



US010376238B2

(12) **United States Patent**
Lee

(10) **Patent No.:** **US 10,376,238 B2**
(45) **Date of Patent:** **Aug. 13, 2019**

(54) **SYSTEM AND METHOD FOR CUSTOMIZING A PROBE GRIP FOR AN ULTRASOUND PROBE**

(58) **Field of Classification Search**
CPC B33Y 50/00; B33Y 80/00; B29L 2031/463
See application file for complete search history.

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 735 days.

(21) Appl. No.: **14/961,903**

(Continued)

(22) Filed: **Dec. 8, 2015**

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(65) **Prior Publication Data**

WO 2003037448 A1 5/2003

US 2017/0156694 A1 Jun. 8, 2017

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(51) **Int. Cl.**
A61B 8/00 (2006.01)
B29C 67/00 (2017.01)
B33Y 50/02 (2015.01)
B33Y 80/00 (2015.01)
B33Y 10/00 (2015.01)
B33Y 30/00 (2015.01)
B33Y 40/00 (2015.01)
B33Y 50/00 (2015.01)
B29L 31/46 (2006.01)

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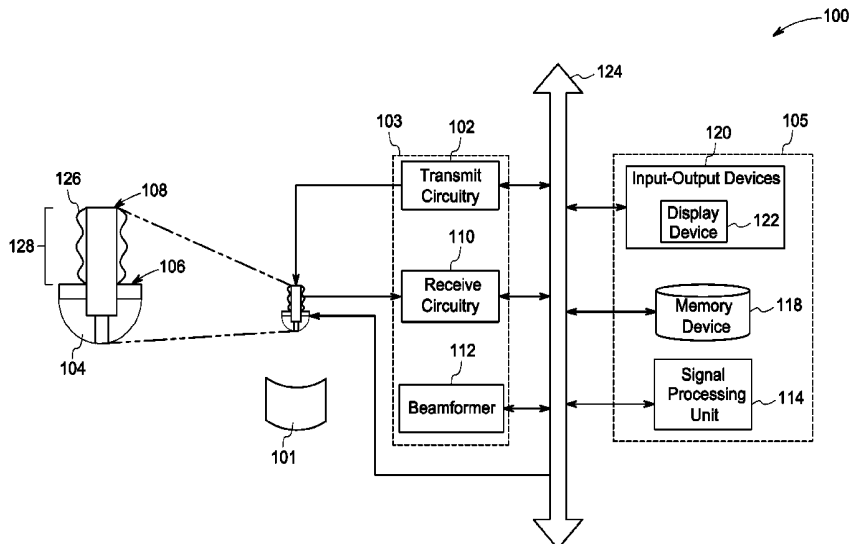
Primary Examiner — Mark A Connolly

(52) **U.S. Cl.**
CPC **A61B 8/4455** (2013.01); **B33Y 10/00** (2014.12); **B33Y 30/00** (2014.12); **B33Y 40/00** (2014.12); **B33Y 50/00** (2014.12); **B33Y 50/02** (2014.12); **B33Y 80/00** (2014.12); **B29L 2031/463** (2013.01)

(57) **ABSTRACT**

A method for customizing a probe grip of an ultrasound probe for a user is presented. The method includes printing the probe grip in a three-dimensional shape of the probe grip based on grip data corresponding to the user. Further, the method includes installing the printed probe grip on the ultrasound probe.

19 Claims, 5 Drawing Sheets



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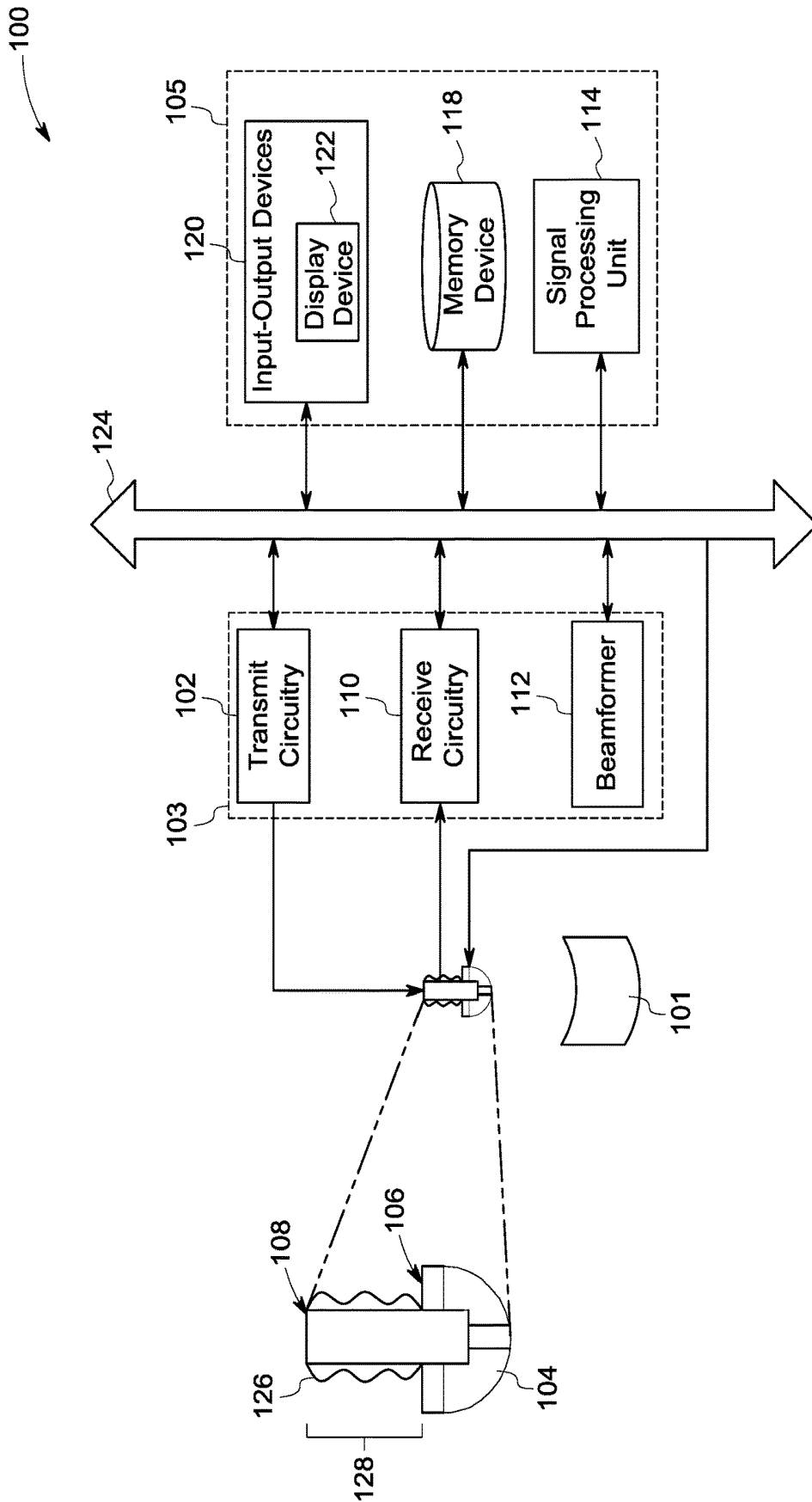


FIG. 1

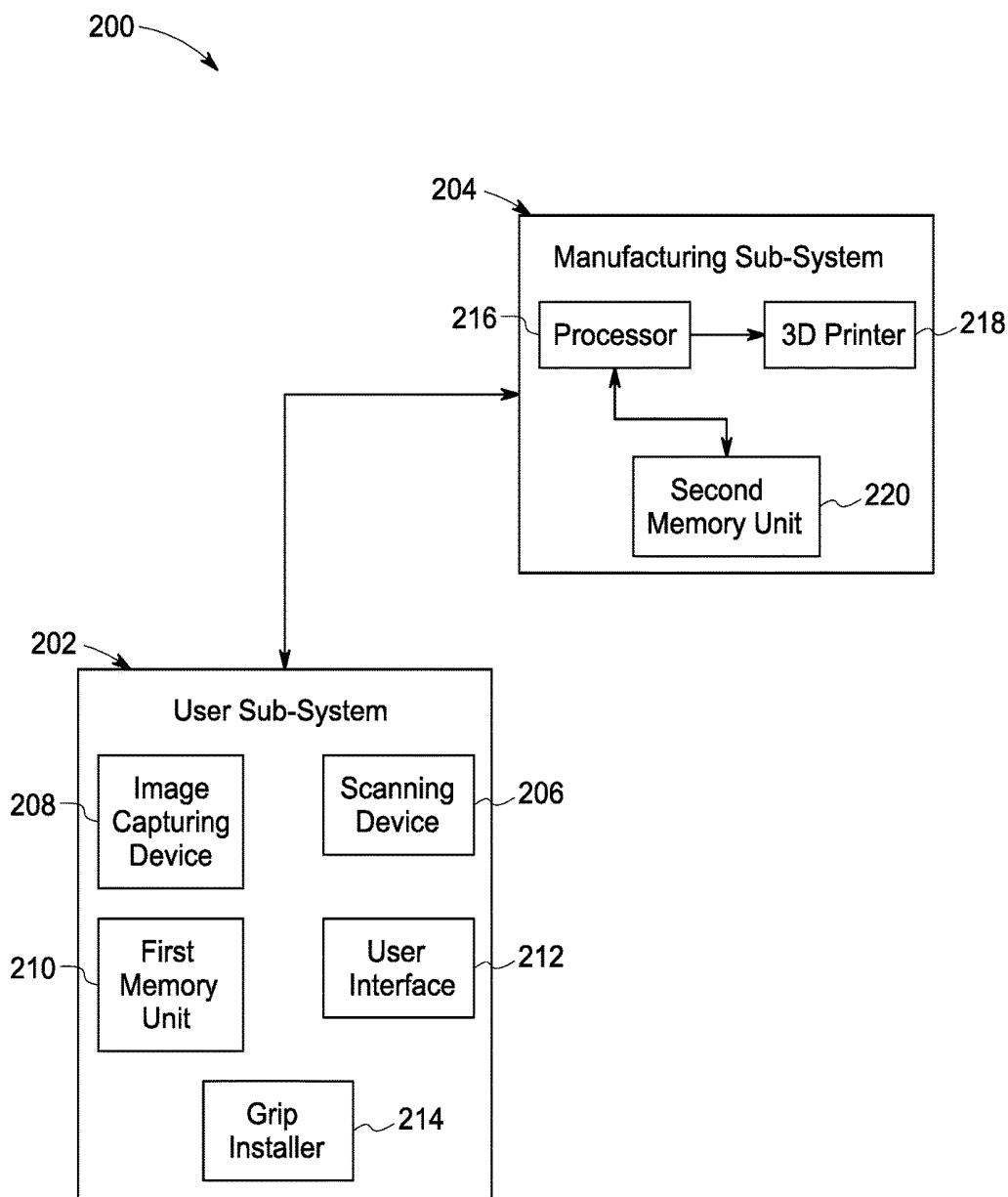


FIG. 2

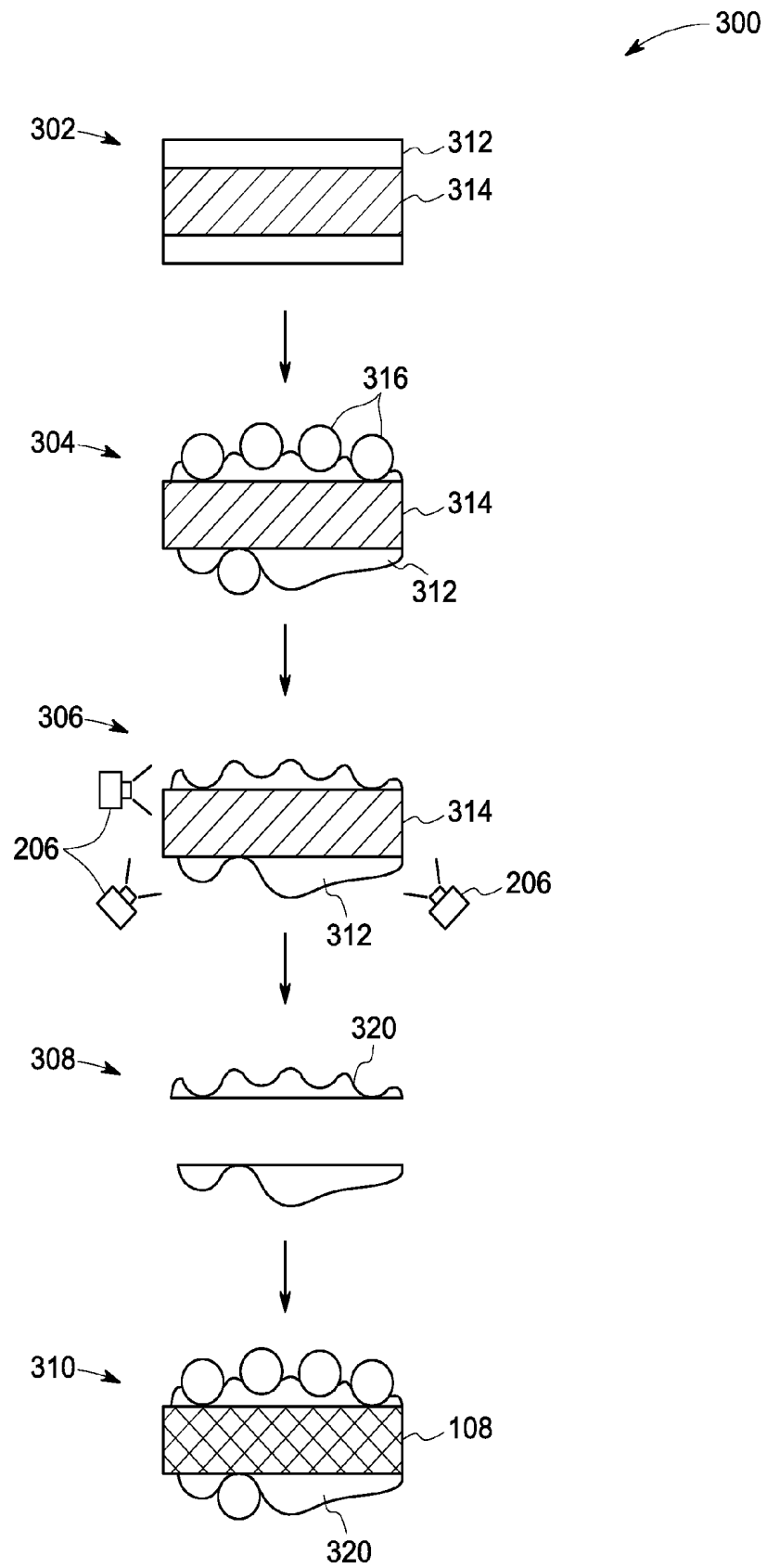


FIG. 3

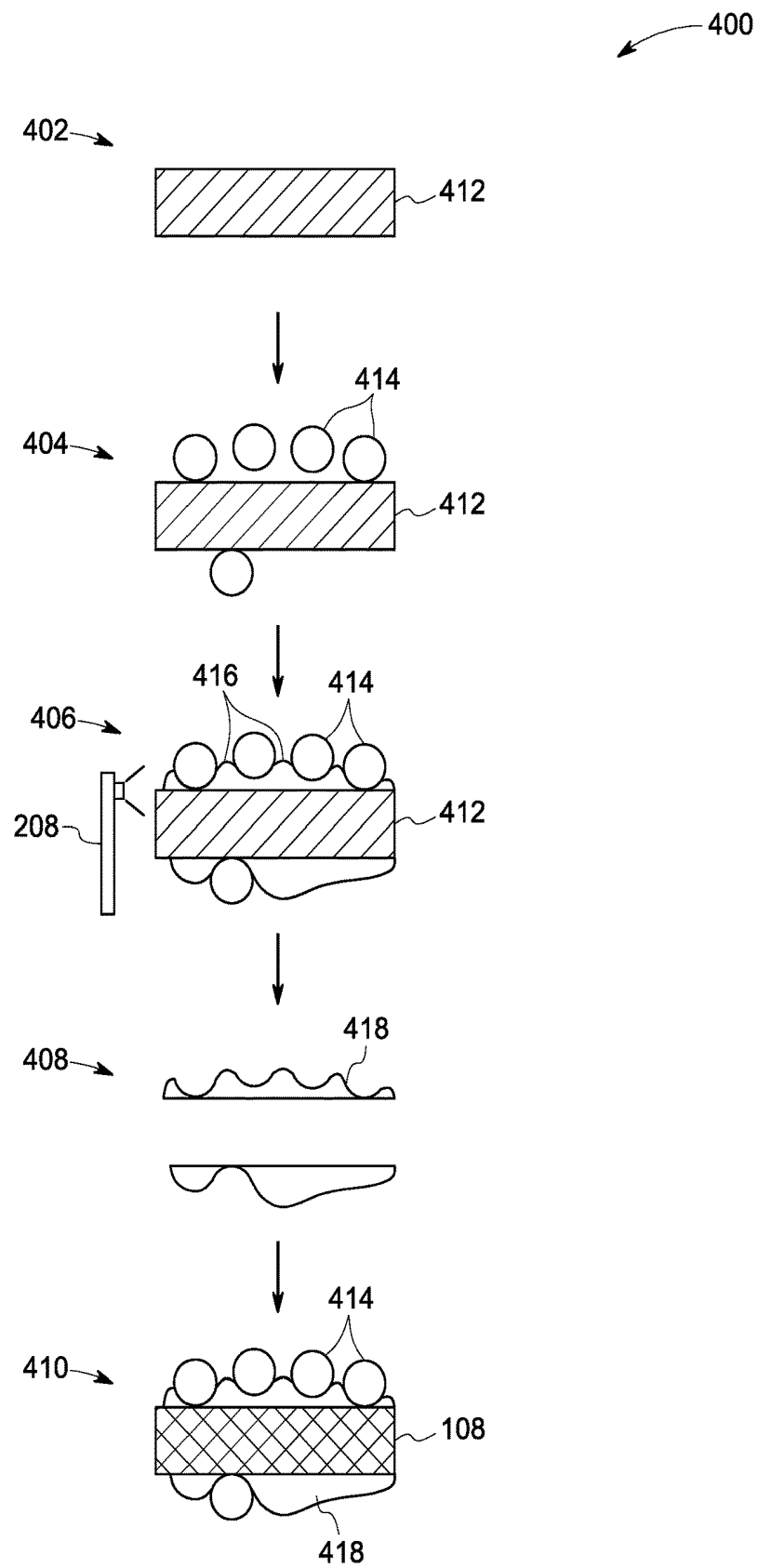


FIG. 4

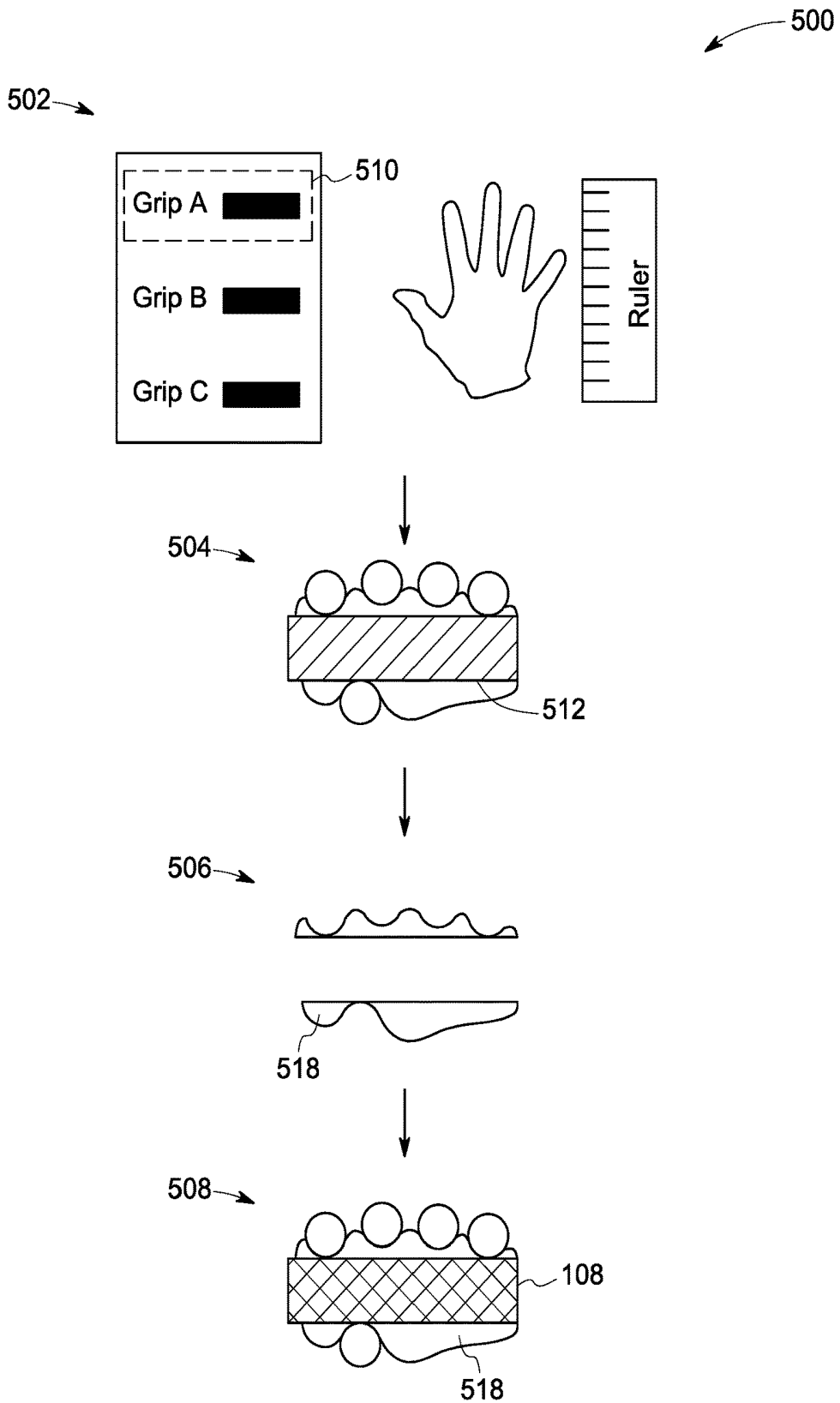


FIG. 5

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SYSTEM AND METHOD FOR CUSTOMIZING A PROBE GRIP FOR AN ULTRASOUND PROBE

BACKGROUND

Embodiments of the present specification relate generally to an ultrasound probe, and more particularly to a system and method for customizing a probe grip for the ultrasound probe.

Medical diagnostic ultrasound is an imaging modality that employs ultrasound waves to probe acoustic properties of biological tissues by producing corresponding images. Particularly, ultrasound systems are used to provide an accurate visualization of muscles, tendons, and other internal organs to assess their size, structure, movement, and/or any pathological conditions using near real-time images. Moreover, owing to the ability to image the underlying tissues without the use of ionizing radiation, ultrasound systems find extensive use in angiography and prenatal scanning.

Typically, ultrasound systems employ an ultrasound probe for transmitting and receiving ultrasound signals from a target volume in a subject or a patient. Further, these ultrasound signals are processed by a processing unit in the ultrasound systems to obtain a quality image of the subject. Moreover, for ultrasound exams, a user, such as a sonographer, may have to hold and manipulate the ultrasound probe at one or more locations and/or positions over the subject/patient for a period of time. Also, the user may be required to perform repeated ultrasound exams throughout the day. However, due to poor ergonomic working conditions, the user may experience repetitive strain injuries. A major portion of these poor ergonomic working conditions for the user may be attributed to handling of the ultrasound probe.

In conventional ultrasound systems, a probe grip may influence the ergonomics of the ultrasound probe. Also, despite differences in the size and shape of users' hands, the probe grip is designed with a single shape and size. Consequently, different users having different sizes of hands are expected to use ultrasound probes with similar probe grips, thereby causing discomfort and pain for the user. Also, over a period of time, working with incorrect probe grip, the user may experience multiple strain injuries.

BRIEF DESCRIPTION

In accordance with aspects of the present specification, a method for customizing a probe grip of an ultrasound probe for a user is presented. The method includes printing the probe grip in a three-dimensional shape of the probe grip based on grip data corresponding to the user. Further, the method includes installing the printed probe grip on the ultrasound probe.

In accordance with a further aspect of the present specification, a system for customizing a probe grip of an ultrasound probe for a user is presented. The system includes a processor configured to process grip data corresponding to the user associated with a three-dimensional shape of the probe grip. Further, the system includes a three dimensional printer coupled to the processor and configured to print the probe grip in the three-dimensional shape based on the processed grip data.

In accordance with another aspect of the present specification, an ultrasound probe is presented. The ultrasound probe includes at least a transducer array of transducer elements configured to transmit and receive ultrasound signals from a target volume. Also, the ultrasound probe

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includes a probe grip installed over a portion of the ultrasound probe, wherein the probe grip is customized based on one or more parameters of a user.

In accordance with yet another aspect of the present specification, an imaging system is presented. The imaging system includes an acquisition subsystem configured to obtain image data corresponding to a target volume in an object of interest and including at least an ultrasound probe. Further, the ultrasound probe includes at least an array of transducer elements configured to transmit and receive ultrasound signals from a target volume, and a probe grip installed over a portion of the ultrasound probe, wherein the probe grip is customized based on one or more parameters of a user. In addition, the imaging system includes a processing subsystem in operative association with the acquisition subsystem and configured to process the acquired image data to generate one or more images corresponding to the target volume in the object of interest.

DRAWINGS

These and other features, aspects, and advantages of the present invention will become better understood when the following detailed description is read with reference to the accompanying drawings in which like characters represent like parts throughout the drawings, wherein:

FIG. 1 is a diagrammatical representation of an ultrasound system for imaging a target volume in a subject, in accordance with aspects of the present specification;

FIG. 2 is a diagrammatical representation of a system for customizing a probe grip, in accordance with aspects of the present specification;

FIG. 3 is a schematic representation of an exemplary method for customizing the probe grip, in accordance with aspects of the present specification;

FIG. 4 is a schematic representation of another exemplary method for customizing the probe grip, in accordance with aspects of the present specification; and

FIG. 5 is a schematic representation of yet another exemplary method for customizing the probe grip, in accordance with aspects of the present specification.

DETAILED DESCRIPTION

As will be described in detail hereinafter, various embodiments of exemplary systems and methods for customizing a probe grip for an ultrasound probe are presented. In particular, the probe grip is customized as per the shape and size of a user's hand. By customizing the probe grip, ergonomics of the ultrasound probe may be significantly improved, which in turn minimizes strain injuries to the user. Also, the user may examine a subject/patient without experiencing any pain or discomfort associated with the probe grip.

FIG. 1 illustrates an ultrasound system **100** for imaging a target volume **101** in a subject. In one embodiment, the ultrasound system **100** may be configured as a console system or a cart-based system. Alternatively, the ultrasound system **100** may be configured as a portable system, such as a hand-held, laptop-style and/or a smartphone-based system. For ease of description, the ultrasound system **100** is represented as a portable ultrasound system.

Further, in the present specification, the ultrasound system **100** is presented as being used to image a target volume **101** in biological tissues of interest. In one example, the target volume **101** may include cardiac tissues, liver tissues, breast tissues, prostate tissues, thyroid tissues, lymph nodes, vascular structures adipose tissue, muscular tissue, and/or blood

cells. Alternatively, the system 100 may be employed for imaging non-biological materials such as manufactured parts, plastics, aerospace composites, and/or foreign objects within a body such as a catheter or a needle.

In certain embodiments, the system 100 includes an acquisition subsystem 103 and a processing subsystem 105. The acquisition subsystem 103 is configured to obtain image data corresponding to a target volume 101 in an object of interest. Further, the processing subsystem 105 is configured to process the acquired image data to generate one or more images corresponding to the target volume 101 in the object of interest. The acquisition subsystem 103 includes transmit circuitry 102, receive circuitry 110, and a beamformer 112. The processing subsystem 105 includes a signal processing unit 114, a memory device 118, and input-output devices 120.

In a presently contemplated configuration, the transmit circuitry 102 generates a pulsed waveform to drive a transducer array 104 of transducer elements 106 housed within an ultrasound probe 108. Particularly, the pulsed waveform drives the transducer array 104 of transducer elements 106 to emit ultrasonic pulses into the target volume 101. The transducer elements 106, for example, may include piezoelectric, piezoceramic, capacitive, and/or microfabricated crystals. At least a portion of the ultrasonic pulses generated by the transducer elements 106 is back-scattered from the target volume 101 to produce echoes that return to the transducer array 104 and are received by receive circuitry 110 for further processing. It may be noted that the terms "ultrasonic" and "ultrasound" may be used interchangeably in the following description.

Also, in the embodiment illustrated in FIG. 1, the receive circuitry 110 is coupled to a beamformer 112 that processes the received echoes and outputs corresponding radio frequency (RF) signals. Subsequently, a signal processing unit 114 receives and processes the RF signals in near real-time and/or offline mode. The signal processing unit 114 includes devices such as one or more general-purpose or application-specific processors, digital signal processors, microcomputers, microcontrollers, Application Specific Integrated Circuits (ASICs), Field Programmable Gate Arrays (FPGA), or other suitable devices in communication with other components of the system 100.

Moreover, in certain embodiments, the signal processing unit 114 also provides control and timing signals for configuring one or more imaging parameters for imaging the target volume 101 in the subject. Furthermore, in one embodiment, the signal processing unit 114 stores the delivery sequence, frequency, time delay, and/or beam intensity, for example, in a memory device 118 for use in imaging the target volume 101. The memory device 118 includes storage devices such as a random access memory, a read only memory, a disc drive, solid-state memory device, and/or a flash memory. In one embodiment, the signal processing unit 114 uses the stored information for configuring the transducer elements 106 to direct one or more groups of pulse sequences toward the target volume 101. Subsequently, the signal processing unit 114 tracks the displacements in the target volume 101 caused in response to the incident pulses to determine corresponding tissue characteristics. The displacements and tissues characteristics, thus determined, are stored in the memory device 118. The displacements and tissues characteristics may also be communicated to a medical practitioner, such as a radiologist, for further diagnosis.

In some embodiments, the signal processing unit 114 may be further coupled to one or more user input-output devices 120 for receiving commands and inputs from an operator,

such as the medical practitioner. The input-output devices 120, for example, may include devices such as a keyboard, a touchscreen, a microphone, a mouse, a control panel, a display device 122, a foot switch, a hand switch, and/or a button. In one embodiment, the signal processing unit 114 processes the RF signal data to prepare image frames and to generate the requested medically relevant information based on user input. Particularly, the signal processing unit 114 may be configured to process the RF signal data to generate two-dimensional (2D) and/or three-dimensional (3D) datasets corresponding to different imaging modes.

Further, the signal processing unit 114 may be configured to reconstruct desired images from the 2D or 3D datasets. Subsequently, the signal processing unit 114 may be configured to display the desired images on the associated display device 122 that may be communicatively coupled to the signal processing unit 114. The display device 122, for example, may be a local device. Alternatively, in one embodiment, the display device 122 may be remotely located to allow a remotely located medical practitioner to access the reconstructed images and/or medically relevant information corresponding to the target volume 101 in the subject/patient. It may be noted that the various components of the ultrasound system 100 are communicatively coupled via a communication channel 124.

Moreover, during ultrasound examinations, a user, such as a sonographer, may have to hold and manipulate the ultrasound probe at one or more locations and/or positions over the subject/patient. Also, the user may be required to perform repeated ultrasound exams throughout the day. Due to poor ergonomic working conditions, the user may experience repetitive strain injuries. Particularly, due to different size and shape of users' hand, a probe grip of the ultrasound probe may adversely affect the ergonomics of the ultrasound probe. This in turn may cause discomfort to the user during scanning of the subject/patient. Also, the use of such probe grips may result in multiple strain injuries to the user over a period of time.

To overcome the above problems or shortcomings, the exemplary ultrasound system 100 includes a probe grip 126 that is customized as per the size and shape of an individual user's hand. The probe grip 126 may be an external grip that is installed over a portion 128 of the ultrasound probe 108, where the user holds the ultrasound probe 108 during the ultrasound exams more specifically, grip data associated with one or more parameters of the user is received or computed. In one example, the parameters of the user may include a size of the user's hand and/or fingers, a grip style of the user, and gaps/space between the fingers when the user holds the probe 108. Further, the probe grip 126 is designed and printed based on the grip data. In one example, a three-dimensional (3D) printer is used to print or mold the probe grip 126. Furthermore, the printed probe grip 126 is installed over the ultrasound probe 108, which is later used by the user for holding the probe 108. As the probe grip 126 is customized as per the user's requirement, the user may perform ultrasound exams without any discomfort and/or pain. The aspect of customizing the probe grip 126 will be described in greater detail with reference to FIGS. 2-4.

Referring to FIG. 2, a diagrammatical representation of a system 200 for customizing a probe grip, in accordance with aspects of the present specification, is depicted. For ease of understanding, the system 200 is described with reference to the components of FIG. 1. The system 200 includes a user sub-system 202 and a manufacturing sub-system 204. The user sub-system 202 may be configured to provide a grip data to the manufacturing subsystem 204. In one example,

the user sub-system **202** may be a combination of components that is used by the user for communicating the grip data to the manufacturing subsystem **204**. On the other hand, the manufacturing sub-system **204** may be configured to customize the probe grip **126** based on the received grip data. In one example, the grip data may be a data corresponding to a size of the user's hand and a grip style of the user.

In a presently contemplated configuration, the user sub-system **202** may include components, such as a scanning device **206**, an image capturing device **208**, a first memory unit **210**, and a user interface **212**. It may be noted that the user sub-system **202** may use one or more of these components to provide the grip data to the manufacturing subsystem **204**. In one embodiment, the scanning device **206** may be used to scan impressions of the user's fingers on a mock-up unit. In one example, the mock-up unit may be a dummy probe grip having a deformable outer surface. Further, the scanning device **206** may send this scanned data as the grip data to the manufacturing sub-system **204**. The aspect of providing the grip data using the scanning device **206** will be explained in greater detail with reference to FIG. 3.

In another embodiment, the image capturing device **208** may be used to capture a three-dimensional (3D) image of the user gripping the mock-up unit. This 3D image may include an image of the user's fingers, gaps/space between the fingers, and a portion of the mock-up unit. Further, the image capturing device **208** may communicate this 3D image as the grip data to the manufacturing sub-system **204**. The aspect of providing the grip data using the image capturing device **208** will be explained in greater detail with reference to FIG. 4.

In yet another embodiment, the first memory unit **210** may store a plurality of hand sizes and a plurality of grip styles. In one example, a grip style may be indicative of a style of the user holding the ultrasound probe **108**. Further, the user may use the user interface **212** to select one of the hand sizes and one of the grip styles. In one example, the user may send an input signal to select a hand size and a grip style that are corresponding to the user via the user interface **212** or a remote device. Further, the first memory unit **210** may communicate the selected hand size and the grip style as the grip data to the manufacturing sub-system **204**. In one example, the first memory unit **210** in conjunction with a transmitter or a transceiver may communicate the grip data to the manufacturing sub-system **204**. The aspect of providing the grip data using the first memory unit **210** will be explained in greater detail with reference to FIG. 5.

At the other end, the manufacturing sub-system **204** is configured to customize the probe grip based on the grip data. In one exemplary embodiment, the manufacturing sub-system **204** includes a processor **216**, a three-dimensional (3D) printer **218**, and a second memory unit **220**. The processor **216** may be configured to receive the grip data from the user sub-system **202**. This grip data may be received from the scanning device **206**, the image capturing device **208**, and/or the first memory unit **210** of the user sub-system **202**. Further, the processor **216** may process this grip data to determine a three-dimensional (3D) shape of the probe grip. In one example, the processor **216** may use one or more algorithms or software stored in the second memory unit **220** to determine the 3D shape of the probe grip. Furthermore, the processor **216** may send printing data associated with the 3D shape of the probe grip to the 3D printer **218**.

The 3D printer **218** may print the probe grip in the 3D shape based on the received printing data. In one example, the 3D printer **218** may mold a gripping material into the three-dimensional shape of the probe grip. Also, in one example, gripping material may be fabricated from materials such as polymers, thermoplastics, rubbers, silicones, and/or thermoplastic elastomers.

Upon printing or molding the probe grip, the manufacturing sub-system **204** may send this printed or molded probe grip to the user sub-system **202** for installing on the ultrasound probe **108**. At the user sub-system **202**, a grip installer **214** may be used to install the probe grip over a grip portion **128** of the ultrasound probe **108**. In one example, the manufacturing sub-system **204** may install this probe grip on the ultrasound probe **108**. Further, the manufacturing sub-system **204** may send this ultrasound probe **108** to the user. In one embodiment, the manufacturing sub-system **104** may use the 3D printer **218** to print the probe grip as a plurality of sub-sections. Further, these sub-sections are fastened or coupled to an outer surface of the ultrasound probe **108** to form the probe grip.

Thus, by employing the exemplary system **200**, the probe grip may be customized as per the user's hand and grip style. By customizing the probe grip, ergonomics of the ultrasound probe **108** may be significantly improved, which in turn minimizes strain injuries in the user. Also, the user may examine a subject/patient without any pain or discomfort.

FIG. 3 illustrates different stages of a method for customizing a probe grip, in accordance with one embodiment of the present specification. For ease of understanding, the method **300** is described with reference to the components of FIGS. 1 and 2.

The method begins at a first stage **302**, where a deformable segment **312** is disposed around a mock-up unit **314**. In one embodiment, the deformable segment **312** may be presented as an outer layer of the mock-up unit **314**. In one example, the deformable segment **312** may be referred to as a moldable segment that is capable of changing its shape as per an applied grip of a user. In one embodiment, a manufacturer may ship the mock-up unit **314** having the deformable segment **312** to the user. It may be noted that the mock-up unit **314** may be a cylindrical housing that is capable of housing a grip portion **128** of the ultrasound probe **108**.

Subsequently, at a second stage **304**, grip data associated with the three-dimensional shape of the probe grip is translated onto the deformable segment. By way of example, the user may grip or hold the mock-up unit **314** in a desired manner to translate the grip data onto the deformable segment. Particularly, the user may place their fingers **316** on the deformable segment **312** to hold or grip the mock-up unit **314**. When the user holds the mock-up unit **314**, a determined pressure is applied on the deformable segment **312** that is disposed on an outer surface of the mock-up unit **314**. This determined pressure may in turn deform or mold the deformable segment **312** into a three-dimensional (3D) shape, where the 3D shape is a signature of the user's grip. In one example, the deformable segment **312** may have an impression of the fingers **316** of the user holding the mock-up unit **314**. Thus, the 3D shape of the deformable segment **312** corresponds to a size of the user's fingers as well as the grip style of the user holding the mock-up unit **314**.

Furthermore, at a third stage **306**, the mock-up unit **314** along with the deformable segment **312** having the user's grip signature may be scanned by a scanning device **206** at the user sub-system **202**. Particularly, the deformable seg-

ment **312** that is molded or deformed on the outer surface of the mock-up unit **314** may be 3D scanned by the scanning device **206** to capture the details of the 3D shape of the deformable segment **312**.

Additionally, at a fourth stage **308**, the scanning device **206** may communicate this 3D scanned data associated with the 3D shape of the deformable segment **312** to the manufacturing sub-system **204**. In one example, the scanning device **206** may transmit this 3D scanned data as the grip data to the processor **216** in the manufacturing sub-system **204**. Further, the processor **216** in the manufacturing sub-system **204** may process this scanned 3D data to determine a three-dimensional (3D) shape of a probe grip **320**. In one example, the processor **216** may use one or more algorithms or software stored in a second memory unit **220** to determine the 3D shape of the probe grip **320**. Furthermore, the processor **216** may send printing data associated with the 3D shape of the probe grip **320** to the 3D printer **218**. In one embodiment, the 3D scanned data may be directly communicated to the 3D printer **218** without using the processor **216**. Upon receiving the printing data or 3D scanned data, the 3D printer **218** may print the probe grip **320** in the 3D shape that is desired by the user. In one example, the 3D printer **218** may mold a gripping material into the 3D shape of the probe grip **320**.

Subsequently, at a fifth stage **310**, the printed probe grip **320** may be made available for installing on the ultrasound probe **108**. In certain embodiments, the manufacturer may install this printed probe grip **320** on the ultrasound probe **108**. Further, the manufacturer may send the ultrasound probe **108** having this printed probe grip **320** to the user. Alternatively, the probe grip **320** may be provided to the user for installing on the ultrasound probe **108**. In one example, the grip installer **214** may be used to install this probe grip **320** on the ultrasound probe **108**. In some embodiments, the probe grip **320** may be printed as one or more sub-sections of the probe grip **320**. Further, these sub-sections of the probe grip **320** may be fastened to on an outer surface of the probe **108** as the probe grip **320**.

Thus, by employing the exemplary method, the probe grip **320** may be customized as desired by the user. Also, by using the customized probe grip **320**, the user may not experience pain or discomfort otherwise experienced with conventional probe grips while scanning the patient/subject. Moreover, if a new user wishes to use the ultrasound probe **108**, the probe grip **320** may be easily replaced with a new probe grip that is customized as per the requirement of the new user. Thus, the ultrasound probe **108** may be rendered ergonomically suitable for more than one user by providing customized probe grips for the same ultrasound probe.

FIG. 4 illustrates different stages of a method **400** for customizing the probe grip, in accordance with another embodiment of the present specification. For ease of understanding, the method **400** is described with reference to the components of FIGS. 1 and 2.

The method **400** begins at a first stage **402**, where a mock-up unit **412** is sent to a user of the ultrasound probe **108**. In one example, the mock-up unit **412** may be a cylindrical housing that is capable of housing a grip portion **128** of the ultrasound probe **108**. The mock-up unit **412** may be sent to the user by a manufacturer. Optionally, the manufacturer may send a glove along with the mock-up unit **412** to the user. The glove may be a tight fitting glove that is designed with a predetermined color and/or pattern. In one example, a color of the glove is different from a color of the outer surface of the mock-up unit **412**. This difference in the colors of the glove and the outer surface of the mock-up unit

412 aids in differentiating between the user's hand/fingers and the outer surface of the mock-up unit **412**. Also, this difference in the colors of the glove and the outer surface of the mock-up unit **412** enables easy identification/determination of gaps/spaces between the fingers when the user holds the mock-up unit **412**.

Subsequently, at a second stage **404**, the user may grip or hold the mock-up unit **412** in a manner similar to that of holding an ultrasound probe for examining a patient, for example optionally, the user may wear a glove and then grip or hold the mock-up unit **412** in the desired manner. Reference numeral **414** is generally representative of the fingers of the user.

Additionally, at a third stage **406**, an image capturing device such as the image capturing device **208** in the user sub-system **202** may be used to capture an image of the user gripping or holding the mock-up unit **412**. In one example, a smart phone having a camera and/or a sensor may be used as the image capturing device **208**. Particularly, the smart phone may be used to detect and record the position of user's hand/fingers on the mock-up unit **412**. In one embodiment, the image capturing device **208** may capture an image of the user holding the mock-up unit **412** with the glove. In this embodiment, the captured image may visually depict gaps **416** between the fingers **414** on the mock-up unit **412** and gaps between the fingers **414** and the mock-up unit **412**.

Furthermore, at a fourth stage **408**, the image capturing device **208** may communicate this captured image to the manufacturing sub-system **204**. In one example, the image capturing device **208** may transmit this captured image as grip data to the processor **216** in the manufacturing sub-system **204**. Also, the processor **216** in the manufacturing sub-system **204** may process this captured image to determine a three-dimensional (3D) shape of a probe grip **418**. In one example, the processor **216** may use one or more algorithms or software stored in the second memory unit **220** to determine the 3D shape of the probe grip **418**. Furthermore, the processor **216** may send printing data associated with the 3D shape of the probe grip **418** to the 3D printer **218**. In one embodiment, the captured image data may be directly communicated to the 3D printer **218** without using the processor **216**. Upon receiving the printing data or the captured image, the 3D printer **218** may print the probe grip **418** in the 3D shape that is desired by the user. In one example, the 3D printer **218** may mold a gripping material into the three-dimensional shape of the probe grip **418**.

Subsequently, at a fifth stage **410**, the printed probe grip **418** may be sent to the user for installing on the ultrasound probe **108**. In one embodiment, the user may use the grip installer **214** in the user sub-system **202** to install or slide the probe grip **418** over the ultrasound probe **108**. In another embodiment, the manufacturer may install this printed probe grip **418** on the ultrasound probe **108**. In one example, the manufacturer may attach the printed probe grip **418** to one or more sides of the ultrasound probe. Further, the manufacturer may send the ultrasound probe **108** having this printed probe grip **418** to the user. In another embodiment, the manufacturer may print the probe grip **418** as one or more sub-sections. Further, these sub-sections are fastened to the outer surface of the probe as the probe grip **418**.

FIG. 5 illustrates different stages of a method **500** for customizing a probe grip, in accordance with one embodiment of the present specification. For ease of understanding, the method **500** is described with reference to the components of FIGS. 1 and 2.

The method begins at a first stage **502**, where a user may select a hand size from a plurality of hand sizes. Also, the

user may select a grip style from a plurality of grip styles. Particularly, the first memory unit **210** in the user sub-system **202** may be configured to store the plurality of hand sizes and the plurality of grip styles. Further, the user may use the user interface **212** of the user sub-system **202** to select one of the hand sizes and/or one of grip styles. FIG. **5** depicts the user selecting “Grip A” as the user’s grip style **510**. In one example, the user may send an input signal from a remote device or the user interface **212** to select a hand size and a grip style that correspond to the user. Further, the first memory unit **210** may communicate the selected hand size and the grip style as the grip data to the manufacturing sub-system **204**. In one example, the first memory unit **210** in conjunction with a transmitter may communicate the grip data to the manufacturing sub-system **204**.

Subsequently, at a second stage **504**, the processor **216** in the manufacturing sub-system **204** may determine a 3D grip model **512** based on the selected hand size and the grip style of the user. In one embodiment, the processor **216** may use one or more algorithms or software stored in the second memory unit **220** to determine the 3D grip model **512**. In another embodiment, the processor **216** may determine the 3D grip model **512** based on a combination of the selected hand size, the grip style, and a predetermined dimension of the ultrasound probe.

Additionally, at a third stage **506**, the processor **216** may send data associated with the determined 3D grip model **512** to the 3D printer **218** to print a probe grip **518** in the 3D shape that is desired by the user. In one example, the 3D printer **218** may mold a material for the grip into the 3D shape of the probe grip **518**.

Subsequently, at a fourth stage **508**, the printed probe grip **518** may be sent to the user for installation on the ultrasound probe **108**. In one embodiment, the manufacturer may install this printed probe grip **518** on the ultrasound probe **108**. In one example, the manufacturer may attach the printed probe grip **518** to one or more sides of the ultrasound probe. Further, the manufacturer may send the ultrasound probe **108** having this printed probe grip **518** to the user. In another embodiment, the manufacturer may print the probe grip **518** as one or more sub-sections. Further, these sub-sections are assembled or fastened to the outer surface of the probe **108** as the probe grip **518**.

The various embodiments of the exemplary systems and methods aid in customizing the probe grip as required by the user. By customizing the probe grip, ergonomics of the ultrasound probe may be significantly improved, which in turn minimizes strain injuries in the user. Also, the user may examine a subject/patient without feeling the discomfort that is otherwise felt due to off-the-shelf probe grips that are not customized, and hence may not be ergonomically suitable for the user. Additionally, different users can use the same probe by merely changing the probe grip that is customized for each individual user.

While only certain features of the invention have been illustrated and described herein, many modifications and changes will occur to those skilled in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the invention.

The invention claimed is:

1. A method for customizing a probe grip of an ultrasound probe for a user, the method comprising:

receiving a grip data associated with a three-dimensional shape of the probe grip, wherein receiving the grip data comprises capturing a three-dimensional image of the user gripping a mock-up unit;

printing the probe grip in the three-dimensional shape of the probe grip based on grip data corresponding to the user; and

installing the printed probe grip on the ultrasound probe.

2. The method of claim **1**, further comprising determining gaps between fingers of the user gripping the mock-up unit and gaps between the fingers and the mock-up unit based on the captured three-dimensional image.

3. The method of claim **1**, wherein printing the probe grip in the three-dimensional shape comprises communicating the received grip data to a three-dimensional printer to print the three-dimensional shape of the probe grip.

4. The method of claim **1**, wherein installing the printed probe grip on the ultrasound probe comprises sliding or attaching the printed probe grip to the ultrasound probe.

5. The method of claim **1**, wherein installing the printed probe grip on the ultrasound probe comprises:

manufacturing a plurality of sub-sections associated with the probe grip; and

fastening the plurality of sub-sections to an outer surface of the ultrasound probe.

6. A method for customizing a probe grip of an ultrasound probe for a user, the method comprising:

receiving a grip data associated with a three-dimensional shape of the probe grip, wherein the receiving the grip data comprises:

receiving at least a hand size and a grip style associated with the user of the ultrasound probe;

determining a grip model based on the hand size and the grip style;

printing the probe grip in the three-dimensional shape of the probe grip based on the grip data corresponding to the user; and

installing the printed probe grip on the ultrasound probe.

7. The method of claim **6**, wherein receiving at least the hand size and the grip style comprises:

selecting the d size from a plurality of hand sizes; and

selecting the grip style from a plurality of grip styles.

8. The method of claim **6**, wherein printing the probe grip in the three-dimensional shape comprises communicating the received grip data to a three-dimensional printer to print the three-dimensional shape of the probe grip.

9. The method of claim **6**, wherein installing the printed probe grip on the ultrasound probe comprises sliding or attaching the printed probe grip to the ultrasound probe.

10. The method of claim **6**, wherein installing the printed probe grip on the ultrasound probe comprises:

manufacturing a plurality of sub-sections associated with the probe grip; and

fastening the plurality of sub-sections to an outer surface of the ultrasound probe.

11. A system for customizing a probe grip of an ultrasound probe for a user, the system comprising:

an image capturing device configured to capture a three-dimensional image of the user gripping a mock-up unit as a grip data corresponding to the user;

a processor configured to process the grip data corresponding to the user associated with a three-dimensional shape of the probe grip; and

a three-dimensional printer coupled to the processor and configured to print the probe grip in the three-dimensional shape based on the processed grip data.

12. The system of claim **11**, wherein the processor is configured to process the three-dimensional image to determine gaps between fingers of the user gripping the mock-up unit.

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13. The system of claim 11, where the image capturing device is configured to communicate the grip data to the processor.

14. The system of claim 11, further comprising a grip installer configured to install the printed probe grip on the ultrasound probe. 5

15. A system for customizing a probe grip of an ultrasound probe for a user, the system comprising:
a memory unit configured to store a plurality of hand sizes and a plurality of grip styles; 10
a user interface coupled to the memory unit and configured to select a hand size from the plurality of hand sizes and a grip style from the plurality of grip styles based on an input signal provided by the user as a grip data corresponding to the user; 15
a processor configured to process the grip data corresponding to the user associated with a three-dimensional shape of the probe grip; and
a three-dimensional printer coupled to the processor and configured to print the probe grip in the three-dimensional shape based on the processed grip data. 20

16. The system of claim 15, where in the memory unit is configured to communicate the grip data to the processor.

17. The system of claim 15, further comprising a grip installer configured to install the printed probe grip on the ultrasound probe. 25

18. An ultrasound probe for a user, comprising:
at least a transducer array of transducer elements configured to transmit and receive ultrasound signals from a target volume; and 30
a customized probe grip installed over a portion of the ultrasound probe, wherein the customized probe grip is

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customized based on a grip data corresponding to the user, and wherein the grip data comprises at least one of a three-dimensional image of the user gripping a mock-up unit or a hand size associated with the user selected from a plurality of hand sizes and a grip style associated with the user selected from a plurality of grip styles.

19. An imaging system, comprising:
an acquisition subsystem configured to obtain image data corresponding to a target volume in an object of interest and comprising at least an ultrasound probe for a user, wherein the ultrasound probe comprises:
at least an array of transducer elements configured to transmit and receive ultrasound signals from a target volume;
a customized probe grip installed over a portion of the ultrasound probe, wherein the customized probe grip is customized based on a grip data corresponding to the user, and wherein the grip data comprises at least one of a three-dimensional image of the user gripping a mock-up unit or a hand size associated with the user selected from a plurality of hand sizes and a grip style associated with the user selected from a plurality of grip styles; and
a processing subsystem in operative association with the acquisition subsystem and configured to process acquired image data to generate one or more images corresponding to the target volume in the object of interest.

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专利名称(译)	用于定制超声探头的探头手柄的系统和方法		
公开(公告)号	US10376238	公开(公告)日	2019-08-13
申请号	US14/961903	申请日	2015-12-08
[标]申请(专利权)人(译)	通用电气公司		
申请(专利权)人(译)	通用电气公司		
当前申请(专利权)人(译)	通用电气公司		
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IPC分类号	A61B8/00 B33Y30/00 B33Y40/00 B33Y50/00 B29C67/00 B33Y50/02 B33Y80/00 B33Y10/00 B29L31/46		
CPC分类号	A61B8/4455 B33Y10/00 B33Y30/00 B33Y50/00 B33Y50/02 B33Y80/00 B33Y40/00 B29L2031/463 B29C64/386		
其他公开文献	US20170156694A1		
外部链接	Espacenet		

摘要(译)

提出了一种用于为用户定制超声探头的探头握把的方法。该方法包括基于对应于用户的抓握数据将探针夹具打印成探针夹具的三维形状。此外，该方法包括将印刷的探针夹具安装在超声探针上。

