

CLAIMS

1. A drive controlling apparatus that drives a vibrating element of an electronic device including a display part, a top panel disposed on a display surface side of the display part and having a manipulation input surface, a coordinate detector detecting a coordinate of a manipulation input performed on the manipulation input surface and the vibrating element generating a vibration in the manipulation input surface, comprising:

a drive controlling part being configured to drive the vibrating element by using a driving signal causing the vibrating element to generate a natural vibration in an ultrasound-frequency-band in the manipulation input surface, the drive controlling part being configured to drive the vibrating element so that an intensity of the natural vibration varies in accordance with a position and a temporal change degree of the position of a manipulation input performed onto the manipulation input surface.

2. The drive controlling apparatus as claimed in claim 1, wherein the driving signal causes the vibrating element to generate the natural vibration in the ultrasound-frequency-band in the manipulation input surface, the natural vibration having a constant frequency and a constant phase.

3. The drive controlling apparatus as claimed in claims 1 or 2, wherein the drive controlling part drives the vibrating element so that the intensity of the natural vibration varies when the position of the manipulation input moves across a boundary of a GUI input part displayed on the display part or moves while the GUI input part is being manipulated.

4. The drive controlling apparatus as claimed in claims 1 or 2, wherein the drive controlling part drives the vibrating element so that the intensity of the

natural vibration varies when the position of the manipulation input moves across pages of picture images displayed on the display part.

5. The drive controlling apparatus as claimed in claims 1 or 2, wherein the drive controlling part drives the vibrating element so that the intensity of the natural vibration varies when the position of the manipulation input moves in an area of a designated GUI input part displayed on the display part.

6. The drive controlling apparatus as claimed in any one of claims 1 to 5, wherein the manipulation input surface has a rectangular shape having long sides and short sides in plan view, and

wherein the drive controlling part causes the vibrating element to vibrate so that a standing wave of which amplitude varies along the long side occurs on the manipulation input surface.

7. The drive controlling apparatus as claimed in any one of claims 1 to 6, wherein the drive controlling part estimates the position of the manipulation input after an elapse of a designated period of time based on the temporal change degree of the position, and drives the vibrating element so that the intensity of the natural vibration varies in accordance with the estimated position of the manipulation input.

8. An electronic device comprising:

a display part;

a top panel disposed on a display surface side of the display part and having a manipulation input surface;

a coordinate detector detecting a coordinate of a manipulation input performed on the manipulation input surface;

a vibrating element generating a vibration in the manipulation input surface; and

a drive controlling part being configured to drive the vibrating element by using a driving signal causing the vibrating element to generate a natural vibration in an ultrasound-frequency-band in the manipulation input surface, the drive controlling part being configured to drive the vibrating element so that an intensity of the natural vibration varies in accordance with a position and a temporal change degree of the position of a manipulation input performed onto the manipulation input surface.

9. A drive controlling method for driving a vibrating element of an electronic device including a display, part, a top panel disposed on a display surface side of the display part and having a manipulation input surface, a coordinate detector detecting a coordinate of a manipulation input performed on the manipulation input surface and the vibrating element generating a vibration in the manipulation input surface, comprising:

driving, by a computer, the vibrating element by using a driving signal causing the vibrating element to generate a natural vibration in an ultrasound-frequency-band in the manipulation input surface, the driving being configured to drive the vibrating element so that an intensity of the natural vibration varies in accordance with a position and a temporal change degree of the position of a manipulation input performed onto the manipulation input surface.

10. The drive controlling apparatus as claimed in any one of claims 1 to 7, wherein the vibrating element is disposed at an edge portion of the top panel in plan view.

11. The drive controlling apparatus as claimed in any one of claims 1 to 7 and 10, wherein the vibrating element is placed outside of a display area of the display part in plan view.

12. The drive controlling method as claimed in claim 9, wherein the driving signal causes the vibrating element to generate the natural vibration in the ultrasound-frequency-band in the manipulation input surface, the natural vibration having a constant frequency and a constant phase.

13. The drive controlling method as claimed in claims 9 or 12, wherein the driving is performed so that the intensity of the natural vibration varies when the position of the manipulation input moves across a boundary of a GUI input part displayed on the display part or moves while the GUI input part is being manipulated.

14. The drive controlling method as claimed in claims 9 or 12, wherein the driving is performed so that the intensity of the natural vibration varies when the position of the manipulation input moves across pages of picture images displayed on the display part.

15. The drive controlling method as claimed in claims 9 or 12, wherein the driving is performed so that the intensity of the natural vibration varies when the position of the manipulation input moves in an area of a designated GUI input part displayed on the display part.

16. The drive controlling method as claimed in any one of claims 9 and 12 to 15, wherein the manipulation input surface has a rectangular shape having long sides and short sides in plan view, and

wherein the driving causes the vibrating element to vibrate so that a standing wave of which amplitude varies along the long side occurs on the manipulation input surface.

17. The drive controlling method as claimed in any one of claims 9 and 12 to 16, further comprising:

estimating the position of the manipulation input after an elapse of a designated period of time based on the temporal change degree of the position,

wherein the driving is performed so that the intensity of the natural vibration varies in accordance with the estimated position of the manipulation input.