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(54) **ULTRASOUND APPARATUS AND GRAPHICAL INTERFACE FOR PROCEDURAL ASSISTANCE**

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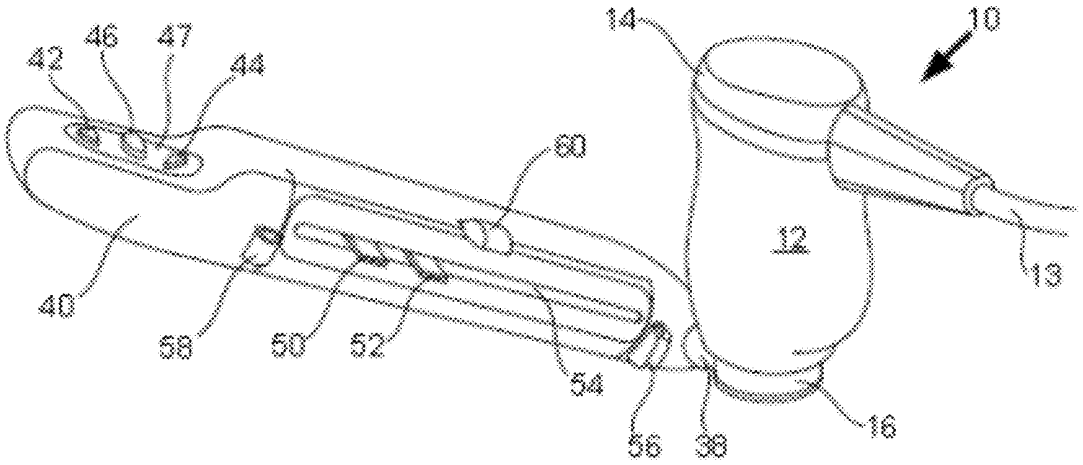
G09B 23/28	(2006.01)

(52) **U.S. Cl.** **600/439**; 600/443; 434/262; 715/781; 715/705

(57) **ABSTRACT**

A system includes an ultrasound transducer and a processing device coupled to the transducer and configured to generate to a display device a graphical user interface. The processing device is further configured to generate to a first region of the user interface an ultrasound image of a patient region of interest, generate to the first region at least one overlay image configured to indicate a specific feature associated with the region of interest, generate to a second region of the user interface a first set of selectable soft keys, the second region being exclusive of the first region, and in response to user selection of a first-set soft key, generate to a third region of the user interface a corresponding functional image.



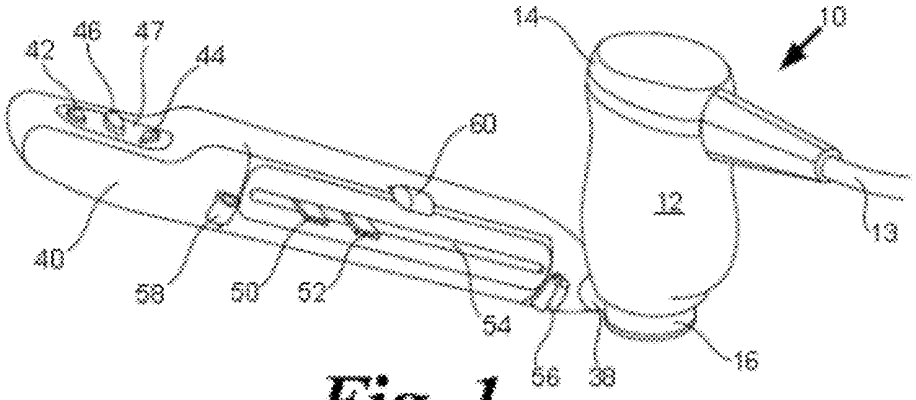


Fig. 1

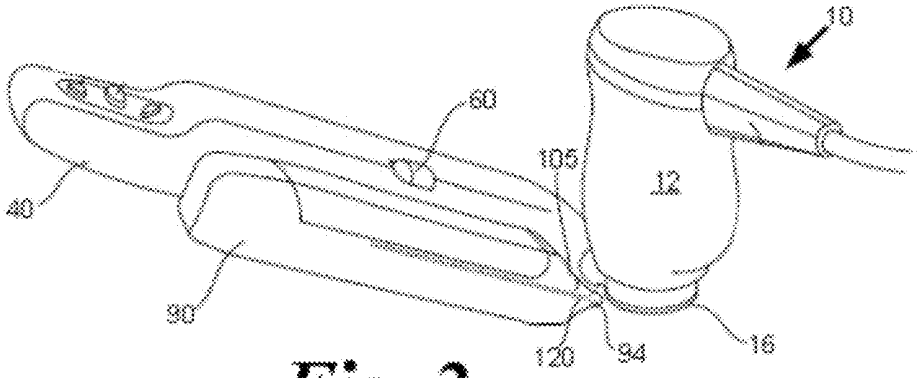


Fig. 2

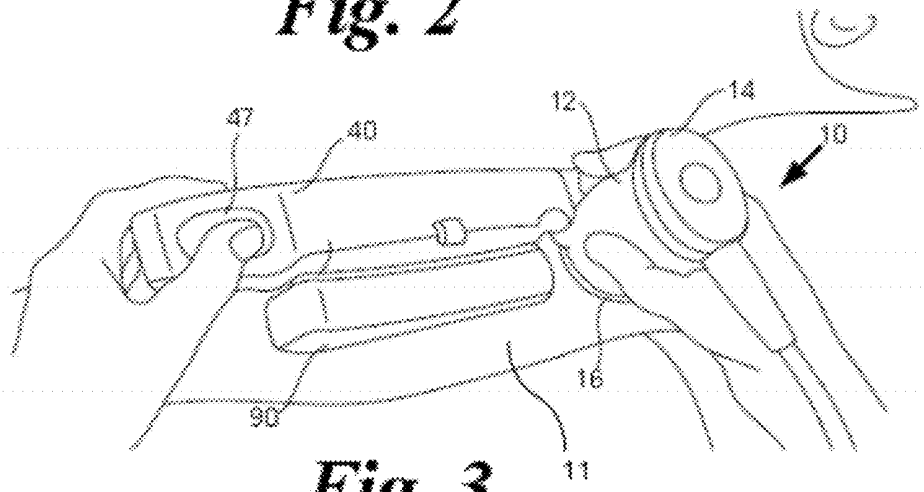


Fig. 3

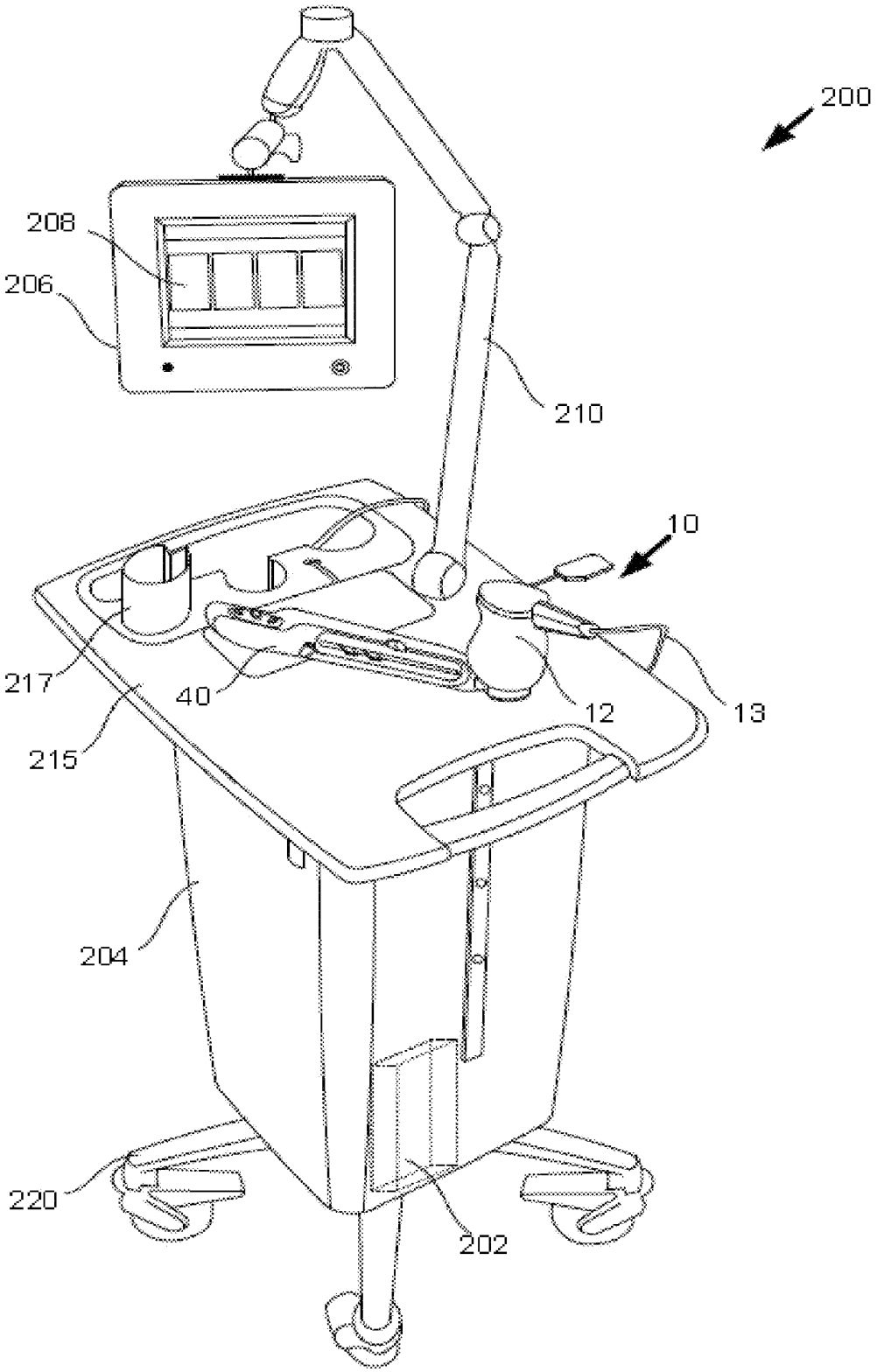


Fig. 4

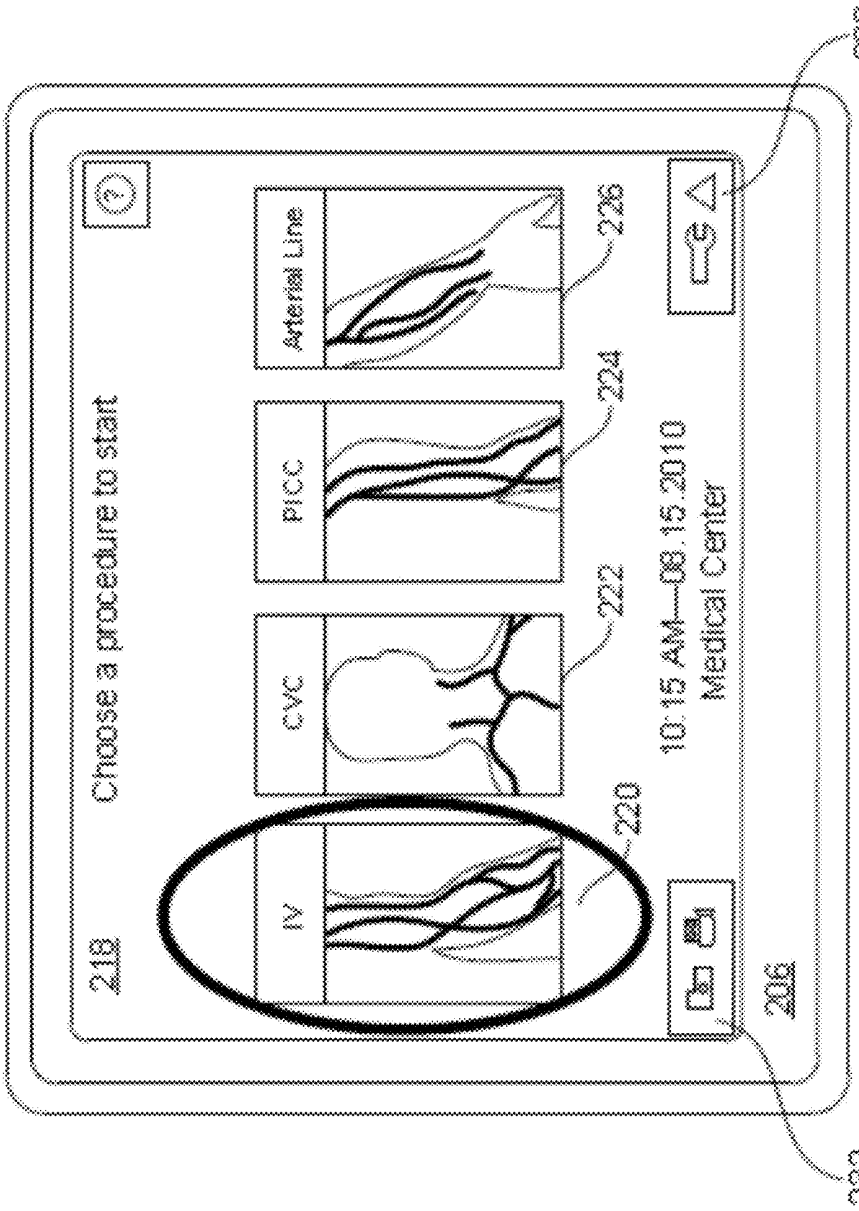

228
218
Choose a procedure to start
IV
220
CVC
222
PICC
224
Arterial Line
226
10:15 AM—08.15.2010
Medical Center
206
232

Fig. 5

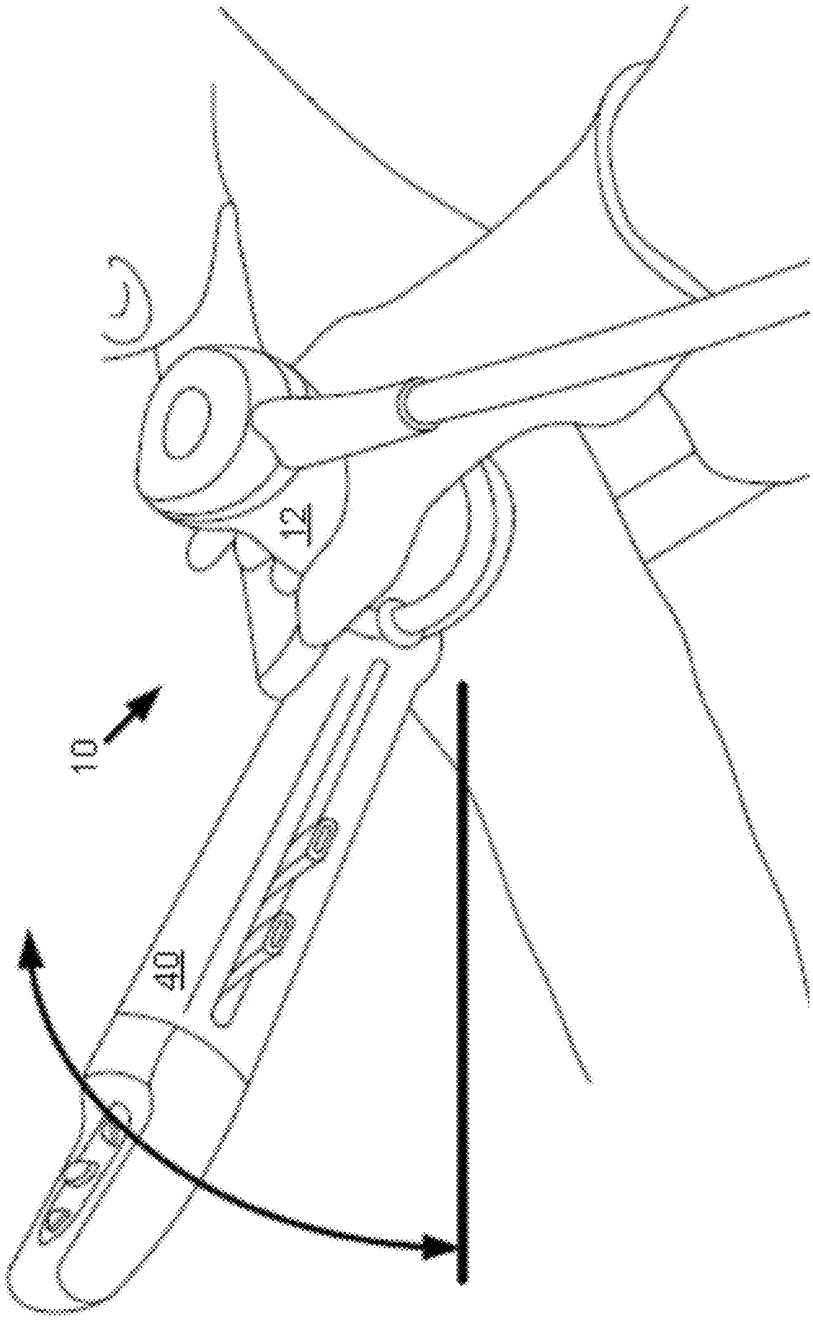


Fig. 6

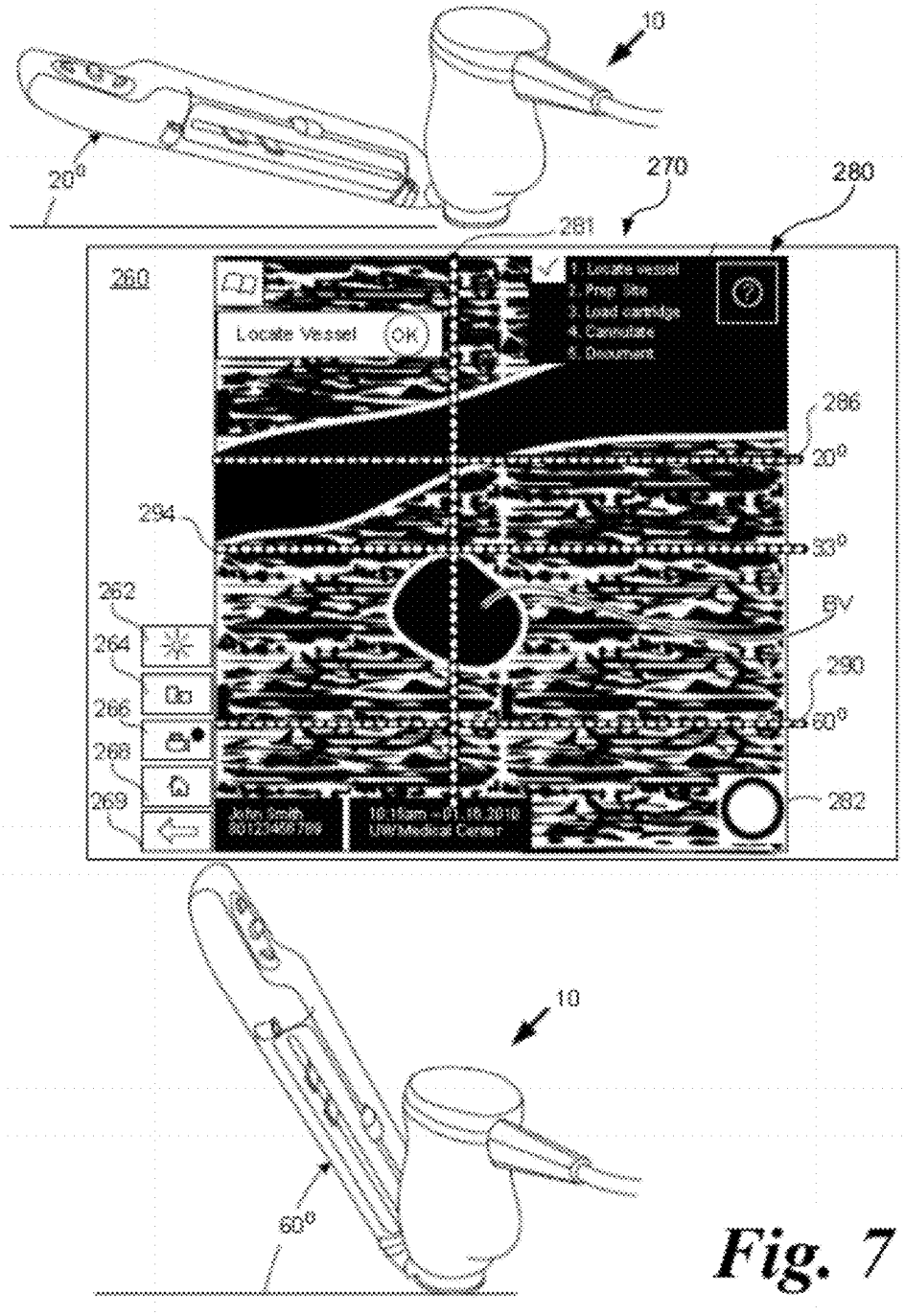

10
20°
270
280
281
260
Locate Vessel
OK
286
30°
284
33°
262
5V
264
290
266
60°
268
269
282
10
60°

Fig. 7

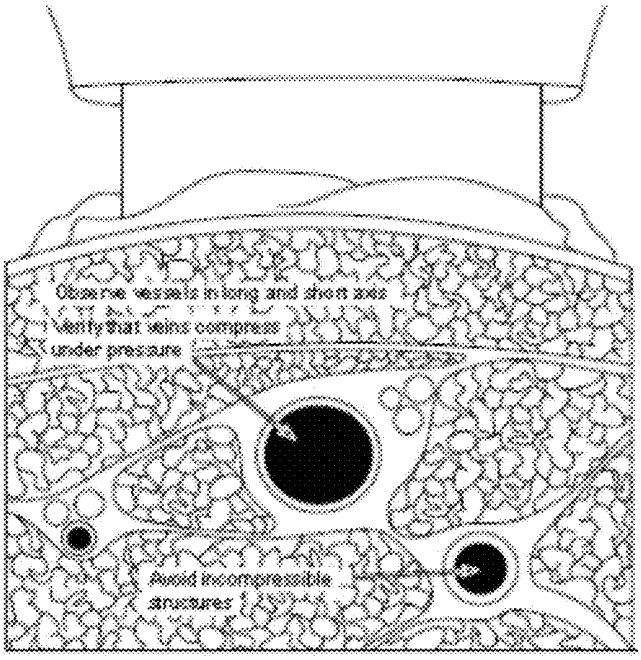

Observe vessels in long and short axes
Identify that veins compress
under pressure
Avoid incompressible
structures

Fig. 8

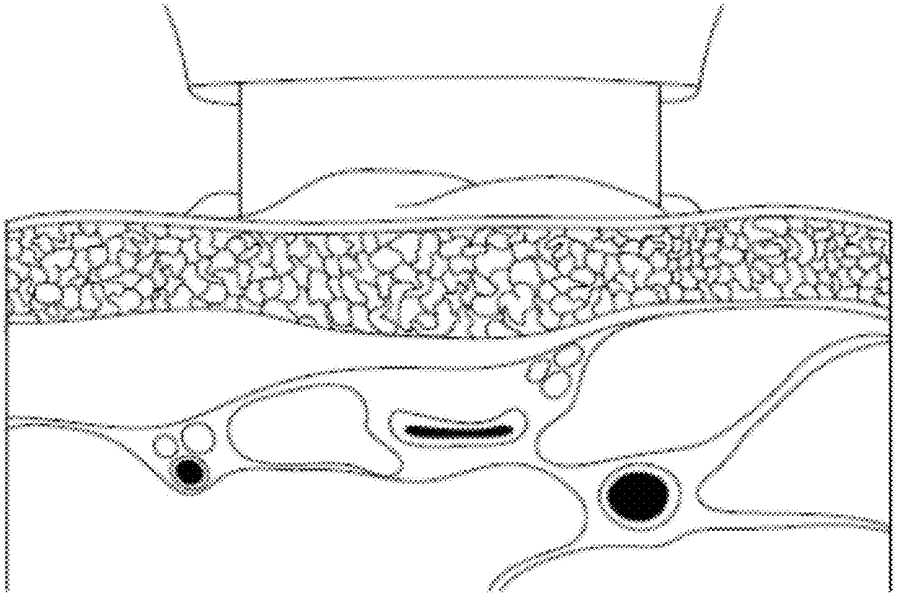


Fig. 9

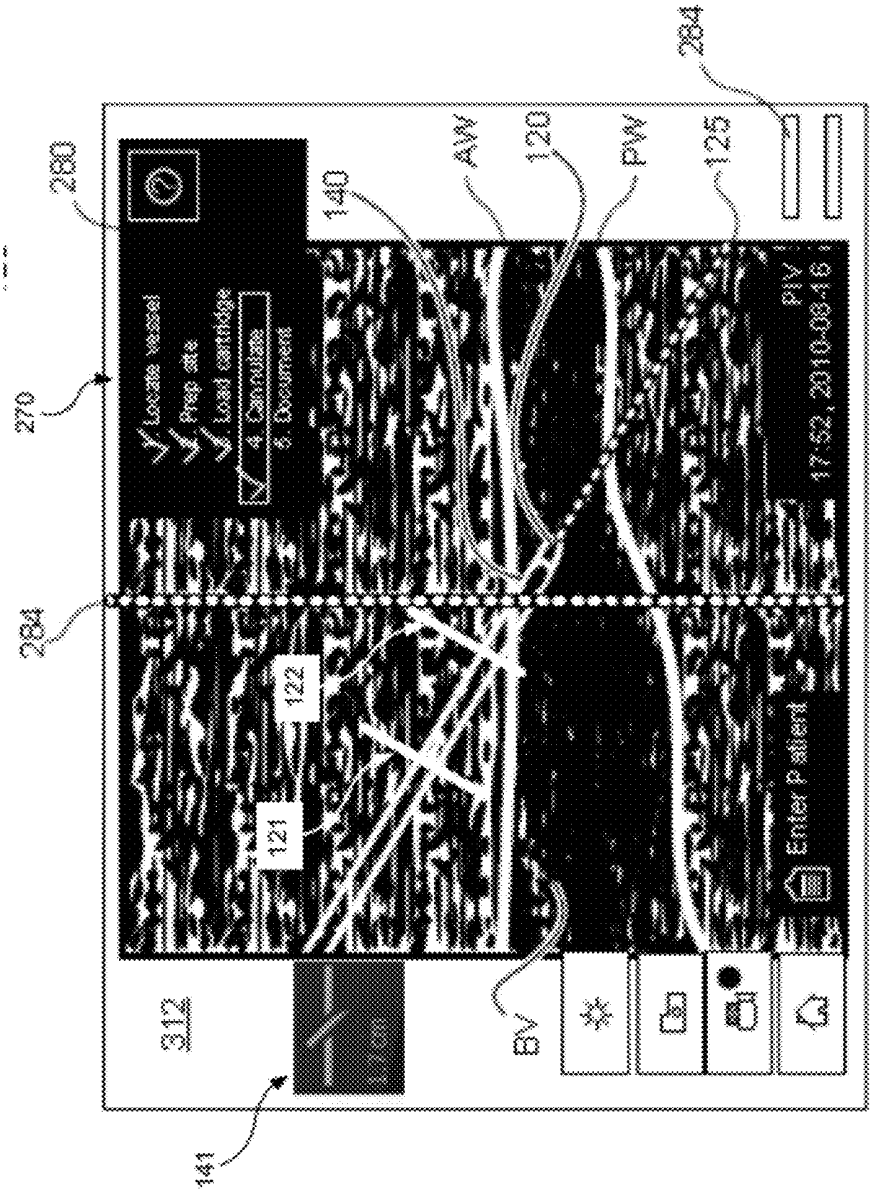

284
280
140
AW
120
PW
125
270
Locate vessel
Prep site
Load cartridge
4 Cannulate
5 Disconnect
284
122
121
Enter Patient
312
BV
141

Fig. 10

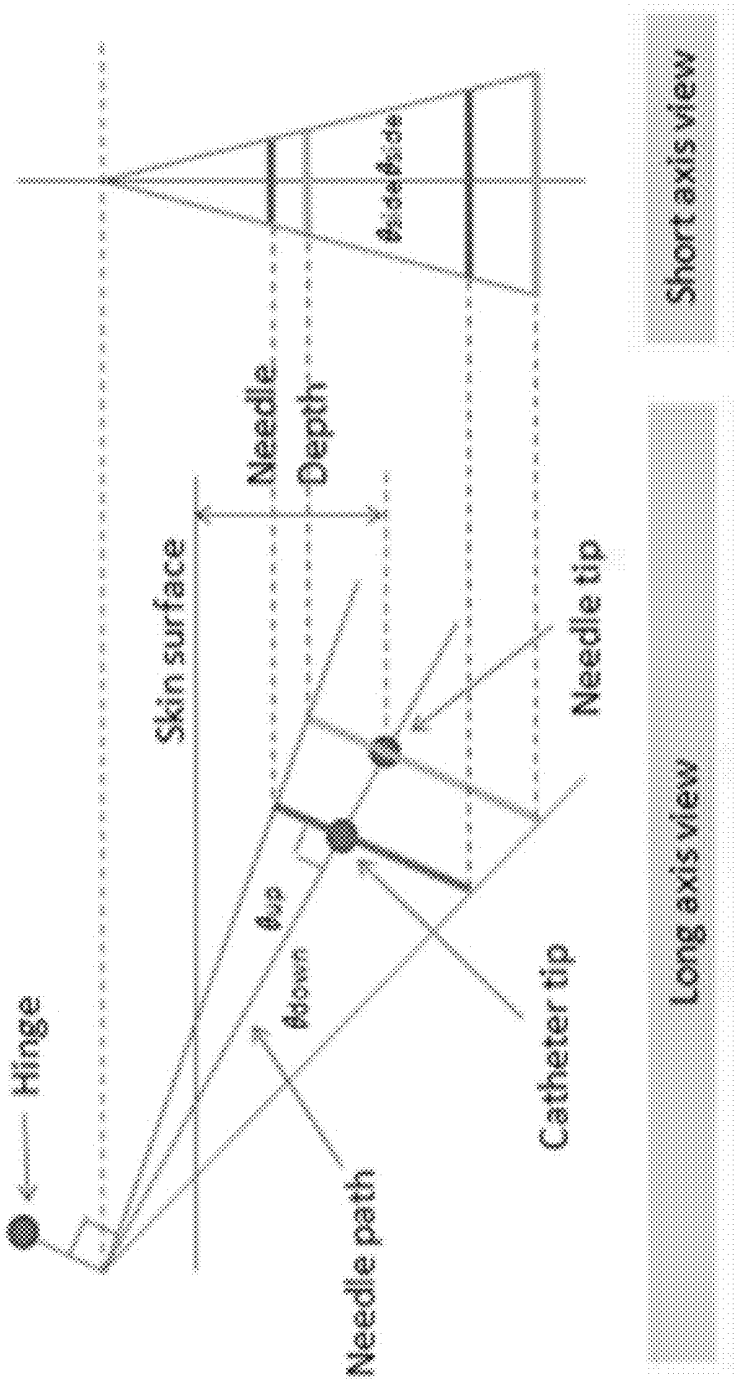

Hinge
Skin surface
Needle Depth
Needle tip
Catheter tip
Needle path
Long axis view
Short axis view

Fig. 11

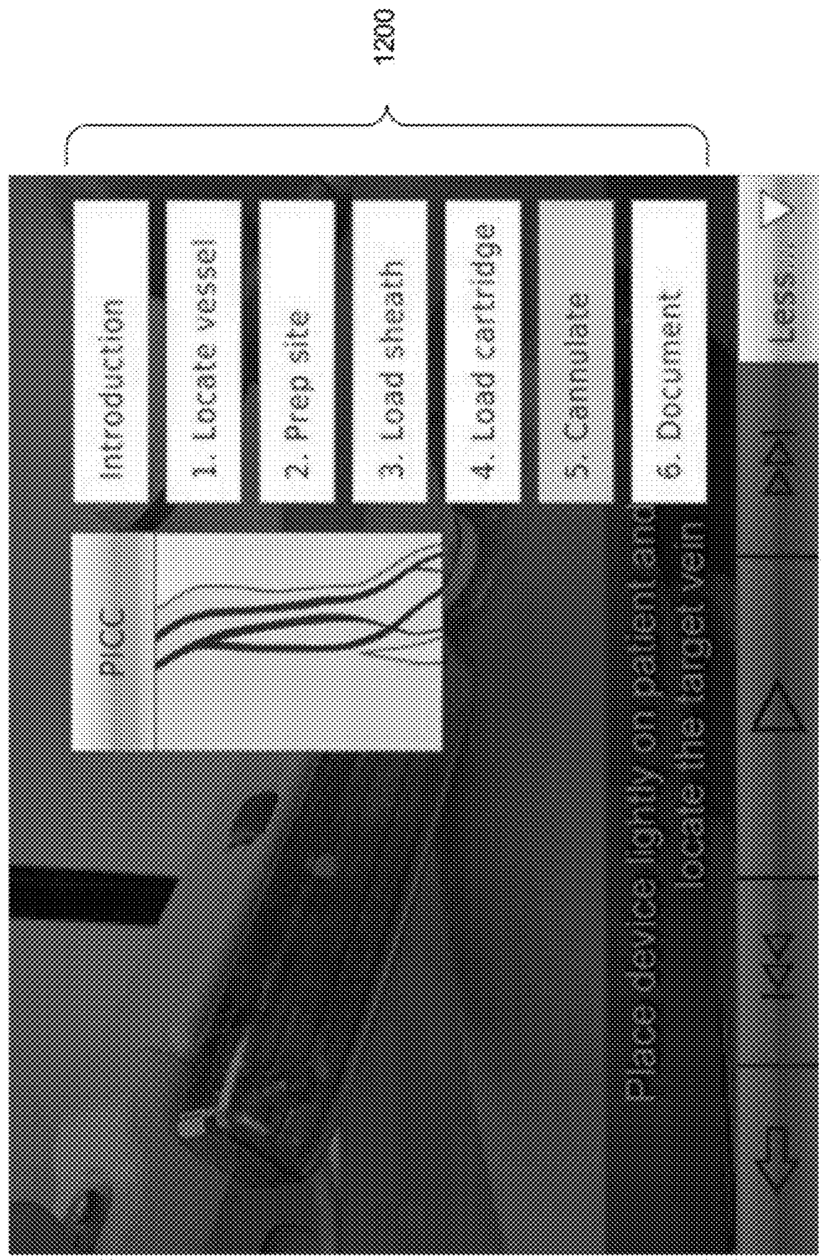

1200
Introduction
1. Locate vessel
2. Prep site
3. Load sheath
4. Load cartridge
5. Cannulate
6. Document
PICC
Less
Place device lightly on patient and locate the target vein

Fig. 12

ULTRASOUND APPARATUS AND GRAPHICAL INTERFACE FOR PROCEDURAL ASSISTANCE

CROSS REFERENCES TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. patent application Ser. No. 12/986,143, filed Jan. 6, 2011, which in turn claims priority to U.S. Provisional Patent Application Ser. No. 61/293,004 filed Jan. 7, 2010. Each of these patent applications is incorporated by reference in its entirety as if fully set forth herein.

BACKGROUND OF THE INVENTION

[0002] Medical personnel can be faced with patients who present arteries or veins that are difficult to access with a needle and any needle-cannula assembly due to the qualities of the overlaying skin and/or the size and configuration of a given artery or vein, and the techniques undertaken to access a given blood vessel. The vein or artery may be obscured due to overlying fatty tissues, or lack of sufficient blood flow may insufficiently till the lumen to make the blood vessel palpable, as may occur in the cases of blown veins compromised with a hematoma, veins that are otherwise structurally compromised as found in the elderly, users of intravenously administered drugs, and critically ill patients with very low blood pressure.

[0003] Such patients as these, as well as obese patients, prove difficult to cannulate under "blind" procedures. In many cases these patients have to endure multiple stabs with a needle, sometimes with penetration through the posterior wall of a vein before a successful placement of the needle is achieved and stable residence of the cannula or catheter within the blood vessel is achieved. Even allowing for an occasionally successful blind stick-and-insert catheter operation, the inserted catheter, if entered at too sharp an angle into a given blood vessel, may kink on insertion and thus hamper fluid delivery into or removal from the blood. vessel lumen.

[0004] Moreover, current ultrasound-image-guided blood-vessel-access procedures require two people: one person to hold the ultrasound probe to secure a guiding image, and another person to insert the needle/cannula. Accordingly, there is a need for solutions, for accessing blood vessels and other bodily structures, that do not require two people to perform, and that are more precise than are offered by current devices and procedures.

SUMMARY OF THE INVENTION

[0005] In an embodiment, a system includes an ultrasound transducer and a processing device coupled to the transducer and configured to generate to a display device a graphical user interface. The processing device is further configured to generate to a first region of the user interface an ultrasound image of a patient region of interest, generate to the first region at least one overlay image configured to indicate a specific feature associated with the region of interest, generate to a second region of the user interface a first set of selectable soft keys, the second region being exclusive of the first region, and in response to user selection of a first-set soft key, generate to a third region of the user interface a corresponding functional image.

BRIEF DESCRIPTION OF THE DRAWING

[0006] Preferred and alternative embodiments of the present invention are described in detail below with reference to the following figures:

[0007] FIG. **1** is a perspective view of a region-of-interest access handset in accordance with an embodiment of the invention;

[0008] FIG. **2** is a perspective view of the handset device of FIG. **1** equipped with a detachably attachable cartridge or cassette in accordance with an embodiment of the invention;

[0009] FIG. **3** is a perspective view of the handset device in accordance with an embodiment of the invention placed on a patient's arm;

[0010] FIG. **4** is a perspective view of an embodiment of an ultrasound system deployed from a movable cart;

[0011] FIG. **5** illustrates a touch screen monitor presenting a home screen of a user interface in accordance with an embodiment of the invention;

[0012] FIG. **6** illustrates the handset surveying for a peripheral vein to facilitate an IV procedure in accordance with an embodiment of the invention;

[0013] FIG. **7** schematically depicts an ultrasound image presented the context of a user interface in accordance with an embodiment of the invention;

[0014] FIGS. **8-9** illustrate instructional images in accordance with an embodiment of the invention;

[0015] FIG. **10** illustrates a screenshot of a user interface in accordance with an embodiment of the invention;

[0016] FIG. **11** illustrates the manner in which position indicators are calculated according to an embodiment of the invention; and

[0017] FIG. **12** illustrates a graphical user interface in accordance with an embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0018] Embodiments of the invention are operational with numerous general purpose or special purpose computing system environments or configurations. Examples of well known computing systems, environments, and/or configurations that may be suitable for use with the invention include, but are not limited to, personal computers, server computers, hand-held or laptop devices, multiprocessor systems, microprocessor-based systems, set top boxes, programmable consumer electronics, network PCs, minicomputers, mainframe computers, distributed computing environments that include any of the above systems or devices, and the like.

[0019] Embodiments of the invention may be described in the general context of computer-executable instructions, such as program modules, being executed by a computer and/or by computer-readable media on which such instructions or modules can be stored. Generally, program modules include routines, programs, objects, components, data structures, etc. that perform particular tasks or implement particular abstract data types. The invention may also be practiced in distributed computing environments where tasks are performed by remote processing devices that are linked through a communications network. In a distributed computing environment,

program modules may be located in both local and remote computer storage media including memory storage devices.

[0020] Embodiments of the invention may include or be implemented in a variety of computer readable media. Computer readable media can be any available media that can be accessed by a computer and includes both volatile and non-volatile media, removable and non-removable media. By way of example, and not limitation, computer readable media may comprise computer storage media and communication media. Computer storage media include volatile and nonvolatile, removable and non-removable media implemented in any method or technology for storage of information such as computer readable instructions, data structures, program modules or other data. Computer storage media includes, but is not limited to, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, versatile disks (DVD) or other optical disk storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store the desired information and which can accessed by computer. Communication media typically embodies computer readable instructions, data structures, program modules or other data in a modulated data signal such as a carrier wave or other transport mechanism and includes any information delivery media. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared and other wireless media. Combinations of the any of the above should also be included within the scope of computer readable media.

[0021] According to one or more embodiments, the combination of software or computer-executable instructions with a computer-readable medium results in the creation of a machine or apparatus. Similarly, the execution of software or computer-executable instructions by a processing device results in the creation of a machine or apparatus, which may be distinguishable from the processing device, itself, according to an embodiment.

[0022] Correspondingly, it is to be understood that a computer-readable medium is transformed by storing software or computer-executable instructions thereon. Likewise, a processing device is transformed in the course of executing software or computer-executable instructions. Additionally, it is to be understood that a first set of data input to a processing device during, or otherwise in association with, the execution of software or computer-executable instructions by the processing device is transformed into a second set of data as a consequence of such execution. This second data set may subsequently be stored, displayed, or otherwise communicated. Such transformation, alluded to in each of the above examples, may be a consequence of, or otherwise involve, the physical alteration of portions of a computer-readable medium. Such transformation, alluded to in each of the above examples, may also be a consequence of, or otherwise involve, the physical alteration of, for example, the states of registers and/or counters associated with a processing device during execution of software or computer-executable instructions by the processing device.

[0023] FIG. **1** is a perspective view of a region-of-interest access handset **10**, according to an embodiment, that provides images of internal bodily structures utilizing, for example, B-mode based single scan planes and/or rotationally-configured scan plane arrays. The handset **10** includes an ultrasound transceiver housing **12** in communication with a central processing unit (FIG. **4**) via power and data communication cable **13**. The transceiver housing **12** includes a swiveling portion that allows the transceiver housing **12** to be grasped by righted-handed or left-handed users. Transceiver housing **12** includes a top **14** and transducer base **16**. Attached in pivotable contact with the transducer base **16** is a friction hinge housing **38** that connects an injector arm **40** to the transceiver housing **12** via the transducer base **16**.

[0024] The injector arm **40** is equipped with a controller **47** having a rearward-located pushbutton control **42**, a forward-located pushbutton control **44**, and a 4-way toggle control **46**. In signal communication with the push and toggle buttons **42**, **44**, and **46** of controller **47** are motorized moveable platforms **50** and **52** that slidably transit along the length of a slot **54**. Rearward control **42** retracts the moveable platform **50** away from the patient's region-of-interest independently of the position of the moveable platform **52**. Forward control **44** moves the moveable platform **52** towards the patient's targeted region-of-interest independently of the position of the moveable platform **50**. The 4-way toggle control **46** synchronously moves the moveable platforms **50** and **52** together toward the patient's region-of-interest if toggled towards the patient, and synchronously together away from the patient's region-of-interest if toggled away from the patient. Adjacent to the slot **54** are cassette holders **56** and **58**. As shown in FIG. **1**, the motorized platforms **50** and **52** occupy the distal third portion of the slot **54** away from the patient denoted as the "home" or "start" position within slot **54**.

[0025] FIG. **2** is a perspective view of the handset device **10** of FIG. **1** equipped with a detachably attachable cartridge or cassette **90** to the slot **54** side of the injector arm **40** by engagement with cassette holders **56**, **58** and moveable platforms **50**, **52**. Moveable platform **50** detachably engages with a slideable needle mount (not shown) and moveable platform **52** detachably engages with a slideable cannula mount (not shown) when the slideable mounts are positioned within the cassette **90** in the "home" or "start" position that is dimensionally accommodating or orientationally equivalent to the "home" and "start" positions of the motorized platforms **50** and **52** described with regard to FIG. **1** above.

[0026] As depicted in FIG. **2**, cartridge **90** includes a needle guide **94** at the end near the support base **16**. An aperture of the needle guide **94** serves to prevent significant sideways slippage of the needle **120** and/or overlapping cannula **140** as they pass through the needle guide. As shown in FIG. **2**, the mounted needle **120** is depicted as a pair of dashed lines suspended internally within the cassette **90**. Used cassettes **90** may be easily detached from injector arm **40** by pressing cartridge release button **60**.

[0027] FIG. **3** is a perspective view of the handset **10** placed on a patient's arm **11**. The handset **10** includes the cassette **90** attached to the slot **54** side of the injector arm **40** during a cannula placement operation into the patient's peripheral vasculature. In the illustrated embodiment, the transceiver housing **12** is pivoted for right-handed holding of the transducer base **16** against the patient's arm **11**. The left hand of the user operates the tilting of the injector arm **40** about the friction hinge housing **38** and operation of the push and toggle buttons **42**, **44**, and **46** of controller **47** depicted in FIG. **1** above.

[0028] FIG. **4** is a top perspective view of an embodiment of an ultrasound system **200** deployed from a movable cart. The

system **200** includes a monitor **206** equipped with a touch-sensitive screen **208**. The monitor **206** is supported by an articulating arm **210** extending from a countertop **215** on which the handset **10** can be prepared for various region-of-interest access procedures. The power supply and communication cable **13** can conveniently access a computer having a central processing unit **202** disposed, for example, within cart support **204**. Alternatively, or additionally, the central processing unit **202** may be integral to the monitor **206**. The central processing unit **202** is configured to receive and process echoes of ultrasound signals to present images of insonified vasculatures. Included in the countertop **215** is a handset holder **217**. The system **200** with handset **10**, monitor **206**, and central processing unit **202** may be conveniently rolled via wheeled extensions **220**.

[0029] FIG. **5** illustrates the touch screen monitor **206** presenting a home screen **218** of a user interface, generated by unit **202**, illustrating a panel of four blood-vessel-based access procedures characterized by different icons and acronyms. As stated previously, monitor **206** may be a touch screen enabling a user to interact with the user interface displayed thereon. Additionally, in an embodiment, the user may interact with any user interface displayed on monitor **206** using one or more controls associated with handset **10**, discussed herein above. The panel of icons (soft keys) representing blood-vessel access procedures includes a peripheral intravenous IV procedure **220**, a central venous catheter CVC procedure **222**, a peripherally inserted central catheter PICC procedure **224**, and an arterial tine procedure **226**. In the case of a touch screen monitor **206**, the IV procedure **220** icon is touched by the user, indicated by the oval, to bring up menu items to conduct this blood vessel access procedure. Also shown are touch sensitive tool icon **228** and data output icon **232**. Selection of the tool icon **228**, in an embodiment, may invoke display on the screen **218** of a configuration screen (not shown) allowing the user to customize conventional settings such as, for example, text-language selection and screen brightness. Selection of the data output icon **232**, in an embodiment, may invoke a review screen (not shown) wherein images captured during previous procedures can be viewed.

[0030] FIG. **6** illustrates the handset **10** surveying for a peripheral vein to facilitate the IV procedure selected from the home screen **218** depicted in FIG. **5**. The injector arm **40** can pivot freely from shallow acute angles to steep acute angles in relation to the transceiver base **16** as denoted by the arrow in FIG. **6**.

[0031] FIG. **7** schematically depicts an ultrasound image presented in the context of a user interface **260** on the monitor **206** while surveying for a blood vessel during a short-axis mode when a scan plane emanating from the handheld **10** intersects a blood vessel BV**1** substantially at a perpendicular orientation. Interface **260** may include a brightness icon **262**, a still-capture icon **264**, a movie-capture icon **266**, a home-return icon **268**, and a return-to-prior-screen icon **269**. In an embodiment, at key points (e.g., when the procedure step changes, before the transducer rotates, when the needle changes direction, etc.) throughout a given procedure, the processor **202** automatically takes screen shots of the ultrasound image. Consequently, at the end of a procedure, the user will always have a record of the procedure, even if they did not use the touch screen to request specific screen shots.

[0032] Upon selection of a procedure represented by the icons **220**, **222**, **224**, **226** illustrated in FIG. **5**, interface **260** displays a procedure-specific checklist **270** to assist the user in successfully completing each required task of such procedure. This checklist **270** may be displayed as an overlay relative to the displayed ultrasound image. For example, in response to user selection of the peripheral intravenous IV procedure **220**, the user interface **260** displays a checklist **270** that includes the steps that must be performed to successfully complete such procedure. As illustrated in the checklist **270** of FIG. **7**, these steps include 1. Locating the target vessel (Locate Vessel); 2. Preparing the site (Prep Site); 3. Load cartridge **90** onto injector arm **40** (Load Cartridge); 4. Cannulate the target vessel (Cannulate), and 5. Document the procedure (Document).

[0033] The interface **260** further includes a help button **280** that, when selected, is operable to invoke for display on the monitor **206** context-specific and/or selectable instructional images to assist the user in performing particular tasks, as discussed above, required for successful completion of a selected procedure. Referring to FIGS. **8** and **9**, such instructional images may take the form of one or more still images or tutorial videos, and may occupy the entirety, or smaller portion, of the display screen of the monitor **206**. For example, in response to user selection of the help button **280** during the "Locate Vessel" portion of the IV procedure **220**, the interface **260** may display one or more images illustrating graphically and textually the correct approach to be taken by the user, as shown in FIG. **8**. Subsequently, as illustrated in FIG. **9**, the interface **260** may display one or more images illustrating the appearance of the ultrasound image if the user is employing the previously illustrated correct approach.

[0034] Alternatively, and as illustrated FIG. **12**, selection of the help button **280** may invoke a menu **1200** of soft keys allowing the user to choose an image or tutorial video of a particular topic that may or may not be specific to the context of the procedure or procedure portion in which the user is currently engaged. Such topics may involve assisting the user in, for example, employing elements of the handset device **10** or interpretation of ultrasound images generated during a procedure.

[0035] Referring back to FIG. **7**, in this interface **260** including an insonified vasculature image, a center located blood vessel BV is presented in short-axis cross section when the position of the rotatable transducer is indicated to be in short-axis mode by the presence of a short-axis icon **282**, depicted in FIG. **7** as a thick circle. Applied to the ultrasound image of interface **260** is an overlay having positional information in the form of a vertical axis line **281**. The vertical axis line **281** is shown bisecting the blood vessel BV and represents the approximate location of the center of the rotatable transducer of handset **10**. Perpendicular to and intersecting the vertical axis line **281** are three horizontal lines **286**, **290**, **294** indicating various inclination angles of the injector arm **40** relative to the base **16** to achieve varying corresponding penetration depths (e.g., intersection of the needle with the ultrasound plane) for needle injection and cannulation. For example, horizontal axis line **286** represents a target depth of the needle/cannula when the injector arm **40** is at a 20-degree inclination angle (as illustrated at the top of FIG. **7**), and horizontal axis line **290** represents a target depth of the needle/cannula when the injector arm **40** is at a 60-degree inclination angle (as illustrated at the bottom of FIG. **7**). Between lines **286**, **290** is horizontal axis line **294** that represents a target depth of the needle/cannula when the injector arm **40** is at a 33-degree inclination angle.

[0036] The intersection of any given horizontal axis line, seen in this example as horizontal axis lines **286**, **290**, or **294** with the vertical axis line **281** represents a targeting "cross-hair" or sighting-aid position where a cutting bevel end (not shown) of the needle **120** is expected to appear as the needle crosses the ultrasound plane when advancing at the corresponding angles described above. The horizontal axis can be adjusted to intersect at any given location of the vertical axis **281**, indicative of the location of the base **16**, by tilting or pivoting the injector arm **40** while holding the base firmly against the patient's skin. In this example, the intersection of horizontal line **294** with vertical line **281** is near the midline portion of the anterior wall (i.e., wall closest to the base **16**) of the short-axis cross-sectional view of blood vessel BV. Generally, penetration of the blood vessel by the needle **120** near the midline of the anterior wall represents an ideal position for needle injection and cannulation procedures.

[0037] FIG. **10** illustrates a screenshot **312** of the interface **260** in long-axis cross-sectional view at the moment that the needle **120** with overlapping cannula **140** (or, alternatively, a representation of the needle and cannula generated by processor **202**) is seen to be penetrating through the blood vessel BV at 30 degrees relative to the base **16** during the "cannulate" procedure of access menu **280**. Processor **202** applies to the ultrasound image of screenshot **312** an overlay having positional information in the form of a trajectory line **125**. Trajectory line **125** identifies the expected pathway that the needle **120** with overlapping cannula **140** will transit based on the angle between injector arm **40** and base **16**, as well as needle/catheter advance position. Here, an image of the needle **120** with overlapping cannula **140** is shown penetrating the anterior watt AW of the blood vessel shown in long-axis mode as indicated by tong axis icon **284**.

[0038] Still referring to FIG. **10**, in an embodiment, if the user changes the angle between injector arm **40** and base **16** during a procedure, the processor **202** is configured to automatically adjust the depth setting of the displayed ultrasound image to keep the needle **120** with overlapping cannula **140** in full view within interface **260**. For example, a steeper angle between injector arm **40** and base **16** is correlated to a deeper displayed image (i.e., more tissue surrounding the needle/cannula comes into view, white needle/cannula image is somewhat diminished in size), while a shallower angle is correlated to a shallower displayed image (i.e., less tissue surrounding the needle/cannula comes into view, while needle/cannula image is somewhat magnified in size). Optionally, this automatic depth-adjustment feature may be disabled by the user to maintain constant depth setting.

[0039] Processor **202** can also apply to the ultrasound image of screenshot **312** an overlay of a catheter-tip position indicator **121** and needle-tip position indicator **122**. The position indicators **121**, **122** indicate to the projected position of the cannula and needle tip in the ultrasound image. The position indicators **121**, **122** may likewise be generated in the short-axis view depicted in FIG. **7**. FIG. **11** illustrates the manner in which the position indicators **121**, **122** are calculated according to an embodiment.

[0040] As illustrated in FIGS. **10** and **11**, in long-axis view, the position indicator **122**, in an embodiment: (1) intersects the calculated location of the needle tip; (2) is perpendicular to the trajectory line; (3) has an upper endpoint that forms an angle θ_{up} between the hinge and the calculated needle tip location; and (4) has a lower endpoint that forms an angle θ_{down} between the hinge and the calculated needle tip location. Indicator **121** is developed analogously with respect to the catheter.

[0041] In the case of the short-axis view, tip positions are shown by horizontal lines positioned at the top and bottom of the lines calculated for the long-axis view. The width of the lines increases as depth increases, according to the angle θ_{side} shown in FIG. **11**.

[0042] As further illustrated FIG. **10**, the interface **260** may further include a tip-depth indicator **141**. The tip-depth indicator **141** indicates whether the needle tip is above or below the skin surface. Above the skin surface, an icon of a first visual format (e.g., blue font) is shown, and the distance above the skin surface is shown as a negative number. Below the skin surface, an icon of a second visual format (e.g., orange font), different from the first format, is shown, and distance below the skin surface is shown as a positive number.

[0043] While the preferred embodiment of the invention has been illustrated and described, as noted above, many changes can be made without departing from the spirit and scope of the invention. For example, when ultrasound is displayed, it may always be scaled to fill as much of the interface **260** as possible—no frames or borders associated with, for example, soft keys or overlays, reduce the available area of ultrasound viewing. Moreover, soft keys and/or instructional images may or may not overlap a displayed ultrasound image. Additionally, during a procedure, needle/cannula trajectory may always be from upper-left to bottom-right. This area of the screen is kept clear of controls and indicators, which may be clustered in the upper-right and bottom-left portions of interface **260**. Additionally, as the brightness of the ultrasound image changes, the processor **202** may automatically adjust the ultrasound gain to compensate for such changes. Accordingly, the scope of the invention is not limited by the disclosure of the preferred embodiment. Instead, the invention should be determined entirely by reference to the claims that follow.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A computer-readable medium including executable instructions that, when executed by a processing device, enable the processing device to perform a method of generating to a display device a graphical user interface, the method comprising the steps of:

generating to a first region of the user interface an ultrasound image of a patient region of interest;

generating to the first region at least one overlay image configured to indicate a specific feature associated with the region of interest;

generating to a second region of the user interface a first set of selectable soft keys, the second region being exclusive of the first region; and

in response to user selection of a first-set soft key, generating to a third region of the user interface a corresponding functional image.

2. The medium of claim **1**, wherein the third region is exclusive of the first region.

3. The medium of claim **1**, wherein the ultrasound image, at least one overlay image and first set of soft keys are simultaneously generated to the user interface.

4. The medium of claim **1**, wherein the method further comprises, prior to generating the ultrasound image to the user interface, generating to the user interface a second set of

selectable soft keys, the second set of soft keys enabling a user to select an ultrasound procedure from a plurality of ultrasound procedures.

5. The medium of claim **1**, wherein the at least one overlay image comprises an expected trajectory of an object intended for insertion into the region of interest.

6. The medium of claim **1**, wherein the at least one overlay image comprises an image of an object being inserted into the region of interest.

7. The medium of claim **1**, wherein the at least one functional image comprises a tutorial video describing to the user a method of performing a procedure using the ultrasound image.

8. The medium of claim **1**, wherein the at least one overlay image comprises a checklist describing steps to be taken in performing a procedure using the ultrasound image.

9. The medium of claim **1**, wherein the processing device is in electronic communication with an apparatus comprising an ultrasound-transducer base and an element configured to insert an object into the region of interest, the element being configured to be at an adjustable angle relative to the base, the method further comprising automatically adjusting a depth of the ultrasound image based on the angle of the element relative to the base.

10. The medium of claim **1**, wherein the method further comprises automatically capturing, at a set of predetermined time intervals, a series of screenshots of the ultrasound image.

11. A system, comprising:

an ultrasound transducer; and

a processing device coupled to the transducer and configured to generate to a display device a graphical user interface, the processing device further configured to:

generate to a first region of the user interface an ultrasound image of a patient region of interest;

generate to the first region at least one overlay image configured to indicate a specific feature associated with the region of interest;

generate to a second region of the user interface a first set of selectable soft keys, the second region being exclusive of the first region; and

in response to user selection of a first-set soft key, generate to a third region of the user interface a corresponding functional image.

12. The system of claim **11**, wherein the third region is exclusive of the firs region.

13. The system of claim **11**, wherein the ultrasound image, at least one overlay image and first set of soft keys are simultaneously generated to the user interface.

14. The system of claim **11**, wherein the processing device is further configured to, prior to generating the ultrasound image to the user interface, generate in the user interface a second set of selectable soft keys, the second set of soft keys enabling a user to select an ultrasound procedure from a plurality of ultrasound procedures.

15. The system of claim **11**, wherein the at least one overlay image comprises an expected trajectory of an object intended for insertion into the region of interest.

16. The system of claim **11**, wherein the at least one overlay image comprises an image of an object being inserted into the region of interest.

17. The system of claim **11**, wherein the at least one functional image comprises a tutorial video describing to the user a method of performing a procedure using the ultrasound image.

18. The system of claim **11**, wherein the at least one overlay image comprises a checklist describing steps to be taken in performing a procedure using the ultrasound image.

19. The system of claim **11**, wherein the ultrasound transducer comprises a base, the system further comprising an element configured to insert an object into the region of interest, the element being configured to be at an adjustable angle relative to the base, the processing device further configured to automatically adjust a depth of the ultrasound image based on the angle of the element relative to the base.

20. The system of claim **11**, wherein the processing device is further configured to automatically capture, at a set of predetermined time intervals, a series of screenshots of the ultrasound image.

* * * * *

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摘要(译)

一种系统包括超声换能器和耦合到换能器并且被配置为向显示设备生成图形用户界面的处理设备。处理设备还被配置为向用户界面的第一区域生成患者感兴趣区域的超声图像，向第一区域生成至少一个覆盖图像，该覆盖图像被配置为指示与感兴趣区域相关联的特定特征，生成第一组可选软键到用户界面的第二区域，第二区域不包括第一区域，并且响应于用户对第一组软键的选择，生成到用户界面的第三区域a相应的功能图像。