DETAILED DESCRIPTION

[0021] Aspects of the present invention relate to display screens of electronic devices that are illuminated via light guides by side lights positioned near the perimeters of the display screens.

[0022] Reference is made to **FIG. 1**, which is a top view of an electronic device **100** with a display screen **110** that is illuminated by light transmitted through light guides **200** positioned at the four corners of the display, in accordance with an embodiment of the present invention. A casing **120** surrounds the perimeter of display screen **110**.

[0023] Reference is made to **FIG. 2**, which is an exposed top view of electronic device **100** with peripheral casing **120** removed, in accordance with an embodiment of the present invention. **FIG. 2** shows a printed circuit board **300** on which the circuitry for display screen **110** is mounted.

[0024] **FIG. 2** also shows a projector **130**, which is used in an embodiment of the present invention in which display screen **110** is a touch-sensitive display screen. In this embodiment, a plurality of infrared light emitters (not shown), for emitting infrared light, are provided near the perimeter of display screen **110**, and a plurality of infrared light receivers (not shown), for receiving infrared light emitted by the infrared light emitters, are provided near the perimeter of display screen **110**. Projector **130** projects the infrared light emitted by the infrared light emitters across display screen **110** in order to enable detection of touch position when an object touches display screen **110**. Use of infrared emitters and infrared receivers for providing touch detection is described in assignee's US Patent No. 8,339,379 entitled LIGHT-BASED TOUCH SCREEN, the contents of which are hereby incorporated in their entirety.

[0025] Light-based touch screens operate by emitting light beams across a touch screen from two adjacent edges, and detecting whether the light

CLAIMS

What is claimed is:

1. A light guide for illuminating a display screen, comprising:

a vertical cone-shaped entrance surface comprising an aperture for admitting light beams emitted by an LED;

a folding mirror for reflecting the admitted light beams at an angle of approximately 90°, and for horizontally collimating the admitted light beams;

a horizontal guide for guiding the reflected light beams to an exit surface; and

an exit surface positioned above a perimeter of a display screen for directing the guided light towards a portion of the display screen, the exit surface being tilted vertically from the horizontal at a slight angle to direct the guided light beams towards the display, and being shaped horizontally as a concave lens to spread the guided light beams horizontally over an angular expanse of the display screen.

2. The light guide of claim **1** wherein said horizontal guide comprises upper and lower walls are painted black to absorb light and prevent internal reflections off of said upper and lower walls.

3. The light guide of claim **1** wherein said exit surface is tilted so as to direct a central light beam emitted by the LED to a location that is between 25% and 50% along the extent of the display screen.

4. The light guide of claim **1** wherein said exit surface is tilted at an angle of approximately 4°.

5. The light guide of claim **1** wherein said horizontal entrance surface, said horizontal guide and said exit surface are comprised of a plastic material.

6. A display for an electronic device, comprising:

a rectangular display screen;

four LEDs positioned near the four corners of said rectangular display screen;

four light guides positioned near said four LEDs, each light guide comprising a light guide in accordance with claim **1**, for transmitting light beams generated by said four LEDs over said rectangular display screen so as to illuminate said display screen.

7. The display of claim **6** further comprising:

a plurality of infrared light emitters positioned near the perimeter of said rectangular display screen for emitting infrared light;

a plurality of infrared light receivers positioned near the perimeter of said rectangular display screen, for receiving infrared light emitted by said infrared light emitters; and

a projector mounted near the perimeter of said rectangular display screen for projecting the infrared light emitted by said infrared light emitters across said rectangular display screen in order to enable detection of touch position when an object touches said rectangular display screen.

DETAILED DESCRIPTION

[0021] Aspects of the present invention relate to display screens of electronic devices that are illuminated via light guides by side lights positioned near the perimeters of the display screens.

[0022] Reference is made to **FIG. 1**, which is a top view of an electronic device **100** with a display screen **110** that is illuminated by light transmitted through light guides **200** positioned at the four corners of the display, in accordance with an embodiment of the present invention. A casing **120** surrounds the perimeter of display screen **110**.

[0023] Reference is made to **FIG. 2**, which is an exposed top view of electronic device **100** with peripheral casing **120** removed, in accordance with an embodiment of the present invention. **FIG. 2** shows a printed circuit board **300** on which the circuitry for display screen **110** is mounted.

[0024] **FIG. 2** also shows a projector **130**, which is used in an embodiment of the present invention in which display screen **110** is a touch-sensitive display screen. In this embodiment, a plurality of infrared light emitters **101**, for emitting infrared light, are provided near the perimeter of display screen **110**, and a plurality of infrared light receivers **102**, for receiving infrared light emitted by the infrared light emitters, are provided near the perimeter of display screen **110**. Projector **130** projects the infrared light emitted by the infrared light emitters across display screen **110** in order to enable detection of touch position when an object touches display screen **110**. Use of infrared emitters and infrared receivers for providing touch detection is described in assignee's US Patent No. 8,339,379 entitled LIGHT-BASED TOUCH SCREEN, the contents of which are hereby incorporated in their entirety.

[0025] Light-based touch screens operate by emitting light beams across a touch screen from two adjacent edges, and detecting whether the light

CLAIMS

What is claimed is:

1. A light guide for illuminating a display screen, comprising:

a vertical cone-shaped entrance surface comprising an aperture admitting light beams emitted by an LED;

a folding mirror reflecting the admitted light beams at an angle of approximately 90°, and horizontally collimating the admitted light beams;

a horizontal guide guiding the reflected light beams to an exit surface; and

the exit surface positioned above a perimeter of a display screen directing the guided light towards a portion of the display screen, the exit surface being tilted vertically from the horizontal at a slight angle to direct the guided light beams exiting through the exit surface towards the display to illuminate a displayed image, and being shaped horizontally as a concave lens to spread the guided light beams horizontally over an angular expanse of the display screen.

2. The light guide of claim 1 wherein said horizontal guide comprises upper and lower walls that are painted black to absorb light and prevent internal reflections off of said upper and lower walls.

3. The light guide of claim 1 wherein said exit surface is tilted so as to direct a central light beam emitted by the LED to a location that is between 25% and 50% along the extent of the display screen.

4. The light guide of claim 1 wherein said exit surface is tilted at an angle of approximately 4°.

5. The light guide of claim 1 wherein said entrance surface, said horizontal guide and said exit surface are comprised of a plastic material.

6. A display for an electronic device, comprising:

a rectangular display screen;

four LEDs positioned near the four corners of said rectangular display screen;

four light guides positioned near said four LEDs, each light guide comprising a light guide in accordance with claim 1, transmitting light beams generated by said four LEDs over said rectangular display screen so as to illuminate said display screen.

7. The display of claim 6 further comprising:

a plurality of infrared light emitters positioned near the perimeter of said rectangular display screen for emitting infrared light;

a plurality of infrared light receivers positioned near the perimeter of said rectangular display screen, for receiving infrared light emitted by said infrared light emitters; and

a projector mounted near the perimeter of said rectangular display screen for projecting the infrared light emitted by said infrared light emitters across said rectangular display screen in order to enable detection of a touch position when an object touches said rectangular display screen.