CLAIMS

What is claimed is:

1. A touch screen system, comprising:

a near-infrared transparent screen comprising a screen cover comprised of one or more of the group consisting of glass, crystal, acrylic and plastic, the screen cover comprising a plurality of reflective elements embedded inside thereof;

a circuit board comprising circuitry for controlled selective activation of electronic components connected thereto;

at least one light source connected to said circuit board, for emitting light; and

at least one light detector connected to said circuit board, for detecting light emitted by said at least one light source and reflected by said reflective elements.

2. The touch screen system of claim **1** further comprising at least one optical element for guiding light emitted by said at least one light source towards said reflective elements.

3. The touch screen system of claim **2** wherein said plurality of optical elements comprises fibers.

4. The touch screen system of claim **2** wherein said plurality of optical elements comprises elliptical mirrors.

5. The touch screen system of claim **2** wherein said plurality of optical elements comprises filament light guides.

6. The touch screen system of claim **2** wherein said plurality of optical elements comprises wedge-shaped plates.

7. The touch screen system of claim **2** wherein said plurality of optical elements comprises planar plates positioned parallel to said screen cover.

8. The touch screen system of claim **1** wherein said at least one light detector comprises at least one camera.

9. The touch screen system of claim **1** wherein said at least one light detector comprises at least one photo detector.

10. The touch screen system of claim **1** wherein said at least one light source is placed underneath said screen cover.

11. The touch screen system of claim **1** wherein said at least one light detector is placed underneath said screen cover.

12. The touch screen system of claim **1** wherein said screen cover comprises at least two layers, wherein said at least one light source emits light in a first layer and said at least one light detector detects light transmitted in a second layer.

13. A touch screen system comprising:

a display screen comprising a screen cover comprised of one or more of the group consisting of glass, crystal, acrylic and plastic;

a circuit board comprising circuitry for controlled selective activation of electronic components connected thereto;

a plurality of near-infrared LEDs connected to said circuit board, for emitting light;

a first plurality of photo diodes connected to said circuit board, for detecting received light along a first edge of said display screen; and

a second plurality of photo diodes connected to said circuit board, for detecting received light along a second edge of said display screen,

wherein said circuitry generates signals responsive to blocked light from said near-infrared LEDs detected at said first plurality of photo diodes and signals responsive to reflected light from said near-infrared LEDs detected at said second plurality of photo diodes and calculates a position of a pointer that touches said display screen, by combining data from the signals for the blocked light with data from the signals for the reflected light.

14. (canceled)

15. The touch screen system of claim **13** further comprising at least one optical element for guiding light emitted by said near-infrared NIRs over said touch screen.

16. The touch screen system of claim **13** wherein said near-infrared LEDs are embedded inside said screen cover.

17. The touch screen system of claim **13** wherein said screen cover comprises a plurality of reflective elements embedded therein, which reflect light emitted by said near-infrared LEDs.

18. The touch screen system of claim **13** wherein said first plurality of photo diodes are embedded inside said screen cover.

19. The touch screen system of claim **13** wherein said second plurality of photo diodes are embedded inside said screen cover.

20. A touch screen system, comprising:

a display screen for displaying a plurality of buttons at designated horizontal and vertical screen coordinates thereon;

a plurality of light sources for emitting light across said display screen along the designated horizontal coordinates and along the designated vertical coordinates;

a plurality of photo diodes for detecting that the light emitted by one or more of said light sources is being blocked by an object touching said display screen; and

a calculating unit coupled with said photo diodes for recognizing that the object is touching a specific one of the buttons based on light emitted from two light sources being blocked, and for recognizing that the object is touching another specific one of the buttons based on light emitted from only one light source being blocked.

21 - 24. (canceled)

25. The touch screen system of claim **20** wherein said display screen is between 6" and 9" in length.

26. The touch screen system of claim **20** wherein said display screen is at least 30" in length.

27. The touch screen system of claim **20** wherein said display screen is at least 40" in length.

28. The touch screen system of claim **20** wherein said photo diodes are spaced approximately 10 mm apart.

29. The touch screen system of claim **20** wherein a first coordinate of a touch location is determined based on light detected by at least one of said photo diodes, and a second coordinate of the touch location is determined by correlating the detected light with an activation of at least one of said light sources.

30. A touch screen system, comprising:

a display screen comprising a designated bi-directional touch sensitive sub-area;

a plurality of light sources for emitting light across said display screen in substantially two directions, the emitted light passing across and beyond said designated bi-directional touch sensitive sub-area;

a plurality of photo diodes for detecting that the light emitted by one or more of said light sources is being blocked by an object touching said display screen; and

a calculating unit coupled with said photo diodes (i) for recognizing that the object is touching a location on said display screen inside said designated bi-directional touch sensitive sub-area based on light emitted from two light sources being blocked, (ii) for further recognizing that the object is touching a location on said display screen

outside said designated bi-directional touch sensitive sub-area based on light emitted from only one light source being blocked, (iii) for interpreting the recognizing as a first user input command, and (iv) for interpreting the further recognizing as a second user input command.

31. The touch screen system of claim **30** wherein the designated bi-directional touch sensitive sub-area comprises less than 25% of the area of said display screen.

32. The touch screen system of claim **30** wherein the designated bi-directional touch sensitive sub-area comprises less than 10% of the area of said display screen.

33. The touch screen system of claim **30** wherein the designated bi-directional touch sensitive sub-area is situated in a corner of said display screen.

34. The touch screen system of claim **30** wherein the designated bi-directional touch sensitive sub-area is surrounded on four sides by portions of the remainder of said display screen.

35 - 37. (canceled)

38. The touch screen system of claim **30** wherein said display screen is between 6" and 9" in length.

39. The touch screen system of claim **30** wherein said display screen is at least 30" in length.

40. The touch screen system of claim **30** wherein said display screen is at least 40" in length.

41. The touch screen system of claim **30** wherein said photo diodes are spaced approximately 10 mm apart.

42. The touch screen system of claim **30** wherein a first coordinate of a touch location is determined based on light detected by at least one of said photo diodes, and a second coordinate of the touch location is determined by correlating the detected light with an activation of at least one of said light sources.

43. A touch screen system comprising:

a display screen comprising a plurality of layers substantially parallel to one another;

a circuit board comprising circuitry for controlled selective activation of electronic components connected thereto;

a plurality of near-infrared LEDs connected to said circuit board, for emitting light that is guided through a first layer of said display screen by internal reflection; and

a plurality of photo diodes connected to said circuit board, for receiving light that is guided through a second layer of said display screen by internal reflection,

wherein said circuitry generates signals responsive to light detected at said plurality of photo diodes.

44. A touch screen system, comprising:

a screen;

a plurality of light sources coupled with said screen, some of the light sources emitting light beams in a first direction across the width of said screen, and the others of the light sources emitting light beams in a second direction across the length of said screen, the light sources being spaced apart such that there are gaps between the light beams that they emit;

a plurality of photo diodes coupled with said screen, for detecting the light beams emitted by said light sources;

a plurality of lenses coupled respectively with said plurality of light sources to widen the light beams emitted by said light sources such that areas of said screen aligned with the gaps between said light sources are covered by neighboring widened beams, wherein a first set of the widened beams span a portion of the length of said screen, wherein a second set of the widened beams span a portion of the width of said screen, and wherein an overlap between the first and second sets comprises a bi-directional touch sensitive sub-area of said screen; and

a calculating unit coupled with said photo diodes, for recognizing sweep gestures made by the object on said screen outside the bi-directional touch sensitive sub-area, based on blockage of light beams, detected by said photo diodes, from only light sources that emit light in a same direction.

45. The touch screen system of claim **44** further comprising a second plurality of lenses coupled respectively with said plurality of photo diodes to narrow the widened beams onto said photo diodes.

46. The touch screen system of claim **45** wherein said second lenses are placed at least 4 mm away from respective ones of said photo diodes.

47. The touch screen system of claim **45** wherein said photo diodes and said second lenses are placed adjacent to an edge of said screen.

48. The touch screen system of claim **45** wherein said light sources are placed under said screen and said second lenses are placed adjacent to an edge of said screen.

49. (canceled)

50. The touch screen system of claim **44** wherein the bi-directional touch sensitive sub-area is situated in a corner of said screen.

51. The touch screen system of claim **44** wherein the bi-directional touch sensitive sub-area is surrounded on four sides by portions of the remainder of said screen.

52. The touch screen system of claim **44** wherein said calculating unit calculates a location of a pen tip that touches said screen within one of the widened beams.

53. The touch screen system of claim **52** wherein said calculating unit calculates the location of the pen tip based upon a light intensity detected by at least one of said photo diodes.

54. The touch screen system of claim **52** wherein said calculating unit calculates the location of the pen tip along one dimension of said screen based upon light intensities detected by said photo diodes along a single dimension of said screen.

55. The touch screen system of claim **44** wherein said screen is between 6" and 9" in length.

56. The touch screen system of claim **44** wherein said screen is at least 30" in length.

57. The touch screen system of claim **44** wherein said screen is at least 40" in length.

58. The touch screen system of claim **44** wherein said photo diodes are spaced approximately 10 mm apart.

59. The touch screen system of claim **44** wherein said calculating unit calculates a first coordinate of a touch location based on reflected light detected by at least one of said photo diodes, and calculates a second coordinate of the touch location by correlating the detected light with an activation of at least one of said light sources.

60. The touch screen system of claim **44** wherein said lenses are placed at least 4 mm away from respective ones of said light sources.

61. The touch screen system of claim **44** wherein said light sources are placed under said screen and said lenses are placed adjacent to an edge of said screen.

62. The touch screen system of claim **44** wherein said light sources and said lenses are placed adjacent to an edge of said screen.

63. The touch screen system of claim **44** wherein said lenses are placed at least 10 mm away from respective ones of said light sources.

64. The touch screen system of claim **44** wherein said lenses are placed at least 20 mm away from respective ones of said light sources.

65. The touch screen system of claim **30** wherein some of said light sources emit light in a first direction and the others of said light sources emit light in a second direction, and wherein said calculating unit recognizes sweep gestures made by the object on said display screen outside said designated bi-directional touch sensitive sub-area based on blockage of light from only light sources that emit light in a same direction.

CLAIMS

What is claimed is:

1. A touch screen system, comprising:

a near-infrared transparent screen comprising a screen cover comprised of one or more of the group consisting of glass, crystal, acrylic and plastic, the screen cover comprising a plurality of reflective elements embedded inside thereof;

a circuit board comprising circuitry for controlled selective activation of electronic components connected thereto;

at least one light source connected to said circuit board, for emitting light; and

at least one light detector connected to said circuit board, for detecting light emitted by said at least one light source and reflected by said reflective elements.

2. The touch screen system of claim **1** further comprising at least one optical element for guiding light emitted by said at least one light source towards said reflective elements.

3. The touch screen system of claim **2** wherein said plurality of optical elements comprises fibers.

4. The touch screen system of claim **2** wherein said plurality of optical elements comprises elliptical mirrors.

5. The touch screen system of claim **2** wherein said plurality of optical elements comprises filament light guides.

6. The touch screen system of claim **2** wherein said plurality of optical elements comprises wedge-shaped plates.

7. The touch screen system of claim **2** wherein said plurality of optical elements comprises planar plates positioned parallel to said screen cover.

8. The touch screen system of claim **1** wherein said at least one light detector comprises at least one camera.

9. The touch screen system of claim **1** wherein said at least one light detector comprises at least one photo detector.

10. The touch screen system of claim **1** wherein said at least one light source is placed underneath said screen cover.

11. The touch screen system of claim **1** wherein said at least one light detector is placed underneath said screen cover.

12. The touch screen system of claim **1** wherein said screen cover comprises at least two layers, wherein said at least one light source emits light in a first layer and said at least one light detector detects light transmitted in a second layer.

13. A touch screen system comprising:

a display screen comprising a screen cover comprised of one or more of the group consisting of glass, crystal, acrylic and plastic;

a circuit board comprising circuitry for controlled selective activation of electronic components connected thereto;

a plurality of near-infrared LEDs connected to said circuit board, for emitting light;

a first plurality of photo diodes connected to said circuit board, for detecting received light along a first edge of said display screen; and

a second plurality of photo diodes connected to said circuit board, for detecting received light along a second edge of said display screen,

wherein said circuitry generates signals responsive to blocked light from said near-infrared LEDs detected at said first plurality of photo diodes and signals responsive to reflected light from said near-infrared LEDs detected at said second plurality of photo diodes and calculates a position of a pointer that touches said display screen, by combining data from the signals for the blocked light with data from the signals for the reflected light.

14. The touch screen system of claim **13** further comprising at least one optical element for guiding light emitted by said near-infrared NIRs over said touch screen.

15. The touch screen system of claim **13** wherein said near-infrared LEDs are embedded inside said screen cover.

16. The touch screen system of claim **13** wherein said screen cover comprises a plurality of reflective elements embedded therein, which reflect light emitted by said near-infrared LEDs.

17. The touch screen system of claim **13** wherein said first plurality of photo diodes are embedded inside said screen cover.

18. The touch screen system of claim **13** wherein said second plurality of photo diodes are embedded inside said screen cover.

19. A touch screen system, comprising:

a display screen for displaying a plurality of buttons at designated horizontal and vertical screen coordinates thereon;

a plurality of light sources for emitting light across said display screen along the designated horizontal coordinates and along the designated vertical coordinates;

a plurality of photo diodes for detecting that the light emitted by one or more of said light sources is being blocked by an object touching said display screen; and

a calculating unit coupled with said photo diodes for recognizing that the object is touching a specific one of the buttons based on light emitted from two light sources being blocked, and for recognizing that the object is touching another specific one of the buttons based on light emitted from only one light source being blocked.

20. The touch screen system of claim **19** wherein said display screen is between 6″ and 9″ in length.

21. The touch screen system of claim **19** wherein said display screen is at least 30″ in length.

22. The touch screen system of claim **19** wherein said display screen is at least 40″ in length.

23. The touch screen system of claim **19** wherein said photo diodes are spaced approximately 10 mm apart.

24. The touch screen system of claim **19** wherein a first coordinate of a touch location is determined based on light detected by at least one of said photo diodes, and a second coordinate of the touch location is determined by correlating the detected light with an activation of at least one of said light sources.

25. A touch screen system, comprising:

a display screen comprising a designated bi-directional touch sensitive sub-area;

a plurality of light sources for emitting light across said display screen in substantially two directions, the emitted light passing across and beyond said designated bi-directional touch sensitive sub-area;

a plurality of photo diodes for detecting that the light emitted by one or more of said light sources is being blocked by an object touching said display screen; and

a calculating unit coupled with said photo diodes (i) for recognizing that the object is touching a location on said display screen inside said designated bi-directional touch sensitive sub-area based on light emitted from two light sources being blocked, (ii) for further recognizing that the object is touching a location on said display screen outside said designated bi-directional touch sensitive sub-area based on light emitted from only one light source being blocked, (iii) for interpreting the recognizing as a first user input command, and (iv) for interpreting the further recognizing as a second user input command.

26. The touch screen system of claim **25** wherein the designated bi-directional touch sensitive sub-area comprises less than 25% of the area of said display screen.

27. The touch screen system of claim **25** wherein the designated bi-directional touch sensitive sub-area comprises less than 10% of the area of said display screen.

28. The touch screen system of claim **25** wherein the designated bi-directional touch sensitive sub-area is situated in a corner of said display screen.

29. The touch screen system of claim **25** wherein the designated bi-directional touch sensitive sub-area is surrounded on four sides by portions of the remainder of said display screen.

30. The touch screen system of claim **25** wherein said display screen is between 6" and 9" in length.

31. The touch screen system of claim **25** wherein said display screen is at least 30" in length.

32. The touch screen system of claim **25** wherein said display screen is at least 40" in length.

33. The touch screen system of claim **25** wherein said photo diodes are spaced approximately 10 mm apart.

34. The touch screen system of claim **25** wherein a first coordinate of a touch location is determined based on light detected by at least one of said photo diodes, and a second coordinate of the touch location is determined by correlating the detected light with an activation of at least one of said light sources.

35. A touch screen system comprising:

a display screen comprising a plurality of layers substantially parallel to one another;

a circuit board comprising circuitry for controlled selective activation of electronic components connected thereto;

a plurality of near-infrared LEDs connected to said circuit board, for emitting light that is guided through a first layer of said display screen by internal reflection; and

a plurality of photo diodes connected to said circuit board, for receiving light that is guided through a second layer of said display screen by internal reflection,

wherein said circuitry generates signals responsive to light detected at said plurality of photo diodes.

36. A touch screen system, comprising:

a screen;

a plurality of light sources coupled with said screen, some of the light sources emitting light beams in a first direction across the width of said screen, and the others of the light sources emitting light beams in a second direction across the length of said screen, the light sources being spaced apart such that there are gaps between the light beams that they emit;

a plurality of photo diodes coupled with said screen, for detecting the light beams emitted by said light sources;

a plurality of lenses coupled respectively with said plurality of light sources to widen the light beams emitted by said light sources such that areas of said screen aligned with the gaps between said light sources are covered by neighboring widened beams, wherein a first set of the widened beams span a portion of the length of said screen, wherein a second set of the widened beams span a portion of the width of said screen, and wherein an overlap between the first and second sets comprises a bi-directional touch sensitive sub-area of said screen; and

a calculating unit coupled with said photo diodes, for recognizing sweep gestures made by the object on said screen outside the bi-directional touch sensitive sub-area, based on blockage of light beams, detected by said photo diodes, from only light sources that emit light in a same direction.

37. The touch screen system of claim **36** further comprising a second plurality of lenses coupled respectively with said plurality of photo diodes to narrow the widened beams onto said photo diodes.

38. The touch screen system of claim **37** wherein said second lenses are placed at least 4 mm away from respective ones of said photo diodes.

39. The touch screen system of claim **37** wherein said photo diodes and said second lenses are placed adjacent to an edge of said screen.

40. The touch screen system of claim **37** wherein said light sources are placed under said screen and said second lenses are placed adjacent to an edge of said screen.

41. The touch screen system of claim **36** wherein the bi-directional touch sensitive sub-area is situated in a corner of said screen.

42. The touch screen system of claim **36** wherein the bi-directional touch sensitive sub-area is surrounded on four sides by portions of the remainder of said screen.

43. The touch screen system of claim **36** wherein said calculating unit calculates a location of a pen tip that touches said screen within one of the widened beams.

44. The touch screen system of claim **43** wherein said calculating unit calculates the location of the pen tip based upon a light intensity detected by at least one of said photo diodes.

45. The touch screen system of claim **43** wherein said calculating unit calculates the location of the pen tip along one dimension of said screen based upon light intensities detected by said photo diodes along a single ~~axis~~ dimension of said screen.

46. The touch screen system of claim **36** wherein said screen is between 6″ and 9″ in length.

47. The touch screen system of claim **36** wherein said screen is at least 30″ in length.

48. The touch screen system of claim **36** wherein said screen is at least 40″ in length.

49. The touch screen system of claim **36** wherein said photo diodes are spaced approximately 10 mm apart.

50. The touch screen system of claim **36** wherein said calculating unit calculates a first coordinate of a touch location based on reflected light detected by at least one of said photo diodes, and calculates a second coordinate of the touch location by correlating the detected light with an activation of at least one of said light sources.

51. The touch screen system of claim **36** wherein said lenses are placed at least 4 mm away from respective ones of said light sources.

52. The touch screen system of claim **36** wherein said light sources are placed under said screen and said lenses are placed adjacent to an edge of said screen.

53. The touch screen system of claim **36** wherein said light sources and said lenses are placed adjacent to an edge of said screen.

54. The touch screen system of claim **36** wherein said lenses are placed at least 10 mm away from respective ones of said light sources.

55. The touch screen system of claim **36** wherein said lenses are placed at least 20 mm away from respective ones of said light sources.

56. The touch screen system of claim **25** wherein some of said light sources emit light in a first direction and the others of said light sources emit light in a second direction, and wherein said calculating unit recognizes sweep gestures made by the object on said display screen

outside said designated bi-directional touch sensitive sub-area based on blockage of light from only light sources that emit light in a same direction.