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(19) **United States**(12) **Patent Application Publication**  
**Halmann et al.**(10) **Pub. No.: US 2018/0185009 A1**(43) **Pub. Date: Jul. 5, 2018**(54) **METHOD AND SYSTEM FOR PDA-BASED  
ULTRASOUND***G01S 15/89* (2006.01)*G01S 7/52* (2006.01)(71) Applicant: **GE Medical Systems Global  
Technology Company, LLC,**  
Waukesha, WI (US)(72) Inventors: **Menachem Halmann,** Milwaukee, WI  
(US); **Shinichi Amemiya,** Tokyo (JP)(21) Appl. No.: **15/910,724**(22) Filed: **Mar. 2, 2018**(52) **U.S. Cl.**CPC ..... *A61B 8/462* (2013.01); *A61B 8/145*  
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*A61B 8/4427* (2013.01); *G01S 15/8909*  
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*7/52082* (2013.01); *G01S 7/5208* (2013.01);  
*A61B 8/4472* (2013.01); *A61B 8/14* (2013.01)**Related U.S. Application Data**(60) Continuation of application No. 14/274,122, filed on  
May 9, 2014, now Pat. No. 9,936,936, which is a  
continuation of application No. 14/015,252, filed on  
Aug. 30, 2013, which is a continuation of application  
No. 11/044,401, filed on Jan. 27, 2005, now Pat. No.  
8,535,227, which is a division of application No.  
10/063,342, filed on Apr. 12, 2002, now Pat. No.  
7,115,093.(60) Provisional application No. 60/332,023, filed on Nov.  
21, 2001.**Publication Classification**(51) **Int. Cl.***A61B 8/00* (2006.01)*A61B 8/14* (2006.01)*A61B 8/08* (2006.01)

(57)

**ABSTRACT**

A method and system are disclosed for a compact, inexpensive ultrasound system using an off-the-shelf personal digital assistant (PDA) device interfacing to a hand-held probe assembly through a standard digital interface. The hand-held probe assembly comprises a detachable transducer head attached to a beamforming module that performs digital beamforming. The PDA runs Windows applications and displays menus and images to a user. The PDA also runs ultrasound data processing software to support a plurality of imaging modes. An internal battery is provided in the PDA to power the system. The transducer head is detachable from the beamforming module.

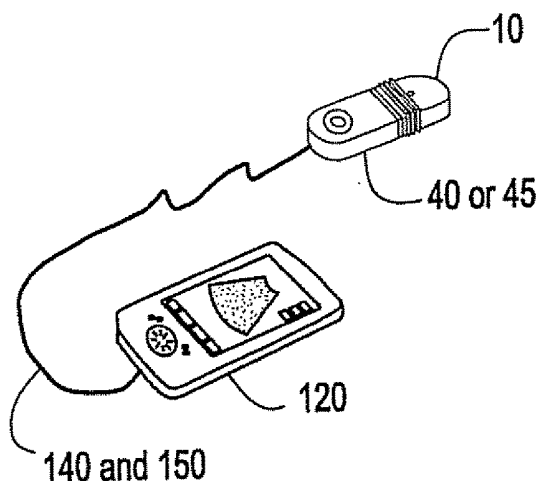
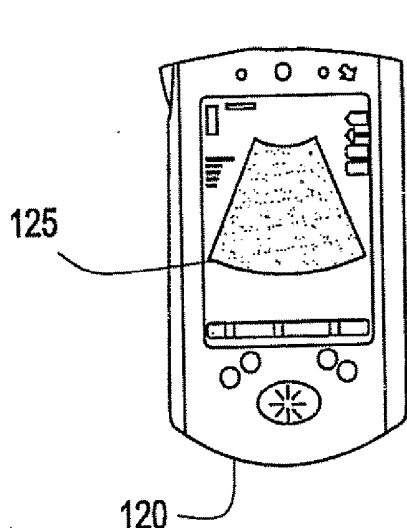


FIG. 1

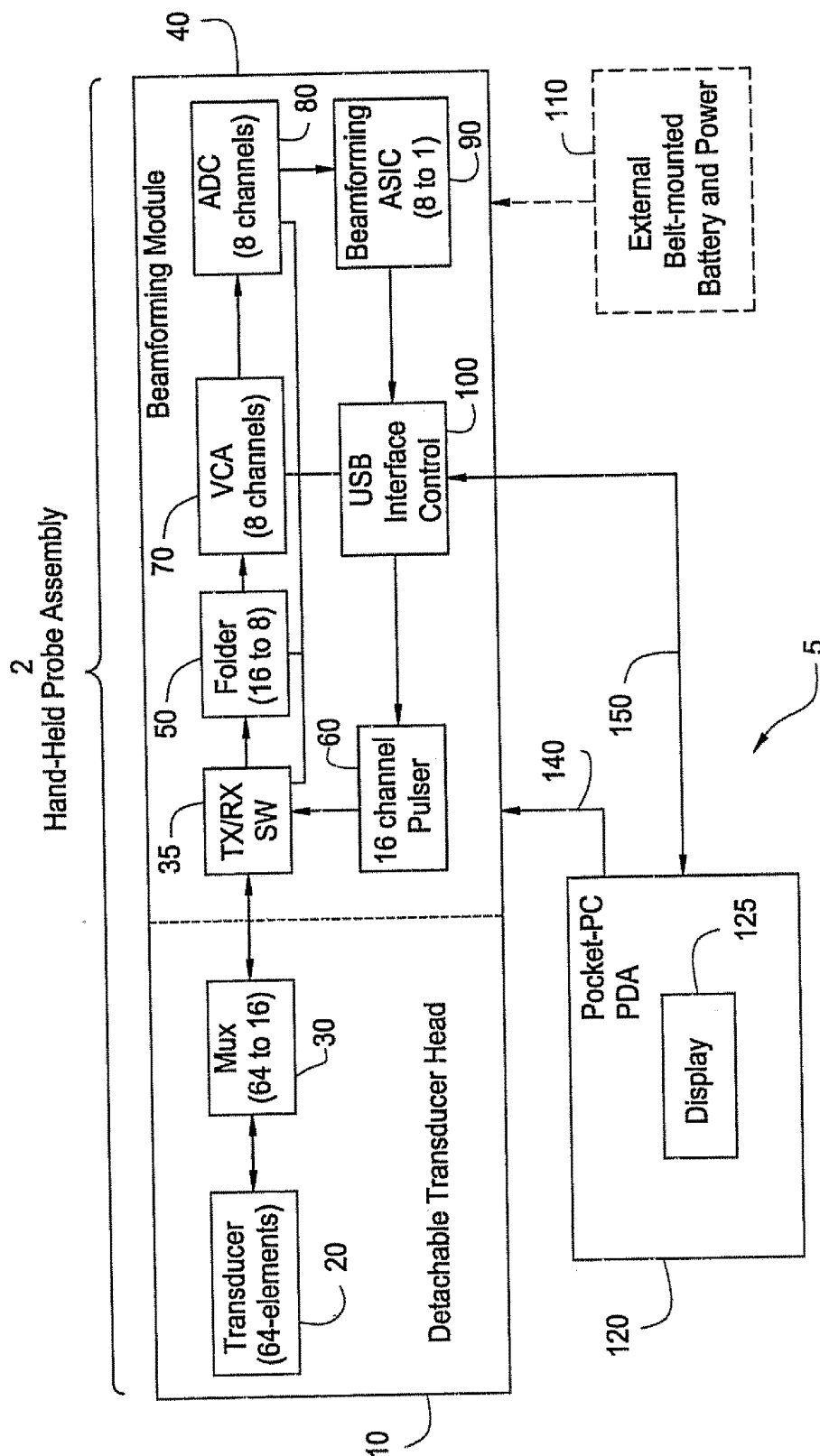


FIG. 1B

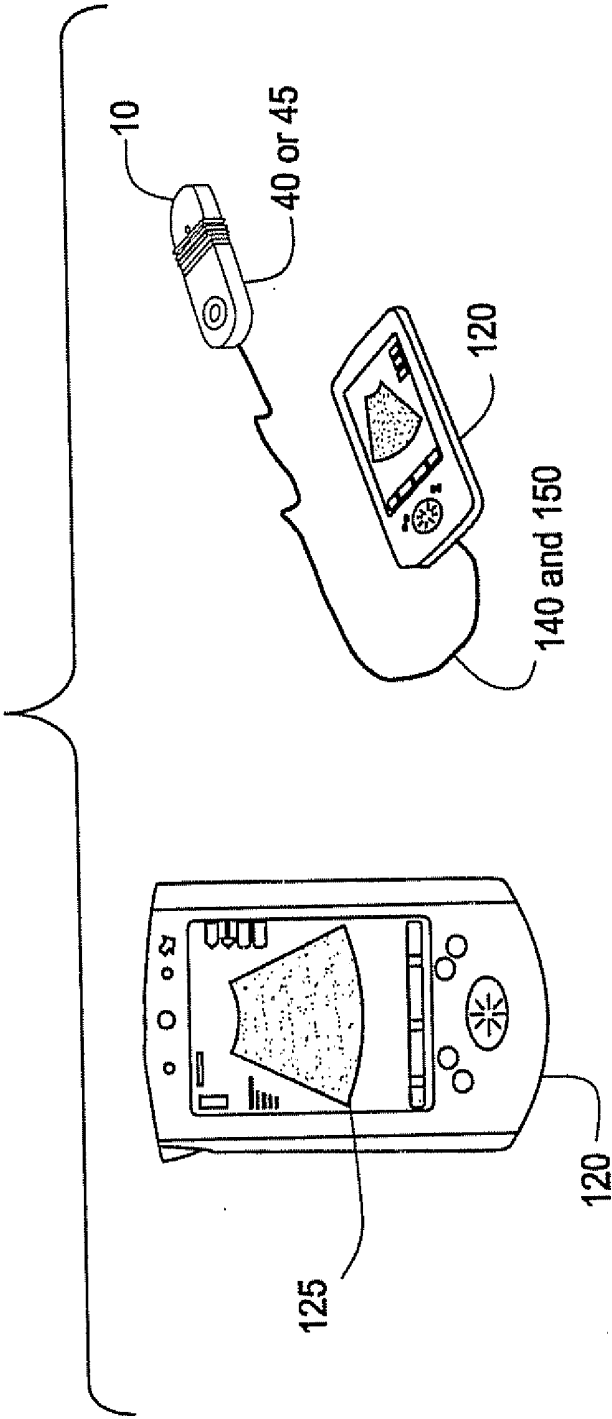


FIG. 2

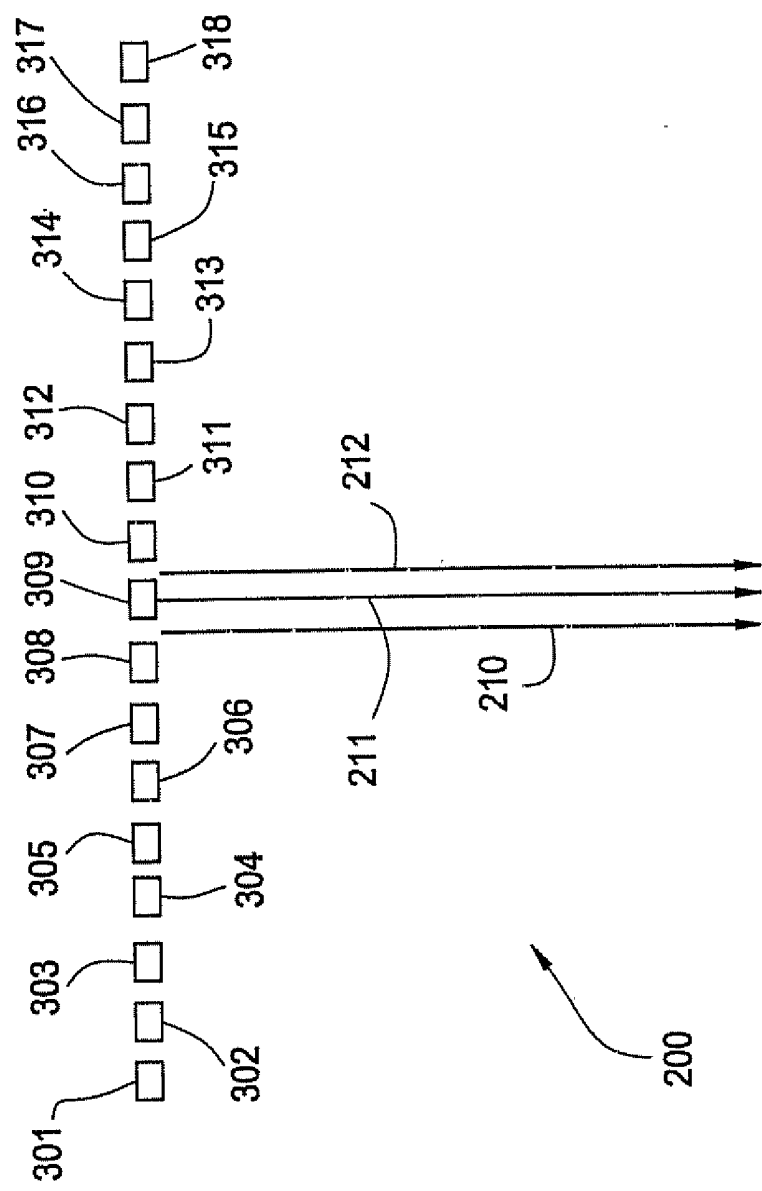


FIG. 3

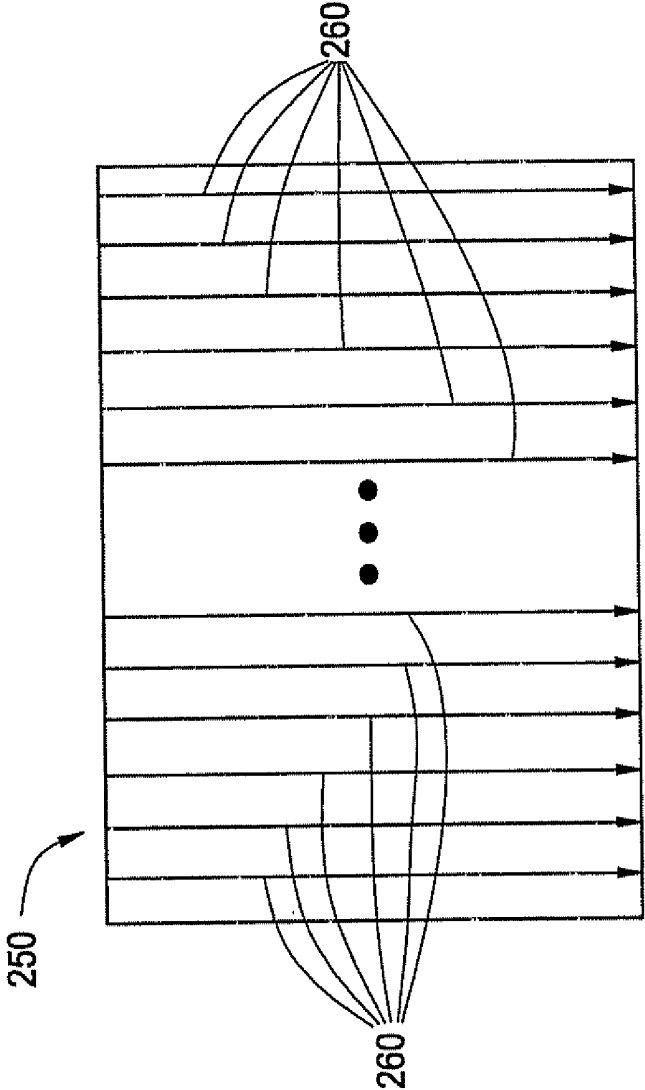


FIG. 4

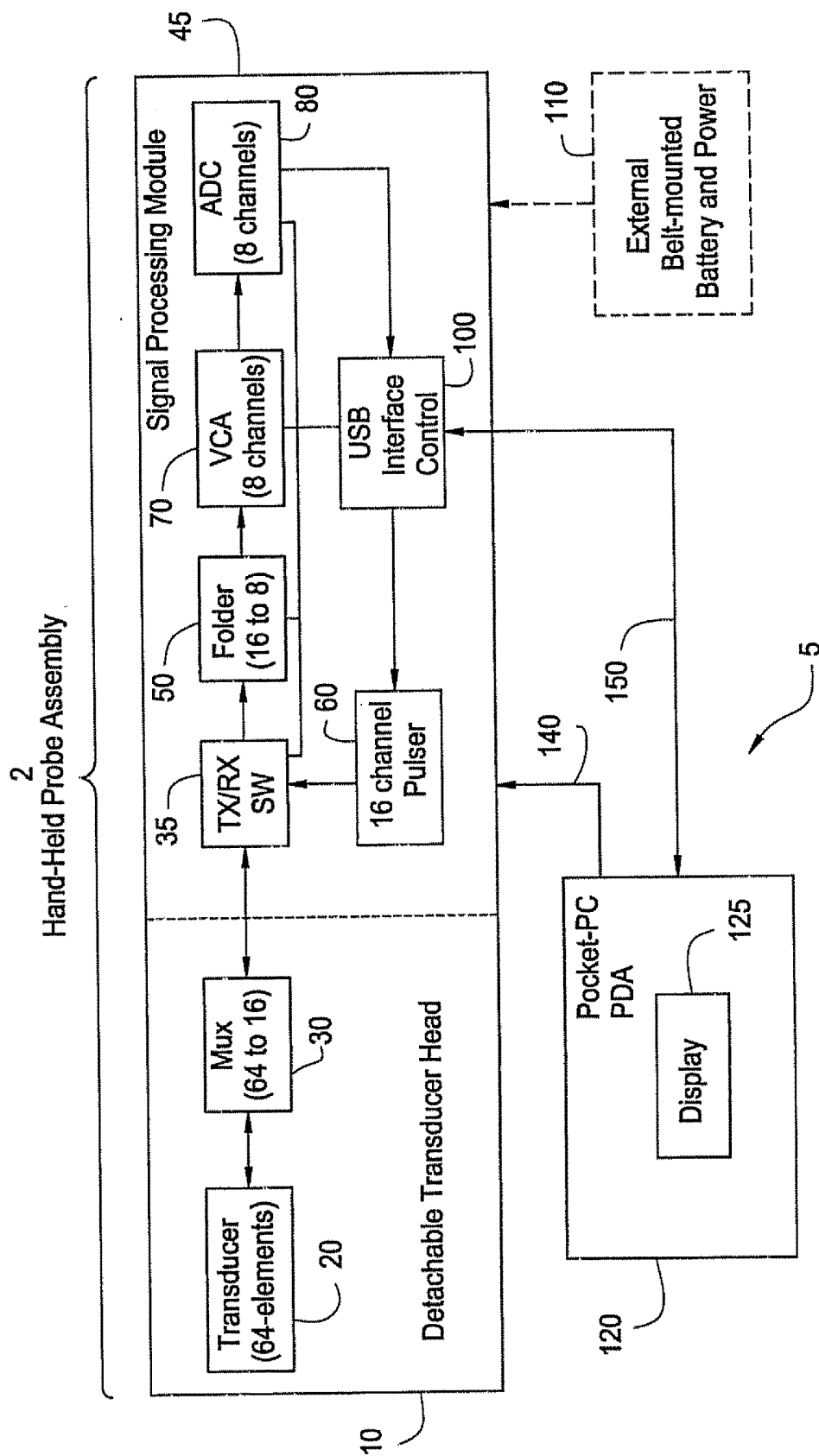
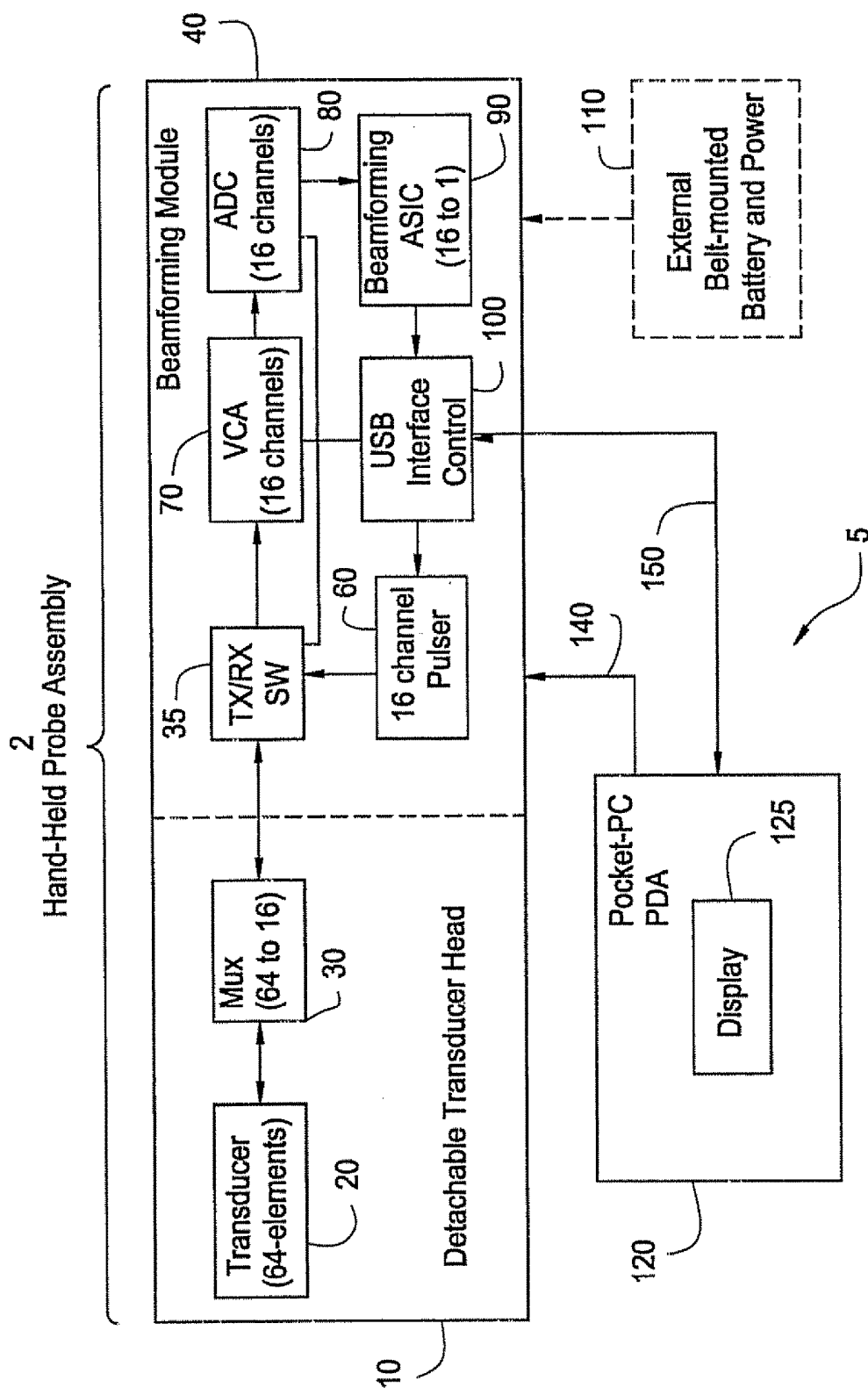


FIG. 5



## METHOD AND SYSTEM FOR PDA-BASED ULTRASOUND

### RELATED APPLICATIONS

**[0001]** The applicants claimed priority based on provisional application No. 60/332,023 filed Nov. 21, 2001 in the names of Nahi Halmann and Shinichi Amemiya.

### FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

**[0002]** [Not Applicable]

### BACKGROUND OF THE INVENTION

**[0003]** Certain embodiments of the present invention relate to a medical diagnostic ultrasound scanner. More particularly, certain embodiments relate to a method and system for configuring a personal digital assistant (PDA) device as an integral part of a portable, hand-held ultrasound system.

**[0004]** Traditional ultrasound systems are often large and bulky and do not lend themselves for ease of portability and tend to be expensive. Therefore, traditional ultrasound systems are not practical for certain market segments such as emergency medical personnel in ambulances, medical school students in training, and physicians and nurses at remote locations.

**[0005]** For example, today, emergency medical personnel (EMP) may use a stethoscope to listen to a patient's chest for lung rattles, or abdominal sounds such as bowel noise, or heart murmurs, etc. If equipped with ultrasound, the EMP could see fluid in the lungs, movement of the bowel, or blood flow in the heart. A more portable type of ultrasound system is required for such an application.

**[0006]** Smaller systems exist but are often still too expensive and/or do not provide desired features. For example, in U.S. Pat. No. 6,106,472 to Chiang et al., a portable ultrasound imaging system is described that uses charge coupled device (CCD) technology and performs beamforming in the analog domain. Such an implementation is limited by the specialized CCD technology and by performing beamforming in the analog domain.

**[0007]** It is more desirable to perform beamforming in the digital domain by first converting ultrasound data from the analog domain to the digital domain by, for example, using a simple analog-to-digital converter (ADC). Beamforming in the digital domain provides more flexibility and potentially better accuracy than beamforming in the analog domain.

**[0008]** A need exists for a small, inexpensive, highly portable ultrasound system employing existing technology that may be used quickly and easily for basic diagnosis in emergency situations at remote locations and for training purposes. A need also exists to perform digital beamforming in a highly portable ultrasound system in order to increase beamforming flexibility and remove the need for specialized hardware.

### BRIEF SUMMARY OF THE INVENTION

**[0009]** An embodiment of the present invention provides for a compact, inexpensive ultrasound system using an off-the-shelf, commercially available personal digital assistant (PDA) device interfacing to a signal beamforming module through a standard digital interface. A detachable

ultrasound transducer head also interfaces to the beamforming module to form a hand-held probe assembly. The PDA runs Windows applications and displays menus and images to a user. The PDA is also modified to include ultrasound data processing and application software to support a plurality of ultrasound imaging modes. An internal battery is provided in the PDA to power the system. Digital beamforming is performed within the beamforming module by a beamforming ASIC.

**[0010]** A method is provided for attaching a detachable transducer head to a beamforming module to form a hand-held probe assembly that includes the beamforming module and the detachable transducer head. Ultrasound signals are received with the hand-held probe assembly from a region of interest to generate a plurality of received digital signals within the hand-held probe assembly. The plurality of received digital signals are digitally beamformed within the hand-held probe assembly to generate beams of digital data corresponding to the region of interest. The beams of digital data are transmitted to a commercially available personal digital assistant (PDA) over a standard digital interface to be further processed and displayed to a user as a displayed image representing the region of interest.

**[0011]** Certain embodiments of the present invention afford an approach to interface a standard, off-the-shelf, inexpensive PDA device to a hand-held ultrasound probe assembly to provide ultrasound scanning capability that is highly portable and affordable.

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0012]** FIG. 1 is a schematic block diagram of a portable diagnostic ultrasound system formed in accordance with an embodiment of the present invention such that digital beamforming is performed within a hand-held probe assembly.

**[0013]** FIG. 1B shows a realistic illustration of the portable diagnostic ultrasound system of FIG. 1.

**[0014]** FIG. 2 illustrates the formation of ultrasound beams in a scan plane originating at certain locations with respect to transducer elements in accordance with an embodiment of the present invention.

**[0015]** FIG. 3 illustrates an image frame made up of multiple received beams in accordance with an embodiment of the present invention.

**[0016]** FIG. 4 is a schematic block diagram of a diagnostic ultrasound system formed in accordance with another embodiment of the present invention such that digital beamforming is performed in a PDA device.

**[0017]** FIG. 5 is a schematic block diagram of a diagnostic ultrasound system formed in accordance with a third embodiment of the present invention.

**[0018]** The foregoing summary, as well as the following detailed description of certain embodiments of the present invention, will be better understood when read in conjunction with the appended drawings. It should be understood, however, that the present invention is not limited to the arrangements and instrumentality shown in the attached drawings.

### DETAILED DESCRIPTION OF THE INVENTION

**[0019]** FIG. 1 is a schematic block diagram of a portable ultrasound system 5 in accordance with an embodiment of the present invention. Certain illustrated elements of the



ultrasound system 5 include a detachable transducer module 10, a beamforming module 40, a PDA device 120, and, optionally, an external battery/power source 110. The transducer module 10 attaches to the beamforming module 40 to form a hand-held probe assembly 2. In an embodiment of the present invention, the PDA 120 includes an internal battery to power the PDA 120 and the hand-held probe assembly 2. A battery power interface 140 connects between the PDA 120 and the hand-held probe assembly 2. FIG. 1B shows a more realistic illustration of the ultrasound system 5.

[0020] The transducer module 10 comprises a 64-element transducer array 20 and a 64 channel to 16 channel multiplexer 30. The beamforming module 40 comprises a pulser 60, a TX/RX switching module 35, a folder module 50, a voltage controlled amplifier (VCA) 70, an analog-to-digital converter (ADC) 80, a beamforming ASIC 90, and a PDA interface controller 100. The PDA device 120 is a standard, off-the-shelf device such as a Palm Pilot running Windows applications such as Windows-CE applications and having a touch-screen display 125. The PDA 120 is also modified to include ultrasound data processing and application software to support a plurality of ultrasound imaging modes.

[0021] In the transducer module 10, the transducer array 20 is connected to the multiplexer 30. When the transducer module 10 is connected to the beamforming module 40, the multiplexer 30 is then connected to an input of TX/RX switching module 35.

[0022] In the beamforming module 40, the output of the TX/RX switching module 35 connects to the input of the folder module 50 and the output of the folder module 50 connects to the input of the VCA 70. The output of the VCA 70 connects to the input of the ADC 80. The output of the ADC 80 connects to the input of the beamforming ASIC 90. The output of the beamforming ASIC 90 connects to the input of the PDA interface controller 100. The output of the 16-channel pulser 60 connects to an input of TX/RX switching module 35. Optionally, an external battery/power source 110 connects to beamforming module 40.

[0023] The PDA interface controller 100 connects to the pulser 60, and to the PDA device 120 through a standard digital interface 150. In an embodiment of the present invention, the standard digital interface 150 is a Universal Serial Bus (USB) interface and the PDA interface controller 100 is a USB controller. Optionally, the standard digital interface 150 may be a parallel interface where the PDA interface controller 100 is a PC card. As a further alternative, the standard digital interface may be a wireless interface such as Bluetooth providing RF communication between the PDA interface controller 100 and the PDA 120.

[0024] The various elements of the portable ultrasound system 5 may be combined or separated according to various embodiments of the present invention. For example, the folder 50 and VCA 70 may be combined into a single processing element. Also, the external battery 110 may be integrated into the beamforming module 40, becoming an internal battery.

[0025] A function of the PDA-based ultrasound scanner 5 is to transmit ultrasound energy into a subject to be imaged, and receive and process backscattered ultrasound signals from the subject to create and display an image on the display 125 of the PDA device 120. A user selects a transducer head 10 to connect to the beamforming module 40 to form a hand-held probe assembly 2 to be used for a particular scanning application. The transducer head is

selected from a group of transducers including linear arrays, curved arrays, and phased arrays. An imaging mode may be selected from a menu on the display 125 of the PDA device 120 using a touch-screen stylus.

[0026] To generate a transmitted beam of ultrasound energy, the PDA device 120 sends digital control signals to the PDA interface controller 100 within the beamforming module 40 through the standard digital interface 150. The digital control signals instruct the beamforming module 40 to generate transmit parameters to create a beam of a certain shape that originates from a certain point at the surface of the transducer array 20. The transmit parameters are selected in the pulser 60 in response to the digital control signals from the PDA device 120. The pulser 60 uses the transmit parameters to properly encode transmit signals to be sent to the transducer array 20 through the TX/RX switching module 35 and the multiplexer 30. The transmit signals are set at certain levels and phases with respect to each other and are provided to individual transducer elements of the transducer array 20. The transmit signals excite the transducer elements of the transducer array 20 to emit ultrasound waves with the same phase and level relationships as the transmit signals. As a result, a transmitted beam of ultrasound energy is formed in a subject within a scan plane 200 (see FIG. 2) along a scan line 210 when the transducer array 20 is acoustically coupled to the subject by using, for example, ultrasound gel.

[0027] In an embodiment of the present invention, a single ultrasound beam is formed along a particular scan line (e.g. 210) using 16 transducer elements. For example, elements 301 through 316 may be used to form a first ultrasound beam along a scan line 210 and elements 302 through 317 may be used to form a second adjacent ultrasound beam along a scan line 212 and so on. As a result, 64 ultrasound beams may be formed to create an image if the transducer array 20 has 64 transducer elements. Alternatively, elements 301 to 316 may be used to form a first ultrasound beam along a scan line 210 and elements 302 through 316 may be used to form a second adjacent ultrasound beam along a scan line 211 and elements 302 through 317 may be used to form a third ultrasound beam along a scan line 212 adjacent to the second ultrasound beam and so on. As a result, 128 ultrasound beams may be formed to create an image if the transducer array 20 has 64 transducer elements. In any event, the pulser 60 sends 16 transmit signals at a time through multiplexer 30 to form a given transmit ultrasound beam along a given scan line. The multiplexer 30 routes the transmit signals to the correct subset of transducer elements in the transducer array 20 to form a particular transmit beam along a particular scan line.

[0028] The transducer elements form a two-way transducer array 20. Once ultrasound waves are transmitted into a subject, the ultrasound waves are backscattered off of tissue and blood samples within the structure. The backscattered waves arrive at the transducer array 20 at different times, depending on the distance into the subject they return from and the angle with respect to the surface of the transducer array 20 at which they return. The transducer elements are responsive to the backscattered waves and convert the ultrasound energy from the backscattered waves into received electrical signals.

[0029] The received electrical signals are routed through the multiplexer 30, 16 signals at a time, to the folder module 50 by way of the TX/RX switching module 35 in beamforming module 40. The folder module 50 uses the symme-

try of the ultrasound beam to process the signals from the 8 right-most transducer elements in the same manner as the signals from the 8 left-most transducer elements since the ultrasound beam originates from the center of 16 transducer elements. The folder module **50** amplifies and weights the received signals and collapses the original 16 received signals into 8 received signals due to the symmetry of the transducer elements about the received beam to be formed.

**[0030]** Next, the received signals are passed to the VCA **70**. The VCA **70** provides the function of gain compensation as a function of time (distance into the image). Next, the ADC **80** digitizes the received signals. The beamforming ASIC **90** then takes the digitized received signals and creates a received beam of data along a scan line (e.g. **210**). The beamforming ASIC **90** operates on the digitized received signals by performing time delaying and summing to create the received beam of data corresponding to sample volumes along a scan line (e.g. **210**) in the scan plane **200** within the subject. The beamforming ASIC **90** is a digital ASIC performing beamforming in the digital domain and providing beamforming flexibility. For example, the beamforming ASIC **90** may be digitally loaded with various beamforming coefficients and instructions from the PDA **120** to perform different types of digital beamforming.

**[0031]** The received beam of digital data is sent to the PDA device **120** by the PDA interface controller **100** over the standard digital interface **150**. The process is repeated for the next receive beam to be formed and so on to generate all of the received beams **260** that make up the image frame **250** for the region of interest (see FIG. **3**).

**[0032]** The PDA device **120** collects and processes the received beam data for the entire set of received beams **260** that make up an image frame **250** and displays the resultant image to the user on the display **125** of the PDA device **120**. The PDA device **120** performs ultrasound data processing including the ultrasound functions of demodulation, parameter estimation, scan conversion, and display processing. A plurality of ultrasound modes may be supported including Doppler processing modes and non-Doppler processing modes.

**[0033]** Frame rates on the order of 10 frames per second may be achieved and the system may consume less than 5 watts of power, allowing for operation over approximately a 2-hour period of time.

**[0034]** As an alternative, the function of the beamforming ASIC **90** may be performed by software in the PDA device **120** as shown in FIG. **4**. Instead of the transducer head attaching to a beamforming module **40**, it attaches to a signal processing module **45** that does not include the beamforming ASIC **90**. The data out of the ADC **80** is sent to the PDA interface controller **100** and the pre-beamformed data is sent to the PDA **120**. Digital beamforming is performed by software within the PDA **120** along with the other subsequent data processing functions.

**[0035]** As a further alternative, the hand-held-probe assembly may include an internal battery to provide power. A docking station may also be provided for the hand-held probe assembly to provide the function of battery recharging.

**[0036]** As still a further alternative, the transducer module **10** may be a sterile probe for use in an operating room (OR), such as in a sterile wireless probe assembly.

**[0037]** As yet another alternative, the beamforming module (or signal processing module) may be designed to

perform 16 bit processing. For example, the folder module **50** may be eliminated and the VCA **70** and the ADC **80** may be designed to handle 16 bits instead of just 8 bits as shown in FIG. **5**.

**[0038]** The various configurations and interfaces within the system **5** may be combined or separated according to various embodiments of the present invention. For example, the beamforming module **40** may comprise custom hardware elements such as a small circuit board with digital signal processors or may comprise readily available off-the-shelf components.

**[0039]** In summary, the advantages and features include, among others, a light-weight, portable ultrasound system based on inexpensive, off-the-shelf PDA technology to provide high portability and ease of use for certain users. Digital beamforming provides maximum beamforming flexibility, and a transducer head may be selected from a set of detachable transducer heads to connect to a beamforming or signal processing module to form a hand-held probe assembly. A user may easily change applications by attaching a different transducer head to the beamforming module or signal processing module and/or by selecting a new imaging application on the touch-screen display of the PDA.

**[0040]** While the invention has been described with reference to certain embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from its scope. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed, but that the invention will include all embodiments falling within the scope of the appended claims.

**1-52.** (canceled)

**53.** A system for performing ultrasound imaging, the system comprising:

a hand-held probe assembly comprising:

a transducer head configured to receive ultrasound signals; and

a beamforming module comprising at least one probe processor disposed in a hand-held probe assembly housing, the at least one probe processor configured to:

generate a plurality of received digital signals from the ultrasound signals; and

digitally beamform the plurality of received digital signals to

generate at least one beam of digital data;

a hand-held display assembly comprising:

at least one display processor disposed in a hand-held display assembly housing, the at least one display processor configured to execute ultrasound application software to create an ultrasound image from the at least one beam of digital data; and

a display configured to present the ultrasound image; and

a digital interface configured to communicatively couple the hand-held probe assembly with the hand-held display assembly, wherein the at least one beam of digital data is transmitted over the digital interface.

**54.** The system of claim **53**, wherein the digital interface is a standard digital interface.

55. The system of claim 54, wherein the standard digital interface is wireless.

56. The system of claim 54, wherein the standard digital interface is a Universal Serial Bus (USB) interface.

57. The system of claim 53, wherein the at least one display processor is configured to receive an imaging mode selection from a plurality of imaging modes via a user interface at the hand-held display assembly.

58. The system of claim 57, wherein the ultrasound application software is configured to create the ultrasound image based at least in part on the imaging mode selection.

59. The system of claim 57, wherein the at least one display processor is configured to send a digital control signal via the digital interface to the beamforming module, the digital control signal comprising instructions for generating transmit parameters to acquire the ultrasound signals.

60. The system of claim 53, wherein the ultrasound application software is configured to perform one or more of demodulation, parameter estimation, and scan conversion.

61. The system of 53, wherein the transducer head is one of a plurality of detachable transducer heads, each of the plurality of detachable transducer heads of a different type corresponding to one of a plurality of imaging applications of the ultrasound application software, and wherein each of the plurality of detachable transducer heads is configured to detachably couple with the beamforming module.

62. The system of claim 53, wherein the display is a touch-screen display.

63. The system of claim 62, wherein the touch-screen display is configured to display menus generated by the ultrasound application software.

64. The system of claim 53, wherein the hand-held probe assembly includes an internal battery to power the hand-held probe assembly.

65. The system of claim 53, comprising a docking station to plug the hand-held probe assembly into for charging a battery of the hand-held probe assembly.

66. The system of claim 53, wherein each of the hand-held probe assembly and the hand-held display assembly comprises an internal battery.

67. The system of claim 53, comprising a cable with a detachable connector configured to detachably couple the hand-held probe assembly and the hand-held display assembly.

68. The system of claim 53, wherein the transducer head comprises:

- a set of transducer elements; and
- a multiplexer connecting to the set of transducer elements to select and route a first set of received analog signals from a subset of the set of transducer elements to the beamforming module.

69. The system of claim 53, wherein the beamforming module comprises:

- an analog-to-digital converter (ADC) configured to convert a third set of received analog signals to a first set of received digital signals; and
- a pulser module configured to generate a set of analog transmit signals in response to digital control data received from the hand-held display assembly and send the set of analog transmit signals to the transducer head.

70. The system of claim 69, wherein the beamforming module comprises:

a TX/RX switching module configured to switch between passing the set of analog transmit signals and a first set of received analog signals;

a folder module configured to generate a second set of received analog signals from the first set of received analog signals received from the transducer head via the TX/RX switching module;

a voltage controlled amplifier (VCA) connecting to the folder module and configured to generate the third set of received analog signals from the second set of received analog signals; and

a digital interface controller connecting to the ADC and configured to transmit the first set of received digital signals to the hand-held display assembly and receive the digital control data from the hand-held display assembly over the digital interface.

71. A method of ultrasound imaging, the method comprising:

receiving ultrasound signals at a transducer head of a hand-held probe assembly;

generating, by at least one probe processor disposed in a hand-held probe assembly housing of a beamforming module of the hand-held probe assembly, a plurality of received digital signals from the ultrasound signals;

digitally beamforming, by the at least one probe processor, the plurality of received digital signals to generate at least one beam of digital data;

transmitting the at least one beam of digital data to a hand-held display assembly over a digital interface communicatively coupling the hand-held probe assembly with the hand-held display assembly;

executing, by at least one display processor disposed in a hand-held display assembly housing of the hand-held display assembly, ultrasound application software to create an ultrasound image from the at least one beam of digital data; and

presenting, at a display of the hand-held display assembly, the ultrasound image.

72. The method of claim 71, wherein the digital interface is a standard digital interface.

73. The method of claim 72, wherein the standard digital interface is wireless.

74. The method of claim 72, wherein the standard digital interface is a Universal Serial Bus (USB) interface.

75. The method of claim 71, comprising receiving, by the at least one display processor, an imaging mode selection from a plurality of image modes via a user interface at the hand-held display assembly.

76. The method of claim 75, wherein the executing the ultrasound application software to create the ultrasound image is based at least in part on the imaging mode selection.

77. The method of claim 75, comprising transmitting, by the at least one display processor, a digital control signal via the digital interface to the beamforming module, the digital control signal comprising instructions for generating transmit parameters to acquire the ultrasound signals.

78. The method of claim 71, comprising performing by the at least one display processor executing the ultrasound application software, one or more of demodulation, parameter estimation, and scan conversion.

79. The method of 71, comprising automatically changing to one of a plurality of imaging applications based on the transducer head detachably coupled to the beamforming module, wherein the transducer head is one of a plurality of

detachable transducer heads configured to detachably couple with a beamforming module of the hand-held probe assembly, each of the plurality of detachable transducer heads of a different type corresponding to one of the plurality of imaging applications of the ultrasound application software.

**80.** The method of claim **71**, wherein the display is a touch-screen display.

**81.** The method of claim **80**, comprising displaying menus generated by the ultrasound application software at touch-screen display.

**82.** The method of claim **71**, comprising detachably coupling the hand-held probe assembly and the hand-held display assembly by a cable with a detachable connector.

**83.** The method of claim **71**, wherein the transducer head is one of a plurality of detachable transducer heads selected from a group comprising a linear array transducer, a curved array transducer, and a phased array transducer.

**84.** The method of claim **71**, wherein the executing, by the at least one display processor, the ultrasound application

software to create the ultrasound image from the at least one beam of digital data comprises:

demodulating the at least one beam of digital data to generate demodulated data;

parameter estimating the demodulated data to generate parameter estimate data;

scan converting the parameter estimate data to generate scan converted data; and

display processing the scan converted data to create the ultrasound image for presentation on the display of the hand-held display assembly.

**85.** The method of claim **84**, wherein the parameter estimating comprises performing Doppler processing.

**86.** The method of claim **71**, wherein the digitally beamforming includes time delaying and summing the plurality of received digital signals.

**87.** The method of claim **71**, comprising recharging an internal battery in the hand-held probe assembly.

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|               |                                                                                                                                                                           |         |            |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|------------|
| 专利名称(译)       | 基于pda的超声的方法和系统                                                                                                                                                            |         |            |
| 公开(公告)号       | <a href="#">US20180185009A1</a>                                                                                                                                           | 公开(公告)日 | 2018-07-05 |
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| 申请(专利权)人(译)   | 通用电气医疗系统全球性技术公司，有限责任公司                                                                                                                                                    |         |            |
| 当前申请(专利权)人(译) | 通用电气医疗系统全球性技术公司，有限责任公司                                                                                                                                                    |         |            |
| [标]发明人        | HALMANN MENACHEM<br>AMEMIYA SHINICHI                                                                                                                                      |         |            |
| 发明人           | HALMANN, MENACHEM<br>AMEMIYA, SHINICHI                                                                                                                                    |         |            |
| IPC分类号        | A61B8/00 A61B8/14 A61B8/08 G01S15/89 G01S7/52                                                                                                                             |         |            |
| CPC分类号        | A61B8/462 A61B8/14 A61B8/4411 A61B8/4488 A61B8/56 A61B8/463 A61B8/465 A61B8/469 A61B8/5207 A61B8/4427 G01S15/8909 G01S7/52085 G01S7/52082 G01S7/5208 A61B8/4472 A61B8/145 |         |            |
| 优先权           | 60/332023 2001-11-21 US                                                                                                                                                   |         |            |
| 其他公开文献        | US10575821                                                                                                                                                                |         |            |
| 外部链接          | <a href="#">Espacenet</a> <a href="#">USPTO</a>                                                                                                                           |         |            |

#### 摘要(译)

公开了一种用于紧凑，便宜的超声系统的方法和系统，该超声系统使用通过标准数字接口连接到手持式探针组件的现成个人数字助理（PDA）设备。手持探针组件包括可拆卸的换能器头，该换能器头连接到执行数字波束形成的波束形成模块。PDA运行Windows应用程序并向用户显示菜单和图像。PDA还运行超声数据处理软件以支持多种成像模式。PDA中提供内部电池以为系统供电。换能器头可从波束形成模块拆卸。

