Title: TOUCH PANEL AND INTERACTIVE INPUT SYSTEM INCORPORATING THE SAME

Abstract: A touch panel comprises a substrate having a forward major surface and formed of a plurality of assembled substrate segments. Cover material overlies the forward major surface to reduce the visibility of seams between adjacent substrate segments.
TOUCH PANEL AND INTERACTIVE INPUT SYSTEM INCORPORATING
THE SAME

Field of the Invention

[0001] The present invention relates generally to interactive input systems and in particular to a touch panel and to an interactive touch system incorporating the same.

Background of the Invention

[0002] Touch systems are well known in the art and typically include a touch screen or panel having a touch or input surface on which contacts are made using a pointer in order to generate user input. Pointer contacts with the touch surface are detected and are used to generate corresponding output depending on areas of the touch surface where the contacts are made. Many types of touch systems exist that utilize different technologies to identify pointer contacts with the touch surface. These technologies include for example analog resistive, electromagnetic, capacitive, acoustic or machine-vision detection arrangements to identify pointer contacts with the touch surface.

[0003] For example, International PCT Application No. PCT/CA0 1/00980 filed on July 5, 2001 and published under No. WO 02/03316 on January 10, 2002, assigned to SMART Technologies Inc., assignee of the subject application, discloses a camera-based touch system comprising a touch screen that defines a touch surface on which a computer-generated image is presented. Depending on the application, a front or rear projection device may be used to project the image that is visible on the touch surface. A rectangular bezel or frame surrounds the touch surface and supports digital cameras at its corners. The digital cameras have overlapping fields of view that encompass and look across the touch surface from different viewpoints. The digital cameras acquire images looking across the touch surface and generate image data. Image data acquired by the digital cameras is processed by digital signal processors to determine if a pointer exists in the captured image data. When it is determined that a pointer exists in the captured image data, the digital signal processors convey pointer characteristic data to a master controller, which in turn processes the pointer characteristic data to determine the location of the pointer in (x,y)-coordinates relative to the touch surface using triangulation. The
pointer coordinate data is conveyed to a computer executing one or more applications programs. The computer uses the pointer coordinate data to update the computer-generated image that is presented on the touch surface. Pointer contacts on the touch surface can therefore be recorded as writing or drawing or used to control execution of applications programs executed by the computer.

[0004] Interest in machine vision touch systems has increased with the result being a growing demand for such touch systems with larger touch surfaces. In many environments such as in teaching institutions, very large scale touch systems are desired so that visible presentations can be made to large groups. To meet this need, a very large scale touch system has been designed and is described in U.S. Patent Application No. 10/750,219 to Hill et al., assigned to SMART Technologies Inc. This very large scale touch system comprises a touch panel having a plurality of input sub-regions that overlap to define a generally contiguous input surface. Each coordinate input sub-region has associated cameras that acquire overlapping images looking across the input sub-region and that generate pointer coordinate data in response to pointer contacts on the input surface. The pointer coordinate data is processed to update image data presented on the input surface. When a pointer contact is made on a portion of a coordinate input sub-region that does not overlap with an adjacent coordinate input sub-region, the coordinate input sub-region processes acquired images to derive pointer data and triangulates the position of the pointer using the derived pointer data thereby to determine the position of the pointer contact relative to the touch surface.

When a pointer contact is made on a portion of a coordinate input sub-region that overlaps with an adjacent coordinate input sub-region, each overlapping coordinate input sub-region processes acquired images to derive pointer data and triangulates the position of the pointer using the derived pointer data. The triangulated positions generated by the overlapping coordinate input sub-regions are then processed in accordance with defined logic thereby to determine the position of the pointer contact relative to the touch surface.
In the above-described Hill et al. touch system, as in many touch systems, the touch panel comprises a rigid, one-piece substrate and a low-gloss, dry-erase laminate sheet adhered or otherwise secured to the substrate and defining the input touch surface. As will be appreciated, manufacturing and shipping such a large scale touch panel is expensive. Also, as the demand for even larger touch panels increases, so do the associated manufacturing and shipping costs. As a result, there exists a need for less expensive touch panels.

It is therefore an object of the present invention to provide a novel touch panel and interactive input system incorporating the same.

Summary of the Invention

Accordingly, in one aspect there is provided a touch panel comprising a substrate having a forward major surface and being formed of a plurality of assembled substrate segments.

In one embodiment, the touch panel further comprises cover material on the forward major surface to reduce the visibility of seams between adjacent substrate segments. The cover material comprises a sheet generally overlying the forward major surface of the substrate. The sheet may be formed of a dry-erase, low-gloss material or other suitable material that is adhered or otherwise secured to the substrate.

In one embodiment, the sheet is adhered to the substrate at selected locations to enable the substrate segments to be moved from an assembled side-by-side arrangement to a stacked arrangement. In the stacked arrangement, the sections of the sheet extending between substrate segments that are not adhered to the substrate segments form living hinges.

In one embodiment, the substrate segments are interlocking and are generally rectangular in plan. Abutting sides of adjacent substrate segments carrying mating formations.

According to another aspect there is provided a kit for a touch panel comprising a plurality of substrate panels, said panels being assembleable in seriatum to form a substrate having a major forward surface.
According to yet another aspect there is provided a touch panel comprising a plurality of side-by-side substrate panels and a cover sheet secured to the substrate panels at selected locations to enable the substrate panels to assume a stacked orientation, sections of the cover sheet extending between adjacent substrate panels forming living hinges.

According to still yet another aspect there is provided an interactive input system comprising a touch panel having an input surface and comprising a substrate formed of a plurality of assembled substrate panels. A detection arrangement detects pointer contacts on the input surface of the touch panel.

In one embodiment, the detection arrangement comprises at least one imaging device. The interactive input system further comprises at least one display unit generating an image that is visible when looking at the input surface and processing structure communicating with the at least one imaging device. The processing structure processes image data captured by the at least one imaging device to detect pointer contacts. The processing structure updates data conveyed to the at least one display unit in accordance with detected pointer contacts.

As will be appreciated, as the substrate is formed of substrate segments or panels that can be easily assembled, the touch panel can be shipped to its installation site in an unassembled, compact state and assembled on-site thereby reducing significantly labour and shipping costs. When the unassembled touch panel arrives at the installation site, the substrate segments or panels can be quickly and easily interconnected and cover material readily applied, if appropriate, thereby to complete assembly of the touch panel.

**Brief Description of the Drawings**

Embodiments will now be described more fully with reference to the accompanying drawings in which:

Figure 1 is a front plan view of an interactive input system comprising an elongate, rectangular touch panel;
Figure 2 is a side cross-sectional view of a portion of the touch panel shown in Figure 1;

Figure 3 is a front plan view of a touch panel substrate comprising a plurality of interconnected substrate panels;

Figure 4 are side views showing assembly of two substrate panels forming the touch panel of Figure 2;

Figure 5 is a front plan view of alternative substrate panels;

Figures 6a and 6b are side views of additional alternative substrate panels; and

Figures 7a and 7b are side elevational views of an alternative touch panel in assembled and collapsed conditions.

**Detailed Description of the Embodiments**

Turning now to Figures 1 and 2, an interactive input system is shown and is generally identified by reference numeral 50. Interactive input system 50 is similar to that described in U.S. Patent Application No. 11/331,448 to Morrison et al. filed on January 13, 2006, the content of which is incorporated herein by reference. As can be seen, interactive input system 50 comprises an elongate, generally rectangular touch panel 52 defining a touch input surface 54. The input surface 54 may extend over the entire forward face of the touch panel 52 or over a portion thereof. A detection assembly 56 extends along one side of the touch panel 52. The detection assembly 56 includes a valence 58 secured to one side edge of the touch panel 52. Digital cameras 60 are positioned adjacent opposite ends of the valence 58. The fields of view of the digital cameras 60 overlap over the entire input surface 54 so that pointer contacts made on the input surface 54 are visually detected by both digital cameras 60.

An infrared (IR) receiver 62 is positioned adjacent to and communicates with an associated digital camera 60. Each IR receiver 62 is similar to those found on consumer electronics and comprises a lensed IR detector coupled to a gain controlled amplifier. The digital cameras 60 are coupled to a computer 64 or other suitable processing device via a universal...
serial bus (USB) hub 65 and a high speed data bus 66 such as for example USB-2. Computer 64 executes one or more application programs and provides display output to a display unit 68. In this embodiment, the touch panel 52 is opaque and the display unit 68 is a front projection unit that projects an image onto the input surface 54 in response to the display output received from the computer 64. If the touch panel 52 is transparent or translucent, a rear projection unit such as a plasma display, liquid crystal display or other suitable display device can be employed. The touch panel 52, computer 64 and display unit 68 form a closed-loop so that pointer contacts with the input surface 54 can be recorded as writing or drawing or used to control execution of the application programs executed by the computer 64.

[0026] Each digital camera 60 in this embodiment includes a two-dimensional CMOS image sensor and associated lens assembly and an on-board processing device such as a digital signal processor (DSP). Of course other suitable image sensors such as for example charge coupled devices (CCDs) can be employed.

[0027] In this embodiment, an active pointer 70 is used to interact with the input surface 54. The active pointer 70 includes a pointer body 72 having a tip 74 at one end designed to be brought into contact with the input surface 54. The tip of the pointer 70 illuminates when the pointer is brought into contact with input surface 54. Thus, as the digital cameras 60 capture images looking generally across the input surface 54, the illuminated pointer tip 74 appears as a bright point of illumination against a dark background.

[0028] During operation of the interactive input system 50, images captured by each camera 60 are processed on-board to determine if a pointer exists in the captured images. If a pointer exists in an image captured by the camera, pointer characteristic data is generated by the camera and is conveyed to the computer 64. When the computer 64 receives pointer characteristic data from both cameras 60, the computer 64 triangulates the pointer characteristic data to calculate the position of the pointer in (x,y)-coordinates in a manner similar to that described in U.S. Patent No. 6,954,197.
to Morrison et al., the content of which is incorporated herein by reference. As a result, a bounding box surrounding the pointer contact is determined allowing the location of the pointer in \((x,y)\)-coordinates to be calculated. The computer 64 in turn records the pointer coordinate data as writing or drawing if the pointer contact is a write event or injects the pointer coordinate data into the active application program being run by the computer 64 if the pointer contact is a mouse event. To determine if a pointer contact is a write or mouse event, the point of first contact between the pointer 70 and input surface 54 is examined. If the pointer contact is within a designated writing area of the image visible on the input surface 54, the pointer contact is treated as a write event; otherwise the pointer contact is treated as a mouse event.

Turning now to Figures 2 and 3, the touch panel 52 is better illustrated. As can be seen, the touch panel 52 comprises a rigid, generally rectangular substrate 150 and a low gloss, dry-erase laminate cover sheet 152 adhered to the forward major face 154 of the substrate 150 and defining the input surface 54. In this embodiment, the substrate 150 comprises a plurality of rectangular, interconnected substrate panels 160 in seriatum that are formed of a resin-based, fibrous composite material, although plastic, wood, metal or other suitable material may be used. Abutting sides of adjacent substrate panels 160 carry mating formations allowing the substrate panels 160 to interlock. In this embodiment, the mating formations are in the form of tongues 162 and grooves 164 (see Figure 4). As the cover sheet 152 overlies the forward major surface 154 of the substrate 150, the seams 170 between adjacent substrate panels 160 are covered and are thus, obscured from view so as not to be seen by the cameras 60.

To reduce manufacturing and shipping costs, the substrate panels 160 and laminate cover sheet 152 are shipped to the installation site in kit form, unassembled. The kit comprises the requisite number of interlocking substrate panels 160 needed to construct the touch panel 52 of the desired size and a continuous laminate cover sheet 152 generally sized to overlie the major forward face 154 of the substrate 150 once the substrate panels 160
have been assembled. In this embodiment, the laminate cover sheet 152 has an adhesive layer thereon protected by a removable release layer.

[0031] In order to assemble the touch panel 52, the requisite substrate panels 160 are interconnected by joining the tongues 162 and grooves 164 of adjacent substrate panels in the manner shown in Figure 4 thereby to complete assembly of the substrate 150. Once the substrate 150 has been assembled, the laminate cover sheet 152 is adhered to the major forward face 154 of the substrate 150 by removing the release layer from the adhesive surface of the laminate cover sheet 152 and laying the laminate cover sheet 152 over the major forward face 154. With the touch panel 52 assembled, the valence 58 can then be affixed to the touch panel and the touch panel can be secured or otherwise attached to a wall surface.

[0032] If desired, a laminate cover sheet 152 that is larger than the substrate 150 can be included in the kit. In this case, during assembly, the edges of the laminate cover sheet 152 that extend beyond the periphery of the substrate can either be folded under the substrate 150 or the laminate cover sheet 152 can be trimmed to fit the substrate.

[0033] Although the above embodiment describes use of a laminate cover sheet 152 disposed on the assembled substrate panels 160, those of skill in the art will appreciate that alternative methods to reduce visibility of the seams 170 between adjacent substrate panels may be employed. For example, paint or caulking can be applied to the substrate 150 to cover and/or fill in the seams 170 after the substrate panels 160 have been assembled. Alternatively, the proximate edges of adjacent substrate panels 160 may be finely machined to virtually eliminate the visual perceptibility of the seams 170.

[0034] Although the substrate panels 160 are described as carrying mating formations in the form of tongues 162 and grooves 164, those of skill in the art will appreciate that the substrate panels 160 may carry formations of other configurations. For example, Figures 5, 6a and 6b show but a few alternative mating formations provided on adjacent substrate panels 160. Rather than using mating formations to interlock adjacent substrate panels
160, clips, clamps, brackets, adhesive, fasteners or other suitable techniques may be used to secure adjacent substrate panels to one another.

[0035] Turning now to Figures 7a and 7b, an alternative touch panel is shown and is generally identified by reference numeral 202. Similar to the previous embodiment, the touch panel 202 comprises a substrate 250 formed of a plurality of interlocked substrate panels 260 in seriatum. Adjacent substrate panels 260 carry mating formations. A cover sheet 252 overlies the major forward face of the substrate 250. The cover sheet 252 in this embodiment is secured to the substrate panels 260 by adhesive 270 placed at selected locations to enable the substrate panels to assume the stacked, collapsed condition of Figure 7b when the touch panel 202 is to be shipped. As will be appreciated, the sections 272 of the cover sheet 252 that are not adhered to substrate panels 260 form living hinges.

[0036] Although the touch panel has been described with reference to the interactive input system 50 shown in Figure 1, those of skill in the art will appreciate that the touch panel 52 may be used in a variety of interactive environments. For example, the touch panel 52 is also very suitable for use in other machine vision touch systems such as those disclosed in aforementioned U.S. Patent No. 6,972,401 and U.S. Patent Application No. 10/750,219 to Hill et al, the contents of which are incorporated herein by reference. Of course, the touch panel is not limited to use in machine vision touch systems. The touch panel can also be used in interactive input systems employing ultrasonic, electromagnetic or other non-vision sensing systems as well as in analog resistive and capacitive interactive input systems. In these latter cases, as will be appreciated by those of skill in the art, mechanical and electrical connections between adjacent substrate panels are required.

[0037] Those of skill in the art will appreciate that the touch panel may be used in still other applications. In particular, the touch panel may be used on its own in a conventional non-interactive touch panel environment. The touch panel may also be used in other systems such as that disclosed in U.S. Patent Application No. 09/876,230 to Keenan et al., the content of which is incorporated herein by reference.
Although embodiments have been described with reference to the figures, those of skill in the art will appreciate that variations and modifications may be made without departing from the spirit and scope thereof as defined by the appended claims.
What is claimed is:

1. A touch panel comprising a substrate having a forward major surface and being formed of a plurality of assembled substrate segments.

2. A touch panel according to claim 1 further comprising cover material on said forward major surface to reduce the visibility of seams between adjacent substrate segments.

3. A touch panel according to claim 2 wherein said cover material comprises a sheet generally overlying said forward major surface.

4. A touch panel according to claim 3 wherein said sheet is formed of a dry-erase, low-gloss material.

5. A touch panel according to claim 3 wherein said sheet is adhered to said substrate.

6. A touch panel according to claim 1 wherein said substrate segments are interlocking.

7. A touch panel according to claim 6 wherein abutting sides of adjacent substrate segments carry mating formations.

8. A touch panel according to claim 1 wherein each of said substrate segments is generally rectangular in plan.

9. A touch panel according to claim 8 further comprising cover material on said forward major surface to reduce the visibility of seams between adjacent substrate segments.
10. A touch panel according to claim 8 wherein said cover material comprises a sheet generally overlying said forward major surface.

11. A touch panel according to claim 10 wherein said sheet is formed of a dry-erase, low-gloss material.

12. A touch panel according to claim 10 wherein said sheet is adhered to said substrate.

13. A touch panel according to claim 5 said sheet is adhered to said substrate at selected locations to enable the substrate segments to be moved from an assembled side-by-side arrangement to a stacked arrangement.

14. A touch panel according to claim 12 said sheet is adhered to said substrate at selected locations to enable the substrate segments to be moved from an assembled side-by-side arrangement to a stacked arrangement.

15. A kit for a touch panel comprising a plurality of substrate panels, said panels being assembleable in seriatum to form a substrate having a major forward surface.

16. A kit according to claim 15 further comprising cover material for application to the forward major surface of said substrate when assembled to reduce the visibility of seams between adjacent substrate panels.

17. A kit according to claim 16 wherein said cover material is a sheet sized generally to overlie said forward major surface.

18. A kit according to claim 17 wherein said sheet is formed of a dry-erase, low-gloss material.
19. A kit according to claim 17 wherein said sheet comprises an adhesive layer on one surface thereof and a release layer disposed on said adhesive layer.

20. A kit according to claim 15 wherein said substrate panels are interlocking.

21. A kit according to claim 20 wherein said substrate panels carry mating formations.

22. A kit according to claim 15 wherein each of said substrate panels is generally rectangular in plan.

23. A touch panel comprising:

- a plurality of side-by-side substrate panels; and
- a cover sheet secured to said substrate panels at selected locations to enable said substrate panels to assume a stacked orientation, sections of said cover sheet extending between adjacent substrate panels forming living hinges.

24. A touch panel according to claim 23 wherein said cover sheet is adhered to said substrate panels.

25. A touch panel according to claim 24 wherein said sheet is formed of a dry-erase, low-gloss material

26. A touch panel according to claim 24 wherein said substrate panels are interlocking.

27. A touch panel according to claim 24 wherein abutting sides of adjacent substrate panels carry mating formations.
28. An interactive input system comprising:
   a touch panel having an input surface comprising a substrate
   formed of a plurality of assembled substrate panels; and
   a detection arrangement detecting pointer contacts on the input
   surface of said touch panel.

29. An interactive input system according to claim 28 wherein said
detection arrangement comprises at least one imaging device.

30. An interactive input system according to claim 29 further
    comprising at least one display unit generating an image that is visible when
    looking at said touch panel.

31. An interactive input system according to claim 29 further
    comprising processing structure communicating with said at least one imaging
    device, said processing structure processing image data captured by said at
    least one imaging device to detect pointer contacts.

32. An interactive input system according to claim 31 wherein said
    processing structure updates data conveyed to said display unit in
    accordance with detected pointer contacts.

33. An interactive input system according to claim 32 comprising at
    least two imaging devices having overlapping fields of view looking at said
    touch panel from different viewpoints, said processing structure processing
    image data captured by each imaging device.

34. An interactive input system according to claim 28 wherein said
    touch panel comprises cover material reducing the visibility of seams between
    adjacent substitute panels.
35. An interactive input system according to claim 34 wherein said cover material comprises a sheet overlying said substrate.

36. An interactive input system according to claim 35 wherein said sheet is formed of a dry-erase, low-gloss material.

37. An interactive input system according to claim 35 wherein said sheet is adhered to said substrate.

38. An interactive input system according to claim 28 wherein said substrate panels are interlocking.

39. An interactive input system according to claim 38 wherein adjacent substrate panels carry mating formations.

40. An interactive input system according to claim 28 wherein each of said substrate panels is generally rectangular in plan.
INTERNATIONAL SEARCH REPORT

International application No
PCT/CA2008/001310

A CLASSIFICATION OF SUBJECT MATTER
IPC G06K 11/06 (2006 01) , G06F 3/042 (2006 01)
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 All

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

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
Canadian patent database, Delphion, WEST, and Google
Some search terms touch, panel, screen, segments, substrate, cover, sheet, seam, dry erase, interlock, projection

C DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>X</td>
<td>US 6,377,228 (Jenkm et al ) 23 April 2002 (23-04-2002) abstract, column 3, lines 48-52 figures 3 and 5</td>
<td>1-5, 8-12, 15-19, 22, 28</td>
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[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents
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<td>US 2006/0244734 (Hill et al.) 2 November 2006 (02-11-2006) abstract; paragraphs 53-54, figure 1</td>
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<td>A</td>
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