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(54) **ULTRASOUND SYSTEM WITH OPACITY SETTING UNIT**

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(52) **U.S. Cl.** **600/443**

(57) **ABSTRACT**

There are provided an ultrasound system with an opacity setting unit capable of setting opacity corresponding to rendering of volume data throughout depth. In one embodiment, an ultrasound system comprises an opacity setting unit configured to receive input information for setting opacity corresponding to rendering of volume data throughout the depth.

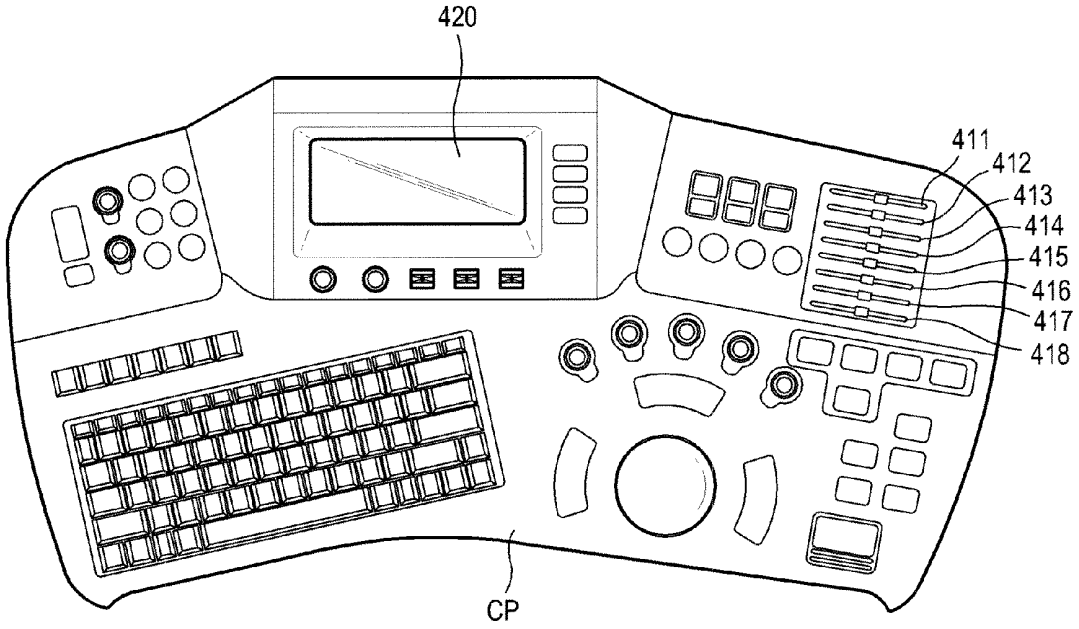


FIG. 1

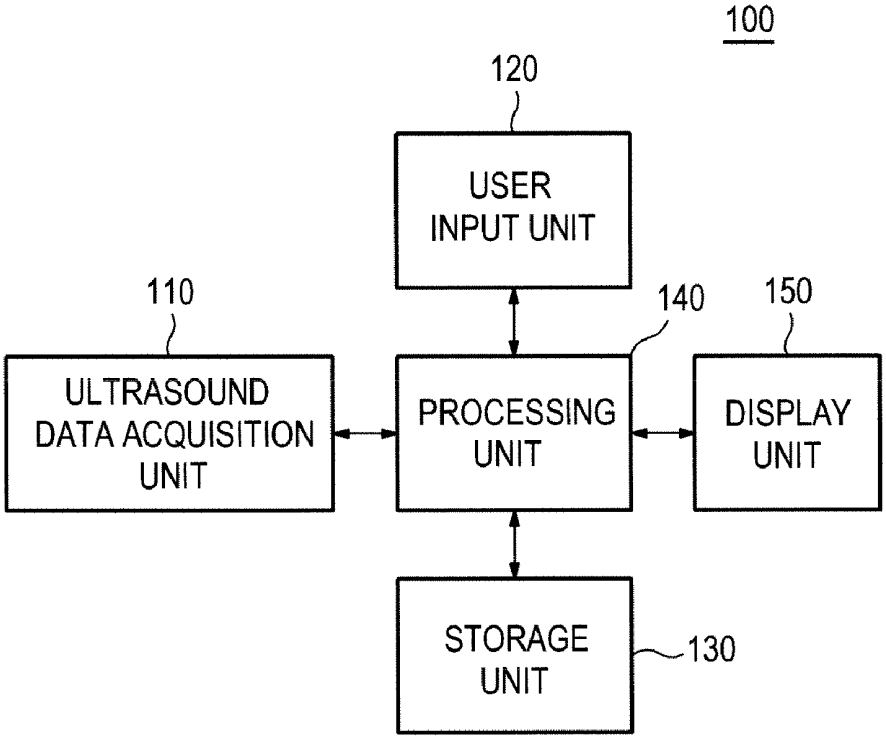

100
120
USER INPUT UNIT
110
140
150
ULTRASOUND DATA ACQUISITION UNIT
PROCESSING UNIT
DISPLAY UNIT
STORAGE UNIT
130

FIG. 2

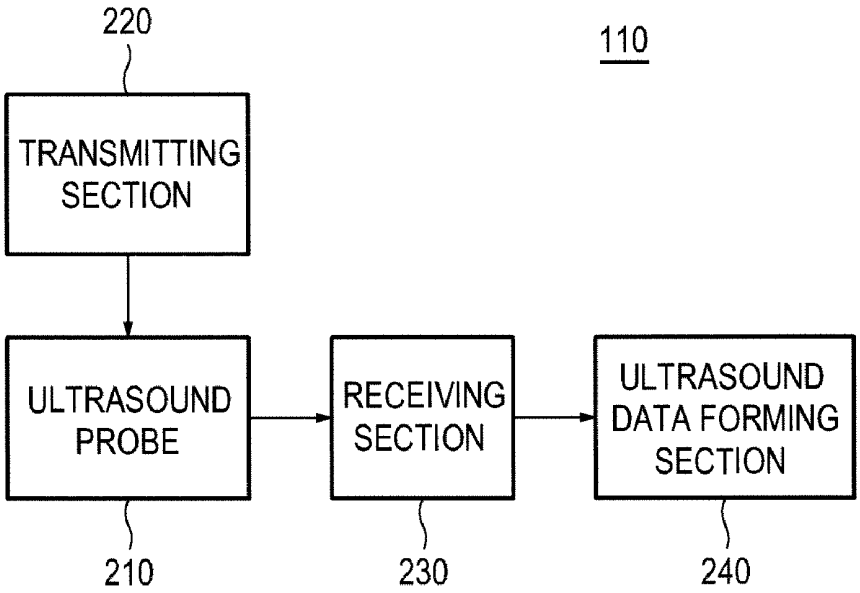

220
110
TRANSMITTING SECTION
ULTRASOUND PROBE
RECEIVING SECTION
ULTRASOUND DATA FORMING SECTION
210
230
240

FIG. 3

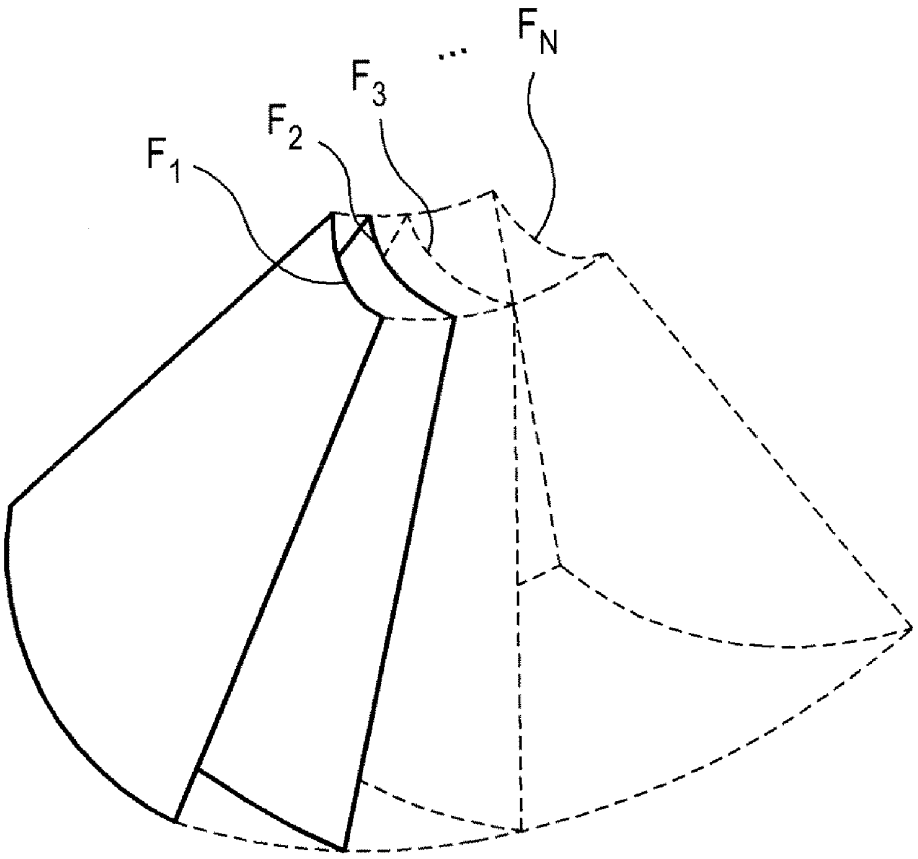


FIG. 4

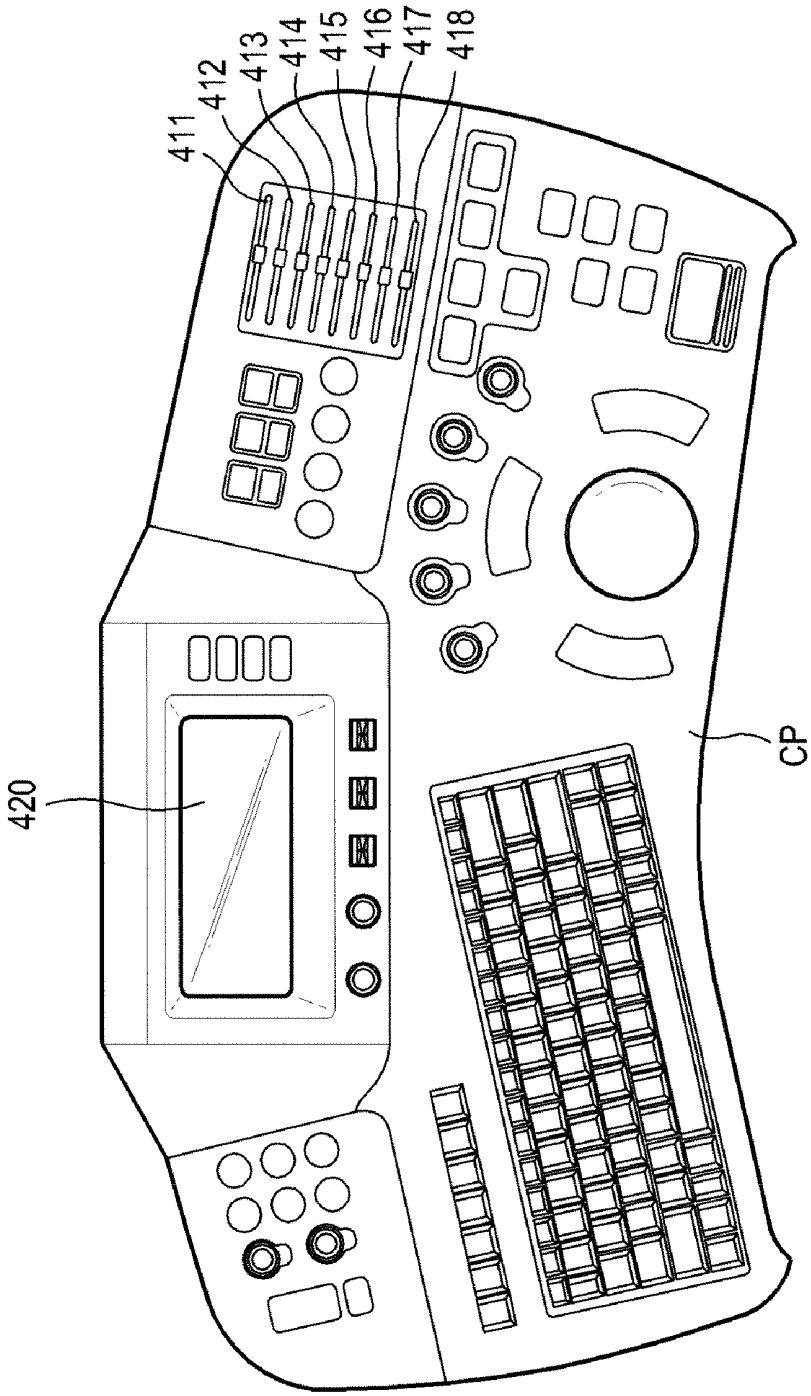


FIG. 5

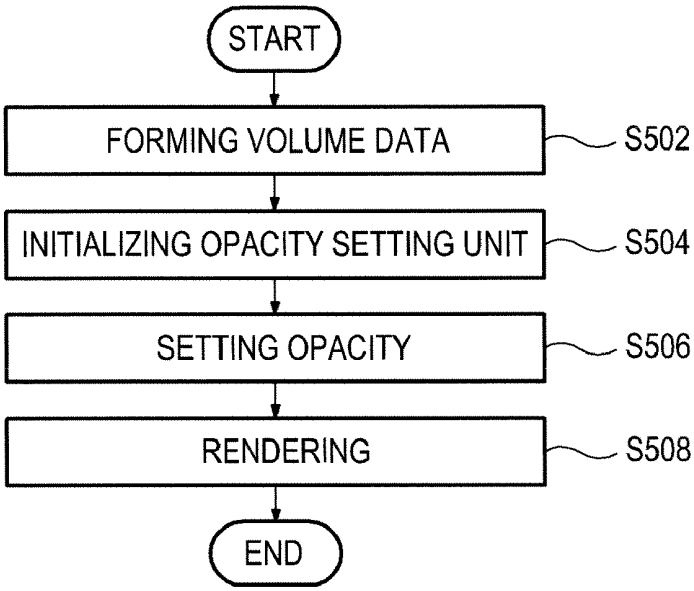

START
FORMING VOLUME DATA
S502
INITIALIZING OPACITY SETTING UNIT
S504
SETTING OPACITY
S506
RENDERING
S508
END

FIG. 6

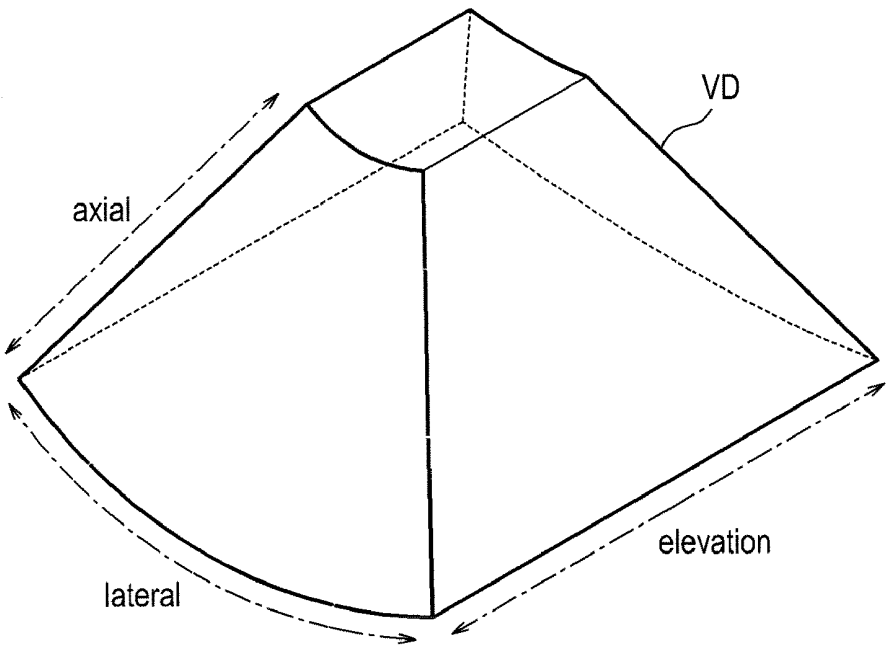

VD
axial
lateral
elevation

FIG. 7

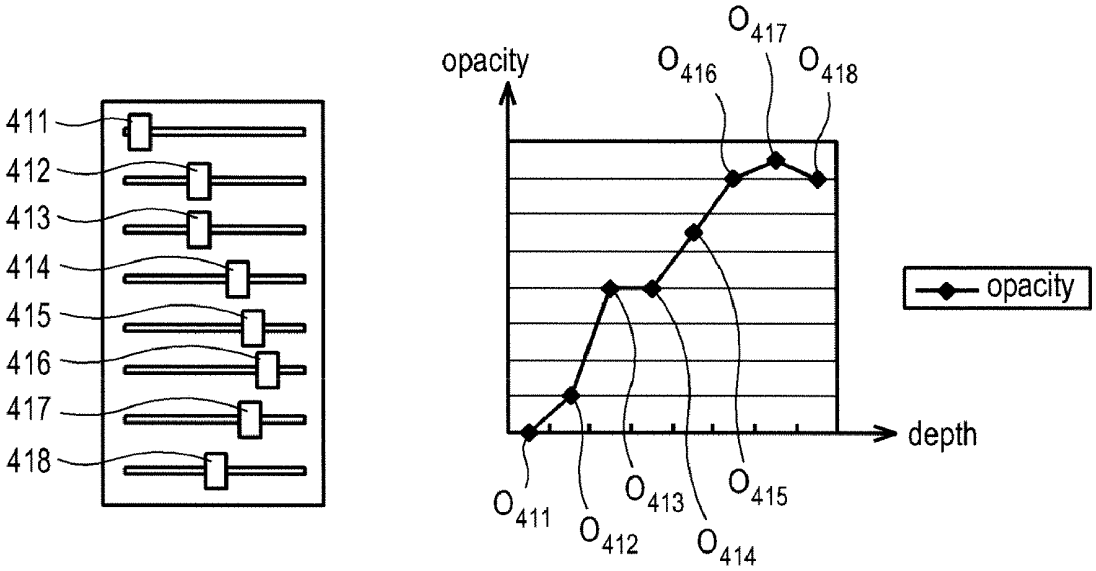
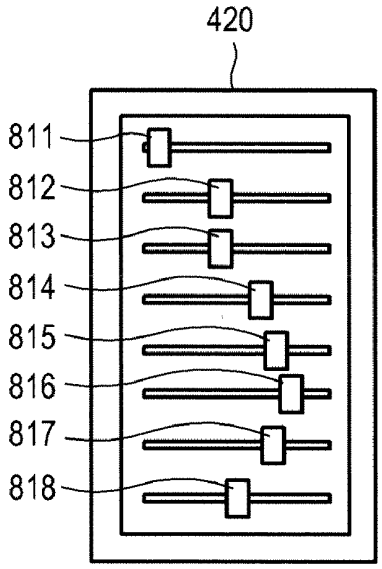

411
412
413
414
415
416
417
418
opacity
O_{417}
O_{416}
O_{418}
opacity
depth
O_{411}
O_{412}
O_{413}
O_{414}
O_{415}

FIG. 8


420
811
812
813
814
815
816
817
818

ULTRASOUND SYSTEM WITH OPACITY SETTING UNIT

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority from Korean Patent Application No. 10-2011-0007908 filed on Jan. 26, 2011, the entire subject matter of which is incorporated herein by reference.

TECHNICAL FIELD

[0002] The present disclosure generally relates to ultrasound systems, and more particularly to an ultrasound system with an opacity setting unit configured to set opacity for rendering volume data throughout depth.

BACKGROUND

[0003] An ultrasound system has become an important and popular diagnostic tool since it has a wide range of applications. Specifically, due to its non-invasive and non-destructive nature, the ultrasound system has been extensively used in the medical profession. Modern high-performance ultrasound systems and techniques are commonly used to produce two or three-dimensional ultrasound images of internal features of a target object (e.g., human organs).

[0004] The ultrasound system may provide a 3D ultrasound image including clinical information such as spatial information and anatomical figures of the target object, which cannot be provided by a 2D ultrasound image. The ultrasound system may transmit ultrasound signals into a target object and receive ultrasound echo signals reflected from the target object. The ultrasound system may further form volume data based on the ultrasound echo signals. The ultrasound system may also render the volume data to thereby form the 3D ultrasound image.

[0005] The ultrasound system may set opacity for rendering the volume data based on an intensity corresponding to each of the voxels of the volume data. Thus, it is required to the ultrasound system with an opacity setting unit capable of setting the opacity throughout depth.

SUMMARY

[0006] There is provided an ultrasound system with an opacity setting unit capable of setting opacity corresponding to rendering of volume data throughout depth.

[0007] In one embodiment, by way of non-limiting example, an ultrasound system comprises an opacity setting unit configured to receive input information for setting opacity corresponding to rendering of volume data throughout the depth.

[0008] This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key or essential features of the claimed subject matter, nor is it intended to be used in determining the scope of the claimed subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. **1** is a block diagram showing an illustrative embodiment of an ultrasound system.

[0010] FIG. **2** is a block diagram showing an illustrative embodiment of an ultrasound data acquisition unit.

[0011] FIG. **3** is a schematic diagram showing an example of acquiring ultrasound data corresponding to a plurality of frames.

[0012] FIG. **4** is a schematic diagram showing an example of a user input unit.

[0013] FIG. **5** is a flow chart showing a process of setting opacity throughout depth.

[0014] FIG. **6** is a schematic diagram showing an example of volume data.

[0015] FIG. **7** is a schematic diagram showing an example of input information.

[0016] FIG. **8** is a schematic diagram showing an example of soft buttons.

DETAILED DESCRIPTION

[0017] A detailed description may be provided with reference to the accompanying drawings. One of ordinary skill in the art may realize that the following description is illustrative only and is not in any way limiting. Other embodiments of the present invention may readily suggest themselves to such skilled persons having the benefit of this disclosure.

[0018] Referring to FIG. **1**, an ultrasound system **100** in accordance with an illustrative embodiment is shown. As depicted therein, the ultrasound system **100** may include an ultrasound data acquisition unit **110**.

[0019] The ultrasound data acquisition unit **110** may be configured to transmit ultrasound signals to a living body. The living body may include target objects (e.g., blood vessels, blood flow, a heart, a liver, etc.). The ultrasound data acquisition unit **110** may be further configured to receive ultrasound signals (i.e., ultrasound echo signals) from the living body to acquire ultrasound data.

[0020] FIG. **2** is a block diagram showing an illustrative embodiment of the ultrasound data acquisition unit. Referring to FIG. **2**, the ultrasound data acquisition unit **110** may include an ultrasound probe **210**.

[0021] The ultrasound probe **210** may include a plurality of transducer elements (not shown) for reciprocally converting between ultrasound signals and electrical signals. The ultrasound probe **210** may be configured to transmit the ultrasound signals to the living body. The ultrasound probe **210** may be further configured to receive the ultrasound echo signals from the living body to output received signals. The ultrasound probe **210** may include a three-dimensional mechanical probe, a two-dimensional array probe and the like.

[0022] The ultrasound data acquisition unit **110** may further include a transmitting section **220**. The transmitting section **220** may be configured to control the transmission of the ultrasound signals. The transmitting section **220** may be further configured to generate electrical signals ("transmitting signals") for obtaining an ultrasound image in consideration of the elements and focusing points. The transmitting section **220** may include a transmitting signal generating section (not shown), a transmitting delay time information memory (not shown), a transmitting beam former (not shown) and the like.

[0023] In the embodiment, the transmitting section **220** may form the transmitting signals for obtaining a plurality of frames F_i ($1 \leqq i \leqq N$) corresponding to a three-dimensional ultrasound image at every predetermined time, as shown in FIG. **3**. Thus, the ultrasound probe **210** may convert the transmitting signals provided from the transmitting section **220** into the ultrasound signals, transmit the ultrasound signals to the living body and receive the ultrasound echo signals from the living body to thereby output the received signals.

[0024] FIG. **3** is a schematic diagram showing an example of acquiring ultrasound data corresponding to the plurality of frames F_i ($1 \leqq i \leqq N$). Referring to FIG. **3**, the plurality of frames F_i ($1 \leqq i \leqq N$) may represent sectional planes of the living body (not shown). However, it should be noted herein that the plurality of frames F_i ($1 \leqq i \leqq N$) may not be limited thereto.

[0025] Referring back to FIG. **2**, the ultrasound data acquisition unit **110** may further include a receiving section **230**. The receiving section **230** may be configured to convert the received signals into digital signals. The receiving section **230** may be also configured to apply delays to the digital signals in consideration of the elements and the focusing points to thereby output digital receive-focused signals. The receiving section **230** may include an analog-to-digital converter (not shown), a receiving delay time information memory (not shown), a receiving beam forming (not shown) and the like.

[0026] The ultrasound data acquisition unit **110** may further include an ultrasound data forming section **240**. The ultrasound data forming section **240** may be configured to form ultrasound data corresponding to the frames F_i ($1 \leqq i \leqq N$) based on the digital receive-focused signals provided from the receiving section **230**. The ultrasound data may include radio frequency data. However, it should be noted herein that the ultrasound data may not be limited thereto. The ultrasound data forming section **240** may be also configured to perform signal processing (e.g., gain control, etc) upon the digital receive-focused signals.

[0027] Referring back to FIG. **1**, the ultrasound system **100** may further include a user input unit **120**. The user input unit **120** may be configured to receive input information of a user. In the embodiment, the input information may include first input information for selecting a diagnostic mode corresponding to the three-dimensional ultrasound image. The input information may further include second input information for setting opacity corresponding to rendering of the volume data throughout depth. The depth may represent depth in a rendering direction. However, it should be noted herein that the depth may not be limited thereto.

[0028] In the embodiment, the user input unit **120** may include an opacity setting unit configured to receive the second input information for setting the opacity throughout the depth.

[0029] As one example, the opacity setting unit may include a plurality of time gain compensation sliders **411** to **418** of a control panel CP, as shown in FIG. **4**. The time gain compensation sliders **411** to **418** may set the opacity of 0 to 255.

[0030] As another example, the opacity setting unit may include a plurality of soft buttons **811** to **818**, which are displayed on a touch screen **420** of the control panel CP, as shown in FIG. **8**. The soft buttons **811** to **818** may set the opacity of 0 to 255.

[0031] Although it has been described that the soft buttons **811** to **818** may be displayed on the touch screen **420** of the control panel CP, the soft buttons **811** to **818** may be further displayed on a display unit **150** corresponding to the touch screen.

[0032] The ultrasound system **100** may further include a storage unit **130**. The storage unit **130** may store the ultrasound data acquired by the ultrasound data acquisition unit **110**. The storage unit **130** may further store a mapping table for providing the depth and an opacity setting range corresponding to the opacity setting unit of the user input unit **120**. For example, the storage unit **130** may store the mapping table as shown in Table 1.

TABLE 1

Opacity setting unit	Depth	Opacity setting range
Time gain compensation slider 411 or soft button 811	0~2 cm	0~255
Time gain compensation slider 412 or soft button 812	2.1 cm~4.0 cm	0~255
Time gain compensation slider 413 or soft button 813	4.1 cm~6.0 cm	0~255
Time gain compensation slider 414 or soft button 814	6.1 cm~8.0 cm	0~255
Time gain compensation slider 415 or soft button 815	8.1 cm~10.0 cm	0~255
Time gain compensation slider 416 or soft button 816	10.1 cm~12.0 cm	0~255
Time gain compensation slider 417 or soft button 817	12.1 cm~14.0 cm	0~255
Time gain compensation slider 418 or soft button 818	14.1 cm~16.0 cm	0~255

[0033] The ultrasound system **100** may further include a processing unit **140**. The processing unit **140** is in communication with the ultrasound data acquisition unit **110**, the user input unit **120** and the storage unit **130**. The processing unit **140** may include a central processing unit, a microprocessor, a graphic processing unit and the like.

[0034] FIG. **5** is a flow chart showing a process of forming the three-dimensional ultrasound image. Referring to HG **5**, the processing unit **140** may be configured to form volume data VD based on the input information (i.e., first input information) provided from the user input unit **120** as shown in FIG. **6**, at step S**502** in FIG. **5**. The volume data VD may be formed by using the ultrasound data provided from the ultrasound data. The volume data may be stored in the storage unit **130**.

[0035] FIG. **6** is a schematic diagram showing an example of the volume data VD. The volume data VD may include a plurality of voxels (not shown) having brightness values. In FIG. **6**, the axial direction may be a transmission direction of the ultrasound signals, the lateral direction may be a longitudinal direction of the elements, and the elevation direction may be a swing direction of the elements, i.e., a depth direction of the 3D ultrasound image.

[0036] Referring back to FIG. **5**, the processing unit **140** may be configured to initialize the opacity setting unit of the user input unit **120** based on the first input information, at step S**504** in FIG. **5**.

[0037] As one example, the processing unit **140** may convert the plurality of time gain compensation sliders **411** to **418** of the control panel CP into the opacity setting unit based on the first input information. The processing unit **140** may further set the opacity of 0 to 255 on each of the time gain compensation sliders **411** to **418**.

[0038] As another example, the processing unit **140** may form the plurality of soft buttons **811** to **818**. The processing unit **140** may further set the opacity of 0 to 255 on each of the soft buttons **811** to **818**. The processing unit **140** may further control display of the soft buttons **811** to **818**.

[0039] The processing unit **140** may be configured to set the opacity corresponding to the input information (i.e., second input information) provided from the user input unit **120** based on the mapping table, at step S**506** in FIG. **5**. For

example, the processing unit **140** may set the opacity O_{411} to O_{418} corresponding to the second input information based on the mapping table, as shown in FIG. **7**. The opacity O_{411} to O_{418} may correspond to the time gain compensation sliders **411** to **418**, respectively.

[0040] The processing unit **140** may be configured to render the volume data VD based on the set opacity to thereby form the three-dimensional ultrasound image, at step S**508** in FIG. **5**. The methods of rendering volume data based on the opacity are well known in the art. Thus, they have not been described in detail so as not to unnecessarily obscure the present disclosure.

[0041] Referring back to FIG. **1**, the ultrasound system **100** may further include the display unit **150**. The display unit **150** may display the three-dimensional ultrasound image formed by the processing unit **140**. The display unit **150** may further display the soft buttons **811** to **818**.

[0042] Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this disclosure. More particularly, numerous variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

What is claimed is:

1. An ultrasound system, comprising:

an opacity setting unit configured to receive input information for setting opacity corresponding to rendering of volume data throughout the depth.

2. The ultrasound system of claim **1**, further comprising:

an ultrasound data acquisition unit configured to transmit ultrasound signals to a living body and receive ultrasound echo signals from the living body to acquire ultrasound data;

a storage unit configured to store a mapping table for providing depth and an opacity setting range corresponding to the opacity setting unit; and

a processing unit configured to form the volume data based on the ultrasound data, set the opacity corresponding to the input information based on the mapping table, and render the volume data based on the opacity.

3. The ultrasound system of claim **1**, wherein the opacity setting unit includes a plurality of time gain control sliders.

4. The ultrasound system of claim **1**, wherein the opacity setting unit includes a plurality of soft buttons.

* * * * *

专利名称(译)	具有不透明度设定单元的超声系统		
公开(公告)号	US20120190984A1	公开(公告)日	2012-07-26
申请号	US13/358961	申请日	2012-01-26
[标]申请(专利权)人(译)	三星麦迪森株式会社		
申请(专利权)人(译)	三星MEDISON CO.，LTD.		
当前申请(专利权)人(译)	三星MEDISON CO.，LTD.		
[标]发明人	KIM SUNG YOON HYUN DONG GYU KIM JONG SIK		
发明人	KIM, SUNG YOON HYUN, DONG GYU KIM, JONG SIK		
IPC分类号	A61B8/00		
CPC分类号	A61B8/14 A61B8/466 A61B8/467 A61B8/5207 A61B8/483 G06T15/08 G06T15/503 G06T2210/41 G06T2210/62 A61B8/5246		
优先权	1020110007908 2011-01-26 KR		
外部链接	Espacenet USPTO		

摘要(译)

提供了一种具有不透明度设置单元的超声系统，其能够设置对应于整个深度的体数据的渲染的不透明度。在一个实施例中，超声系统包括不透明度设置单元，该不透明度设置单元被配置为接收用于设置对应于整个深度的体数据的渲染的不透明度的输入