

[0028] Reference is made to **FIG. 2**, which is a simplified flowchart of a method to activate a zoom function on a pressure-sensitive touch screen, in accordance with an embodiment of the present invention. At operation **1011** a determination is made whether a touch is detected on the touch screen. If not, the method exits. If so, at operation **1012** a further determination is made whether pressure is being applied to the touch screen. If not, the method returns to operation **1011**. If so, then the current level of pressure being applied to the screen is detected, and compared with the level of pressure previously applied to the screen. If it is determined at operation **1013** that the current pressure level is greater than the previous pressure level, then at operation **1015** the rate of zoom is increased and the method returns to operation **1012**. Otherwise, if it is determined at operation **1014** that the current pressure level is less than the previous pressure level, then at operation **1016** the rate of zoom is decreased and the method returns to operation **1012**. Otherwise, the current pressure and the previous pressure levels are the same, and at operation **1017** the zoom rate is maintained and the method returns to operation **1012**.

[0029] Conventional zoom commands, such as commands activated by a pinch or spread gesture, zoom in on the center of a displayed image portion. In order to zoom in on a different portion of the image, a user is required to pan the image so as to bring its center to a desired location, and then perform a zoom command.

[0030] In distinction, with embodiments of the present invention, the center of a zoom is the location touched on the display. Reference is made to **FIG. 53**, which is a simplified illustration of activation of a zoom function on a pressure-sensitive touch screen, in accordance with an embodiment of the present invention. **FIG. 53** shows two images of a pressure-sensitive touch screen **800**, before and after a zoom operation

is performed. In the upper image, showing touch screen **800** before the zoom operation is performed, touch screen **800** displays an airplane in the upper right corner of the screen. A finger **900** is shown applying downward pressure on touch screen **800**, at the location of the airplane, to activate a zoom function. Touch screen **800** detects the location of finger **900**, and centers the zoomed image at that location. As such, in the lower image, showing touch screen **800** after the zoom operation is performed, the airplane is at the center of touch screen **800**. Finger **900** remains at its original location throughout the zoom.

[0031] In embodiments of the present invention, the pressure sensor controls parameters of a scroll command. When display of a document or other object extends beyond the limits of touch screen **800**, a portion of the document or object is displayed, and the users sweeps a finger along the vertical dimension of the screen in order to scroll the document or object up or down. In one embodiment, the scroll continues even when the user's finger has reached the upper or lower edge of the screen, as long as contact with the screen is maintained. In this embodiment, the speed of scrolling is determined based on the amount of pressure applied by the finger to touch screen **800**, whereby a greater pressure on the screen corresponds to a faster scroll rate.

[0032] Often it is useful for a user scrolling through a large document or object to change the speed of the scroll dynamically. E.g., a user may wish to scroll quickly in order to move to a desired area within a document, and then continue to scroll slowly within the desired area. In accordance with embodiments of the present invention, the user controls the scrolling speed by adjusting the amount of pressure applied by the finger on touch screen **800**. In one embodiment, the user reduces the scrolling speed by applying more pressure on the screen. As such, navigating a document is intuitive; namely, the user begins scrolling by

CLAIMS

What is claimed is:

- 1.** A touch screen, comprising:

 - a housing;
 - a display mounted in said housing;
 - a touch sensor, mounted in said housing and connected to said display, for identifying an object that is gliding along an upper surface of said display;
 - a pressure sensor, mounted in said housing and connected to said display, for determining that pressure is being applied to said display; and
 - a processor, mounted in said housing and connected to said touch and pressure sensors and to said display, for applying a first scroll command to an image rendered on said display in response to said touch sensor identifying the object gliding along the upper surface of said display, and for applying a second scroll command to the image in response to said pressure sensor determining that pressure is being applied to said display.
- 2.** The touch screen of claim **1** wherein said display is flexibly mounted in said housing, and wherein said pressure sensor comprises:

 - at least one light receiver rigidly mounted below said display in said housing; and
 - a calculating unit connected to said at least one light receiver and to said processor, for receiving outputs indicating amounts of light received by said at least one light receiver, and for determining that pressure is being applied to said display based on an increase in an output from said at least one light receiver.

3. The touch screen of claim **1** wherein said display comprises a flexible material that bends resiliently in response to applied pressure, and wherein said pressure sensor comprises:

at least one light receiver rigidly mounted below said display in said housing; and

a calculating unit connected to said at least one light receiver and to said processor, for receiving output indicating amounts of received light from said at least one light receiver, and for determining that pressure is being applied to said display based on an increase in an output from said at least one light receiver.

4. The touch screen of claim **1** wherein said pressure sensor distinguishes multiple levels of pressure being applied to said display, and wherein said processor zooms or scrolls the image rendered on said display at a speed corresponding to the level of pressure detected by said pressure sensor.

5. The touch screen of claim **1**, wherein said processor determines that pressure is being applied to said display only when said touch sensor detects a touch on said display.

6. The touch screen of claim **1** wherein said touch sensor and said pressure sensor comprise:

a shared plurality of light emitters below said display in said housing, for emitting light beams across said display; and

a shared plurality of light receivers below said display in said housing, for receiving the emitted light beams; and

a shared calculating unit, connected to said light receivers, for determining (i) a location of a touch based on receiving less than an

expected amount of light at a first one of said receivers, and (ii) a pressure of the touch based on receiving more than an expected amount of light at a second one of said receivers.

7. The touch screen of claim **1**, wherein the second scroll command is applied only when said touch sensor identifies the object at an edge of said display while said pressure sensor determines that pressure is being applied to said display.

8. The touch screen of claim **7**, wherein the second scroll command is applied only when it is preceded by the first scroll command.

9. A non-transitory computer readable medium storing instructions which, when executed by a processor of an electronic device that comprises a touch sensitive and pressure sensitive display, cause the processor to enable a user interface of the electronic device, by which a glide gesture along the display and an amount of pressure applied to the display both generate the same user interface command.

10. The non-transitory computer readable medium of claim **9**, wherein when the glide gesture reaches an edge of the display, the user interface continues to invoke the user interface command in response to the pressure being applied to the display.

11. The non-transitory computer readable medium of claim **9**, wherein a parameter of the user interface command is set in accordance with a speed of the glide gesture and an amount of the pressure applied to the display.

12. The non-transitory computer readable medium of claim **11**, wherein the user interface command is a scroll command for scrolling information rendered on the display, and wherein the parameter is the speed of the scrolling.

13. The non-transitory computer readable medium of claim **12**, wherein greater amounts of pressure correspond to slower scroll speeds.

14. The non-transitory computer readable medium of claim **11**, wherein the user interface command is a zoom command for zooming an image rendered on the display, and wherein the parameter is the speed of the zooming.

15. The non-transitory computer readable medium of claim **14**, wherein greater amounts of pressure correspond to slower zoom speeds.

16. A non-transitory computer readable medium storing instructions which, when executed by a processor of an electronic device that comprises a touch sensitive and pressure sensitive display, cause the processor to enable a user interface of the device, by which an image rendered on the display is zoomed in response to pressure being applied to the display, whereby the zoom is performed such that the location within the image at which the pressure is first applied is the center of the zoomed image.

[0028] Reference is made to **FIG. 2**, which is a simplified flowchart of a method to activate a zoom function on a pressure-sensitive touch screen, in accordance with an embodiment of the present invention. At operation **1011** a determination is made whether a touch is detected on the touch screen. If not, the method exits. If so, at operation **1012** a further determination is made whether pressure is being applied to the touch screen. If not, the method returns to operation **1011**. If so, then the current level of pressure being applied to the screen is detected, and compared with the level of pressure previously applied to the screen. If it is determined at operation **1013** that the current pressure level is greater than the previous pressure level, then at operation **1015** the rate of zoom is increased and the method returns to operation **1012**. Otherwise, if it is determined at operation **1014** that the current pressure level is less than the previous pressure level, then at operation **1016** the rate of zoom is decreased and the method returns to operation **1012**. Otherwise, the current pressure and the previous pressure levels are the same, and at operation **1017** the zoom rate is maintained and the method returns to operation **1012**.

[0029] Conventional zoom commands, such as commands activated by a pinch or spread gesture, zoom in on the center of a displayed image portion. In order to zoom in on a different portion of the image, a user is required to pan the image so as to bring its center to a desired location, and then perform a zoom command.

[0030] In distinction, with embodiments of the present invention, the center of a zoom is the location touched on the display. Reference is made to **FIG. 3**, which is a simplified illustration of activation of a zoom function on a pressure-sensitive touch screen, in accordance with an embodiment of the present invention. **FIG. 3** shows two images of a pressure-sensitive touch screen **800**, before and after a zoom operation

is performed. In the upper image, showing touch screen **800** before the zoom operation is performed, touch screen **800** displays an airplane in the upper right corner of the screen. A finger **900** is shown applying downward pressure on touch screen **800**, at the location of the airplane, to activate a zoom function. Touch screen **800** detects the location of finger **900**, and centers the zoomed image at that location. As such, in the lower image, showing touch screen **800** after the zoom operation is performed, the airplane is at the center of touch screen **800**. Finger **900** remains at its original location throughout the zoom.

[0031] In embodiments of the present invention, the pressure sensor controls parameters of a scroll command. When display of a document or other object extends beyond the limits of touch screen **800**, a portion of the document or object is displayed, and the user sweeps a finger along the vertical dimension of the screen in order to scroll the document or object up or down. In one embodiment, the scroll continues even when the user's finger has reached the upper or lower edge of the screen, as long as contact with the screen is maintained. In this embodiment, the speed of scrolling is determined based on the amount of pressure applied by the finger to touch screen **800**, whereby a greater pressure on the screen corresponds to a faster scroll rate.

[0032] Often it is useful for a user scrolling through a large document or object to change the speed of the scroll dynamically. E.g., a user may wish to scroll quickly in order to move to a desired area within a document, and then continue to scroll slowly within the desired area. In accordance with embodiments of the present invention, the user controls the scrolling speed by adjusting the amount of pressure applied by the finger on touch screen **800**. In one embodiment, the user reduces the scrolling speed by applying more pressure on the screen. As such, navigating a document is intuitive; namely, the user begins scrolling by

CLAIMS

1. A touch screen, comprising:
 - a housing;
 - a display mounted in said housing;
 - a touch sensor, mounted in said housing and connected to said display, for dynamically sensing a current location of an object that is touching said display;
 - a pressure sensor, mounted in said housing and connected to said display, for dynamically sensing a current relative pressure being applied by the object to said display;
 - and
 - a processor, mounted in said housing and connected to said touch and pressure sensors and to said display, for enabling (i) a scroll-by-glide user interface whereby the processor performs a scroll operation in response to detecting the object gliding along said display via said touch sensor, (ii) a scroll-by-press user interface whereby the processor continues the scroll operation in response to detecting a current relative pressure being applied by the object to said display via said pressure sensor and dynamically reduces the scrolling speed in accordance with increasing amounts of current relative pressure applied to the display, and (iii) a transition from the scroll-by-glide interface to the scroll-by-press interface in response to the object gliding over to an edge of said display.
2. The touch screen of claim 1 wherein said display is flexibly mounted in said housing, and wherein said pressure sensor comprises at least one light receiver for generating outputs indicating amounts of light received, said at least one light receiver being mounted below said display in said housing in such a way that the amounts of light received by said at least one light receiver change when said display moves within said housing, and wherein said processor identifies the current relative pressure being applied to said display by the object based on a change in an output from said at least one light receiver.

3. The touch screen of claim 1 wherein said display comprises a flexible material that bends resiliently in response to applied pressure, and wherein said pressure sensor comprises at least one light receiver for generating outputs indicating amounts of light received, said at least one light receiver being mounted below said display in said housing in such a way that the amounts of light received by said at least one light receiver change when said flexible material bends, and wherein said processor identifies the current relative pressure being applied to said display by the object based on a change in an output from said at least one light receiver.

4. The touch screen of claim 1 wherein said touch sensor and said pressure sensor comprise:

a shared plurality of light emitters below said display in said housing, for emitting light beams across said display; and

a shared plurality of light receivers below said display in said housing, for receiving the emitted light beams,

wherein said processor identifies the current location of the object touching said display based on at least two of said light receivers receiving less than an expected amount of light from beams emitted by said light emitters that cross that location, detects the object gliding along said display based on a time series of such identified current locations, and detects an increase of pressure being applied by the object to said display based on increased amounts of light arriving at the remaining light receivers from beams emitted by said light emitters that cross identifiable locations on said display at which the object is not currently located.

5. A non-transitory computer readable medium storing instructions which, when executed by a processor of an electronic device that comprises a touch sensitive and pressure sensitive display, cause the processor to enable (i) a scroll-by-glide user interface whereby the processor performs a scroll operation in response to an object gliding along the display, (ii) a scroll-by-press user interface whereby the processor performs a scroll operation in response to a current relative pressure being applied by the object to the display

and dynamically reduces the scrolling speed in accordance with increasing amounts of current relative pressure applied to the display, and (iii) a transition from the scroll-by-glide interface to the scroll-by-press interface in response to the object gliding over to an edge of said display.

6. The touch screen of claim 1, wherein the edge of said display is devoid of graphics representing the scrolling.

7. The non-transitory computer readable medium of claim 5, wherein the device includes a housing in which the display is mounted, a shared plurality of light emitters, below the display in the housing, for emitting light beams across said display, and a shared plurality of light receivers, below the display in the housing, for receiving the emitted light beams, and wherein the stored instructions, when executed by the processor, further enable the processor to identify a current location of the object touching the display based on at least two of the light receivers receiving less than an expected amount of light from beams emitted by the light emitters that cross that location, to detect an object gliding along the display based on a time series of such identified current locations, and to detect an increase of pressure being applied by the object to the display based on increased amounts of light arriving at the light receivers from beams emitted from the light emitters that cross identifiable locations on the display at which the object is not currently located.

8. The touch screen of claim 1, wherein, for the scroll-by-press user interface, said processor maintains the current scrolling speed when decreasing amounts of current relative pressure are applied to the display.

9. The non-transitory computer readable medium of claim 5, wherein, for the scroll-by-press user interface, the processor maintains the current scrolling speed when decreasing amounts of current relative pressure are applied to the display.