

CLAIMS

1. A sensing screen, wherein the sensing screen comprises a display screen, a first transparent medium layer, a transparent connection layer, and a transparent antenna layer, wherein the first transparent medium layer is sandwiched between the connection layer and the antenna layer, and the connection layer is sandwiched between the first transparent medium layer and the display screen; and

the antenna layer comprises multiple antenna units and multiple antenna feeders configured to feed the antenna units, and the multiple antenna units comprise at least one first antenna unit and multiple second antenna units, wherein the multiple antenna units and the multiple antenna feeders are disposed above the display screen and overlap the display screen, the first antenna unit is configured to transmit a sensing signal in a sensing timeslot, and the second antenna units are configured to receive reflected signals of the sensing signal in a sensing timeslot, wherein the reflected signals are generated by a touch object by reflecting the sensing signal, and the first antenna unit and the second antenna units are configured to simultaneously transmit or receive a communication signal in a communication timeslot, and the multiple second antenna units are interspersed with the first antenna unit.

2. The sensing screen according to claim 1, wherein each antenna feeder is connected to one antenna unit, or each antenna feeder is connected to multiple antenna units, and different antenna feeders are connected to different antenna units.

3. The sensing screen according to claim 1 or 2, wherein all the antenna units form an antenna array, a radiation direction of an array formed by some antenna units in the antenna array is parallel with the display screen, and a radiation direction of an array formed by the other antenna units in the antenna array is perpendicular to the display screen.

4. The sensing screen according to any one of claims 1 to 3, wherein the antenna units are made of one or more of indium tin oxide, fluorine-doped tin oxide, aluminum-doped zinc oxide, and indium-doped zinc oxide.

5. The sensing screen according to any one of claims 1 to 4, wherein the antenna units are low-profile antennas, and the low-profile antennas comprise one or more of a patch antenna, a slot antenna, and a Vivaldi antenna.

6. The sensing screen according to any one of claims 1 to 5, wherein the connection layer comprises a shield layer and a ground layer, wherein the shield layer is configured to shield the antenna layer and return the communication signal, the sensing signal, and the reflected signals, and the ground layer is configured to ground the antenna layer.

7. The sensing screen according to any one of claims 1 to 6, wherein the sensing screen further comprises a second transparent medium layer disposed between the display screen and the connection layer.

8. The sensing screen according to any one of claims 1 to 7, wherein the sensing screen further comprises a transparent protective layer that overlies the antenna layer, and the transparent protective layer and the first transparent medium layer are located on two sides of the antenna layer.

9. A control circuit of a sensing screen, configured to control the sensing screen according to any one of claims 1 to 8, wherein the control circuit comprises an adjustment module and a control module, wherein: the adjustment module is controlled by the control module to adjust the sensing signal, the reflected signals, and the communication signal, the control module is further configured to determine a location of a touch object according to the adjusted sensing signal and reflected signals, and the adjustment module is electrically connected to the sensing screen and the control module,

the control module is further configured to:

in the sensing timeslot, control the first antenna unit in the sensing screen to transmit the sensing signal, and controlling the second antenna units to receive the reflected signals of the sensing signal; and

in the communication timeslot, control the antenna units to simultaneously transmit or receive the communication signal.

10. The control circuit according to claim 9, wherein the adjustment module comprises:

a radio frequency front-end channel, configured to receive the sensing signal, the reflected signals, and the communication signal, and perform standing-wave detection, signal

amplification, and filtering on the sensing signal, the reflected signals, and the communication signal;

an adjustment unit, configured to adjust amplitude, a phase, or a delay of the sensing signal, the reflected signals, and the communication signal;

a frequency conversion unit, configured to perform frequency conversion on the sensing signal, the reflected signals, and the communication signal; and

a power division and combination unit, configured to perform power division on the sensing signal, perform power combination on the reflected signals, and perform power combination or power division on the communication signal.

11. The control circuit according to claim 10, wherein the radio frequency front-end channel, the adjustment unit, the power division and combination unit, and the frequency conversion unit are connected in this order between the sensing screen and the control module; or

the radio frequency front-end channel, the adjustment unit, the frequency conversion unit, and the power division and combination unit are connected in this order between the sensing screen and the control module; or

the radio frequency front-end channel, the frequency conversion unit, the adjustment unit, and the power division and combination unit are connected in this order between the sensing screen and the control module.

12. A sensing screen apparatus, wherein the sensing screen apparatus comprises the sensing screen according to any one of claims 1 to 8 and a control apparatus, wherein the control apparatus comprises a housing and the control circuit according to any one of claims 9 to 11, the control circuit is disposed in the housing, and the control circuit is connected to the sensing screen by using the housing.

13. The sensing screen apparatus according to claim 12, wherein the sensing screen is connected to the control circuit by using a jumper, or a connector, or a slot disposed on the housing.

14. A control method of a sensing screen, used to control the sensing screen according to any one of claims 1 to 8, wherein the method comprises:

in the sensing timeslot, controlling the first antenna unit in the sensing screen to transmit the sensing signal, and controlling the second antenna units to receive the reflected signals of the sensing signal;

when the reflected signals of the sensing signal are received, determining coordinates of the touch object on a plane on which the sensing screen is located, according to power of the received reflected signals and coordinates, of the second antenna units that receive the reflected signals, on the plane; and

in the communication timeslot, controlling the antenna units to simultaneously transmit or receive the communication signal.

15. The method according to claim 14, wherein one sensing timeslots is inserted between two adjacent communication timeslots.

16. The method according to any one of claims 14 or 15, wherein the controlling the first antenna unit in the sensing screen to transmit the sensing signal comprises:

randomly selecting one antenna unit from the multiple antenna units, or selecting one antenna unit with highest frequency of use from the multiple antenna units; and

controlling the selected one antenna unit to transmit the sensing signal.

17. The method according to any one of claims 14 to 16, wherein the determining coordinates of the touch object on a plane on which the sensing screen is located, according to power of the received reflected signals and coordinates, of the second antenna units that receive the reflected signals, on the plane comprises:

selecting four reflected signals with highest power from the received reflected signals;

determining coordinates of four second antenna units that receive the four selected reflected signals; and

determining the coordinates of the touch object on the plane according to the four selected reflected signals and the coordinates of the four second antenna units.

18. The method according to claim 17, wherein the determining the coordinates of the touch object on the plane according to the four selected reflected signals and the coordinates of the four second antenna units comprises:

detecting whether power of the four reflected signals reaches a set threshold; and

reselecting a first antenna unit when power of one reflected signal among the four reflected signals does not reach the set threshold.

19. The method according to any one of claims 14 to 18, wherein the method further comprises:

checking whether the coordinates of the touch object on the plane exceed an edge of the sensing screen, to obtain a check result; and

when the check result is that the coordinates of the touch object on the plane exceed no edge of the sensing screen, generating an operation control instruction according to the coordinates of the touch object on the plane.

20. The method according to claim 19, wherein the method further comprises:

storing the coordinates of the touch object on the plane and the check result of the coordinates of the touch object on the plane.

21. The method according to any one of claims 14 to 20, wherein the method further comprises:

according to the coordinates of the touch object on the plane and a distance from the touch object to the sensing screen, controlling a beam angle generated by the antenna units in the communication timeslot, wherein the touch object is located outside the generated beam angle.

22. The method according to any one of claims 14 to 21, wherein the method further comprises:

separately detecting whether strength of a reflected signal received by each antenna unit reaches a set threshold; and

closing a communication channel of an antenna unit corresponding to a reflected signal that reaches the threshold.