

PATENT

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ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS

BACKGROUND

Technical Field

This disclosure generally relates to ultrasound imaging systems and methods and, more particularly, to systems and methods for determining whether acquired ultrasound images represent a clinically desirable view of one or more organs in a patient.

Description of the Related Art

Ultrasound imaging is typically performed in a clinical setting, by trained ultrasound experts. For diagnostic ultrasound imaging, particular views of an organ or other tissue or body feature (such as fluids, bones, joints or the like) are clinically significant. Such views may be prescribed by clinical standards as views that should be captured by the ultrasound technician, depending on the target organ, diagnostic purpose or the like. Ultrasound technicians generally require specialized training to properly operate ultrasound imaging equipment, and to recognize when an acquired image or view of an organ or other tissue or body feature of a patient adequately represents a clinically desirable view. Nonetheless, ultrasound images captured by an ultrasound technician are typically reviewed by a physician to determine whether the captured images sufficiently represent the clinically desirable or standard views.

While conventional ultrasound imaging systems may be suitable for most patients in a hospital or similar clinical setting, such systems require significant training to operate and to adequately capture clinically desirable views. This adds to the overall cost of such ultrasound imaging and further limits the availability of ultrasound imaging to patients, as only well-trained professionals can properly operate conventional ultrasound imaging devices.

BRIEF SUMMARY

The present disclosure provides ultrasound systems and methods that facilitate ultrasound image recognition. In particular, the ultrasound systems and methods are operable to determine whether ultrasound images acquired by an ultrasound imaging device correspond to known, clinically desirable views of one or more organs or tissues or body features in a patient. Artificial intelligence approaches are employed in an ultrasound image recognition module to make such determinations about ultrasound images captured by an ultrasound imaging device.

In one embodiment, an ultrasound system is provided that includes an ultrasound imaging device and an ultrasound image recognition module. The ultrasound imaging device is configured to acquire ultrasound images of a patient. The ultrasound image recognition module is configured to receive the acquired ultrasound images from the ultrasound imaging device and to determine whether the received ultrasound images represent a clinically desirable view of an organ or other body feature. Positive or negative feedback may then be provided to the user to indicate whether or not a clinically desirable view has been captured, such as through a visual or audible cue. To assist the system in determining whether a clinically desirable view has been captured, the user may identify, before or during the image capture process, the particular image perspective or view the user desires to capture, which input the system then can use to assist in identifying whether the desired view in fact has been captured.

In another embodiment, a method is provided that includes acquiring, by an ultrasound imaging device, one or more ultrasound images of a patient; transmitting the acquired ultrasound images of the patient to an ultrasound image recognition module; and determining, by the ultrasound image recognition module, whether the acquired ultrasound images represent a clinically desirable view of an organ or other body feature.

In another embodiment, an ultrasound system is provided that includes an ultrasound imaging device configured to acquire ultrasound images of a patient, and ultrasound image recognition means for determining whether the acquired ultrasound images represent a clinically desirable view of an organ or other body feature.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

Figure 1 illustrates a block diagram of an ultrasound image recognition system, in accordance with one or more embodiments of the disclosure;

Figure 2 is a block diagram illustrating training of the ultrasound image recognition module, in accordance with one or more embodiments of the disclosure;

Figure 3 is a block diagram illustrating a neural network, which may be implemented by the ultrasound image recognition module, in accordance with one or more embodiments of the disclosure;

Figure 4 is a schematic illustration of an ultrasound imaging device, in accordance with one or more embodiments of the disclosure; and

Figure 5 is a flowchart illustrating an ultrasound image recognition method, in accordance with one or more embodiments of the disclosure.

DETAILED DESCRIPTION

The present disclosure provides several embodiments of ultrasound image recognition systems and methods. The systems and methods provided herein may be particularly useful for ultrasound imaging performed by novice ultrasound technicians and/or for ultrasound imaging utilizing a handheld or mobile ultrasound imaging device which may be deployed in a non-traditional clinical setting. Utilizing artificial intelligence approaches, the systems and methods provided herein are capable of determining whether acquired ultrasound images accurately depict or represent a desired view of a patient's organ or other tissue, feature or region of interest in a patient. These systems may also then provide feedback to a user to indicate whether or not a desired view of a patient's organ or other tissue or feature has been captured. Alternatively, or in addition, these systems may accept input from a user regarding the particular view of a patient's organ the user desires to capture. In addition, the system may guide the user to attempt to capture one or more particular views of particular anatomy in order, and confirm for the user whether or not one or more of the desired views has been captured.

Figure 1 illustrates a block diagram of an ultrasound system 100, in accordance with embodiments of the present disclosure. As shown in Figure 1, the ultrasound system 100 includes an ultrasound imaging device 110, a communications network 102, an ultrasound image recognition module 120 and an image knowledge database 122. Each of these may be incorporated into a single ultrasound device, such as a hand-held or portable device, or may constitute multiple devices operatively linked or linkable to one another.

The ultrasound imaging device 110 is any ultrasound device operable to acquire ultrasound images of a patient, and may be, for example, a handheld ultrasound imaging device. The ultrasound imaging device 110 may include a display 112, memory 114, one or more processors 116. The ultrasound imaging device 110 is operatively coupled to an ultrasound probe 118.

The memory 114 may be or include any computer-readable storage medium, including, for example, read-only memory (ROM), random access memory (RAM), flash memory, hard disk drive, optical storage device, magnetic storage device, electrically erasable programmable read-only memory (EEPROM), organic storage media, or the like.

The processor 116 may be any computer processor operable to execute instructions (e.g., stored in memory 114) to perform the functions of the ultrasound imaging device 110 as described herein.

The ultrasound probe 118 is driven by the ultrasound imaging device 110 to transmit signals toward a target region in a patient, and to receive echo signals returning from the target region in response to the transmitted signals. In operation, a user of the ultrasound device 110 may hold the probe 118 against a patient's body at a position and angle to acquire a desired ultrasound image. The signals received by the probe (i.e., the echo signals) are communicated to the ultrasound imaging device 110 and may form, or be processed to form, an ultrasound image of the target region of the patient. Further, the ultrasound images may be provided to the display 112, which may display the ultrasound images and/or any other relevant information to the user.

The ultrasound images thus acquired by the ultrasound imaging device 110 may be provided to the ultrasound image recognition module 120 via a communications network 102.

Ultrasound images from the ultrasound imaging device 110 are provided to the ultrasound image recognition module 120, as shown by reference numeral 101. Communications network 102 may utilize one or more protocols to communicate via one or more physical networks, including local area networks, wireless networks, dedicated lines, intranets, the Internet, and the like.

5 The ultrasound image recognition module 120 receives the ultrasound images acquired from the ultrasound imaging device 110, and determines whether one or more of the received ultrasound images represent a clinically desirable view of an organ or other aspect, region or feature of the patient. The ultrasound image recognition module 120 may be implemented by any computationally intelligent system that employs artificial intelligence, drawing from an image
10 knowledge database 122, to determine whether received ultrasound images represent a clinically desirable view.

 “Artificial intelligence” is used herein to broadly describe any computationally intelligent systems and methods that can learn knowledge (*e.g.*, based on training data), and use such learned
15 knowledge to adapt its approaches for solving one or more problems. Artificially intelligent machines may employ, for example, neural network, deep learning, convolutional neural network, and Bayesian program learning techniques to solve problems such as image recognition. Further, artificial intelligence may include any one or combination of the following computational techniques: constraint program, fuzzy logic, classification, conventional artificial intelligence, symbolic manipulation, fuzzy set theory, evolutionary computation, cybernetics, data mining, approximate reasoning, derivative-free
20 optimization, decision trees, and/or soft computing. Employing one or more computationally intelligent techniques, the ultrasound image recognition module 120 may learn to adapt to an unknown and/or changing environment for better performance.

 The image knowledge database 122 may include a variety of information facilitating image analysis, with respect to received ultrasound images, by the ultrasound image recognition module
25 120. In particular, for example, the image knowledge database 122 may contain information relating to various image views of various organs. For example, the image knowledge database 122 may include information associated with clinically standard or desirable views of a heart. The clinically standard views of a heart may include, for example, suprasternal, subcostal, short- and long-axis parasternal, 2-

chamber apical, 3-chamber apical, 4-chamber apical and 5-chamber apical views. Additionally, the information associated with clinically standard views may be information associated with a three-dimensional view, a two-dimensional cross section view and/or a set of two-dimensional cross section views. The image knowledge database 122 may be stored in any computer-readable storage medium
5 accessible by the ultrasound image recognition module 120.

The ultrasound image recognition module 120 may include, or otherwise be executed by, a computer processor configured to perform the various functions and operations described herein. For example, the ultrasound image recognition module 120 may be executed by a general purpose computer or a data processor selectively activated or reconfigured by a stored computer program, or
10 may be a specially constructed computing platform for carrying out the features and operations described herein.

Figure 2 is a block diagram illustrating training of the ultrasound image recognition module 120, in accordance with one or more embodiments. The ultrasound image recognition module 120 may be trained based on training images 210. Training images 210 may include any ultrasound
15 image information. For example, the training images 210 may include a variety of ultrasound image information associated with known views of an organ, such as the heart. As a further example, the training images 210 may be clinically desirable images of, *e.g.*, suprasternal views of a heart. In such a case, the training images 210 may be ultrasound images which have been pre-determined (*e.g.*, by a physician) as adequately showing a clinically desirable suprasternal view of a heart. Each such training
20 image 210 may have slightly different characteristics (*e.g.*, higher quality images, lower quality images, blurry images, images taken at slightly different angles, and so on), yet each such training image 210 may nonetheless be pre-determined as adequately representing a clinically desirable view of a heart.

Moreover, the training images 210 may include not only image information associated with clinically standard or desirable views, but may further include image information associated with
25 non-clinically desirable views. Accordingly, the ultrasound recognition module 120 may receive, for example, a view of a heart which is not representative of any particular clinically desirable view (*e.g.*, suprasternal, subcostal, short- and long-axis parasternal, 2-chamber apical, 3-chamber apical, 4-chamber apical and 5-chamber apical views). In such a case, the ultrasound recognition module 120

may nonetheless recognize the image as being a view of a heart, and may further recognize the image as being an image somewhere between, for example, a 2-chamber apical view and a 3-chamber apical view. A clinically standard 3-chamber apical view is generally obtainable, for example, by rotating an ultrasound imaging probe about 60° counterclockwise with respect to the 2-chamber apical view.

5 Ultrasound images obtained with the probe at an angle of rotation somewhere between, for example, 5° and 55° counterclockwise with respect to the 2-chamber apical view may be determined as not representing a clinically desirable view of a heart. However, the ultrasound image recognition module 120 may be trained with training images 210 showing a variety of known, but non-clinically desirable, views of a heart (such as views somewhere between the 2-chamber apical and the 3-chamber apical
10 views), and thus may recognize such views (*e.g.*, the ultrasound image recognition module 120 may recognize a view as representing a 35° counterclockwise rotation of the probe 118 with respect to the 2-chamber apical view).

Other training input 220 may further be provided to the ultrasound image recognition module 120 for training. The other training input 220 may include, for example, manually-entered input
15 to adjust or otherwise manage the image recognition model developed in the image recognition module 120 through the training process.

Using training images 210, the ultrasound image recognition module 120 may implement an iterative training process. Training may be based on a wide variety of learning rules or training algorithms. For example, the learning rules may include one or more of the following: back-
20 propagation, real-time recurrent learning, pattern-by-pattern learning, supervised learning, interpolation, weighted sum, reinforced learning, temporal difference learning, unsupervised learning, and/or recording learning.

The back-propagation learning algorithm is a common method of training artificial neural networks (and may be employed, for example, with the artificial neural network 300 shown in
25 Figure 3). Back-propagation generally includes two phases: propagation and weight update. In the propagation phase, a training pattern's input is forward propagated through the neural network in order to generate the propagation's output activations. Then, the propagation's output activations are backward propagated through the neural network using the training pattern target in order to generate

deltas (*i.e.*, the difference between the input and output values) of all output and hidden neurons. In the weight update phase, for each weight-synapse the following steps are generally performed: 1. Multiply its output delta and input activation to get the gradient of the weight; 2. Subtract a ratio (percentage) of the gradient from the weight. The propagation and weight update phases are repeated
5 as desired until performance of the network is satisfactory.

As a result of the training, the ultrasound image recognition module 120 may learn to modify its behavior in response to the training images 210, and obtain or generate ultrasound image knowledge 230. The ultrasound image knowledge 230 may represent any information upon which the ultrasound image recognition module 120 may determine an appropriate response to new data or
10 situations. In particular, the ultrasound image knowledge 230 represents relationships between ultrasound images and one or more views of an organ (*e.g.*, one or more functions that describe one or more views of an organ based on ultrasound image parameters, coefficients, weighting information, parameters associated with the example network shown in Figure 3, below, or any such variable). The ultrasound image knowledge 230 may be stored in the ultrasound image knowledge database 122.

15 Based on the training images 210, the ultrasound image recognition module 120 may learn to modify its behavior, and may apply knowledge contained in the image knowledge database 122 to alter the manner in which it makes determinations with respect to new input, such as, for example, ultrasound image information received from the ultrasound imaging device 110.

Figure 3 is a block diagram illustrating one example of an artificial neural network 300,
20 which may be implemented by the ultrasound image recognition module 120, in accordance with one or more embodiments. Artificial neural networks (ANNs) are artificial intelligence models that are used to estimate or approximate functions that can depend on a large number of inputs, and which are generally unknown. Such neural networks generally include a system of interconnected “neurons” which exchange information between each other. The connections have numeric weights that can be
25 tuned based on experience, and thus neural networks are adaptive to inputs and are capable of learning.

The artificial neural network 300 shown in Figure 3 includes three layers: an input layer 310 including input neurons i_1 through i_3 , a hidden layer 320 including hidden layer neurons h_1 through h_4 , and an output layer 330 including output neurons f_1 and f_2 . While the neural network 300 of Figure 3 is shown having three layers, it should be readily appreciated that additional layers may be included in the neural network 300 as desired to achieve optimal training and performance of the ultrasound image recognition module 120. Similarly, the neurons in each layer are shown for exemplary purposes, and it should be readily understood that each layer may include more, even significantly more, neurons than shown in Figure 3.

The neural network 300 may be trained by providing training images 210 to the input layer 310. As described with respect to Figure 2, the training images may include ultrasound image information having a wide variety of known characteristics, including, for example, various organ views, various image qualities or characteristics, various imaging angles, and so on. Through training, the neural network 300 may generate and/or modify the hidden layer 320, which represents weighted connections mapping the training images 210 provided at the input layer 310 to known output information at the output layer 330 (e.g., classification of an image as a subcostal view of a heart, a suprasternal view, etc.). Relationships between neurons of the input layer 310, hidden layer 320 and output layer 330, formed through the training process and which may include weight connection relationships, are generally referred to herein as "ultrasound image knowledge," and may be stored, for example, in the ultrasound image knowledge database 122.

Once the neural network 300 has been sufficiently trained, the neural network 300 may be provided with non-training ultrasound images at the input layer 310 (i.e., ultrasound images taken of a patient utilizing the ultrasound imaging device 110). Utilizing ultrasound image knowledge stored in the ultrasound image knowledge database 122 (which may include, for example, weighted connection information between neurons of the neural network 300), the neural network 300 may make determinations about the received ultrasound image information at the output layer 330. For example, the neural network 300 may determine whether the received ultrasound images represent one or more clinically desirable views of an organ.

The neural network 300 of Figure 3 is provided as just one example, among various possible implementations of an ultrasound image recognition module 120 that employs artificial intelligence to make determinations with respect to received ultrasound image information. For example, the ultrasound image recognition module 120 may implement any of neural network, deep learning, convolutional neural network, and Bayesian program learning techniques to make
5 determinations with respect to received ultrasound images of a patient.

Moreover, the ultrasound recognition module 120 may be trained, utilizing a variety of training images 210 and/or a variety of sequences of training images 210, to make a variety of determinations relating to received ultrasound image information. For example, the ultrasound
10 recognition module 120 may be trained or otherwise configured to determine whether a received ultrasound image represents one or more clinically standard or desirable views. Further, the ultrasound recognition module 120 may determine whether a received ultrasound image represents a non-clinically desirable view (and may recognize such non-clinically desirable view as a particular view or angle of a particular organ or other tissue within a patient), and may further determine based on a sequence of
15 received ultrasound images whether the images are approaching or moving away from a clinically desirable view of an organ. Based on its recognition of whether the images are approaching or moving away from a clinically desirable view of the organ, and/or on its recognition of the actual image captured, the system may then be configured to provide feedback to the user to assist the user in capturing the desired view of the organ, for example, by indicating a direction in which the user may
20 wish to move the probe and/or an angle of rotation or orientation in which the user may wish to angle the probe.

For example, as discussed above, the ultrasound image recognition module 120 may be trained with training images 210 showing a variety of known, but non-clinically desirable, views of a heart (such as views somewhere between the 2-chamber apical and the 3-chamber apical views), and
25 thus may recognize such views (*e.g.*, the ultrasound image recognition module 120 may recognize a view as representing a 35° counterclockwise rotation of the probe 118 with respect to the 2-chamber apical view). Further, the ultrasound image recognition module 120 may be trained with a sequence of recognized, but non-clinically standard or desirable views of a heart. For example, the ultrasound image

recognition module 120 may be trained to recognize ultrasound images showing a view of the heart at each degree of counterclockwise rotation between 0° and 60° with respect to the 2-chamber apical view (*i.e.*, every degree between the 2-chamber apical and the 3-chamber apical views). Further, the ultrasound image recognition module 120 may be trained to recognize a sequence of or progression of such non-clinically desirable views toward and/or away from a clinically desirable view (*e.g.*, the training images 210 may include a sequence of ultrasound images representing rotation of the probe 118 from the 2-chamber apical view toward and/or away from the 3-chamber apical view). The ultrasound image recognition module 120 may thus be trained to recognize that received ultrasound images, while not being representative of a particular clinically desired view, may be getting successively closer to (or moving away from) the clinically desired view.

Further, the ultrasound image recognition module 120 may be trained such that the ultrasound image recognition module 120 may determine whether received ultrasound images represent any of a plurality of clinically desirable views of an organ. Such clinically desirable views of an organ may include, for example, suprasternal, subcostal, short- and long-axis parasternal, 2-chamber apical, 3-chamber apical, 4-chamber apical and 5-chamber apical views of a heart.

Referring again to Figure 1, the ultrasound image recognition module 120 may provide a feedback signal (indicated by reference numeral 103) to the ultrasound imaging device 110, as described in further detail below. The feedback signal 103 may be provided in response to a determination made by the ultrasound image recognition module 120 with respect to a received ultrasound image.

Figure 4 schematically illustrates an ultrasound imaging device 110, in accordance with one or more embodiments. The ultrasound imaging device 110 may include a display 112, a user interface 410 including one or more input elements 412, one or more visual feedback elements 420, an audible feedback element 430 and/or a haptic feedback element 440.

The user interface 410 allows a user to control or otherwise communicate with the ultrasound imaging device 110. Various types of user input may be provided, for example, via the user input elements 412, which may be buttons or similar user input elements. Additionally or alternatively, the display 112 may be a touchscreen display, and user input may be received via the display 112. Using

the ultrasound imaging device 110, a user may select (*e.g.*, via the input elements 412 and/or display 112) or otherwise input a desired view of an organ that is to be imaged in a patient. For example, a user may select one view (*e.g.*, a subcostal view of a heart) from among a plurality of clinically desirable views that are stored in the ultrasound imaging device 110 and presented to the user. The ultrasound imaging device 110 may communicate the selected view to the ultrasound image recognition module 120, and the ultrasound image recognition module 120 may thus be configured to determine whether received ultrasound images represent the selected view. That is, the ultrasound image recognition module 120 may access the appropriate ultrasound image knowledge (*e.g.*, knowledge, rules or relations associated with a subcostal view of a heart) in the image knowledge database 122 such that received ultrasound images may be compared with, or processed by, knowledge corresponding to the selected view. Alternatively, the user may select a mode of operation in which the system guides the user through capture of one of more of a series of standard views of an organ, such as a heart as described above. In such a mode, the system would first select a desired view of the organ to be imaged, and then confirm for the user when the desired image had been captured and/or guide the user towards the desired view based on the initial image capture. The system would then repeat this process, in series, for each of the desired standard views of the organ to be imaged. Alternatively, the system could operate in such a way to compare any captured image against each of the images to be captured and confirm when one or more of the desired standard views had been captured, without first indicating which view was to be captured first.

The visual feedback elements 420 may be any element that can provide a visual indication to a user of the ultrasound imaging device 110, and may be, for example, one or more lights, colors, shapes, icons or the like, whether static or moving. The audible feedback element 430 may be any element capable of producing an audible indication to a user of the ultrasound imaging device 110, and may be, for example, a speaker for producing various tones or sounds associated with lack of correspondence and correspondence between the captured image and the image desired to be captured. Similarly, the haptic feedback element 440 may be any element capable of providing a haptic effect to a user of the ultrasound imaging device 110, and may be, for example, a vibration device.

Feedback signals 103 provided by the ultrasound image recognition module 120 may indicate any of a variety of determinations made by the ultrasound image recognition module 120 regarding ultrasound images received from the ultrasound imaging device 110.

5 For example, the ultrasound image recognition module 120 may provide a feedback signal 103 indicating that a current or most recently received ultrasound image represents a clinically desirable view of the organ (*e.g.*, the selected clinically desirable view). In a further example, the ultrasound image recognition module 120 may determine whether the received ultrasound images are sequentially approaching or moving away from a clinically desirable view of an organ, and provides a feedback signal 103 that indicates whether the received ultrasound images are sequentially approaching
10 or moving away from the clinically desirable view of the organ. This feedback signal could include a visual or audible command to instruct the user to move or angle the probe in a certain way, or an icon, such as a straight or curved arrow(s), indicating the direction and/or angle of movement required of the probe in order to better approach the desired image of the organ.

The ultrasound imaging device 110 receives the feedback signal 103, and in response,
15 may activate one or more feedback elements (*i.e.*, visual feedback elements 420, audible feedback element 430 and/or haptic feedback element 440) to provide a feedback effect to a user of the ultrasound imaging device 110. For example, the feedback signal 103 may indicate that the current or most recently received ultrasound image represents a clinically desirable view of an organ. In such a case, the feedback effect provided by the ultrasound imaging device 110 may include flashing a green
20 light 420a of the visual feedback element 420, an audible tone or beep from the audible feedback element 430 and/or a vibrational pulse provided by the haptic feedback element 440. The flashing green light 420a, audible tone and/or vibrational pulse indicates to the user that the desired view has been obtained, and the user may thus retain the ultrasound image of the desired view (*e.g.*, utilizing one or more of the user input elements 412) and store the image in an ultrasound image database 115.

25 Additionally or alternatively, upon determining that a clinically desirable view of an organ is represented in a received ultrasound image, the ultrasound image recognition module 120 may cause (*e.g.*, by a feedback signal 103) the ultrasound imaging device 110 to automatically retain and store the ultrasound image in the ultrasound image database 115. A table may also be displayed with

appropriate indications next to each desired type of image, to indicate whether the user had already captured the desired image or whether the desired image remains to be captured for the particular patient being imaged.

In embodiments where a feedback signal 103 indicates that the received ultrasound
5 images are sequentially approaching or moving away from the clinically desirable view of the organ, the ultrasound imaging device 110 may communicate this to the user, for example, by providing a changing feedback effect, such as an audible tone having an increasing (or decreasing) frequency as the received ultrasound images are approaching (or moving away from) the clinically desired view, a series of vibrational pulses having an increasing (or decreasing) intensity as the received ultrasound images are
10 approaching (or moving away from) the clinically desired view, and/or illuminating a different color or position of lights as the received ultrasound image are approaches or moving away from the clinically desired view (*e.g.*, illuminating red outer lights 420c, then yellow intermediate lights 420b, then green center light 420a as the received ultrasound images approach the clinically desired view).

The probe 118, which is operatively coupled with the ultrasound imaging device 110,
15 may include one or more motion sensors 450, which may be any motion sensors, including, for example, accelerometers, gyroscopes, or the like. Accordingly, the ultrasound imaging device 110 may determine a position and/or motion of the probe 118. In particular, the ultrasound imaging device 110 may determine a position and/or motion of the probe 118 with respect to one or more known points on a patient. For example, a user may position the probe 118 in a known orientation (*e.g.*, substantially
20 normal to the patient's skin) at a known point on the patient (*e.g.*, a particular point on the patient's chest), and the ultrasound imaging device 110 may capture (*e.g.*, via user input elements 412) this position as a reference or initialization point. The ultrasound imaging device 110 may thus determine its position with respect to the known reference point utilizing any known positioning algorithms, including, for example, inertial navigation techniques. Similarly, the ultrasound image recognition module 120
25 may determine, for example, that the received ultrasound images are moving away from a clinically desirable view (as described herein), and may recommend a movement (*e.g.*, via feedback signal 103) of the probe 118, with respect to the known point on the patient, in order to acquire the clinically desirable view. For example, the ultrasound image recognition module 120 may determine, for

example, that the received ultrasound images represent successive views of a heart associated with 45°, 40°, then 35° of counterclockwise rotation with respect to the 2-chamber apical view. The clinically desirable view may be, for example, a 3-chamber apical view, which may be obtainable by rotating the probe 118 about 60° with respect to the 2-chamber apical view. Accordingly, the ultrasound image
5 recognition module 120 may determine that the received ultrasound images are moving away from the clinically desirable view, and may further recommend, for example, that the user rotate the probe 118 about 25° (as the most recent view may represent a 35° counterclockwise rotation with respect to the 2-chamber apical view, an additional 25° counterclockwise rotation should result in the desired 3-chamber apical view) in a counterclockwise direction in order to obtain the 3-chamber apical view.

10 While the ultrasound image recognition module 120 has been described herein as being separate from the ultrasound imaging device 110, and accessible via the communications network 102, it should be readily appreciated that the ultrasound image recognition module 120 may be included within the ultrasound imaging device 110. That is, the ultrasound image recognition module 120 may be contained within the ultrasound imaging device 110, and may be stored, for example, in memory 114
15 and the features and/or functionality of the ultrasound image recognition module 120 may be executed or otherwise implemented by the processor 116.

Figure 5 is a flowchart illustrating an ultrasound image recognition method 500, in accordance with one or more embodiments. At block 502, the method 500 includes acquiring, by an ultrasound imaging device 110, ultrasound images of a patient. The acquired ultrasound images may
20 include, for example, a view of an organ in the patient.

At block 504, the method 500 includes transmitting the acquired ultrasound images to an ultrasound image recognition module 120. The acquired ultrasound images may be transmitted via a communications network 102, or alternatively, the ultrasound image recognition module 120 may be contained within the ultrasound imaging device 110, and the acquired ultrasound images may be
25 transmitted via a hardwired connection.

At block 506, the method 500 includes determining, by the ultrasound image recognition module 120, whether the acquired ultrasound images represent a clinically desirable view of

an organ. The ultrasound image recognition module 120 may employ any artificial intelligence methodologies to facilitate the determination, as shown and described, for example, in Figures 2 and 3.

5 At block 508, the method 500 may further include transmitting a feedback signal 103 to the ultrasound imaging device 110, in response to determining whether the received ultrasound images represent the clinically desirable view of the organ. The feedback signal 103 may communicate a variety of potential messages to the ultrasound imaging device 110. For example, the feedback signal 103 may indicate that an acquired ultrasound image represents the clinically desirable view, does not represent the clinically desirable view, and/or the images are sequentially approaching or moving away from the clinically desirable view.

10 At block 510, the method 100 may further include storing an acquired ultrasound image in response to the ultrasound image recognition module 120 determining that the acquired ultrasound image represents the clinically desirable view of the organ. In such a case, the acquired ultrasound image may be automatically stored, for example, in the ultrasound image database 115. Additionally or
15 alternatively, a user of the ultrasound imaging device 110 may be prompted to store the acquired ultrasound image, for example, by providing an input to the ultrasound imaging device 110 via the user interface 410.

 The various embodiments described above can be combined to provide further embodiments. These and other changes can be made to the embodiments in light of the above-detailed description. In general, in the following claims, the terms used should not be construed to limit the
20 claims to the specific embodiments disclosed in the specification and the claims, but should be construed to include all possible embodiments along with the full scope of equivalents to which such claims are entitled. Accordingly, the claims are not limited by the disclosure.

CLAIMS

1. An ultrasound system, comprising:

an ultrasound imaging device configured to acquire ultrasound images of a patient; and

an ultrasound image recognition module configured to receive the acquired ultrasound
5 images from the ultrasound imaging device and to determine whether the received ultrasound images
represent a clinically desirable view of an organ.

2. The ultrasound system of claim 1, wherein the ultrasound image recognition
module is configured to implement at least one of neural network, deep learning, convolutional neural
network, and Bayesian program learning techniques to determine whether the received ultrasound
10 images represent the clinically desirable view of the organ.

3. The ultrasound system of claim 1, wherein the clinically desirable view of the
organ includes at least one of suprasternal, subcostal, short axis parasternal, long axis parasternal, 2-
chamber apical, 3-chamber apical, 4-chamber apical and 5-chamber apical views of a heart.

4. The ultrasound system of claim 1, the ultrasound imaging device including a
15 user interface operable to receive a selection of one of a plurality of clinically desirable views of the
organ, wherein the ultrasound image recognition module is configured to determine whether the
received ultrasound images represent the selected clinically desirable view of the organ.

5. The ultrasound system of claim 1, wherein the ultrasound image recognition
module is operable to determine whether the received ultrasound images represent at least one of a
20 plurality of clinically desirable views of the organ.

6. The ultrasound system of claim 1, wherein the ultrasound image recognition
module is further configured to provide a feedback signal to the ultrasound imaging device, in response

to the determination of whether the received ultrasound images represent the clinically desirable view of the organ.

7. The ultrasound system of claim 6, wherein the feedback signal indicates whether a most recently received ultrasound image represents the clinically desirable view of the organ.

5 8. The ultrasound system of claim 6, wherein the ultrasound image recognition module is configured to determine whether the received ultrasound images are sequentially approaching or moving away from the clinically desirable view of the organ, wherein the feedback signal indicates whether the received ultrasound images are sequentially approaching or moving away from the clinically desirable view of the organ.

10 9. The ultrasound system of claim 6, the ultrasound imaging device including a feedback element, the ultrasound imaging device being configured to activate the feedback element, based on the feedback signal, to provide a feedback effect to a user of the ultrasound imaging device.

10. The ultrasound system of claim 9, wherein the feedback element comprises at least one of a visual, audible or haptic feedback element.

15 11. The ultrasound system of claim 1, further comprising a non-transitory computer-readable storage medium, wherein the ultrasound imaging device is configured to provide an acquired ultrasound image to the storage medium for storage in response to the ultrasound image recognition module determining that the acquired ultrasound image represents the clinically desirable view of the organ.

20 12. The ultrasound system of claim 1, wherein the ultrasound image recognition module is further configured to determine a recommended movement of the ultrasound imaging device, with respect to one or more known points on the patient, for acquiring the clinically desirable view of the organ.

13. The ultrasound system of claim 1, wherein the ultrasound image recognition module is operated within the ultrasound imaging device.

14. A method, comprising:

acquiring, by an ultrasound imaging device, ultrasound images of a patient;

5 transmitting the acquired ultrasound images of the patient to an ultrasound image recognition module; and

determining, by the ultrasound image recognition module, whether the acquired ultrasound images represent a clinically desirable view of an organ.

15. The method of claim 14, wherein determining whether the received ultrasound images represent the clinically desirable view of the organ includes:

implementing at least one of neural network, deep learning, convolutional neural network, and Bayesian program learning techniques to determine whether the received ultrasound images represent the clinically desirable view of the organ.

16. The method of claim 14, wherein determining whether the received ultrasound images represent the clinically desirable view of the organ includes:

determining whether the received ultrasound images represent at least one of suprasternal, subcostal, short axis parasternal, long axis parasternal, 2-chamber apical, 3-chamber apical, 4-chamber apical and 5-chamber apical views of a heart.

17. The method of claim 14, further comprising:

20 receiving a selection of one of a plurality of clinically desirable views of the organ, wherein the ultrasound image recognition module is configured to determine whether the received ultrasound images represent the selected clinically desirable view of the organ.

18. The method of claim 14, further comprising:

transmitting a feedback signal to the ultrasound imaging device, in response to the determining whether the received ultrasound images represent the clinically desirable view of the organ.

5 19. The method of claim 18, further comprising:

determining, by the ultrasound image recognition module, whether the received ultrasound images are sequentially approaching or moving away from the clinically desirable view of the organ, wherein the feedback signal indicates whether the received ultrasound images are sequentially approaching or moving away from the clinically desirable view of the organ.

10 20. The method of claim 18, further comprising:

activating a feedback element in the ultrasound imaging device, based on the feedback signal, to provide a feedback effect to a user of the ultrasound imaging device.

21. The method of claim 14, further comprising:

15 storing an acquired ultrasound image in a non-transitory computer-readable storage medium in response to the ultrasound image recognition module determining that the acquired ultrasound image represents the clinically desirable view of the organ.

22. The method of claim 14, further comprising:

20 determining, by the ultrasound image recognition module, a recommended movement of the ultrasound imaging device, with respect to one or more known points on the patient, for acquiring the clinically desirable view of the organ; and

transmitting a signal to the ultrasound imaging device indicating the recommended movement.

23. An ultrasound system, comprising:

an ultrasound imaging device configured to acquire ultrasound images of a patient; and

ultrasound image recognition means for determining whether the acquired ultrasound images represent a clinically desirable view of an organ.

5

24. The ultrasound system of claim 23, further comprising:

feedback means for providing a feedback effect to a user of the ultrasound imaging device based on the determination of whether the acquired ultrasound images represent the clinically desirable view of the organ.

10

Electronic Patent Application Fee Transmittal

Application Number:					
Filing Date:					
Title of Invention:	ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS				
First Named Inventor/Applicant Name:	Nikolaos Pagoulatos				
Filer:	Justin E. Coe				
Attorney Docket Number:	290139.402P1				
Filed as Small Entity					
Filing Fees for Provisional					
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)	
Basic Filing:					
Provisional Application Filing Fee	2005	1	130	130	
Pages:					
Claims:					
Miscellaneous-Filing:					
Petition:					
Patent-Appeals-and-Interference:					
Post-Allowance-and-Post-Issuance:					

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				130

Electronic Acknowledgement Receipt

EFS ID:	25153370
Application Number:	62305980
International Application Number:	
Confirmation Number:	6616
Title of Invention:	ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS
First Named Inventor/Applicant Name:	Nikolaos Pagoulatos
Customer Number:	500
Filer:	Justin E. Coe
Filer Authorized By:	
Attorney Docket Number:	290139.402P1
Receipt Date:	09-MAR-2016
Filing Date:	
Time Stamp:	19:38:12
Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	\$130
RAM confirmation Number	5887
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	290139_402P1_ADS.pdf	1823078 852badabbcbdec24d026c19d6d1a16a13f0b696	no	8
Warnings:					
Information:					
2	Drawings-only black and white line drawings	290139_402P1_FIGS.pdf	81061 82c0537b552320d0a963c0f32840a0ab86607bf5	no	5
Warnings:					
Information:					
3	Miscellaneous Incoming Letter	290139_402P1_FDA.pdf	44901 cdebec4ac647520185686fd48df9c0283114c90d	no	1
Warnings:					
Information:					
4		290139_402P1_APP.pdf	97664 5dd1776b35dfdf5c76d8e80333d742cd7e56fba0	yes	21
	Multipart Description/PDF files in .zip description				
	Document Description	Start	End		
	Specification	1	16		
	Claims	17	21		
Warnings:					
Information:					
5	Fee Worksheet (SB06)	fee-info.pdf	29816 dec094a126f7470bfcba421315e87bcc94ab0b	no	2
Warnings:					
Information:					
Total Files Size (in bytes):			2076520		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	290139.402P1
		Application Number	
Title of Invention	ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

Secrecy Order 37 CFR 5.2:

Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor	1				Remove	
Legal Name						
Prefix	Given Name	Middle Name	Family Name	Suffix		
	Nikolaos		Pagoulatos			
Residence Information (Select One) <input checked="" type="radio"/> US Residency <input type="radio"/> Non US Residency <input type="radio"/> Active US Military Service						
City	Kirkland	State/Province	WA	Country of Residence	US	
Mailing Address of Inventor:						
Address 1	c/o EchoNous, Inc.					
Address 2	19125 North Creek Parkway #104					
City	Bothell	State/Province	WA			
Postal Code	98011	Country	US			
Inventor	2				Remove	
Legal Name						
Prefix	Given Name	Middle Name	Family Name	Suffix		
	Ramachandra		Pailoor			
Residence Information (Select One) <input checked="" type="radio"/> US Residency <input type="radio"/> Non US Residency <input type="radio"/> Active US Military Service						
City	Woodinville	State/Province	WA	Country of Residence	US	
Mailing Address of Inventor:						
Address 1	c/o EchoNous, Inc.					
Address 2	19125 North Creek Parkway #104					
City	Bothell	State/Province	WA			
Postal Code	98011	Country	US			
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button.						
Add						

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	290139.402P1
		Application Number	
Title of Invention	ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS		

An Address is being provided for the correspondence information of this application.

Customer Number	00500		
Email Address	justinc.docketing@seedip.com	<input type="button" value="Add Email"/>	<input type="button" value="Remove Email"/>

Application Information:

Title of the Invention	ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS		
Attorney Docket Number	290139.402P1	Small Entity Status Claimed	<input checked="" type="checkbox"/>
Application Type	Provisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	5	Suggested Figure for Publication (if any)	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

Request Early Publication (Fee required at time of Request 37 CFR 1.219)

Request Not to Publish. I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not be** the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer number will be used for the Representative Information during processing.

Please Select One:	<input checked="" type="radio"/> Customer Number	<input type="radio"/> US Patent Practitioner	<input type="radio"/> Limited Recognition (37 CFR 11.9)
Customer Number	00500		

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	290139.402P1
		Application Number	
Title of Invention	ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	<input type="text"/>	<input type="button" value="Remove"/>
Application Number	Continuity Type	Prior Application Number
<input type="text"/>	<input type="text"/>	Filing or 371(c) Date (YYYY-MM-DD)
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.		<input type="button" value="Add"/>

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)ⁱ the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application Number	Country ⁱ	Filing Date (YYYY-MM-DD)	Access Code ⁱ (if applicable)
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Additional Foreign Priority Data may be generated within this form by selecting the Add button.			<input type="button" value="Add"/>

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

- This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
- NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	290139.402P1
		Application Number	
Title of Invention	ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS		

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	290139.402P1
		Application Number	
Title of Invention	ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS		

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.			
Applicant	1	<input type="button" value="Remove"/>	
If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.			
<input type="button" value="Clear"/>			
Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor	
<input type="radio"/> Person to whom the inventor is obligated to assign.		<input type="radio"/> Person who shows sufficient proprietary interest	
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:			
▼			
Name of the Deceased or Legally Incapacitated Inventor: <input type="text"/>			
If the Applicant is an Organization check here. <input checked="" type="checkbox"/>			
Organization Name	EchoNous, Inc.		
Mailing Address Information For Applicant:			
Address 1	19125 North Creek Parkway #104		
Address 2			
City	Bothell	State/Province	WA
Country	US	Postal Code	98011
Phone Number		Fax Number	
Email Address			
Additional Applicant Data may be generated within this form by selecting the Add button. <input type="button" value="Add"/>			

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	290139.402P1
		Application Number	
Title of Invention	ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS		

Assignee 1				
Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.				
				<input type="button" value="Remove"/>
If the Assignee or Non-Applicant Assignee is an Organization check here. <input type="checkbox"/>				
Prefix	Given Name	Middle Name	Family Name	Suffix
Mailing Address Information For Assignee including Non-Applicant Assignee:				
Address 1				
Address 2				
City		State/Province		
Country i		Postal Code		
Phone Number		Fax Number		
Email Address				
Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.				<input type="button" value="Add"/>

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Justin Coe/		Date (YYYY-MM-DD)	2016-03-09
First Name	Justin	Last Name	Coe	Registration Number
				67382
Additional Signature may be generated within this form by selecting the Add button.				<input type="button" value="Add"/>

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	290139.402P1
		Application Number	
Title of Invention	ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS		

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

FIG. 1

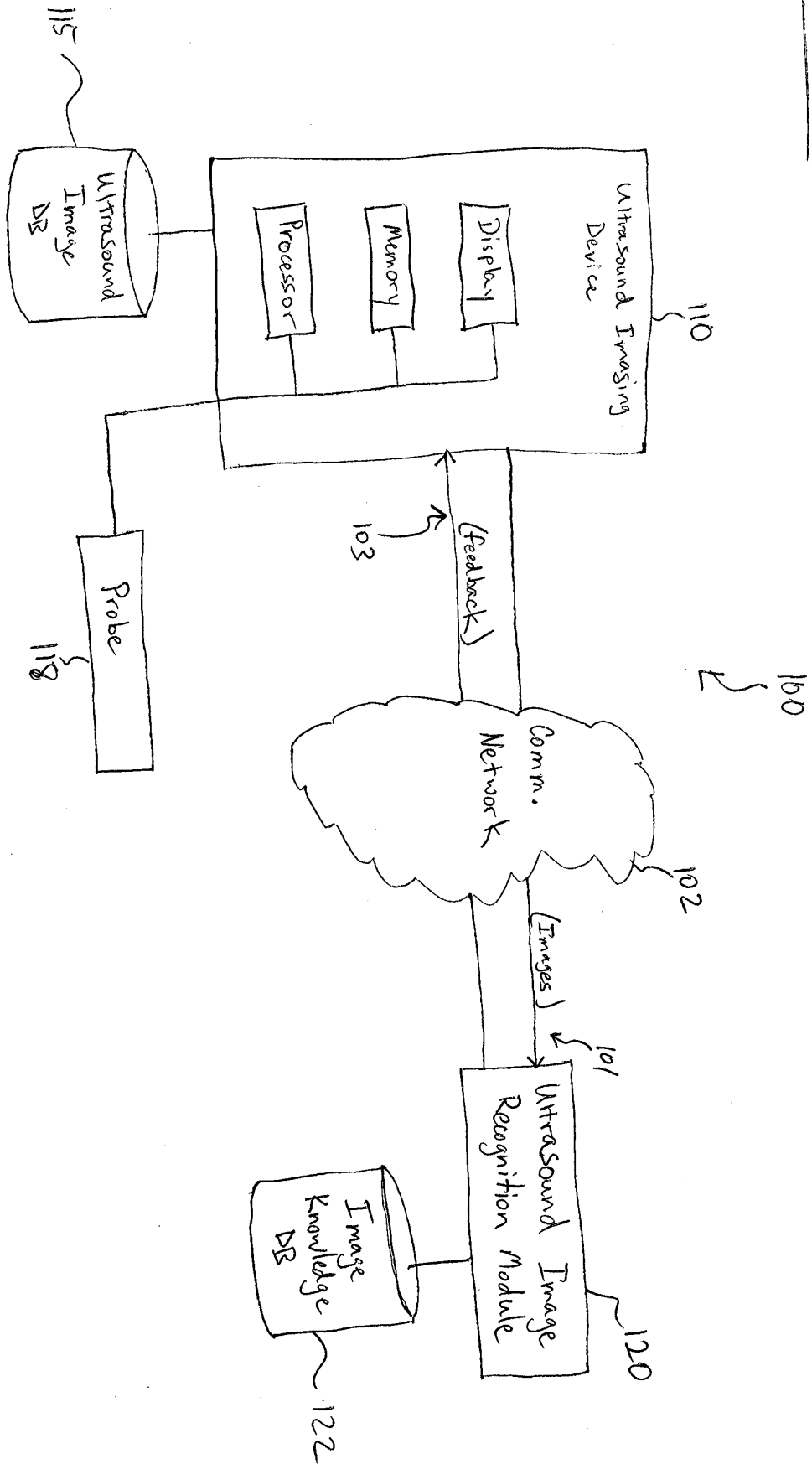


FIG. 2

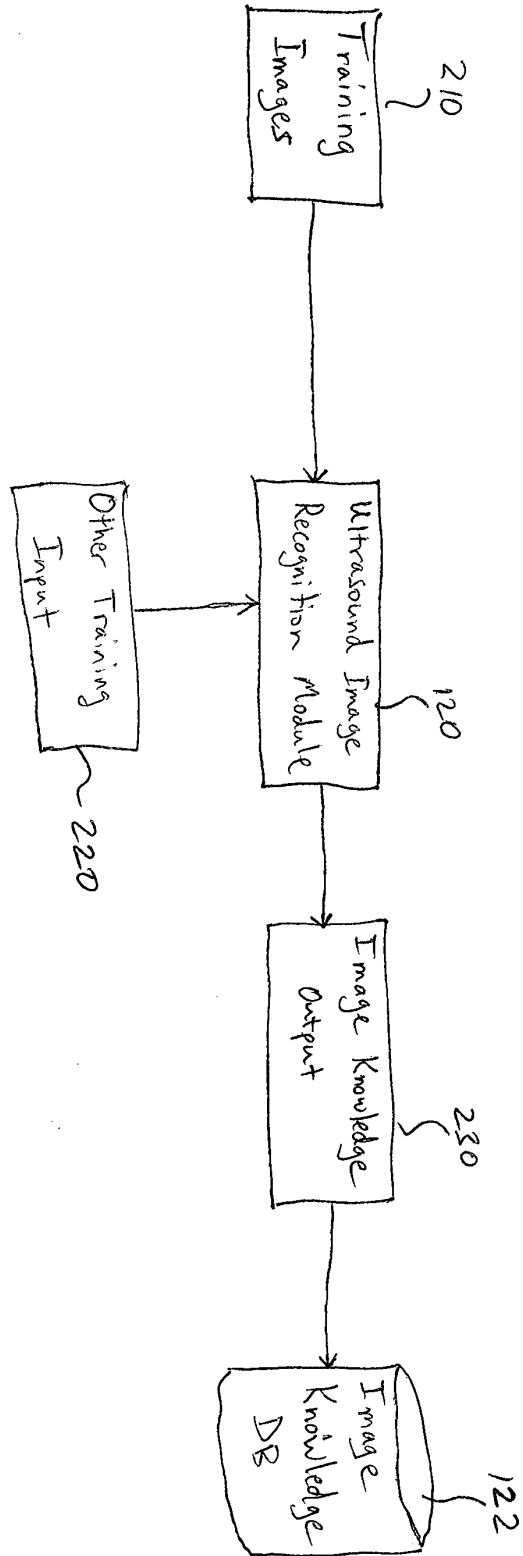


FIG. 3

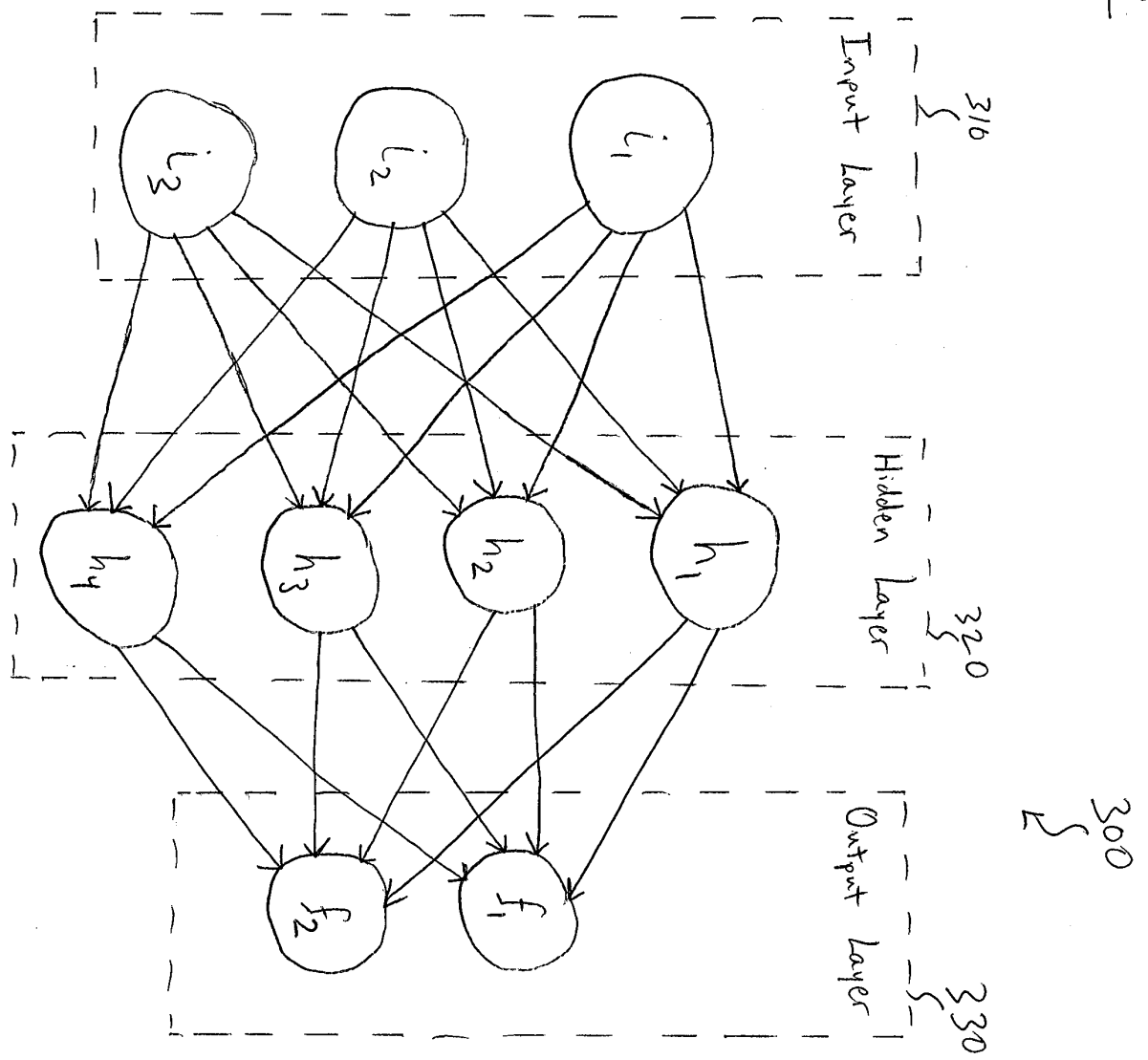


FIG. 4

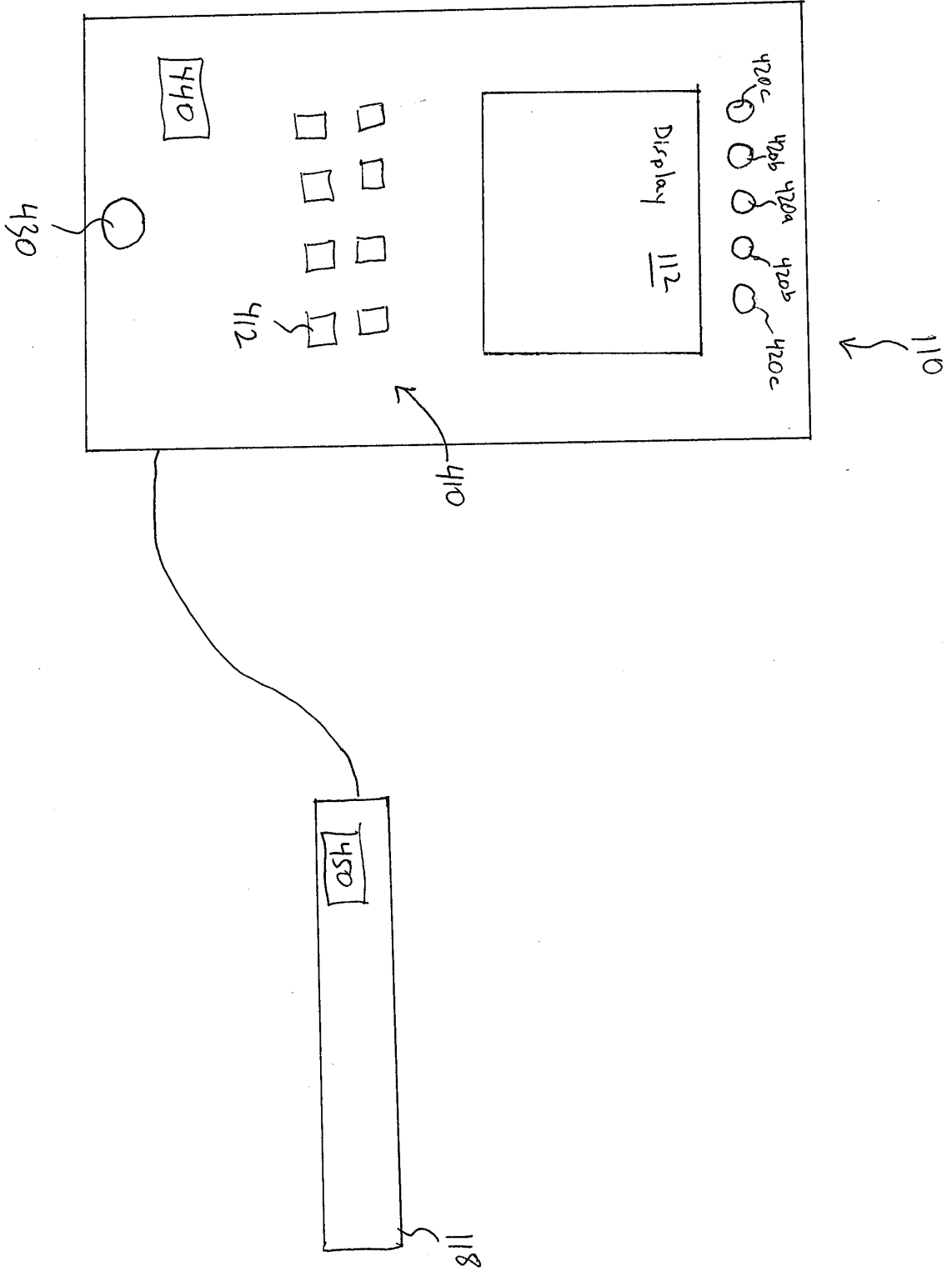
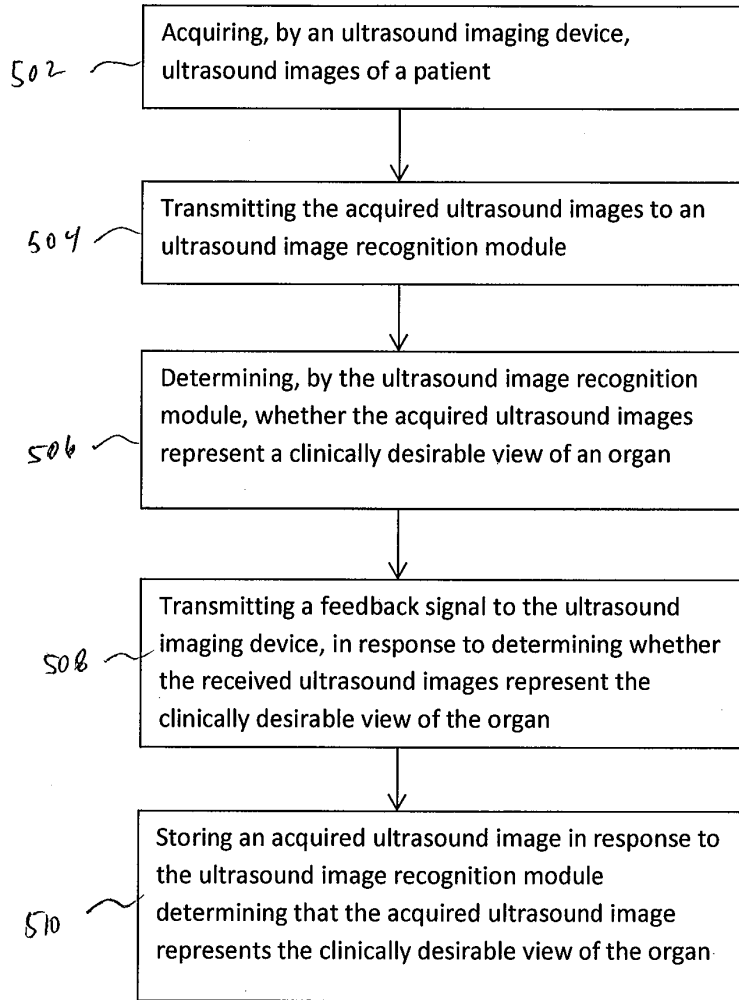


FIG. 5

500
↓



PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s) : Nikolaos Pagoulatos et al.
Application No. : 62/305,980
Filed : March 9, 2016
For : ULTRASOUND IMAGE RECOGNITION SYSTEMS AND
METHODS

Docket No. : 290139.402P1
Date : March 21, 2016

Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

REQUEST TO CORRECT INVENTORSHIP OF PROVISIONAL PATENT APPLICATION
PURSUANT TO 37 CFR 1.48(d)

Commissioner:

Applicant hereby respectfully requests, pursuant to 37 CFR 1.48(d), that the inventorship of the above-identified patent application be corrected to **add** the following inventor:

Kevin Goodwin

The correct inventorship is as follows:

Nikolaos Pagoulatos
Ramachandra Pailoor
Kevin Goodwin

The inventorship error occurred without deceptive intent on the part of the added inventor. Enclosed is the requisite processing fee of \$50. The Director is authorized to charge any additional fees due by way of this Request, or credit any overpayment, to our Deposit Account No. 19-1090.

Respectfully submitted,

SEED Intellectual Property Law Group PLLC

/Justin Coe/

Justin Coe

Registration No. 67,382

JEC:trl

701 Fifth Avenue, Suite 5400
Seattle, Washington 98104
(206) 622-4900
Fax: (206) 682-6031

4792902_1.docx

CORRECTIVE ADS

PTO/AIA/14 (11-15)

Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	290139.402P1
		Application Number	62/305,980
Title of Invention	ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS		
<p>The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.</p>			

Secrecy Order 37 CFR 5.2:

Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1					Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Nikolaos		Pagoulatos		
Residence Information (Select One) <input checked="" type="radio"/> US Residency <input type="radio"/> Non US Residency <input type="radio"/> Active US Military Service					
City	Kirkland	State/Province	WA	Country of Residenceⁱ	US
Mailing Address of Inventor:					
Address 1	c/o EchoNous, Inc.				
Address 2	19125 North Creek Parkway #104				
City	Bothell	State/Province	WA		
Postal Code	98011	Countryⁱ	US		
Inventor 2					Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Ramachandra		Pailoor		
Residence Information (Select One) <input checked="" type="radio"/> US Residency <input type="radio"/> Non US Residency <input type="radio"/> Active US Military Service					
City	Woodinville	State/Province	WA	Country of Residenceⁱ	US
Mailing Address of Inventor:					
Address 1	c/o EchoNous, Inc.				
Address 2	19125 North Creek Parkway #104				
City	Bothell	State/Province	WA		
Postal Code	98011	Countryⁱ	US		
Inventor 3					Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Kevin		Goodwin		
Residence Information (Select One) <input checked="" type="radio"/> US Residency <input type="radio"/> Non US Residency <input type="radio"/> Active US Military Service					

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	290139.402P1
	Application Number	<u>62/305,980</u>
Title of Invention	ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS	

City	<u>Kirkland</u>	State/Province	<u>WA</u>	Country of Residence	<u>US</u>
------	-----------------	----------------	-----------	----------------------	-----------

Mailing Address of Inventor:

Address 1	<u>c/o EchoNous, Inc.</u>				
Address 2	<u>19125 North Creek Parkway #104</u>				
City	<u>Bothell</u>	State/Province	<u>WA</u>		
Postal Code	<u>98011</u>	Country ⁱ	<u>US</u>		

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button.

Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

An Address is being provided for the correspondence information of this application.

Customer Number	00500				
Email Address	justinc.docketing@seedip.com	<table border="1"><tr><td>Add Email</td></tr></table>	Add Email	<table border="1"><tr><td>Remove Email</td></tr></table>	Remove Email
Add Email					
Remove Email					

Application Information:

Title of the Invention	ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS		
Attorney Docket Number	290139.402P1	Small Entity Status Claimed	<input checked="" type="checkbox"/>
Application Type	Provisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	5	Suggested Figure for Publication (if any)	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

Request Early Publication (Fee required at time of Request 37 CFR 1.219)

Request Not to Publish. I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	290139.402P1
		Application Number	<u>62/305,980</u>
Title of Invention	ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS		

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative information during processing.

Please Select One:	<input checked="" type="radio"/> Customer Number	<input type="radio"/> US Patent Practitioner	<input type="radio"/> Limited Recognition (37 CFR 11.9)
Customer Number	00500		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Remove		
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)¹ the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application Number	Country ¹	Filing Date (YYYY-MM-DD)	Remove
			Access Code ¹ (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	290139.402P1
	Application Number	<u>62/305,980</u>
Title of Invention	ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS	

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

<p>This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.</p> <p><input type="checkbox"/> NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.</p>
--

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	290139.402P1
		Application Number	<u>62/305,980</u>
Title of Invention	ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS		

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	290139.402P1
	Application Number	62/305,980
Title of Invention	ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.			
Applicant 1			
If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.			
<input type="button" value="Clear"/>			
<input type="radio"/> Assignee	<input type="radio"/> Legal Representative under 35 U.S.C. 117	<input type="radio"/> Joint Inventor	
<input checked="" type="radio"/> Person to whom the inventor is obligated to assign.		<input type="radio"/> Person who shows sufficient proprietary interest	
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:			
Name of the Deceased or Legally Incapacitated Inventor: <input type="text"/>			
If the Applicant is an Organization check here. <input checked="" type="checkbox"/>			
Organization Name	EchoNous, Inc.		
Mailing Address Information For Applicant:			
Address 1	19125 North Creek Parkway #104		
Address 2			
City	Bothell	State/Province	WA
Country	US	Postal Code	98011
Phone Number		Fax Number	
Email Address			
Additional Applicant Data may be generated within this form by selecting the Add button.			

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	290139.402P1
	Application Number	<u>62/305,980</u>
Title of Invention	ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS	

Assignee 1				
Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.				
If the Assignee or Non-Applicant Assignee is an Organization check here. <input type="checkbox"/>				
Prefix	Given Name	Middle Name	Family Name	Suffix
Mailing Address Information For Assignee including Non-Applicant Assignee:				
Address 1				
Address 2				
City		State/Province		
Country ⁱ		Postal Code		
Phone Number		Fax Number		
Email Address				
Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.				

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Justin Coe/		Date (YYYY-MM-DD)	<u>2016-03-21</u>
First Name	Justin	Last Name	Coe	Registration Number 67382
Additional Signature may be generated within this form by selecting the Add button.				

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	290139.402P1
		Application Number	<u>62/305,980</u>
Title of Invention	ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS		

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:	62305980				
Filing Date:					
Title of Invention:	ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS				
First Named Inventor/Applicant Name:	Nikolaos Pagoulatos				
Filer:	Justin E. Coe/Tyler Livas				
Attorney Docket Number:	290139.402P1				
Filed as Small Entity					
Filing Fees for Provisional					
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)	
Basic Filing:					
Pages:					
Claims:					
Miscellaneous-Filing:					
Petition:					
Patent-Appeals-and-Interference:					
Post-Allowance-and-Post-Issuance:					
Extension-of-Time:					

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Miscellaneous:				
Processing Fee for Provis. Applications	2807	1	50	50
Total in USD (\$)				50

Electronic Acknowledgement Receipt

EFS ID:	25260972
Application Number:	62305980
International Application Number:	
Confirmation Number:	6616
Title of Invention:	ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS
First Named Inventor/Applicant Name:	Nikolaos Pagoulatos
Customer Number:	500
Filer:	Justin E. Coe/Tyler Livas
Filer Authorized By:	Justin E. Coe
Attorney Docket Number:	290139.402P1
Receipt Date:	21-MAR-2016
Filing Date:	
Time Stamp:	18:07:55
Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	\$50
RAM confirmation Number	5377
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Request under Rule 48 correcting inventorship	290139_402P1_REQUEST.pdf	68727 09780267633cb342dd74d78399f0f39e7b0117b2	no	2
Warnings:					
Information:					
2	Application Data Sheet	290139_402P1_CORRECTIVE_A DS.pdf	3230232 63086dd2152f1366c2fb8086b09171b5503a6696	no	9
Warnings:					
Information:					
This is not an USPTO supplied ADS fillable form					
3	Miscellaneous Incoming Letter	290139_402P1_FDA.pdf	44956 5fedcf96cl716a00efcfdfe727460ab6024d9641a	no	1
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	30276 74a89f41b81a1041bd919ccf56a593d85b049bad	no	2
Warnings:					
Information:					
Total Files Size (in bytes):			3374191		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

Table with 7 columns: APPLICATION NUMBER, FILING or 371(c) DATE, GRP ART UNIT, FIL FEE REC'D, ATTY DOCKET NO, TOT CLAIMS, IND CLAIMS

62/305,980 03/09/2016 130 290139.402P1

CONFIRMATION NO. 6616

FILING RECEIPT

500
SEED INTELLECTUAL PROPERTY LAW GROUP PLLC
701 FIFTH AVE
SUITE 5400
SEATTLE, WA 98104



Date Mailed: 03/24/2016

Receipt is acknowledged of this provisional patent application. It will not be examined for patentability and will become abandoned not later than twelve months after its filing date. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections

Inventor(s)

Nikolaos Pagoulatos, Kirkland, WA;
Ramachandra Pailoor, Woodinville, WA;
Kevin Goodwin, Kirkland, WA;

Applicant(s)

EchoNous, Inc., Bothell, WA

Power of Attorney:

Justin Coe--67382

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted:

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is US 62/305,980

Projected Publication Date: None, application is not eligible for pre-grant publication

Non-Publication Request: No

Early Publication Request: No

** SMALL ENTITY **

Title

ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
62/305,980	03/09/2016	Nikolaos Pagoulatos	290139.402P1

CONFIRMATION NO. 6616

500
SEED INTELLECTUAL PROPERTY LAW GROUP PLLC
701 FIFTH AVE
SUITE 5400
SEATTLE, WA 98104

**37 CFR 1.48(d)
ACKNOWLEDGEMENT LETTER**



Date Mailed: 03/24/2016

NOTICE OF ACCEPTANCE OF REQUEST UNDER 37 CFR 1.48(d)

This is in response to the applicant's request under 37 CFR 1.48(d) submitted on 03/21/2016.

">The request under 37 CFR 1.48(d) to correct the inventorship, to correct or update the name of an inventor, or to correct the order of names of joint inventors is accepted.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at (571) 272-4000 or (571) 272-4200 or 1-888-786-0101.

/amanalac/



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Table with 7 columns: APPLICATION NUMBER, FILING or 371(c) DATE, GRP ART UNIT, FIL FEE REC'D, ATTY DOCKET NO, TOT CLAIMS, IND CLAIMS

62/305,980 03/09/2016 130 290139.402P1

CONFIRMATION NO. 6616
UPDATED FILING RECEIPT

500
SEED INTELLECTUAL PROPERTY LAW GROUP PLLC
701 FIFTH AVE
SUITE 5400
SEATTLE, WA 98104



Date Mailed: 03/24/2016

Receipt is acknowledged of this provisional patent application. It will not be examined for patentability and will become abandoned not later than twelve months after its filing date. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections

Inventor(s)
Nikolaos Pagoulatos, Kirkland, WA;
Ramachandra Pailoor, Woodinville, WA;
Kevin Goodwin, Kirkland, WA;

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Power of Attorney:
Justin Coe--67382

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted:

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is US 62/305,980

Projected Publication Date: None, application is not eligible for pre-grant publication

Non-Publication Request: No

Early Publication Request: No

** SMALL ENTITY **

Title

ULTRASOUND IMAGE RECOGNITION SYSTEMS AND METHODS

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

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