parameter in the direction of the sliding touch. Such an activation area may have the form of a thumbwheel to provide the user with a recognizable control. A numerical readout can be displayed in association with the activation area to display a value of the parameter while the parameter is being adjusted. Moreover, the activation area or indication(s) within the activation area can change shape to conform to the shape drawn by the sliding touch.

[0015] In one embodiment, a profile of a parameter is adjustable by touching an activation area which responds to user touch by drawing a contour on the touchscreen in response to the track of the user's touch. The contour represents the control profile, i.e., a sequence of control values which vary according to the shape of the drawn contour. The control profile is used by the system to drive a control function that varies with some parameter such as time during a scan line. For example, the TGC (time-gain compensation) profile may be determined by a user-drawn TGC contour. The activation area is displayed with an initial, existing profile. Subsequent touches and drawing movements in the activation area by the user modify the profile, with the modified profile then being displayed for user review and possible further adjustment. The modifications may be strong, e.g., a single gesture replaces the existing contour, or they may be gradual, e.g., each gesture moves the profile to an intermediate position between the previous contour and the new one created by the gesture.

[0016] The activation areas can be provided with assigned functions which vary for different operation modes of the imaging system. The processor would thus assign functions relating to the imaging system to each activation area depending on an operation mode thereof. As the operation mode is changed, the functions of the activation areas, and their labels, shapes, colors, and degrees of transparency would change. For example, an activation area that acts as a button may indicate its function by means of its outline shape and a graphic displayed in the area, with no text label at all. Semi-transparency may be used to overlay activation areas upon each other or upon the underlying ultrasound image, so that display area consumption is minimized.

[0017] The user interface can also be designed to process handwritten text drawn or traced on the touchscreen by a finger, stylus or the like, using a handwriting recognition algorithm which converts touches on the touchscreen into text. By allowing for handwritten text entry, the user interface enables users to enter complex information such as patient data, comments, labels for regions of the images and the like.

[0018] An exemplifying ultrasound imaging system is capable of displaying real-time three-dimensional ultrasound images so that the activation areas have unique assigned functions relating to processing of three-dimensional images. The three-dimensional ultrasound images can be displayed as multiple planes oriented in their true spatial positions with respect to each other.

[0019] A method for providing user control over device functions of an ultrasound imaging system in accordance with the invention includes displaying ultrasound images on a touchscreen, defining a plurality of activation areas on a touchscreen simultaneous with the display of the ultrasound images, assigning a unique function relating to processing of the ultrasound images to each activation area, displaying an indication of the function on each activation area, positioning the activation areas to minimize interference with the simultaneous display of the ultrasound images, detecting when an activation area is touched, and performing the function associated with the touched activation area to change the displayed ultrasound images.

[0020] The appearance and disappearance of the activation areas may be controlled based on need for the functions assigned to the activation areas and/or based on activation by a user. This increases the time that the entire visual field of the touchscreen is occupied by the ultrasound images. In display formats where it is especially important to conserve space, activation areas with semi-transparent controls may be overlaid temporarily on other activation areas, and/or the image, and/or the informational graphics that accompany the image. Since the user's attention is focused on manipulating the controls and not on the fine detail of the underlying image and graphics, the semi-transparent controls do not diminish the utility of the display. The system changes made by the user's manipulation of a semi-transparent control may be visible through the control itself. For example, if the control is for image receive gain and its activation area is superimposed on the ultrasound image, the change in brightness of the image during manipulation of the control will be visible to the user not only from the region of the image surrounding the activation area, but underneath it as well, owing to the semi-transparency.

[0021] The activation areas may be arranged along a left or right side of a visual field of the touchscreen, or the top or bottom of the visual field, to minimize obscuring of the ultrasound images. The simultaneous display of the activation areas and ultrasound images enables the user to immediately view changes to the ultrasound images made by touching the activation areas.

[0022] The invention, together with further objects and advantages thereof, may best be understood by reference to the following description taken in conjunction with the accompanying drawings wherein like reference numerals identify like elements.

[0023] FIG. **1** is a block diagram of an ultrasound imaging system incorporating a user interface in accordance with the invention.

[0024] FIG. **2** shows a touchscreen of the ultrasound imaging system with a sample activation area layout.

[0025] FIGS. **3**A and **3**B show two forms of cascading menus used in the user interface.

[0026] FIGS. **4**A, **4**B and **4**C show an exemplifying activation area for a user-controllable value profile, and a sequence of operations to change the profile.

[0027] FIG. **5** shows a touchscreen of the ultrasound imaging system with a three-dimensional image and a sample activation area layout.

[0028] FIGS. **6**A and **6**B show exemplifying graphic symbols within activation areas for enabling the manipulation of the orientation of a displayed three-dimensional image.

[0029] Referring to FIG. **1**, an ultrasound imaging system **10** in accordance with the invention includes an ultrasound scanner **12**, an electromechanical subsystem **14** for controlling the ultrasound scanner **12**, a processing unit or computer **16** for controlling the electromechanical subsystem **12** and a touchscreen **18** on which ultrasound images and virtual controls are displayed. The electromechanical subsystem **14** implements the electrical and mechanical subsystems of the ultrasound imaging system **10** apart from the computer software, monitor, and touchscreen interface. For example, the