(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) **World Intellectual Property Organization**
International Bureau

(43) **International Publication Date**
27 March 2014 (27.03.2014)

WIPO | PCT

(10) **International Publication Number**
WO 2014/047436 A1

(51) **International Patent Classification**:
G09B 23/30 (2011.01)

(21) **International Application Number**:
PCT/US2013/060915

(22) **International Filing Date**:
20 September 2013 (20.09.2013)

(25) **Filing Language**: English

(26) **Publication Language**: English

(30) **Priority Data**:
61/704,379 21 September 2012 (21.09.2012) US

(71) **Applicant**: **Z-MEDICA, LLC** [US/US]; 4 Fairfield Blvd, Wallingford, CT 06492 (US).

(72) **Inventor**: **HUEBNER, Robert**; 9 Hayledge Court, Wallingford, CT 06492 (US).

(74) **Agent**: **CHRISTENSEN, Michael, R.**; Knobbe, Martens, Olson & Bear, LLP, 2040 Main Street, 14th Floor, Irvine, CA 92614 (US).

(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) **Title**: SYSTEMS AND METHODS FOR PROVIDING HEMORRHAGE CONTROL TRAINING

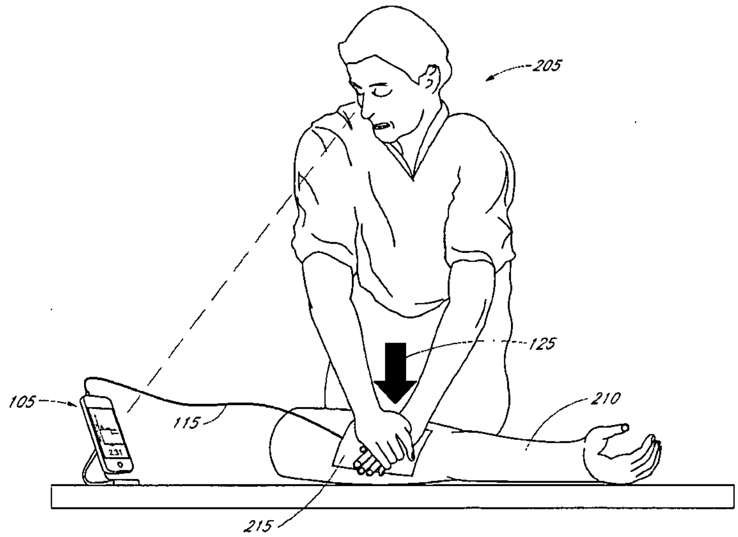


FIG. 2

(57) **Abstract**: Embodiments of a task monitoring system for hemorrhage control provide real-time or near real-time feedback to a trainee on the force that the trainee is applying to a simulated wound. In some embodiments, the task monitoring system comprises a mobile device, a pressure sensor, and a software application ("app") that runs on the mobile device. The task monitoring system allows the trainee (e.g., medic, doctor, nurse, or other health worker) to practice applying the correct force on simulated wounds over defined time periods, training muscle memory of the health service provider to apply the correct pressure over the correct time duration.

WO 2014/047436 A1

SYSTEMS AND METHODS FOR PROVIDING HEMORRHAGE CONTROL TRAINING

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates generally to training devices, and more particularly to devices for training users to perform physical actions.

Description of the Related Art

[0002] In daily life, people perform many physical tasks that require specific movements and procedures. In some cases, these tasks involve certain techniques that must be learned over time to enable a person to consistently perform the tasks well. In some situations, it can be difficult to train people in certain tasks because critical factors, such as human injury or high monetary costs, may be at risk each time the tasks are performed, even in training exercises. Errors performed during training can be extremely regrettable. To diminish this risk, training simulations can help a person develop the skills to perform a task before the real task is performed for the first time, or can help a person to improve the skills involved in a task on an ongoing basis.

[0003] In one example, a task that may require specific training is the proper treatment of a severely bleeding wound. In a wide variety of circumstances, animals, including humans, can be wounded. Bleeding is often associated with such wounds. In some circumstances, the wound and the bleeding are minor, and all that is required is the application of simple first aid and the normal blood clotting function of the body. Unfortunately, in other circumstances substantial bleeding can occur. These situations may require specialized equipment and materials, as well as personnel trained to administer appropriate aid. If such aid is not readily available, excessive blood loss can occur. Moreover, severe wounds can often be inflicted in remote areas or in situations such as on a battlefield, where adequate medical assistance is not immediately available. In these instances, it can be very useful for personnel to be trained to stop the bleeding, even in less severe wounds, long enough to allow the injured person or animal to receive serious medical attention.

SUMMARY OF THE INVENTION

[0004] Training devices and systems can include a first contact portion on which a trainee performs one or a plurality of physical actions that can be measured or graded using one or a plurality of criteria, and a second feedback portion that provides information regarding the physical action performed by the trainee. In some embodiments, simulation systems can include a contact portion in the form of a simulated item on which a simulated task is performed, such as a life-size human body manikin or a body-part manikin or moulage. Simulated items can include features such as joint mobility for easy positioning in various environments. In some embodiments, a wound simulator can replicate a wide range of real trauma conditions that are likely to confront the rescuer and can be used for demonstrating and teaching proper first aid techniques.

[0005] According to some embodiments, a task monitoring system for hemorrhage control can be placed into communication with the simulated item to provide real-time or historical feedback to a trainee regarding one or more aspects of performing blood stanching properly. For example, in some embodiments, feedback can be provided to the trainee on the force and/or time that the trainee is applying to a simulated wound. In some embodiments, the task monitoring system comprises a mobile device, a pressure sensor, and a software application ("app") that runs on the mobile device. The mobile device can be configured to receive pressure data from a pressure sensor. The app can read the pressure data from the pressure sensor and can graphically display the force and/or time on the screen, providing graphical feedback, and/or audio feedback, or other indications to the trainee on the proper pressure and/or timing used to apply a dressing, compression bandage or other hemostatic material to a wound. All references to the capabilities, features, and/or logic structure of an app described herein can apply to any other type of computer or electronic processing system, including but not limited to a desk-top or lap-top computer or an onboard processing device in a simulation system.

[0006] The task monitoring system can provide trainees with valuable feedback on the proper procedures for controlling bleeding. A common method to control bleeding is to place a dressing on a bleeding wound and then apply manual compression over the dressing for sufficient time. This may be done in clinical settings (e.g., in hospitals and or other treatment facilities) as well as other settings such as in the field (e.g., on a battlefield or in an ambulance), or other emergency care settings. Different wound types can require

different levels of manual pressure and compression time. If the force is too light, then the risk of not controlling the bleeding is higher. If the force is too high and/or applied for too long, it could cause complications such as artery occlusion, which is a blood clot in the artery.

[0007] It can therefore be useful to train caregivers in the proper technique for controlling various types of bleeding on various types of wound types with the appropriate amount of force over various time durations. Feedback-based training methods can develop the caregiver's muscle memory to maintain the correct force over a certain time duration. Embodiments of the task monitoring system described herein can allow the caregiver to practice applying the an appropriate amount of force on simulated bleeding wounds over defined time periods, to teach the trainee how to apply the correct pressure over the correct time duration.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Throughout the drawings, reference numbers may be re-used to indicate correspondence between referenced elements. The drawings are provided to illustrate example embodiments described herein and are not intended to limit the scope of the disclosure.

[0009] FIG. 1 illustrates an embodiment of a task monitoring system (TMS) for monitoring force applied by a trainee over time on a simulated wound site.

[0010] FIG. 2 illustrates an example of using the task monitoring system of FIG. 1 with a simulated body part.

[0011] FIG. 3 schematically illustrates an example of a logical flow diagram for a monitoring process to monitor the pressure applied over time by the trainee on the simulated wound site.

[0012] FIG. 4 schematically illustrates a logical flow diagram for a training process for the trainee to learn correct techniques for hemorrhage control.

[0013] FIG. 5 shows an example of a contact portion or simulated item with a feedback portion integrated into it.

DETAILED DESCRIPTION

[0014] A training system can provide trainees with valuable feedback on the proper procedures for performing tasks. In some examples, a task monitoring system allows a health service provider (e.g., medic, doctor, nurse, or other health worker) to practice applying the proper force range on simulated bleeding wounds over particular time periods, training the health service provider to apply the correct pressure range over a correct time interval.

[0015] FIG. 1 illustrates an embodiment of a task monitoring system (TMS) 100 for monitoring force applied by a user on a simulated wound site. The task monitoring system 100 can include a computing device comprising one or more processors and computer memory, a pressure sensor 110, a communication link 115 between the pressure sensor and the computing device, and a pressure signal receiver 120 for receiving an electronic signal that includes pressure data from the pressure sensor.

[0016] In some examples, the task monitoring system 100 can be used for training a user or trainee in proper techniques for stopping wounds from bleeding. Generally, different wounds can require different amounts of force and/or the application of force for different lengths of time. In some cases, the level of force for a wound may require change over time. For example, greater force may be required when first attempting to stop bleeding from a wound but the required force may lessen as the bleeding slows. Thus, the task monitoring system 100 can be used to train the trainee in the correct levels of force (including a changing force), and/or a time duration. In some types of wounds, such as the access site on the wrist following radial access for percutaneous coronary intervention, a proper amount of force applied to a wound can be at least about one pound of force (4.4_newtons) and less than about ten pounds of force (44 newtons).

[0017] In the illustrated embodiment, the computing device is a mobile device 105 (e.g., smart phone, tablet, etc.) capable of running applications 103. The mobile device can comprise a video display screen and a portable power source. In some embodiments, the mobile device 105 includes the pressure signal receiver 120 for receiving pressure data. In some embodiments, the pressure signal receiver 120 comprises an audio port on the mobile device that is repurposed to receive pressure data. In some embodiments, the pressure signal receiver 120 comprises a digital connector technology, such as Universal Serial Bus (USB), FireWire, etc.

[0018] In some embodiments, the sensor 110 sends the pressure data serially using an analog signal to the audio port on the mobile device. Some audio ports can have filters on the input that block frequencies that are too high. Thus, in some embodiments, the analog signal is band-limited so that high frequencies are not used.

[0019] In some embodiments, the audio part can be a tip ring sleeve (TRS) or similar connector. A TRS connector refers to a family of connectors typically used for analog signals, including audio. It is generally cylindrical in shape, and it has a plurality of separate electrical contacts (e.g., typically three contacts, although variations with two contacts (a TS connector) or four contacts (a TRRS connector) can be used). A TRS jack generally fits into a TRS socket. For a three-contact TRS connecter, the three contacts typically map to the left audio channel, the right audio channel, and ground. Many mobile phones use a TRRS connector with four contacts, which maps to left, right, and ground, with a fourth connector that maps to a microphone. Connecters are available in a variety of sizes, such as 2.5mm (e.g., used by some mobile phones to save space), 3.5mm (e.g., for phones, mp3 player, etc.) and .25" (e.g., for larger headphones, guitars, etc).

[0020] In some embodiments, the communication link 115 comprises a wired connection between the pressure sensor 110 and the pressure signal receiver 120. For example, one end of the wire can be a TRS jack that fits into an audio port and the other end of the wire terminates at a data interface with the pressure sensor 110. Data received from the pressure sensor 110 at the data interface is then transmitted on the wire and into the audio port as an electronic signal. In some embodiments, the electronic signal carries pressure data, including compression force levels measured at a wound site. Depending on the embodiment, the electronic signal may be analog or digital. In some embodiments, the communication link 115 is a wireless connection, such as Bluetooth, 802.11a/b/g/n, infrared, radio, or other type of connection.

[0021] In some embodiments, the contact portion or simulated item can comprise one or more transducers that create electrical signals from physical actions. An example of a type of transducer is a pressure sensor 100. In some embodiments, the pressure sensor 110 comprises one or a plurality of electrical devices for measuring pressure on a surface, such as a load cell. Load cells are typically inexpensive, thereby keeping down the cost of the task monitoring system 100. Generally, a load cell is a transducer that is used to convert a force on the load cell into an electrical signal. Typically, this conversion is indirect and happens in two stages. For example, through a mechanical arrangement, the force being sensed by the load cell can deform a strain gauge.

The strain gauge can then measure the deformation (strain) as an electrical signal, because the strain changes the effective electrical resistance of the wire.

[0022] Generally, a strain gauge (also referred to as a strain gage) is a device used to measure the strain placed on an object. In some embodiments, a strain gauge includes an insulating flexible backing which supports a metallic foil pattern. The gauge can be attached to the object by a suitable adhesive, such as cyanoacrylate, epoxy, acrylic glue or the like. As the object is deformed, the foil is deformed, causing its electrical resistance to change. When an electrical conductor is stretched within the limits of its elasticity such that it does not break or permanently deform, it becomes narrower and longer, causing an increase in its electrical resistance end-to-end. Conversely, when a conductor is compressed such that it does not buckle, it broadens and shortens, causing a decrease in its electrical resistance end-to-end. By measuring the electrical resistance of the strain gauge, the amount of applied stress can be inferred from the electrical resistance.

[0023] In some embodiments, the load cell includes four strain gauges in a Wheatstone bridge configuration, though other electrical circuit configurations are possible. For example, load cells with one strain gauge (e.g., a quarter bridge) or two strain gauges (e.g., a half bridge) are also possible. The electrical signal output from a load cell is typically in the order of a few millivolts and may require amplification by an instrumentation amplifier. In some cases, load cells with higher power outputs may be used. In some embodiments, an application or other process on the mobile device 105 receives the electrical signal output from the load cell and calculates the pressure applied on the load cell based at least partly on the strength of the electrical signal. Other types of load cells may also be used. Some examples of other load cell types are hydraulic or hydrostatic load cells, piezoelectric load cells, vibrating wire load cells, and capacitive load cells.

[0024] Furthermore, other types of pressure sensors can also be used. Some examples of pressure sensors include piezoresistive strain gauges (of which load cells are one possible type), capacitive pressure sensors, electromagnetic pressure sensors, piezoelectric pressure sensors, optical pressure sensors, potentiometric pressure sensors, resonant pressure sensors, thermal pressure sensors, ionization pressure sensors, or the like. The pressure sensor 110 can include one or more of the different pressure sensor types, including combinations of different pressure sensor types. In some embodiments, the pressure sensor includes a power source, such as a portable electrical power source.

[0025] Force 125 applied to the pressure sensor 110, causes an electronic signal to be generated by the sensor 110 and transmitted to the mobile device 105. In some embodiments, an application 103 on the mobile device processes the electronic signal to determine the current pressure being applied by the pressure sensor 110. The application can then compare this current pressure with a target pressure 130 that is pre-set or otherwise defined for the application. The application can determine the current pressure for an instant, for multiple instants, or generally continuously over a period of time. In some embodiments, the current pressure is determined continuously and compared continuously to the target pressure 130. In some embodiments, if the application determines that the current pressure varies or deviates from the target pressure, it signals such a deviation to the trainee so that the trainee can modify the pressure the trainee is applying. Various signals can be used, such as visual, auditory or physical cues. For example, the mobile device can generate an auditory or tactical indicator, such as an alarm, a flash or other visual cue on the screen, a vibration, or some other human-perceptible signal.

[0026] In this example, by signaling to the trainee in real time or near real time, the application beneficially creates a feed-back loop that informs the trainee when he or she is or is not applying the proper amount of pressure. In some embodiments, the application only generates a signal when the deviation is greater than a particular threshold, and in some embodiments the application generates a signal displaying all pressure readings over a period of time.

[0027] In some embodiments, the mobile device 105 includes a display screen that comprises at least part of a feed-back loop for a user. The display screen can show a chart of pressure (e.g., along a vertical or "Y" axis) and time (e.g., along a horizontal or "X" axis). In some embodiments, the display screen is a touch screen capable of receiving user inputs, such as the target force. During training, the user can observe the deviation, if any, between the compression force being applied by the user and the target force over time. With repeated practice, the user can develop muscle memory to control various bleeding wound simulations appropriately. The user can learn to adjust to fatigue and maintain the right force for the required time.

[0028] FIG. 2 illustrates the usage of an example of the task monitoring system 100 of FIG. 1. In this example, a trainee 205 is using the task monitoring system 100 to learn the proper techniques for hemorrhage control of various wounds. In FIG. 2, the trainee 205 applies pressure on a simulated wound while being monitored by the TMS 100. The pressure applied to the wound site and monitored by the TMS can be continuous or pulsed pressure.

[0029] In the illustrated embodiment, the task monitoring system 100 is incorporated into or operated with a wound simulator 210 (e.g. a moulage or manikin). In some embodiments, the sensor 110 is attached to the wound simulator at a simulated wound site 215. The sensor 110 can be located in a variety of locations, such as within the wound simulator, under the wound site, on top of the wound site or the like. Many different types of wound simulators can be used, such as partial body models (e.g., arms or legs), full-body manikins, wound models for placement on real humans or animals for a more realistic simulation, makeup or the like. In some embodiments, the sensor 110 can include a plurality of sensing units to enable the sensor 110 to indicate not only an amount of applied forces but also where in a given area a force, or multiple forces, are applied. This can assist in determining whether a trainee is positioning his or her hands appropriately and/or otherwise pushing in the right places.

[0030] In some embodiments, an assembly comprising a sensor 110 can be removably positioned directly on or near a body part such as by using a sticker, suction cup, strap, or other temporary retention device, either for simulations or for use in actual blood-stanching activities to help ensure that a proper range of compression force is applied for a therapeutically effective range of time. A sensor 110 in some applications can be sufficiently thin to fit between the folds of a bandage being applied to a real bleeding wound. The sensor 110 can be disposable or can be provided with a disposable covering.

[0031] In some embodiments, the task monitoring system 100 provides training for a variety of wound types that require different levels of pressure and/or time. For example, the application 103 on the mobile device 105 can include a selection screen for selecting or specifying wound-related parameters, such as the size, location, blood flow and/or type of the wound. Based on these parameters, the application 103 can select the target pressure and/or time for the wound. In some embodiments, the application 103 allows a user to select or provide the target pressure and/or time directly by specifying the target values. In other embodiments, distinct applications or devices are created for various wound types such that each particular wound type application or device has a pre-set target pressure and/or time for the particular wound.

[0032] In the illustrated example, the trainee 205 is training in the proper technique for a particular wound type. A mobile device 105 is configured to monitor the trainee and determine whether the trainee 205 is applying pressure at the target pressure level and/or for the target time. The mobile device 105 can be placed on a stand, attached to a surface or mount, or otherwise configured such that a display of the mobile device 105 is viewable by the trainee or by a teacher or both. As the trainee applies force 125 at the simulated wound site 215, the pressure sensor at the wound site sends an electronic signal (e.g., via a wire 115 or other communication link) to the mobile device 105, the signal including pressure data. The mobile device 105 can determine the current pressure level from the pressure data. The mobile device 105 may also track instantaneous pressure level readings over time.

[0033] In some embodiments, the mobile device 105 provides a graph or other data representation of the pressure level readings on its display, so that the trainee or a teacher, or both, can see the data presentation in real time, after the training is complete, or both. For example, the current pressure line on the graph can move above the target pressure line 130 if the current pressure is too high or below the target pressure line 130 if the pressure is too low. In some embodiments, a first symbol (e.g., an "up" arrow) can direct the trainee to apply less pressure and a second symbol (e.g., a "down" arrow) can direct the trainee to apply less pressure, and a third symbol can indicate to the trainee that the amount of pressure is about right.

[0034] In some embodiments, the app can also provide advice and instructions about how to perform a task or how to perform a task in a better way. Instructions can be provided in a series manner as certain tasks are completed, or can be accessed by a user or trainee in any order for review. In some embodiments, appropriate instructions can be given as needed to help a trainee correct an action or clues or hints can be provided to assist a trainee in recalling certain steps. The instructions can also be accessed when performing the actual task (rather than a simulated version of the task). In some embodiments, the instructions or feedback can be read or announced to the trainee in an audible voice by the processor to avoid districting the trainee, since the trainee's eyes may be focusing primarily on performing the task.

[0035] By providing the trainee with feedback on whether he is applying the proper pressure, the trainee is better able to learn the proper technique for the wound. Furthermore, additional or alternative forms of feedback can be provided to the trainee to indicate when the trainee is deviating from the proper technique. As discussed above, user feedback can include visual, auditory or physical cues that can indicate proper or improper technique. In some embodiments, such cues are based at least partly on the degree of deviation from the target values (e.g., time and/or pressure). For example, the mobile device 105 may vibrate or emit a tone or other sound that increases in strength based on the deviation from the target values, such that the trainee is encouraged to apply the proper technique in order to minimize the emitted sound. In another example, the mobile device 105 display may begin to blink more rapidly or may progressively display different levels or brightness and/or different colors (e.g., green, orange, red, etc.) as the trainee deviates further from or closer to the target values. In another example, the pressure sensor can include a buzzer or vibration device such that the trainee is given physical feedback (e.g., via his hands on the wound) that increases or decreases based on the level of deviation or proximity.

[0036] By providing cues that are based at least partially on the level of deviation from or proximity to target values, the task monitoring system 100 can provide the trainee with an indication of the amount of corrective action that the trainee needs to take. For example, the trainee would know to press harder or ease off more on the pressure on the wound site 215 if the cue indicates a high deviation compared to if the cue indicates a low deviation. Thus, the trainee can more quickly return to the proper technique.

[0037] In some embodiments, the task monitoring system 100 provides cues that are based at least partly on whether the trainee is applying too much pressure or too little pressure. For example, if too little pressure, the mobile device 105 display may flash red while, if too much pressure, the display may flash blue. In another example, different sounds are played depending on whether the pressure is too low or too high. In another example, different vibration pattern are used depending on whether the pressure is too low or too high.

[0038] In some embodiments, the target value used by the task monitoring system 100 is a range of values rather than a single value. For such embodiments, the task monitoring system 100 may only provide a particular cue when measured values fall outside the ranges of the target values.

[0039] The task monitoring system 100 can track the pressure applied by the trainee over time. After a certain amount of time, the trainee finishes applying pressure for the amount of time required by the particular technique and the training session ends. In some embodiments, the mobile device 105 indicates to the trainee that the session has ended through a cue (e.g., visual, auditory, physical, etc.). If the trainee wishes to practice the technique again, the trainee can restart the training session. In some embodiments, the mobile device 105 may automatically start a new training session until a specified amount of sessions are completed. For example, training sessions may be repeated 2, 3, 4 or more times in order to develop the trainee's muscle memory. In some embodiments, the mobile device 105 pauses between sessions to provide a break to the trainee. In some embodiments, the proper time is not revealed to the trainee until after the end of each simulation to permit the trainee to learn to estimate mentally when the right amount of time has passed. In some embodiments, the trainee or instructor can switch between settings in the app to display the time as it elapses or only after a simulation is completed, depending on whether the trainee is still learning the proper time duration or has already learned the proper time duration and is seeking to test his or her estimating skill without viewing the passing time.

[0040] FIG. 3 schematically illustrates a logical flow diagram for a monitoring process 300 to monitor the pressure applied by a user to a wound simulator. In some implementations, the process is performed by embodiments of the task monitoring system 100 described with reference to FIG. 1 or by another a component of the system 100, such as the mobile device 105 or an application 103 operating on the mobile device 105. For ease of explanation, the following describes the process as performed by the mobile device 105. The process is discussed in the context of an example that is intended to illustrate, but not to limit, various aspects of the task monitoring system 100.

[0041] Beginning at block 305, the mobile device 105 receives wound simulation data, such as a selection of one of a plurality of wound simulations or some other simulation parameters. In some embodiments, the mobile device 105 includes settings for a variety of scenarios for different wound types. The mobile device 105 can provide a user with a selection screen in which the user can select a particular training situation. In some embodiments, the mobile device 105 allows the user to input simulation parameters, such as the target force to apply and/or the target time for the pressure to be applied. In some cases, the system can be configured so that the user may train in the correct force to apply and only provide a target force. In some cases, the user may train in the correct time to apply force and only provide a target time. In some cases, the user may train how to apply the correct force for the correct amount of time and provide both the target force and the target time. The mobile device 105 can store these values (e.g., force and/or time) in memory for future reference.

[0042] At block 310, the mobile device 105 receives pressure data from a pressure sensor 110. As discussed above, the pressure data can be received through a communication link, such as a wired or wireless link. At block 315, the mobile device 105 identifies the target pressure and target time associated with the selected type of wound simulation. The target pressure and target time may be pre-set parameters associated with the scenario or may have been entered into the mobile device by the user. At block 320, the mobile device 105 compares the measured pressure and/or the time the pressure has been applied with the target pressure and/or the target time. At bock 325, the mobile device 105 provides an indication when force and/or time deviate from the target force and/or target time. In some embodiments, the mobile device 105 provides a cue when the values deviate from the target. The process may then end.

[0043] In some cases, the mobile device 105 records data from the training session, which can be used for the future reference of the user. For example, the mobile device 105 can use the data to generate a report on how closely the user met the target values. In some embodiments, the mobile device 105 can generate a score that indicates how closely the user met the target values. The app can also aggregate data from multiple users to permit a training instructor to identify trends that may influence teaching approaches. The app may also be configured to receive and store identifying data regarding a trainee (e.g., name and/or personnel number) and communicate such information to a computer system regarding a particular person's success or failure in certifying competence in performing a particular simulated task or series of tasks.

[0044] FIG. 4 schematically illustrates a logical flow diagram for a training process 400 for a user to learn correct techniques for hemorrhage control. In some implementations, the process is performed by a user of the task monitoring system 100. For ease of explanation, the following describes the user as interacting with the mobile device 105 of the task monitoring system 100, however, in other embodiments, the user may be interacting with other components of the task monitoring system 100. The process is discussed in the context of an example scenario that is intended to illustrate, but not to limit, various aspects of the training process.

[0045] Beginning at block 405, the user inputs wound simulation data into the mobile device 105 of the task monitoring system 100, such as a selection of a wound simulation scenario or simulation parameters. The mobile device 105 can store these parameter values (e.g., force and/or time) in memory for future reference. At block 410, the user applies pressure on a simulated wound site on a wound simulator. In some embodiments, a pressure sensor at the wound site sends pressure data to the mobile device 105. At block 415, the user monitors the applied pressure he is applying to the wound site via the mobile device 105. For example, the mobile device 105 may display a graph or provide other indications of how closely the applied pressure matches the target values. At block 420, the user adjusts the applied pressure based at least partly on indications from the mobile device 105. For example, the mobile device 105 may provide auditory, visual, or physical cues to indicate if the user is deviating from the target values and/or the degree to which the user is deviating, thereby creating a feed-back loop for the user. The user can adjust the pressure he is applying according to such indications. The indications may be provided directly by the mobile device (e.g., on a built-in display or speaker) or indirectly (e.g., on an external display, speaker or vibration device). After a defined time, the training session may end. In some cases, the user may repeat the process in order to receive additional training.

[0046] Many versions of the task monitoring system 100 can be used. For example, while this disclosure has generally described the system 100 as including a mobile device 105, in some embodiments the task monitoring system 100 includes a desktop computer, terminal or other stationary computing device that performs functions similar to the mobile device 105.

[0047] FIG. 5 illustrates an embodiment of a task monitoring system that is built into or integrated on or within a wound simulator 510. For example, as illustrated in FIG. 5, the wound simulator 510 can include a computing device and a display 520 that performs functions similar to the mobile device 105 of FIG. 1. The computing device can be in communication with a pressure sensor, which may be located at a simulated wound site 515.

[0048] In some embodiments, the wound simulator can be configured to simulate blood flow from a wound (such as by emitting a red-colored liquid) and the task monitoring system 100 can be configured to control the blood flow in response to the amount of pressure applied by a trainee. For example, if the trainee has applied correct pressure to the wound, the system 100 can cause the wound simulator to stop emitting simulated blood. In some cases, the system 100 can increase the bleeding from the simulator, for example, if the trainee applies the wrong pressure (e.g., pressing hard enough on the wound to cause further bleeding or not hard enough to stop bleeding).

[0049] Other variations of the task monitoring system 100 are also possible. For example, while embodiments above have been described in terms training methods for hemorrhage control, the task monitoring system 100 can also be used in other situations, such as in other types of simulations, where force needs to be measured during training. For example, embodiments of the task monitoring system 100 could be used to train people in cardiopulmonary resuscitation (CPR) or the Heimlich maneuver. Many other types of applications and simulated activities can be used.

[0050] In some embodiments, the task monitoring system 100 can be used during actual treatment of a wound by medical personnel. For example, a pressure sensor may be applied or attached to a compression bandage or dressing. During actual treatment, the system 100 monitors the pressure sensor and indicates to the medical personnel when incorrect pressure is being applied to the wound.

[0051] Other types of interactions (additionally or alternatively) between the task monitoring system 100 and the users are possible in addition to those described above. For example, the user may be able to input data into or control the task monitoring system 100 through another device, such as a keyboard, mouse, or remote control.

[0052] In some embodiments, the task monitoring system 100 can be implemented with one or more computing devices, such as several interconnected devices.

Thus, each of the components depicted in the task monitoring system 100 can include hardware and/or software for performing various features.

[0053] In many embodiments, the task monitoring system 100 may be configured differently than illustrated in the figures. For example, various functionalities provided by the illustrated modules can be combined, rearranged, added, or deleted. In some embodiments, additional or different processors or modules may perform some or all of the functionalities described with reference to the example embodiment illustrated in the figures above. Many implementation variations are possible.

[0054] In some embodiments, the task monitoring system 100 and its components are executed or embodied by one or more computing devices. For example, in some embodiments, a computing device that has components including a central processing unit (CPU), input/output (I/O) components, storage and memory may be used to execute some or all of the processes of the task monitoring system 100. The I/O components can include a display (e.g., a touch screen), a network connection to the network 105, a computer-readable media drive and other I/O devices (e.g., a keyboard, a mouse, speakers, a touch screen, etc.). In some embodiments, the task monitoring system 100 may be configured differently than described above.

[0055] Components of the task monitoring system 100 can be stored as one or more executable program modules in the memory of the computing device and/or on other types of non-transitory computer-readable storage media, and the task monitoring system 100 can interact with computing assets over a network or other communication link. In some embodiments, the task monitoring system 100 may have additional components or fewer components than described above.

[0056] Each of the processes, methods and algorithms described in the preceding sections may be embodied in, and fully or partially automated by, code modules executed by one or more computers, computer processors, or machines configured to execute computer instructions. The code modules may be stored on any type of non-transitory computer-readable storage medium or tangible computer storage device, such as hard drives, solid state memory, optical disc and/or the like. The processes and algorithms may be implemented partially or wholly in application-specific circuitry. The results of the disclosed processes and process steps may be stored, persistently or otherwise, in any type of non-transitory computer storage such as, e.g., volatile or non-volatile storage.

[0057] The various features and processes described above may be used independently of one another, or may be combined in various ways. All possible combinations and subcombinations are intended to fall within the scope of this disclosure. In addition, certain method, event, state or process blocks may be omitted in some implementations. The methods and processes described herein are also not limited to any particular sequence, and the blocks or states relating thereto can be performed in other sequences that are appropriate. For example, described tasks or events may be performed in an order other than that specifically disclosed, or multiple tasks may be combined in a single block or state. The example tasks or events may be performed in serial, in parallel, or in some other manner. Tasks or events may be added to or removed from the disclosed example embodiments. The example systems and components described herein may be configured differently than described. For example, elements may be added to, removed from, or rearranged compared to the disclosed example embodiments.

[0058] Conditional language used herein, such as, among others, "can," "could," "might," "may," "e.g.," and the like, unless specifically stated otherwise, or otherwise understood within the context as used, is generally intended to convey that certain embodiments include, while other embodiments do not include, certain features, elements and/or steps. Thus, such conditional language is not generally intended to imply that features, elements and/or steps are in any way required for one or more embodiments or that one or more embodiments necessarily include logic for deciding, with or without author input or prompting, whether these features, elements and/or steps are included or are to be performed in any particular embodiment. The terms "comprising," "including," "having," and the like are synonymous and are used inclusively, in an open-ended fashion, and do not exclude additional elements, features, act, operations and so forth. Also, the term "or" is used in its inclusive sense (and not in its exclusive sense) so that when used, for example, to connect a list of elements, the term "or" means one, some, or all of the elements in the list. Conjunctive language such as the phrase "at least one of X, Y and Z," unless specifically stated otherwise, is otherwise understood with the context as used in general to convey that an item, term, etc. may be either X, Y or Z. Thus, such conjunctive language is not generally intended to imply that certain embodiments require at least one of X, at least one of Y and at least one of Z to each be present.

[0059] While certain example embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions disclosed herein. Thus, nothing in the foregoing description is intended to imply that any particular feature, characteristic, step, module, or block is necessary or indispensable. Indeed, the novel methods and systems described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the methods and systems described herein may be made without departing from the spirit of the inventions disclosed herein.

THE FOLLOWING IS CLAIMED:

1. A training system for hemorrhage control, the system comprising:

a wound simulator having a pressure sensor at a wound site; and

a computer software application comprising one or more subroutines configured to: (a) monitor the compression force from the pressure sensor; (b) compare the compression force with a target force; and (c) indicate a deviation from or proximity to the target force based on the comparison.

2. A training system for hemorrhage control, the system comprising:

a wound simulator having a pressure sensor at a wound site; and

a mobile device comprising:

a data port connected to the pressure sensor;

a monitoring module configured to monitor pressure data received on the data port from the pressure sensor; and

a device output configured to provide an indication when the pressure data deviates from a target pressure.

3. The training system of Claim 1, wherein the data port is a repurposed audio jack

4. The training system of Claim 1, wherein the device output comprises at least one of a display, a speaker, or a vibration device.

5. The training system of Claim 1, wherein the indication comprises at least one of a physical cue, an auditory cue, or a visual cue.

6. The training system of Claim 1, wherein the mobile device is a smart phone that includes a pressure monitoring application.

7. A training device for hemorrhage control, the training device comprising:

a pressure signal receiver configured to receive pressure data including compression force from a pressure sensor; and

one or more processors configured to:

(a) monitor the compression force from the pressure sensor;

(b) compare the compression force with a target force; and

(c) indicate a deviation from or proximity to the target force based on the comparison.

8. The training device of Claim 7, wherein the one or more processors are further configured to:

track a compression time during which the compression force is applied; and

indicate a deviation from a target time based on a comparison of the compression time with the target time.

9. The training device of Claim 7, further comprising a device output configured to provide an indication of the deviation.

10. The training device of Claim 9, wherein the device output comprises at least one of a display, a speaker, or a vibration device.

11. The training device of Claim 9, wherein the indication comprises at least one of a physical cue, an auditory cue, or a visual cue.

12. The training device of Claim 7, wherein the training device is a smart phone that includes a pressure monitoring application.

13. The training device of Claim 12, wherein the pressure signal receiver is an audio port on the smart phone.

14. The training device of Claim 7, wherein the training device is built into a wound simulator.

15. The training device of Claim 7, wherein the pressure sensor is external to the training device.

16. A method for training health service providers in hemorrhage control, the method comprising:

receiving wound simulation data that identifies a target force;

receiving, on a computing device, pressure data including a compression force from a pressure sensor;

comparing the compression force with the target force; and

indicating, on the computing device, a deviation from the target force based on the comparison.

17. The method of claim 16, wherein the deviation is indicated via at least one of a physical cue, an auditory cue, or a visual cue.

18. The method of claim 16, wherein computing device comprises a smart phone including a pressure monitoring application.

19. The method of claim 16, further comprising

tracking a compression time during which the compression force is applied; and

indicating a deviation from a target time based on a comparison of the compression time with the target time.

20. A non-transitory computer storage having stored thereon instructions that, when executed by a computer system having computer storage, cause the computer system to perform operations comprising:

receiving wound simulation data that identifies a target force;

receiving pressure data including a compression force from a pressure sensor;

comparing the compression force with the target force; and

indicating a deviation from the target force based on the comparison.

21. The non-transitory computer storage of Claim 20, wherein the deviation is indicated via at least one of a physical cue, an auditory cue, or a visual cue.

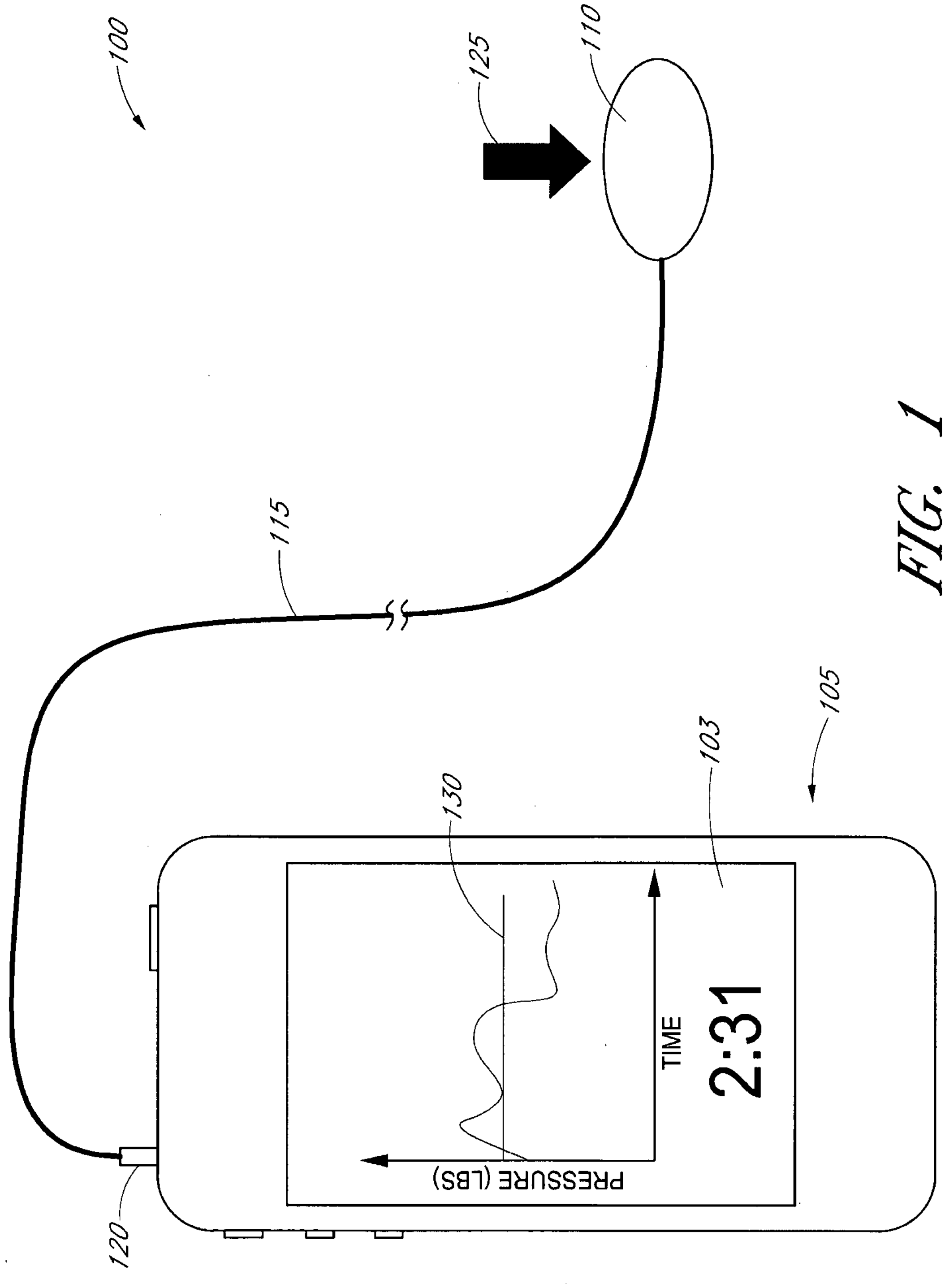


FIG. 1

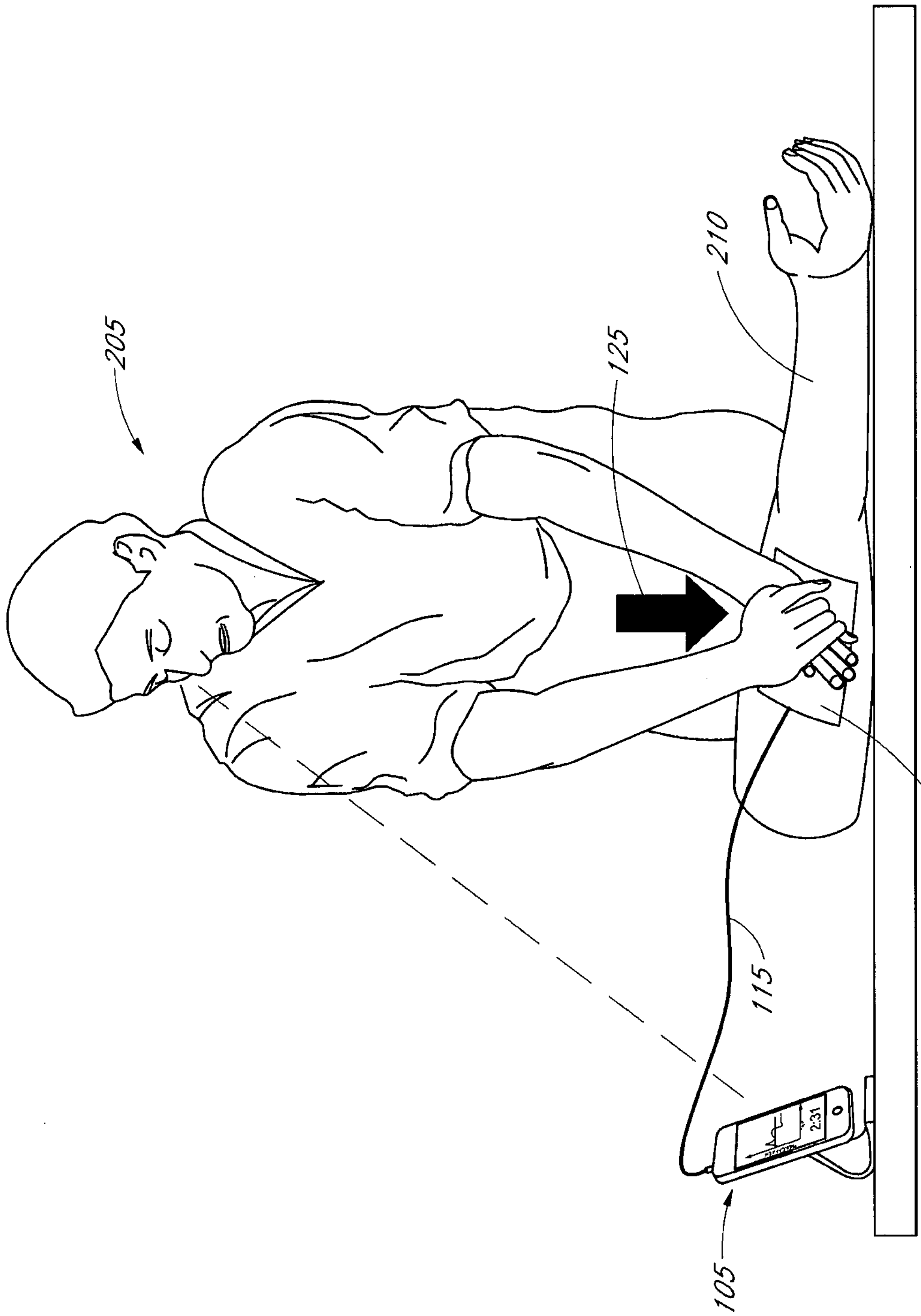


FIG. 2

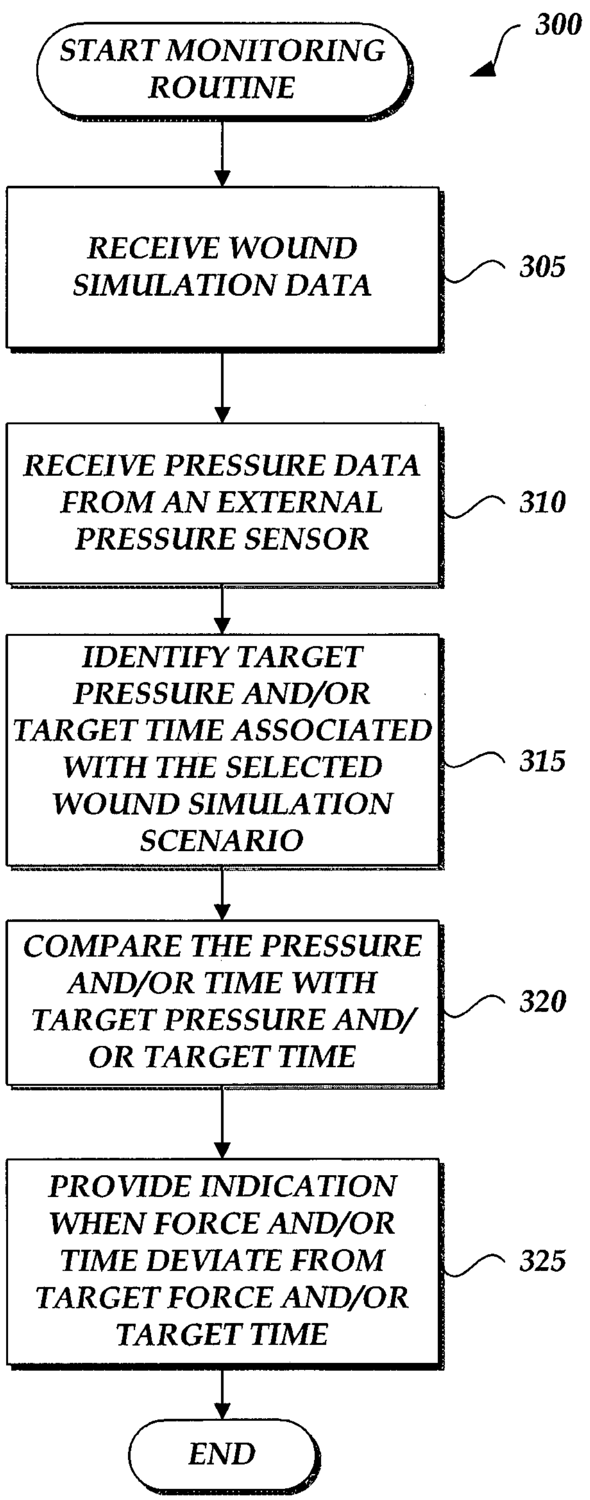

300
START MONITORING ROUTINE
RECEIVE WOUND SIMULATION DATA
305
RECEIVE PRESSURE DATA FROM AN EXTERNAL PRESSURE SENSOR
310
IDENTIFY TARGET PRESSURE AND/OR TARGET TIME ASSOCIATED WITH THE SELECTED WOUND SIMULATION SCENARIO
315
COMPARE THE PRESSURE AND/OR TIME WITH TARGET PRESSURE AND/ OR TARGET TIME
320
PROVIDE INDICATION WHEN FORCE AND/OR TIME DEVIATE FROM TARGET FORCE AND/OR TARGET TIME
325
END

Fig. 3

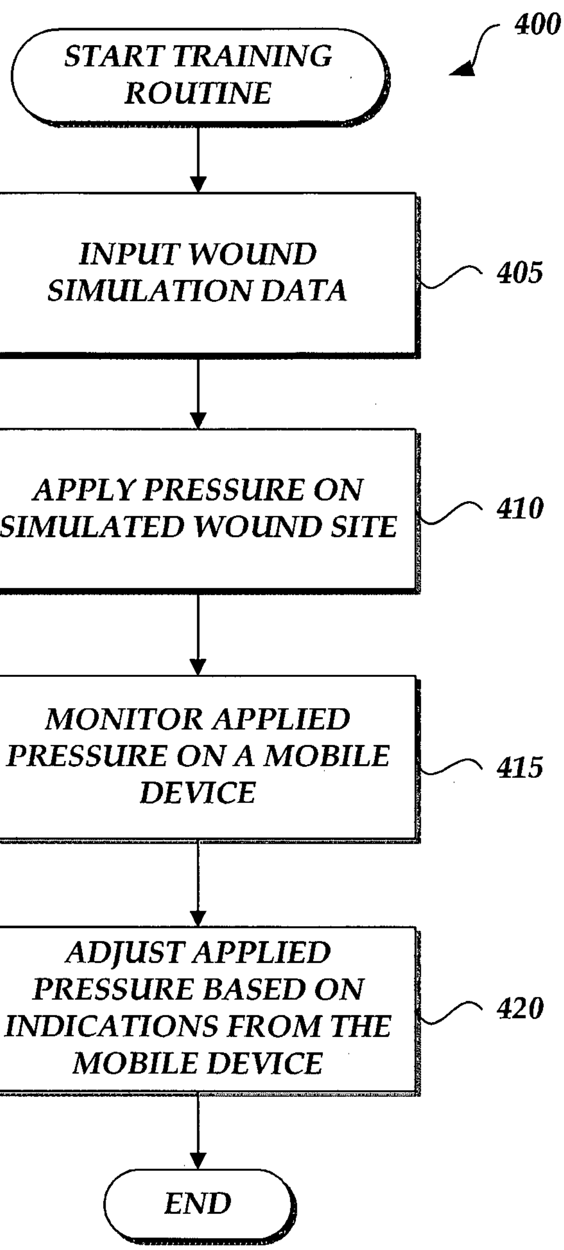

400
START TRAINING ROUTINE
INPUT WOUND SIMULATION DATA
405
APPLY PRESSURE ON SIMULATED WOUND SITE
410
MONITOR APPLIED PRESSURE ON A MOBILE DEVICE
415
ADJUST APPLIED PRESSURE BASED ON INDICATIONS FROM THE MOBILE DEVICE
420
END

Fig. 4

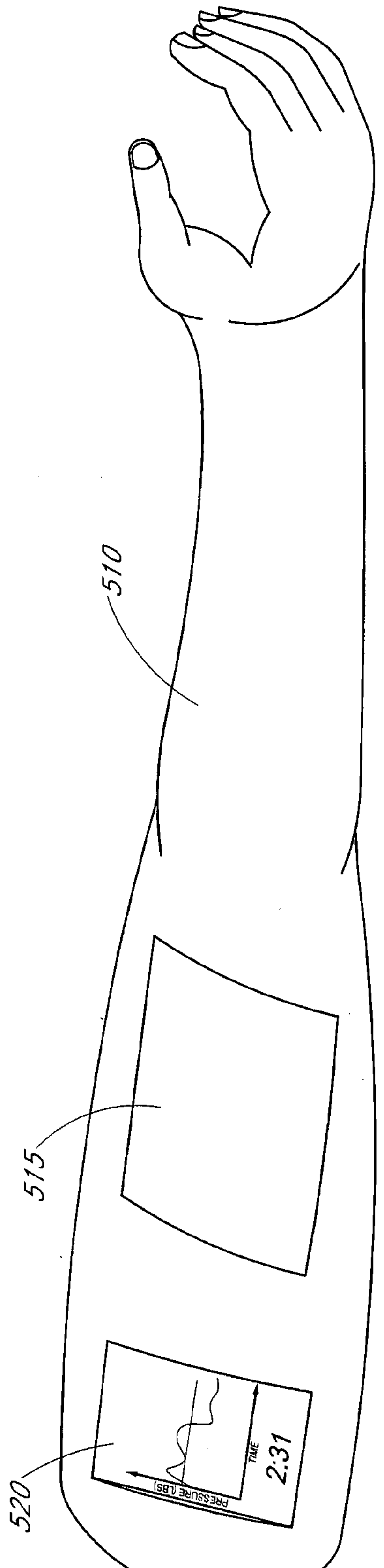


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/060915

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - G09B 23/30 (2014.01)
USPC - 434/267
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - G09B 23/00, 23/28, 23/30, 23/32, 23/34 (2014.01)
USPC - 434/262, 267, 268, 269

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC - G06F 19/3437; G09B 23/00, 23/28, 23/30, 23/303 (2013.01)

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US 2009/0011394 A1 (MEGLAN et al) 08 January 2009 (08.01.2009) entire document	1, 4, 5, 7-11, 14-17, 19-21 -- 2, 6, 12, 18
Y	US 2008/0131855 A1 (EGGERT et al) 05 June 2008 (05.06.2008) entire document	2, 6, 12, 18
A	US 2010/0079395 A1 (KIM et al) 01 April 2010 (01.04.2010) entire document	1-21
A	US 2012/0045742 A1 (MEGLAN et al) 23 February 2012 (23.02.2012) entire document	1-21
A	US 6,638,073 B1 (KAZIMIROV et al) 28 October 2003 (28.10.2003) entire document	1-21

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
05 February 2014	18 FEB 2014

Name and mailing address of the ISA/US	Authorized officer:
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

(19) 中华人民共和国国家知识产权局

(12) 发明专利申请

(10) 申请公布号 CN 104641407 A
(43) 申请公布日 2015.05.20

(21) 申请号 201380048710.5
(22) 申请日 2013.09.20
(30) 优先权数据
61/704379 2012.09.21 US
(85) PCT国际申请进入国家阶段日
2015.03.19
(86) PCT国际申请的申请数据
PCT/US2013/060915 2013.09.20
(87) PCT国际申请的公布数据
WO2014/047436 EN 2014.03.27
(71) 申请人 Z- 医疗有限责任公司
地址 美国康涅狄格州
(72) 发明人 R·休伯纳
(74) 专利代理机构 北京泛华伟业知识产权代理有限公司 11280
代理人 王勇 李科

(51) Int. Cl.
G09B 23/30(2006.01)

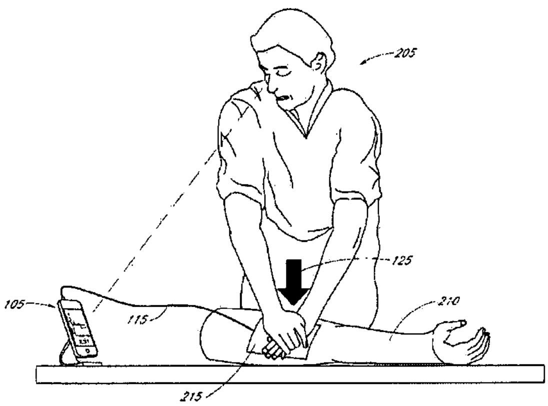
权利要求书2页 说明书9页 附图4页

(54) 发明名称

用于达成出血控制训练的系统和方法

(57) 摘要

本发明的用于出血控制的作业监控系统的实施例，针对受训者施加于模拟伤口上的力向受训者提供实时的或接近实时的反馈。在一些实施例中，所述作业监控系统包括移动设备、压力传感器以及在所述移动设备上运行的软件应用程序（“app”）。所述作业监控系统使所述受训者（例如医师、医生、护士或其他保健工作者）得以练习在模拟伤口上在限定的时间段施加恰当的力，训练保健服务提供者的肌肉记忆以在恰当的持续时间内施加恰当的压力。



CN 104641407 A

1. 一种用于出血控制的训练系统，所述系统包括：

伤口模拟器，所述伤口模拟器在伤口部位具有压力传感器；以及

计算机软件应用程序，所述计算机软件应用程序包括一个或多个子例程，所述应用程序用来：(a) 监测来自所述压力传感器的压力；(b) 将所述压力与目标力比较；以及 (c) 基于所述比较来指示与所述目标力的偏离或接近。

2. 一种用于出血控制的训练系统，所述系统包括：

伤口模拟器，所述伤口模拟器在伤口部位具有压力传感器；以及

移动设备，所述移动设备包括：

连接到所述压力传感器的数据端口；

监测模块，所述监测模块用来监测在所述数据端口上从所述压力传感器接收的压力数据；以及

设备输出装置，所述设备输出装置用来在所述压力数据偏离目标压力时提供指示。

3. 根据权利要求 1 所述的训练系统，其中所述数据端口是改变用途的音频插口。

4. 根据权利要求 1 所述的训练系统，其中所述设备输出装置包括显示器、扬声器或振动器件中的至少一者。

5. 根据权利要求 1 所述的训练系统，其中所述指示包括身体提示、听觉提示或视觉提示中的至少一者。

6. 根据权利要求 1 所述的训练系统，其中所述移动设备是智能电话，所述智能电话包括压力监测应用程序。

7. 一种用于出血控制的训练装置，所述训练装置包括：

压力信号接收器，所述压力信号接收器用来从压力传感器接收包括压力的压力数据；以及

一个或多个处理器，所述处理器用来：

(a) 监测来自所述压力传感器的所述压力；

(b) 将所述压力与目标力比较；以及

(c) 基于所述比较来指示与所述目标力的偏离或接近。

8. 根据权利要求 7 所述的训练装置，其中所述一个或多个处理器还用来：

跟踪其间所述压力被施加的施压时间；以及

基于所述施压时间与目标时间的比较来指示与所述目标时间的偏离。

9. 根据权利要求 7 所述的训练装置，还包括用来提供对所述偏离的指示的设备输出装置。

10. 根据权利要求 9 所述的训练装置，其中所述设备输出装置包括显示器、扬声器或振动器件中的至少一者。

11. 根据权利要求 9 所述的训练装置，其中所述指示包括身体提示、听觉提示或视觉提示中的至少一者。

12. 根据权利要求 7 所述的训练装置，其中所述训练装置是智能电话，所述智能电话包括压力监测应用程序。

13. 根据权利要求 12 所述的训练装置，其中所述压力信号接收器是所述智能电话上的音频端口。

14. 根据权利要求 7 所述的训练装置，其中所述训练装置内设于伤口模拟器中。

15. 根据权利要求 7 所述的训练装置，其中所述压力传感器在所述训练装置的外部。

16. 一种培训保健服务提供者练习出血控制的方法，所述方法包括：

接收确定目标力的伤口模拟数据；

在计算装置上接收来自压力传感器的包括压力的压力数据；

将所述压力与所述目标力比较；以及

在所述计算装置上基于所述比较指示与所述目标力的偏离。

17. 根据权利要求 16 所述的方法，其中所述偏离经由身体提示、听觉提示或视觉提示中的至少一者指示。

18. 根据权利要求 16 所述的方法，其中计算装置包括智能电话，所述智能电话包括压力监测应用程序。

19. 根据权利要求 16 所述的方法，所述方法还包括：

跟踪其间所述压力被施加的施压时间；以及

基于所述施压时间与目标时间的比较来指示与所述目标时间的偏离。

20. 一种非瞬时性计算机存储器，所述计算机存储器上存储有指令，当被具有计算机存储器的计算机系统执行时所述指令使得所述计算机系统进行操作，所述操作包括：

接收确定目标力的伤口模拟数据；

从压力传感器接收包括压力的压力数据；

将所述压力与所述目标力比较；以及

基于所述比较来指示与所述目标力的偏离。

21. 根据权利要求 20 所述的非瞬时性计算机存储器，其中所述偏离经由身体提示、听觉提示或视觉提示中的至少一者指示。

用于达成出血控制训练的系统和方法

技术领域

[0001] 本发明整体涉及训练装置，并且更具体地讲，涉及用于训练使用者进行身体动作的装置。

背景技术

[0002] 在日常生活中，人们进行许多需要特定移动和程序的身体作业。在一些情况下，这些活动涉及某些技巧，这些技巧必须经过一段时间学会，以使人能一直很好地进行所述活动。在一些处境中，在某些作业中因为一些关键因素（例如人体受伤或高昂费用）而可能难以训练人员，在每次进行这些作业时甚至在训练练习中冒风险。在训练过程中所犯的错误可能是非常令人遗憾的。为了减少这种风险，模拟训练可帮助人在第一次进行实际作业之前提高作业技能，或可帮助人持续地改进作业所涉及的技能。

[0003] 在一个例子中，可能需要特定训练的作业是正确处理严重出血的伤口。在很多情况下，动物（包括人类）可能会受伤。出血常与这样的伤口相关。在一些情况下，伤口和出血是轻微的，只需施用简单的急救和人体正常的凝血功能即可。不幸的是，在其它情况下可能发生大量出血。这些情况可能需要专门设备和材料，以及受过培训的人员来给予适当的救助。如果没有易得的此类救助，可能发生失血过多。此外，在偏远地区或在诸如战场之类的环境中可能时常会遭受严重创伤，这些情况下充分的医疗援助不能立即获得。在这些情况下，可能非常有用的是，对人员进行训练来止血足够长的时间以使受伤（即使在伤口不太严重的场合）的人或动物能得到认真的医疗照护。

发明内容

[0004] 训练装置和系统可包括第一接触部分，受训者在该第一接触部分上进行一个或多个可使用一个或多个标准测量或评分的身体动作；以及第二反馈部分，该第二反馈部分提供关于由受训者进行的身体动作的信息。在一些实施例中，模拟系统可包括呈被模拟物形式的接触部分，例如真人大小的人体模型或部分人体模型或印模，在该被模拟物上进行模拟活动。被模拟物可包括诸如关节灵活性等性能以易于放置在各种环境中。在一些实施例中，伤口模拟器可复制救助者可能面对的广泛范围的真实创伤情形，并可用来演示和教导正确的急救技术。

[0005] 根据一些实施例，用于出血控制的作业监控系统可置于与被模拟物通信以向受训者提供有关正确进行止血的一个或多个方面的实时或历史反馈。例如，在一些实施例中，受训者施加在模拟伤口上的力和／或时间的反馈可被提供给受训者。在一些实施例中，作业监控系统包括移动设备、压力传感器以及在该移动设备上运行的软件应用程序（“app”）。移动设备可用来从压力传感器接收压力数据。应用程序可从压力传感器读取压力数据，并可将力和／或时间以图形方式显示在屏幕上，对受训者用来施用敷料、压迫绷带或其它止血材料到伤口上的恰当压力和／或时间提供图形反馈和／或音频反馈，或其它指示。所有提及的本文描述的应用程序的功能、特征和／或逻辑结构可以涉及任何其它类型的计算机

或电子处理系统，包括但不限于台式或笔记本电脑或模拟系统中的机载处理装置。

[0006] 作业监控系统可在用于控制出血的正确程序方面向受训者提供有价值的反馈。控制出血的常见方法是将敷料放置在出血的伤口上，然后在敷料上用手施压足够长的时间。这可能是在临床环境下（例如，在医院和或其它治疗设施中）以及其它环境下如在野外（例如，在战场或救护车中），或其它紧急护理的环境下进行。不同的伤口类型可能需要不同程度的人工压力和施压时间。如果用力过轻，则不能控制出血的风险较高。如果用力过大和／或施压时间过长，可引起如动脉阻塞（一种动脉中血凝块）等并发症。

[0007] 因此，可能有用的是训练护理者掌握正确的技术，使用适量的力持续各种时间来控制各种类型伤口上的各种类型的出血。基于反馈的训练方法可以培养护理者的肌肉记忆，以在一定的持续时间保持恰当的力。本文描述的作业监控系统的实施例可使护理者在模拟出血伤口上练习在限定的时间段施加适力量，以教导受训者如何在恰当的持续时间内施加恰当的压力。

附图说明

[0008] 在整个附图中，附图标记可以被重复使用以表示被参照要素之间的一致性。提供附图来图示本文描述的示例性实施例，无意用来限制本发明的范围。

[0009] 图 1 示出用于监控由受训者随时间推移施加在模拟伤口部位的力的作业监控系统 (TMS) 的一个实施例。

[0010] 图 2 示出与模拟身体部分一起使用图 1 的作业监控系统的一个实例。

[0011] 图 3 示意性地示出监控由受训者随时间推移施加在模拟伤口部位的压力的监控过程的逻辑流程图的一个实例。

[0012] 图 4 示意性地示出受训者学习用于出血控制的正确技术的训练过程的逻辑流程图。

[0013] 图 5 示出一例接触部分或被模拟物，其内整合有反馈部分。

具体实施方式

[0014] 训练系统可给受训者提供关于进行作业的正确程序的有价值的反馈。在一些实例中，作业监控系统使保健服务提供者（例如医师、医生、护士或其他保健工作者）得以练习在模拟的出血伤口上在特定时间段内施加适当范围的力，训练保健服务提供者在恰当的时间间隔施加恰当的压力范围。

[0015] 图 1 示出用于监控由使用者在模拟伤口部位上施加的力的作业监控系统 (TMS) 100 的实施例。作业监控系统 100 可包括计算装置，该计算装置包括一个或多个处理器和计算机存储器、压力传感器 110、在压力传感器与计算装置之间的通信链路 115，以及用于自压力传感器接收电子信号（包括压力数据）的压力信号接收器 120。

[0016] 在一些实例中，作业监控系统 100 可用于训练使用者或受训者使伤口停止出血的正确技术。一般来讲，不同的伤口可能需要不同力量和／或在不同的时长下施加力。在一些情况下，针对一个伤口的力量可能需要随时间推移而变化。例如，当第一次试图阻止伤口出血时可能需要较大的力，但当出血变慢时所需的力就可以减小。因此，作业监控系统 100 可用来训练受训者使用恰当的力量（包括变化的力）和／或持续时间。在一些伤口类型中，

如在经皮冠状动脉介入治疗的桡侧进入 (radial access) 后的手腕上的伤口部位 (access site)，施加于伤口上的恰当力量可为至少约 1 磅的力 (4.4 牛顿) 并且小于约 10 磅的力 (44 牛顿)。

[0017] 在图示实施例中，计算装置是能够运行应用程序 103 的移动设备 105(如智能电话、平板电脑等)。移动设备可包括视频显示屏幕和便携式电源。在一些实施例中，移动设备 105 包括用于接收压力数据的压力信号接收器 120。在一些实施例中，压力信号接收器 120 包括位于移动设备上的音频端口，该音频端口经改变用途以接收压力数据。在一些实施例中，压力信号接收器 120 包括数字连接器技术，例如通用串行总线 (Universal Serial Bus, USB)、火线 (FireWire) 等。

[0018] 在一些实施例中，传感器 110 使用模拟信号将压力数据连续地发送给移动设备上的音频端口。一些音频端口在输入端可具有阻止过高频率的滤波器。以此方式，在一些实施例中，将模拟信号进行频带限制，以使高频不被使用。

[0019] 在一些实施例中，音频配件可以是一个顶 - 环 - 套 (tip ring sleeve, TRS) 连接器或类似的连接器。TRS 连接器指的是通常用于模拟信号 (包括音频) 的一类连接器。它一般是圆柱形，并且它具有多个独立的电触点 (例如，典型地三个触点，虽然可以使用具有两个触点 (TS 连接器) 或四个触点 (TRRS 连接器) 的变型形式)。一个 TRS 插头 (jack) 通常插接在 TRS 插口中。对于一个三触点 TRS 连接器，这三个触点通常配接至 (map to) 左音频通道、右音频通道和地。许多移动电话使用具有四个触点的 TRRS 连接器，其配接至左、右和地，第四触点配接至麦克风。可使用多种尺寸的连接器，例如 2.5mm(如某些移动电话所用，以节省空间)、3.5mm(如用于电话，mp3 播放器等) 以及 0.25″(如用于较大的耳机、吉他等)。

[0020] 在一些实施例中，通信链路 115 包括压力传感器 110 与压力信号接收器 120 之间的有线连接。例如，线的一端可以是插接进音频端口的 TRS 插头，且线的另一端端接于与压力传感器 110 的数据接口。从压力传感器 110 的数据接口处接收到的数据随后在线上传输，并作为电子信号传入音频端口。在一些实施例中，电子信号携带压力数据，包括在伤口部位测得的压力电平。取决于实施例，电子信号可以是模拟的或数字的。在一些实施例中，通信链路 115 是无线连接，例如蓝牙 (Bluetooth)、802.11a/b/g/n、红外、射频或其它类型的连接。

[0021] 在一些实施例中，接触部分或被模拟物可包括从身体动作创建电信号的一个或多个测量变换器 (transducer)。一种测量变换器类型的例子为压力传感器 100。在一些实施例中，压力传感器 110 包括一个或多个用于测量表面上的压力的电气元件，如测力传感器 (load cell)。测力传感器通常是廉价的，从而保持作业监控系统 100 的成本较低。通常，测力传感器是用于将在测力传感器上的力转换成电信号的测量变换器。通常，这种转换是间接的，且在两个阶段发生。例如，经由一个机械结构，由测力传感器感测到的力可使应变仪变形。应变仪随后可将变形 (应变) 测量为电信号，因为应变改变了金属丝的有效电阻。

[0022] 一般而言，应变仪 (也称为应变计) 是用来测量加于物体的应变的装置。在一些实施例中，应变仪包括支撑金属薄片图案的绝缘柔性背衬。该应变仪可经由合适的粘合剂，如氰基丙烯酸酯、环氧树脂、丙烯酸树脂胶等附接到物体上。当物体变形时，金属薄片变形，导致它的电阻变化。当电导体在其不至于断裂或永久变形的弹性极限范围内受到拉伸时，

它变得更窄更长，导致它的端到端电阻增加。反之，当导体被压缩成使得它不变弯曲时，它变宽更并变短，导致它的端到端电阻降低。经由测量应变仪的电阻，所施加的应力量可从电阻推断出。

[0023] 在一些实施例中，测力传感器包括构成为惠斯通电桥（Wheatstone bridge）的四个应变仪，虽然也可以采用其它电路构型。例如，也可以是具有一个应变仪（例如四分之一桥）或两个应变仪（例如半桥）的测力传感器。从测力传感器输出的电信号通常为约几毫伏，且可能需要由仪表放大器来放大。在一些情况下，可使用具有较高功率输出的测力传感器。在一些实施例中，移动设备 105 上的应用程序或其它进程接收从测力传感器输出的电信号并至少部分地基于电信号的强度来计算施加在测力传感器上的压力。也可使用其它类型的测力传感器。其它测力传感器类型的一些实例是液压式或流体静力学测力传感器、压电式测力传感器、振弦式测力传感器以及电容测力传感器。

[0024] 此外，还可使用其它类型的压力传感器。压力传感器的一些实例包括压阻式应变仪（其中测力传感器是一种可能的类型）、电容压力传感器、电磁压力传感器、压电压力传感器、光学压力传感器、电位压力传感器、谐振压力传感器、热压力传感器、电离压力传感器等。压力传感器 110 可包括一种或多种不同的压力传感器类型，其中包括不同压力传感器类型的组合。在一些实施例中，压力传感器包括电源，如便携式电源。

[0025] 施加到压力传感器 110 上的力 125 使传感器 110 产生电子信号并传送到移动设备 105。在一些实施例中，移动设备上的应用程序 103 处理电子信号以确定由压力传感器 110 施加的当前压力。然后，应用程序可将这个当前压力与为该应用程序预设或以其他方式限定的目标压力 130 相比较。应用程序可在一个瞬间、在多个瞬间或在一段时间大致连续地确定当前压力。在一些实施例中，连续确定当前压力并且连续与目标压力 130 相比较。在一些实施例中，如果应用程序确定当前压力与目标压力不同或偏离目标压力，它将这种偏离发信号给受训者，使受训者可以修改他正在施加的压力。各种信号都可以使用，例如视觉、听觉或身体提示。例如，移动设备可产生听觉或触觉指示，如报警、闪烁或屏幕上的其它视觉提示、振动或一些其它可被人感知的信号。

[0026] 此例中，经由向受训者发送实时或接近实时的信号，应用程序有利地建立反馈环路，当受训者在施加或不在施加恰当的压力量时，该反馈环路通知受训者。在一些实施例中，应用程序只在偏差大于特定阈值时产生信号，而在一些实施例中，应用程序生成显示一段时间内的所有压力读数的信号。

[0027] 在一些实施例中，移动设备 105 包括显示屏幕，所述屏幕构成使用者反馈环路的至少一部分。显示屏幕可显示压力（例如沿垂直轴即“Y”轴）与时间（例如沿水平轴即“X”轴）的图表。在一些实施例中，显示屏幕是能够接收使用者输入（如目标力）的触摸屏。在训练期间，使用者可观察由使用者自己施加的压力和目标力之间随时间推移而变化的偏差，如果有的话。经反复练习，使用者可培养肌肉记忆来适当地控制各种出血伤口模拟。使用者可学会调节疲劳并将恰当的力保持所需要的时间。

[0028] 图 2 示出了图 1 的一例作业监控系统 100 的的使用。在此实例中，受训者 205 在使用作业监控系统 100 学习用于各种伤口的出血控制的正确技术。在图 2 中，受训者 205 在 TMS 100 监控下在模拟伤口上施加压力。施加到伤口部位并由 TMS 监控的压力可以是连续的或脉冲的压力。

[0029] 在图示实施例中，作业监控系统 100 包括在伤口模拟器 210 中或与伤口模拟器 210（例如印模或人体模型）一起操作。在一些实施例中，传感器 110 被连接到伤口模拟器的模拟伤口部位 215。传感器 110 可位于多种位置，例如在伤口模拟器内、在伤口部位下面、在伤口部位上面等。可使用许多不同类型的伤口模拟器，例如部分身体模型（例如，手臂或腿）、全身人体模型、放置在真实人类或动物身上以获得更现实模拟的伤口模型、构造等。在一些实施例中，传感器 110 可包括多个感测单元，以使传感器 110 不仅指示施加的力量，而且指示在给定区域的何处施加一个力，或多个力。这可帮助确定受训者是否将手放在适当位置和／或换言之是否在正确的位置推动。

[0030] 在一些实施例中，无论是供模拟情况下或供实际止血作业中使用，包括传感器 110 的组件可例如经由使用黏贴物、吸盘、带子或其他临时保持装置以可拆卸的方式直接设置在身体部分上或邻近身体部分处，以帮助确保以治疗有效的时间范围施加恰当范围的压力。在一些应用中的传感器 110 可以足够薄以适配于真实出血伤口使用的绷带的折叠之间。传感器 110 可为一次性的或可带有一次性覆盖物。

[0031] 在一些实施例中，作业监控系统 100 提供用于需要不同程度的压力和／或时间的多种伤口类型的训练。例如，移动设备 105 上的应用程序 103 可包括用于选择或指定与伤口相关的参数，如伤口的大小、位置、血流和／或类型的选择屏幕。基于这些参数，应用程序 103 可选择针对伤口的目标压力和／或目标时间。在一些实施例中，应用程序 103 允许使用者经由指定目标值直接选择或提供目标压力和／或目标时间。在其它实施例中，对于各种伤口类型创建不同的应用程序或设备，使得每一个特定的伤口类型的应用程序或设备都具有针对该特定伤口预设的目标压力和／或目标时间。

[0032] 在所示出的实例中，受训者 205 正在接受针对特定伤口类型的正确技术的训练。移动设备 105 用来监测受训者并确定受训者 205 是否以目标压力电平和／或目标时间施加压力。移动设备 105 可放置在托架上、附接到表面或安装座，或以其它方式配置，使得移动设备 105 的显示器可被受训者或教员或两者观看。当受训者在模拟伤口部位 215 施加力 125 时，伤口部位的压力传感器向移动设备 105 发送电子信号（例如经由导线 115 或其它通信链路），所述信号包括压力数据。移动设备 105 可根据压力数据确定当前压力电平。移动设备 105 还可随时间推移跟踪瞬时压力电平读数。

[0033] 在一些实施例中，移动设备 105 在它的显示器上提供压力电平读数的曲线或其他数据表示，以使受训者或教员（或两者）都可看到实时数据、训练完成后的数据或两种数据的显示。例如，如果当前压力太高，则图上的当前压力线可移动到高于目标压力线 130，或如果压力太低，则当前压力线可移动到低于目标压力线 130。在一些实施例中，第一符号（如“向上”箭头）可指导受训者施加较小压力，第二符号（如“向下”箭头）可指导受训者施加较小压力，而第三符号可向受训者指示压力的量大致合适。

[0034] 在一些实施例中，应用程序还可关于如何进行作业或如何以更好方式进行作业提供建议和指令。指令可随着某些作业的完成被系列地提供，或可由使用者或受训者以任何顺序访问查看。在一些实施例中，当需要时可给出适当指令来帮助受训者纠正动作，或可提供提示或暗示来帮助受训者回忆某些步骤。所述指令还可在进行实际的作业（而不是作业的模拟版本）时被访问。在一些实施例中，可由处理器将指令或反馈以可听见的声音读出或播报给受训者以避免受训者分心，因为受训者的眼睛可能主要集中于进行的作业上。

[0035] 通过向受训者提供他是否在施加恰当压力的反馈，受训者能更好地学习针对伤口的正确技术。此外，可向受训者提供附加的或可选形式的反馈以在受训者偏离正确技术时进行指示。如上所讨论，使用者反馈可包括可指示正确或不正确技术的视觉、听觉或身体提示。在一些实施例中，此类提示至少部分地基于偏离目标值（例如时间和／或压力）的程度。例如，移动设备 105 可振动或发出强度基于与目标值的偏差而增加的音调或其他声音，以鼓励受训者采用正确技术从而使发出的声音最小化。在另一实例中，随受训者进一步偏离或接近目标值，移动设备 105 的显示器会开始更迅速地闪烁，或可渐进地显示不同等级的亮度和／或不同的颜色（例如绿色、橙色、红色等）。在另一实例中，压力传感器可包括蜂鸣器或振动器件使得受训者被给予身体反馈（例如经由他在伤口上的手），该身体反馈基于偏离或接近的程度而增大或减小。

[0036] 经由提供至少部分地基于偏离或接近目标值的提示，作业监控系统 100 可向受训者提供受训者需要采用的动作纠正量的指示。例如，与提示给出低偏差时相比，当提示给出高偏差时，受训者会知道在伤口部位 215 上按压更大的压力或更减轻按压的压力。因此，受训者可更快速地返回到正确的技术。

[0037] 在一些实施例中，作业监控系统 100 提供至少部分地基于受训者是否施加了过大压力或过小压力的提示。例如，如果压力过小，则移动设备 105 的显示器可闪烁红色，而如果压力过大，则显示器可闪烁蓝色。在另一实例中，根椐压力是过低还是过高可播放不同的声音。在另一实例中，根椐压力是过低还是过高可采用不同的振动模式。

[0038] 在一些实施例中，作业监控系统 100 所用的目标值是一系列的值而不是单一值。对于此类实施例，作业监控系统 100 可能只在测量值落在目标值范围之外时提供一个特别提示。

[0039] 作业监控系统 100 可随时间推移跟踪受训者施加的压力。经过一定时间，受训者完成在特定技术所需要的时间长度内施加压力，于是训练期结束。在一些实施例中，移动设备 105 通过提示（例如视觉、听觉、身体等）向受训者指示训练期结束。如果受训者希望再练习该技术，那么该受训者可重新开始该训练期。在一些实施例中，移动设备 105 会自动开始新的训练期直到完成指定量的训练期。例如，训练期可重复 2 次、3 次、4 次或更多次以便培养受训者的肌肉记忆。在一些实施例中，移动设备 105 在训练期之间暂停以给受训者提供休息时间。在一些实施例中，直到各个模拟结束以后才将恰当时间透露给受训者，以让受训者学会用脑估计何时已到恰当的时间量。在一些实施例中，受训者或指导者可在应用程序的设置之间切换，以随着时间流逝显示或仅在模拟结束后显示时间，这取决于受训者是仍在学习恰当的持续时间还是已学到恰当的持续时间并正在寻求不查看经过时间来检验其估计技能。

[0040] 图 3 示意性地示出监控过程 300 监控由使用者向伤口模拟器施加压力的逻辑流程图。在一些具体实施中，该过程通过参照图 1 描述的作业监控系统 100 的实施例进行，或由系统 100 的另一部件执行，例如移动设备 105 或在移动设备 105 上操作的应用程序 103。为便于解释，以下描述由移动设备 105 执行的过程。所述过程在旨在说明而非限制作业监控系统 100 的各个方面的示例的语境中讨论。

[0041] 从方框 305 开始，移动设备 105 接收伤口模拟数据，如选择多个伤口模拟之一或一些其它的模拟参数。在一些实施例中，移动设备 105 包括针对不同伤口类型的多种场景的

设置。移动设备 105 可向使用者提供选择屏幕，在该屏幕中使用者可选择特定训练情形。在一些实施例中，移动设备 105 允许使用者输入模拟参数，例如施加的目标力和 / 或施加压力的目标时间。在一些情况下，所述系统可被配置成使得使用者可训练施加恰当的力，且仅设置目标力。在一些情况下，使用者可训练施加力的恰当时间，并仅提供目标时间。在一些情况下，使用者可以训练如何施加恰当的力达恰当的时间量，并设置目标力和目标时间这两者。移动设备 105 可将这些值（例如力和 / 或时间）存储在存储器中以供将来参考。

[0042] 在方框 310，移动设备 105 从压力传感器 110 接收压力数据。如上所讨论，压力数据可以通过通信链路来接收，例如有线或无线链路。在方框 315，移动设备 105 识别与选定类型的伤口模拟相关联的目标压力和目标时间。目标压力和目标时间可为预先设定的与场景相关联的参数，或可已被使用者输入到移动设备中。在方框 320，移动设备 105 将测量的压力和 / 或施加压力的时间与目标压力和 / 或目标时间相比较。在方框 325，当力和 / 或时间偏离目标力和 / 或目标时间时，移动设备 105 提供指示。在一些实施例中，当所述值偏离目标时，移动设备 105 给出提示。然后所述过程可结束。

[0043] 在一些情况下，移动设备 105 记录来自训练期的数据，所述数据可供使用者将来参考。例如，移动设备 105 可使用该数据来生成关于使用者如何接近地满足目标值的报告。在一些实施例中，移动设备 105 可生成指示使用者如何接近地满足目标值的分数。该应用程序还可从多个使用者汇集数据，以使训练指导者可确认可能影响教学方法的趋势。该应用程序还可被配置成可接收和存储关于受训者的识别数据（例如，名字和 / 或人员编号）并将关于在进行特定模拟活动或系列作业时特定人员的成功或失败的能力证实信息传送到计算机系统。

[0044] 图 4 示意性地示出使用者学习用于出血控制的正确技术的训练过程 400 的逻辑流程图。在一些具体实施中，由作业监控系统 100 的使用者进行所述过程。为了易于说明，以下描述为使用者与作业监控系统 100 的移动设备 105 进行交互，但是，在其它实施例中，使用者可与作业监控系统 100 的其他部件进行交互。所述过程在旨在说明而非限制训练过程的各个方面的示例场景的语境中讨论。

[0045] 从方框 405 开始，使用者将伤口模拟数据输入作业监控系统 100 的移动设备 105，例如选择伤口模拟场景或模拟参数。移动设备 105 可将这些参数值（例如力和 / 或时间）存储在存储器中以供将来参考。在方框 410，使用者将压力施加到伤口模拟器上的模拟伤口部位。在一些实施例中，伤口部位的压力传感器将压力数据发送到移动设备 105。在方框 415，使用者经由移动设备 105 监控他施加到伤口部位的压力。例如，移动设备 105 可显示曲线图或提供所施加的压力如何匹配目标值的其它指示。在方框 420，使用者至少部分地基于来自移动设备 105 的指示来调整所施加的压力。例如，移动设备 105 可提供听觉、视觉或身体提示，如果偏离，它们用来指示使用者偏离了目标值和 / 或使用者偏离的程度，从而形成使用者反馈环路。使用者可根据这些指示调整他施加的压力。所述指示可由移动设备直接提供（例如在内置显示器或扬声器上）或间接提供（例如在外部显示器、扬声器或振动器件上）。训练期可在限定时间后结束。在一些情况下，使用者可重复该过程以接受更多训练。

[0046] 可使用许多版本的作业监控系统 100。例如，虽然本发明将系统 100 一般地描述为包括移动设备 105，但在一些实施例中，作业监控系统 100 包括台式计算机、终端或其他固

定计算装置，它们进行的功能类似于移动设备 105。

[0047] 图 5 示出一个作业监控系统的实施例，它内设于伤口模拟器 510 中或整合于伤口模拟器 510 上或伤口模拟器 510 内。例如，如图 5 中所示，伤口模拟器 510 可包括计算装置和显示器 520，计算装置和显示器 520 进行类似于图 1 的移动设备 105 的功能。计算装置可与压力传感器通信，而后者可位于模拟伤口部位 515。

[0048] 在一些实施例中，伤口模拟器可被构造成可模拟血液从伤口流出（例如通过喷出红色液体），并且作业监控系统 100 可被构造成根据受训者施加的压力量来控制血流。例如，如果受训者已对伤口施加了恰当的压力，则系统 100 可使伤口模拟器停止喷出模拟血液。在一些情况下，系统 100 会增加模拟器的出血量，例如，如果受训者施加了错误的压力（例如，在伤口上按压太用力导致进一步出血或用力太轻不足以止血）。

[0049] 作业监控系统 100 的其它变型也是可能的。例如，尽管上述实施例明确描述用于出血控制的训练方法，作业监控系统 100 还可用于其他情形，例如在训练过程中需要对力进行测量的其他类型的模拟中。例如，作业监控系统 100 的实施例可用来培训人学会心肺复苏术 (CPR) 或哈姆立克急救法 (Heimlich maneuver)。可使用许多其他类型的应用和模拟活动。

[0050] 在一些实施例中，在伤口实际治疗中可由医务人员使用作业监控系统 100。例如，压力传感器可被施用或附接到压迫绷带或敷料上。在实际治疗中，系统 100 监测压力传感器，并且当不恰当的压力被施加到伤口上时向医务人员指示。

[0051] 除了上文所述的以外，作业监控系统 100 和使用者之间也可以（附加地或替代地）有其他类型的交互。例如，使用者可以通过其它装置将数据输入作业监控系统 100 或控制作业监控系统 100，所述其它装置例如键盘、鼠标或遥控器。

[0052] 在一些实施例中，作业监控系统 100 可用一个或多个计算装置（例如若干个互连的装置）来实施。因此，在作业监控系统 100 中描述的部件各自可包括硬件和 / 或软件，以实施各种性能。

[0053] 在许多实施例中，作业监控系统 100 可被配置为与图中所示不同。例如，由所示出的模块提供的各种功能可被组合、重新配置、添加或删除。在一些实施例中，另外的或不同的处理器或模块可以执行结合上文所述的图中示出的示例性实施例描述的功能的一些或全部。可以有许多实施变型形式。

[0054] 在一些实施例中，作业监控系统 100 及其部件是由一个或多个计算装置执行或实施。例如，在一些实施例中，可使用包括中央处理单元 (CPU)、输入 / 输出 (I/O) 部件、保存和存储器部件的计算装置来执行作业监控系统 100 的一些或全部过程。I/O 部件可包括显示器（例如触摸屏）、至网络 105 的网络连接、计算机可读介质驱动和其它 I/O 装置（例如键盘、鼠标、扬声器、触摸屏等）。在一些实施例中，作业监控系统 100 可被配置为与以上描述的不同。

[0055] 作业监控系统 100 的部件可作为一个或多个可执行程序模块储存在计算装置的存储器中和 / 或其他类型的非瞬时性计算机可读存储介质上，并且该作业监控系统 100 可经网络或其它通信链路与计算资源交互。在一些实施例中，作业监控系统 100 可具有比以上描述更多或比更少的部件。

[0056] 前面部分中描述的过程、方法和算法可各自体现在代码模块中，并且被代码模块

完全或部分地自动化，所述代码模块由一个或多个计算机、计算机处理器或被配置为执行计算机指令的机器执行。代码模块可存储在任何类型的非瞬时性计算机可读存储介质或有形的计算机存储装置上，例如硬盘驱动器、固态存储器、光盘和／或类似物。过程和算法可部分地或全部地在专用电路中实施。所公开的过程和方法步骤的结果可以被持久地存储或以其他方式存储在任何类型的非瞬时性计算机存储器（例如易失性或非易失性存储器）中。

[0057] 以上描述的各种特征和过程可被彼此独立地使用，或以各种方式加以组合。所有可能的组合和子组合都旨在落入本发明的范围之内。此外，在一些具体实施中，某些方法、事件、状态或过程的方框可被省略。本文描述的方法和过程也并不限于任何特定的顺序，并且与其相关的方框或状态可以适当的其他顺序来执行。例如，所描述的任务或事件可以不同于具体公开的顺序来执行，或多个任务可组合在单个方框或状态中。示例的任务或事件可以串行方式、并行方式或以一些其它方式来执行。可在所公开的示例性实施例中添加或去除任务或事件。本文所述的示例性系统和部件可被构造为与所描述的不同。例如，与所公开的示例性实施例相比，可添加、去除或重新配置要素。

[0058] 本文所用的条件性语言，例如（除其他以外）“能”、“可”、“可能”、“可以”、“例如”等等，除非另外特别说明，或换言之理解为语境内所使用的含义，一般旨在传达在某些实施例中包括某些特征、要素和／或步骤，而在其它实施例中不包括。因此，这种条件性语言一般不旨在暗示一个或多个实施例以任何方式需要特征、要素和／或步骤，或一个或多个实施例必须包括用于决定（在有或没有作者的输入或提示的情况下）这些特征、要素和／或步骤包括在任何特定实施例中或在任何特定实施例中执行的逻辑。术语“包含”、“包括”、“具有”等是同义的，并被以开放的形式包容性地使用，且不排除其它要素、特征、动作、操作等等。另外，术语“或”以其包容性意义（而非其排他性意义）使用，使得在用来（例如）连接一系列要素时，术语“或”是指该系列要素中的一个、一些或全部。结合性语言，例如短语“X、Y 和 Z 中至少一个”，除非特别声明，否则用通常使用的语境来理解，其是表达项目、条件等可能是 X、Y 或 Z 的任一个。因此，这种结合性语言通常不旨在暗示某些实施例中针对每一个要求至少一个 X、至少一个 Y 以及至少一个 Z 存在。

[0059] 虽然已描述某些示例性实施例，但这些实施例仅以举例的方式呈现，并且不旨在限制本文所公开的本发明的范围。因此，前文所述完全不旨在暗示任何特定的特征、特性、步骤、模块或方框是必需的或不可缺少的。实际上，本文所述的新颖的方法和系统可以体现在多种其它形式中。此外，在不脱离本文所公开的发明的精神的情况下，可对本文所述的方法和系统的形式做出各种省略、替换和改变。

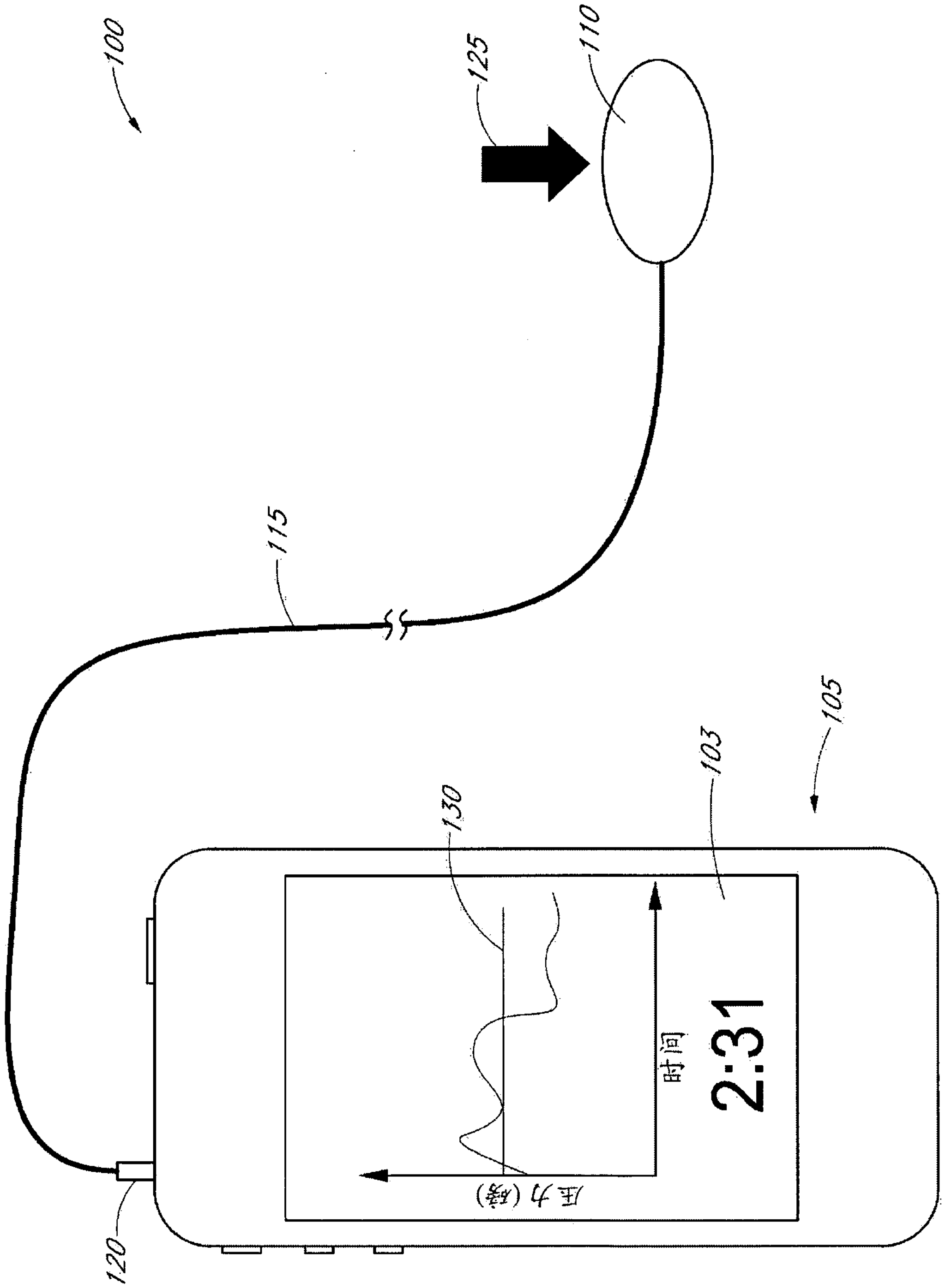


图 1

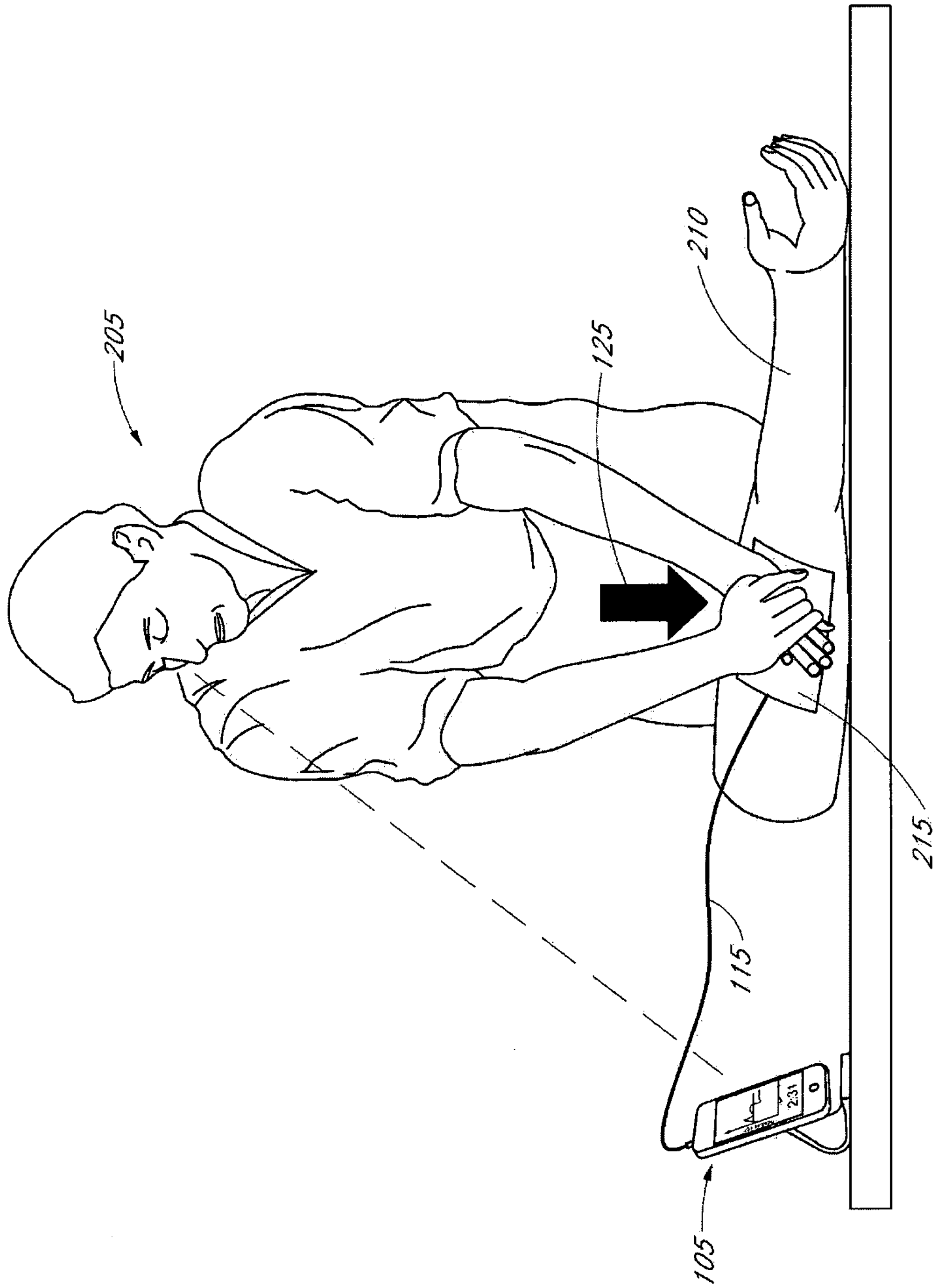


图 2

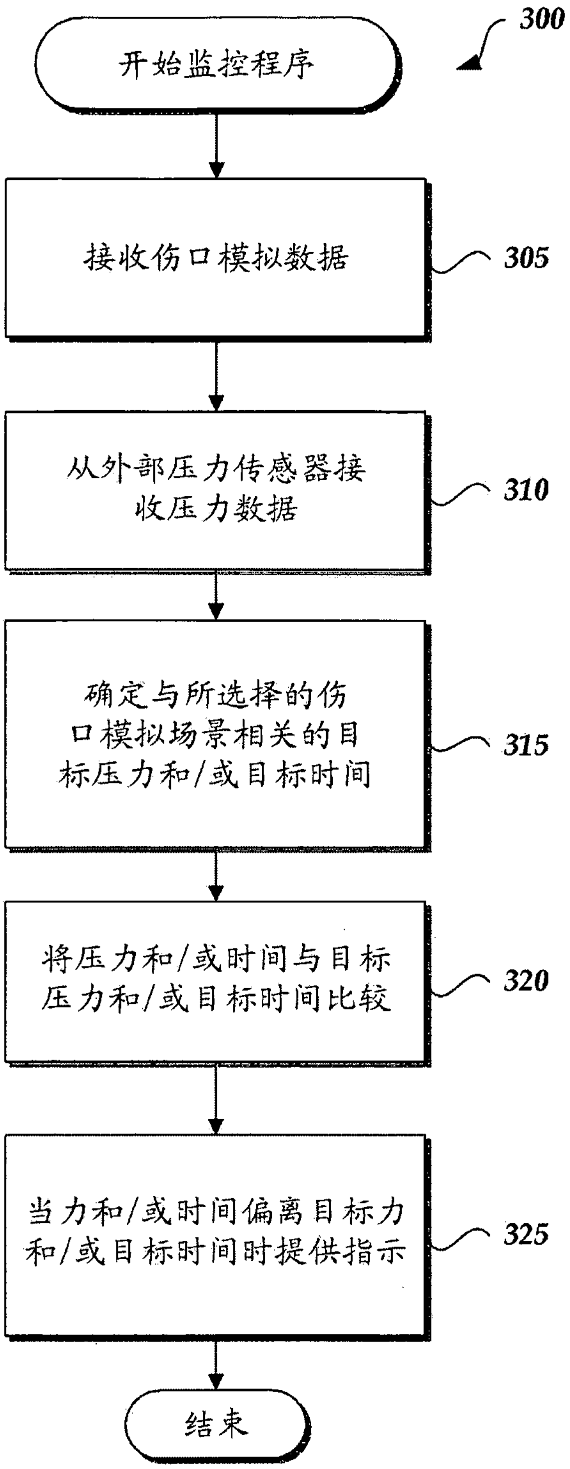

300
开始监控程序
接收伤口模拟数据
305
从外部压力传感器接收压力数据
310
确定与所选择的伤口模拟场景相关的目标压力和/或目标时间
315
将压力和/或时间与目标压力和/或目标时间比较
320
当力和/或时间偏离目标力和/或目标时间时提供指示
325
结束

图 3

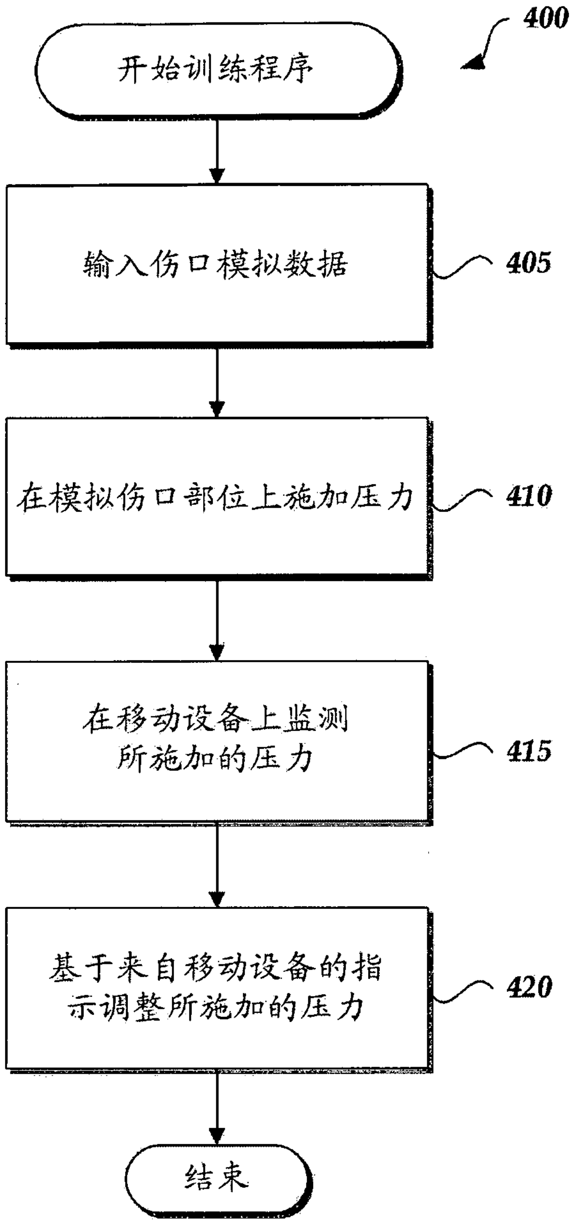

400
开始训练程序
输入伤口模拟数据
405
在模拟伤口部位上施加压力
410
在移动设备上监测所施加的压力
415
基于来自移动设备的指示调整所施加的压力
420
结束

图 4

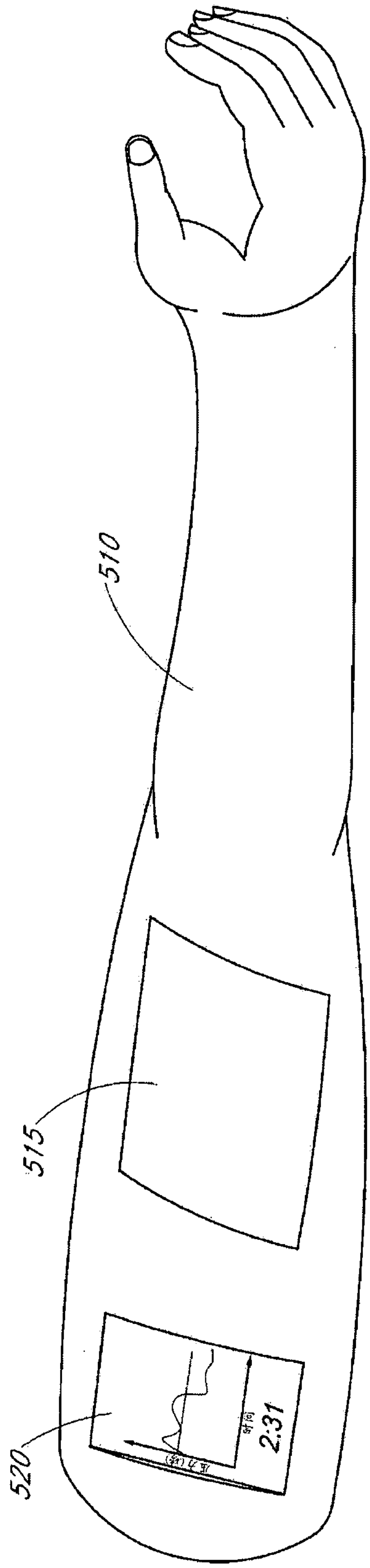


图 5

中国专利公开号：CN104641407A

中国专利公开日：2015 年 05 月 20 日

摘　要

本发明的用于出血控制的作业监控系统的实施例，针对受训者施加于模拟伤口上的力向受训者提供实时的或接近实时的反馈。在一些实施例中，所述作业监控系统包括移动设备、压力传感器以及在所述移动设备上运行的软件应用程序（“app”）。所述作业监控系统使所述受训者(例如医师、医生、护士或其他保健工作者)得以练习在模拟伤口上在限定的时间段施加恰当的力，训练保健服务提供者的肌肉记忆以在恰当的持续时间内施加恰当的压力。