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Becerra et al.

(54) **PORTABLE ULTRASOUND WITH TOUCH SCREEN INTERFACE**

(75) Inventors: **Carlos Becerra**, Atlanta, GA (US); **William K. Chandler**, Lawrenceville, GA (US); **Abebaw Zeleke**, Marietta, GA (US)

Correspondence Address:
BRYAN W. BOCKHOP, ESQ.
BOCKHOP & ASSOCIATES, LLC
2375 MOSSY BRANCH DR.
SNELLVILLE, GA 30078

(73) Assignee: **NORTH AMERICAN MEDICAL CORPORATION**, Marietta, GA (US)

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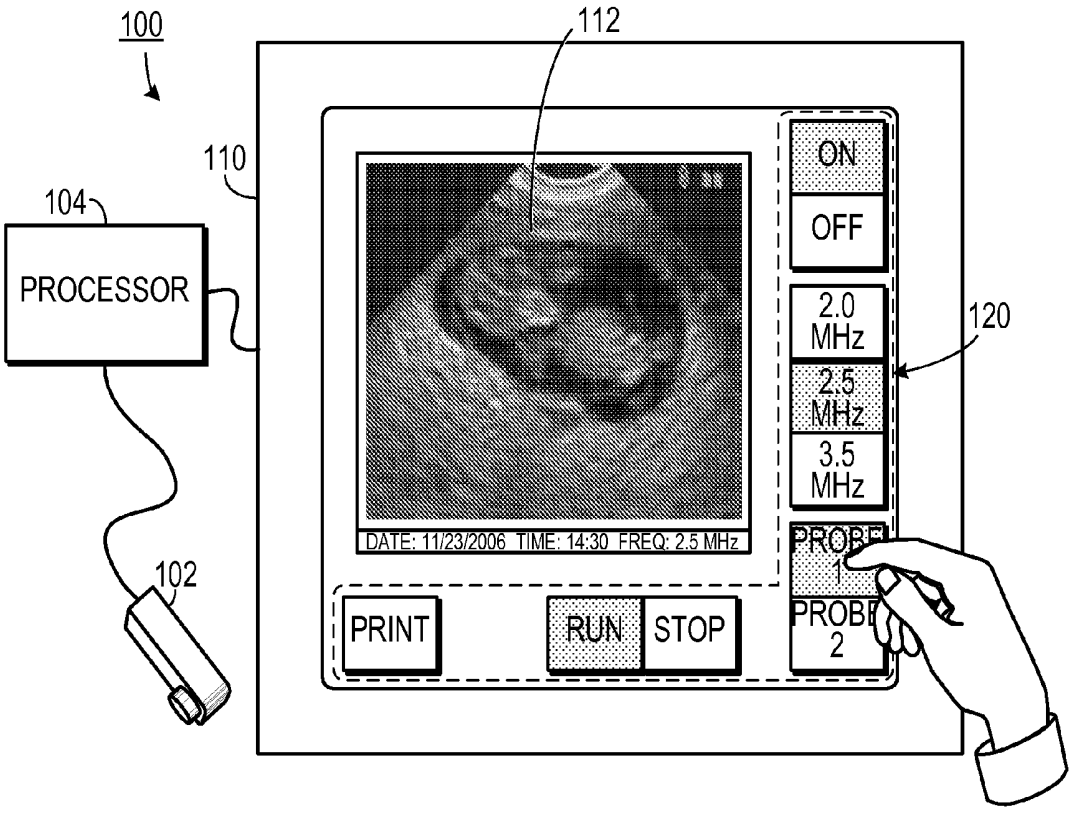
(57) **ABSTRACT**

An ultrasound system for imaging an object using data received from an ultrasound transducer employs a first touch screen configured to display ultrasound images and to receive control inputs relating to the images. A second touch screen is configured as a user input device. A processor is coupled to the ultrasound transducer so as to receive data therefrom. The processor is also coupled to the first touch screen and to the second touch screen. The processor is configured to generate ultrasound images based on the data received from the ultrasound transducer. The processor is also configured to cause the first touch screen to display the ultrasound images. The processor is also configured to receive control input data from the first touch screen and the second touch screen.



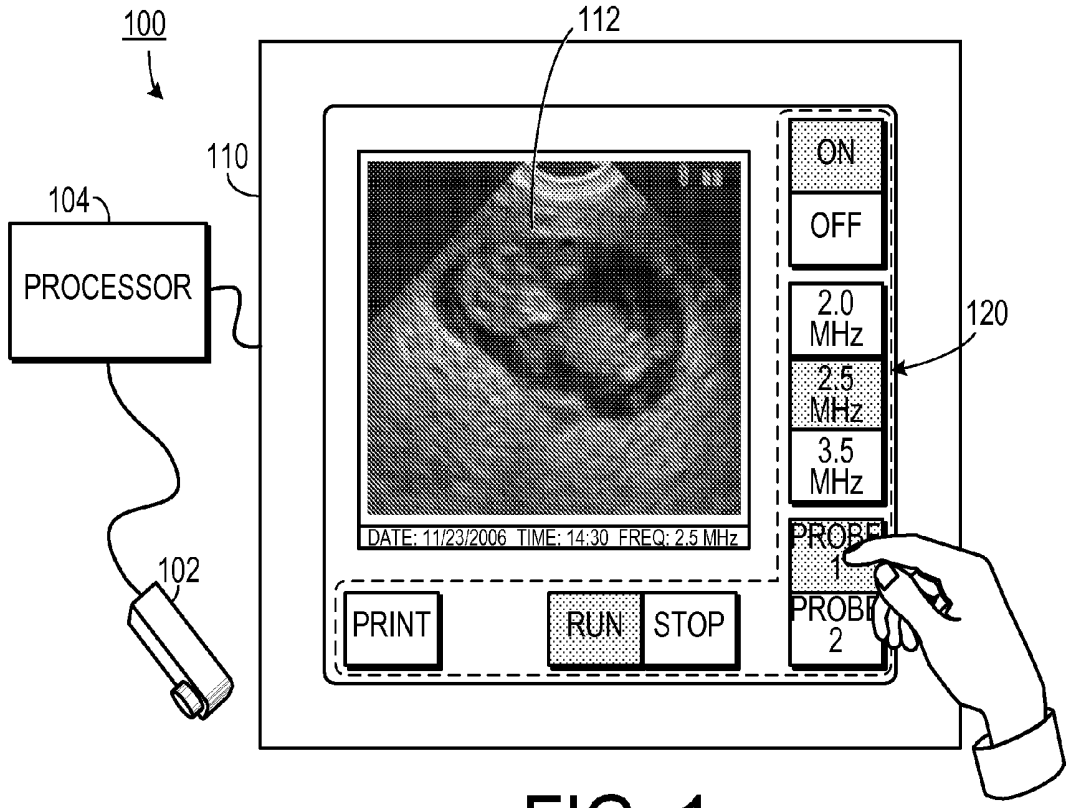


FIG. 1

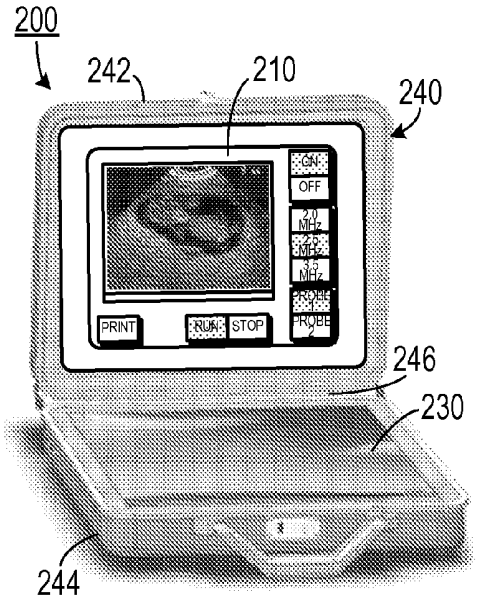


FIG. 2A

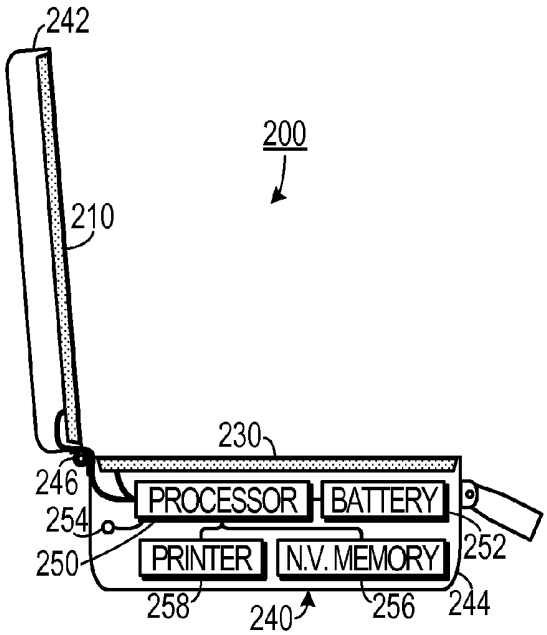


FIG. 2B

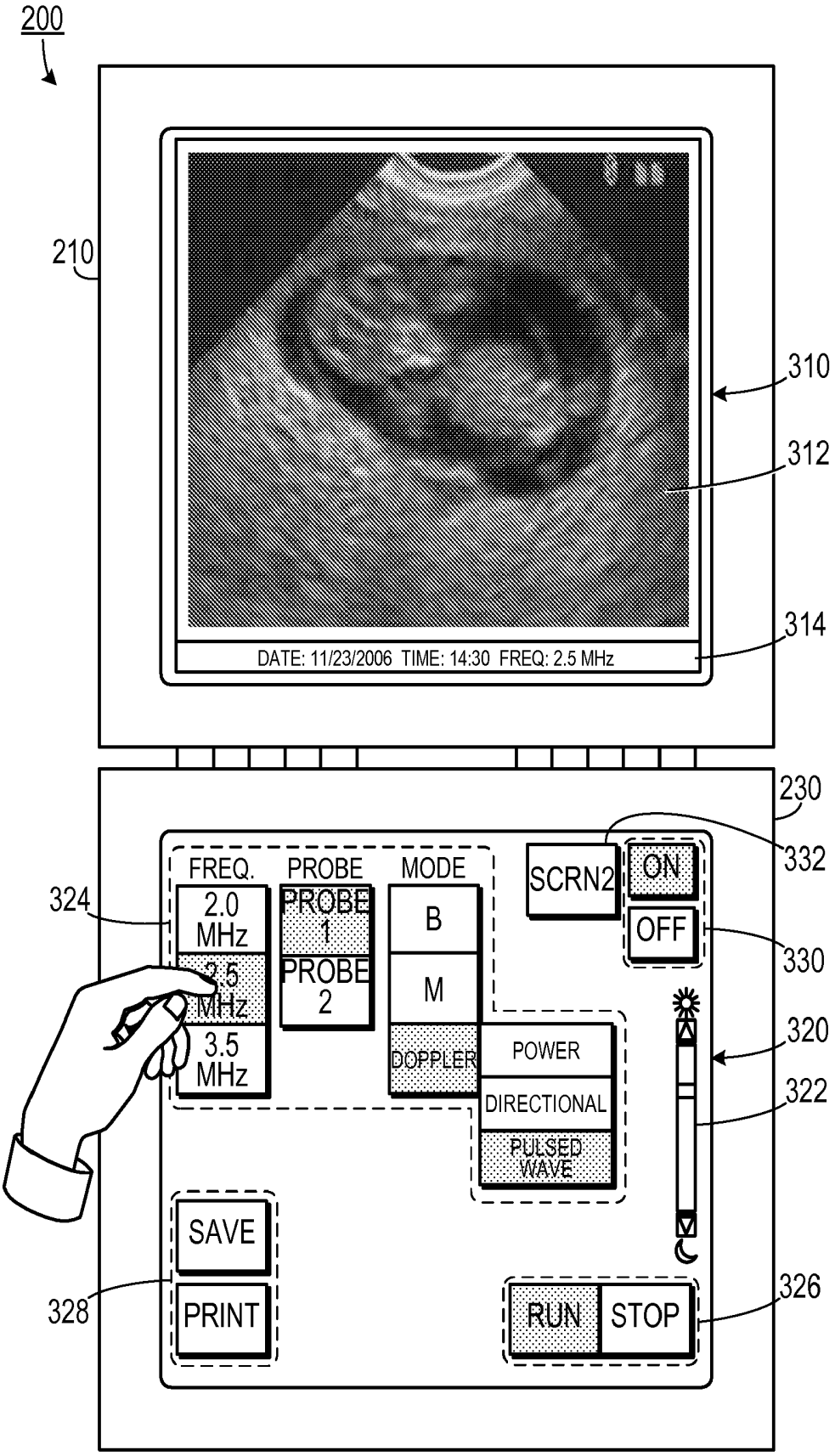

200
210
310
312
314
DATE: 11/23/2006 TIME: 14:30 FREQ: 2.5 MHz
230
332
324
FREQ.
2.0 MHz
2.5 MHz
3.5 MHz
PROBE
PROBE 1
PROBE 2
MODE
B
M
DOPPLER
POWER
DIRECTIONAL
PULSED WAVE
SCRN2
ON
OFF
330
320
322
SAVE
PRINT
328
RUN
STOP
326

FIG. 3A

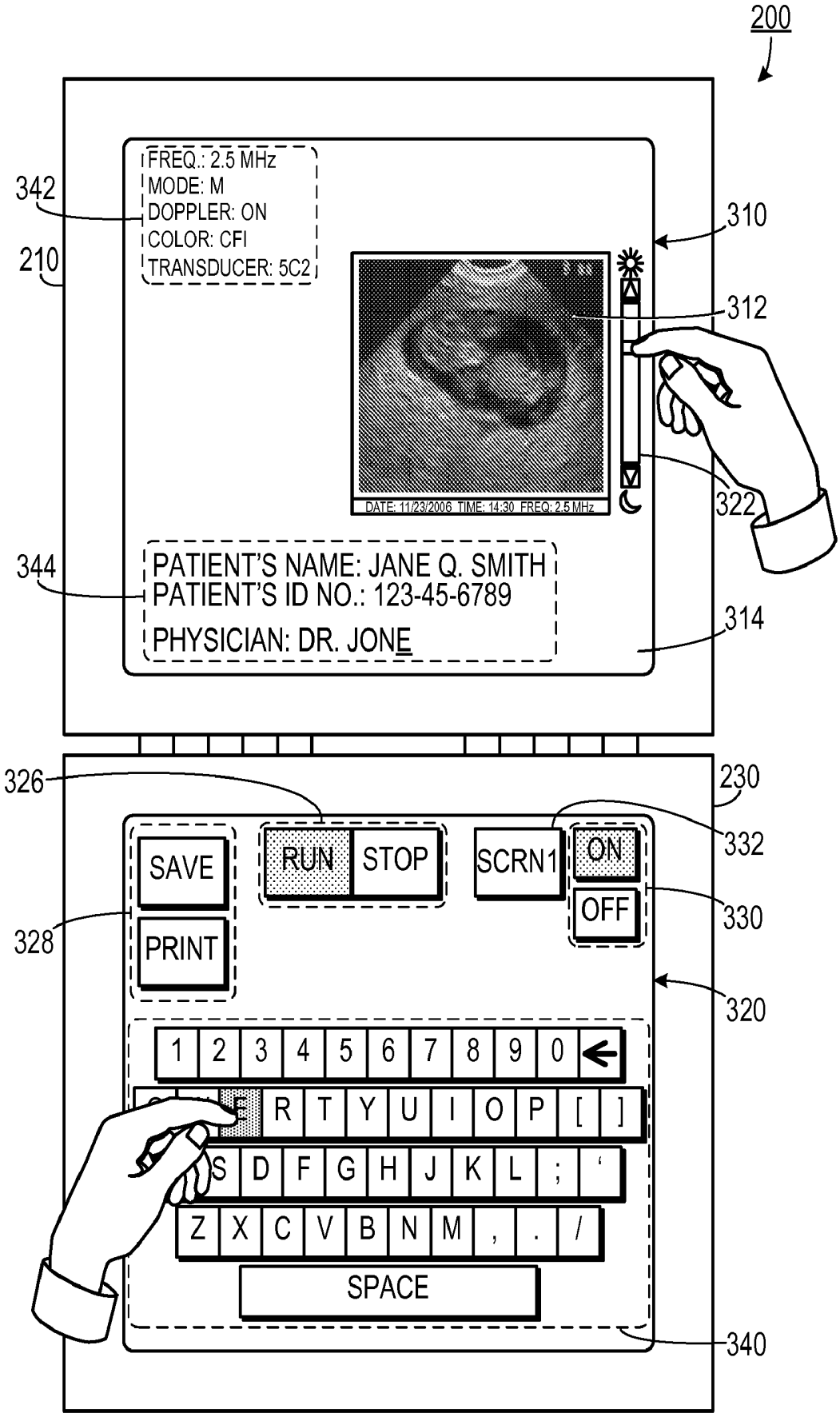

200
342
210
FREQ.: 2.5 MHz
MODE: M
DOPPLER: ON
COLOR: CFI
TRANSDUCER: 5C2
310
312
322
DATE: 11/23/2006 TIME: 14:30 FREQ: 2.5 MHz
344
PATIENT'S NAME: JANE Q. SMITH
PATIENT'S ID NO.: 123-45-6789
PHYSICIAN: DR. JONE
314
326
230
SAVE
RUN
STOP
SCRN1
ON
OFF
332
330
328
PRINT
320
1 2 3 4 5 6 7 8 9 0
R T Y U I O P [ ]
S D F G H J K L ; '
Z X C V B N M , . /
SPACE
340

FIG. 3B

PORTABLE ULTRASOUND WITH TOUCH SCREEN INTERFACE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. Provisional Patent Application Ser. No. 60/866470, filed 11/20/2006, the entirety of which is hereby incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to ultrasound systems and, more specifically, to a portable ultrasound system.

[0004] 2. Description of the Prior Art

[0005] Ultrasound imaging has long been used by physicians, and other health care professionals, to view images of phenomena within a body. A typical ultrasound imaging system includes a transducer, a keyboard input, a computer and a display screen. The health care professional enters system input to the computer via the keyboard and views images on the display screen.

[0006] Typically, gels and other fluids get on the hands of the health care professional using an ultrasound imaging system. These fluids can be transferred to the keyboard. Thus, the keyboard must be cleaned regularly. However, this is a difficult process since the keyboard typically has an uneven surface.

[0007] One approach to facilitate cleaning of the keyboard is to place a plastic overlay over the keyboard. The overlay has a shape that is complimentary to the keys of the keyboard and prevents fluids from traveling into the keyboard. However, this approach still requires cleaning of the overlay, which may be difficult because of its irregular shape.

[0008] Several existing system have employed touch screen technology to provide a partial data input interface. However, such systems typically also include a traditional keyboard for data input or are too small for the effective display of ultrasound images.

[0009] Many clinicians need to perform ultrasound imaging away from a fixed site. Typical systems that employ keyboards are bulky, which makes performing ultrasound imaging away from a clinic difficult. One portable system includes a handheld personal digital assistant coupled to an ultrasound probe. This system has a relatively small screen that does not facilitate highly precise real-time diagnostics in many situations.

[0010] Therefore, there is a need for a portable ultrasound imaging system that has an easy to clean user interface.

SUMMARY OF THE INVENTION

[0011] The disadvantages of the prior art are overcome by the present invention which, in one aspect, is an ultrasound system for imaging an object using data received from an ultrasound transducer. A first touch screen is configured to display ultrasound images and to receive control inputs relating to the images. A second touch screen is configured as a user input device. A processor is coupled to the ultrasound transducer so as to receive data therefrom. The processor is also coupled to the first touch screen and to the second touch screen. The processor is configured to generate ultrasound images based on the data received from the ultrasound transducer. The processor is also configured to cause the first touch screen to display the ultrasound images. The processor is also configured to receive control input data from the first touch screen and the second touch screen.

[0012] In another aspect, the invention is an ultrasound system that includes an ultrasound transducer, a first touch screen, a second touch screen, and a processor. The processor is configured to drive the ultrasound transducer and to receive signals therefrom. The processor is electrically coupled to the first touch screen and to the second touch screen. The processor includes a memory on which is stored a program. The program is configured to: drive the first touch screen so as to display on the first touch screen an ultrasound image corresponding to ultrasound data received from the ultrasound transducer, drive the second touch screen so as to display an image of a control interface that includes at least one specific input field indicative of a control value, receive at least one user input juxtaposed with the specific input field, and modify an operating parameter of the ultrasound system so as to conform to the control value. A battery is electrically coupled to, and configured for providing power to, the ultrasound transducer, the processor, the first touch screen and the second touch screen. A briefcase includes a first half that is hingedly attached to a second half. The first touch screen is mounted in the first half and the second touch screen is mounted in the second half. The processor is mounted in a selected one of the first half and the second half and the battery is mounted in a selected one of the first half and the second half.

[0013] In yet another aspect, the invention is an ultrasound apparatus for allowing a user to perform ultrasound imaging. The ultrasound apparatus includes an ultrasound transducer, a processor and a touch screen. The processor is configured to drive the ultrasound transducer and to receive signals therefrom. The touch screen is coupled to the processor. The touch screen is configured to display ultrasound images and to receive control inputs from the user so that the apparatus employs only the touch screen for both displaying the ultrasound images and for receiving the control inputs.

[0014] These and other aspects of the invention will become apparent from the following description of the preferred embodiments taken in conjunction with the following drawings. As would be obvious to one skilled in the art, many variations and modifications of the invention may be effected without departing from the spirit and scope of the novel concepts of the disclosure.

BRIEF DESCRIPTION OF THE FIGURES OF THE DRAWINGS

[0015] FIG. **1** is a schematic diagram of an embodiment of an ultrasound system including a touch screen.

[0016] FIG. **2**A is a photograph of a two touch screen embodiment.

[0017] FIG. **2**B is a cross-sectional schematic diagram of the embodiment shown in FIG. **2**A.

[0018] FIG. **3**A is a schematic diagram of a two touch screen embodiment with a first touch screen configured as a display and a second touch screen configured as a button-type control interface.

[0019] FIG. **3**B is a schematic diagram of a two touch screen embodiment with a first touch screen configured as a display and a second touch screen configured as a keyboard-type control interface.

DETAILED DESCRIPTION OF THE INVENTION

[0020] A preferred embodiment of the invention is now described in detail. Referring to the drawings, like numbers indicate like parts throughout the views. As used in the description herein and throughout the claims, the following terms take the meanings explicitly associated herein, unless the context clearly dictates otherwise: the meaning of "a," "an," and "the" includes plural reference, the meaning of "in" includes "in" and "on."

[0021] As shown in FIG. **1**, one embodiment of the invention includes an ultrasound system **100** for imaging an object. The system **100** includes an ultrasound transducer **102** that generates an ultrasound imaging signal and that receives a return ultrasound imaging data signal (which could be in the form of analog data, digital data, or a combination thereof).

[0022] A processor **104** drives the ultrasound transducer **102** and receives a data signal therefrom. A touch screen **110** is coupled to the processor **104**. The touch screen **110** is configured to display an ultrasound control interface**120**, which can take the form of images of control buttons, and is configured to receive control input from a user. The processor **104** is configured to generate an ultrasound image **112** of an object based on data received from the ultrasound transducer **102** and then display the image **112** of the object on the touch screen **110**. The touch screen **110** presents the sole control interface to the user so that a keyboard is not necessary. Also, the touch screen is of sufficient size that a user is able to make a competent interpretation of the image **112** and so that a user is able to activate individual control buttons **120**.

[0023] As shown in FIGS. **2**A and **2**B, one embodiment of an ultrasound system **200** includes a first touch screen **210** mounted in a first half **242** of a briefcase **240** and a second touch screen **230** mounted in a second half **244** of the briefcase **240**. The first half **242** is coupled to the second half **244** by means of a hinge **246**, or other similar connector. The briefcase **240** could include a rigid material, such as aluminum or plastic. Also mounted in a selected one of the top half **242** and the bottom half **244** is the processor **250** and a power supply (such as a battery **252**), which supplies power to the processor **250**, the first touch screen **210**, the second touch screen **230** and the ultrasound transducer **102**. While a battery power supply is shown, the ultrasound system **200** could also be configured to operate from an electrical outlet. A transducer port **254** facilitates coupling the ultrasound transducer **102** to the processor **250**. A non-volatile memory **256** (such as a hard drive or a memory stick, etc.) is coupled to the processor **250** for storing the operating system, programming and information, such as ultrasound images. A printer **258** (e.g., a thermal printer) can be included with the system to facilitate printing of ultrasound images, or a printer port (not shown) can be coupled to the processor **250** to allow an external printer to be used.

[0024] The touch screens **210** and **230** may be configured in several different ways according to the user's preferences. For example, as shown in FIG. **3**A, the first touch screen **210** can be configured to display images **310**, such as an ultrasound image **312** based on data received from the ultrasound transducer **102** and information **314** about the image. The second touch screen **230** can be configured as a control interface **320**. The control interface **320** could include control field images and spatially juxtaposed data input fields. (Each combination of a control field image and a corresponding input field is referred to herein as a "button.")

[0025] The buttons allow the user modify an operating parameters of the ultrasound system so as to conform to the control value displayed by the button. The control interface could include such buttons as: a brightness sliding scale control button **322**, which controls the brightness of the display; on-off buttons **330**, which can change cause the system to enter and exit a hibernate mode; run-stop buttons **326**, which are used to begin and end an ultrasound testing episode; save-print buttons **328**, which can cause the system to save information, such as a currently-displayed ultrasound image, on the non-volatile storage device and print such information. Printing an image can be effected by an internal printer or an external printer connected to the system. A plurality of process control buttons **324** allows the user to select the operating parameters of the system. A screen-select button **332** allows the user to select from one or more alternate screens (one of which will be shown in FIG. **3**B).

[0026] An alternate display configuration is shown in FIG. **3**B, in which the ultrasound image **312** is scaled down to allow information, such as operating information **342** and identifying information **344** to be displayed thereon. Scaling of the ultrasound image **312** can be effected by the user touching a corner of the ultrasound image **312** and dragging the corner to a location corresponding to the desired size of the ultrasound image **312**. The brightness sliding scale button **322** is also moved up to the first touch screen **310**. The second touch screen **230** can be configured as a keyboard **340** so as to allow the user to input text and numerical information.

[0027] The processor **250** is programmed to receive control inputs from the touch screens **210** and **230**, to drive and receive ultrasound data from the ultrasound transducer **102** and to generate images for display on the touch screens **210** and **230**. (As used herein "processor" includes all of the interfacing electronics necessary for the ultrasound system **200** to operate with the touch screens **210** and **230**, the ultrasound transducer **102**, the printer **258** and any other peripheral devices that may be used with the ultrasound system **200**.) The processor **258** is programmed using one of the many programming tools available for touch screen systems.

[0028] In one commercial embodiment, a dual touch screen system can be purchased from Terason Ultrasound, Division of Teratech Corporation, 77 Terrace Hall Ave., Burlington, Mass. 01803. The system may run ultrasound software developed by Terason.

[0029] In one commercial embodiment, the ultrasound system **200** can include 256 beam-forming channels to create high image quality. 15-inch screens and a wide viewing angle provide a high level of visibility. Compact design of the system allows for diagnostic capability in cramped spaces, such as ambulances, emergency, and sports medicine clinics. The processor can use a Windows® platform and be programmed for auto-recognition of preset exams. The following are illustrative specifications for a commercial embodiment:

[0030] Physical Characteristics:

- **[0031]** Dual 15" XGA Color TFT Active Matrix Display (1024×768 per screen)
- **[0032]** Dual Resistive Touch Screens
- **[0033]** Intel 2.00 GHz Dual Core Processor
- **[0034]** 80 GB Hard Disk Drive

[0035] 2 GB Memory
[0036] Onboard Intel Video Graphics (Shared Memory)
[0037] 2-USB 2.0 Ports
[0038] Integrated Audio Controller
[0039] 802.11 b/g Wireless Adapter
[0040] Windows XP Professional
[0041] Internal 8 Cell Battery
[0042] Built in AC Adapter
[0043] Weight: 9 lbs
[0044] Dimensions: 12"×14"×3.5"
[0045] Full feature ACPI power management, Stand-by, Suspend to Disk, and Suspend to RAM

[0046] Imaging Modes:
[0047] B-Mode
[0048] M-Mode
[0049] Power Doppler
[0050] Color Flow Imaging
[0051] Directional Power Doppler
[0052] Pulsed Wave Doppler

[0053] Transducers
[0054] 4V2 (Vector)
[0055] Presets: Cardiac, Gynecological, Obstetrical, Pelvic, Prostate, Renal
[0056] 5C2 (Curved Array)
[0057] Presets: Fetal Cardial, Gynecological, Obstectrical, Pelvic, Prostate, Renal
[0058] 7L3 (Linear)
[0059] Presets: Breast, Carotid, Dialysis Access, Musculoskeletal, Testes, Thyroid, Vascular
[0060] Access, Venous
[0061] 12L5 (Linear)
[0062] Breast, Carotid, Dialysis Access, Musculoskeletal, Testes, Thyroid, Vascular Access,
[0063] Venous

[0064] User Interface Features:
[0065] Pre-Programmed Hot Keys
[0066] Adjustable brightness
[0067] Adjustable color scheme
[0068] Controls: zoom, full screen, depth, size, gain, play/pause/next/back, invert, freeze, colorization, smoothing, persistence, MAP, sweep speed, time series image height, contrast, ellipse measurement, linear measurement, text, print, print preview, save as ULT, BMP, JPEG, TIF, export, new patient, patient info, image sorter
[0069] Image Display Properties: body marker, depth ruler, frame rate, measurement value, orientation logo, TGC Display
[0070] Needle Guide Display: Guide Lines, needle guide target indicator, biplanar grid selection
[0071] Annotation: Body Marker, Text
[0072] Help: Help Topics, Technical Support, About

[0073] System Parameters:
[0074] Static Image and Loop Image Storage
[0075] Storage capability of greater than 50,000 images
[0076] Up to 200 frames per second
[0077] 256 Digital Beamforming Channels (128 Transmit, 128 Receive)

[0078] Because the input interface for the ultrasound system is a touch screen, cleaning of the interface is quite easy—requiring only a wiping off of the touch screen.

[0079] The above described embodiments, while including the preferred embodiment and the best mode of the invention known to the inventor at the time of filing, are given as illustrative examples only. It will be readily appreciated that many deviations may be made from the specific embodiments disclosed in this specification without departing from the spirit and scope of the invention. Accordingly, the scope of the invention is to be determined by the claims below rather than being limited to the specifically described embodiments above.

1. An ultrasound system for imaging an object using data received from an ultrasound transducer, comprising:
a. a first touch screen that is configured to display ultrasound images and to receive control inputs relating to the images; and
b. a second touch screen that is configured as a user input device; and
c. a processor, coupled to the ultrasound transducer so as to receive data therefrom, and coupled to the first touch screen and to the second touch screen, the processor configured to generate ultrasound images based on the data received from the ultrasound transducer, the processor also configured to cause the first touch screen to display the ultrasound images, the processor also configured to receive control input data from the first touch screen and the second touch screen.

2. The ultrasound system of claim **1**, wherein the first touch screen is hingedly coupled to the second touch screen.

3. The ultrasound system of claim **2**, wherein the first touch screen is mounted in a first half of a briefcase and wherein the second touch screen is mounted in a second half of the briefcase.

4. The ultrasound system of claim **3**, wherein the processor is mounted in a selected one of the first half of the briefcase and the second half of the briefcase.

5. The ultrasound system of claim **3**, wherein a battery, electrically coupled to the first touch screen and to the second touch screen, is mounted in a selected one of the first half of the briefcase and the second half of the briefcase.

6. The ultrasound system of claim **1**, wherein the processor is programmed to drive the first touch screen so as to receive a touch input indicative of a user's desire to change at least one dimension of an ultrasound image being displayed thereon and wherein the processor is programmed to drive the first touch screen so as to change the ultrasound image so as to have the dimension desired by the user.

7. The ultrasound system of claim **1**, wherein the processor is programmed to:
a. drive the second touch screen so as to display an image of a control interface that includes at least one specific input field indicative of a control value;
b. receive at least one user input juxtaposed with the specific input field; and
c. modify an operating parameter of the ultrasound system so as to conform to the control value.

8. The ultrasound system of claim **7**, wherein the operating parameter indicates a manner in which data is output onto a selected one of the first touch screen and the second touch screen.

9. The ultrasound system of claim **7**, wherein the operating parameter indicates a control value used to drive the ultrasound probe.

10. The ultrasound system of claim **7**, wherein the operating parameter indicates a manner in which data from ultrasound probe is processed.

11. The ultrasound system of claim **1**, further comprising a nonvolatile storage device configured to store a plurality of ultrasound images.

12. The ultrasound system of claim **11**, wherein the nonvolatile storage device comprises a hard drive.

13. An ultrasound system, comprising:

a. an ultrasound transducer;

b. a first touch screen;

c. a second touch screen;

d. a processor configured to drive the ultrasound transducer and to receive signals therefrom, the processor being electrically coupled to the first touch screen and to the second touch screen, the processor including a memory on which is stored a program that is configured to:

i. drive the first touch screen so as to display on the first touch screen an ultrasound image corresponding to ultrasound data received from the ultrasound transducer;

ii. drive the second touch screen so as to display an image of a control interface that includes at least one specific input field indicative of a control value;

iii. receive at least one user input juxtaposed with the specific input field; and

iv. modify an operating parameter of the ultrasound system so as to conform to the control value;

e. a battery, electrically coupled to, and configured for providing power to, the ultrasound transducer, the processor, the first touch screen and the second touch screen; and

f. a briefcase including a first half that is hingedly attached to a second half, the first touch screen mounted in the first half, the second touch screen mounted in the second half, the processor mounted in a selected one of the first half and the second half and the battery mounted in a selected one of the first half and the second half.

14. The ultrasound system of claim **13**, wherein the operating parameter indicates a manner in which data is output onto a selected one of the first touch screen and the second touch screen.

15. The ultrasound system of claim **13**, wherein the operating parameter indicates a control value used to drive the ultrasound probe.

16. The ultrasound system of claim **13**, wherein the operating parameter indicates a manner in which data from ultrasound probe is processed.

17. The ultrasound system of claim **13**, further comprising a nonvolatile storage device configured to store a plurality of ultrasound images.

18. The ultrasound system of claim **13**, wherein the nonvolatile storage device comprises a hard drive.

19. An ultrasound apparatus for allowing a user to perform ultrasound imaging, comprising:

a. an ultrasound transducer;

b. a processor configured to drive the ultrasound transducer and to receive signals therefrom;

c. a touch screen, coupled to the processor, that is configured to display ultrasound images and to receive control inputs from the user so that the apparatus employs only the touch screen for both displaying the ultrasound images and for receiving the control inputs.

* * * * *

专利名称(译)	便携式超声波触摸屏界面		
公开(公告)号	US20080119731A1	公开(公告)日	2008-05-22
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申请(专利权)人(译)	北美医疗法人		
[标]发明人	BECERRA CARLOS CHANDLER WILLIAM K ZELEKE ABEBAW		
发明人	BECERRA, CARLOS CHANDLER, WILLIAM K. ZELEKE, ABEBAW		
IPC分类号	A61B8/00		
CPC分类号	A61B8/00 A61B8/463 A61B8/4427 A61B8/467 A61B8/465 A61B8/461		
优先权	60/866470 2006-11-20 US		
外部链接	Espacenet USPTO		

摘要(译)

使用从超声换能器接收的数据对物体成像的超声系统采用第一触摸屏，该第一触摸屏被配置为显示超声图像并接收与图像有关的控制输入。第二触摸屏被配置为用户输入设备。处理器耦合到超声换能器，以便从其接收数据。处理器还耦合到第一触摸屏和第二触摸屏。处理器被配置为基于从超声换能器接收的数据生成超声图像。处理器还被配置为使第一触摸屏显示超声图像。处理器还被配置为从第一触摸屏和第二触摸屏接收控制输入数据。