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(54) Title: METHOD OF IDENTIFYING MULTI-TOUCH SCALING GESTURE AND DEVICE USING THE SAME

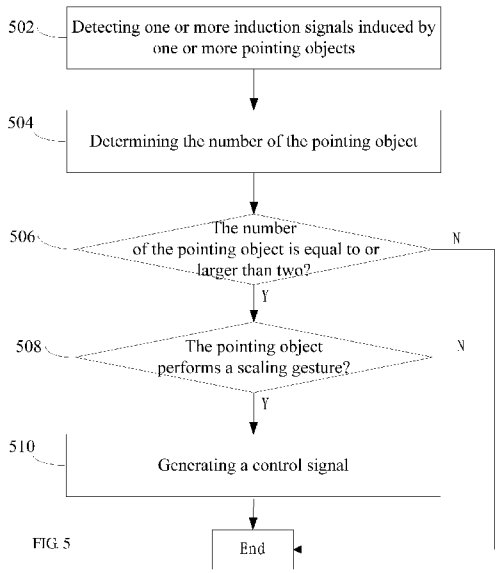


FIG. 5

(57) Abstract: A method of identifying a scaling gesture comprising: detecting in at least one direction one or more induction signals induced by one or more pointing objects that come into contact with a touch-sensitive surface; determining a number of the pointing object; determining whether the pointing objects perform the scaling gesture if the number of the pointing object is more than one; and generating a control signal associated with the determined scaling gesture if the pointing objects perform a scaling gesture.

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METHOD OF IDENTIFYING MULTI-TOUCH SCALING GESTURE AND DEVICE USING THE SAME

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to, and benefits of Chinese Patent Application Serial No. 201110080827.4, filed with the State Intellectual Property Office of P. R. C. on March 31, 2011, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

Example embodiments of the present disclosure relate generally to a method of identifying gestures on a touchpad, and more particularly, to a method of identifying a scaling gesture and a device thereof.

BACKGROUND

Although a keyboard remains a primary input device of a computer, a prevalence of graphical user interfaces (GUIs) may require use of a mouse or other pointing devices such as a trackball, joystick, touch device or the like. Due to its compact size, the touch devices have become popular and widely used in various areas of our daily lives, such as mobile phones, media players, navigation systems, digital cameras, digital cameras, digital photo frame, personal digital assistance (PDA), gaming devices, monitors, electrical control and medical equipment.

A touch device features a sensing surface that can translate a motion and position of a user's fingers to a relative position on its screen. Touchpads operate in several ways. The most common technology includes sensing a capacitive virtual ground effect of a finger, or a capacitance between sensors. For example, by independently measuring a self-capacitance of each X and Y axis electrode on a sensor, a determination of the (X, Y) location of a single touch is provided.

SUMMARY

According to one exemplary embodiment of the present invention, a method of identifying a multi-touch scaling gesture comprises: detecting in at least one direction one or more induction signals induced by one or more pointing objects that come into contact with a touch-sensitive surface; determining a number of the pointing object; determining whether the pointing objects perform the scaling gesture if the number of the pointing object is more than one; and generating a control signal associated with the determined scaling gesture if the pointing objects perform the scaling gesture.

The method of identifying a multi-touch scaling gesture according to an embodiment of the present disclosure, may accurately determine the number of the objects according to the induction signal, and determine whether the objects perform a scaling gesture if the number of the object is more than one, so it may accurately detect a plurality of objects and identify the scaling gesture.

According to another embodiment of the present invention, a device of identifying a multi-touch scaling gesture comprises: a detecting module, configured to detect in at least one direction one or more induction signals induced by one or more pointing objects that come into contact with a touch-sensitive surface; a determination module, configured to determine a number of pointing objects; a gesture determining module, configured to determine whether the pointing objects perform the scaling gesture; and a signal generation module, configured to generate a control signal associated with the determined scaling gesture.

The device of identifying a multi-touch scaling gesture according to an embodiment of the present disclosure, may accurately determine the number of the objects according to the induction signal, and determine whether the objects perform a scaling gesture if the number of the object is more than one, so it may accurately detect a plurality of objects and identify the scaling gesture.

Additional aspects and advantages of the embodiments of the present disclosure will be given in part in the following descriptions, become apparent in part from the following descriptions, or be learned from the practice of the embodiments of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

Having thus described exemplary embodiments of the present disclosure in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

FIG. 1 illustrates a block diagram of a scaling gesture identifying device according to one exemplary embodiment of the present invention;

FIG. 2 illustrates a schematic diagram of inductive lines on a touch-sensitive screen according to one exemplary embodiment of the present invention;

FIG. 3 illustrates a block diagram of a determination module according to one exemplary embodiment of the present invention;

FIG. 4 illustrates a block diagram of a gesture determining module according to one exemplary embodiment of the present invention;

FIG. 5illustrates a method of identifying a scaling gesture according to one exemplary embodiment of the present invention;

FIG. 6 illustrates a method of determining a number of pointing objects that contact the touch screen according to one exemplary embodiment of the present invention;

FIGs. 7-9 illustrate diagrams of a detected induction signal and a reference signal according to one exemplary embodiment of the present invention;

FIG. 10 illustrates a schematic diagram of a rectangle formed by the pointing objects;

FIG. 11 illustrates a schematic diagram of a scaling down gesture according to exemplary embodiments of the present invention;

FIG. 12 illustrates a schematic diagram of a scaling up gesture according to exemplary embodiments of the present invention;

FIG. 13 illustrates a schematic diagram of a distance between the pointing objects.

FIG. 14 illustrates a schematic diagram of a scaling down gesture according to exemplary embodiments of the present invention; and

FIG. 15 illustrates a schematic diagram of a scaling up gesture according to exemplary embodiments of the present invention.

DETAILED DESCRIPTION

The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. In this regard, although example embodiments may be described herein in the context of a touch screen or touch-screen panel, it should be understood that example embodiments are equally applicable to any of a number of different types of touch-sensitive surfaces, including those with and without an integral display (e.g., touchpad). Also, for example, references may be made herein to axes, directions and orientations including X-axis, Y-axis, vertical, horizontal, diagonal, right and/or left; it should be understood, however, that any direction and orientation references are simply examples and that any particular direction or orientation may depend on the particular object, and/or the orientation of the particular object, with which the direction or orientation reference is made. Like numbers refer to like elements throughout.

FIG. 1 illustrates a block diagram of a scaling gesture identifying device according to an exemplary embodiment of the present invention ("exemplary" as used herein referring to "serving as an example, instance or illustration"). As explained below, the scaling gesture identification module 100 may be configured to determine a gesture and generate corresponding control signals based on coordinates of multi-touch points on a touch screen. The scaling gesture identification module 100 may be configured to provide the control signals to a processing unit of a terminal application device to execute the gesture applied to the touch screen. The terminal application device may be any of a number of different

processing devices including, for example, a laptop computer, desktop computer, server computer, or a portable electronic devices such as a portable music player, mobile telephone, portable digital assistant (PDA), tablet or the like. Generally, the terminal application device may include a processing unit, memory, user interface (e.g., display and/or user input interface) and/or one or more communication interfaces. The touch screen may be a resistive touch screen, a capacitive touch screen, an infrared touch screen, an optical imaging touch screen, an acoustic pulse touch screen, surface acoustic touch screen or in any other forms.

As illustrated in FIG. 1, the scaling gesture identification module 100 may include a detecting module 102, a determination module 104, a gesture determining module 106 and a signal generation module 108. The identification module 100 may identify the scaling gesture on a touch-sensitive screen. Inductive lines on the touch-sensitive screen are shown in the diagram of FIG. 2. The determination module 104 may include a comparing unit 1042 and a number determining unit 1044 as illustrated in FIG. 3. The gesture determining module 106 may include an obtaining unit 1062 and a scaling gesture determination unit 1064 as illustrated in FIG. 4.

FIG. 2 illustrates a schematic diagram of a touch-sensitive screen according to one exemplary embodiment of the present invention. There are a plurality of inductive lines 11 and 12 on respective X and Y axes. The touch-sensitive screen may comprise an acoustic sensor, an optical sensor or other kinds of sensors to form a touch-sensitive surface for sensing the touch by the pointing objects. The X and Y axes may be perpendicular to each other, or have other specific angles. As also shown, F1 and F2 indicate two touch points on the touch-sensitive module 102 by two pointing objects according to an exemplary embodiment. The touch-sensitive screen may be embodied in a number of different manners forming an appropriate touch-sensitive surface, such as in the form of various touch screens, touchpads or the like. As used herein, then, reference may be made to the touch-sensitive screen or a touch-sensitive surface (e.g., touch screen) formed by the touch-sensitive module. In some embodiments of the present invention, the touch-sensitive screen may have inductive lines on it in other directions.

In operation, when a pointing object, such as a user's finger or a stylus is placed on the touch-sensitive screen, one or more induction signals induced by the pointing object may be generated. The generated induction signals may be associated with a change in an electrical current, capacitance, acoustic waves, electrostatic field, optical fields or infrared light. The detecting module 102 may detect the induction signals associated with the change induced by one or more pointing objects, such as two pointing objects in one or more directions on the touch screen. In an instance in which two pointing objects are simultaneously applied to the touch screen, the comparing unit 1042 may compare values of a first point and a previous point of the first point of the induction signal to a value of a reference signal to determine a number of a rising wave and a number of a falling wave. The number determining unit 1044

may determine the number of pointing objects according to the number of the rising wave or the number of the falling wave and output the number of the pointing objects to the gesture determining module 106. The comparing unit 1042 may comprise a comparison circuit (not shown) to compare values of the detected induction signal with the value of the reference signal to determine at least one of the number of rising waves and the number of falling waves of the detected induction signal.

In one exemplary embodiment, there may be a plurality of pointing objects in contact with the touch-sensitive screen. The obtaining unit 1064 may obtain relative movements of each group of pointing objects. In an instance, the obtaining unit 1064 may obtain coordinates of first start touch points and first end touch points of the pointing objects. Based on the result obtained by the obtaining unit 1064, the scaling gesture determination unit 1066 may determine whether the pointing objects perform a scaling up gesture or a scaling down gesture. The signal generation module 108 may generate corresponding control signals. A processing unit of the terminal application device may execute according to the control signals.

As described herein, the touch-sensitive screen and the processing unit are implemented in hardware, alone or in combination with software or firmware. Similarly, the detecting module 102, the determination module 104, the gesture determining module 106 and the signal generation module 108 may each be implemented in hardware, software or firmware, or some combination of hardware, software and/or firmware. As hardware, the respective components may be embodied in a number of different manners, such as one or more CPUs (Central Processing Units), microprocessors, coprocessors, controllers and/or various other hardware devices including integrated circuits such as ASICs (Application Specification Integrated Circuits), FPGAs (Field Programmable Gate Arrays) or the like. As will be appreciated, the hardware may include or otherwise be configured to communicate with memory, such as volatile memory and/or non-volatile memory, which may store data received or calculated by the hardware, and may also store one or more software or firmware applications, instructions or the like for the hardware to perform functions associated with operation of the device in accordance with exemplary embodiments of the present invention.

FIG. 5 illustrates a method of identifying a scaling gesture according to one exemplary embodiment of the present invention. When a pointing object, such as a finger, comes into contact with the touch screen at a touch point, the touch-sensitive screen may sense the contact and generate one or more induction signals. The detecting module 102 may detect the induction signals induced by the pointing object at step 502. In an instance in which two or more pointing objects are simultaneously applied to the touch screen, the number of the pointing objects may be obtained by the determination module 104 at step 504. In an instance in which the number of pointing objects is determined to be larger than or equal to two at step 506, the gesture determining module 106 may determine if the pointing objects perform a scaling gesture at step 508. In instances in which the gesture is determined as a scaling gesture, the signal

generation module 108 may generate a control signal associated with the scaling gesture at step 510. The generated control signal may be passed to the processing unit, which may then execute a scaling command in response to the control signal. In an instance in which the number of the pointing objects is less than two, the method goes to an end. In an instance in which the gesture applied to the touch screen is not a scaling gesture at step 508, the method goes to an end.

FIG. 6 illustrates a method of determining the number of pointing objects that contact the touch screen according to one exemplary embodiment of the present invention. When at least one pointing object is in contact with the touch screen, an induction signal generated by the touch-sensitive screen may be detected by the detecting module 102.

At step 600, the value of a first point of the induction signal is compared to a value of a reference signal by the comparing unit 1042. In an instance in which the value of the first point is larger than the value of the reference signal, the value of a previous point of the first point is compared to the value of the reference signal by the comparison circuit (not shown) of the comparing unit 1042. In an instance in which the value of the previous point is less than or equal to the value of the reference signal at step 601, the wave is determined as a rising wave at step 602. In an instance in which the value of the previous point is larger than or equal to the value of the reference signal, the determination module 104 may determine if the first point is the last point in the induction signal at step 605. If it is determined as the last point, the number of pointing objects may be determined at step 606 based on the number of rising waves or the number of falling waves and may be output by the number determining unit 1044 to the gesture determining module 106.

In an instance in which the value of the first point is less than the value of the reference signal at step 600, the value of the previous point is compared to the value of the reference signal at step 603. In an instance in which the value of the previous point is larger than or equal to the value of the reference signal, the wave is determined as a falling wave at step 604. The process may proceed to step 605 to determine if the first point is the last point in the induction signal. In an instance in which the first point is not the last point in the induction signal at step 605, the process may otherwise proceed to select a next point and compare the value of the next point to the value of the reference signal at step 601. If it is determined as the last point, the number of pointing objects may be determined at step 606 based on the number of rising waves and/or the number of falling waves and may be output by the number determining unit 1044 to the gesture determining module 106. In an exemplary embodiment, the number of the pointing objects is determined according to a maximum number of rising waves or falling waves of the first induction signal or the second induction signal. In an exemplary embodiment, if the number of the rising waves is not equal to that of the falling waves, the process may await next induction signals. In one exemplary embodiment, a first initial induction value and a second initial induction value may be predetermined. In

the exemplary embodiment as illustrated in FIG. 7, the first initial induction value and the second initial induction value are predetermined less than the value of the reference signal. In another exemplary embodiment as illustrated in FIG. 8, the first initial induction value and the second initial induction value are predetermined larger than the value of the reference signal. In one exemplary embodiment, when the first point is the initial point of the induction signal and compared with the reference signal, the first initial induction value is regarded as the value of the previous point of the initial point and compared with the value of the reference signal to determine whether the induction signal comprises a rising wave or a falling wave. In one exemplary embodiment, after the last point and the previous point of the last point are compared with the reference signal, the second initial induction value is regarded as the value of the first point and compared with the value of the reference signal and then the last point is compared with the reference signal to determine whether the induction signal comprises a rising wave or a falling wave.

FIG. 7 illustrates a diagram of a detected induction signal 700 and a reference signal 702 according to one exemplary embodiment of the present invention. In an instance in which a pointing object comes into contact with the touch-sensitive screen at a touch point, the contact at that touch point may generate an induction signal 700. Accordingly, the number of rising waves or the number of falling waves may correspond to the number of pointing objects that are in contact with the touch-sensitive screen. The rising wave may cross the reference signal at points A and C (referred as "rising point"). The falling wave may cross the reference signal at points B and D (referred as "drop point"). Due to some unexpected noises, the induction signal may not be induced by a valid contact of a pointing object. To determine whether an induction signal is induced by a valid contact, a distance between one rising point and a subsequent drop point may be measured and compared to a predetermined threshold value by the comparing unit 1042. If the distance is larger than the predetermined threshold value, the induction signal is determined to be induced by a valid touch. For example, the distance between the rising point A and its subsequent drop point B may be measured and compared to a predetermined threshold value.

Different induction signal waves may be obtained due to different analyzing methods or processing methods. FIG. 8 illustrates an induction signal 800 induced by a contact with the touch screen and a reference signal 802 according to an exemplary embodiment. The method of determining a valid contact at a touch point and the number of touch points may be similar to what is described above. To determine whether an induction signal induced by a valid contact, the distance between one drop point and a subsequent rising point may be measured and compared to a predetermined threshold value by the comparing unit 1062. If the distance is larger than the predetermined threshold value, the induction signal is determined to be induced by a valid touch.

Touch points may be determined by measuring the attenuation of waves, such as ultrasonic waves, across the surface of the touch screen. For instance, the detecting module 102 may comprise a

transmitting transducer and a receiving transducer. The transmitting transducer may be powered, to convert a first electrical signal into an ultrasonic signal and to emit the ultrasonic signal. The receiving transducer may receive the acoustic signal from the transmitting transducer, to detect a change in the acoustic signal and to convert the changed ultrasonic signal into a second electrical signal. When a pointing object touches the touch screen, a part of the ultrasonic signal may be absorbed and the ultrasonic wave becomes a changed ultrasonic signal. The receiving transducer may convert the changed ultrasonic signal into the second electrical signal so as to generate one or more induction signals. When the pointing object touches the touch screen, coordinates of the touch point are then determined. An attenuated induction signal 902 crossed by a reference signal 904 and two attenuation parts 906 and 908 are illustrated in FIG. 9.

FIG. 10 illustrates a schematic diagram of a rectangle formed by the pointing objects according to one exemplary embodiment of the present invention. There may be a plurality of pointing objects that simultaneously come into contact with the touch-sensitive screen to perform a gesture, and which pointing objects may induce a plurality of detectable induction signals. To determine whether the pointing objects perform a scaling gesture, the coordinates of the pointing objects may be measured. The coordinates of a first start touch points and a first end touch points of the pointing objects may be obtained by an obtaining unit 1062 of the gesture determining module 106. Then a scaling gesture is determined by a scaling gesture determination unit 1064 of the gesture determining module 106 according to the coordinates of the first start touch point and the first end touch point of the pointing objects. As shown in FIG. 10, a maximum coordinate X_{max} and a minimum coordinate X_{min} of the first start touch points in a first direction are determined by the obtaining unit 1062, and a maximum coordinate Y_{max} and a minimum coordinate Y_{min} of the first start touch points in a second direction are determined by the obtaining unit 1062. The value of the first area is determined according to the formula $S_1 = (X_{max} - X_{min}) \times (Y_{max} - Y_{min})$. Similarly, a maximum coordinate X'_{max} and a minimum coordinate X'_{min} of the first end touch points in the first direction are determined by the obtaining unit 1062, and a maximum coordinate Y'_{max} and a minimum coordinate Y'_{min} of the first end touch points in the second direction are determined by the obtaining unit 1062 after the pointing objects shift. The value of the second area is determined according to the formula $S_2 = (X'_{max} - X'_{min}) \times (Y'_{max} - Y'_{min})$.

The first area is compared with the second area. If the second area which is shown in FIG. 11 is less than the first area, the gesture performed by the pointing object is determined as a scaling down gesture. If the second area which is shown in FIG. 12 is larger than the first area, the gesture performed by the pointing object is determined as a scaling up gesture. In an instance, in the formula $S_1 = (X_{max} - X_{min}) \times (Y_{max} - Y_{min})$, if $X_{max} - X_{min} < 1$, the gesture determining module 106 makes

$X_{max} - X_{min} = 1$; and/or if $Y_{max} - Y_{min} < 1$, the gesture determining module 106 makes $Y_{max} - Y_{min} = 1$. In an instance, in the formula $S_2 = (X'_{max} - X'_{min}) \times (Y'_{max} - Y'_{min})$, if $X'_{max} - X'_{min} < 1$, the gesture determining module 106 makes $X'_{max} - X'_{min} = 1$; and/or if $Y'_{max} - Y'_{min} < 1$, the gesture determining module 106 makes $Y'_{max} - Y'_{min} = 1$. The above setting is to avoid wrong determination. For example, if the difference between the maximum coordinate X_{max} and the minimum coordinate X_{min} is 0.5 and the difference between the maximum coordinate Y_{max} and the minimum coordinate Y_{min} is 2.5 before shifting, and the difference between the maximum coordinate X'_{max} and the minimum coordinate X'_{min} is 0.1 and the difference between the maximum coordinate Y'_{max} and the minimum coordinate Y'_{min} is 5 after shifting, then according to the formula $S_1 = (X_{max} - X_{min}) \times (Y_{max} - Y_{min})$ and $S_2 = (X'_{max} - X'_{min}) \times (Y'_{max} - Y'_{min})$, the first area is 1.25 and the second area is 0.5, the gesture performed by the pointing objects is determined as the scaling down gesture. But actually, the gesture is a scaling up gesture. If make $X_{max} - X_{min} = 1$when $X_{max} - X_{min} < 1$ and make $X'_{max} - X'_{min} = 1$ when $X'_{max} - X'_{min} < 1$, then the first area is 2.5 and the second area is 5, then the gesture is determined as a scaling up gesture. So making $X_{max} - X_{min} = 1$when $X_{max} - X_{min} < 1$ and making $X'_{max} - X'_{min} = 1$ when $X'_{max} - X'_{min} < 1$, and similarly making $Y_{max} - Y_{min} = 1$when $Y_{max} - Y_{min} < 1$ and making $Y'_{max} - Y'_{min} = 1$ when $Y'_{max} - Y'_{min} < 1$ may avoid the wrong determination.

According to one exemplary embodiment of the present invention, the scaling gesture may be determined according to a variation of the distance between two pointing objects. As shown in FIG. 13, the coordinates of a first pointing object is (X_1, Y_1) and the coordinates of a second pointing object is (X_2, Y_2), a first distance between the first pointing object and the second object is $L_1 = \sqrt{(X_1 - X_2)^2 + (Y_1 - Y_2)^2}$. Similarly as shown in FIG. 14 and 15, after shifting, the coordinates of a first pointing object is (X'_1, Y'_1) and the coordinates of a second pointing object is (X'_2, Y'_2), a second distance between the first pointing object and the second object is $L_2 = \sqrt{(X'_1 - X'_2)^2 + (Y'_1 - Y'_2)^2}$. The first distance L_1 is compared with the second distance L_2, and if $L_1 > L_2$ as shown in FIG. 14, the gesture is determined as a scaling down gesture; if $L_1 < L_2$ as shown in FIG. 15, the gesture is determined as a scaling up gesture. In an instance, a scaling factor may be determined according to the difference between the first distance and the second distance.

All or a portion of the system of the present invention, such as all or portions of the aforementioned processing unit and/or one or more modules of the identification module 100, may generally operate under control of a computer program product. The computer program product for performing the

methods of embodiments of the present invention includes a computer-readable storage medium, such as the non-volatile storage medium, and computer-readable program code portions, such as a series of computer instructions, embodied in the computer-readable storage medium.

FIGs. 5 and 6 are flowcharts of methods, systems and program products according to the invention. It will be understood that each block or step of the flowcharts, and combinations of blocks in the flowcharts, can be implemented by computer program instructions. These computer program instructions may be loaded onto a computer or other programmable apparatus to produce a machine, such that the instructions which execute on the computer or other programmable apparatus create means for implementing the functions specified in the block(s) or step(s) of the flowcharts. These computer program instructions may also be stored in a computer-readable memory that can direct a computer or other programmable apparatus to function in a particular manner, such that the instructions stored in the computer-readable memory produce an article of manufacture including instruction means which implement the function specified in the block(s) or step(s) of the flowcharts. The computer program instructions may also be loaded onto a computer or other programmable apparatus to cause a series of operational steps to be performed on the computer or other programmable apparatus to produce a computer implemented process such that the instructions which execute on the computer or other programmable apparatus provide steps for implementing the functions specified in the block(s) or step(s) of the flowcharts.

Accordingly, blocks or steps of the flowcharts support combinations of means for performing the specified functions, combinations of steps for performing the specified functions and program instruction means for performing the specified functions. It will also be understood that each block or step of the flowcharts, and combinations of blocks or steps in the flowcharts, can be implemented by special purpose hardware-based computer systems which perform the specified functions or steps, or combinations of special purpose hardware and computer instructions. Also, it will be understood by those skilled in the art that for the purpose of clear explanation, the method of the invention is described with reference to the device; however, the method may not rely on the specific device of the invention and the device may not need to be used in the specific method of the invention.

It will be appreciated by those skilled in the art that changes could be made to the examples described above without departing from the broad inventive concept. It is understood, therefore, that this invention is not limited to the particular examples disclosed, but it is intended to cover modifications within the spirit and scope of the present invention as defined by the appended claims.

WHAT IS CLAIMED IS:

1. A method of identifying a scaling gesture, comprising:

detecting in at least one direction one or more induction signals induced by one or more pointing objects that come into contact with a touch-sensitive surface;

determining a number of the pointing object;

determining whether the pointing objects perform the scaling gesture if the number of the pointing object is more than one; and

generating a control signal associated with the determined scaling gesture if the pointing objects perform the scaling gesture.

2. The method of claim 1, wherein determining a number of pointing objects comprises:

comparing a value of a first point and a value of a preceding point of the first point on each induction signal to a value of a reference signal to determine a rising wave or a falling wave; and

determining a number of rising waves or falling waves to determine the number of pointing objects.

3. The method of claim 2, wherein comparing a value of a first point and a value of a preceding point of the first point on each induction signal to the value of the reference signal to determine a rising wave or a falling wave comprises:

comparing the value of the first point to the value of the reference signal;

comparing the value of the preceding point to the value of the reference signal; and

determining the induction signal comprises a rising wave if the value of the first point is larger than the value of the reference signal and the value of the preceding point is less than or equal to the value of the reference signal and determining the induction signal comprises a falling wave if the value of the first point is less than the value of the reference signal and the value of the preceding point is larger than or equal to the value of the reference signal.

4. The method of claim 3, further comprising:

identifying one or more rising points on the rising wave intercepted by the reference signal;

identifying one or more drop points on the falling wave intercepted by the reference signal; and

comparing a distance between a rising point and a subsequent drop point to a predetermined threshold value or comparing a distance between a drop point and a subsequent rising point to a predetermined threshold value to determine if the detected induction signal is induced by a valid contact.

5. The method of claim 4, wherein detecting in at least one direction one or more induction signals

comprises:

detecting a first induction signal in a first direction; and

detecting a second induction signal in a second direction, in which the first direction is at an angel with the second direction.

6. The method of claim 5, wherein determining a number of rising waves or falling waves to determine the number of pointing objects comprises:

determining the number of the pointing objects according to a maximum number of rising waves or falling waves of the first induction signal or a maximum number of rising waves or falling waves of the second induction signal.

7. The method of claim 1, wherein the pointing objects come into contact with the touch-sensitive surface at respective touch points, and wherein determining whether the pointing objects perform the scaling gesture comprises:

obtaining coordinates of first start touch points and first end touch points of the pointing objects; and

determining whether the scaling gesture is a scaling up or a scaling down gesture according to the coordinates of the first start touch points and the first end touch points of the pointing objects.

8. The method of claim 7, wherein when the number of the pointing objects is larger than two, determining whether the scaling gesture is a scaling up or a scaling down gesture comprises:

determining a value of a first area according to the coordinates of the first start touch points of the pointing objects;

determining a value of a second area according to the coordinates of the first end touch points of the pointing objects; and

determining whether the scaling gesture is a scaling up or a scaling down gesture according to a difference between the first area and the second area.

9. The method of claim 8, wherein determining a value of the first area or of the second area comprises:

determining a maximum coordinate X_{max} and a minimum coordinate X_{min} of the first start touch points in the first direction and determining a maximum coordinate Y_{max} and a minimum coordinate Y_{min} of the first start touch points in the second direction;

determining a maximum coordinate X'_{max} and a minimum coordinate X'_{min} of the first end touch points in the first direction and determining a maximum coordinate Y'_{max} and a minimum coordinate Y'_{min} of the first end touch points in the second direction; and

determining the value of the first area according to a formula $S_1 = (X_{max} - X_{min}) \times (Y_{max} - Y_{min})$ and the value of the second area according to a formula $S_2 = (X'_{max} - X'_{min}) \times (Y'_{max} - Y'_{min})$.

10. The method of claim 9, wherein

if $X_{max} - X_{min} < 1$, make $X_{max} - X_{min} = 1$, and/or if $Y_{max} - Y_{min} < 1$, make $Y_{max} - Y_{min} = 1$; and

if $X'_{max} - X'_{min} < 1$, make $X'_{max} - X'_{min} = 1$; and/or if $Y'_{max} - Y'_{min} < 1$, make $Y'_{max} - Y'_{min} = 1$.

11. The method of claim 8, wherein determining whether the scaling gesture is a scaling up or a scaling down gesture according to a difference between the first area and the second area comprises:

determining the pointing objects perform a scaling down gesture if the difference between the first area and the second area is larger than zero; and

determining the pointing objects perform a scaling up gesture if the difference between the first area and the second area is less than zero.

12. The method of claim 8, wherein determining whether the pointing objects perform the scaling gesture if the number of the pointing object is more than one comprises:

determining a scaling factor according the difference between the first area and the second area.

13. The method of claim 7, wherein determining whether the scaling gesture is a scaling up or a scaling down gesture according to the coordinates of the first start touch points and the first end touch points of the pointing objects comprises:

determining a first distance according to the coordinates of the first start touch points of two pointing objects;

determining a second distance according to the coordinates of the first end touch points of the two pointing objects; and

determining whether the scaling gesture is a scaling up or a scaling down gesture and a scaling factor according to a difference between the first distance and the second distance.

14. The method of claim 1, wherein detecting in at least one direction one or more induction signals comprises detecting at least one of a change in electrical current, capacitance, acoustic waves, electrostatic field, optical fields or infrared light.

15. A device of identifying a scaling gesture, comprising:

a detecting module, configured to detect in at least one direction one or more induction signals induced by one or more pointing objects that come into contact with a touch-sensitive surface;

a determination module, configured to determine a number of pointing objects;

a gesture determining module, configured to determine whether the pointing objects perform the scaling gesture; and

a signal generation module, configured to generate a control signal associated with the determined scaling gesture.

16. The device of claim 15, wherein the determination module comprises:

a comparing unit, configured to compare a value of a first point and a value of a preceding point of the first point on each induction signal to a value of a reference signal to determine a number of a rising waves or a number of a falling waves; and

a number determining unit, configure to determine the number of pointing objects according to the number of the rising waves or the number of the falling waves.

17. The device of claim 16, wherein the comparing unit configured to compare a value of a first point and a value of a preceding point of the first point on each induction signal to a value of a reference signal comprises to:

compare the value of the first point to the value of the reference signal;

compare the value of the preceding point of the first point to the value of the reference signal; and

determine the induction signal comprises a rising wave if the value of the first point is larger than the value of the reference signal and the value of the preceding point is less than or equal to the value of the reference signal and determining the induction signal comprises a falling wave if the value of the first point is less than the value of the reference signal and the value of the preceding point is larger than or equal to the value of the reference signal.

18. The device of claim 16, wherein the determination module is configured to:

identify one or more rising points on the rising wave intercepted by the reference signal;

identify one or more drop points on the falling wave intercepted by the reference signal; and

compare a distance between a rising point and a subsequent drop point to a predetermined threshold value or comparing a distance between a drop point and a subsequent rising point to a predetermined threshold value to determine if the detected induction signal is induced by a valid contact.

19. The device of claim 15, wherein the detecting module configured to detect a change in at least one of

electrical current, capacitance, acoustic waves, electrostatic field, optical fields and infrared light.

20. The device of claim 15, wherein the detecting module comprises:

a transmitting transducer, configured to be powered and to convert a first electrical signal into an acoustic signal and to emit the acoustic signal; and

a receiving transducer, configured to receive the acoustic signal, to detect a change in the acoustic signal and to convert the changed acoustic signal into a second electrical signal so as to generate one or more induction signals.

21. The device of claim 16, wherein the detecting module is configured to detect a first induction signal in a first direction and to detect a second induction signal in a second direction, in which the first direction is at an angel with the second direction.

22. The device of claim 21, wherein the determination module determines the number of the pointing object according to a maximum number of rising waves or falling waves of the first induction signal or a maximum number of rising waves or falling waves of the second induction signal.

23. The device of claim 15, wherein the gesture determining module comprises:

obtaining unit, configured to obtain coordinates of first start touch points and first end touch points of the pointing objects; and

a scaling gesture determination unit, configured to determine whether the scaling gesture is a scaling up or a scaling down gesture according to the coordinates of the first start touch points and the first end touch points of the pointing objects.

24. The device of claim 23, wherein when the number of the pointing objects is larger than two, the obtaining unit is configured to:

determine a value of a first area according to the coordinates of the first start touch points of the pointing objects, and

determine a value of a second area according to the coordinates of the first end touch points of the pointing objects, in which the gesture determination unit is further configured to determine whether the scaling gesture is a scaling up or a scaling down gesture according to a difference between the first area and the second area.

25. The device of claim 24, wherein the obtaining unit is configured to:

determine a maximum coordinate X_{max} and a minimum coordinate X_{min} of the first start touch points

in the first direction and determining a maximum coordinate Y_{max} and a minimum coordinate Y_{min} of the first start touch points in the second direction;

determine a maximum coordinate X'_{max} and a minimum coordinate X'_{min} of the first end touch points in the first direction and determine a maximum coordinate Y'_{max} and a minimum coordinate Y'_{min} of the first end touch points in the second direction; and

determine the value of the first area according to a formula $S_1 = (X_{max} - X_{min}) \times (Y_{max} - Y_{min})$ and the value of the second area according to a formula $S_2 = (X'_{max} - X'_{min}) \times (Y'_{max} - Y'_{min})$.

26. The device of claim 25, wherein

if $X_{max} - X_{min} < 1$, make $X_{max} - X_{min} = 1$, and/or if $Y_{max} - Y_{min} < 1$, make $Y_{max} - Y_{min} = 1$; and

if $X'_{max} - X'_{min} < 1$, make $X'_{max} - X'_{min} = 1$; and/or if $Y'_{max} - Y'_{min} < 1$, make $Y'_{max} - Y'_{min} = 1$.

27. The device of claim 24, wherein the gesture determination unit is configured to:

determine the pointing objects perform a scaling down gesture if the difference between the first area and the second area is larger than zero; and

determine the pointing objects perform a scaling up gesture if the difference between the first area and the second area is less than zero.

28. The device of claim 24, wherein the gesture determination unit is configured to:

determine the scaling factor according the difference between the first area and the second area.

29. The device of claim 23, wherein when the number of the pointing objects is two, the gesture determination unit is configured to:

determine a first distance according to the coordinates of the first start touch points of the two pointing objects;

determine a second distance according to the coordinates of the first end touch points of the two pointing objects; and

determine whether the scaling gesture is a scaling up or a scaling down gesture and a scaling factor according to a difference between the first distance and the second distance.

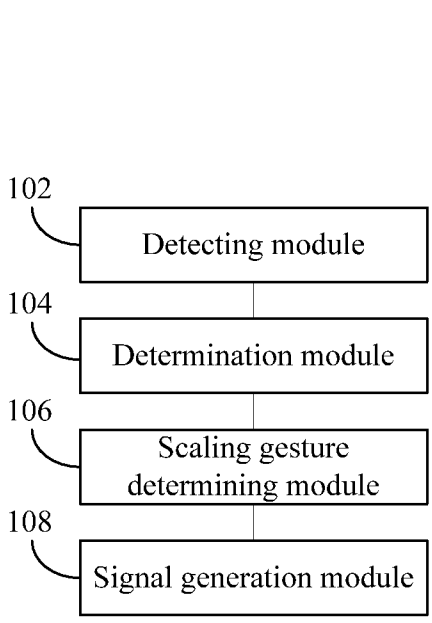


FIG. 1

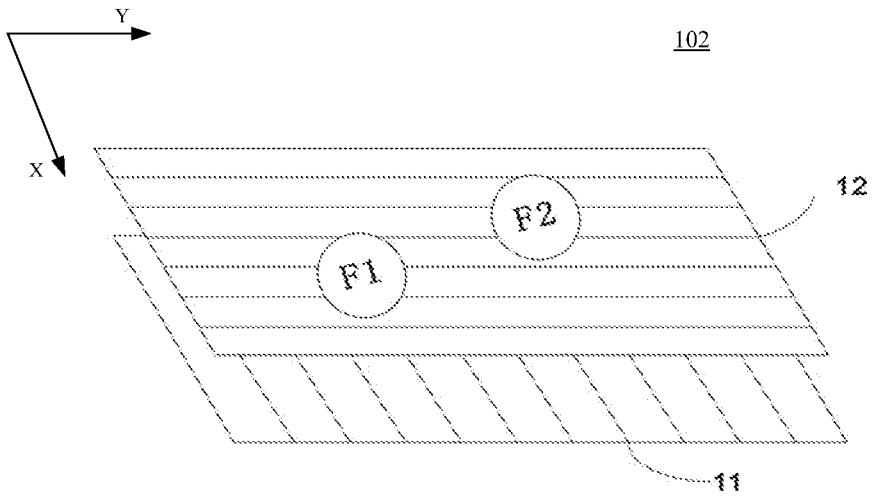


FIG. 2

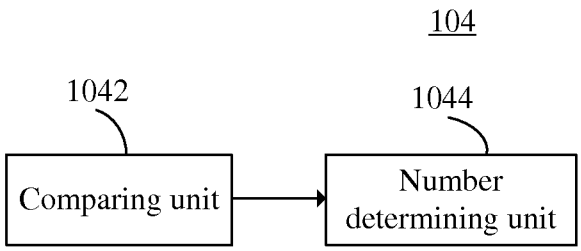


FIG. 3

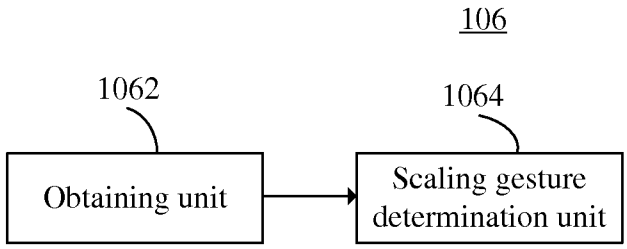

106
1062
1064
Obtaining unit
Scaling gesture determination unit

FIG. 4

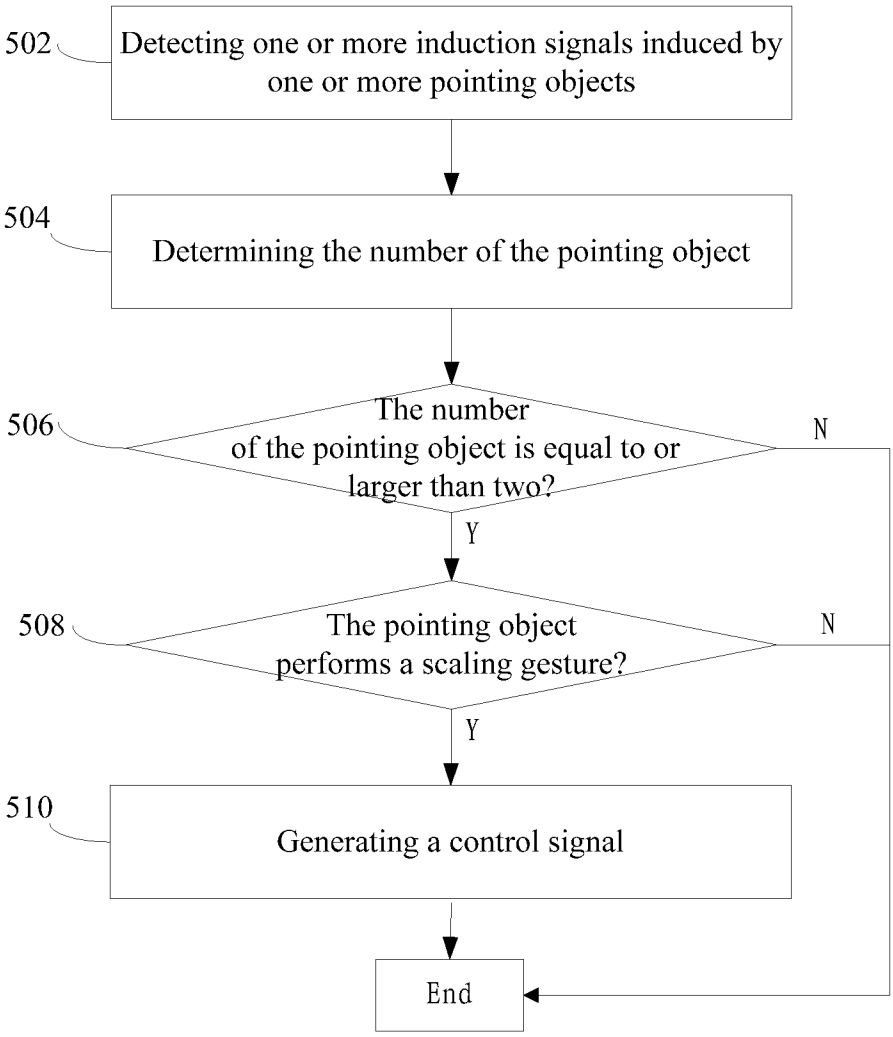

502
Detecting one or more induction signals induced by one or more pointing objects
504
Determining the number of the pointing object
506
The number of the pointing object is equal to or larger than two?
N
Y
508
The pointing object performs a scaling gesture?
N
Y
510
Generating a control signal
End

FIG. 5

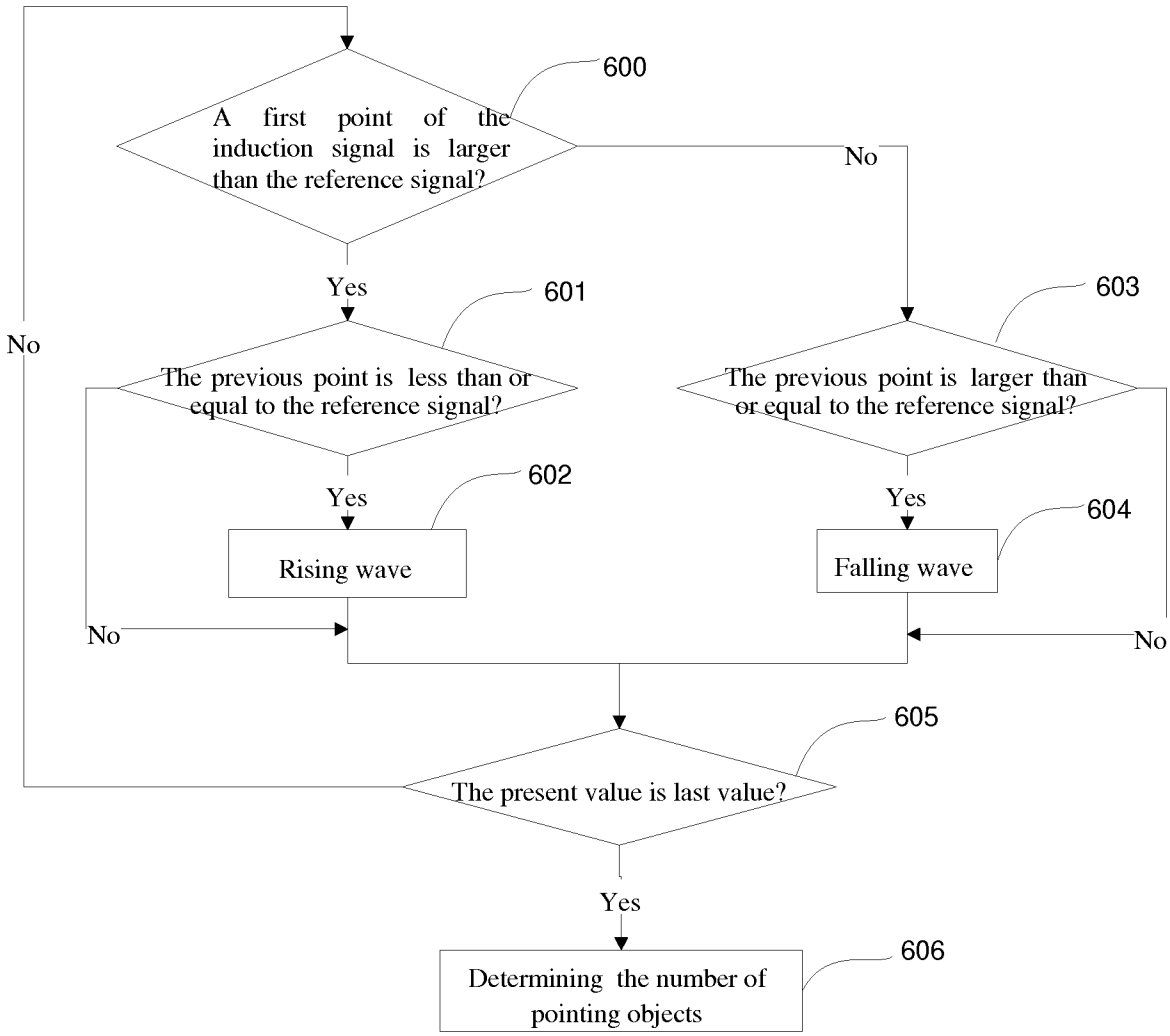


FIG. 6

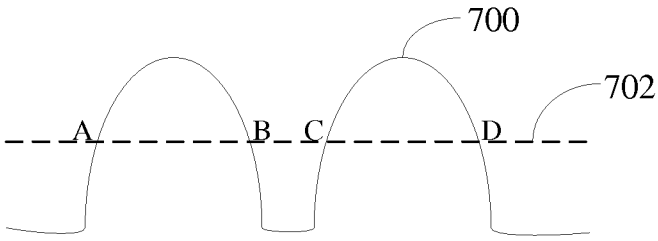


FIG. 7

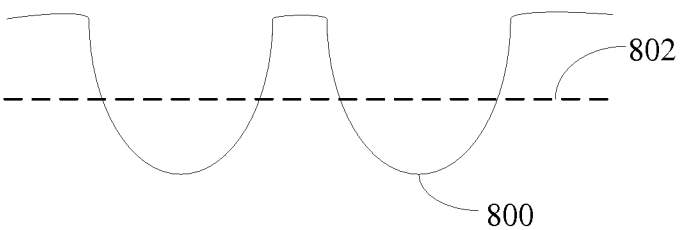


FIG . 8

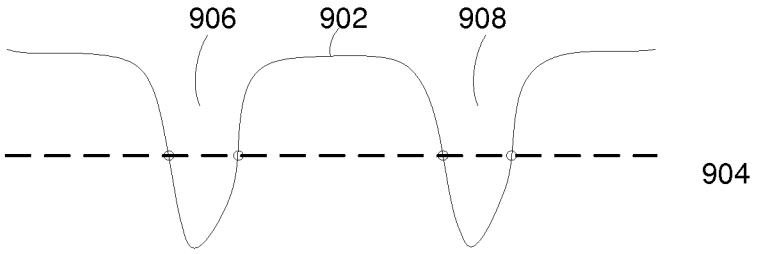


FIG . 9

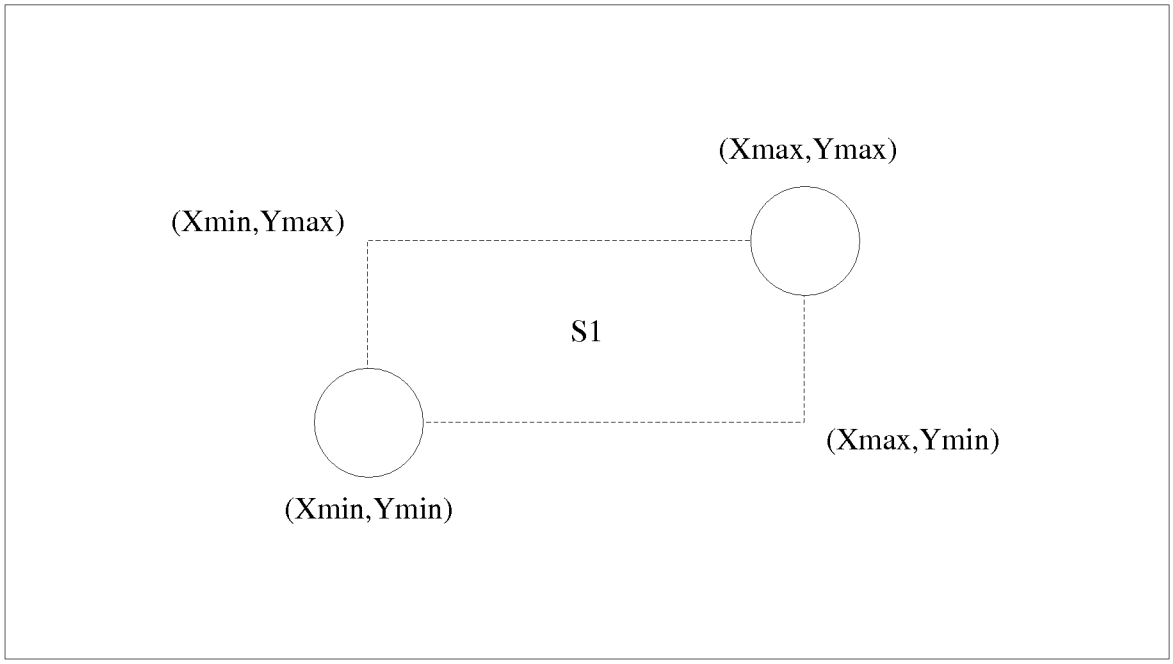


FIG. 10

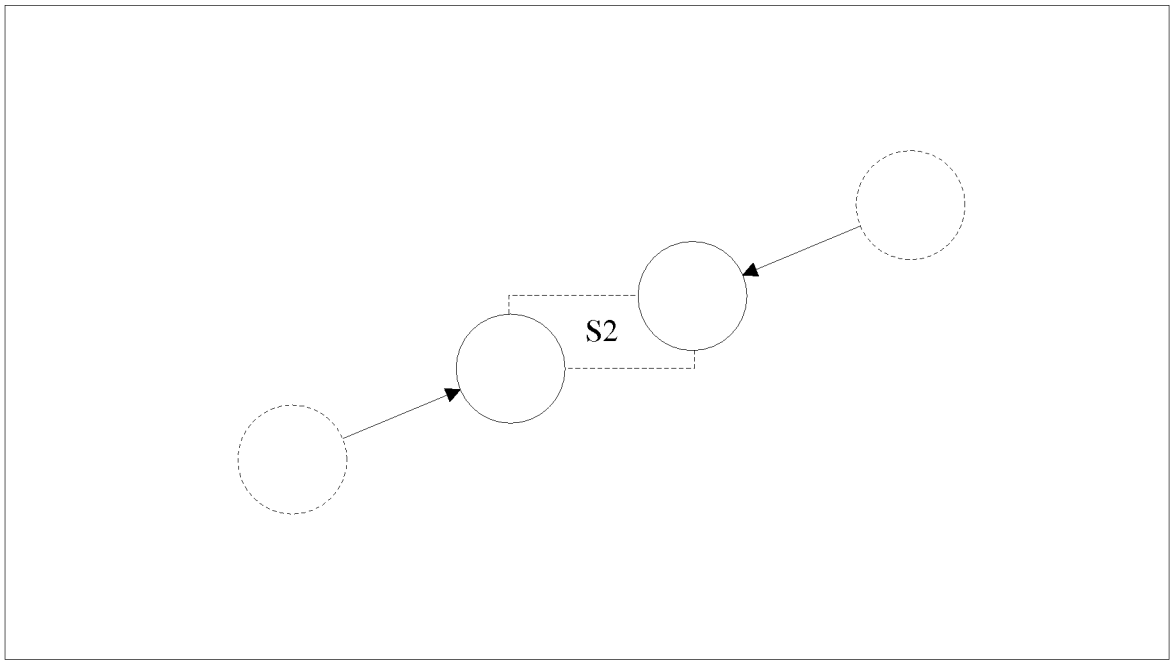


FIG. 11

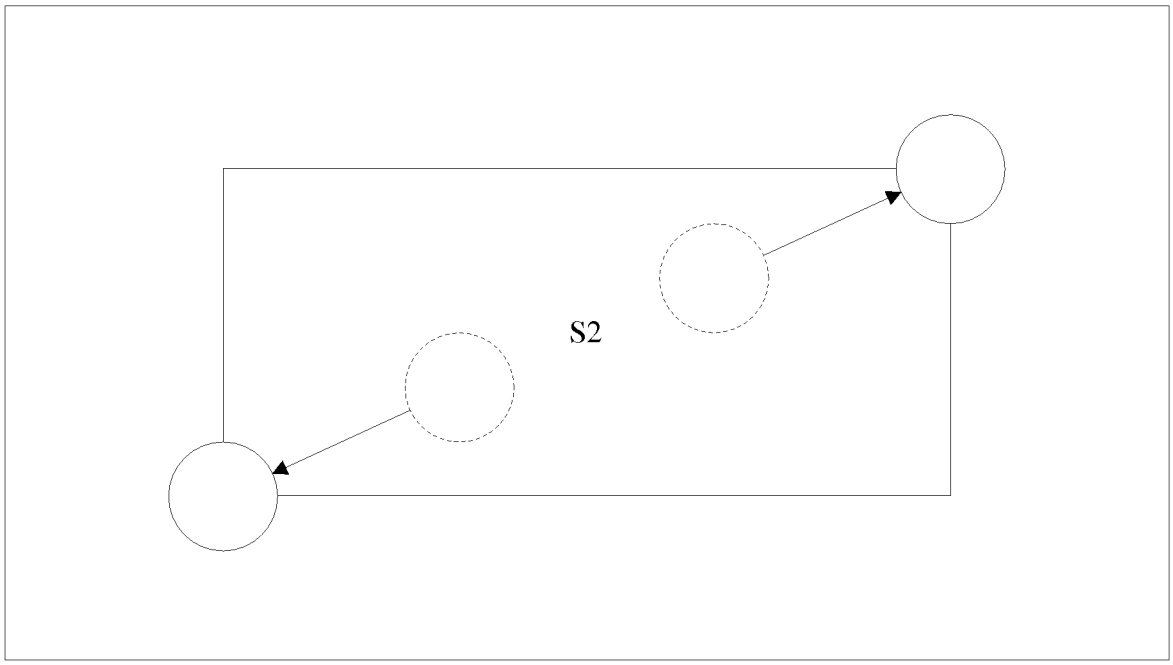


FIG. 12

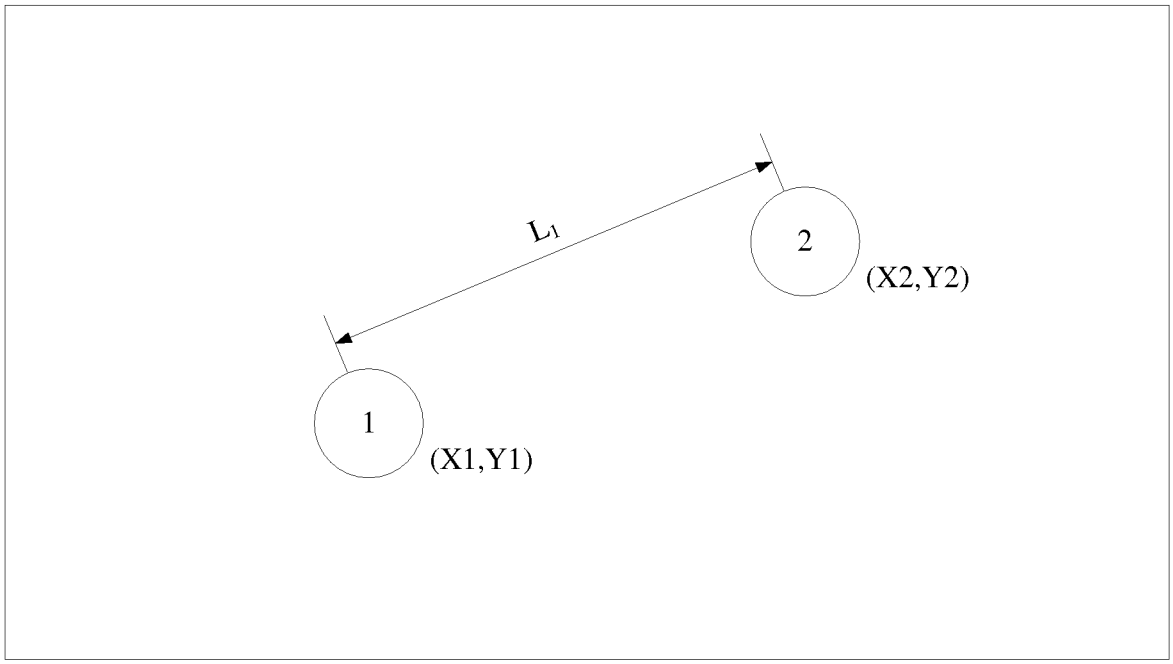


FIG. 13

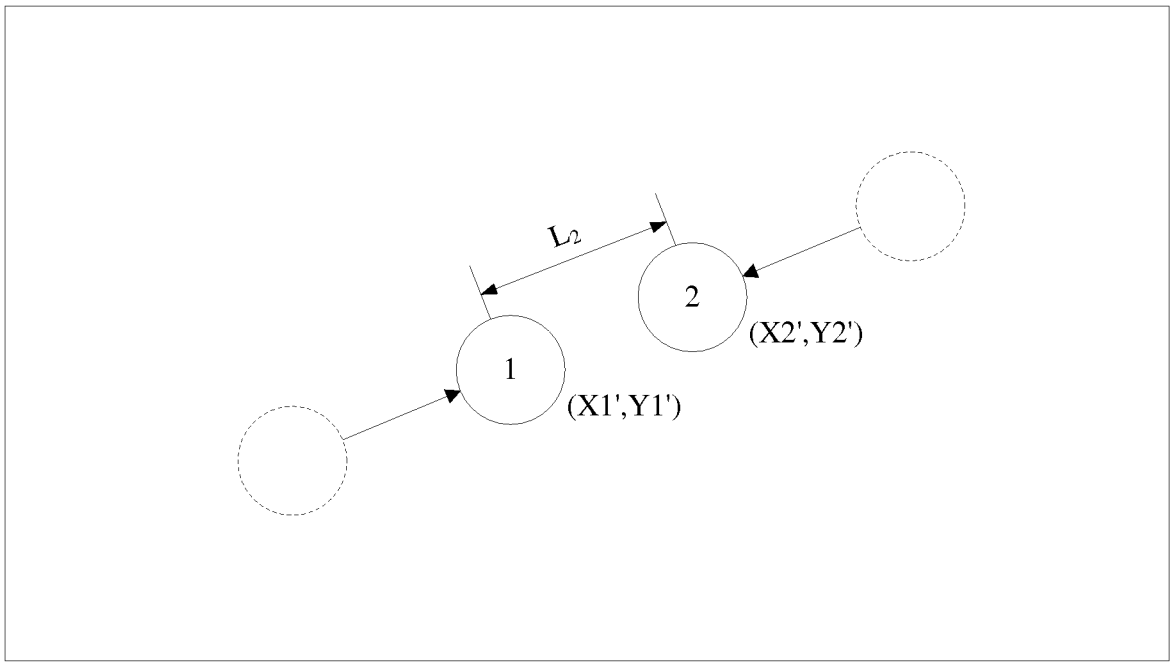


FIG. 14

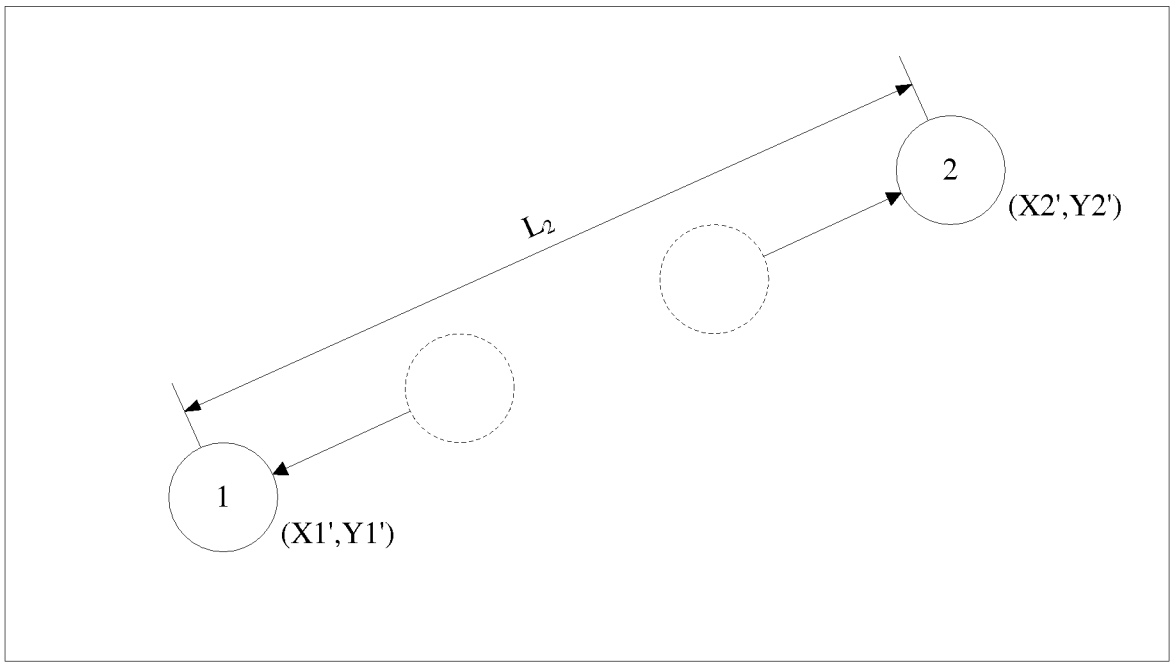


FIG. 15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2012/070187

A. CLASSIFICATION OF SUBJECT MATTER

G06F3/045(2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT, CNKI, WPI, EPODOC: multi, touch, scaling, zoom, coordinate, location, wave, signal, direction, reference

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN101493744 A (MITSUBISHI ELECTRIC CORP et al.) 29 Jul. 2009(29.07.2009) description page 18 line 2 to page 19 line 11, figures 14-17	1,7,13-15,19,23,29
A	US2009284495 A1(3M INNOVATIVE PROPERTIES CO) 19 Nov. 2009(19.11.2009) the whole document	1-29
A	CN101630221 A(ACER INC) 20 Jan. 2010(20.01.2010) the whole document	1-29

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
08 Feb. 2012(08.02.2012)	**29 Mar. 2012 (29.03.2012)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer Dong, Le Telephone No. (86-10)62411673

Form PCT/ISA /210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2012/070187

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
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		CN102084326A	01.06.2011
		WO2009140347A3	25.02.2010
		KR20110015585A	16.02.2011
		EP2300899A2	30.03.2011
CN101630221A	20.01.2010	none	