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(54) **SYSTEMS AND METHODS FOR THE DISPLAY OF ULTRASOUND IMAGES**

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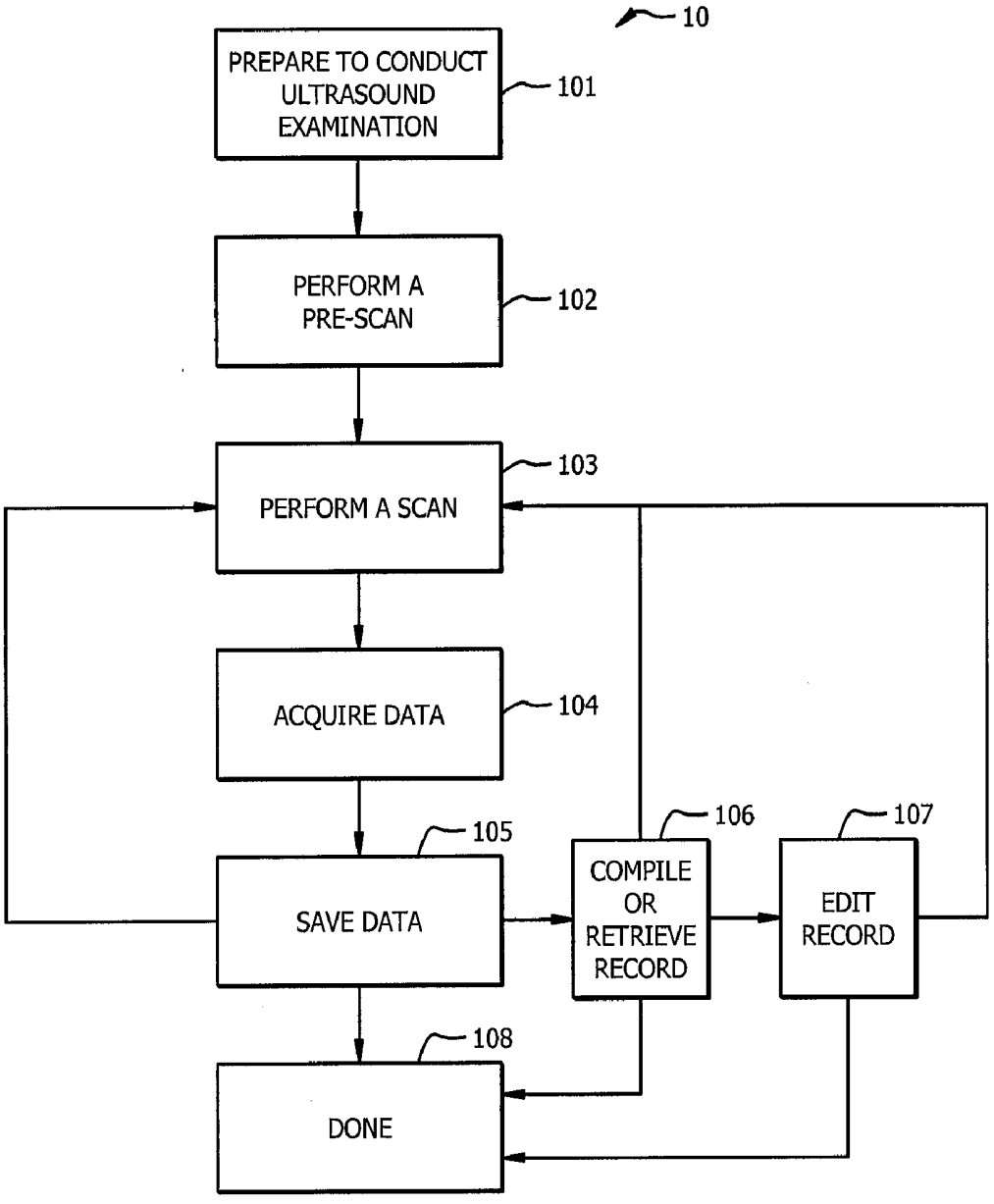
(57) **ABSTRACT**

A method of real time sonographing that includes concurrently displaying a real time ultrasound image and a patient record in a sonographer's paracentral vision. An ultrasound device including a display adapted to concurrently project a real time ultrasound image and a patient record. A method that includes displaying a non-real time ultrasound image and a patient record in a sonographer's paracentral vision. An ultrasound device including a display adapted to project a non real time ultrasound image and a patient record.



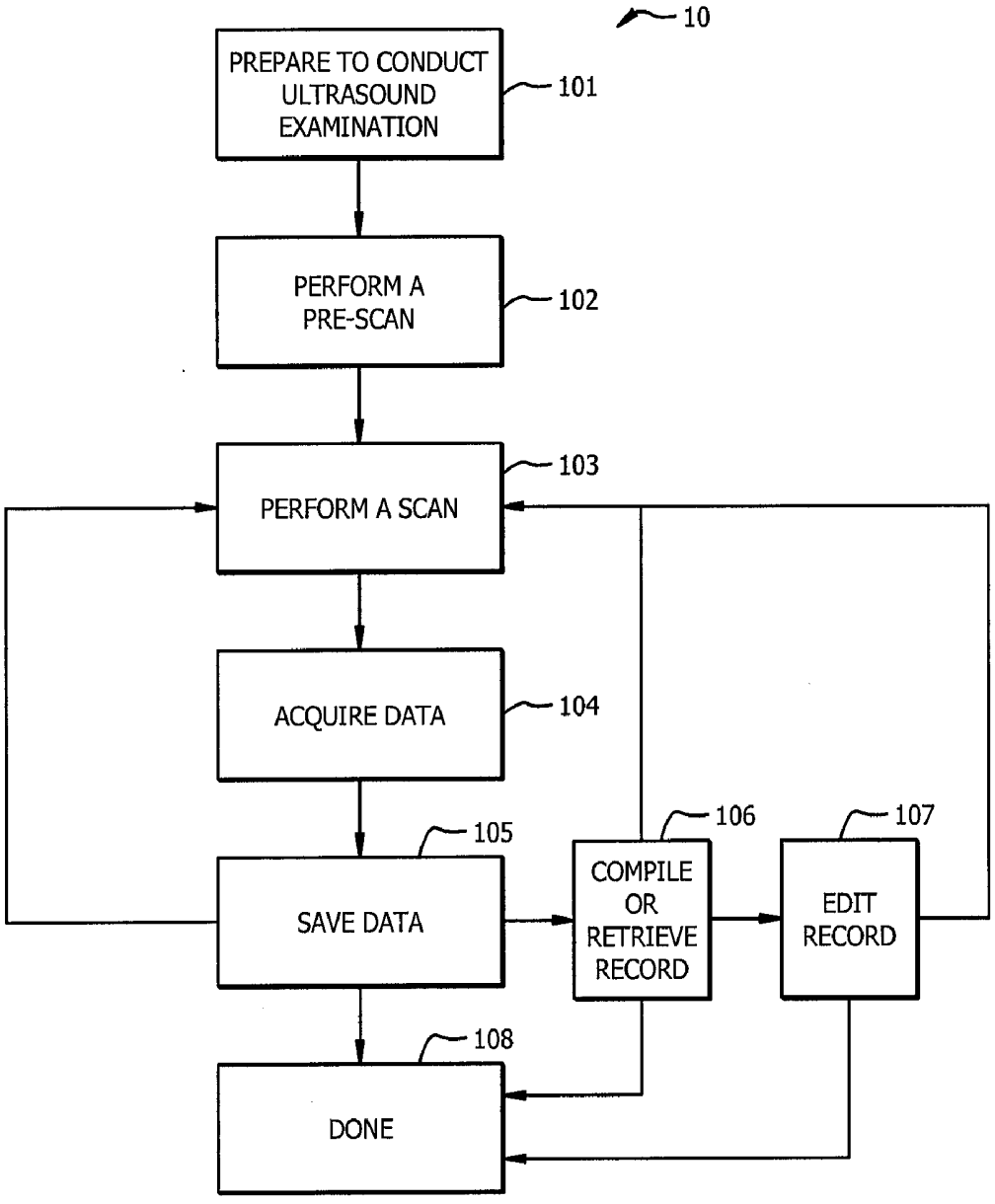

10
PREPARE TO CONDUCT ULTRASOUND EXAMINATION
101
PERFORM A PRE-SCAN
102
PERFORM A SCAN
103
ACQUIRE DATA
104
SAVE DATA
105
COMPILE OR RETRIEVE RECORD
106
EDIT RECORD
107
DONE
108

FIG. 1

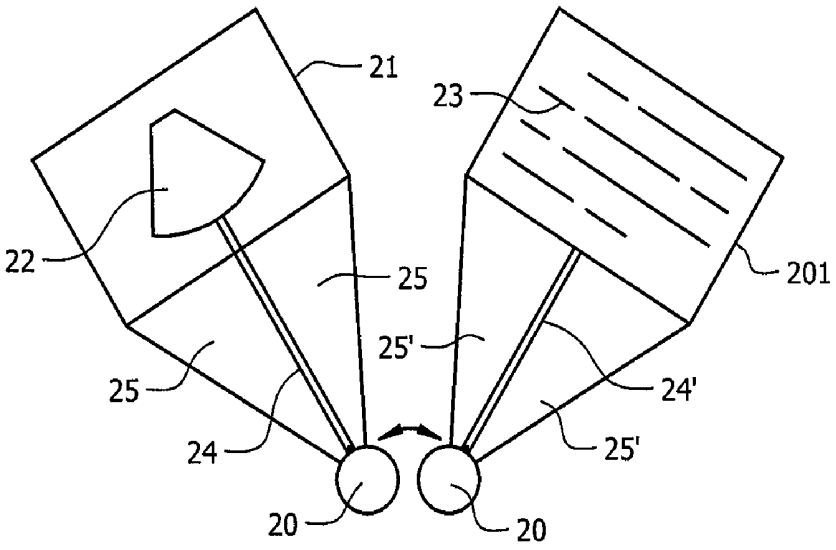


FIG. 2
(Prior Art)

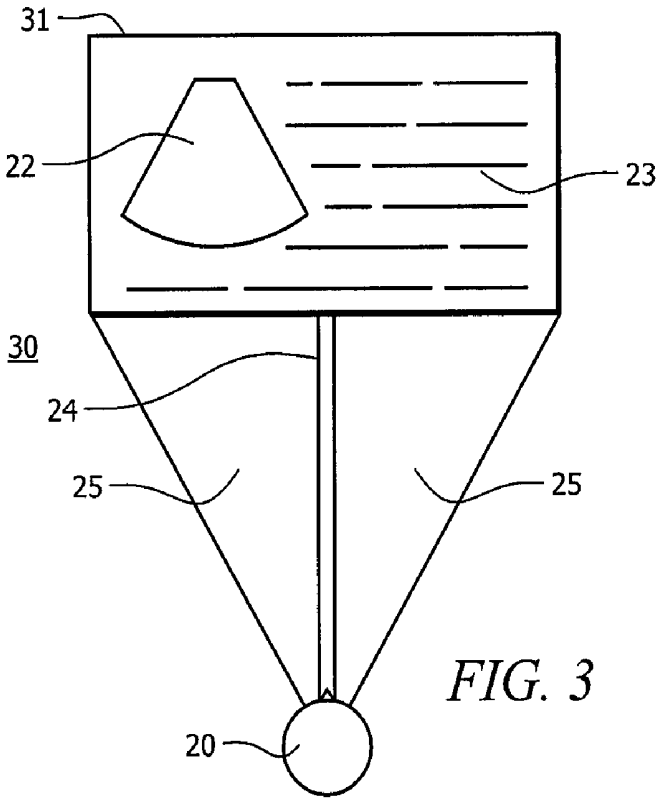


FIG. 3

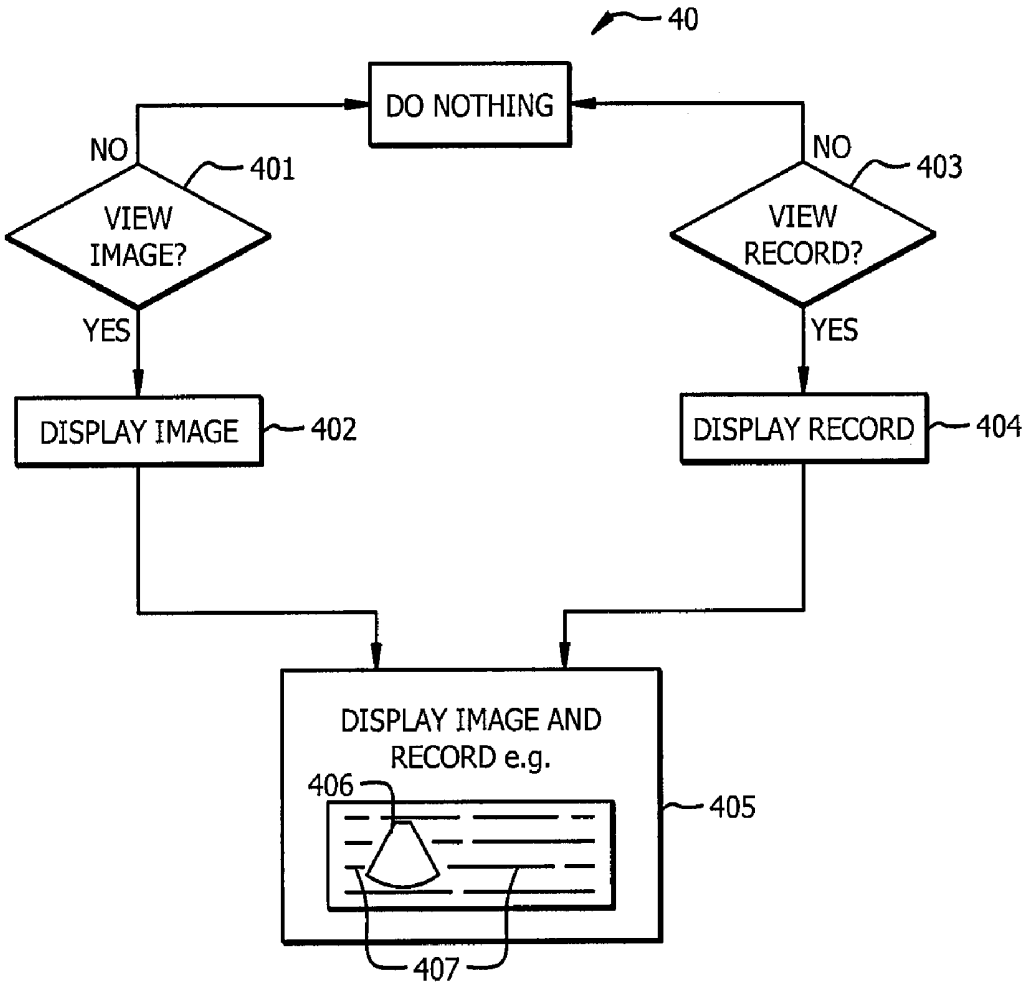

40
DO NOTHING
NO
401
VIEW IMAGE?
YES
DISPLAY IMAGE
402
NO
403
VIEW RECORD?
YES
DISPLAY RECORD
404
DISPLAY IMAGE AND RECORD e.g.
406
405
407

FIG. 4A

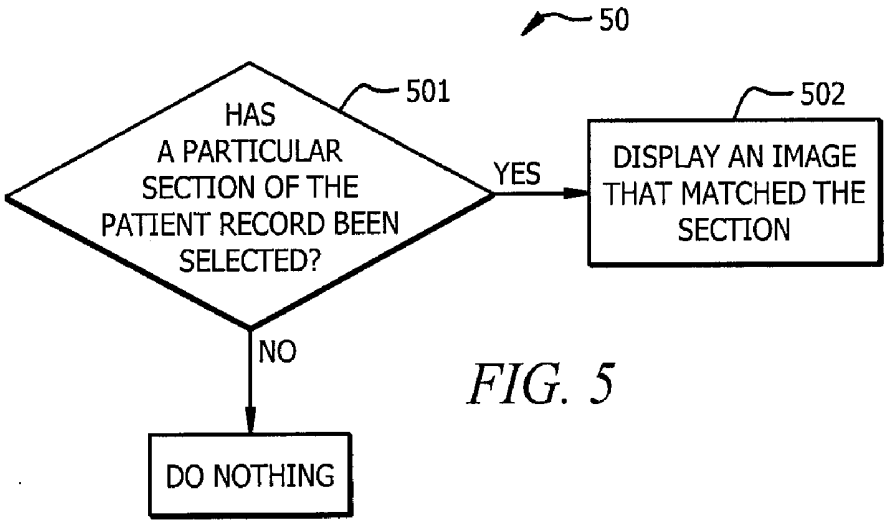

50
501
HAS A PARTICULAR SECTION OF THE PATIENT RECORD BEEN SELECTED?
YES
502
DISPLAY AN IMAGE THAT MATCHED THE SECTION
NO
DO NOTHING

FIG. 5

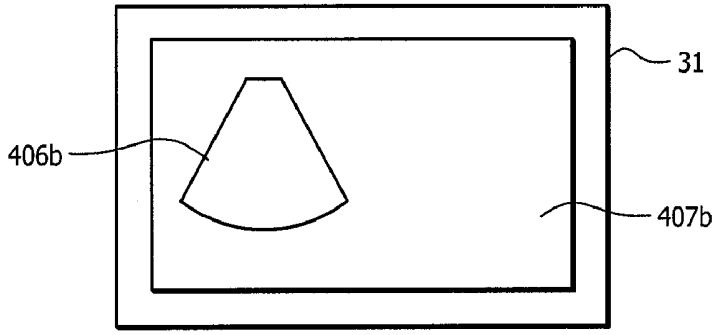


FIG. 4B

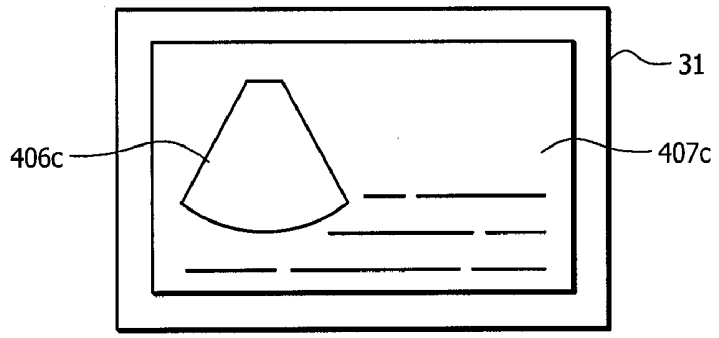


FIG. 4C

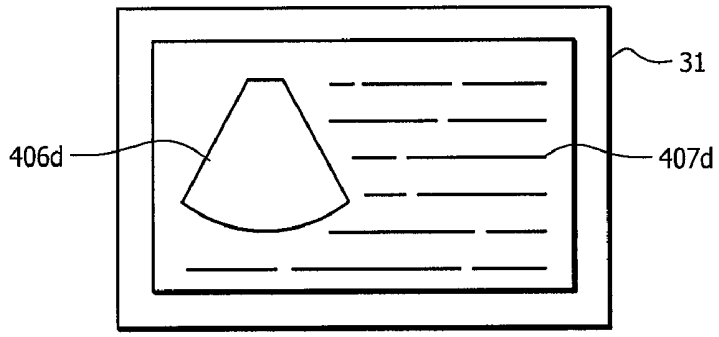


FIG. 4D

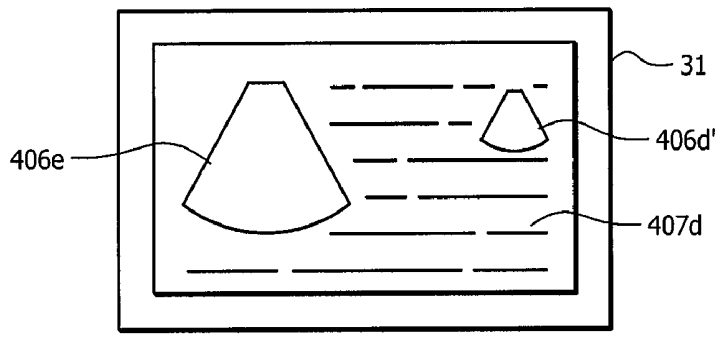


FIG. 4E

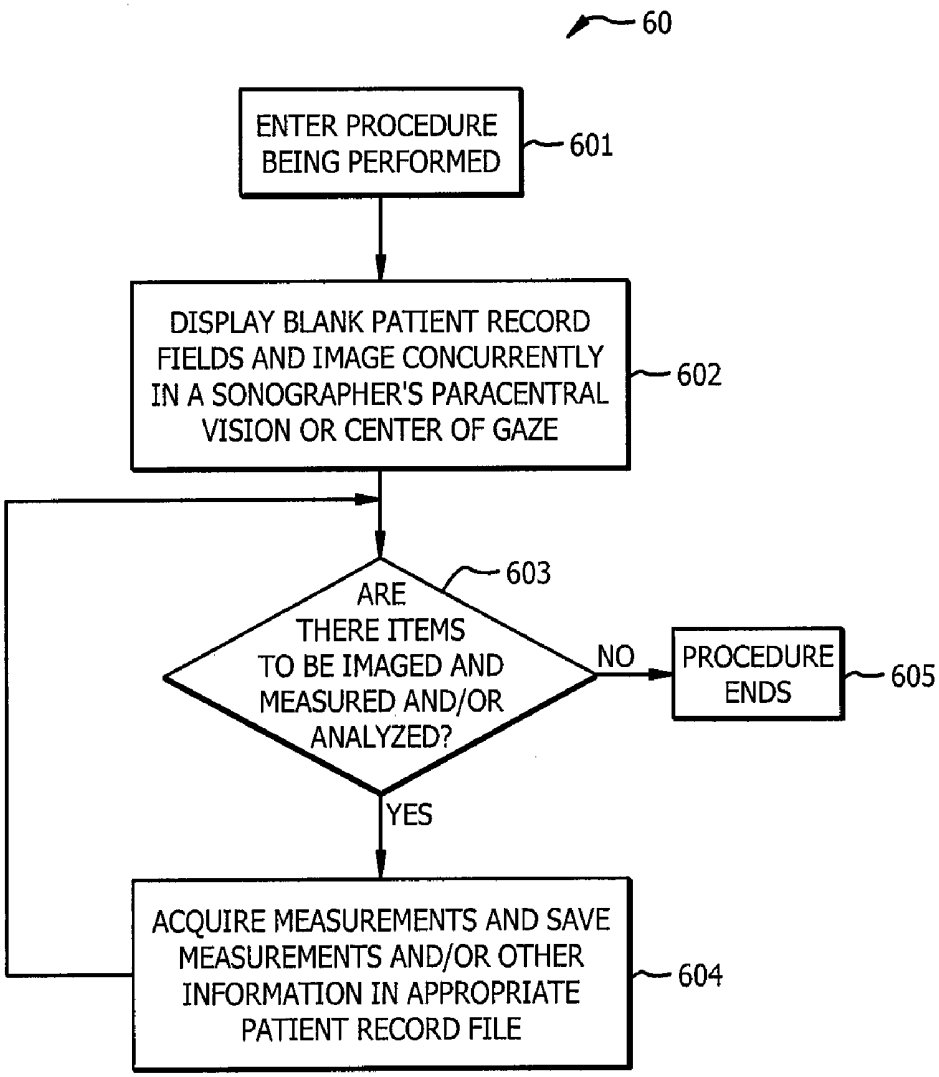

60
ENTER PROCEDURE BEING PERFORMED
601
DISPLAY BLANK PATIENT RECORD FIELDS AND IMAGE CONCURRENTLY IN A SONOGRAPHER'S PARACENTRAL VISION OR CENTER OF GAZE
602
603
ARE THERE ITEMS TO BE IMAGED AND MEASURED AND/OR ANALYZED?
NO
PROCEDURE ENDS
605
YES
ACQUIRE MEASUREMENTS AND SAVE MEASUREMENTS AND/OR OTHER INFORMATION IN APPROPRIATE PATIENT RECORD FILE
604

FIG. 6

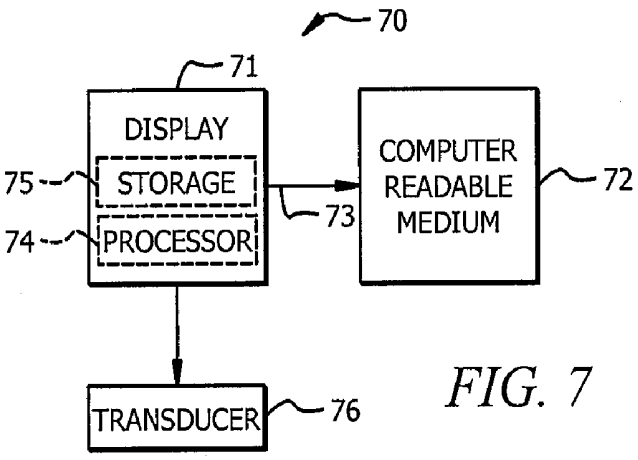

70
71
DISPLAY
75
STORAGE
74
PROCESSOR
73
COMPUTER READABLE MEDIUM
72
TRANSDUCER
76

FIG. 7

SYSTEMS AND METHODS FOR THE DISPLAY OF ULTRASOUND IMAGES

TECHNICAL FIELD

[0001] This disclosure relates to ultrasound imaging and more particularly to systems and methods for displaying ultrasound images and patient records.

BACKGROUND OF THE INVENTION

[0002] Ultrasound is sound with a frequency greater than 20,000 Hz—approximately the upper limit of human hearing. Humans therefore usually cannot hear ultrasound. Ultrasound is utilized for imaging in many different fields. To create an image, ultrasound is made to penetrate a medium and the reflections from the medium are measured and displayed to represent the internal portions of the medium. For example, ultrasound scanning or sonography involves exposing a part of a person's body to ultrasound. The different components of that part of the body reflect the ultrasound differently. Therefore, the reflected ultrasound creates an image of the different components such as organs, tissue, blood vessels etc. One benefit of ultrasound over other imaging techniques, such as x-rays, is that it is captured and observed in real-time. An example of a handheld ultrasound device is disclosed in U.S. Pat. No. 5,722,412, the disclosure of which is incorporated herein by reference.

[0003] A sonographer is a person who operates ultrasonic imaging devices. Typically, in the medical field, ultrasound devices display ultrasound images with the name of the patient and institution where the ultrasound image is being taken. The sonographer usually accesses the patient's medical record from another screen of the ultrasound device, or from another computer's screen or from paper. Additionally, the sonographer observes data from the ultrasound image and manages a patient record on another screen of the ultrasound device, or on another computer's screen or on paper. This process where the sonographer has to direct attention from one medium to another to interpret the ultrasound image and then manage a patient record is time consuming and sometimes confusing. Moreover, the sonographer is subject to making mistakes using this method because it requires the sonographer to memorize and process information as the sonographer moves from one screen to the next or to paper. In sum, current ultrasound devices causes a sonographer to rely heavily on memory or an intermediate step to process a real time ultrasound image and to manage a patient's medical record, which in turn affects the sonographer's efficiency and accuracy.

BRIEF SUMMARY OF THE INVENTION

[0004] The present invention is directed to a system and method which improves the efficiency of a sonographer by facilitating less reliance on memory as the sonographer mentally processes a real time ultrasound image during an ultrasound examination of a patient and manages the patient's medical record. Managing a patient record includes generating, creating, updating, revising and reviewing the patient record. One embodiment of the invention accomplishes this by presenting the ultrasound image and the technical data concurrently in a sonographer's paracentral vision.

[0005] The foregoing has outlined rather broadly the features and technical advantages of the present invention in order that the detailed description of the invention that follows may be better understood. Additional features and advantages of the invention will be described hereinafter which form the subject of the claims of the invention. It should be appreciated by those skilled in the art that the conception and specific embodiment disclosed may be readily utilized as a basis for modifying or designing other structures for carrying out the same purposes of the present invention. It should also be realized by those skilled in the art that such equivalent constructions do not depart from the spirit and scope of the invention as set forth in the appended claims. The novel features which are believed to be characteristic of the invention, both as to its organization and method of operation, together with further objects and advantages will be better understood from the following description when considered in connection with the accompanying figures. It is to be expressly understood, however, that each of the figures is provided for the purpose of illustration and description only and is not intended as a definition of the limits of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] For a more complete understanding of the present invention, reference is now made to the following descriptions taken in conjunction with the accompanying drawing, in which:

[0007] FIG. **1** shows an example of the work flow of an ultrasound examination;

[0008] FIG. **2** shows a prior art illustration of how sonographers currently use ultrasound technology;

[0009] FIG. **3** is one embodiment of the invention;

[0010] FIGS. **4**A-**4**E are processes of embodiments of the invention;

[0011] FIG. **5** is a process of one embodiment of the invention;

[0012] FIG. **6** is a process of one embodiment of the invention; and

[0013] FIG. **7** is a block diagram of one embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0014] FIG. **1** shows work flow **10** of a sonographer doing an ultrasound examination of a patient. In process **101**, the sonographer prepares to conduct the examination. This may include entering patient identification and the procedure being performed into the database of an ultrasound device. Preparation may also involve applying a gel to the area of the body to be scanned. In process **102**, the sonographer uses the transducer—the component of the ultrasound machine that emits the ultrasound—to prescan a part of the patient's body by moving the activated transducer against the body. In process **103**, the sonographer may then apply more gel to the relevant part of the body and performs a complete scan of the relevant part of the body.

[0015] As the sonographer views the ultrasound images in process **103**, the sonographer may determine that the ultrasound image on the screen shows something of interest. In process **104**, the sonographer freezes the ultrasound image and measures portions of the ultrasound image. In process **105**, the sonographer enters these measurements or other information into a database using another screen or paper. The database is stored on a computer readable medium of the ultrasound device. Often times, after the sonographer saves the measurements or other information in process **105**, the

sonographer repeats process **103** and identifies a measurement better than the previous one, or identifies another point of interest. In such a scenario, the sonographer then repeats the acquisition and saving of data in processes **104** and **105** and may replace or augment previously saved data or save the new data as additional data.

[0016] In process **106**, the sonographer may use measurements or other information from the ultrasound image to compile a patient record. Alternatively, in process **106**, the sonographer may retrieve a previously compiled patient record. In process **107**, the sonographer may change edit or delete the previously stored patient record and then return to do further scans, data acquisition and saving in processes **103**, **104** and **105**, respectively. The sonographer may repeat processes **103-105** several times to refine the patient record. One can see, therefore, that the sonographer necessarily and continuously moves back and forth between screens or between screen and paper to view an ultrasound image and manage the patient record.

[0017] FIG. **2** shows how, in current ultrasound imaging technology, sonographer **20** must move his or her focus and attention from screen **21** to screen **201** to perceive ultrasound image **22** on screen **21** and then to see and manage patient record **23** on screen **201**. It should be noted that, instead of a screen, patient record **23** may be on paper. If sonographer **20** is viewing screen **22** at any time, screen **22** will be within sonographer's central area of gaze **24** or in sonographer's paracentral vision **25**. Paracentral vision **25** is the area immediately adjacent to central area of gaze **24**. Thus, for example, it is possible for one to read words in one's paracentral vision but not possible to do so for views outside one's paracentral vision—peripheral vision. Significantly, screen **23** is in sonographer's peripheral view when sonographer **20**'s central area of gaze is on screen **21** and thus patient record **23** on screen **201** cannot be read without sonographer **20** turning his or her head clockwise and thereby changing sonographer **20**'s central area of gaze to central area of gaze $\mathbf{24}^{1}$. Correspondingly, sonographer **20**'s new paracentral vision is paracentral vision $\mathbf{25}^{1}$.

[0018] In sum, if sonographer **20** is viewing screen **21** and then wishes to view screen **201**, sonographer **20** must turn his or her head clockwise to do so. After viewing screen **201** if sonographer **20** wishes to again view screen **21**, sonographer **20** must move his or her head counter clockwise or up or down. Currently, sonographers have to do this repeatedly and it is not only physically tiring but also mentally challenging. Significantly, for sonographer **20** to mentally relate the information from ultrasound image **22** with patient record **23** sonographer **20** must remember the information perceived in the screen not being viewed. In other words, when sonographer **20** views screen **21**, sonographer **20** must remember details shown on **201** and vice versa. This reliance on memory is also necessary if ultrasound image **22** and **23** are displayed consecutively on one screen, say, screen **21**.

[0019] FIG. **3** illustrates one embodiment **30** of the invention—display **31** that allows sonographer **20** to avoid moving his or her head back and forth between an ultrasound image and a screen where sonographer **20** manages a patient record, such as screen **21** and **201**. An ultrasound device display **31** displays, concurrently, ultrasound image **22** and patient record **23** in paracentral vision **25** of sonographer **20**. In some embodiments, the concurrent display of an ultrasound image **22** and patient record **23** is presented in the central area of gaze **24**.

[0020] Concurrently displaying a real-time ultrasound image **22** and patient record **23** in a sonographer's paracentral vision or center of gaze allows the sonographer to view ultrasound image **22** and patient record **23** without having to access another display, flick through different screens on a display or move one's head. Thus, display **31** enables sonographer **20** to avoid the effort and time it would take to access separate screens or media for an ultrasound image and a patient record. This makes it easy for sonographer **20** to analyze information from ultrasound image **22** and to manage patient record **23** at the same time. The sonographer may enter data to manage a patient record by any method, such as by a touch screen feature of display **31** or by a keyboard.

[0021] FIG. **4**A shows the process involved in one embodiment **40** of the invention where the ultrasound device allows the sonographer to determine in processes **401** and **404** whether to view, concurrently, the image and the patient record. If the sonographer wishes to view both, concurrently, then processes **402** and **404** display ultrasound image **406** and patient record **407** at the same time. In other words, this embodiment of the invention achieves a parallel operation as opposed to the prior art which shows a sequential operation. Thus, in process **405**, ultrasound image **406** and patient record **407** are displayed together on a screen so as to fit into a sonographer's paracentral vision or central area of gaze while doing an ultrasound examination. It should be noted that embodiment **40** could involve the concurrent display of any combination of: a real time ultrasound image, a non real time ultrasound image, a current patient record and a previous patient record.

[0022] FIGS. **4**B-**4**E shows how a sonographer generates a patient record **407** using embodiments of the invention. In this example, the sonographer is a medical doctor. The doctor performs a medical procedure on a patient that includes sonographing the chest of a patient. Thus, the doctor may start sonographing the left of the patient's chest and display **31** shows a real time ultrasound image of the left of the patient's chest **406***b*. Because in this example the patient is new, patient record **407***b* has no data in it.

[0023] As the doctor observes real time ultrasound image **406***b*, however, the doctor is able to record data in patient record **407**. Therefore, by the time the doctor sonographs the center of the patient's chest and display **31** shows center chest real time ultrasound image **406***c*, the doctor has recorded clinical information to patient record **407***c* during the current sonographic session.

[0024] The doctor then proceeds to sonograph the right of the patient's chest to display right chest real time ultrasound image **406***e*. As real time ultrasound image **406***e* is displayed, the doctor completes patient record **407***d* for this medical procedure. The doctor may save the patient record **407***d* to a storage device, such as storage device **72** in FIG. **7**. In one embodiment, the doctor may save ultrasound images from real time ultrasound images **406***b*-**406***d*.

[0025] If the patient returns to the doctor, say, months later the doctor may repeat the same procedure by recalling previously stored patient record **407***d*. In one embodiment of the invention, patient record **407***d* may include a non-real time ultrasound image $\mathbf{406}d^{1}$ which was saved from the previous real time ultrasound image **406***d*.

[0026] FIG. **5** shows process **50** of one embodiment of the invention that correlates the ultrasound image with a section of a patient's record. Process **501** determines whether a particular section of a patient record has been selected for

example by a mouse cursor being positioned over that section of the patient record. If a particular section of the patient record has been selected, process **502** automatically displays the ultrasound image that matches the particular section. To facilitate this type of correlation, the software program for the ultrasound device allows the sonographer to store information, in relation to a particular ultrasound image, in a database on a storage medium which can be within the ultrasound device. Alternatively, the ultrasound device's software program makes this correlation automatically based on the ultrasound image displayed when the sonographer initially recorded that section of the patient record.

[0027] FIG. **6** is a flow diagram **60** showing the process of performing an ultrasound examination that involves preparing a patient record using one embodiment of the invention. In process **601**, the sonographer enters the name of the sonographic procedure into the database of the ultrasound device. In process **602**, the ultrasound device concurrently displays, in a sonographer's paracentral vision or center of gaze, an ultrasound image and fields, which are capable of accepting data for a patient's record. In process **603**, the ultrasound device determines (either by asking the sonographer or by use of an internal program) whether there are items to be imaged and measured. If there are, process **604** instructs the user to acquire and save the measurements and/or other information. Process **604** is repeated as many times as is necessary. If there are no items to be imaged then process **605** ends the procedure.

[0028] FIG. **7** shows a block diagram system **70** that represents one embodiment of the invention. Display **71** is capable of concurrently projecting a real time ultrasound image and a patient record. Display **71** is connected to computer readable medium **72** by communication link **73**. Computer readable medium **72** is capable of storing, among other things, software for operating the ultrasound system and a patient record projected on display **71**. Communication link **73** may be any type of communication link including wire or wireless. In one embodiment, processor **74** controls the flow and processing of data to/from transducer **76** and to/from computer readable medium **72** and storage **75**. Note that in some embodiments, elements **71**, **72** and **76** can be in a common housing, or element **72** could be partially in the housing and partially remote therefrom. In one embodiment, system **70** may be a review station. In this embodiment, display **71** concurrently displays an ultrasound image from a previously conducted ultrasound session and a previously stored patient record. The ultrasound image from the previous session and the previous patient record may be retrieved from storage on computer readable medium **72**.

[0029] Although the present invention and its advantages have been described in detail, it should be understood that various changes, substitutions and alterations can be made herein without departing from the spirit and scope of the invention as defined by the appended claims. Moreover, the scope of the present application is not intended to be limited to the particular embodiments of the process, machine, manufacture, composition of matter, means, methods and steps described in the specification. As one of ordinary skill in the art will readily appreciate from the disclosure of the present invention, processes, machines, manufacture, compositions of matter, means, methods, or steps, presently existing or later to be developed that perform substantially the same function or achieve substantially the same result as the corresponding embodiments described herein may be utilized according to the present invention. Accordingly, the appended claims are intended to include within their scope such processes, machines, manufacture, compositions of matter, means, methods, or steps.

What is claimed is:

1. A method of real time sonographing, said method comprising:
concurrently displaying a real time ultrasound image and a patient record in a sonographer's paracentral vision.

2. The method of claim **1** wherein said displaying of said ultrasound image and said patient record is within said sonographer's center of gaze.

3. The method of claim **1** wherein said displaying is done by a single electronic screen of an ultrasound device.

4. The method of claim **1** wherein said patient record is created during said real time sonographing.

5. The method of claim **1** wherein said patient record is updated during said real time sonographing.

6. The method of claim **1** wherein said patient record was stored, prior to said real time sonographing, in a computer readable medium.

7. The method of claim **1** further comprising:
said sonographer managing said patient record.

8. The method of claim **1** further comprising:
identifying information from said ultrasound image; and
correlating said information with said ultrasound image while both said ultrasound image and said correlated information are displayed concurrently.

9. The method of claim **8** wherein said correlation involves displaying said ultrasound image when said information is selected.

10. The method of claim **8** wherein said correlation involves displaying said information when said ultrasound image is selected.

11. An ultrasound device comprising:
a display adapted to concurrently show a real time ultrasound image and a patient record; and
a processor adapted for operating said ultrasound device, said processor comprising computer readable medium for storing said patient record.

12. The ultrasound device of claim **11** wherein said display is an electronic screen.

13. The ultrasound device of claim **12** wherein said electronic screen is a touch screen.

14. The ultrasound device of claim **11** wherein said ultrasound image is an image of at least part of said patient's body and said concurrently displayed patient record comprises data from a current sonographic session.

15. The ultrasound device of claim **11** wherein said ultrasound image is an image of at least part of said patient's body and said concurrently displayed patient record comprises retrieved data.

16. The ultrasound device of claim **15** wherein said retrieved data is selected from: a previous patient record, an ultrasound image from a previous sonographic session.

17. An ultrasound system comprising:
means for concurrently showing a real time ultrasound image and a patient record; and
means for storing said patient record.

18. The ultrasound system of claim **17** wherein said means for concurrently showing is an electronic screen.

19. The ultrasound system of claim **17** wherein said electronic screen is a touch screen.

20. The ultrasound system of claim **17** wherein said ultrasound image is an image of a patient and said concurrently displayed patient record comprises data from a current sonographic session.

21. The ultrasound system of claim **17** wherein said ultrasound image is an image of a patient and said concurrently displayed patient record comprises retrieved data.

22. The ultrasound system of claim **21** wherein said retrieved data is selected from: a previous patient record, an ultrasound image from a previous sonographic session.

23. A method comprising:

concurrently displaying a non-real time ultrasound image and a patient record in a user's paracentral vision.

24. The method of claim **23** wherein said displaying of said ultrasound image and said patient record is within said user's center of gaze.

25. The method of claim **23** wherein said displaying is done by a single electronic screen of an ultrasound device.

26. The method of claim **23** wherein said non-real time ultrasound image and said patient record are retrieved from a computer readable medium's storage.

27. The method of claim **23** further comprising:

managing said patient record.

28. An ultrasound device comprising:

a display adapted to concurrently show a non-real time ultrasound image and a patient record; and

a processor adapted for operating said ultrasound device, said processor comprising computer readable medium for storing said non-real time ultrasound image and said patient record.

29. The ultrasound device of claim **28** wherein said display is an electronic screen.

30. The ultrasound device of claim **29** wherein said electronic screen is a touch screen.

31. An ultrasound system comprising:

means for concurrently showing a non-real time ultrasound image and a patient record; and

means for storing said patient record.

32. The ultrasound system of claim **31** wherein said means for concurrently showing is an electronic screen.

33. The ultrasound system of claim **31** wherein said electronic screen is a touch screen.

* * * * *

专利名称(译)	用于显示超声图像的系统和方法		
公开(公告)号	US20100081930A1	公开(公告)日	2010-04-01
申请号	US12/240634	申请日	2008-09-29
[标]申请(专利权)人(译)	索诺塞特公司		
申请(专利权)人(译)	SONOSITE INC.		
当前申请(专利权)人(译)	SONOSITE INC.		
[标]发明人	DUNBAR LEE		
发明人	DUNBAR, LEE		
IPC分类号	A61B8/00		
CPC分类号	A61B8/00 A61B8/463 G06F19/322 G06F19/321 A61B8/465 G16H10/60 G16H30/20		
外部链接	Espacenet USPTO		

摘要(译)

一种实时超声波检查方法，包括在超声医师的旁中心视觉中同时显示实时超声图像和患者记录。一种超声设备，包括适于同时投影实时超声图像和患者记录的显示器。一种方法，包括在超声医师的旁中心视觉中显示非实时超声图像和患者记录。一种超声设备，包括适于投射非实时超声图像和患者记录的显示器。