102 and/or component thereof. In other embodiments, different types of information sent to, or generated by, the remote interface device 800 may be displayed on either of the sides 805, 810 and, when not in use, both of the sides may be transparent, for example.

The interface device 800 may receive data and information wirelessly transmitted from the dialysis machine 102 and/or otherwise made accessible to the interface device 800, such as via a mobile-accessible server. In an embodiment, information displayed on one or more of the sides 805, 810 may indicate a successful pairing of the interface device 800 with the dialysis machine 102 in connection with streaming of data from the dialysis machine 102 to the interface device 800. In other embodiments, the side 805 may also display other information such as identification information to help ensure the HCP is matching the patient being treated with the proper dialysis machine information being viewed on the interface device 800.

In an embodiment, the information 811, 812, 813 displayed on the side 810 may be information similar to that of the information discussed in connection with the remote interface device 700. Specifically, the information may include monitoring information 811 of the dialysis machine or treatment, input information 812 in connection with soft limits entered by the HCP and an indicator 813 when soft limits are reached and/or otherwise violated. According to the system described herein, in a clinical or dialysis setting, while an HCP is performing other duties, including duties for other patients, remote from the dialysis machine 102 and dialysis treatment being monitored by the HCP, using the interface device 800, the HCP may remotely monitor, and/or control, the dialysis treatment and be informed when soft limits set by the HCP for the treatment

have been reached or violated without having to physically contact the dialysis machine 102 and/or even without having to be physically present at the dialysis machine 102.

In an embodiment, the remote interface device 800 may include a transceiver device 820 that receives and/or transmits signals according to the functionality discussed herein. The transceiver device 820 may include one or more processors to process the signals in connection with the display of the information 811, 812, 813 and in connection with transmission of instructions for remotely controlling the dialysis machine 102. The transceiver device 820 may further include a memory, and/or other non-transitory computer-readable media, to store data in connection with the information transmitted and/or received by the interface device 800 and in connection with the execution of software or other executable code in connection with the operations of the interface device 800, specifically, execution of the remote monitoring application discussed elsewhere herein.

For example, the interface device 800 may include a command recognition device 830 that recognizes and interprets commands in connection with operation of the interface device 800, specifically in connection with selection, control and activation of elements on the screens 805, 810 of the interface device 800. In various embodiments, the commands may be gestures recognized and used by a gesture-recognition module of the command recognition device 830 in connection with the operation of the interface device 800 may include, for example, hand gestures, head gestures and/or eye gestures of the user. In other embodiments, the command recognition device 830 may include a voice recognition module that enables voice-based control of the interface device 800. The command recognition capability thereby enables hands-free, non-contact operation of the interface device and remote control of the dialysis machine according to the system described herein.

In other embodiments, the interface device 800 may further include a camera 840 that may be used in connection with capturing images that may be displayed and/or used by the interface device 800. In various embodiments, the camera 840 may also include video capabilities. It is noted that although the devices 820, 830 and 840 are shown as separate devices, in other embodiments, the functionalities of these devices may be incorporate into one integral device disposed on the interface device 800. Further, the interface device 800 may include a power source 850, such as a battery.

The interface device 800 may further include an audio input/output device 860 that may include a speaker component and a microphone component. The audio device 860 may enable the user to hear audible signals that may be transmitted by the dialysis machine 102. In other embodiments the dialysis machine 102 may also include a speaker and/or a microphone component, such that an intercom-type verbal exchange may be enabled between the HCP wearing the interface device 800 and a patient at the dialysis machine 102. For example, the HCP may then communicate with the patient, and/or with other HCPs or nurses, when the indicator 813 indicates to the HCP that one or more soft limits set at the application on the remote interface device 800 have been reached and/or violated.

In various embodiments, the audio device 860 may also operate in connection with voice command recognition capability of the command recognition device 830, as further discussed elsewhere herein. It is also noted that the processing of the interface device 800 may enable the interface device to recognize a verbal communication from the patient that is then converted into text and displayed on one or more of the screens 805, 810. In connection therewith, the processing of the interface device 800 may enable translation capabilities. For example, a patient may make a verbal communication at the dialysis machine 102 in one language (such as Spanish) and the verbal

communication is transmitted as a signal to the interface device 800, where the verbal communication is converted into text and then translated into another language (such as English) via processing capabilities of the interface device 800 and the translated text displayed on one or more of the screens 805, 810 of the interface device 800.

FIG. 9 is a flow diagram 900 showing processing, using a remote monitoring application, for remote monitoring of a medical treatment being performed with a medical device according to an embodiment of the system described herein. At a step 902, a user (e.g. HCP) executes a remote monitoring application installed on a remote interface device, like that discussed elsewhere herein, that may be actuated, carried and/or worn by the user. After the step 902, at a step 904, the user sets or activates soft limits, through the remote monitoring application on the remote interface device, for treatment parameters of a dialysis treatment that may be occurring at a location remote from the location of the user. The soft limits may be limits set to be reached prior to hard limits set at the dialysis machine that would cause alarms and/or other treatment-disruptive actions at the dialysis machine, such as suspension of the dialysis treatment. After the step 904, at a step 906, the remote monitoring application on the remote interface device receives data concerning the dialysis treatment being performed. In various embodiments, the data may be received at the remote monitoring application directly from the dialysis machine, such as via streamed treatment data, and/or the remote monitoring application may receive the data by accessing a server to which the data has been initially transmitted and/or stored. As further discussed elsewhere herein, in various embodiments the data may be streamed and/or stored on the server using appropriate security and encryption protocols and standards to ensure access to sensitive patient data only by authorized HCPs that have securely logged into the remote monitoring application using appropriate access credentials.

After the step 906, at a test step 908, it is determined whether a soft limit set by the user has been reached. If not, then processing proceeds back to the step 906. If, at the test step 908, it is determined that a soft limit has been reached, then processing proceeds to a step 910 where an indicator is displayed on the remote interface device indicating that the soft limit has been reached. The indicator may indicate that the soft limit has been reached using a warning symbol and may also provide information as to which soft limit has been reached. After the step 910, processing proceeds to a step 912 where a remedial action is initiated to attempt to avoid the reaching of a hard limit for the treatment parameter at the dialysis machine that would cause an alarm and/or other treatment-disruptive action at the dialysis machine. In an embodiment, in some circumstances, the HCP may initiate the remedial action using the remote interface device where appropriate and without necessarily requiring the presence of the HCP at the dialysis machine. In other circumstances, the presence of the HCP may be required at the dialysis machine and/or the patient in order for the HCP to take the remedial action and the HCP may be warned to proceed immediately to the dialysis machine and patient. After the step 912, processing is complete for the iteration of the processing being described. Other iterations of the processing may then be further performed in connection with the system described herein.

It is noted that the system described herein is discussed principally in connection with the use of dialysis machines and treatments. In other embodiments, the system described herein may also be used in connection with other medical devices where remote monitoring of such devices is desirable and may be appropriately performed. It is also noted that the system described herein may be used in connection and conjunction with the features and functions of systems for controlling or monitoring medical devices like that described in US Pub. No. 2014/0267003 A1 to Wang et al., entitled "Wireless Controller to Navigate and Activate Screens on a Medical Device," US Pub. No. 2014/0266983 A1 to Christensen, entitled "Wearable Interface for Remote Monitoring and Control

of a Medical Device," and US Patent App. No. 14/200,156 to Merics et al., filed March 7, 2014, entitled "E-Field Sensing of Non-Contact Gesture Input for Controlling a Medical Device," which are all incorporated herein by reference.

5   Various embodiments discussed herein may be combined with each other in appropriate combinations in connection with the system described herein. Additionally, in some instances, the order of steps in the flow diagrams, flowcharts and/or described flow processing may be modified, where appropriate. Further, various aspects of the system described herein may be implemented using software, hardware, a combination of software and hardware and/or other computer-

10   implemented modules or devices having the described features and performing the described functions. The system may further include a display and/or other computer components for providing a suitable interface with a user and/or with other computers.

Software implementations of the system described herein may include executable code that

15   is stored in a computer-readable medium and executed by one or more processors. The computer-readable medium may include volatile memory and/or non-volatile memory, and may include, for example, a computer hard drive, ROM, RAM, flash memory, portable computer storage media such as a CD-ROM, a DVD-ROM, an SD card, a flash drive or other drive with, for example, a universal serial bus (USB) interface, and/or any other appropriate tangible or non-transitory computer-

20   readable medium or computer memory on which executable code may be stored and executed by a processor. The system described herein may be used in connection with any appropriate operating system.

Other embodiments of the invention will be apparent to those skilled in the art from a

25   consideration of the specification or practice of the invention disclosed herein. It is intended that

the specification and examples be considered as exemplary only, with the true scope and spirit of

the invention being indicated by the following claims.

What is claimed is:

1. A method for remotely monitoring a medical treatment, comprising:

executing a remote monitoring application on a remote interface device;

receiving data, using the remote monitoring application, concerning the medical

treatment being performed with a medical device;

setting a first limit using the remote monitoring application, wherein the first limit is a

limit for a treatment parameter measuring during the medical treatment that is reached before a

second limit set at the medical device for the treatment parameter is reached;

indicating with an indicator on the remote interface device when the first limit is reached;

and

in response to the indicator on the remote interface device, initiating a remedial action in

connection with the treatment parameter before the second limit is reached at the medical device.

2. The method according to claim 1, wherein the medical treatment is a dialysis treatment, and

wherein the medical device is a dialysis machine.

3. The method according to claim 1, wherein the second limit, when reached, causes an alarm or

a suspension of the medical treatment at the medical device.

4. The method according to claim 1, wherein the remote interface device is portable or wearable

by a user.

5. The method according to claim 4, wherein the remote interface device is a smart phone or a tablet device.

6. The method according to claim 4, wherein the remote interface device is worn by the user.

7. The method according to claim 1, wherein the first limit is set on the remote monitoring application by a user according to a preference of the user.

8. The method according to claim 1, wherein the data concerning the medical treatment is streamed from the medical device directly to the remote interface device.

9. The method according to claim 1, wherein the data concerning the medical treatment is first stored on a server, and wherein the remote interface device accesses the data via the server.

10. The method according to claim 1, wherein the data concerning the medical treatment is streamed from the medical device or stored on a server, and wherein the data is encrypted.

11. The method according to claim 1, wherein executing the remote monitoring application on the remote interface device includes requiring authorized access credentials from a user to log into the remote monitoring application.

12.   A non-transitory computer-readable medium storing software for remotely monitoring a medical treatment, the software comprising:

executable code for a remote monitoring application installed on a remote interface device;

executable code that receives data, using the remote monitoring application, concerning the medical treatment being performed with a medical device;

executable code that enables setting a first limit using the remote monitoring application, wherein the first limit is a limit for a treatment parameter measuring during the medical treatment that is reached before a second limit set at the medical device for the treatment parameter is reached;

executable code that indicates with an indicator on the remote interface device when the first limit is reached; and

executable code that, in response to the indicator on the remote interface device, enables initiating of a remedial action in connection with the treatment parameter before the second limit is reached at the medical device.

13.   The non-transitory computer-readable medium according to claim 12, wherein the medical treatment is a dialysis treatment, and wherein the medical device is a dialysis machine.

14.   The non-transitory computer-readable medium according to claim 12, wherein the second limit, when reached, causes an alarm or a suspension of the medical treatment at the medical device.

15. The non-transitory computer-readable medium according to claim 12, wherein the remote interface device is portable or wearable by a user.

16. The non-transitory computer-readable medium according to claim 15, wherein the remote interface device is a smart phone or a tablet device.

17. The non-transitory computer-readable medium according to claim 15, wherein the remote interface device is worn by the user.

18. The non-transitory computer-readable medium according to claim 12, wherein the first limit is set on the remote monitoring application by a user according to a preference of the user.

19. The non-transitory computer-readable medium according to claim 12, wherein the data concerning the medical treatment is streamed from the medical device directly to the remote interface device.

20. The non-transitory computer-readable medium according to claim 12, wherein the data concerning the medical treatment is first stored on a server, and wherein the remote interface device accesses the data via the server.

21. The non-transitory computer-readable medium according to claim 12, wherein the data concerning the medical treatment is streamed from the medical device or stored on a server, and wherein the data is encrypted.

22. The non-transitory computer-readable medium according to claim 12, wherein the executable code for the remote monitoring application on the remote interface device includes executable code that requires authorized access credentials from a user to log into the remote monitoring application.

23. A system for remote monitoring of a medical treatment, comprising:

   a medical device;

   a remote interface device;

   a non-transitory computer-readable medium storing software for remotely monitoring the medical treatment, the software being executed by at least one processor of the remote interface device and including:

      executable code for a remote monitoring application installed on the remote interface device;

      executable code that receives data, using the remote monitoring application, concerning the medical treatment being performed with the medical device;

      executable code that enables setting a first limit using the remote monitoring application, wherein the first limit is a limit for a treatment parameter measuring during the medical treatment that is reached before a second limit set at the medical device for the treatment parameter is reached;

      executable code that indicates with an indicator on the remote interface device when the first limit is reached; and

executable code that, in response to the indicator on the remote interface device, enables initiating of a remedial action in connection with the treatment parameter before the second limit is reached at the medical device.

24. The system according to claim 23, wherein the medical treatment is a dialysis treatment, wherein the medical device is a dialysis machine.

25. The system according to claim 23, wherein the second limit, when reached, causes an alarm or a suspension of the dialysis treatment at the dialysis machine, and wherein the first limit is set on the remote monitoring application by a user according to a preference of the user.
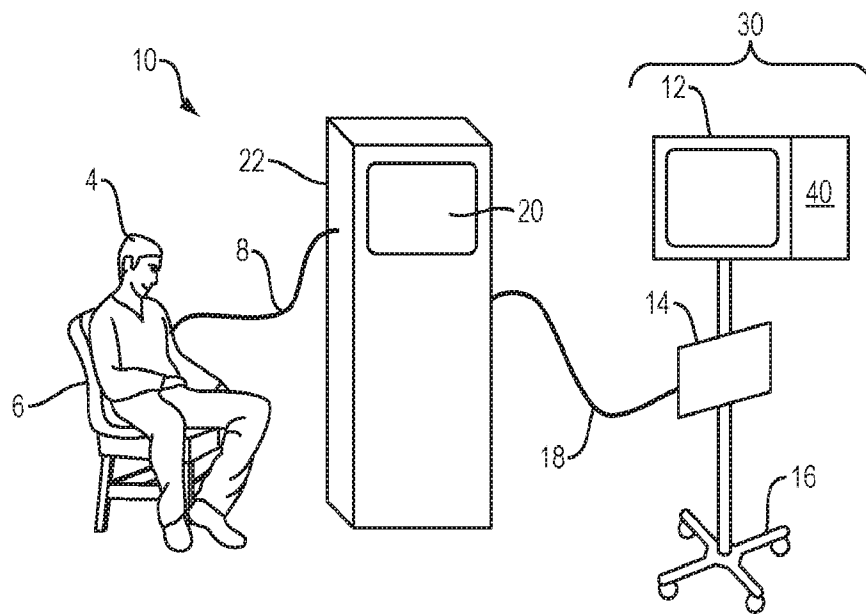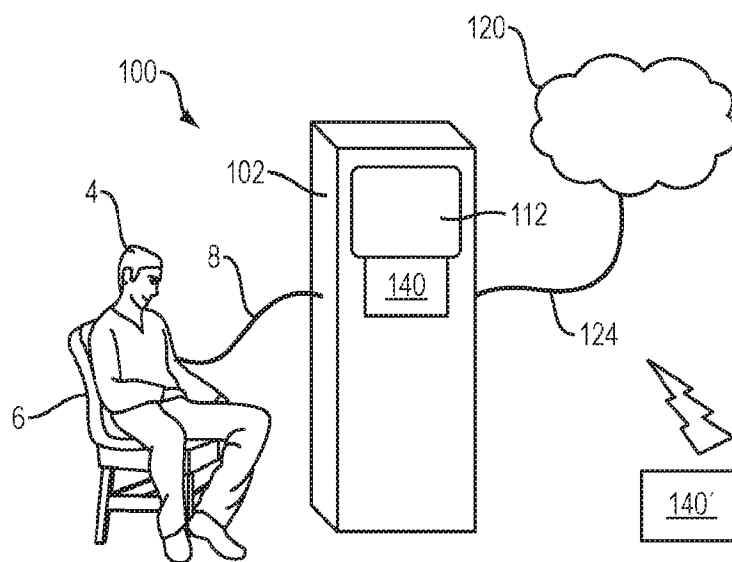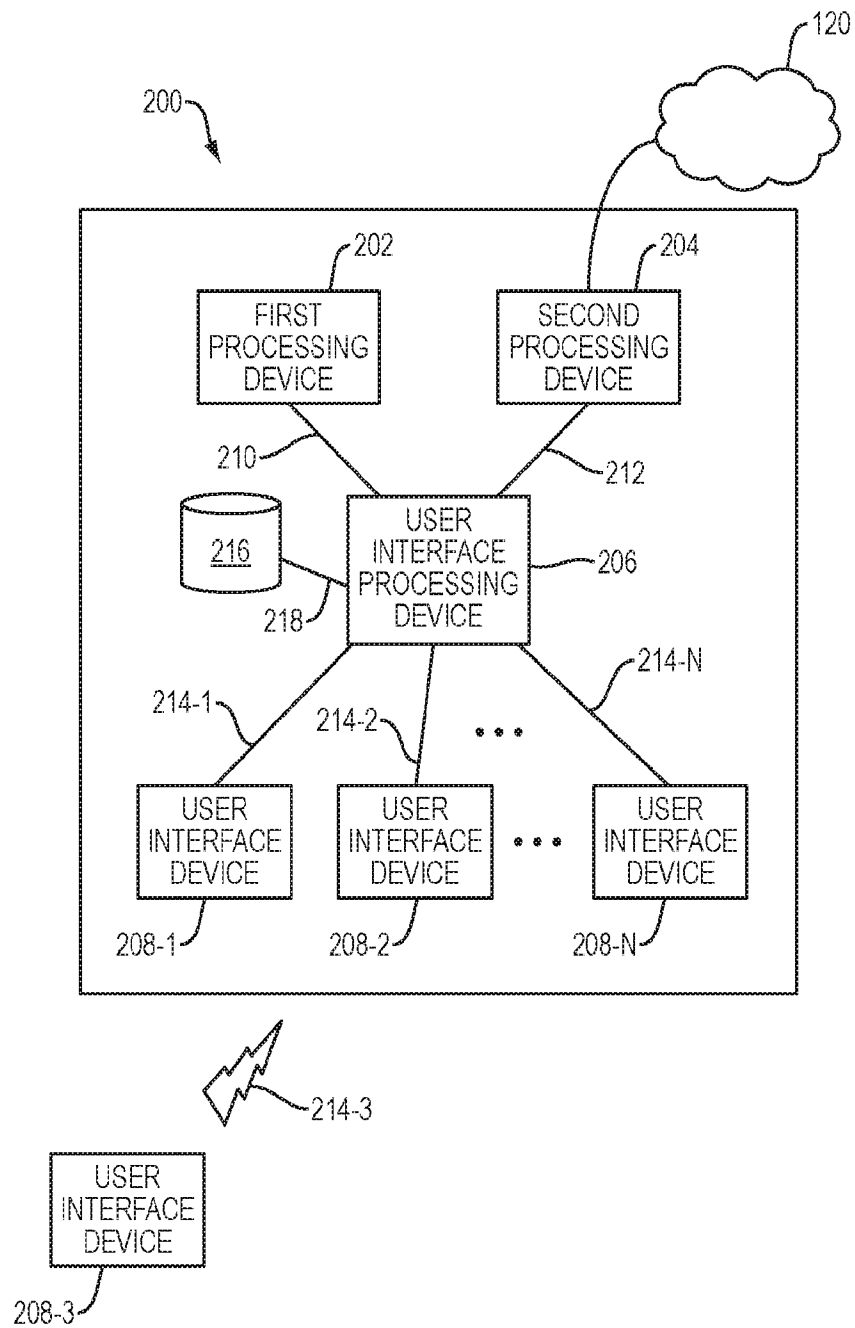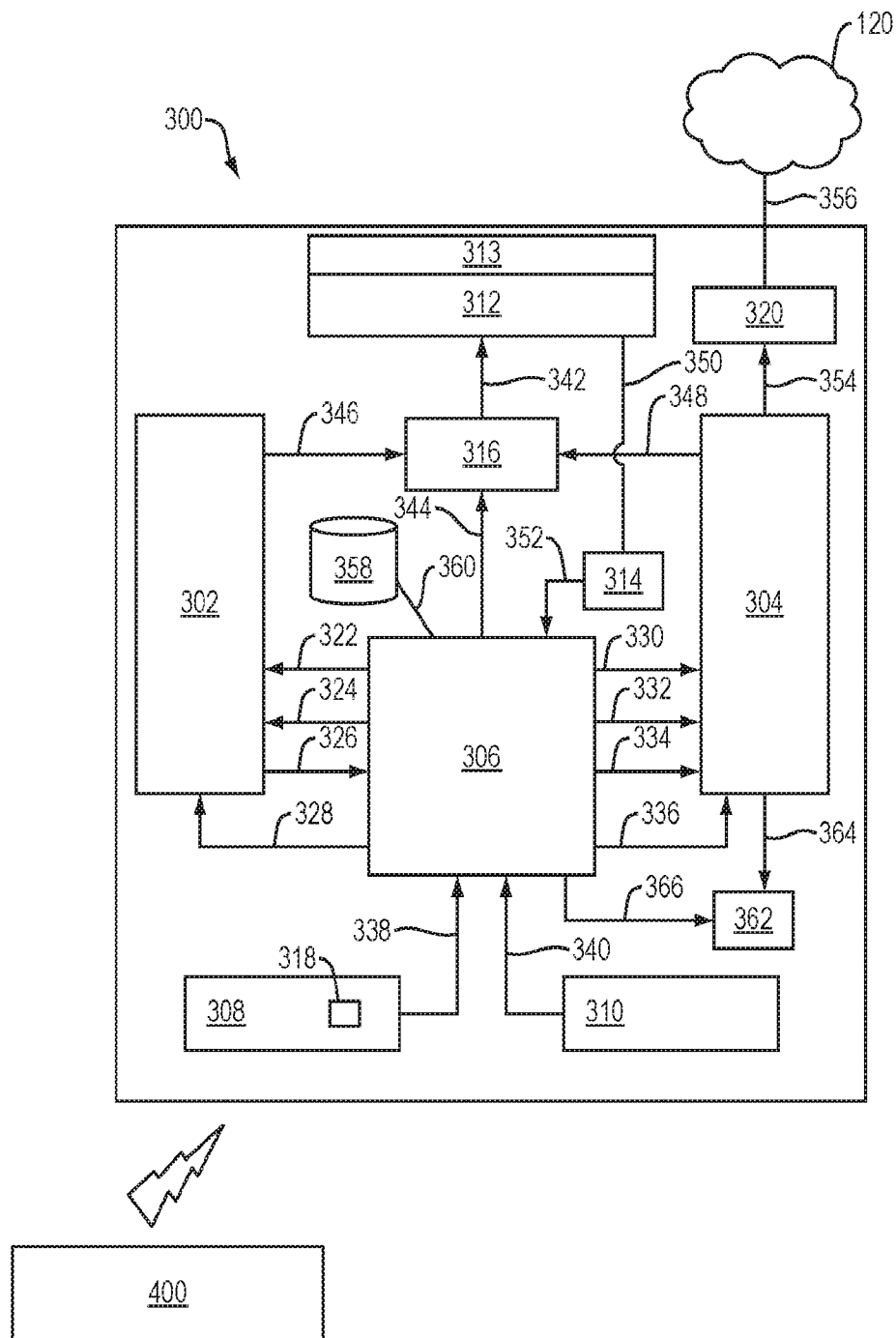
1/8

FIG. 1

FIG. 2

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FIG. 3
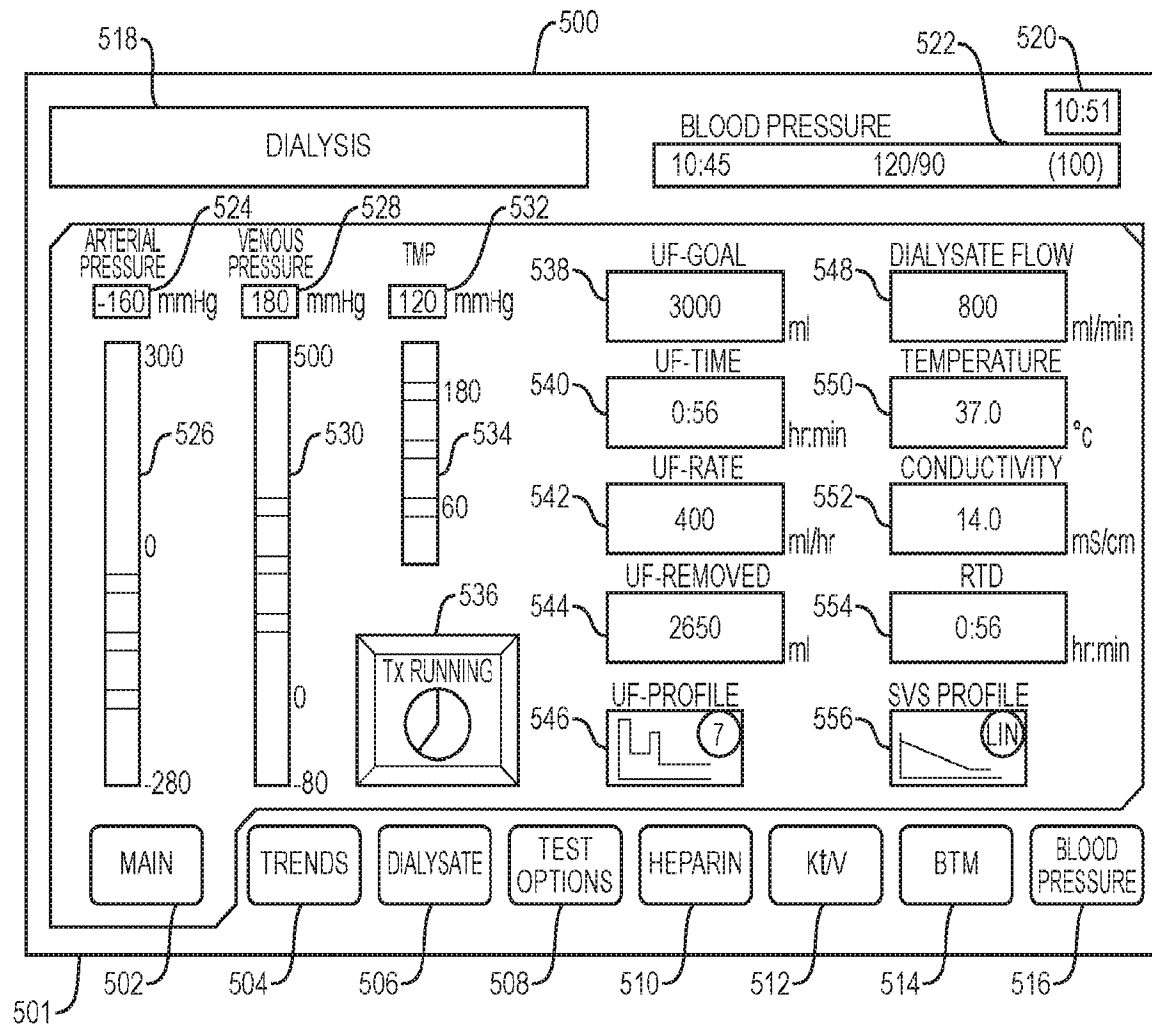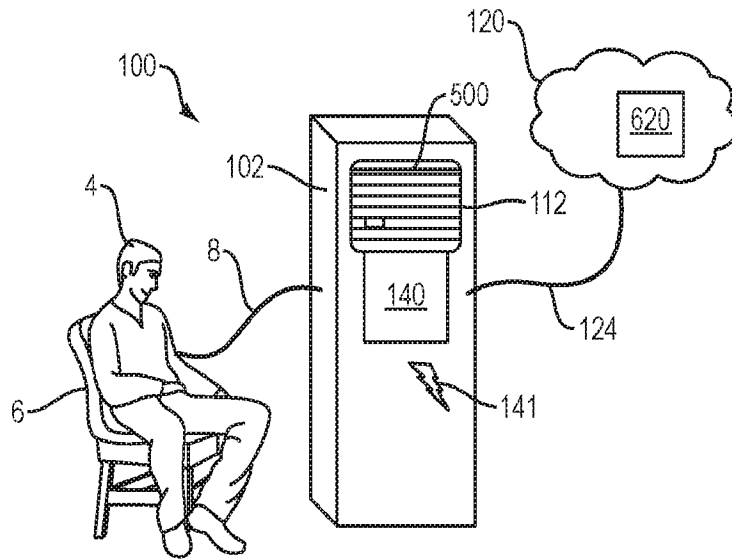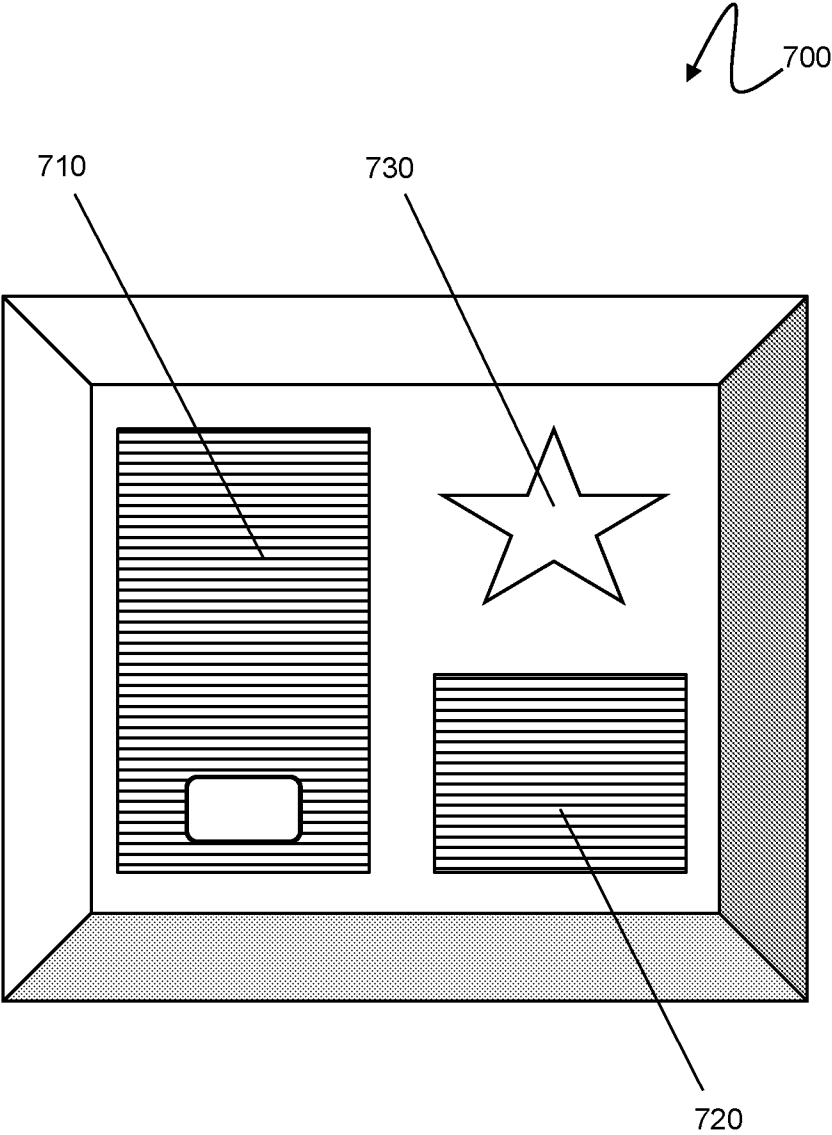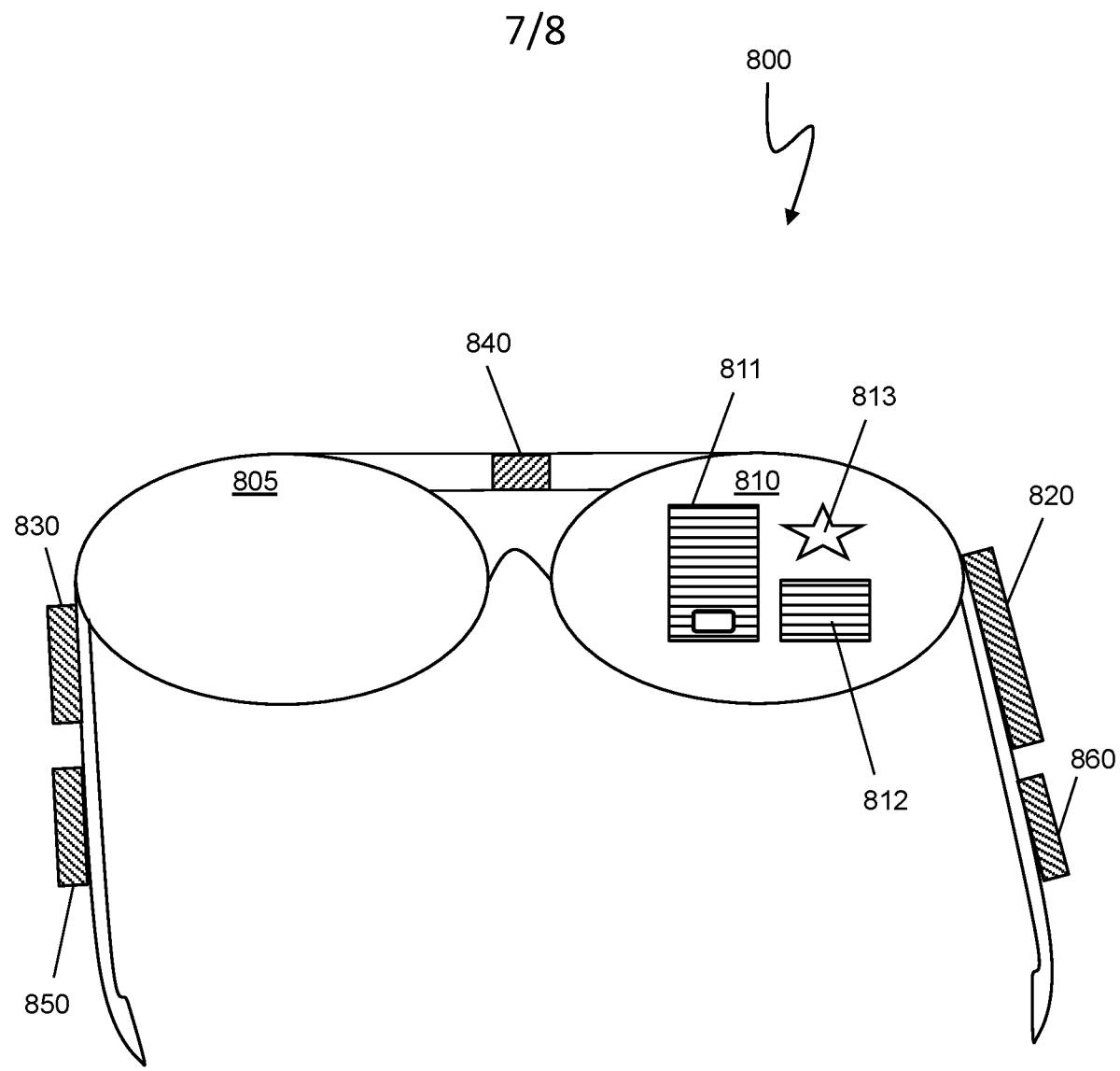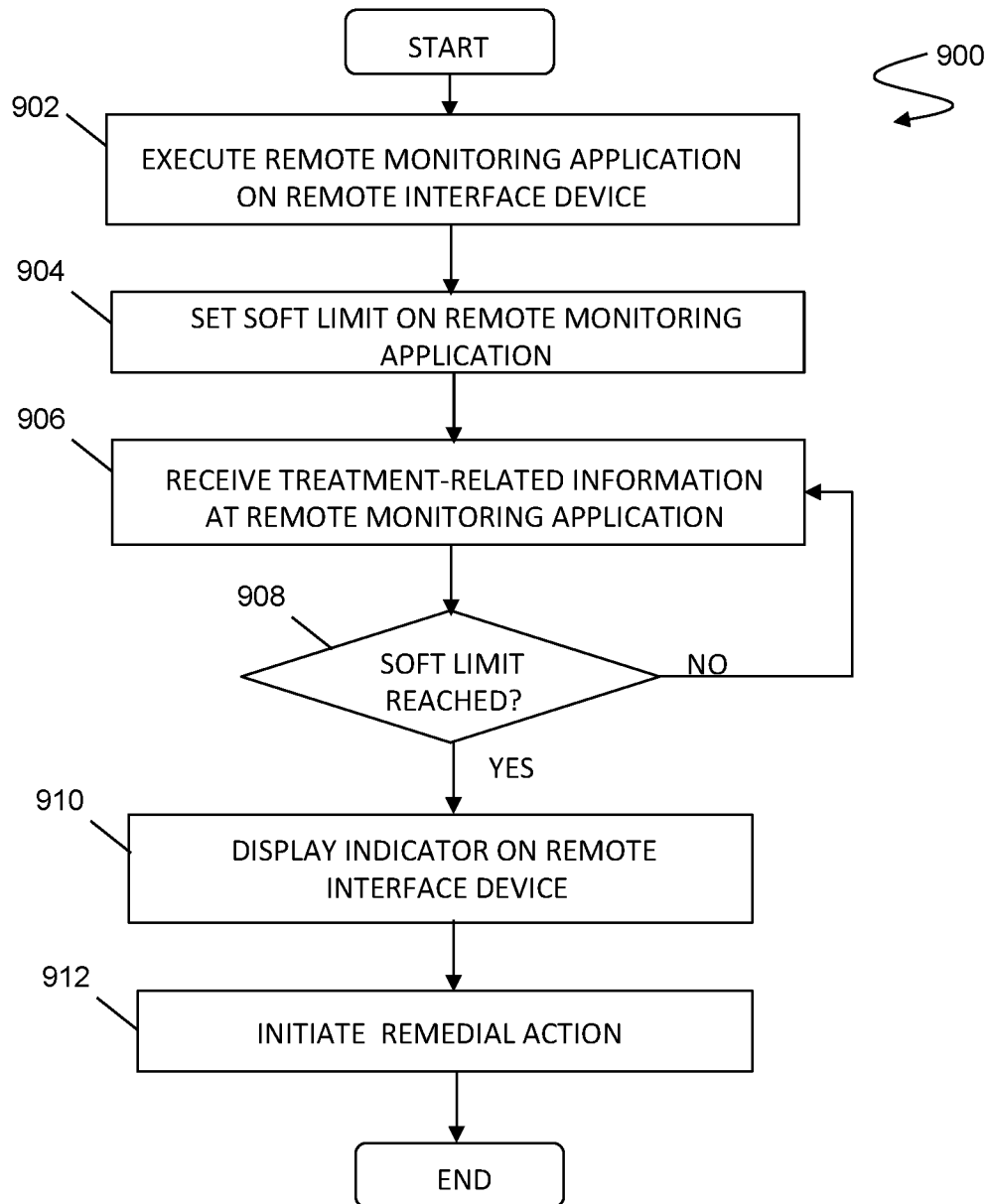
FIG. 4

FIG. 5

FIG. 6

FIG. 7

FIG. 8

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                        ┌─────────────────┐
                        │      START      │
                        └─────────────────┘
                                 │
                                 ▼
902 ──┐      ┌──────────────────────────────────────────┐
      │      │   EXECUTE REMOTE MONITORING APPLICATION   │
             │        ON REMOTE INTERFACE DEVICE         │
             └──────────────────────────────────────────┘
                                 │
                                 ▼
904 ──┐      ┌──────────────────────────────────────────┐
      │      │     SET SOFT LIMIT ON REMOTE MONITORING   │
             │                APPLICATION                │
             └──────────────────────────────────────────┘
                                 │
                                 ▼
906 ──┐      ┌──────────────────────────────────────────┐
      │      │   RECEIVE TREATMENT-RELATED INFORMATION   │◄──┐
             │      AT REMOTE MONITORING APPLICATION     │   │
             └──────────────────────────────────────────┘   │
                                 │                           │
            908                  ▼                           │
              ╲          ╱───────────────╲                   │
               ───────  ╱   SOFT LIMIT    ╲      NO          │
                        ╲    REACHED?      ╱─────────────────┘
                         ╲───────────────╱
                                 │
                                 │ YES
910 ──┐      ┌──────────────────────────────────────────┐
      │      │        DISPLAY INDICATOR ON REMOTE        │
             │             INTERFACE DEVICE              │
             └──────────────────────────────────────────┘
                                 │
                                 ▼
912 ──┐      ┌──────────────────────────────────────────┐
      │      │          INITIATE  REMEDIAL ACTION        │
             └──────────────────────────────────────────┘
                                 │
                                 ▼
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                        │       END       │
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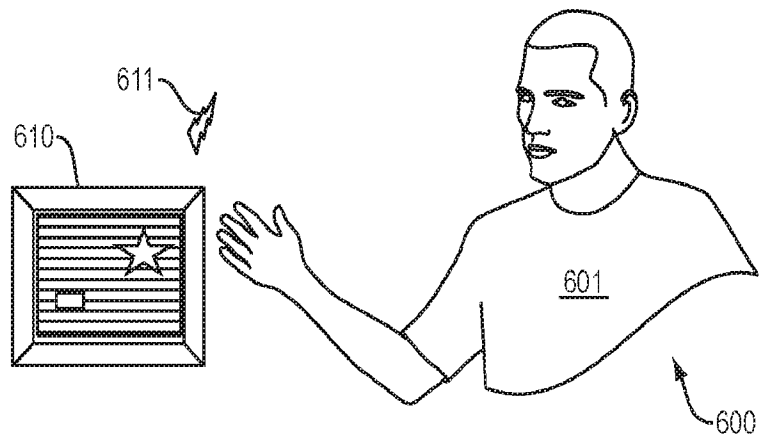
900

FIG. 9

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

INV. G06F19/00   A61B5/00
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G06F G06Q A61B

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2013/297330 A1 (KAMEN DEAN [US] ET AL) 7 November 2013 (2013-11-07) paragraph [0028] paragraph [0078] - paragraph [0093] paragraph [0150] - paragraph [0174] paragraph [0339] - paragraph [0411] paragraph [0482] - paragraph [0503] paragraph [0545] paragraph [0617] paragraph [0788] paragraph [0815] - paragraph [0823] paragraph [0885] - paragraph [0888] ----- -/--	1-25

[X] Further documents are listed in the continuation of Box C.   [X] See patent family annex.

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15 March 2016	24/03/2016

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2013/274642 A1 (SOYKAN ORHAN [US] ET AL) 17 October 2013 (2013-10-17) paragraph [0245] paragraph [0295] - paragraph [0298] paragraph [0311] figures 14, 32, 34 -----	1-25
X	US 2014/184422 A1 (MENSINGER MICHAEL ROBERT [US] ET AL) 3 July 2014 (2014-07-03) paragraph [0165] - paragraph [0170] paragraph [0235] - paragraph [0238] paragraph [0255] -----	1-25

Patent document cited in search report			Publication date	Patent family member(s)			Publication date
US 2013297330	A1		07-11-2013	NONE			
US 2013274642	A1		17-10-2013	NONE			
US 2014184422	A1		03-07-2014	AU	2013371036	A1	16-04-2015
				CA	2886791	A1	03-07-2014
				CN	104885089	A	02-09-2015
				EP	2939158	A2	04-11-2015
				US	2014184422	A1	03-07-2014
				US	2014184423	A1	03-07-2014
				US	2014187890	A1	03-07-2014
				US	2016066866	A1	10-03-2016
				US	2016066867	A1	10-03-2016
				US	2016066868	A1	10-03-2016
				WO	2014105631	A2	03-07-2014