

**APPARATUS AND METHOD FOR
PROVIDING ELEVATED, INDENTED OR
TEXTURIZED SENSATIONS TO AN OBJECT
NEAR A DISPLAY DEVICE OR INPUT
DETECTION USING ULTRASOUND**

FIELD OF INVENTION

[0001] This application is related to an apparatus and method for providing elevated, indented, or texturized sensations to an object near a display device using ultrasound or ultrasonic waves. Ultrasound may also be provided with or without sensations to an object for detecting input. Processes are provided and described involving elevated, indented, or texturized sensations to an object near a display device using ultrasound or ultrasonic waves. Processes are also provided for detecting input from an object using ultrasound.

BACKGROUND

[0002] Display devices for inputting information are commonplace in electronic devices such as mobile devices, cellular phones, personal digital assistants, smart phones, tablet personal computers (PCs), laptop computers, televisions, monitors, touchscreens, picture frames, or the like. Currently, display devices may be based on liquid crystal, plasma, light emitting, or organic light emitting technologies using ridged or flexible substrates. When a display device functions as an input device, such as a touchscreen, their applications are mostly limited to displaying and interacting with a user in two dimensions. Another limitation or problem of current display devices is the lack of texture to the user interface. As the world becomes more electronic, texture is needed for enhancing and enabling certain applications, computer processes, or commerce.

[0003] Ultrasound or ultrasonic technology has become ubiquitous in the medical imaging field. Recently, ultrasound has been proposed for virtual reality applications. However, the use of embedded or integrated ultrasound technology in display devices or computers for enhancing the user interface to multiple dimensions has been limited. Therefore, it is desirable to have display devices or computers that can provide elevated, indented, or texturized sensations to an object near a display device using embedded or integrated ultrasound technology. It is also desirable for ultrasound to be provided to an object with or without sensations for detecting input.

SUMMARY

[0004] An apparatus and method for providing elevated, indented, or texturized contactless sensations to an object at a distance from a display device using ultrasound or ultrasonic waves is disclosed. Processes are also given involving elevated, indented, or texturized sensations to an object near a display device using airborne ultrasound or ultrasonic waves. By providing elevated, indented, or texturized sensations to an object near a display device enhanced input/output functions are provided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] A more detailed understanding may be had from the following description, given by way of example in conjunction with the accompanying drawings wherein:

[0006] FIG. 1 is a diagram of an electronic device having a display device providing elevated, indented, or texturized

sensations to an object near the display device using ultrasound in accordance with one embodiment;

[0007] FIGS. 2a-2d and 2f are diagrams of configurations for providing elevated, indented, or texturized sensations to an object using ultrasound in accordance with another embodiment;

[0008] FIG. 2e is a diagram of various ultrasound focal point patterns in accordance with another embodiment;

[0009] FIG. 3 is a diagram comprising of processes for an electronic device providing elevated, indented, or texturized sensations to an object near a display device using ultrasound in accordance with another embodiment;

[0010] FIG. 4 is a diagram for providing varying ultrasound strengths to an object for providing elevated, indented, or texturized sensations in accordance with another embodiment; and

[0011] FIG. 5 is a process for providing elevated, indented, or texturized sensations to an object near a display device using ultrasound in accordance with another embodiment.

DETAILED DESCRIPTION

[0012] The present invention will be described with reference to the drawing figures wherein like numerals represent like elements throughout. For the processes described below the steps recited may be performed out of sequence and sub-steps not explicitly described or shown may be performed. In addition, "coupled" or "operatively coupled" may mean that objects are linked between zero or more intermediate objects.

[0013] In the examples forthcoming ultrasound or ultrasonic waves are given as an example to provide elevated, indented, or texturized sensation to an object near a display device. However, one of ordinary skill would appreciate that any acoustic or radio wave that excites an afar object or sensed by the human body may be applicable for the examples and processes given in the disclosure.

[0014] In the examples forthcoming, the sensation felt by an object via an airborne ultrasound may be similar to vibration or gyration. The sensation may be varied by producing focal points of different sizes and intensities. For the case where the object is human skin, the vibration or gyration caused by an airborne ultrasound may depend on the targeted receptors in the skin. Adapting or controlling the ultrasound focal or control points for different receptors may cause different sensations for the user's skin.

[0015] Elevation or elevated sensations describe different sensations that may be caused to an object using ultrasound at a predetermined or random distance from a display or electronic device. As an example, the relative distance of the object may be by one or more millimeters to several meters, as desired.

[0016] Indenting may be a configuration where an object is given a sensation around its perimeter while giving little sensation to the inner area of the object. Indenting may also describe a configuration where a given location in space near a display device provides a substantially sensible ultrasound to an object but a point lower or closer to the display device the ultrasound is not substantially sensible. Indenting may also describe a configuration where a given location in space near a display device provides a substantially sensible ultrasound to an object but a point lower or closer to the display device an ultrasound is not substantially sensible until a predetermined point near the display device is reached.