

CAPACITIVE MOTION SENSOR SWITCH FOR DETECTING ENTRY/EXIT REQUESTS ON AN AUTOMATIC DOOR PANEL

FIELD OF THE INVENTION

This invention relates to a motion sensor switch, and more particularly to capacitive motion sensor switch for example for detecting entry/exit requests on an automatic door.

BACKGROUND OF THE INVENTION

Switches for detecting entry/exit requests are commonly arranged on automatic doors. Such switches include tactile press switches that are typically mounted on moving door panels of the automatic door. The tactile press switches are often mounted near the center of the door opening for convenience of the user requesting to open the door. However, in such conventional switches, each tactile press switch is only capable to detect motion for entry/exit requests on the side of the door that the tactile press switch is mounted. For this reason at least one tactile press switch is usually required to be mounted on an each outside and inside surface of the door. With such conventional configurations, the tactile press switch mounted on the outside surface of the door in particular is more prone to vandalism.

As conventional design requires tactile press switches to be mounted on both sides of the automatic door, the tactile press switches are typically battery powered and are configured with an RF wireless transmitter housed within housing of each tactile press switch. However, there are many doors such RF based tactile press switches that are not suitable because the doors have a relatively small gap between a moving door panel and a fixed door panel. For

such applications, the mechanical profile of the RF tactile press switch is required to be reduced to fit within the gap between the moving and fixed panel.

Attempts have been made to reduce the mechanical profile of RF tactile press switches, for example by using smaller batteries. However, smaller batteries results in shorter life of the switch and requires frequent replacement which is inconvenient. Another tactile press switch may have an infrared based transmitter instead of a RF based transmitter. A characteristic of infrared based tactile press switches is that infrared may be transmitted through other materials such as glass, unlike RF based tactile press switches. Similarly, with such infrared based tactile press switches, two tactile press switches are required since a tactile press switch must still be mounted on each side of the glass door panel. Typically, one of the tactile press switches on one surface of the door panel, often the outside surface of the door panel, is equipped with an infrared transmitter and transmits infrared through the glass panel door to the other tactile press switch mounted on the inside surface of the door panel that is equipped with an infrared receiver and RF wireless transmitter. The inside surface mounted tactile press switch upon receiving the infrared transmission sends a RF wireless transmission to the door controller. With such infrared based tactile press switches, care needs to be taken in the positioning of the two tactile press switches to ensure that the infrared transmitter is aligned with the infrared receiver. Additionally, the door must be transparent with such infrared based tactile press switches.

There is a need for a motion sensor switch that addresses or alleviates the problems associated with the conventional tactile press switches. There is a need for a motion sensor switch that is mounted on a single surface of a door panel and configurable to detect entry/exit requests from the other side of the door from which side the sensor is mounted. There is a need to provide a motion sensor switch that is cost and energy efficient.

SUMMARY

An embodiment of the invention provides a capacitive sensor switch for installation on a surface of a panel of electric field penetratable material, the sensor switch comprising an electrode and a return ground arranged to project an electric field through an electric field penetratable material, and for indicating a response to a disturbance in the projected electric field in accordance to a predetermined threshold.

In an embodiment the electrode and the return ground and the predetermined threshold are arranged to detect and indicate a response to a hand of a person. The sensor switch may further comprise a housing for hosting the electrode and the return ground. The housing may be fixed to the electric field penetratable material panel by an adhesive or other mechanical means. The electric field penetratable material of the panel may be glass or other material with similar dielectric properties. The sensor switch may further comprise a transmission module for transmitting the response, and may be arranged for wireless transmission. The sensor switch may be for indicating an entry/exit request to open/close an automatic door. The sensor switch may be for indicating an entry/exit request to open/close an automatic window. The sensor switch may indicate an entry/exit request to open/close an automatic gate. The sensor switch may comprise a power supply, such as a battery or AC mains. The electrode may comprise a plurality of electrodes, wherein the plurality of electrodes may form an array of electrodes. The sensor switch may further comprise an additional electrode and an additional ground return for projecting an additional electric field, wherein the additional electric field is projected through the electric field penetratable material and/or away from the electric field penetratable material. The additional electrode comprises a plurality of electrodes that may form an array of electrodes. A response may be indicated if a predetermined number of the electrodes, for example more than half of the electrodes, in the plurality detect a disturbance above a predetermined threshold. The material of the electrode may any conductive material such as copper, silver,

gold, aluminum, alloys thereof, or the like. The electrode may be formed on a printed circuit board or other conductive parts such as the housing. The sensor switch may further comprise a switch for detecting the disturbance of the electric field.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that embodiments of the invention may be fully and more clearly understood by way of non-limitative example from the following description taken in conjunction with the accompanying drawings in which like reference numerals designate similar or corresponding elements, regions and portions, and in which: glass or similar, transparent or opaque.

FIG. 1 is a schematic diagram illustrating an embodiment of the invention where a sensor switch is mounted on a single side of a door panel and detects entry/exit requests made from both sides of the door panel;

FIG. 2 is a schematic diagram illustrating an embodiment of the invention where a sensor switch is mounted on a single side of a door panel and detects entry/exit requests made from the other side of the door panel;

FIG. 3 is a schematic diagram illustrating an embodiment of the invention where a sensor switch is mounted on a single side of a door panel and detects entry/exit requests made from both sides of the door panel having electrode configurations to project different electric fields from each side of the door panel;

FIG. 4 is a schematic diagram illustrating an embodiment of the invention where a sensor switch is mounted on a single side of a door panel and detects entry/exit requests made from both sides of the door panel having electrode configurations to project different electric fields from each side of the door panel;

FIG. 5 is a schematic diagram illustrating an array of electrodes in accordance with an embodiment of the invention;

FIG. 6A-C are schematic diagrams illustrating an embodiment of the invention mounted on a door panel in accordance with an embodiment of the invention; and

FIG. 7A-C are block circuit diagrams for embodiments of the invention.

DETAILED DESCRIPTION

An embodiment of the invention is shown in FIG. 1 which illustrates a sensor switch 10 that is mounted on a single side of a door panel 20 and detects entry/exit requests made from both sides of the door panel. The sensor switch 10 utilizes capacitive sensing based on single electrode 14 design in this embodiment. The sensor switch 10 comprises a housing 12 which houses the necessary printed circuit board 26, components 18 such as battery or regulator 116, capacitive sensing circuitry 112 and wired or wireless circuitry 118, as shown with reference to FIG. 7A. The printed circuit board may be formed with any conductive material such as copper or other conductive material such as silver, gold, aluminum, alloys or the like. The sensor switch 10 is mounted on the glass door 20, with suitable adhesive. The printed circuit board 26 may be flexible or rigid. The printed circuit board 26 may be mounted in any position suitable within the housing 12.

The components 18, shown in more detail in circuit block diagram 110 of FIG. 7A, capacitive sensing circuitry 112 drives the electrode 14 to project an electric field 22,24 or electromagnetic field, which arcs to the return ground 16. The capacitive sensing circuitry 112 senses the level of the electric field. When an object such as a hand approaches sensor switch 10, the object disturbs the electric field 22,24. The capacitive sensing circuitry 112 compares the rate and

level of disturbance, to a pre-determined threshold, as shown as reference capacitance 114 in FIG. 7A. An output 120 transmission via components wired or wireless circuitry 118 as shown as signal 98 is sent to the door operator or mechanism 108, as shown in FIG. 6A-6C for activation of the door, should the rate and level of disturbance be higher than the pre-determined threshold. FIG. 6A-C show the open/close mechanism 108 that is configured to open and or close the door panels 20 in response to signal 98 received from the capacitive sensor switch 10. The open/close mechanism 108 may be configured differently than shown with two capacitive sensor switches 10 on each door panel 20. One sensor may be sufficient to operate both door panels. The open/close mechanism may be arranged to be activated to close after an open/close signal and respectively closes/open after another close/open request and signal is received. The open/close mechanism may automatically close after a predetermined time, which may employ additional and or other sensors to detect the presence of any obstruction before automatic closure of the doors.

The glass door 20, may be of any non-conductive material and of a dielectric similar to glass or electric field penetratable material. Electric field 22, 24 passes through the glass door 20, with little loss, which allows for detection of hand or object on the opposite side of the glass door 20. It will be appreciated that the electric field penetratable material may take a variety of forms such as a panel, pane, sheet or the like, and may be part of a door, window, gate and the like.

The housing 12 may be of any non-conductive material, and need not to be of any particular dimension or shape but sufficient to be able to house the printed circuit board 26 and components 18.

The electric field 22 is denser than electric field 24. The threshold may be set to activate in response to detection of any sized object such as hand or other object blocking the path of electric field 22. Electric field 24 being less dense, is

relatively difficult to create a disturbance higher than the pre-determined threshold. By changing the threshold, the sensing distance may be adjusted. Similarly, having the electrode and return ground of the size of the desired object to be detected such as a hand or larger than the gap fillers, the threshold may be increased to reduce false detection from objects whose width is smaller than a hand. The electrode and return ground is in a vertical oriented stack such that long vertical, narrow width gap fillers will generate small disturbance. For example, objects such as water droplets on the door or a gap filler 104 as shown in FIG. 6A-C, such as the door frame 102, gasket, brushes, and the like which may be in close proximity to the sensor switch 10 may cause false detection if the configuration of the electrode, return ground, and/or distances between are not chosen. For example, in one embodiment, the threshold is chosen such to reduce the likelihood that water droplets, gap fillers or the like disturb the electric field more than a palm or hand. This configuration ensures that the sensor switch is less prone to false detection due to the close proximity to the door gasket, brushes, door frame, or the like.

The electrode 14, is formed from copper or other conductive material such as gold, silver, aluminum, alloys or the like. The printed circuit board may be hatched or poured on 12 layer or multi-layers. The return ground 16 is positioned a distance from the electrode 14 to ensure the desired electric field 22,24 to be projected. This arrangement and distance between the electrode and the return ground 16 allows for the desired projection of electric field. In this embodiment the electric field is projected to both sides of the printed circuit board 26. In an embodiment the electrode and return ground and the distances between are chosen based on the size of the intended object to detect and/or the size of the objects that may cause a false detection such as a hand or larger than the size of the gap fillers to prevent false detection. The return ground 16, may be laid beneath the electrode 14 and may stretch for the whole length of the printed circuit board 26. This allows projection of electric field to only through the glass door 20.

The sensor operates with a single large area electrode and return ground, formed from the printed circuit board. This configuration is cost and energy efficient, and limits false detection and accurate repeatability of the detection and sensing. The majority of the electric field 22 is looping in relatively dense small arcs from the electrode 14 to the return ground 16. Detection is more dependant on whether a hand or object is placed in the path of the dense small arcs, and less dependant on the dielectric of the person, clothing, shoes or floor. In an embodiment the electrode and return ground is wider than most door gap fillers 104 such as door gaskets, brushes, door frame, and the like. This allows for the threshold for detection to be set for wider objects such as a hand, three fingers, four fingers and the like. This configuration reduces false detection when the sensor, mounted on the moving door panel, passes door gaskets, brushes or frame at close proximity.

Embodiments of the invention relate to entry/exit request motion sensor switches for an automatic door on a panel of electric field penetratable material, and in particular, to glass door mounted capacitive sensing switch which though is only mounted on one side, which may service the entry/exit request from both sides of the door, glass or similar, transparent or opaque. The sensor switch may be applied to a number of different configurations of doors, windows, gates, etc., for example sliding, rotating, swinging doors and the like. Embodiments are directed to an entry/exit request sensor switch which employs capacitive sensing for the detection of an object such as a hand, a palm or an object that is similar having similar dielectric properties. However, it will be appreciated that the sensor switch 10 may be arranged and configured to detect any desired object or objects smaller or bigger in size. Upon detection, the sensor may send an output 120 via wired or wireless transmission to the door operator for activation of the door.

FIG. 1 shows a single electrode 14 embodiment for detecting a hand or object on both sides of the glass door. Although other methods of utilizing capacitive sensor for detection through the glass door are contemplated in other embodiments, it will be appreciated by those skilled in the art that multiple electrodes or single electrode, with or without a switch, tactile press or others, may also be implemented to provide a switch, which may service entry/exit requests from one or both sides of the glass door in accordance with embodiments of the invention.

Some of the additional embodiments are shown in FIG. 2-4 which may be selected for output actuation for either side of the door, for example, front or outside of door only, other side of door such as rear or outside of door only, or both sides of door such as front and rear detection. For example, if the detection is set to front or inside, i.e. one side of the door, the sensor switch may ignore objects and signal requests from the rear or outside, i.e. other side of the door, where front and rear refers to the two sides of the door. The capacitive sensor may be virtually built from the currently available dedicated integrated circuits (IC) or from discrete components. The electric field is projected from the electrode, both through the glass door, or any non-conductive material with similar dielectric properties or electric field penetratable material, and through the housing that embodies the sensor, returning to the return ground of the electrode. The projected electric field may extend in increasing arcs and reduce in intensity, affected by the dielectric properties of the material that it is passing through. When an object approaches the sensor, the electric field may be disturbed. The level and rate of the disturbance may be compared with a pre-determined threshold to determine detection.

In an embodiment, the entry/exit request switch may comprise a press switch or button 52 as shown in FIG. 2. In other embodiments multiple switches may be provided. The sensor switch 50 of FIG. 2 operates in a manner similar to sensor switch 10 of FIG. 1, in the detection of a hand or object through the glass door.

The switch or button 52 may be a tactile press, membrane press switch, or the like, to service requests on the side of the door the switch is mounted. Switch or button 52 may be comprised of multiple switches.

Other conductive objects, multiple electrodes, electrode of different size, or the like may replace the single large electrode 14 shown formed from printed circuit board. To shield the electric field from one side of the door, i.e. the rear or front, a shield 58 is provided that extends a distance sufficient to suppress the electric field projected on one side of the sensor switch 50, which only allows the electric field 22,24 to project to the one desired side. The press switch 52 may be within the same or separate housing 12 of a capacitive sensor switch 50. The capacitive sensor switch 50 in this embodiment services and detects requests or disturbances of the electric field 22,24 that projects through the glass door 20. The components 18 include capacitive sensing circuitry that drives the electrode 10 to project an electric field 22,24, which arcs to the return ground 16. The capacitive sensing circuitry senses the level of the electric field. When a hand or object approaches, the electric field 22,24 is disturbed. The components 18 of the capacitive sensing circuitry compare the rate and level of disturbance, to a pre-determined threshold. A transmission, via wired or wireless components 18, may be sent to the door operator mechanism 108 for activation of the door should the rate and level of disturbance be higher than the pre-determined threshold. The sensor switch 50 comprises the housing 12 which houses the necessary printed circuit board 26 and components 18 as shown in circuit block diagram 130 of FIG. 7B. The components 18 may include battery or regulator 116, capacitive sensing circuitry 112 and wired or wireless circuitry 118. The circuitry 130 may additionally comprise push button 134, decision entry/exit 132, front/rear/front and rear selection 136 modules to provide output 138 from the wire/wireless circuitry 118 to the automatic door mechanism.

FIG. 3 illustrates a schematic diagram of sensor switch 60 of an embodiment. The entry/exit request sensor switch 60 utilizes a multiple electrode 14(n)

capacitive sensing for sensing through the glass door 20 and a capacitive sensing electrode 64 to service request on the side of the door that the sensor switch is mounted. In this configuration there are two return grounds 16,68. The return ground 16 for the multiple electrodes 14(n) are arranged such that the electric field 62 projected through the glass door 20 is relatively dense to ensure that false trigger or detection is not encountered by gap fillers such as brushes, door frames, and the like. The return ground 68 with electrode 64 provides the electric field 62 that is projected from the sensor switch. Electric field 62 does not project through the glass door 20. The return grounds 16,64 both act as shields to prevent inadvertent electric field crossing and interfering with the other electric field projecting from the other respective electrodes. The sensor switch 60 comprises the housing 12 which houses the necessary printed circuit board 26, components 18 as shown in circuit block diagram 140 of FIG. 7C, such as battery or regulator 116, capacitive sensing circuitry 112 and wired or wireless circuitry 118, as shown in FIG. 7C. The circuitry 140 may additionally comprise input detection data from N and Q numbers 142 of electrodes in the array of electrodes 14(n), decision entry/exit 132, and front/rear/front and rear selection 136 modules to provide output 144 from the wire/wireless circuitry 118 to the automatic door mechanism 108. The apparatus 60 is mounted on the glass door 20, with suitable adhesive. The printed circuit board 26 may be flexible or rigid. The printed circuit board 26 may be mounted in any position suitable within the housing 12.

A sensor switch 70 in accordance with an embodiment is shown in FIG. 4 is similar to sensor switch 60 shown in FIG. 3. Sensor switch 70, although how each embodiment utilizes capacitive sensing in the detection of a hand or object through the glass door, is slightly different. Sensor switch 70 comprises two array of electrodes 14(n), 74(n). Electrodes 14(n) are arranged with return ground 16 to project an electric field 62 through the glass panel as discussed with respect to FIG. 3. Electrodes 74(n) are arranged with return ground 78 to project an electric field 72 away from the glass panel 20. The components 18 of

the circuitry 140 shown in FIG. 7C required are similar to that required in the embodiment shown in FIG. 3, and includes additional inputs received from detection of disturbed electric fields by the additional electrodes 74(n). Capacitive sensing circuitry drives the multiple electrodes 14(1...n), 74(1...n) to project an Electric field 62, 72, respectively, which arc to the return grounds 16, 76, respectively. The components 18, capacitive sensing circuitry senses the level of the electric field 62, 72, respectively. When an object such as a hand or the like approaches sensor switch 70, the object may disturb either of the electric fields 62, 72. The components 18, capacitive sensing circuitry, may compare the rate and level of disturbance, to a pre-determined threshold. A transmission of output 144, via components 18 wired or wireless, is sent to the door operator for activation of the door, should the rate and level of disturbance be higher than the pre-determined threshold. By changing the threshold, the sensing distance may be adjusted.

As there are multiple electrodes 14(1...n), 74(1...n) when a hand or object approaches, not all the electric field 62, 72 may be disturbed sufficiently, i.e. not all of the multiple electrodes 14(1...n), 74(1...n) having detection. By setting a threshold of the number of detection of the multiple electrodes 14(1...n), 74(1...n), reduces false detection from objects whose width is smaller than a hand. The glass door 20, may be of any non-conductive material and of a dielectric similar to glass. Electric field 82 may pass through the glass door 20, with little loss. Allowing for detection of hand or object on the opposite side of the glass door 20. The multiple electrodes 14(1...n), 74(1...n) are formed from copper of the printed circuit board, which may be hatched or poured on one layer. The return ground 16, 76, is laid beneath and surrounding the multiple electrodes 14(1...n), 74(1...n), stretching for the whole length of the printed circuit board 26. This allows only projection of electric field to through the glass door 20, and not allowing the electric fields 62, 72 of the multiple electrodes 14(1...n), 74(1...n) from interfering each other.

For the purpose of illustration, apparatus 70 for serving request on the side it is mounted, utilize a capacitive sensing with a electrode mounted beneath the housing 12. Electrode 84, may comprise of single or multiple electrodes. The sensor switch 70 could also be configured with a switch 52, as described in sensor switch 50 with reference to FIG. 2.

The housing 12 may be of any non-conductive material, and need not to be of any particular dimension or shape but sufficient to be available to house the printed circuit board 26 and components 18.

FIG. 5 shows an array 90 of electrodes 94(n) that may be N-number of electrodes by Q-number of electrodes. In FIG. 5 the NxQ array of electrodes is a 6x6 array. The array may be any number of electrodes, and the electrodes may be any shape or form such as square, random, round or the like. Arrangement of the array may be in any formation. The return ground plate 96 is arranged with a space 98(n) between the return ground plate 96 and each electrode 98(n). The space between the return ground plate 96 and each electrode 98(n) may be any distance sufficient to produce an electric field.

In an embodiment of the array of electrodes, detection decision is by counting the number of electrodes triggered and comparing it with a pre-set threshold. For example the pre-set threshold may be any number, such as half of the number of electrodes. In FIG. 5 there are 36 electrodes shown. The pre-set threshold in this embodiment may be for example 18 electrodes. If more than 18 electrodes detect motion, i.e. the electric fields are disturbed by a certain threshold, the output is to activate the automatic door mechanism. Having a threshold of number of electrodes reduces the chance of false detection due to random objects not intended to trigger a exit/entry request. For example, water droplets or a gap filler 104 as shown in FIG. 6A-C, such as the door frame, gasket, brushes, and the like which may be in close proximity to the sensor switch 10. The number of electrodes selected to be a threshold is chosen such that it is not

likely that water droplet or gap filler triggering more than a threshold number of electrodes. A palm or hand is likely to trigger more than threshold number of electrodes. This configuration ensures that the sensor switch is less prone to false detection due to the close proximity to the door gasket, brushes, door frame, or the like.

It will be appreciated that a single motion sensor switch that may service the entry/exit request from both sides of the glass door such that a tactile press switch would not be required to be mounted on one side of the door panel such as the outside, reducing the vulnerability to vandalism. Moreover, it is more convenient to install one switch rather than two. Also, there would be advantages in terms of cost and usage on doors with small gap between the moving 20 and fixed 102 door panel as shown in FIG. 6A-C.

The present invention may be embodied in other specific forms without departing from the scope or essential characteristics thereof. The embodiments are, therefore, to be considered in all aspects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims and all changes which come within the meaning and range of equivalency of the claims are, therefore, to be embraced therein. While embodiments of the invention have been described and illustrated, it will be understood by those skilled in the technology concerned that many variations or modifications in details of design or construction may be made without departing from the present invention.

CLAIMS:

1. A capacitive sensor switch for installation on a surface of a panel of electric field penetratable material, the sensor switch comprising:
a first electrode and a second electrode, and a first return ground and a second return ground arranged to project an electric field through an electric field penetratable material, and circuitry for indicating a response to a disturbance in the projected electric field in accordance to a predetermined threshold, when at least one of the first and the second electrodes detects a disturbance above the predetermined threshold.
2. The sensor switch as claimed in claim 1 wherein the first and second electrode and the first and second return ground and the predetermined threshold are arranged to detect and indicate a response to a hand of a person or other intended target.
3. The sensor switch of claim 1 or 2 wherein the first and second electrode and the first and second return ground and the predetermined threshold are arranged to reduce the likelihood of false detection of objects having a smaller dimension than a hand of a person or other intended target.
4. The sensor switch of any one of claims 1 to 3 further comprising a housing for housing the first and second electrode and the first and second return ground.
5. The sensor switch of claim 4 wherein the housing is fixed to the electric field penetratable material panel by an adhesive or mechanical mounting.
6. The sensor switch according to any one of the preceding claims wherein the electric field penetratable material of the panel is glass.
7. The sensor switch according to any one of the preceding claims wherein the circuitry comprises capacitive sensing circuitry and reference capacitive circuitry for indicating a response to a disturbance in the projected electric field in accordance with a predetermined threshold of the reference capacitive circuitry.

8. The sensor switch according to any one of the claims further comprising a transmission module for transmitting the response.
9. The sensor switch of claim 8 wherein the transmission module is arranged for wireless transmission.
10. The sensor switch of claim 7 wherein the sensor switch is for indicating an entry/exit request to open/close an automatic door.
11. The sensor switch of claim 7 wherein the sensor switch is for indicating an entry/exit request to open/close an automatic window.
12. The sensor switch of claim 7 wherein the sensor switch is for indicating an entry/exit request to open/close an automatic gate.
13. The sensor switch of any one of the preceding claims further comprising a power supply.
14. The sensor switch of claim 11 wherein the power supply is a battery.
15. The sensor switch of claim 11 wherein the power supply is AC mains.
16. The sensor switch of any one of the preceding claims wherein the first and the second electrode comprises a plurality of electrodes.
17. The sensor of claim 15 wherein the plurality of electrodes form an array of electrodes.
18. The sensor switch of any of the preceding claims further comprising a shield between the first electrode and the second electrode or between the plurality of the electrodes to separate the resulting electric fields projected from the respective electrodes.
19. The sensor switch of any of the preceding claims wherein the additional electric field is projected through the electric field penetratable material.

20. The sensor switch of any of the preceding claims wherein the additional electric field is projected away from the electric field penetratable material.
21. The sensor switch according to any one of claims 19 to 20 wherein the first and the second electrode comprises a plurality of electrodes.
22. The sensor switch according to claim 21 wherein the plurality of electrodes are formed into an array of electrodes.
23. The sensor switch according to claim 21 or 22 wherein the circuitry comprises capacitive sensing circuitry and reference capacitive circuitry for each the plurality of electrodes for indicating a response to a disturbance in the projected electric field in accordance with a predetermined threshold of the reference capacitive circuitry.
24. The sensor switch of claim 23 wherein the electrodes and the return grounds and the predetermined threshold are arranged to reduce the likelihood of false detection of objects having a smaller dimension than a hand of a person or other intended target.
25. The sensor switch of any one of claims 19 to 24 wherein the response is indicated if more than half of the electrodes in the plurality detect a disturbance above the predetermined threshold.
26. The sensor switch of any one of the preceding claims wherein the material of the electrode is copper, silver, gold, aluminum, or alloys thereof.
27. The sensor switch of any one of the preceding claims where the electrode is formed on a printed circuit board.
28. The sensor switch of any one of the preceding claims wherein the electrode is formed from the housing which is of a conductive material.
29. The sensor switch of any one of the preceding claims further comprising a switch for detecting the disturbance of the electric field.
30. A system for detecting a request to move a panel, the system comprising:

a mechanism for moving the panel;
a sensor switch according to any one of claims 1 to 29 mounted on the panel;
and
a controller responsive to a signal from the sensor switch for controlling the mechanism for moving the panel.

31. A method for detecting a request for entry/exit of an automatic door, comprising:
arranging an electrode and a return ground to form a capacitive sensor switch to project an electric field through a panel of electric field penetratable material;
sensing a disturbance of the electric field; and
indicating a signal upon sensing a disturbance above a predetermined threshold determined by the projection of the electric field by the arrangement of the electrode and the return ground.