CLAIMS

WHAT IS CLAIMED IS:

1. A touch screen driving circuit configured to drive a touch screen comprising a display panel and a touch panel, the touch screen driving circuit comprising:

an analog driving circuit configured to provide driving signals to the display panel and the touch panel, and generate a touch sensing value based on a touch sensing signal received from the touch panel;

a display noise table (DNT) comprising display noise information indicating display noise that varies according to a driving state of the touch screen and image data;

a feature extractor configured to extract a plurality of feature values from the driving state of the touch screen and the image data; and

a touch processor configured to read display noise values respectively mapped to each of the plurality of feature values from the DNT, perform an operation on the display noise values to generate a display noise value corresponding to a combination of the plurality of feature values, subtract the display noise value from the touch sensing value, and generate a touch value.

2. The touch screen driving circuit of claim 1, wherein the feature extractor is configured to generate a first feature value from among the plurality of feature values based on a plurality of pixel values to be displayed on one row line of the display panel among current image data.

3. The touch screen driving circuit of claim 2, wherein the feature extractor is configured to group the plurality of pixel values into a plurality of subsets, and generate the first feature value based on a representative value of the pixel values of each of the plurality of subsets.

4. The touch screen driving circuit of claim 3, wherein the feature extractor is configured to divide a plurality of grayscales according to pixel values into a plurality of grayscale periods and generate values representing the grayscale periods respectively corresponding to a plurality of representative values corresponding to the plurality of subsets as the first feature value.

5. The touch screen driving circuit of any one of claims 1 to 4, wherein the driving

state of the touch screen comprises at least one of a temperature of the touch screen, a position of a currently driven gate line among a plurality of gate lines of the display panel, a position of a current driving line among a plurality of driving lines of the touch panel, and a phase difference between clock signals used for driving of each of the display panel and the touch panel.

6. The touch screen driving circuit of any one of claims 1 to 4, wherein the feature extractor is configured to generate a third feature value among the plurality of feature values based on position information of a currently driven gate line among a plurality of gate lines of the display panel.

7. The touch screen driving circuit of any one of claims 1 to 6, wherein the feature extractor is configured to extract the plurality of feature values every line driving period of the display panel or every line driving period of the touch panel.

8. The touch screen driving circuit of any one of claims 1 to 7, wherein the analog driving circuit comprises:

a display analog driver configured to provide image signals corresponding to the image data to the display panel in units of a row line of the display panel; and

an analog front end (AFE) configured to provide a driving signal to the touch panel and convert a sensing signal received from the touch panel into the touch sensing value.

9. The touch screen driving circuit of claim 8, wherein the driving state of the touch screen comprises at least one of an operation state of the display analog driver and an operation state of the AFE.

10. The touch screen driving circuit of any one of claims 1 to 9, wherein the touch processor comprises:

a DNT controller configured to read the display noise value by accessing the DNT based on the combination of the plurality of feature values;

a display noise subtractor configured to generate the touch value by subtracting the display noise value from the touch sensing value; and

a touch coordinate calculator configured to determine a touch coordinate based on the touch value of each of a plurality of nodes of the touch panel.

11. The touch screen driving circuit of claim 10, wherein the DNT controller is

configured to, before driving the touch panel, measure the display noise according to a display driving state and the image data to generate the display noise information and store the display noise information in the DNT.

12. The touch screen driving circuit of any one of claims 1 to 11, wherein the display noise information comprises a plurality of display noise values according to the combination of the plurality of feature values.

13. The touch screen driving circuit of any one of claims 1 to 9, wherein the display noise information comprises parameters of a function that outputs the display noise value as input of each of the plurality of feature values.

14. The touch screen driving circuit of claim 13, wherein the touch processor comprises:

a DNT controller configured to read the parameters from the DNT based on the combination of the plurality of feature values, reconstruct the function based on the parameters, and calculate the display noise value corresponding to the combination of the plurality of feature values from the function.

15. The touch screen driving circuit of claim 14, wherein the DNT controller is configured to, before driving the touch panel, measure the display noise according to a display driving state and the image data, extract the parameters representing the function from a measured display noise value, and store the parameters in the DNT.

16. A touch screen controller comprising:

a display noise table (DNT) storing a plurality of display noise values according to image data displayed on a touch screen;

a feature extractor configured to extract a plurality of feature values from current image data to be displayed on the touch screen;

a DNT controller configured to read display noise values respectively mapped to each of the plurality of feature values from the DNT, and perform an operation on the display noise values to output a display noise value corresponding to a combination of the plurality of feature values from the DNT; and

a processor configured to generate a touch value from which display noise is removed based on the display noise value by subtracting the display noise value from a touch sensing

value.

17. The touch screen controller of claim 16, further comprising:

a display controller configured to determine an operation timing of a display driver configured to drive a display panel provided on the touch screen;

an image buffer configured to receive and store the current image data from a host device, provide the current image data to the display driver in units of raw data, the raw data comprising a plurality of pixel values corresponding to one row of the display panel, and

a touch controller configured to determine an operation timing of a touch driver configured to drive and sense a touch panel provided on the touch screen,

wherein the display controller, the touch controller, the feature extractor, and the processor are implemented as a single semiconductor chip and communicate with each other through internal wiring of the semiconductor chip.

18. The touch screen controller of claim 17, wherein the feature extractor is configured to receive the raw data provided to the display driver and extract a first feature value from the raw data.

19. The touch screen controller of claim 18, wherein the feature extractor is configured to extract a second feature value from at least one of temperature information of the touch screen, an operation state and timing information of the display driver received from the display controller, and an operation state and timing information of the touch controller received from the touch controller.

20. A touch screen driving circuit configured to drive a touch screen comprising a display panel and a touch panel, the touch screen driving circuit comprising:

a display noise table (DNT) comprising display noise information indicating display noise that varies according to image data displayed on the touch screen;

a feature extractor configured to extract a plurality of feature values from the image data displayed on the touch screen; and

a touch processor configured to read display noise values respectively mapped to each of the plurality of feature values from the DNT, perform an operation on the display noise values to generate a display noise value corresponding to a combination of the plurality of feature values, subtract the display noise value from a touch sensing value generated based on a sensing value received from the touch panel, and generate a touch value with reduced display noise.