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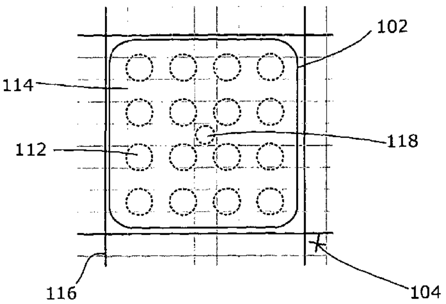

Fig 14

(57) Abstract: Contact-sensitive displays allow for easy interaction between a user and a computing device. They do however enable a much wider range of interaction with an application than simply detection of a human finger. We propose that one or more pads be placed on the underside of an object in order to allow an application running on the computing device to determine information about the object such as location and/or orientation of the object, identification data and/or internal state information. The combination is therefore disclosed of a computing device having a contact-sensitive display panel capable of resolving a plurality of contact points on the display panel, a software application loaded onto the computing device, adapted to receive location information as to the plurality of contact points; and an object having a face placeable against the display panel on which is defined a plurality of contact pads adapted to be recognisable by the display panel, wherein the application is adapted to determine details of the object based on the relative positions of the pads. The pads can be selectably conductive for more complex operation. The object preferably has a lower face that is substantially planar, thereby enabling it to stand in a stable and unsupported manner on the display. An object for placing on a contact-sensitive display panel is also disclosed, comprising at least one pad adapted to be recognisable by the display panel. Such an object is ideally stable standing in an upright state on the panel.

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Interaction with Touch Screen Devices

FIELD OF THE INVENTION

The present invention is concerned with the range of possible interactions between touch screen devices and the world outside them.

BACKGROUND ART

There are many types of input device for computing systems, including buttons, keyboards, mice, trackballs, joysticks, touch sensor panels, touch screens and the like. Of these, touch screens are becoming increasingly popular because of their ease and versatility of operation, as well as their declining price. Touch screens typically include a touch sensor panel, which can be a clear panel with a touch-sensitive surface, and a display device such as a liquid crystal display (LCD) that can be positioned partially or fully behind the panel so that the touch-sensitive surface extends over at least a portion of the viewable area of the display device. Touch screens then allow a user to perform various functions by touching the touch sensor panel using a finger, stylus or other object. In this way, they can interact with a user interface (UI) displayed by the operating system (OS) or application that is controlling the display device.

One design of touch sensor panel typically comprises one or more layers of thin film, deposited and patterned into conductive regions upon at least one layer of a transparent substrate. The conductive regions include a number of capacitive elements arranged into a plurality of rows and columns. When a user's finger contacts a specific region of the touch surface, the approximate location of the user's finger can be determined based upon analysis of one or more sensed signals. Such screens allow "multitouch" functionality, i.e. the independent recognition of more than one "touch event".

The width of the typical human finger is relatively large (roughly 10 mm) in relation to at least one dimension of a capacitive element, but it seems that the resolution of contact-sensitive displays is in fact quite fine. Although the contact-sensitive screens that use row & column formats have relatively wide spacing between adjacent rows and columns, the technology allows measurement of how far a touch is from each of a pair of rows – for example, it can identify that the touch is at a position three quarters of the way between (say) row 9 and row 10.

This is because the user interface requires a higher resolution than finger size, for applications to work correctly. Applications and items such as paint applications, menus, buttons etc are often smaller than a finger, and may not be aligned to the touchpad grid. As a result, it is believed that the user interface on an Apple iPad measures touches with a resolution of about 0.3mm.

Another design of touch sensor panel comprises two conductively-patterned sheets separated by a deformable insulating layer. At least the outer conductively-patterned sheet is flexible. Thus, a point contact with the outer layer deforms the layer and the insulating material beneath that point, to bring the conductively-patterned sheets closer together. This will then affect the capacitance and/or the resistance between the conductively-patterned sheets. By adopting a suitable pattern of conductive regions on the sheets, the location of that touch can be determined.

Generally, touch screens can be overlaid onto any type of standard screen technology (OLED, LED, LCD, etc). The two important subsystems to touch screen technologies are the screen overlay itself (of whatever type) and a controller which processes the variations in electrical properties of the overlay to give useful information about the finger touch(es).

The signal flow might then be pictured in simplified terms as follows, where the various elements are highly inter-dependent:

Device on screen → screen overlay → controller → device OS → software application

Such panels, whether of one of the above types or a different type, will be referred to herein as "contact-sensitive" displays.

SUMMARY OF THE INVENTION

Contact-sensitive displays are intended to provide an easy and intuitive means for a user to make selections and otherwise interact with an application running on a computing device. We have realised, however, that their use is not limited to this and that they enable a much wider range of interaction with an application than simply detection of a human finger.

In particular, it is possible for items other than a human finger to trigger the display. Capacitively-sensing displays can be triggered by a reasonably-sized conductive element placed against the display panel so as to cover at least one of the sensor areas. Others can be triggered by a suitably pointed protrusion that is able to create the necessary localised deformation of the screen. Both are exploited in the design of styluses (or styli) which users can employ. However, a stylus does not extend the capability of the device, it merely replaces the user's finger.

The present invention proposes that one or more pads be placed on the underside of an object in order to allow an application running on the computing device to receive data from the object via the display panel. At its simplest, that information could simply be information about the object, including the location and/or orientation of an object such as a play piece for a game illustrated on the display panel. In more complex embodiments, the information could include identification data as to the object, and/or internal state information relating to the object, and/or data held by the object which is to be transferred to the device.

The present invention therefore provides the combination of a computing device having a contact-sensitive display panel capable of resolving a plurality of contact points on the display panel, a software application loaded onto the computing device, adapted to receive location information as to the plurality of contact points; and an object having a face placeable against the display panel on which is defined a plurality of contact pads adapted to be recognisable by the display panel, wherein the application is adapted to receive data from the object encoded in the location information as to the plurality of contact points.

The data received by the application can include details of the object, such as orientation data relating to the object, data relating to the nature of the object, and/or data relating to the identity of the object. Data from the object can be encoded in some or all of the relative positions of the pads, the strength of the signal detected by the display panel, and a variation with time of the signal detected by the display panel, or otherwise. The application can determine the details of the object by comparing the location information as to the plurality of contact points to a database of object details, although preferably the application will normalise the location information as to the plurality of contact points prior to comparison.

The pads are preferably in a pattern with limited or no rotational symmetry, and can comprise a bump on the face of the object and/or a conductive region on the face of the object. In the latter case, the pads can be selectably conductive, for example becoming conductive when the object is activated by a user such as through use, touch and/or movement.

The object preferably has a lower face that is substantially planar, thereby enabling it to stand in a stable and unsupported manner on the display.

The present invention also relates to an object for placing on a contact-sensitive display panel, comprising at least one pad adapted to be recognisable by the display panel. Such an object is ideally stable standing in an upright state on the panel. Other preferred features of the object are as defined above.

The contact pads can comprise, or consist of, a conductive or an electrolytic layer, to provide an adequate signal via the contact-sensitive display panel. A conductive polymer is especially suitable, particularly a resilient conductive polymer such as a conductive nitrile or Nitrile butadiene rubber (NBR), or silicone. The contact pads preferably have electrical connection with an exposed contact surface elsewhere on the object, as the contact pads are more easily detectable when grounded, either directly or via the capacitance of a human user.

BRIEF DESCRIPTION OF THE DRAWINGS

An embodiment of the present invention will now be described by way of example, with reference to the accompanying figures in which;

Figure 1 shows a first embodiment of the invention, from above;

Figure 2 shows the first embodiment from one side;

Figure 3 shows an alternative version of the first embodiment, from one side;

Figure 4 shows an arrangement for an active pad;

Figure 5 shows an alternative arrangement for an active pad;

Figure 6 shows a second embodiment of the invention, from above;

Figure 7 shows the second embodiment, from one side;

Figures 8 to 13 show pad arrangements for the second embodiment;

Figure 14 shows a third embodiment of the invention, from above

Figure 15 shows the third embodiment from one side; and

Figure 16 shows an alternative design of an active pad.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Figures 1 and 2 show a first and simplest embodiment of the present invention. Figure 1 shows the contact-sensitive multitouch display panel 10 in plan view (i.e. in the direction normally viewed by a user). Lighter lines 12 delineate the square grid of touch-sensitive elements within which a touch by a user will be recognised as a "touch event" and passed to the application running on the device.

A larger grid 14 is displayed on the screen and visible to the user, this forms a chequerboard pattern with a linear spacing of (in this case) three times the touch-sensitive grid. In practice, alternate diagonal squares of the chequerboard will be shown in a contrasting colour in order to contrast with the remaining squares, and the chequerboard grid will ideally match closely to the touch-sensitive grid unless the latter has a much higher resolution than the former. However, for illustrative purposes the shading is omitted and the grids are shown slightly displaced so that both can be discerned.

A user can then place one or more chequer pieces 16 on the display. Each consists of a solid disc 18, on the underside of which is a pad 20 of a conductive or electrolytic material. that is capable of activating the contact sensors of the display panel 10. The discs 18 are sized to fit neatly within one of the chequerboard squares 14, and the pad 20 is about half the diameter of the disc 18 and therefore comfortably covers a square of the touch-sensitive grid 12. Activation of the contact sensors of the display panel 10 may be made easier by creating a conductive path from the pad 20 to ground or to the dock connector. This can be done via a user's finger, for example during the period when the user is placing the piece 16 on the display.

An especially suitable material for the conductive pad is a conductive Nitrile butadiene rubber or silicone polymer. Such materials with a volume resistivity of 5 ohm meters or less can be prepared, such as by starting with NBR 3250, NBR 6240 or NBR 6250 (available from LG Chem, of Seoul, Korea) and adding sufficient graphite powder to achieve the correct conductive properties. The relative softness of such materials allows them to conform to the shape of the screen and establish a good capacitive contact. They can be conductively linked to an exposed contact elsewhere on the surface of the object, which can be touched by a user's finger or otherwise grounded to create the necessary capacitance for a touch event to be recognised. Such materials are also mouldable (for example by injection moulding or compression moulding), allowing the required shapes to be created easily.

Thus, the application can be provided with accurate positional data regarding the discs 18 by way of their interaction with the display panel 10. This enables a game of chequers (also known as checkers, or draughts) to be played intuitively. The player can move his or her pieces across the board that is displayed on the display panel and the application will be able to detect those moves.

This permits a number of styles of gameplay. Two real persons can play, using the screen as the board and with the application checking the legality of moves and alerting the players appropriately when an illegal move is made. A real person could play against the application, with the application's virtual pieces being displayed digitally on the display panel and an AI engine of the application determining the device's next move. A real person could also play against a remote real person, with both people using compatible devices and each device displaying a set of virtual pieces corresponding to the remote person's physical pieces.

In other variations, the relative proportions of the two grids could be changed. Each chequerboard square could correspond to a single touch-sensitive pixel, or to more than 9 pixels.

A variant form of the physical game piece 16' is shown in figure 3. The pad 20' is surrounded by an annular trim region 22 that is of the same thickness as the material of the pad 20' and therefore gives the piece 16' a smooth lower surface. Alternatively, the pad 20' could be recessed into the disc 18'.

Some contact-sensitive multitouch display panels are only able to report a limited number of touch events. For example, applications running on the Apple iPad are given access to a maximum of about 10 or 11 simultaneous touch events, although it is thought that the operating system is able to distinguish more. This restriction will no doubt be relaxed in due course as the technology develops, but in the meantime it may prove to be a limitation. To avoid this, the game could be limited accordingly, or the play pieces could be selectively activated, for example when touched or moved. Thus, when the play piece senses that it is being touched, the pad 20 becomes conductive substantially immediately, and is detected by the application. The application now knows that the play piece is being touched and may move. If it disappears from the contact-sensitive screen and a new touch event happens on a square that did not previously have a play piece, then the application knows that the play piece has been moved to that square. This could also allow the concept to be applied to non-multitouch screens.

This could be achieved by providing semiconducting areas on the underside of the play piece. Alternatively, a thin conductive layer could be provided which is (on its own) unable to trigger the contact-sensitive screen but which is selectively connectable to a more substantial conductive element, with the combined capacitance of the two being sufficient to trigger the screen. The selective connection between the two could be active, or it could be passive by way of conductive tracks on the surface of the play piece which are bridged by a finger – which will of course add further capacitance. In this way, a touch-sensitive element (in the form of the play piece) decides when to activate the touch-sensitive screen.

Figure 4 shows another way of providing a selectively conductive (or "active") pad 20. The circular pad is divided into several segments, in this case four segments 20a, 20b, 20c, 20d. The total number of segments can be decided on so that the individual segments do not present sufficient capacitance to trigger a touch event, but the segments when connected do present sufficient capacitance. Thus, wires or conductive tracks 24, 26, 28, 30 or the like lead from each lead from one pad 20a-20d to a switch 32. This has a conductive element 34 which is able to bridge all the conductors 24, 26, 28, 30 when the switch is activated and (electrically) join the pad segments 20a-20d. The conductive element 34 can be a part of the switch or it can be the surface of a user's finger, which will usually have sufficient conductance.

Where (in effect) a number of pads exist very close together in this manner, and they are selectively connected via the user's finger, then rather than seeing distinct touches the display will think it's seeing a pattern of small movements. This is because the centre of the capacitive coupling to the piece (effectively the 'average' position) will be moving around as the shape of the coupled area changes. Each piece could then have a signature pattern of movement. 'Gesture recognition' systems included in operating system software could then be used to distinguish between pieces.

Figure 5 shows an alternative arrangement. A number of nesting conductive spiral tracks (in this case, two) 36, 38 define the pad 20. Each leads to a switch 40, allowing the two tracks to be joined thereby increasing the capacitance of the pad 20 above the threshold necessary to trigger a touch event.

The various devices available on the market at present include a wide variety of contact-sensitive displays, each of which have such a wide variety of resolutions and sensing mechanisms. It is therefore likely that that various active pad arrangements described above will work on only some of the available devices but not on others.

Figures 6 and 7 show a development of the first embodiment, allowing a game of chess to be played. This involves the additional complexity that the play pieces are non-identical, consisting of two rooks (castles), knights and bishops, one queen, one king, and eight pawns for each player. Thus, the application needs to distinguish between these. One way of doing so is by remembering; provided that the play pieces are set out in the correct pattern at the start of the game, the application can thereafter follow which moves are made and therefore remember which piece is in which location. However, this may be vulnerable to set-up errors and is not resilient to later mistakes.

Figures 6 and 7 therefore show a second embodiment, adapted for a game of chess (or similar board games). In this example, a single square 50 of the chequerboard pattern corresponds to a larger number of touch-sensitive pixels 52 on the display 54, in this case 7x7 but other relative sizes are possible. Clearly, this requires the overall play area to be larger or the individual pixels to be smaller.

This allows the play piece 56 to be provided with a number of conductive pads 58, 60, 62 rather than just one as in the first embodiment. As in the first embodiment, these can be selectively conductive if required, such as to limit the total number of simultaneous touch events with which the device will need to cope. Such a plurality of pads allows different types of play piece to be distinguished from each other and their identity confirmed.

This is illustrated in figures 8 to 13. Figure 8 shows a simple pattern suitable for the commonest pieces, the pawns 64, which consists of one central pad 66. Figures 9 and 10 show more complex patterns for the king 68 and queen 70, each of which includes 3 pads arranged in a distinctive pattern. Thus, the three pads 72, 74, 76 beneath the king piece 68 are arranged in a straight line; one pad 74 at the centre of the piece 68 and the other two pads 72, 76 on either side. The queen 70 has three pads 78, 80, 82 arranged in a triangular pattern.

As a result, if the device detects only one pad 66, it can conclude that the square 50 is occupied by a pawn 64. If it detects three pads then it knows the square 50 is occupied by a king or queen; if the three pads 72, 74, 76 are aligned then the piece must be the king 68 whereas if they are not aligned then the piece must be a queen 70.

Figures 11 to 13 show possible patterns for the other chess pieces, the rook 84, knight 86 and bishop 88 (respectively). Each of these has two pads, arranged in unique patterns. To allow for possible rotation of the play piece and for possible offset positioning of the piece within the square 50, these rely on the distance between the pads. Thus, the rook 84 has two widely-spaced pads 90, 92 with approximately three touch-sensitive pixels between them. The knight 86 has two intermediately-spaced pads 94, 96, spaced by about two touch-sensitive pixels, and the bishop 88 has two closely-spaced pads 98, 100, spaced by a single touch-sensitive pixel.

The allocation of pad patterns to particular pieces is of course entirely arbitrary. All that is needed is sufficient unique patterns to cater for the number of unique pieces in the game. Generally, if there are more of some pieces than others then it may be advantageous to alloacte patterns with fewer pads to those pieces so that the total number of touch events that need to be tracked can be minimised. Equally, more patterns could be employed so that (for example) individual pawns could be distinguished from each other. This might require a greater number of pads, a greater number of pad patterns, or the use of a time- or intensity-varying pad or pads.

With the chess pieces thus identifiable and locateable on the board, the application running on the device can play, supervise or enable chess games as described above in relation to draughts. Thus, a user can play against another user, or against the computer, or against a remote user.

One challenge is of course to work out which dots (contact points) are from which piece. In the chess case (above) this is solved by the rules of chess, which insist that the piece is within a defined square, and that there is only one piece in a square at a time. Another way to solve this would be to provide an annular ring around the identifying pattern, which would stop the pieces getting too close together in a game where pieces are not aligned to a grid (either because there is no grid or because more than one piece is allowed on a square at a time). Where pieces are stackable (e.g. in draughts) this could be recognised by having a contact which is normally floating, but which is bridged to the others when a piece is placed on top.

Based on the above concept, a wide variety of games can be embodied. As well as traditional board games, other board games or any piece-based game can be implemented. Playing pieces could be distributed separately to the game software, for example as free gifts with other purchases such as fast food, or as collectable sets of cards or toys. Different pieces or cards could be provided with a different pattern of pads that can be interpreted by the game software accordingly, such as to enable aspects of the game or gameplay thereby creating a perceived value for the piece.

Figures 14 and 15 show a third and further embodiment of the present invention, in which the use of active pads such as are described above and illustrated in figures 4 and 5 is extended to allow for greater interaction between the play piece and the display. In this case, the play piece 102 resting on the display panel 104 is in the form of a small or handheld electronic device, of a form factor similar to that of a Tamagotchi®, mobile telephone, or mp3 player.

The play piece 102 is itself a computing device, able to run an application or embedded software that may provide a game or other function, controlled via buttons 106, 108 and displayed on a small screen 110. For example, the well-known Tamagotchi® device allows a user to interact with a virtual pet, and depending on the user's actions the pet may thrive, grow, multiply, or become ill and/or die. Different games (or other software) will generally show an input-related development over time. Thus, the data retained by the play piece will change over time.

To allow this development to be communicated from the play piece 102 to the device, the play piece has a plurality of active pads 112 on its underside, and therefore in contact with the display panel 104. These are arranged in an array that is spaced to correlate with spacing of contact-sensitive pixels 114 of the display panel 104, and are sized to match one pixel 114. For clarity of illustration, in this embodiment the pads 112 are spaced at twice the pitch of the pixels 114 and thus each pad 112 has a clear pixel 114 between it and the adjacent pad. To assist the user in correct placement of the play piece 102 on the display panel, guidelines 116 are shown on the display 104. These can correlate with the external shape of the play piece 102. Alternatively, an image of the play piece 102 could be shown on the display 104.

In other embodiments, the pads may be more closely spaced so as to use the available pixels more efficiently, so that there is a 1:1 relationship between the pixels 114 and the pads 112. Equally, a greater or lesser number of pixels could be provided; the 4x4 grid of 16 pixels shown in figure 14 will allow for 16-bit communication between the play piece 102 and the device.

The active nature of the pads 112 allows them to be controlled by the play piece so as to choose a pattern of conductive pads 106 that sends a specific message to the device. For example, with 16 pads 112 as shown, this allows over 60,000 different static states to be communicated. In theory, the upper limit is 2^{16}-1, if we assume that the null state is to be discounted as this is indistinguishable from the absence of the play piece. In practice, limits on the number of simultaneously recognisable touch events (such as the limit of about 10 or 11 mentioned above) will reduce this, as combinations in which more than the maximum number of bits are set to 1 will not be recognised. The actual total may be lower still, depending on what assumptions we make. For example, a (theoretical) upper limit of 2^{16}-17 applies if we also discount single-pad states which may be somewhat more difficult to identify reliably. Alternatively, reducing the theoretical upper limit to 2^{12}-1 allows us to use the four corner pads as reference points for locating the other 12 pads, which reduces the total number of states to just over 4,000 (if unlimited pads can be recognised) but may be more reliable in practice. This may be adequate for a wide range of devices; if not, then either more pads 112 could be provided and/or the state of individual pads could be made time-dependent.

Generally, *'n'* usable active pads can adopt up to 2^n-1 states, and *'n'* pads with a state that is variable with a time period of *'t'* will be able to communicate about (2^n-1)T/t states over a time T. There is some approximation in this latter figure in that it may be possible to use the null state for intermediate states (i.e. other than the first and last state).

In this way, the play piece 102 can communicate data to the device via the contact-sensitive screen. This allows the result of prior inputs to the play piece 102 to be passed to the device easily, just by placing the play piece on the device display. The play piece 102 shown in figures 14 and 15 can also receive data from the device via a photo-sensitive element 118 which is positioned so as to view a part of the display. This permits the device to receive a time-varying signal sent by illuminating the appropriate pixels of the display panel. With two-way communication of this type, handshake and error correction protocols also become possible. Alternatively, other forms of wireless communication could be used instead of or in addition to the above, such as Bluetooth, WiFi, etc.

The active pads 112 of the play piece 102 of the third embodiment can be as described above in relation to figures 4 and 5, or they may be as illustrated in figure 16. This shows a section through a pad 112. A thin conductive film 120 is provided at the base of the pad, perhaps covered with a protective layer (not shown). This is covered with an insulating layer 122, and above that is a larger conductive mass 124. A semiconductor switch 126 is provided between the two conductive elements 120, 124 and is connected to each via wires or conductive tracks 128, 130. The switch 126 may be provided within the pad 112 (as illustrated) or elsewhere within the play piece 102.

To activate the pad 112, the switch 126 connects the two conductive elements 120, 124. This causes the effective capacitance of the thin film 120 to increase. Through careful design of the thicknesses of the various conductive and insulating layers 120, 122, 124 it is possible to ensure that this increase in capacitance takes the capacitance of the pad 112 from under the threshold for triggering a touch event to over the threshold.

Alternatively, an active pad can consist of a conductive element in the underside of the object, selectively connectable to an exposed contact. Thus, provided the exposed contact is being touched or grounded, the active pad will cause a touch event when it is connected to the exposed contact. Connection can be by any form of switch that has a sufficiently low capacitance. Suitable switches include relays or low capacitance semiconductor switches such as a high speed RF FET (Field Effect Transistor), for example the Avago Technologies part number ATF-53189-BLK.

The light-sensitive elements for receiving information from the touch-sensitive screen can be LED elements, as these are easily available and inexpensive. These are colour-sensitive, which allows a degree of multiplexing. Separate channels could be transmitted via, for example, a red and a green LED both aimed at substantially the same area of screen. By illuminating that area in a selected colour, one or both LEDs could be activated according to a simple truth table:

Screen colour	Channel 1	Channel 2
Black	0	0
Red	0	1
Green	1	0
Yellow	1	1

One channel could be a clock signal, and the other channel a data signal. This will be useful on many devices, such as the Apple™ iPad™ in which the application associated with the object may not necessarily have exclusive access to the device resources. Thus, if a different application or process temporarily changes its level of usage of the processor (for example), the rate of image updating by the object-related application may change. A clock signal will allow the object to cope with this.

A range of other types of object are also possible. For example, a doll-type toy could include sufficient pads (or any desired type) for the device to recognise its orientation and/or position, stance, pose etc. This doll could then interact with the application running on the device.

Thus, the invention provides a range of types of pad, including:

'Passive' pads, normally arranged in multiples, arranged to communicate the identity and/or the position of an object,

'Active' pads, which are selectively active so as to transmit state information and the like (such as, that a chess piece is being or about to be moved) etc, and

'Smart' pads which can communicate data through the touchscreen from the object to the computing device (and vice-versa, if combined with photosensitive or like devices).

As noted above, the two main types of contact-sensitive screens are resistive touch screens and capacitive touch screens. There is active ongoing debate about the relative pros and cons of resistive vs. capacitive touch screen technologies. Generally, there are price advantages to resistive screens, versus the multi-touch capabilities of capacitive screens. As a result, there is no clear agreement about the importance of multi-touch and how this will evolve. In the above, we refer to a plurality of contact points which is most easily embodied in a multi-touch screen, which will usually be capacitive. However, the principle is applicable to resistive screens either by adopting a more limited form of application (such as the draughts/checkers game described above) or by using other means to inform the device as to the identity of the object, such as encoding the identity data via a a time-varying signal or in the signal strength, or a combination of both.

Likewise, we describe a matrix of sensors for the touch-sensitive screen. In practice, there are several different physical formulations for the overlay in each case (resistive and capacitive). These vary from matrices of sensing elements to continuous (analogue) measurement systems.

For example, a mutual capacitance screen is a true matrix of sensing elements as described above. Screens based on "Self capacitance" measure along vertical and horizontal lines, which can be thought of as a matrix grid of sensing elements. A 4-wire resistive screen, on the other hand, has a continuous voltage gradient across the x and y axes. In that case, the screen does not have pixel elements as such but does report a location.

Thus, we can cause the object to vary four types of variables on a touch screen in order to determine the location and identity of an object placed on the screen. These are the location, orientation, time and strength of the signal.

The above makes it possible to enhance a game in a number of ways. Thus, in addition to re-creating existing games on touchscreen devices, new types of game can be created which allow for interaction between a physical game piece and the touchscreen device.

For example, UI elements can be made to appear on the screen around an object or figure placed upon it. These can be related to the figure, such as buttons to make that figure do something (for example attack another figure or otherwise interact with an object), status bars, or numbers, or other indications relating to that figure, (for example its name, or game quantities like health or money).

Action buttons on the figure itself could cause the activation of an additional touch pad on its base. These could take the form of a simple conductive pad on top of the figure which is hand operated, or a mechanical switch which connects an extra pad.

Light pipes could be provided within the object. A light pipe could carry light from the screen beneath the object to an externally visible location such as the eyes of a figure represented by the object. The pads on the base of the figure could be used to work out where the base of the light pipe is, and the appropriate region of the screen then illuminated with the appropriate colour.

Extra pads can be provided on any moving parts of an object, such as on the end of an arm of a figure, to allow more detailed interaction.

Other items could be provided for use in conjunction with the object and the touchscreen device. A board with an appropriately shaped hole could receive the touchscreen device and provide a surrounding playing context. The hole could have a dock connector for the touchscreen device, allowing a wide range of functions such as power for the touchscreen device, an earth for the objects, or more complex interaction with the application running on the device. The hole could show all of the touchscreen, or part of it. Part of the hole could overlie a part of the touchscreen, and have an active pad or pads which touch the screen, to allow for communication between the board and the device. Similarly, a light sensor can be provided for the device to communicate with the board.

In a further development, the present invention can be used to allow a touchscreen device to recognise a roll of a die or dice. The dots of the die or dice could be contact pads, internally electrically connected if required. This will allow the screen to see what is on the bottom of the die or dice, and hence read the die.

It will of course be understood that many variations may be made to the above-described embodiment without departing from the scope of the present invention. In particular, it is to be expected that the abilities of contact-sensitive displays will develop over time. Linear developments such as improvements in resolution and improvements in the number of discrete touch events that can be recognised simultaneously will extend the complexity of the above-described embodiments in a corresponding manner. Other developments will allow more varied adjustment of the embodiments; for example, future contact-sensitive displays may be able to detect different shapes and sizes of capacitive contacting objects which will permit the information about the object to be encoded using shape and size rather than merely pixel number and position. Displays may also be triggered by properties other than capacitance, leading to corresponding adjustment of the nature of the contacting pads.

CLAIMS

1. The combination of;

a computing device having a contact-sensitive display panel capable of resolving a plurality of contact points on the display panel;

a software application loaded onto the computing device, adapted to receive location information as to the plurality of contact points; and

an object having a face placeable against the display panel on which is defined a plurality of contact pads adapted to be recognisable by the display panel;

wherein the application is adapted to receive data from the object encoded in the location information as to the plurality of contact points.

2. The combination according to claim 1 in which the received data consists of information concerning the object.

3. The combination according to claim 2 in which the information concerning the object includes orientation data relating to the object.

4. The combination according to claim 2 in which the information concerning the object includes data relating to the nature of the object.

5. The combination according to any one of claims 2 to 4 in which the information concerning the object includes data relating to the identity of the object.

6. The combination according to any one of the preceding claims in which data from the object is encoded in the relative positions of the pads.

7. The combination according to any one of the preceding claims in which data from the object is encoded in the strength of the signal detected by the display panel.

8. The combination according to any one of the preceding claims in which data from the object is encoded in a variation with time of the signal detected by the display panel.

9. The combination according to any one of claims 1 to 6 in which the application determines details of the object by comparing the location information as to the plurality of contact points to a database of object details.

10. The combination according to claim 9 in which the location information as to the plurality of contact points is normalised by the application prior to comparison.

11. The combination according to any one of the preceding claims in which pads are in a pattern with limited rotational symmetry.

12. The combination according to any one of claims 1 to 10 in which the pads are in a pattern with no rotational symmetry.

13. The combination according to any one of the preceding claims in which the pads comprise a bump on the face of the object.

14. The combination according to any one of the preceding claims in which the pads comprise a conductive region on the face of the object.

15. The combination according to claim 14 in which the pads are selectably conductive.

16. The combination according to claim 15 in which the pads are selectably activated by a user.

17. The combination according to claim 15 in which the pads are made conductive when the object senses use.

18. The combination according to claim 15 in which the pads are made conductive when the object senses touch.

19. The combination according to claim 15 in which the pads are made conductive when the object senses movement.

20. The combination according to any one of the preceding claims in which the object has a lower face that is substantially planar.

21. An object for placing on a contact-sensitive display panel, comprising at least one pad adapted to be recognisable by the display panel, the object being stable when resting on the panel.

22. An object for placing on a contact-sensitive display panel, comprising a plurality of pads adapted to be recognisable by the display panel.

23. An object according to claim 22, being stable when resting on the panel.

24. An object according to claim 21 or 23, being stable when standing in an upright state on the panel.

25. The combination of;

a computing device having a display panel;

a software application loaded onto the computing device,; and

an object having a face placeable against the display panel on which is provided a light-sensitive element;

wherein the application is adapted to send data to the object by encoding the data as a digital signal, and selectively illuminating a part of the display panel in accordance with the digital signal; and

the object is adapted to receive the data from the application by sensing the illumination via the light-sensitive element.

26. The combination according to claim 25 wherein the light-sensitive element is an LED device.

27. The combination according to claim 25 or claim 26 wherein the application is adapted to encode a plurality of digital signals, and simultaneously transmit the plurality of signals via the same part of the display panel, by illuminating the part in a colour selected in accordance with the plurality of digital signals.

28. The combination according to claim 25 or claim 26 wherein the object comprises a plurality of light-sensitive elements, each responsive to a different colour.

29. The combination according to any one of claims 1 to 20 or 25 to 28, or the object according to any one of claims 21 to 24, wherein the object includes a substantially transparent element leading from the or a face placeable against the or a display

panel, and adapted to conduct visible light from the display panel to a different external face of the object.

30. An object for placing on a contact-sensitive display panel substantially as any one herein described with reference to and/or as illustrated in the accompanying figures.

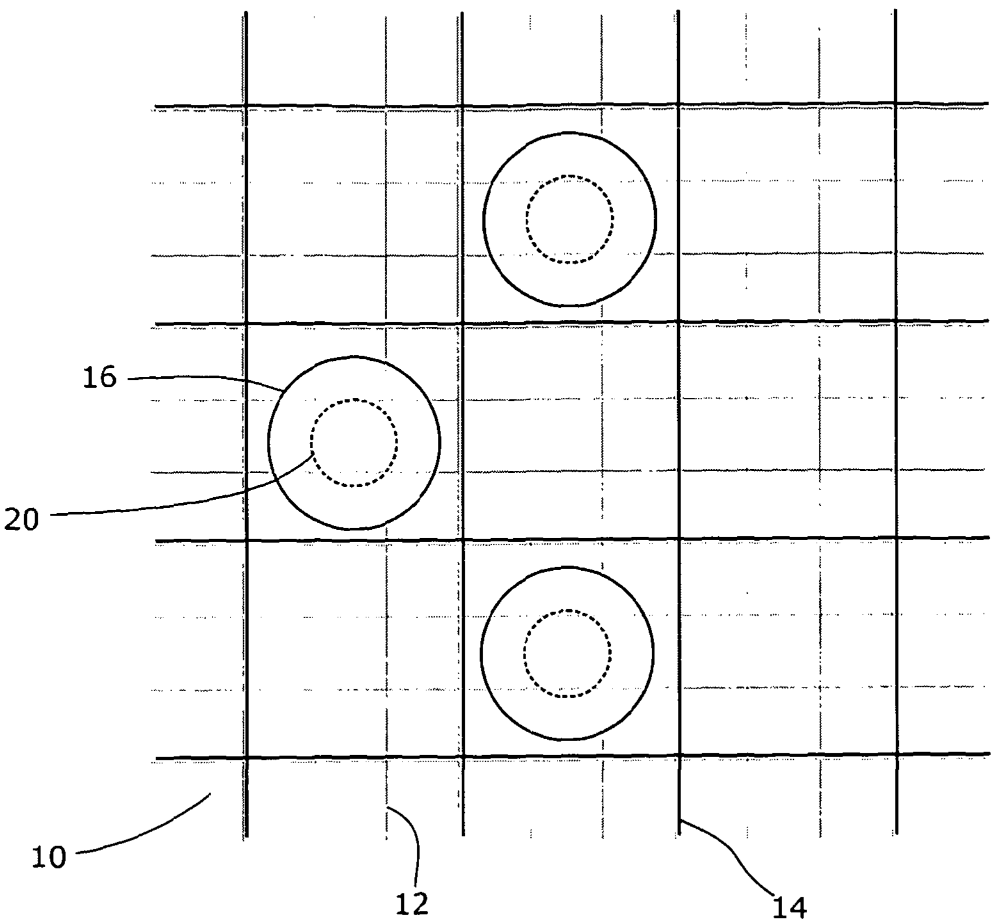
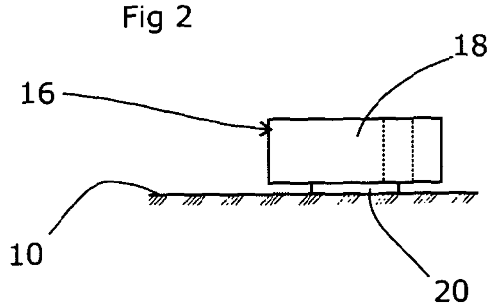


Fig 1

Fig 2



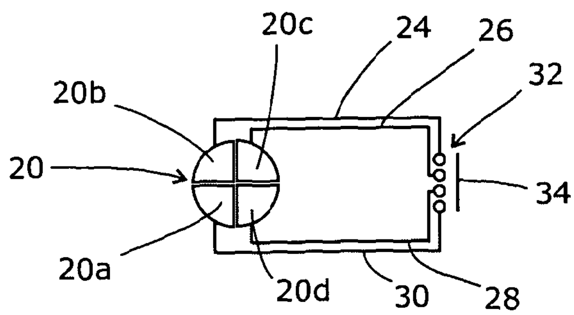
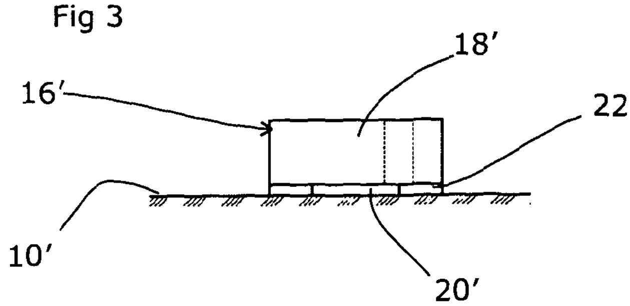


Fig 4

Fig 3



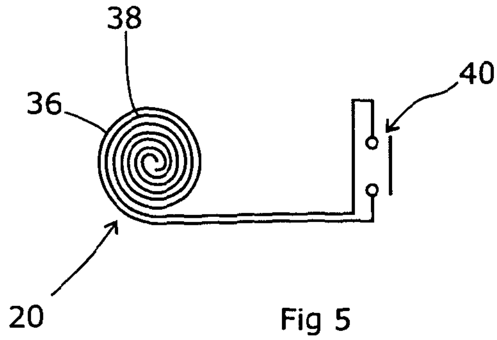


Fig 5

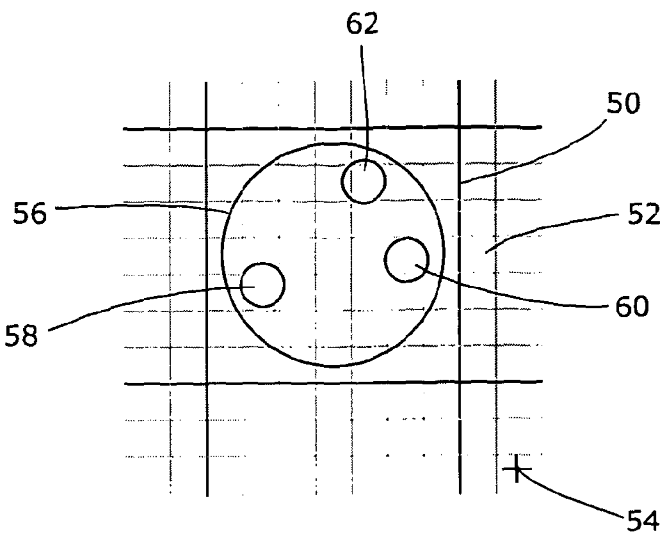


Fig 6

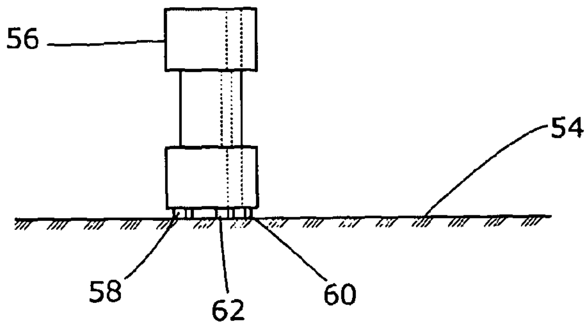


Fig 7

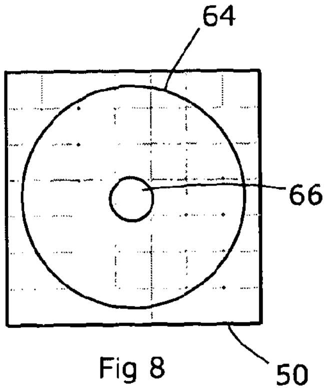


Fig 8

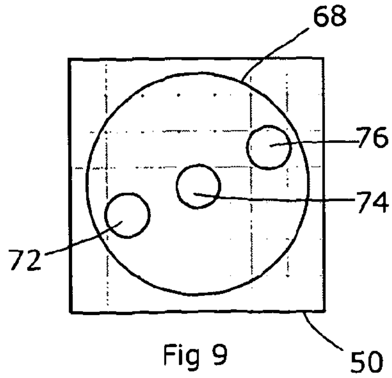


Fig 9

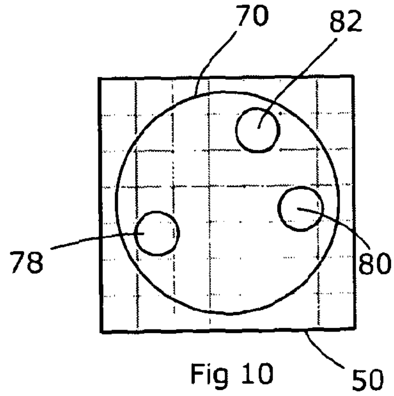


Fig 10

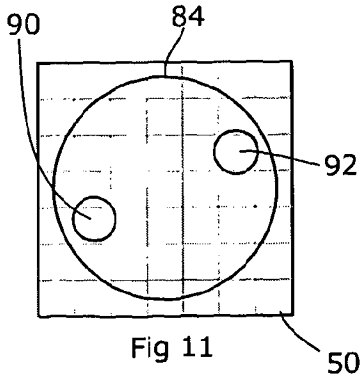


Fig 11

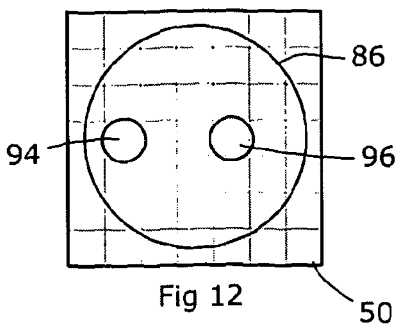


Fig 12

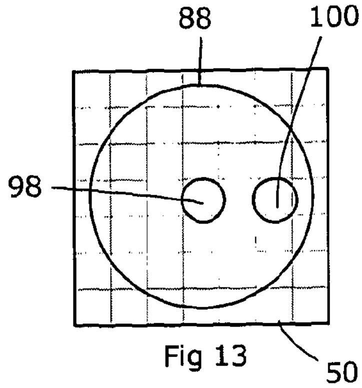


Fig 13

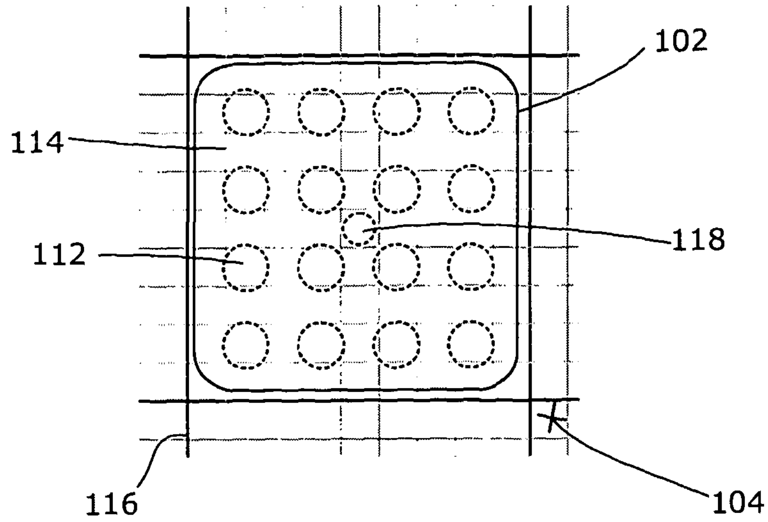


Fig 14

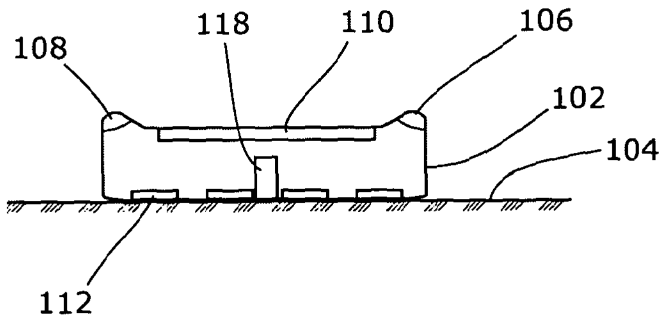


Fig 15

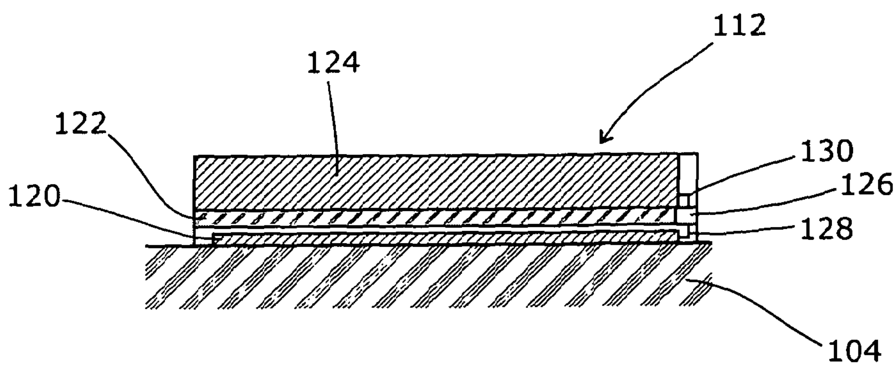


Fig 16