US 20110282205A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2011/0282205 A1**

(43) **Pub. Date: Nov. 17, 2011**

KIM

(54) **PROVIDING AT LEAST ONE SLICE IMAGE WITH ADDITIONAL INFORMATION IN AN ULTRASOUND SYSTEM**

(75) Inventor: **Sung Yoon KIM**, Seoul (KR)

(73) Assignee: **Samsung Medison Co., Ltd.**

(21) Appl. No.: **13/104,506**

(22) Filed: **May 10, 2011**

(30) **Foreign Application Priority Data**

May 13, 2010 (KR) 10-2010-0044770

Publication Classification

(51) **Int. Cl.**
A61B 8/14 (2006.01)

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

(57) **ABSTRACT**

Embodiments for providing at least one slice image with additional information are disclosed. In one embodiment, by way of non-limiting example, an ultrasound system comprises: an ultrasound data acquisition unit configured to acquire ultrasound data of a living body; a user input unit configured to receive input information for setting at least three points on a three-dimensional ultrasound image from a user; and a processing unit being configured to form the three-dimensional ultrasound image based on the volume data, set the at least three points on the three-dimensional ultrasound image based on the input information, set at least one slice on the three-dimensional ultrasound image based on the at least three points and form at least one slice image corresponding to the at least one slice and additional information corresponding to positions of the at least three points based on the volume data and the input information.

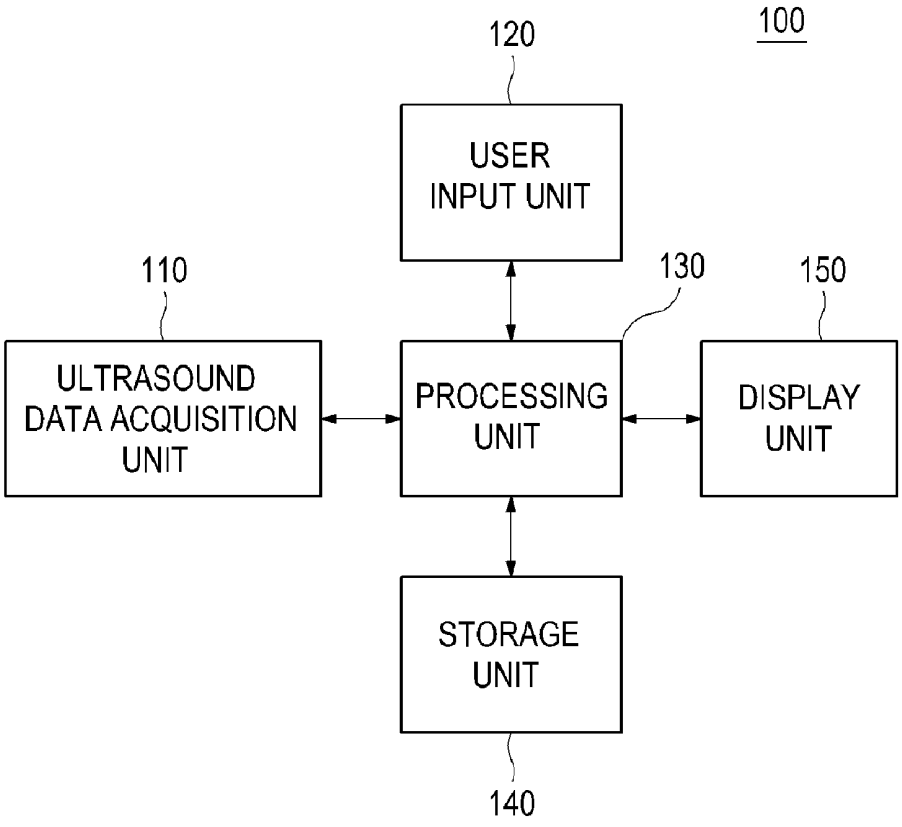


FIG. 1

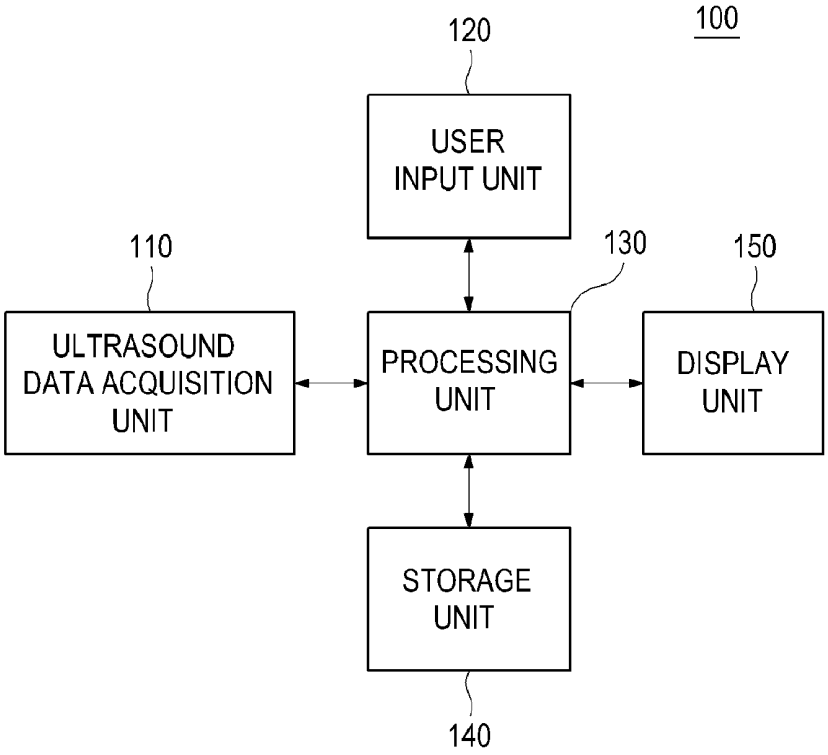

100
120
USER INPUT UNIT
110
130
150
ULTRASOUND DATA ACQUISITION UNIT
PROCESSING UNIT
DISPLAY UNIT
STORAGE UNIT
140

FIG. 2

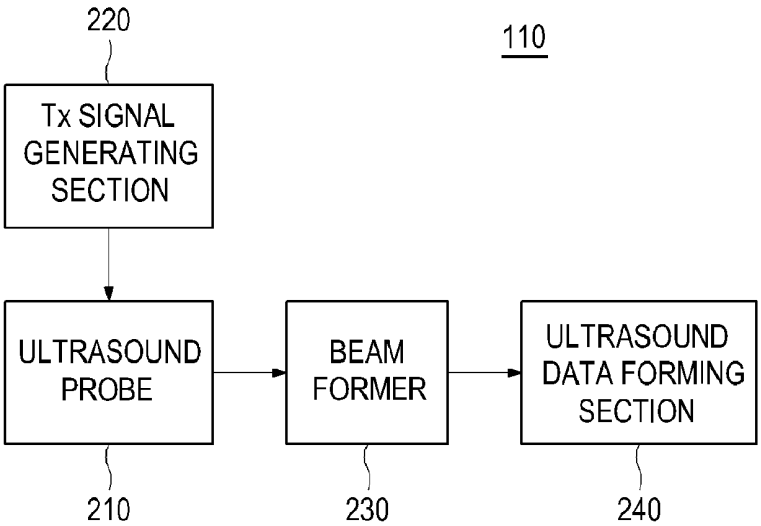

220
110
Tx SIGNAL GENERATING SECTION
ULTRASOUND PROBE
BEAM FORMER
ULTRASOUND DATA FORMING SECTION
210
230
240

FIG. 3

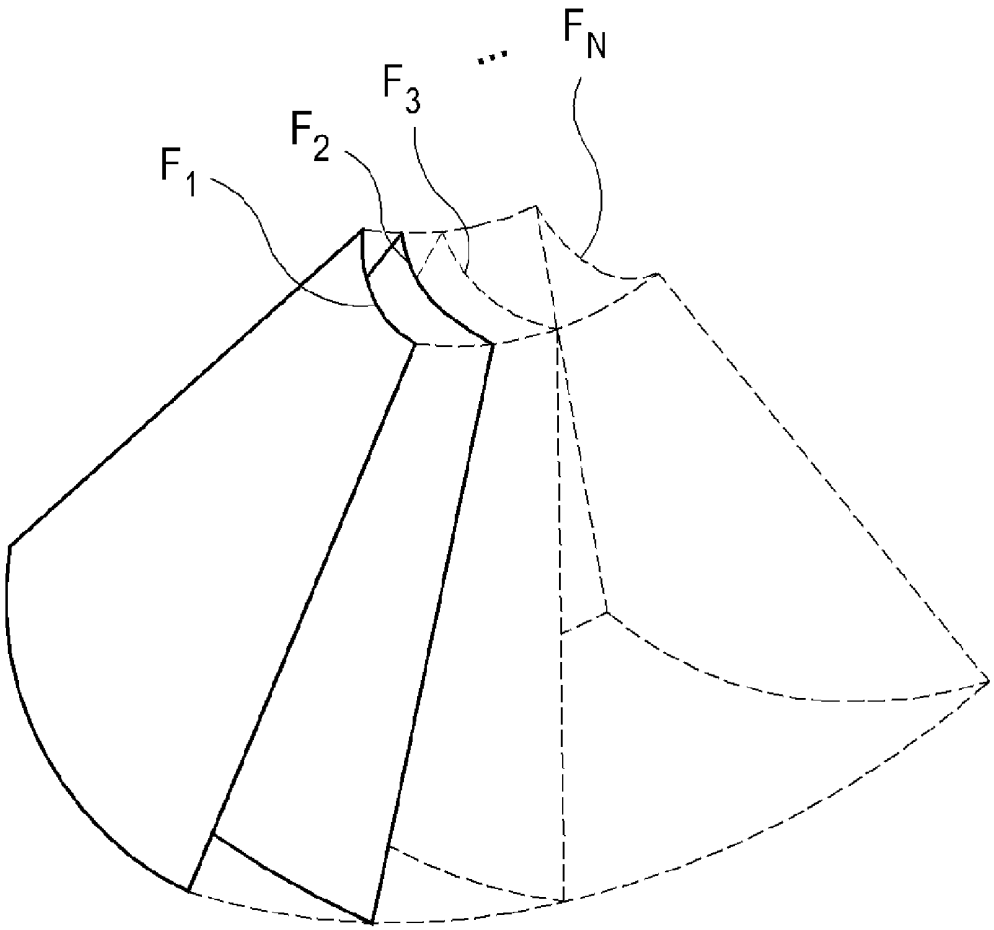


FIG. 4

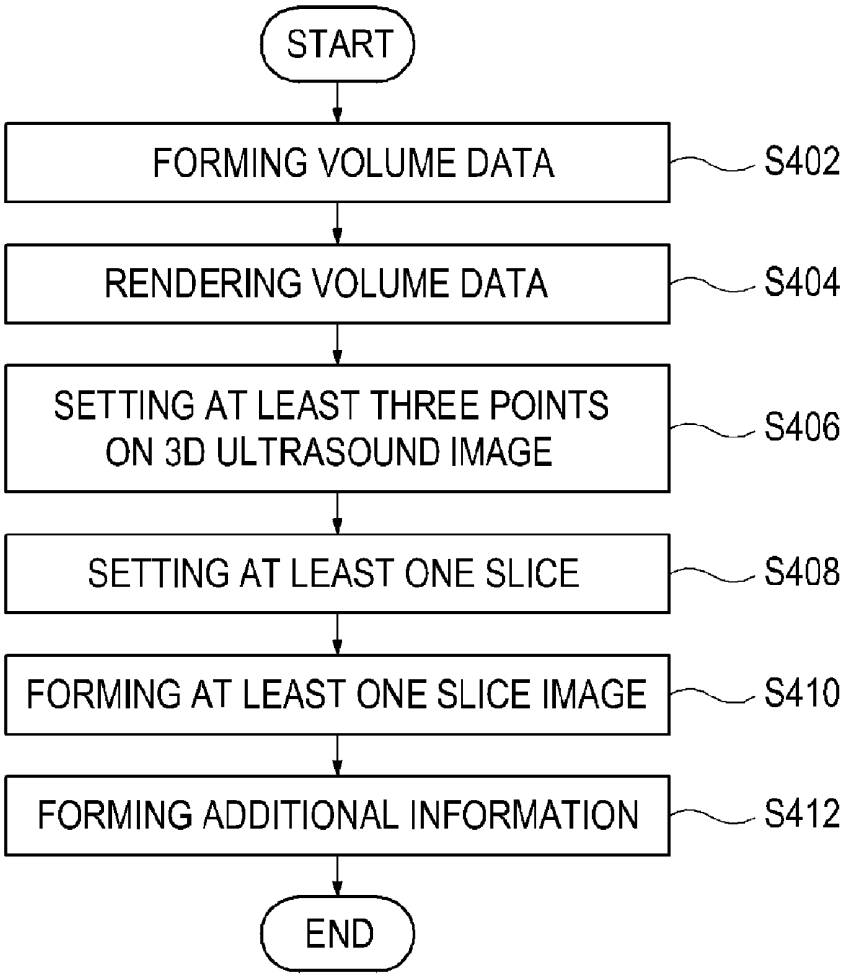

START
FORMING VOLUME DATA
S402
RENDERING VOLUME DATA
S404
SETTING AT LEAST THREE POINTS ON 3D ULTRASOUND IMAGE
S406
SETTING AT LEAST ONE SLICE
S408
FORMING AT LEAST ONE SLICE IMAGE
S410
FORMING ADDITIONAL INFORMATION
S412
END

FIG. 5

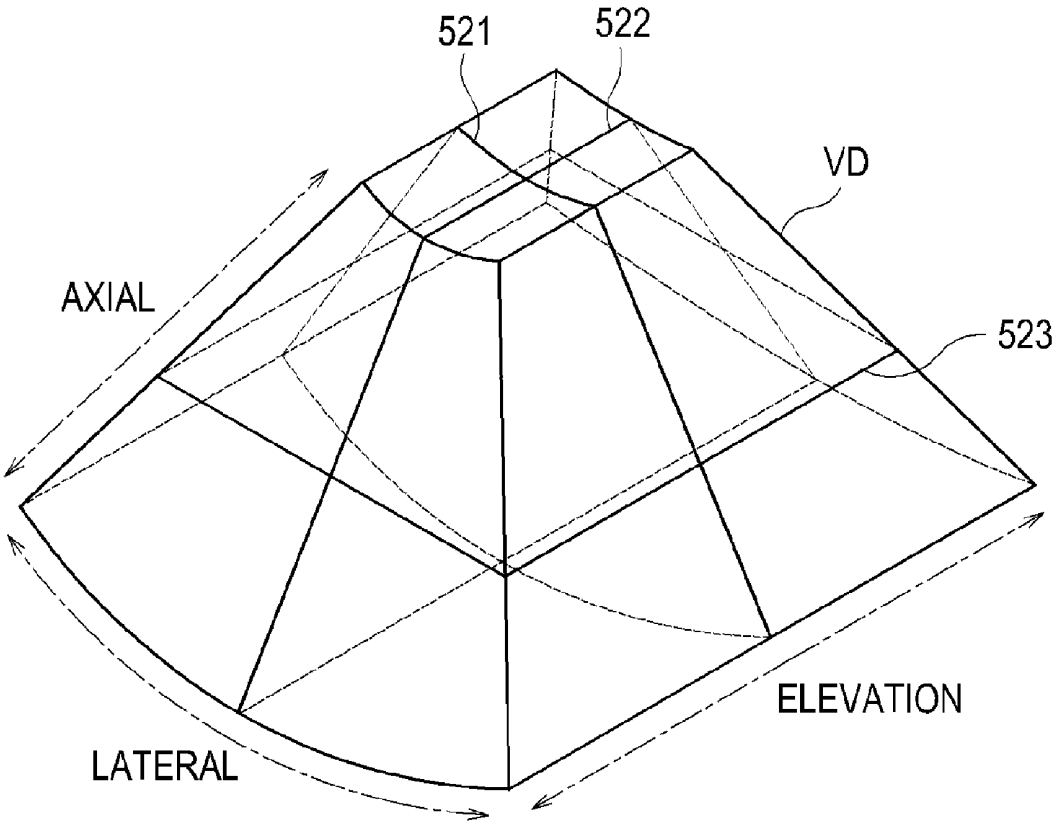


FIG. 6

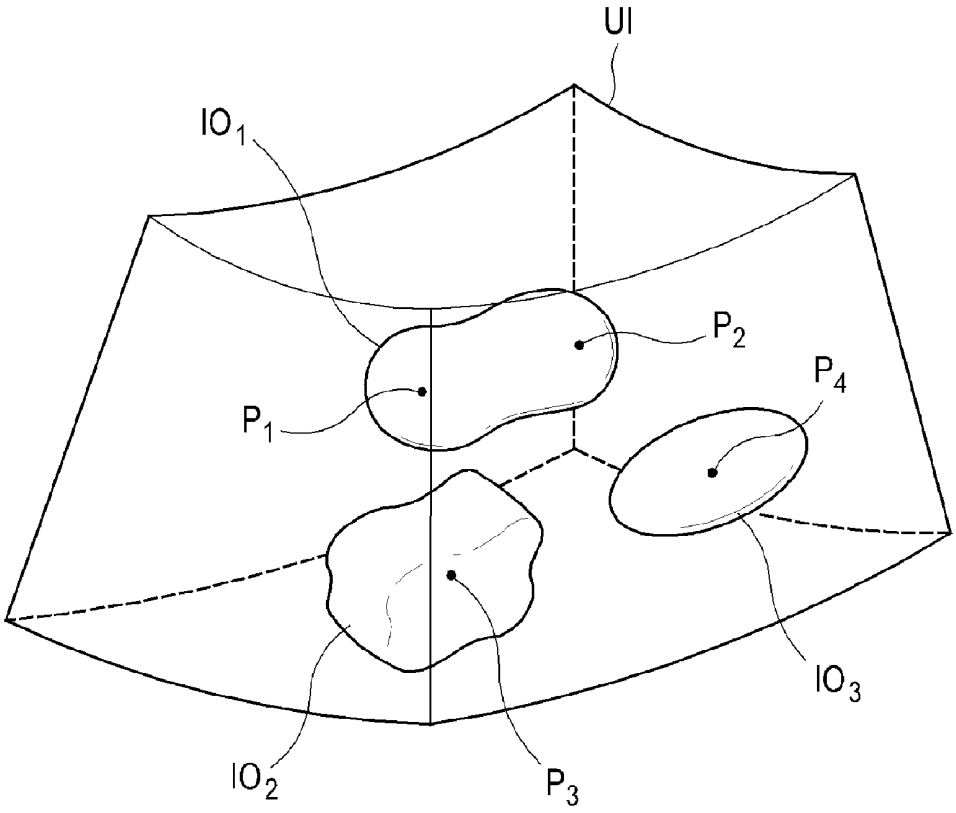


FIG. 7

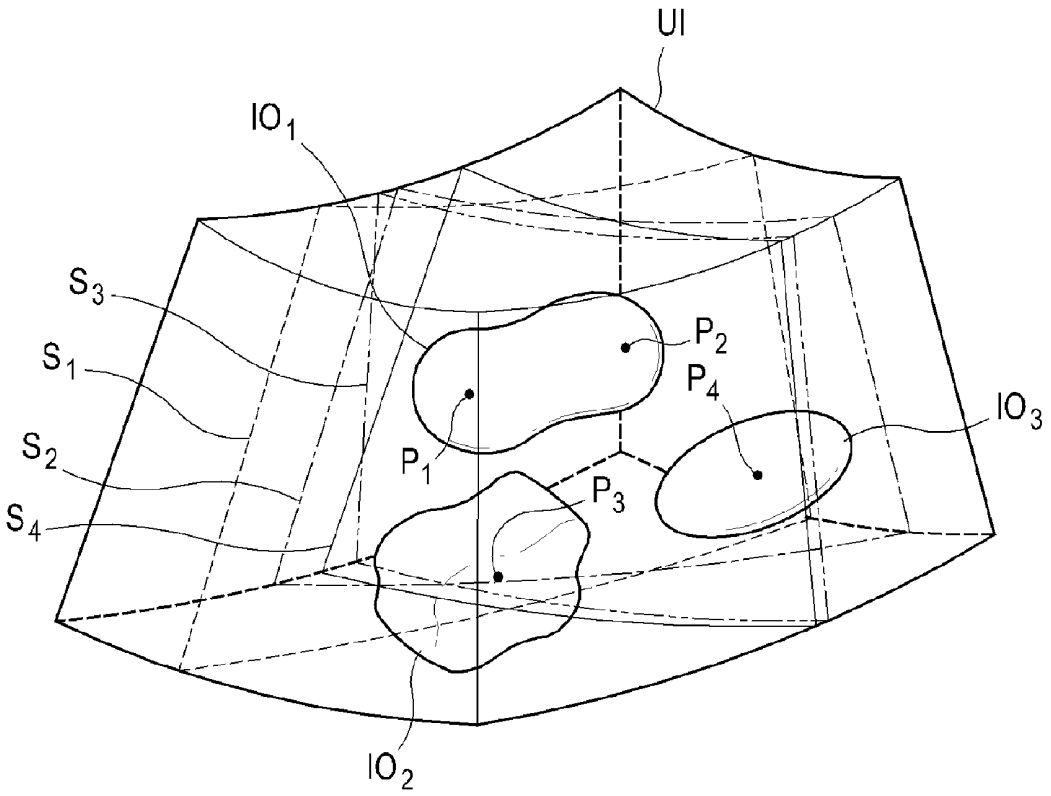


FIG. 8

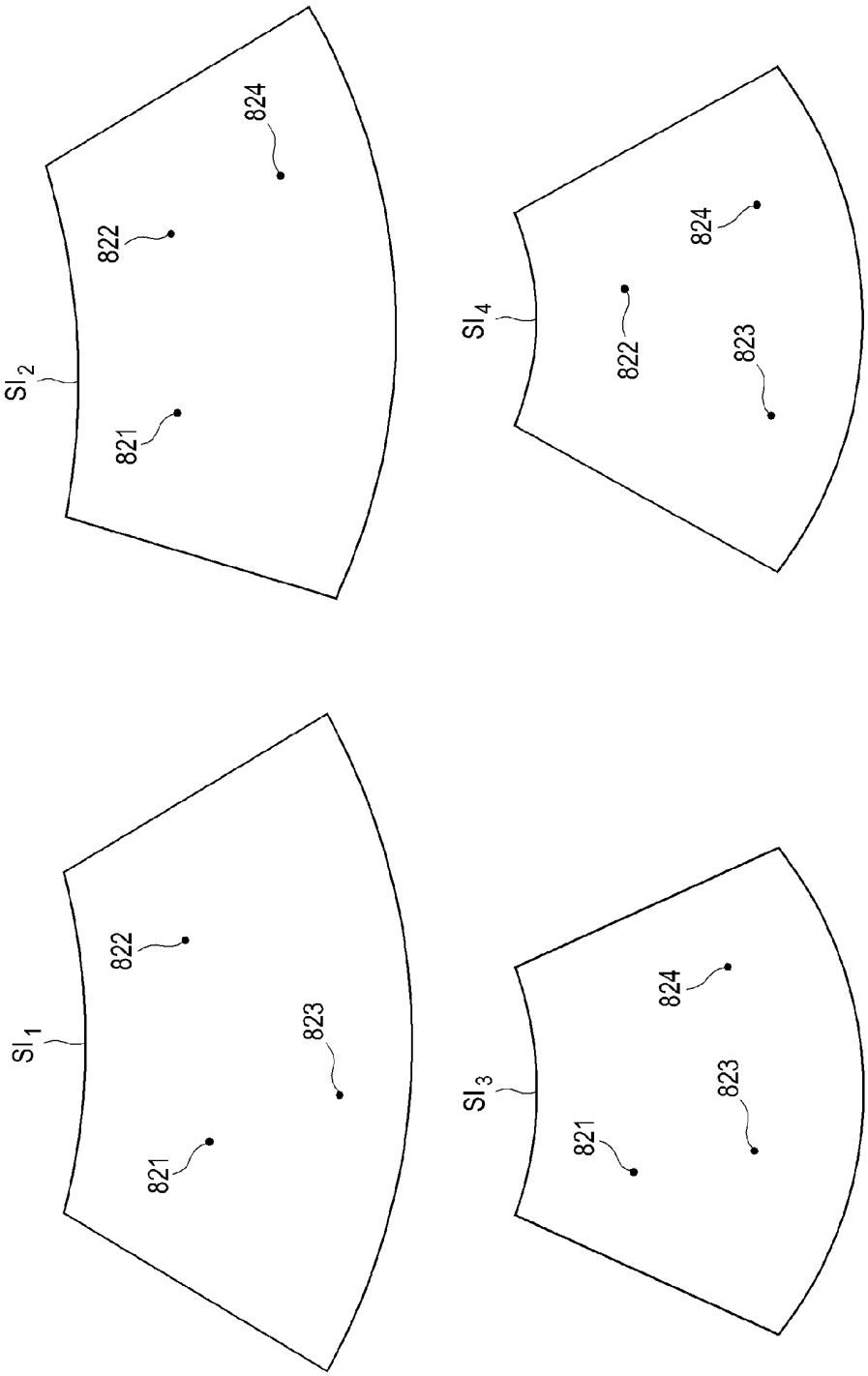
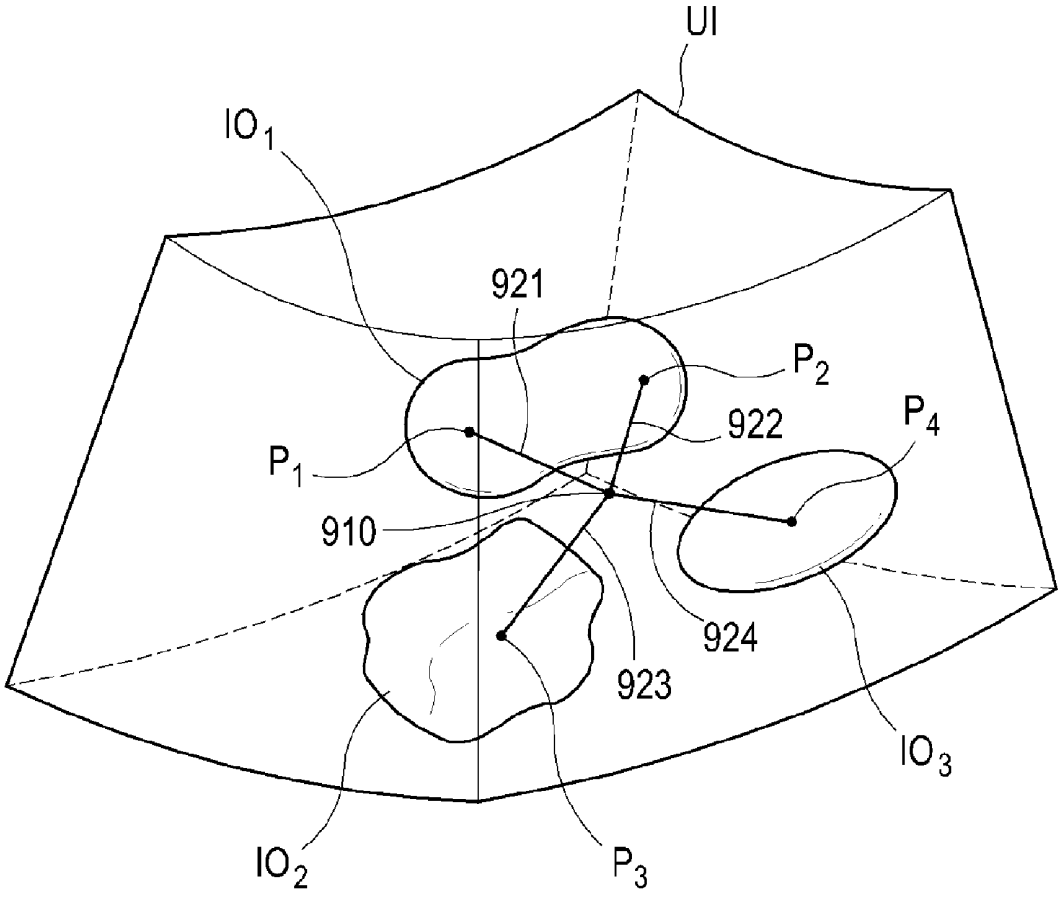


FIG. 9



PROVIDING AT LEAST ONE SLICE IMAGE WITH ADDITIONAL INFORMATION IN AN ULTRASOUND SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority from Korean Patent Application No. 10-2010-0044770 filed on May 13, 2010, 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 providing at least one slice image with additional information in an ultrasound system.

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-dimensional (2D) or three-dimensional (3D) ultrasound images of internal features of an object (e.g., human organs).

[0004] The ultrasound system may provide the 3D ultrasound image including clinical information such as spatial information and anatomical figures of the target object, which cannot be provided by the 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 further render the volume data to thereby form the 3D ultrasound image.

[0005] However, to find a region of interest from the 3D ultrasound image, a user may need to rotate or move the 3D ultrasound image. Also, it may be difficult to provide at least one slice image including a plurality of regions of interest from the 3D ultrasound image.

SUMMARY

[0006] Embodiments for providing a plurality of slice images in an ultrasound system are disclosed herein. In one embodiment, by way of non-limiting example, an ultrasound system comprises: an ultrasound data acquisition unit configured to transmit and receive ultrasound signals to and from a living body to output ultrasound data; a user input unit configured to receive input information for setting at least three points on a three-dimensional ultrasound image from a user; and a processing unit in communication with the ultrasound data acquisition unit and the user input unit, the processing unit being configured to form volume data based on the ultrasound data, render the volume data to form the three-dimensional ultrasound image, set the at least three points on the three-dimensional ultrasound image based on the input information, set at least one slice on the three-dimensional ultrasound image based on the at least three points and form at least one slice image corresponding to the at least one slice and additional information corresponding to positions of the at least three points based on the volume data and the input information.

[0007] In another embodiment, there is provided a method of providing slice images with additional information, comprising: a) transmitting and receiving ultrasound signals to and from a living body to output ultrasound data; b) forming volume data based on the ultrasound data; c) rendering the volume data to form the three-dimensional ultrasound image; d) receiving input information for setting at least three points on the three-dimensional ultrasound image from a user; e) setting the at least three points on the three-dimensional ultrasound image based on the input information; f) setting at least one slice on the three-dimensional ultrasound image based on the at least three points; and g) forming at least one slice image corresponding to the at least one slice and additional information corresponding to positions of the at least three points.

[0008] In yet another embodiment, there is provided a computer readable medium comprising computer executable instructions configured to perform the following acts: a) acquiring ultrasound data of a living body; b) forming volume data based on the ultrasound data; c) rendering the volume data to form the three-dimensional ultrasound image; d) receiving input information for setting at least three points on the three-dimensional ultrasound image from a user; e) setting the at least three points on the three-dimensional ultrasound image based on the input information; f) setting at least one slice on the three-dimensional ultrasound image based on the at least three points; and g) forming at least one slice image corresponding to the at least one slice and additional information corresponding to positions of the at least three points.

[0009] The 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

[0010] FIG. **1** is a block diagram showing an illustrative embodiment of an ultrasound system.

[0011] FIG. **2** is a block diagram showing an illustrative embodiment of an ultrasound data acquisition unit.

[0012] FIG. **3** is a schematic diagram showing an example of acquiring ultrasound data corresponding to a plurality of frames.

[0013] FIG. **4** is a flow chart showing a process of forming at least one slice image based on at least three points set on a 3D ultrasound image.

[0014] FIG. **5** is a schematic diagram showing an example of volume data.

[0015] FIG. **6** is a schematic diagram showing an example of points set on the 3D ultrasound image.

[0016] FIG. **7** is a schematic diagram showing an example of slices set on the 3D ultrasound image.

[0017] FIG. **8** is a schematic diagram showing an example of additional information.

[0018] FIG. **9** is a schematic diagram showing an example of the additional information.

DETAILED DESCRIPTION

[0019] 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.

[0020] 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**. The ultrasound data acquisition unit **110** may be configured to transmit and receive ultrasound signals to and from a living body, and output ultrasound data. The living body may include a plurality of target objects (e.g., blood vessels, a heart, etc.).

[0021] FIG. **2** is a block diagram showing an illustrative embodiment of the ultrasound data acquisition unit **110**. Referring to FIG. **2**, the ultrasound data acquisition unit **110** may include an ultrasound probe **210**, a transmit (Tx) signal generating section **220**, a beam former **230** and an ultrasound data forming section **240**.

[0022] The ultrasound probe **210** may include a plurality of elements (not shown) for reciprocally converting between ultrasound signals and electrical signals. The ultrasound probe **210** may be configured to transmit ultrasound signals to the living body. The ultrasound probe **210** may further receive ultrasound signals (i.e., ultrasound echo signals) from the living body and output the received signals. The received signals may be analog signals. The ultrasound probe **210** may include a three-dimensional (3D) mechanical probe or a two-dimensional (2D) array probe. However, it should be noted herein that the ultrasound probe **210** may not be limited thereto.

[0023] The Tx signal generating section **220** may be configured to control the transmission of the ultrasound signals. The Tx signal generating section **220** may further generate electrical signals ("Tx signals") in consideration of the elements and focal points. Thus, the ultrasound probe **210** may convert the Tx signals provided from the Tx signal generating 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] In one embodiment, the Tx signal generating section **220** may generate Tx signals for obtaining a plurality of frames $F_i(1 \leqq i \leqq N)$ corresponding to a three-dimensional (3D) ultrasound image at every predetermined time, as shown in FIG. **3**.

[0025] FIG. **3** is a schematic diagram showing an example of acquiring ultrasound data corresponding to the plurality of frames $F_i(1 \leqq i \leqq N)$. The plurality of frames $F_i(1 \leqq i \leqq N)$ may represent sectional planes of the living body (not shown).

[0026] Referring back to FIG. **2**, the beam former **230** may be configured to convert the received signals provided from the ultrasound probe **210** into digital signals. The beam former **230** may further apply delays to the digital signals in consideration of the elements and the focal points to output digital receive-focused signals.

[0027] 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 beam former **230**. The ultrasound data forming section **240** may further perform various signal processing (e.g., gain adjustment) upon the digital receive-focused signals.

[0028] 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 for setting at least three points on the three-dimensional (3D) ultrasound image. The user input unit **120** may include a control panel, a mouse or a keyboard. However, it should be noted herein that the user input unit **120** may not be limited thereto.

[0029] The ultrasound system **100** may further include a processing unit **130** in communication with the ultrasound data acquisition unit **110** and the user input unit **120**. The processing unit **130** may include a central processing unit, a microprocessor or a graphic processing unit. However, it should be noted herein that the processing unit **130** may not be limited thereto.

[0030] FIG. **4** is a flow chart showing a process of providing slice images with additional information. The processing unit **130** may be configured to synthesize the ultrasound data corresponding to the plurality of frames F_i $(1 \leqq i \leqq N)$ to form volume data VD as shown in FIG. **5**, at step **S402** in FIG. **4**.

[0031] FIG. **5** 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. **5**, reference numerals **521**, **522** and **523** represent an A plane, a B plane and a C plane, respectively. The A plane **521**, the B plane **522** and the C plane **523** may be mutually orthogonal. Also, in FIG. **5**, the axial direction may be a Tx 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.

[0032] The processing unit **130** may be configured to perform a rendering upon the volume data VD to form the 3D ultrasound image UI as shown in FIG. **6**, at step **S404** in FIG. **4**. The 3D ultrasound image UI may be displayed on a display unit **150** in FIG. **1**. Thus, the user may set the at least three points on the 3D ultrasound image UI displayed on the display unit **150** by using the user input unit **120**.

[0033] The processing unit **130** may be configured to set the at least three points on the 3D ultrasound image based on the input information provided from the user input unit **120**, at step **S406** in FIG. **4**. In one embodiment, the processing unit **130** may set points P_1 to P_4 on corresponding positions of the 3D ultrasound image UI as shown in FIG. **6**, based on the input information provided from the user input unit **120**. In FIG. **6**, reference numerals IO_1 to IO_3 represent the target objects within the living body.

[0034] The processing unit **130** may be configured to set at least one slice based on the at least three points set on the 3D ultrasound image, at step **S408** in FIG. **4**.

[0035] In one embodiment, the processing unit **130** may set point groups from the points P_1 to P_4 that are set on the 3D ultrasound image UI as shown in FIG. **6**, wherein each of the point groups includes three points. That is, The processing unit **130** may set: a first point group including points P_1, P_2 and P_3 from the points P_1 to P_4; a second point group including points P_1, P_2 and P_4 from the points P_1 to P_4; a third point group including points P_1, P_3 and P_4 from the points P_1 to P_4; and a fourth point group including points P_2, P_3 and P_4 from the points P_1 to P_4. The processing unit **130** may further set: a first slice S_1 passing through the points P_1, P_2 and P_3 of the first point group; a second slice S_2 passing through the points P_1, P_2 and P_4 of the second point group; a third slice S_3 passing through the points P_1, P_3 and P_4 of the third point group; and a fourth slice S_4 passing through the points P_2, P_3 and P_4 of the fourth point group on the 3D ultrasound image UI as shown in FIG. **7**.

[0036] The processing unit **130** may be configured to form at least one slice image corresponding to the at least one slice in consideration of geometry information of the at least one slice set on the 3D ultrasound image based on the volume data VD, at step S**410** in FIG. **4**.

[0037] In one embodiment, the processing unit **130** may form a first slice image SI_1 corresponding to the first slice S_1 in consideration of geometry information of the first slice S_1 based on the volume data VD, as shown in FIG. **8**. The processing unit **130** may further form a second slice image SI_2 corresponding the second slice S_2 in consideration of geometry information of the second slice S_2 based on the volume data VD, as shown in FIG. **8**. The processing unit **130** may further form a third slice image SI_3 corresponding to the third slice S_3 in consideration of geometry information of the third slice S_3 based on the volume data VD, as shown in FIG. **8**. The processing unit **130** may further form a fourth slice image SI_4 corresponding to the fourth slice S_4 in consideration of geometry information of the fourth slice S_4 based on the volume data VD, as shown in FIG. **8**.

[0038] The processing unit **130** may be configured to form additional information corresponding to positions of the at least three points, at step S**412** in FIG. **4**.

[0039] In one embodiment, the processing unit **130** may form the additional information representing the at least three points on the at least one slice image corresponding to the at least one slice. For example, the processing unit **130** may form first additional information **821**, **822** and **823** representing the points P_1, P_2 and P_3 on the first slice image SI_1, second additional information **821**, **822** and **824** representing the points P_1, P_2 and P_4 on the second slice image SI_2, third additional information **821**, **823**, and **824** representing the points P_1, P_3 and P_4 on the third slice image SI_3, and fourth additional information **822**, **823** and **824** representing the points P_2, P_3 and P_4 on the fourth slice image SI_4, based on the input information provided from the user input unit **120** and the geometry information of the first to fourth slices S_1 to S_4.

[0040] In another embodiment, the processing unit **130** may detect a center of the 3D ultrasound image, measure distances between the center and each of the at least three points, and form the additional information representing the distances between the center and each of the at least three points. For example, the processing unit **130** may detect the center **910** of the 3D ultrasound image UI, as shown in FIG. **9**. The processing unit **130** may further measure a first distance between the center **910** and the point P_1, a second distance between the center **910** and the point P_2, a third distance between the center **910** and the point P_3, and a fourth distance between the center **910** and the point P_4. The processing unit **130** may further form first additional information **921** representing the first distance, second additional information **922** representing the second distance, third additional information **923** representing the third distance, and fourth additional information **924** representing the fourth distance. The first to fourth additional information **921** to **924** may be represented as at least one of a symbol, a color, a text, a numerical value, a brightness of the color, a diagram and the like.

[0041] Referring back to FIG. **1**, the ultrasound system **100** may further include a storage unit **140**. The storage unit **140** may store the ultrasound data acquired by the ultrasound data acquisition unit **110**. The storage unit **140** may further store the volume data formed by the processing unit **130**. The storage unit **140** may further store the input information received from the user input unit **120**.

[0042] The ultrasound system **100** may further include the display unit **150**. The display unit **150** may display the 3D ultrasound image formed by the processing unit **130**. The display unit **150** may further display the at least one slice image and the additional information formed by the processing unit **130**. The display unit **150** may include a cathode ray tube, a liquid crystal display, an organic light emitting diode and the like.

[0043] In another embodiment, the present invention may provide a computer readable medium comprising computer executable instructions configured to perform the following acts: a) acquiring ultrasound data of a living body; b) forming volume data based on the ultrasound data; c) rendering the volume data to form the three-dimensional ultrasound image; d) receiving input information for setting at least three points on the three-dimensional ultrasound image from a user; e) setting the at least three points on the three-dimensional ultrasound image based on the input information; f) setting at least one slice on the three-dimensional ultrasound image based on the at least three points; and g) forming at least one slice image corresponding to the at least one slice and additional information corresponding to positions of the at least three points. The computer readable medium may comprise a floppy disk, a hard disk, a memory, a compact disk, a digital video disk, etc.

[0044] 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 ultrasound data acquisition unit configured to transmit and receive ultrasound signals to and from a living body to output ultrasound data;

a user input unit configured to receive input information for setting at least three points on a three-dimensional ultrasound image from a user; and

a processing unit in communication with the ultrasound data acquisition unit and the user input unit, the processing unit being configured to form volume data based on the ultrasound data, render the volume data to form the three-dimensional ultrasound image, set the at least three points on the three-dimensional ultrasound image based on the input information, set at least one slice on the three-dimensional ultrasound image based on the at least three points and form at least one slice image corresponding to the at least one slice and additional information corresponding to positions of the at least three points based on the volume data and the input information.

2. The ultrasound system of claim **1**, wherein the processing unit is configured to:

set at least one point group from the at least three points, wherein each of the at least one point group includes three points from the at least three points and the at least one slice passes the at least one point group.

3. The ultrasound system of claim 1, wherein the processing unit is configured to form the additional information representing the positions of the at least three points on the at least one slice image.

4. The ultrasound system of claim 1, wherein the processing unit is configured to detect a center of the three-dimensional ultrasound image, measure distances between the center and each of the at least three points, and form the additional information representing the distances.

5. The ultrasound system of claim 4, wherein the additional information comprises at least one of a symbol, a color, a text, a numerical value, a brightness of the color and a diagram.

6. A method of providing slice images with additional information, comprising:

a) transmitting and receiving ultrasound signals to and from a living body to output ultrasound data;

b) forming volume data based on the ultrasound data;

c) rendering the volume data to form the three-dimensional ultrasound image;

d) receiving input information for setting at least three points on the three-dimensional ultrasound image from a user;

e) setting the at least three points on the three-dimensional ultrasound image based on the input information;

f) setting at least one slice on the three-dimensional ultrasound image based on the at least three points; and

g) forming at least one slice image corresponding to the at least one slice and additional information corresponding to positions of the at least three points.

7. The method of claim 6, wherein the step f) comprises:

setting at least one point group from the at least three points, wherein each of the at least one point group includes three points from the at least three points and the at least one slice passes the at least one point group.

8. The method of claim 6, wherein the step g) comprises:

forming the additional information representing the positions of the at least three points on the at least one slice image.

9. The method of claim 6, wherein the step g) comprises:

detecting a center of the three-dimensional ultrasound image;

measuring distances between the center and each of the at least three points; and

forming the additional information representing the distances.

10. The method of claim 9, wherein the additional information comprises at least one of a symbol, a color, a text, a numerical value, a brightness of the color and a diagram.

11. A computer readable medium comprising computer executable instructions configured to perform following acts:

a) acquiring ultrasound data of a living body;

b) forming volume data based on the ultrasound data;

c) rendering the volume data to form the three-dimensional ultrasound image;

d) receiving input information for setting at least three points on the three-dimensional ultrasound image from a user;

e) setting the at least three points on the three-dimensional ultrasound image based on the input information;

f) setting at least one slice on the three-dimensional ultrasound image based on the at least three points; and

g) forming at least one slice image corresponding to the at least one slice and additional information corresponding to positions of the at least three points.

* * * * *

专利名称(译)	在超声系统中提供具有附加信息的至少一个切片图像		
公开(公告)号	US20110282205A1	公开(公告)日	2011-11-17
申请号	US13/104506	申请日	2011-05-10
[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		
发明人	KIM, SUNG YOON		
IPC分类号	A61B8/14		
CPC分类号	A61B8/469 A61B8/483 A61B8/523 G01S7/5206 G06T2219/008 G01S7/52084 G01S15/8993 G06T19/00 G01S7/52073		
优先权	1020100044770 2010-05-13 KR		
外部链接	Espacenet USPTO		

摘要(译)

公开了用于向至少一个切片图像提供附加信息的实施例。在一个实施例中，作为非限制性示例，超声系统包括：超声数据获取单元，被配置为获取活体的超声数据;用户输入单元，被配置为从用户接收用于在三维超声图像上设置至少三个点的输入信息;处理单元，用于根据体数据形成三维超声图像，基于输入信息在三维超声图像上设置至少三个点，在三维超声上设置至少一个切片所述图像基于所述至少三个点并且基于所述体数据和所述输入信息形成与所述至少一个切片对应的至少一个切片图像和与所述至少三个点的位置对应的附加信息。