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(54) **ULTRASOUND IMAGING BREAST TUMOR DETECTION AND DIAGNOSTIC SYSTEM AND METHOD**

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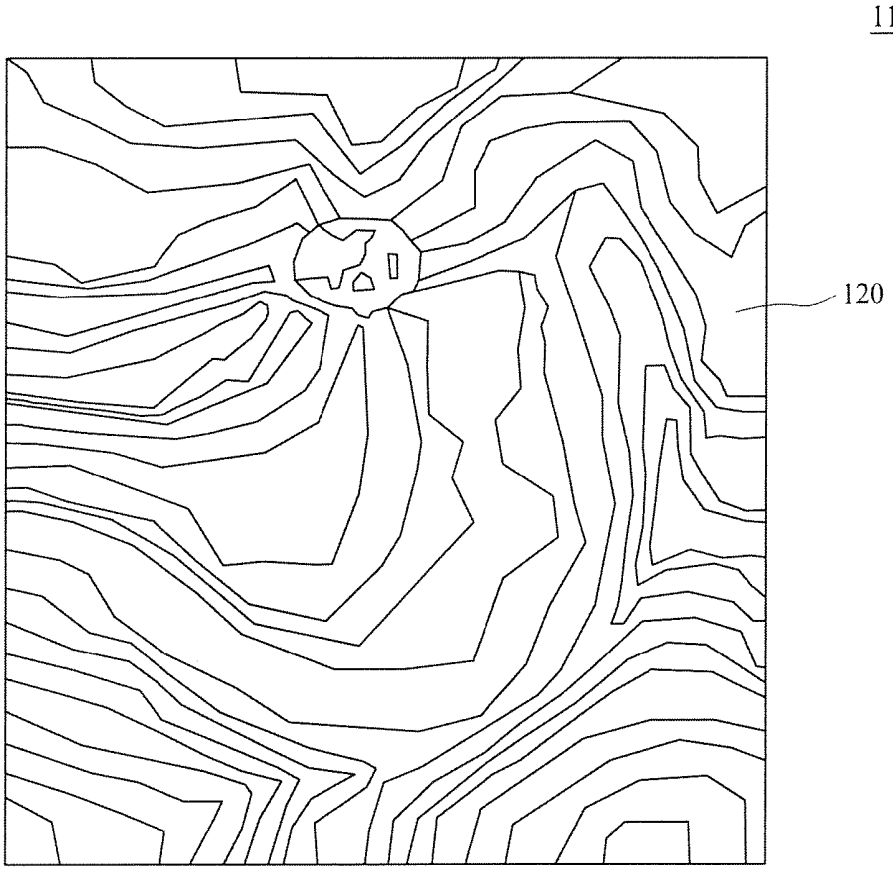
(57) **ABSTRACT**

An ultrasound imaging breast tumor detection and diagnostic system and method is disclosed. The method uses the system to acquire a plurality of 3D breast ultrasound images, and then to cut out multiple regions from the 3D breast ultrasound images using a 3D means shift algorithm, and then to acquire the mean grayscale value (MGV) of each region, and then to classify the regions to groups subject to the mean grayscale value (MGV), and to merge each of the regions of the darkest group with adjacent regions of the similar grayscale into a respective suspicious tumor tissue full region, and then to recognize each suspicious tumor tissue full region to be a tumor tissue region or non-tumor tissue region. Thus, using region as the basic computing unit, tumor tissues are quickly recognized from the 3D breast ultrasound images.



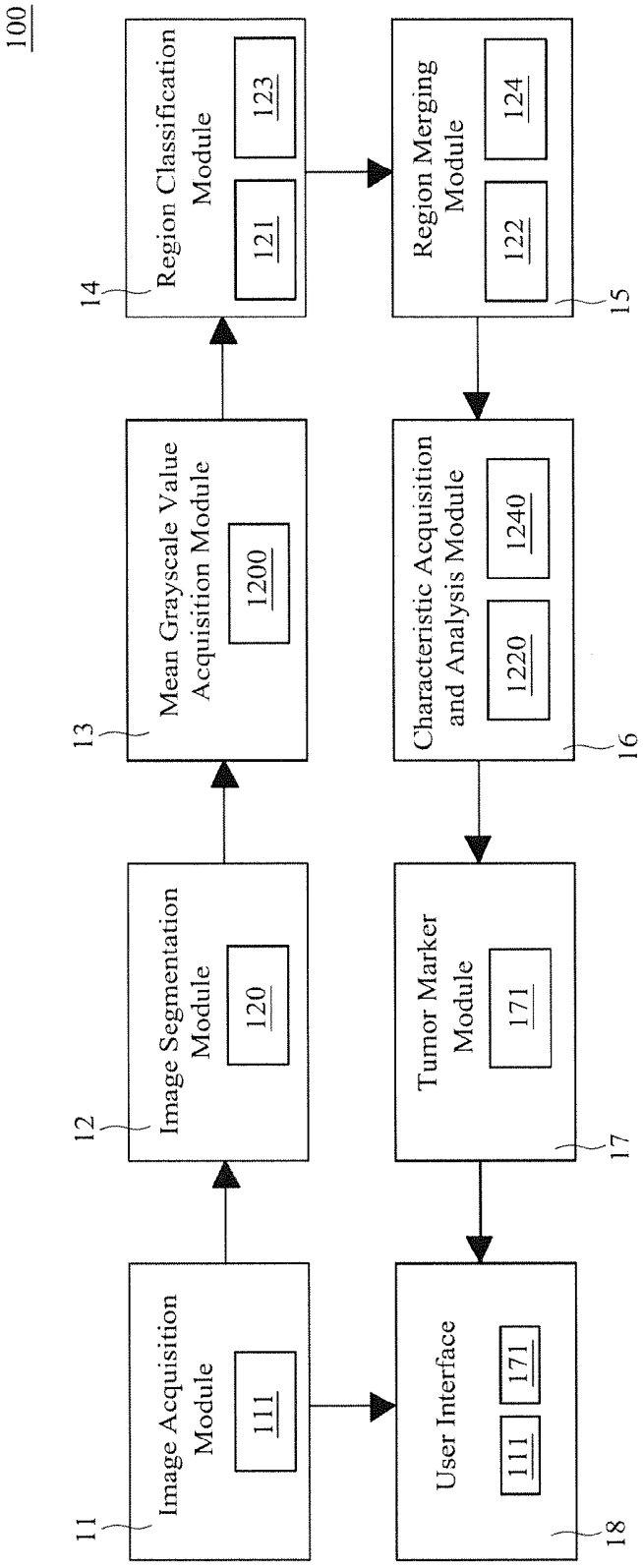

100
Image Acquisition Module
111
11
Image Segmentation Module
120
12
Mean Grayscale Value Acquisition Module
1200
13
Region Classification Module
121
123
14
Region Merging Module
122
124
15
Characteristic Acquisition and Analysis Module
1220
1240
16
Tumor Marker Module
171
17
User Interface
111
171
18

FIG. 1

111

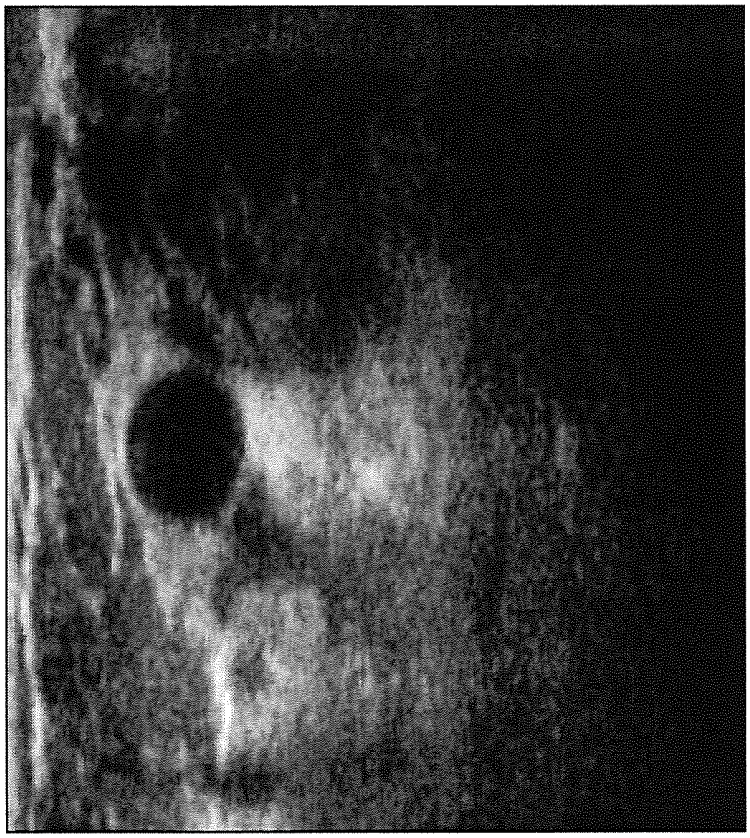


FIG. 2

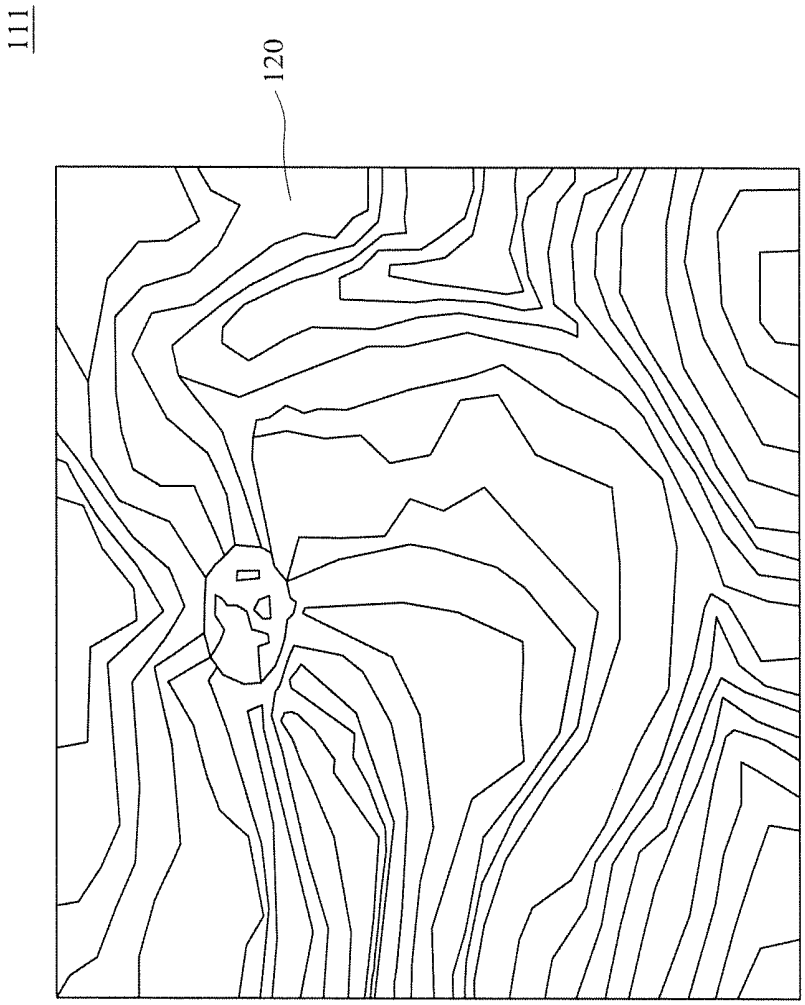


FIG. 3

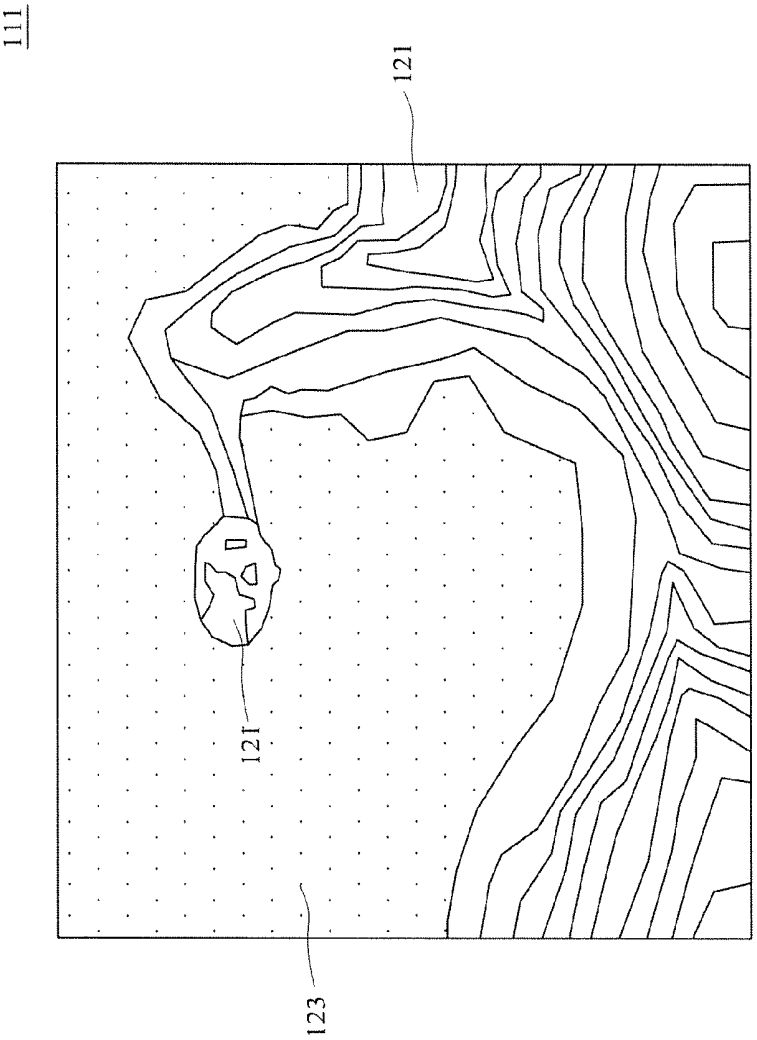


FIG. 4

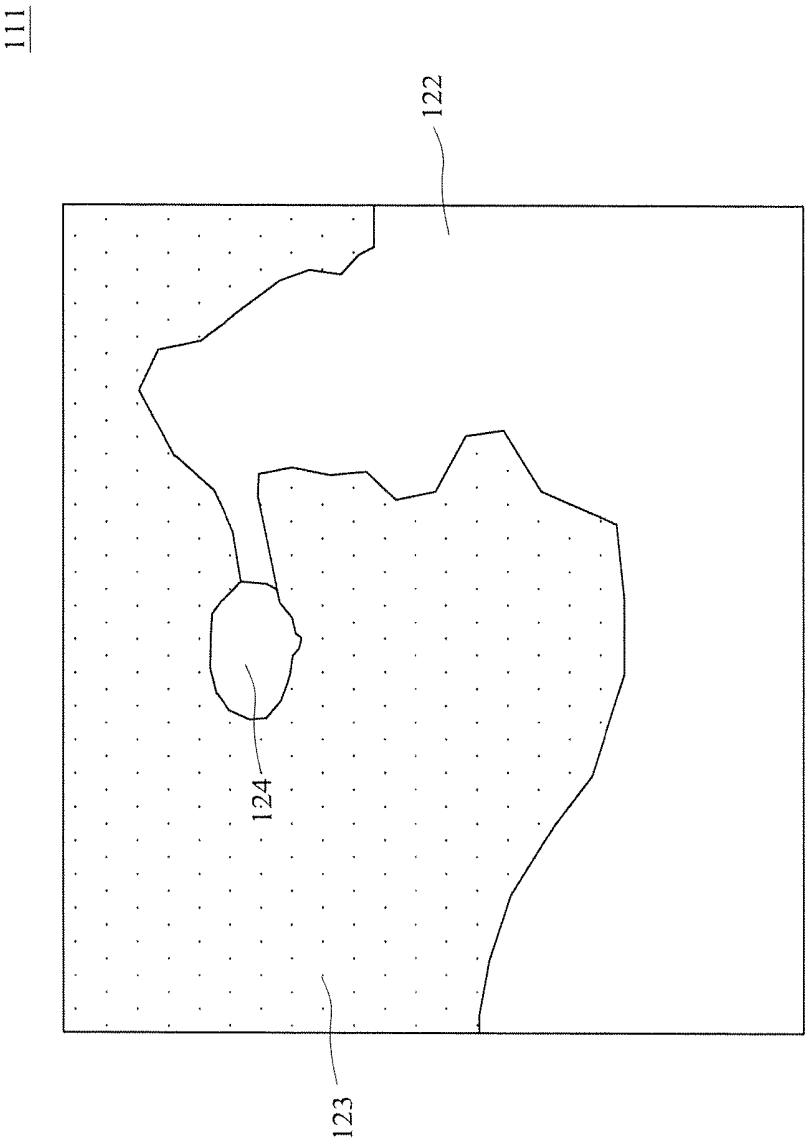


FIG. 5

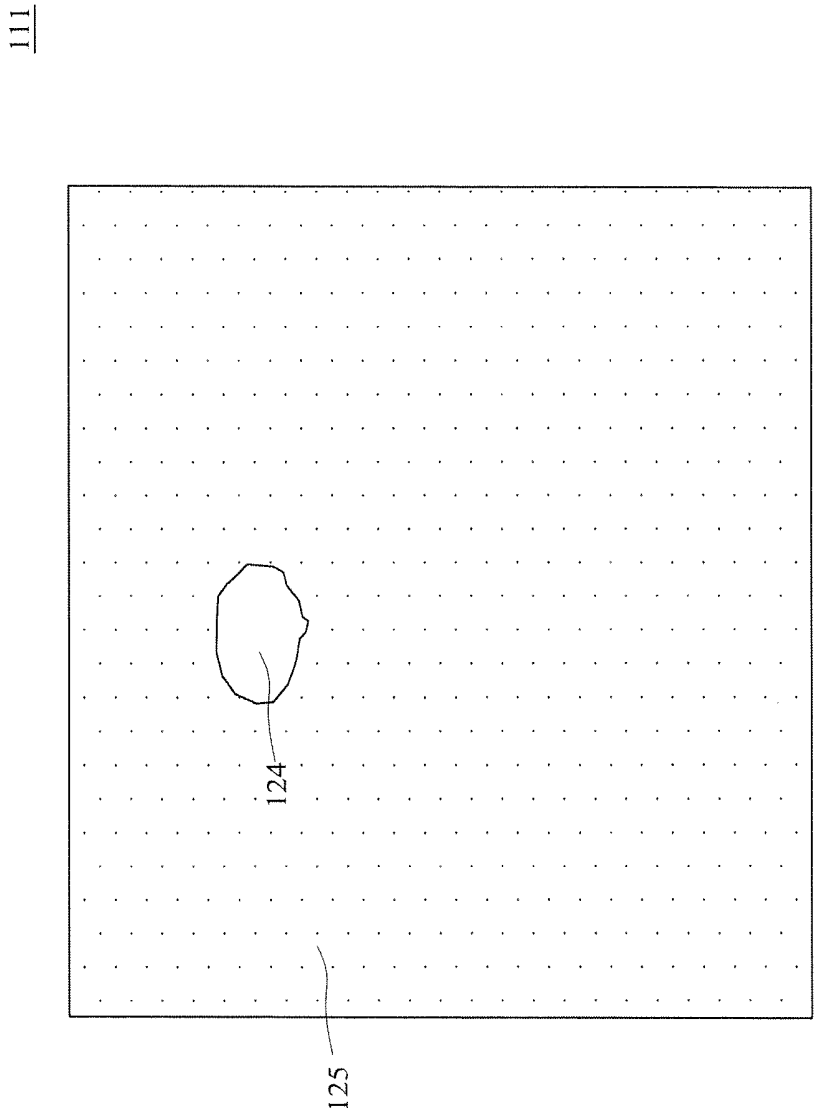


FIG. 6

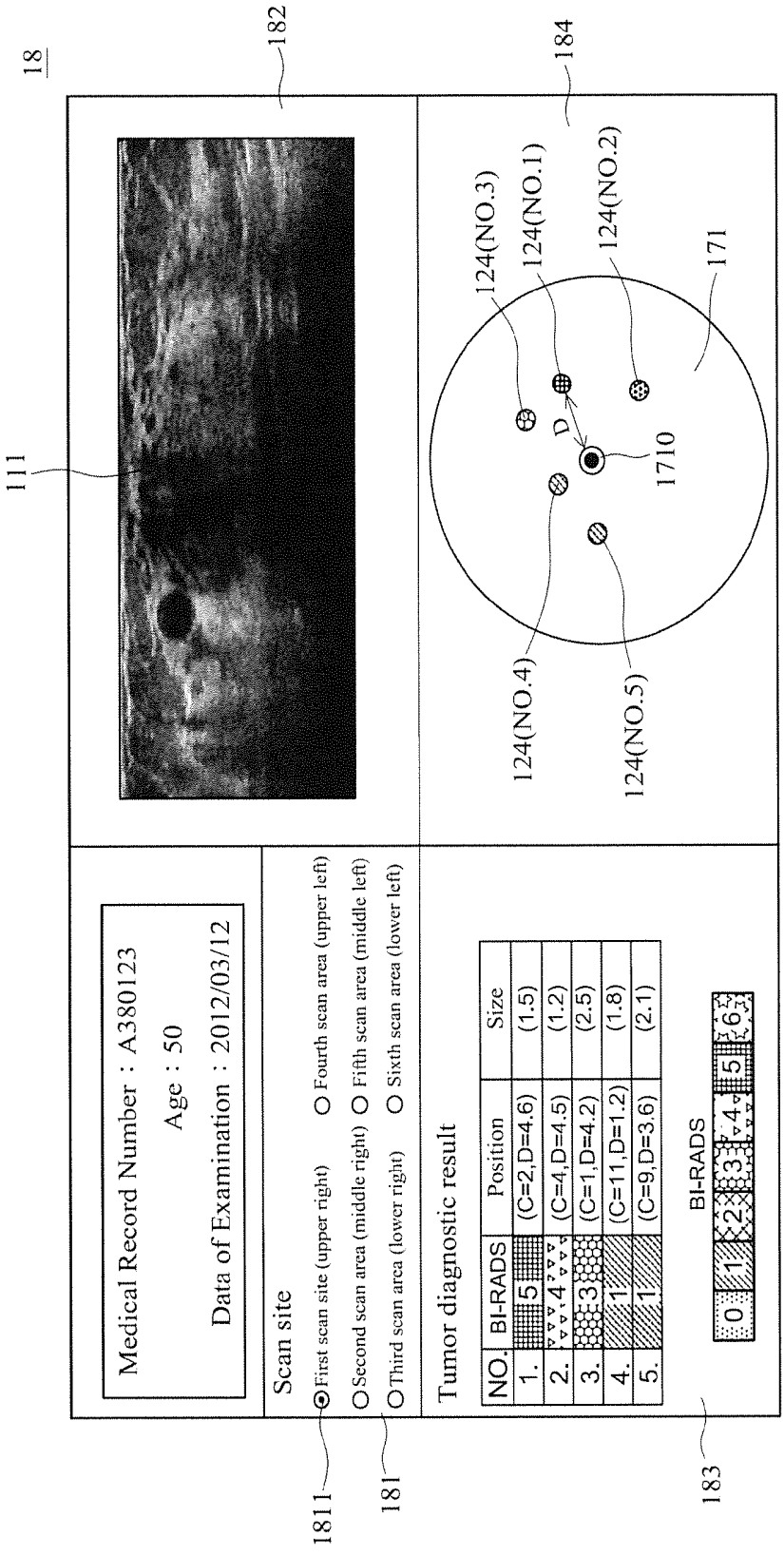

18
111
182
184
Medical Record Number : A380123
Age : 50
Data of Examination : 2012/03/12
Scan site
First scan site (upper right)
Second scan area (middle right)
Third scan area (lower right)
Fourth scan area (upper left)
Fifth scan area (middle left)
Sixth scan area (lower left)
1811
181
Tumor diagnostic result
NO. BI-RADS Position Size
1. 5 (C=2,D=4.6) (1.5)
2. 4 (C=4,D=4.5) (1.2)
3. 3 (C=1,D=4.2) (2.5)
4. 1 (C=11,D=1.2) (1.8)
5. 1 (C=9,D=3.6) (2.1)
BI-RADS
0 1 2 3 4 5 6
183
124(NO.3)
124(NO.1)
124(NO.2)
124(NO.4)
124(NO.5)
D
1710
171

FIG. 7

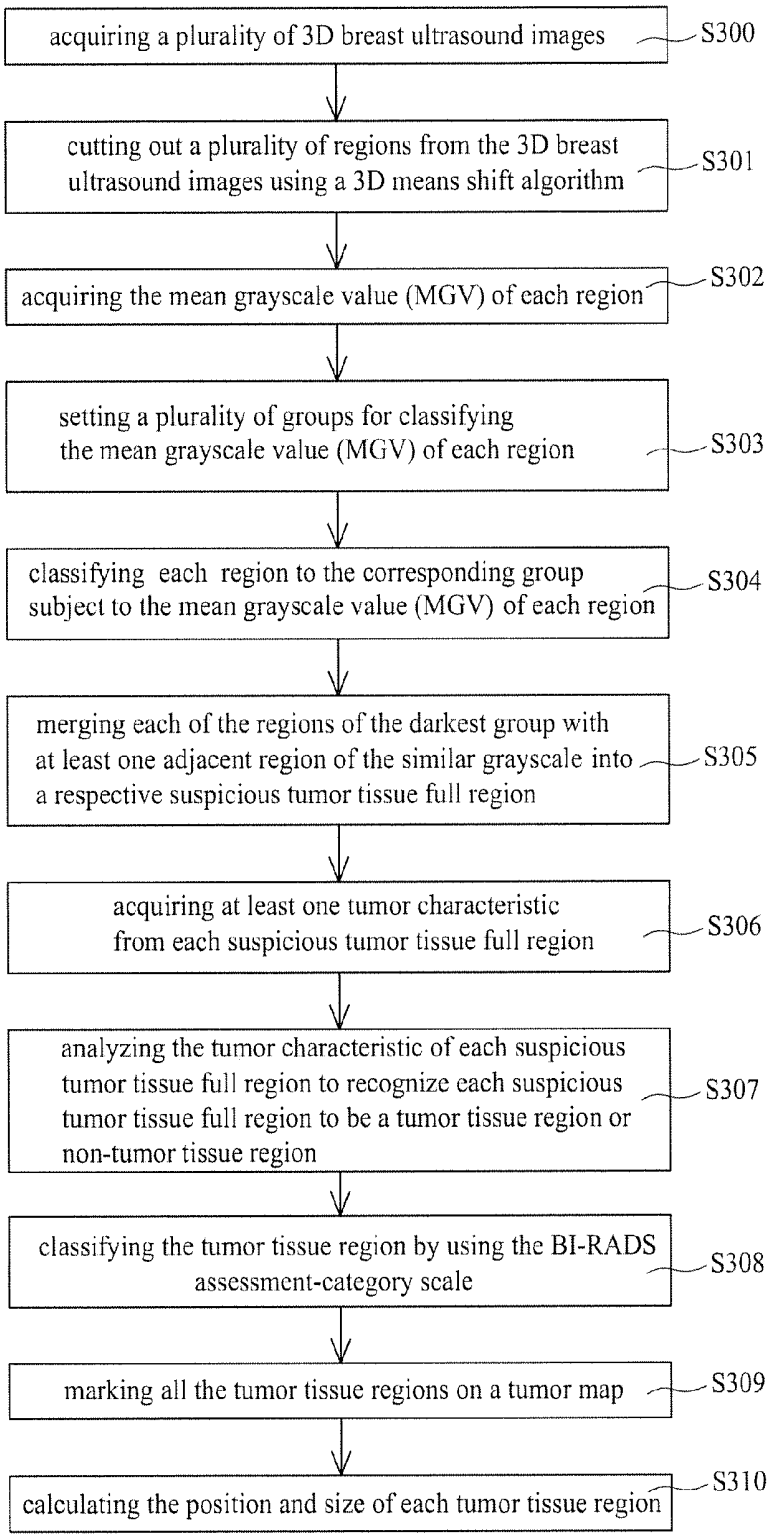

acquiring a plurality of 3D breast ultrasound images
S300
cutting out a plurality of regions from the 3D breast ultrasound images using a 3D means shift algorithm
S301
acquiring the mean grayscale value (MGV) of each region
S302
setting a plurality of groups for classifying the mean grayscale value (MGV) of each region
S303
classifying each region to the corresponding group subject to the mean grayscale value (MGV) of each region
S304
merging each of the regions of the darkest group with at least one adjacent region of the similar grayscale into a respective suspicious tumor tissue full region
S305
acquiring at least one tumor characteristic from each suspicious tumor tissue full region
S306
analyzing the tumor characteristic of each suspicious tumor tissue full region to recognize each suspicious tumor tissue full region to be a tumor tissue region or non-tumor tissue region
S307
classifying the tumor tissue region by using the BI-RADS assessment-category scale
S308
marking all the tumor tissue regions on a tumor map
S309
calculating the position and size of each tumor tissue region
S310

FIG. 8

ULTRASOUND IMAGING BREAST TUMOR DETECTION AND DIAGNOSTIC SYSTEM AND METHOD

1. FIELD OF THE INVENTION

[0001] The present invention relative to breast tumor detection and diagnostic technology and more particularly, to an ultrasonic imaging breast tumor detection and diagnostic system for rapidly detecting breast tumor tissues from ultrasound images. The invention relates also to detection and diagnosis of breast tumor using the ultrasonic imaging breast tumor detection and diagnostic system.

2. BACKGROUND OF THE INVENTION

[0002] Breast cancer has become one of the commonest cancers for women. According to clinical experiences, the cure rate would be rather high if a patient is medically treated right after being diagnosed with breast cancer at an early stage.

[0003] Currently, the ultrasound breast examination is one of major techniques for breast lesion checkup because of its advantages such as non-radioactivity, non-invasiveness, and harmlessness to breast tissues, accurate positioning, convenience and ease of use. Most of all, it is less costly compared to CT and MRT. Moreover, ultrasound breast examination is suitable for Asian women because their breast tissues are denser.

[0004] Further, during a breast ultrasound scanning operation, a large amount of breast ultrasound images can be synchronously recorded by a breast ultrasound imaging system. Further, a breast ultrasound imaging system can detect the presence of tumor tissues by means of analysis of breast ultrasound imaging contents, thereby reminding the doctor of the situations.

[0005] The breast ultrasound image analysis programs of conventional breast ultrasound imaging systems are mostly pixel-based, i.e., using pixel as the basic computing unit. However, a high-quality breast ultrasound image is often more than a million pixels, and its operation is very impressive, so that the breast ultrasound image analysis program must spend a lot of time.

[0006] In view of this, the present invention provides an ultrasonic imaging breast tumor detection and diagnostic system and method using region as the basic computing unit. This region-based computing method not only can greatly reduce the computational complexity and quickly detect tumor tissues, but also can effectively eliminate speckle noise from the images.

SUMMARY OF THE PRESENT INVENTION

[0007] It is one object of the present invention to provide an ultrasonic imaging breast tumor detection and diagnostic system and method, which is configured to cut out a plurality of regions from the scanned 3D breast ultrasound images and to analyze 3D breast ultrasound images using every region as a basic computing unit, thereby greatly reducing the amount of computation and rapidly recognizing tumor tissues from the 3D breast ultrasound images.

[0008] It is another object of the present invention to provide an ultrasonic imaging breast tumor detection and diagnostic system and method, which achieves image smoothing effects by effectively removing speckle noise from the scanned 3D breast ultrasound images using a 3D means shift algorithm.

[0009] It is still another object of the present invention to provide an ultrasonic imaging breast tumor detection and diagnostic system and method, which is used for classifying each tumor tissue region recognized from the 3D breast ultrasound images by using the BI-RADS (breast imaging reporting and data system) assessment category scale so as to the doctor to be clear of the benign and malignant status of each tumor tissue region.

[0010] It is still another object of the present invention to provide an ultrasonic imaging breast tumor detection and diagnostic system and method, which provides a tumor map and marks all suspicious tumor tissue full regions on the tumor map in different colors subject to the BI-RADS assessment categories of the tumor tissue regions so as to facilitate doctor observing the tumor tissue distribution and determining the severity of the tumor tissue.

[0011] It is still another object of the present invention to provide an ultrasonic imaging breast tumor detection and diagnostic system and method, which is used for classifying each tumor tissue region recognized from the 3D breast ultrasound images by using the BI-RADS assessment-category scale and calculating the position and size of each tumor tissue region so that the doctor easily achieve the breast diagnostic report recording work.

[0012] To achieve above objects, the present invention provides an ultrasonic imaging breast tumor detection and diagnostic system, comprising: an image acquisition module adapted to acquire a plurality of 3D breast ultrasound images; an image segmentation module connected to the image acquisition module and used to receive the 3D breast ultrasound images so as to cut out a plurality of regions from the 3D breast ultrasound images using a 3D means shift algorithm; a mean grayscale value acquisition module connected to the image segmentation module and used to acquire the mean grayscale value (MGV) of each region; a region classification module connected to the mean grayscale value acquisition module, the region classification module having set therein a plurality of groups for classifying the mean grayscale value (MGV) of each region to the corresponding group, so that the regions classified to the darkest group are considered as suspicious tumor regions; and a region merging module connected to the region classification module and used to respectively merge each of the regions of the darkest group with at least one adjacent region of the similar grayscale into a respective suspicious tumor tissue full region.

[0013] In one embodiment of the present invention, wherein the 3D means shift algorithm is used for clustering each of adjacent pixels with a respective similar grayscale value in the 3D breast ultrasound images into the same region.

[0014] In one embodiment of the present invention, wherein the region classification module is configured to employ a fuzzy c-means algorithm for classifying the mean grayscale value (MGV) of each region to groups.

[0015] In one embodiment of the present invention, further comprising a characteristic acquisition and analysis module connected to the region merging module, and used to acquire and analyze at least one tumor characteristic from each suspicious tumor tissue full region so as to recognize each suspicious tumor tissue full region to be a tumor tissue region or non-tumor tissue region.

[0016] In one embodiment of the present invention, wherein the characteristic acquisition and analysis module is used for classifying each recognized tumor tissue region by using the BI-RADS (breast imaging reporting and data system) assessment category scale.

[0017] In one embodiment of the present invention, further comprising a tumor marker module connected to the characteristic acquisition and analysis module, the tumor marker module providing a tumor map and adapted to mark all recognized tumor tissue regions on the tumor map according to their distribution in the position of breast.

[0018] In one embodiment of the present invention, wherein the tumor marker module is used for marking all recognized tumor tissue regions on the tumor map in different colors subject to the respective classified BI-RADS assessment categories.

[0019] In one embodiment of the present invention, wherein the tumor marker module is used for calculating the position and size of each recognized tumor tissue region based on the nipple position as a center.

[0020] In one embodiment of the present invention, further comprising a user interface connected to the tumor marker module, the user interface comprising a tumor map display zone and being adapted to display the tumor map on the tumor map display zone.

[0021] In one embodiment of the present invention, further comprising a user interface connected to the tumor marker module, the user interface comprising a tumor diagnosis zone adapted to display the diagnostic result of each recognized tumor tissue region in a list, the diagnostic result comprising the BI-RADS assessment category of each recognized tumor tissue region and the position and/or size of each recognized tumor tissue region.

[0022] In one embodiment of the present invention, wherein the diagnostic results of the recognized tumor tissue regions are listed in a predetermined order subject to the respective BI-RADS assessment categories and positions and/or sizes.

[0023] In one embodiment of the present invention, further comprising a user interface connected to the image acquisition module, the user interface comprising a breast scanning site selection zone and an ultrasound imaging display zone, the breast scanning site selection zone comprising a plurality of scanning site selection components, the 3D breast ultrasound image of the corresponding breast site be displayed on the ultrasound imaging display zone via the click of the specific scanning site selection component.

[0024] The present invention further provides an ultrasonic imaging breast tumor detection and diagnostic method, comprising the steps of: acquiring a plurality of 3D breast ultrasound images; cutting out a plurality of regions from the 3D breast ultrasound images using a 3D means shift algorithm; acquiring the mean grayscale value (MGV) of each region; setting a plurality of groups for classifying the mean grayscale value (MGV) of each region; classifying each region to the corresponding group subject to the mean grayscale value (MGV) of each region; and merging each of the regions of the darkest group with at least one adjacent region of the similar grayscale into a respective suspicious tumor tissue full region.

[0025] In one embodiment of the present invention, further comprising the steps of: acquiring at least one tumor characteristic from each suspicious tumor tissue full region; and analyzing the tumor characteristic of each suspicious tumor tissue full region to recognize each suspicious tumor tissue full region to be a tumor tissue region or non-tumor tissue region.

[0026] In one embodiment of the present invention, further comprising the step of performing a benign and malignant classification on each suspicious tumor tissue full region been recognized as a tumor tissue region by using the Bl-RADS assessment-category scale.

[0027] In one embodiment of the present invention, further comprising the step of marking all recognized tumor tissue regions on a tumor map.

[0028] In one embodiment of the present invention, wherein all recognized tumor tissue regions are marked on a tumor map in different colors subject to the respectively classified BI-RADS assessment categories.

[0029] In one embodiment of the present invention, further comprising the step of calculating the position and size of each recognized tumor tissue region.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] FIG. **1** is a system block diagram of an ultrasound imaging breast tumor detection and diagnostic system in accordance with one preferred embodiment of the present invention.

[0031] FIG. **2** is a schematic drawing of a 3D breast ultrasound image in accordance with the present invention.

[0032] FIG. **3** is a schematic drawing illustrating a segmented region of a 3D breast ultrasound image in accordance with the present invention.

[0033] FIG. **4** is a schematic drawing illustrating a segmented region of a 3D breast ultrasound image after a classification procedure in accordance with the present invention.

[0034] FIG. **5** is a schematic drawing illustrating a classified region of a 3D breast ultrasound image after a merge procedure in accordance with the present invention.

[0035] FIG. **6** is a schematic drawing illustrating a classified region of a 3D breast ultrasound image after a tumor analysis procedure in accordance with the present invention.

[0036] FIG. **7** is a schematic drawing of the user interface of the ultrasound imaging breast tumor detection and diagnostic system in accordance with the present invention.

[0037] FIG. **8** is a flow chart of an ultrasound imaging breast tumor detection and diagnostic method in accordance with one preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0038] Please refer to FIG. **1**, a system block diagram of an ultrasound imaging breast tumor detection and diagnostic system in accordance with one preferred embodiment of the present invention is shown. As illustrated, the ultrasound imaging breast tumor detection and diagnostic system **100** comprises an image acquisition module **11**, an image segmentation module **12**, a mean grayscale value acquisition module **13**, a region classification module **14**, and a region merging module **15**.

[0039] Firstly, an ultrasound probe performs the breast ultrasound scanning process on the breasts so as to acquire a continuous of 3D breast ultrasound images **111** by the image acquisition module **11**, as shown in FIG. **2**. The image segmentation module **12** is connected to the image acquisition module **11** to receive the 3D breast ultrasound images **111** and to cluster each of adjacent pixels with a respective similar

grayscale value in the 3D breast ultrasound images into the same region by using a 3D means shift algorithm so that the 3D breast ultrasound images **111** can be segmented into multiple regions **120**, as shown in FIG. **3**.

[0040] The mean grayscale value acquisition module **13** is connected to the image segmentation module **12**, and used for calculating the grayscale pixel mean value of every region **120** so as to acquire the mean grayscale value (MGV) **1200** of each region **120**.

[0041] The region classification module **14** is connected to the mean grayscale value acquisition module **13**, having set therein multiple, for example, 4 groups for classifying the mean grayscale value (MGV) **1200** of each region **120**. Further, the region classification module **14** can be configured to employ a fuzzy c-means algorithm for classifying the mean grayscale value (MGV) **1200** of each region **120**. As shown in FIG. **4**, after region classification, 3D breast ultrasound images **111** can be classified into regions **121** of a first type and region **123** of a second type, wherein the regions **121** of the first type are classified to the darkest group: the region **123** of the second type is classified to the other group with brighter grayscale value. Further, in one embodiment of the present invention, the region **123** of the second type can be further processed through an image filtering process to remove the image contents. For general ultrasound scan, the color of a tumor tissue is more dark and deep than the color of a normal tissue. Thus, the regions **121** of the first type classified to the darkest group may be considered as a suspicious tumor region.

[0042] The region merging module **15** is connected to the region classification module **14**, and used to respectively merge each of the regions **121** of the first type of the darkest group with at least one adjacent similar region **121** of the first type (for example: the difference between the mean grayscale values (MGV) **1200** of two regions **120** is within a predetermined threshold range) into a respective suspicious tumor tissue full region **122**、**124**, so as to really cut out a suspicious tumor boundary, as shown in FIG. **5**.

[0043] The ultrasound imaging breast tumor detection and diagnostic system **100** further comprises a characteristic acquisition and analysis module **16** connected to the region merging module **15**, and used to acquire at least one tumor characteristic **1220**、**1240** from every suspicious tumor tissue full region **122**、**124**, such as the region volume, the mean grayscale value, the standard deviation of grayscale value, and/or the grayscale difference between neighboring tissues, etc. Afterward, the characteristic acquisition and analysis module **16** analyzes the tumor characteristic **1220**、**1240** so as to recognize each suspicious tumor tissue full region **122**、**124** to be a tumor tissue region or non-tumor tissue region. In this example, the suspicious tumor tissue full region **124** is recognized as a tumor tissue region, and the suspicious tumor tissue full region **122** is recognized as a non-tumor tissue region.

[0044] Further, as shown in FIG. **5** and FIG. **6**, in one application example of the present invention, after the suspicious tumor tissue full region **122** was recognized as a non-tumor tissue region, an image filtering process is employed to remove image contents from the suspicious tumor tissue full region **122** and enabling the suspicious tumor tissue full region **122** to be combined with the other region **123** to form a non-tumor tissue region **125**. Thus, analysis by the characteristic pickup and analysis module **16** to assist doctors to detect and diagnose the authenticity of the suspicious tumor tissue full regions **122**、**124** can effectively reduce the occurrence of too many non-tumor tissues to be erroneously diagnosed as a tumor.

[0045] Further, in one embodiment of the present invention, the characteristic acquisition and analysis module **16** further classifies every recognized tumor tissue region **124** by using the BI-RADS (breast imaging reporting and data system) assessment category scale, for example, BI-RADS 0-6. Subject to the BI-RADS classified assessment category, the doctor is clear of the benign and malignant status of every recognized tumor tissue region **124**. However, it is to be understood that, except the method of using the breast imaging reporting and data system (BI-RADS) assessment-category scale to classify every recognized tumor tissue region **124**, the doctor can judge the benign and malignant status of every recognized tumor tissue region **124** or correct the classification result of the characteristic acquisition and analysis module **16** subject to his (her) medical experience so as to enhance diagnosis accuracy. As stated above, the ultrasound imaging breast tumor detection and diagnostic system **100** of the invention uses every region **120** as a basic computing unit for analysis of 3D breast ultrasound images **111**, it not only can greatly reduce the computation to detect and cut out tumor tissues from the 3D breast ultrasound images **111** but also achieve image smoothing effects by effectively removing speckle noise from the 3D breast ultrasound images **111** by using the 3D means shift algorithm.

[0046] Referring to FIG. **7** and FIG. **1** again, a schematic diagram illustrating a user interface used for displaying the 3D breast ultrasound imaging and tumor diagnostic information. The ultrasound imaging breast tumor detection and diagnostic system **100** comprises a tumor marker module **17** and a user interface **18**. The tumor marker module **17** is connected to the characteristic acquisition and analysis module **16**. The user interface **18** is connected to the image acquisition module **11** and/or the tumor marker module **17**.

[0047] The user interface **18** comprises a breast scanning site selection zone **181**, an ultrasound imaging display zone **182**, a tumor diagnosis zone **183**, and a tumor map display zone **184**.

[0048] Wherein, the breast scanning site selection zone **181** comprises a plurality of scanning site selection components **1811**. During a breast ultrasound scanning operation, the doctor moves the ultrasound probe over selected breast site to start scanning breast ultrasound imaging, so that the image acquisition module **11** acquires a continuous of 3D breast ultrasound images **111** from every selected breast site. At this time, the continuous of 3D breast ultrasound images **111** acquired from every selected breast site is linked to a respective scanning site selection component **1811**. Thus, the doctor can click one specific scanning site selection component **1811** and then view the continuous of 3D breast ultrasound images **111** of the corresponding breast site. For example, when the doctor clicks the first scanning site selection component **1811**, the ultrasound imaging display zone **182** will display the 3D breast ultrasound images **111** of the upper right part of the breast.

[0049] The tumor marker module **17** provides a tumor map **171** that will be displayed on the tumor map display zone **184** of the user interface **18**. The tumor marker module **17** marks all recognized tumor tissue regions **124** on the tumor map **171** in different colors subject to their original distribution location in the breast and their BI-RADS assessment categories. For example, every recognized tumor tissue region **124** clas-

sified as BI-RADS 0 is marked in brown, or purple for BI-RADS 1, blue for BI-RADS 2, green for BI-RADS 3, yellow for BI-RADS 4, orange for BI-RADS 5, and red for BI-RADS 6.

[0050] Further, after the tumor marker module **17** marks all recognized tumor tissue regions **124** on the tumor map **171**, the position of every recognized tumor tissue region **124** is calculated and indicated by clockwise (clock; C) and distance (distance; D) based on the nipple **1719** position as a center. Further, the tumor marker module **17** will simultaneously calculate the size of every recognized tumor tissue region **124**, for example, the maximum diameter of tumor.

[0051] Thereafter, the tumor diagnosis zone **183** of the user interface **18** displays the diagnostic result of every recognized tumor tissue region **124** in a list. The diagnostic result includes the BI-RADS assessment category of each recognized tumor tissue region **124** and the position and/or size of each recognized tumor tissue region **124**. Further, the diagnostic results of the recognized tumor tissue regions **124** can be listed in a predetermined order subject to their BI-RADS assessment categories, their positions and/or sizes.

[0052] In the example shown in FIG. **7**, the diagnostic results of the recognized tumor tissue regions **124** are sequentially arranged in accordance with their BI-RADS assessment categories. For example, the recognized tumor tissue regions **124** arranged in the first priority (No. 1) are classified to the BI-RADS 5; the recognized tumor tissue regions **124** arranged in the fifth priority (No. 5) are classified to the BI-RADS 1.

[0053] In accordance to the above-stated statement, the ultrasound imaging breast tumor detection and diagnostic system **100** of the present invention uses the tumor map **171** to show the location of every recognized tumor tissue region **124** in the breast and to mark the location with a corresponding color subject to its BI-RADS assessment category so as to facilitate the doctor observing the tumor tissue distribution and determining the severity of the tumor tissue. Further, with the diagnostic results indicated by the tumor diagnosis zone **183**, the doctor can aware of the condition of the tumor tissue to be benign or malignant and the information of the position and size of the tumor tissue, easily achieving the breast diagnostic report recording work.

[0054] Referring to FIG. **8**, there is shown a flow chart of an ultrasound imaging breast tumor detection and diagnostic method in accordance with one preferred embodiment of the present invention. Firstly, in step S**300**, the ultrasound probe performs the breast ultrasound scanning process on the breasts so as to acquire a continuous of 3D breast ultrasound images **111** by the image acquisition module **11**, as shown in FIG. **2**.

[0055] In Step **301**, the image segmentation module **12** can cluster each of adjacent pixels with a respective similar grayscale value in the 3D breast ultrasound images into the same region by using a 3D means shift algorithm so that the 3D breast ultrasound images **111** can be segmented into multiple regions **120**, as shown in FIG. **3**.

[0056] In Step **302**, the mean grayscale value acquisition module **13** can calculate the grayscale pixel mean value of every region **120** so as to acquire the mean grayscale value (MGV) **1200** of each region **120**.

[0057] In Step **303**, the region classification module **14** has set therein a plurality of groups for classifying the mean grayscale value (MGV) **1200** of each region **120**.

[0058] In Step **304**, the region classification module **14** can be used to classify the mean grayscale value (MGV) **1200** of each region **120** to the corresponding group so that the regions **120** of the 3D breast ultrasound images **111** having the darkest region color are classified to regions **121** of the darkest group and considered as suspicious tumor regions, as shown in FIG. **4**.

[0059] In Step **305**, the region merging module **15** is used to respectively merge each of the regions **121** of the first type of the darkest group with at least one adjacent similar region **121** of the first type into a respective suspicious tumor tissue full region **122**、**124**, as shown in FIG. **5**. In Step **306**, the characteristic acquisition and analysis module **16** is used to acquire at least one tumor characteristic **1220**、**1240** from every suspicious tumor tissue full region **122**、**124**.

[0060] In Step **307**, the characteristic acquisition and analysis module **16** is used to judge each suspicious tumor tissue full region **122**、**124** to be a tumor tissue region or non-tumor tissue region by analyzing the respective tumor characteristics **1220**、**1240**. Take FIG. **5** and FIG. **6** as an example, the suspicious tumor tissue full region **124** is recognized as a tumor tissue region and the suspicious tumor tissue full region **122** is recognized as a non-tumor tissue region. In Step **308**, after the tumor tissue region **124** is recognized from the 3D breast ultrasound images **111**, the characteristic acquisition and analysis module **16** further starts a benign and malignant classification of the recognized tumor tissue region **124** by using the BI-RADS assessment category scale.

[0061] In Step **309**, the tumor marker module **17** marks all recognized tumor tissue regions **124** on the tumor map **171** in different colors subject to their original distribution location in the breast and their BI-RADS assessment categories so as to facilitate the doctor observing the tumor tissue distribution and determining the severity of the tumor tissue.

[0062] Finally, in Step **310**, the tumor marker module **17** simultaneously calculates the size of each recognized tumor tissue region **124** when marking each recognized tumor tissue region **124** on the tumor map **171**, and then to combine the BI-RADS assessment category, position and size of each recognized tumor tissue region **124** into a diagnostic result for reference by the doctor so that the doctor can easily achieve the breast diagnostic report recording work.

[0063] The present invention is not limited to the above-described embodiments. Various alternatives, modifications and equivalents may be used. Therefore, the above embodiments should not be taken as limiting the scope of the invention, which is defined by the appending claims.

What is claimed is:

1. An ultrasonic imaging breast tumor detection and diagnostic system, comprising:

an image acquisition module used to acquire a plurality of 3D breast ultrasound images;

an image segmentation module connected to said image acquisition module and used to receive said 3D breast ultrasound images so as to cut out a plurality of regions from said 3D breast ultrasound images using a 3D means shift algorithm;

a mean grayscale value acquisition module connected to said image segmentation module and used to acquire the mean grayscale value (MGV) of each said region;

a region classification module connected to said mean grayscale value acquisition module, said region classification module having set therein a plurality of groups for classifying the mean grayscale value (MGV) of each

said region to the corresponding group, so that the regions classified to the darkest group are considered as suspicious tumor regions; and

a region merging module connected to said region classification module and used to respectively merge each of the regions of the darkest group with at least one adjacent region of the similar grayscale into a respective suspicious tumor tissue full region.

2. The ultrasonic imaging breast tumor detection and diagnostic system according to claim **1**, wherein said 3D means shift algorithm is used for clustering each of adjacent pixels with a respective similar grayscale value in said 3D breast ultrasound images into the same region.

3. The ultrasonic imaging breast tumor detection and diagnostic system according to claim **1**, wherein said region classification module is configured to employ a fuzzy c-means algorithm for classifying the mean grayscale value (MGV) of each said region to the corresponding group.

4. The ultrasonic imaging breast tumor detection and diagnostic system according to claim **1**, further comprising a characteristic acquisition and analysis module connected to said region merging module, and used to acquire and analyze at least one tumor characteristic from each said suspicious tumor tissue full region so as to recognize each said suspicious tumor tissue full region to be a tumor tissue region or non-tumor tissue region.

5. The ultrasonic imaging breast tumor detection and diagnostic system according to claim **4**, wherein said characteristic acquisition and analysis module is used for classifying each said recognized tumor tissue region by using the BI-RADS (breast imaging reporting and data system) assessment category scale.

6. The ultrasonic imaging breast tumor detection and diagnostic system according to claim **5**, further comprising a tumor marker module connected to said characteristic acquisition and analysis module, said tumor marker module providing a tumor map and adapted to mark all said recognized tumor tissue regions on said tumor map according to their distribution position in the breast.

7. The ultrasonic imaging breast tumor detection and diagnostic system according to claim **6**, wherein said tumor marker module is used for marking all said recognized tumor tissue regions on said tumor map in different colors subject to the respective classified BI-RADS assessment categories.

8. The ultrasonic imaging breast tumor detection and diagnostic system according to claim **6**, wherein said tumor marker module is used for calculating the position and size of each said recognized tumor tissue region based on the nipple position as a center.

9. The ultrasonic imaging breast tumor detection and diagnostic system according to claim **6**, further comprising a user interface connected to said tumor marker module, said user interface comprising a tumor map display zone and being adapted to display said tumor map on said tumor map display zone.

10. The ultrasonic imaging breast tumor detection and diagnostic system according to claim **8**, further comprising a user interface connected to said tumor marker module, said user interface comprising a tumor diagnosis zone adapted to display the diagnostic result of each said recognized tumor tissue region in a list, said diagnostic result comprising said BI-RADS assessment category of each said recognized tumor tissue region and the position and/or size of each said recognized tumor tissue region.

11. The ultrasonic imaging breast tumor detection and diagnostic system according to claim **10**, wherein the diagnostic results of said recognized tumor tissue regions are listed in a predetermined order subject to the respective BI-RADS assessment categories, positions and/or sizes.

12. The ultrasonic imaging breast tumor detection and diagnostic system according to claim **1**, further comprising a user interface connected to said image acquisition module, said user interface comprising a breast scanning site selection zone and an ultrasound imaging display zone, said breast scanning site selection zone comprising a plurality of scanning site selection components, said 3D breast ultrasound image of the corresponding breast site be displayed on said ultrasound imaging display zone via the click of said specific scanning site selection component.

13. An ultrasonic imaging breast tumor detection and diagnostic method, comprising the steps of:

acquiring a plurality of 3D breast ultrasound images;

cutting out a plurality of regions from said 3D breast ultrasound images using a 3D means shift algorithm;

acquiring the mean grayscale value (MGV) of each said region;

setting a plurality of groups for classifying the mean grayscale value (MGV) of each said region;

classifying each said region to the corresponding group subject to the mean grayscale value (MGV) of each said region; and

merging each of the regions of the darkest group with at least one adjacent region of the similar grayscale into a respective suspicious tumor tissue full region.

14. The ultrasonic imaging breast tumor detection and diagnostic method according to claim **13**, further comprising the steps of:

acquiring at least one tumor characteristic from each said suspicious tumor tissue full region; and

analyzing said tumor characteristic of each said suspicious tumor tissue full region to recognize each said suspicious tumor tissue full region to be a tumor tissue region or non-tumor tissue region.

15. The ultrasonic imaging breast tumor detection and diagnostic method according to claim **14**, further comprising the step of performing a benign and malignant classification on each said suspicious tumor tissue full region been recognized as a tumor tissue region by using the BI-RADS assessment-category scale.

16. The ultrasonic imaging breast tumor detection and diagnostic method according to claim **15**, further comprising the step of marking all said recognized tumor tissue regions on a tumor map.

17. The ultrasonic imaging breast tumor detection and diagnostic method according to claim **16**, wherein all said recognized tumor tissue regions are marked on a tumor map in different colors subject to the respectively classified BI-RADS assessment categories.

18. The ultrasonic imaging breast tumor detection and diagnostic method according to claim **16**, further comprising the step of calculating the position and size of each said recognized tumor tissue region.

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专利名称(译)	超声成像乳腺肿瘤检测和诊断系统和方法		
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摘要(译)

公开了一种超声成像乳腺肿瘤检测和诊断系统和方法。该方法使用该系统获取多个3D乳房超声图像，然后使用3D均值偏移算法从3D乳房超声图像中切出多个区域，然后获取每个区域的平均灰度值（MGV），然后将区域分类到受平均灰度值（MGV）影响的组，并将最暗组的每个区域与相似灰度的相邻区域合并到相应的可疑肿瘤组织满区域，然后识别每个区域可疑肿瘤组织的完整区域是肿瘤组织区域或非肿瘤组织区域。因此，使用区域作为基本计算单元，从3D乳房超声图像中快速识别肿瘤组织。