

achieved exactly, but that deviations or variations, including for example, tolerances, measurement error, measurement accuracy limitations and other factors known to skill in the art, may occur in amounts that do not preclude the effect the characteristic was intended to provide. Herein below, description will be given of a method and apparatus of generating three-dimensional vibration according to a user's touch using a plurality of vibrators in a portable terminal. Although a portable terminal having four vibrators will be exemplarily described below for illustrative purposes, it should be noted that the teachings of the present invention are applicable to a portable terminal including two or more vibrators.

**[0023]** FIG. 1 is a block diagram illustrating a haptic effect in a portable terminal according to the present invention.

**[0024]** Referring to FIG. 1, the portable terminal includes a user input unit 100, a vibration strength determination unit 110, a division and control unit 120, a first vibrator 130, a second vibrator 132, a third vibrator 134 and a fourth vibrator 136.

**[0025]** The user input unit 100 receives a touch operation of a user, detects the input touch operation, then provides the detected result to the vibration strength determination unit 110. The user input unit 100 includes a touch sensor, which detects and provides a user's screen touch style, i.e., a touch position, a moving direction of the touch, a touch duration, or the like, to the vibration strength determination unit 110. For example, capacitive positioning sensor may be used. Here, the user input unit 100 detects the position of the screen touched by the user, and provides a corresponding coordinate to the vibration strength determination unit 110. Here, the finger may be in contact with the touch screen physically or near the screen.

**[0026]** The vibration strength determination unit 110 receives the detected touch result from the user input unit 100, and, in response, determines an appropriate vibration strength of each vibrator corresponding to the detected touch result. In detail, the vibration strength determination unit 110 determines the vibration strength of each vibrator by receiving the coordinate is indicative of the touched position of the screen and touch duration from the user input unit 100 and acquiring relative distance information between the touched position of the screen and each vibrator. That is, the vibration strength determination unit 110 determines the strength of each vibrator that needs to yield according to a distance ratio between the touched position of the screen and each vibrator. For example, the vibration strength determination unit 110 determines the level of vibration force being exerted on each vibrator which depends on the distance between the touched position of the screen and each vibrator. Hence, a vibrator disposed closer to the touched position of the screen generates a higher level of vibration and a vibrator disposed farther from the touched position of the screen has a lower level of vibration.

**[0027]** Thereafter, the vibration strength determination unit 110 re-determines the vibration strength level of each of the vibrators using a second consideration, which is based on the duration of touch operation by the user. Namely, the vibration strength determination unit 110 re-determines the vibration strength level of each vibrator in such a manner that the vibration strength of each vibrator increases as the touch duration increases. The vibration strength level of each vibrator may increase proportionally to the detected touch duration.

**[0028]** Finally, the vibration strength determination unit 110 provides the determined vibration strength level of each vibrator to the division and control unit 120.

**[0029]** The division and control unit 120 receives the vibration strength level of each vibrator from the vibration strength determination unit 110, and controls each vibrator to generate vibration according to the determined vibration strength level. Here, the division and control unit 120 determines a vibration pattern of each vibrator corresponding to the determined vibration strength level, and controls the first to fourth vibrators 130, 132, 134 and 136 to generate according to the determined vibration pattern. The vibration patterns of the respective vibrators may be identically or different depending on the touch location and duration of the touch.

**[0030]** The first to fourth vibrators 130, 132, 134 and 136 generate vibration according to the control of the division and control unit 120.

**[0031]** FIG. 2 is a flowchart illustrating a procedure of performing the haptic function using a plurality of vibrators in a portable terminal according to the present invention.

**[0032]** Referring to FIG. 2, in step 201, the portable terminal detects whether a user input is generated. That is, the portable terminal detects whether a user touches the screen or makes a contact near the screen without actual contact.

**[0033]** In step 203, when the user input is generated, the portable terminal determines a coordinate where the user input is generated, i.e., a coordinate corresponding to the user's touch position of the screen. Afterwards, the portable terminal counts a duration of user's input time in step 205. Here, at the timing when the user input is generated, a count number may be 1.

**[0034]** Thereafter, in step 207, the portable terminal acquires distance information between the coordinate corresponding to the user's input position and each vibrator, and then determines the vibration strength level of each vibrator using the acquired distance information. For example, the portable terminal determines the strength of a force exerted on each vibrator according to the distance between the touched position of the screen and each vibrator so that a vibrator disposed closer to the touched position of the screen has a stronger vibration or a higher vibration strength level and a vibrator disposed farther from the touched position of the screen has a weaker vibration or a lower vibration strength level.

**[0035]** Next, in step 209, the portable terminal re-determines the vibration strength level of each vibrator using the counted input time from the measured duration of the user's touch. Here, the portable terminal further re-adjusts or re-determines the vibration strength in such a manner that the vibration strength level of each vibrator increases proportionally as the touch duration increases. Here, the strength level of each vibration may be same or different from each vibrator.

**[0036]** The above teachings may be more apparent with reference to FIG. 3, which shows a method of determining the vibration strength level of each vibrator in the case where a specific position 300 is touched by a user in a portable terminal. Note that four vibrators V1 to V4 (301 to 304) are positioned at edges thereof or at edges of the screen. If a width is divided into m1 311 and m2 312 and a height is divided into m3 313 and m4 314 based on the touched position 300, the