[0014] In a detailed aspect of the invention, monitoring the output of each light receiving element associated with the activated light emitting element for blockage of a light beam path involves comparing the profile of the output to an expected profile having a time-based noise threshold and identifying a light beam as "noise", "connected" or "blocked" accordingly. A beam is considered noise if there is a pulse edge in the profile prior to the noise threshold, connected if there is a pulse edge in the profile after the noise threshold and blocked in all other instances.

[0015] In a further detailed aspect, in order to identify a light beam as connected or blocked, the identification of the light beam is counted over successive triggers of the light emitting element associated with the light beam. A light beam is confirmed as being blocked or connected after the counter has reached a specified value, such as at least two successive triggers of the associated light emitting element.

[0016] These and other aspects and advantages of the invention will become apparent from the following detailed description and the accompanying drawings which illustrate by way of example the features of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] **FIG. 1** is a planar view of a prior art touchframe system including a plurality of infrared (IR) light emitting diodes (LED) and phototransistor pairs arranged around a detection area display to form an IR grid;

[0018] **FIG. 2** is an isometric view of the touchframe system of **FIG. 1**;

[0019] **FIG. 3** is a block diagram of a touchframe system configured in accordance with the invention including a touchframe and a printed circuit board assembly (PCBA) interfacing with a graphical user interface (GUI) system;

[0020] **FIG. 4** is a planar view of an exemplary configuration of the touchframe of **FIG. 3** including a plurality of LEDs and infrared (IrDA) receiver positioned around the perimeter of a display;

[0021] **FIG. 5** is a detailed block diagram of the PCBA of **FIG. 3** including a controller and multiplexing circuitry;

[0022] **FIG. 6** depicts two rows of LEDs each with an associated IrDA receiver forming overlapping triangular zones of light beam paths;

[0023] **FIG. 7** depicts the directional alignment of a row of LEDs and two opposed IrDA receivers;

[0024] **FIG. 8** is a schematic of the controller and multiplexing system of **FIG. 3**;

[0025] **FIG. 9** is a timing diagram illustrating the optical noise immunity feature of the touchframe system;

[0026] **FIG. 10** is a schematic representation of two triangular zones of light beam paths formed by the row of LEDs and the IrDA receivers of **FIG. 7** with a touch event blocking some of the light beam paths;

[0027] **FIG. 11** is a state diagram illustrating the progression of state values used by the touchframe system to determine whether a light beam is blocked or connected;

[0028] **FIGS. 12***a* through **12***d* are schematic representations of twelve triangular zones formed by the LED rows and IrDA receivers of **FIG. 4**;

[0029] **FIGS. 13***a* through **13***d* depict four sets of orthogonally overlapping zones which collectively cover the lower portion of the display of **FIG. 4**;

[0030] **FIGS. 13***e* through **13***h* depict another four sets of orthogonally overlapping zones which collectively cover the lower portion of the display of **FIG. 4**;

[0031] **FIGS. 13***i* and **13***j* depict examples of non-orthogonally overlapping triangular zones;

[0032] **FIG. 14** is a schematic representation of a touch event occurring within two overlapping triangular zones along with two blocked light beam paths intersecting at the touch event;

[0033] **FIG. 15** depicts a touch event blocking a plurality of light beam paths; and

[0034] **FIG. 16** is a schematic representation two blocked light beam paths intersecting at a touch event

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0035] Referring now to the drawings, which are provided for the purposes of illustration and not by way of limitation, and particularly to **FIG. 3**, there is shown a system **10** incorporating an infrared touchframe system **12** configured in accordance with the invention and including a touchframe **14** and printed circuit board assembly (PCBA) **16**. The system **10** also includes a graphical user interface (GUI) system **18** which includes a GUI display **20** and a GUI central processing unit (CPU) **22**. Detailed descriptions of the system architecture and system operation follow.

[0036] System Architecture

[0037] With reference to **FIG. 4**, the touchframe **14** is mounted to the GUI display **20** such that its perimeter is generally aligned with the perimeter of the GUI display. The purpose of the touchframe system **12** is to detect operator interaction with the GUI display **20** by means of locating the logical X and Y coordinate position of an operator's touch within the touchframe **14** perimeter. The operator's touch may be generated by a finger or mechanical instrument.

[0038] With continued reference to **FIG. 4**, the touchframe **14** includes a plurality of infrared LEDs **24** and a plurality of infrared (IrDA) receivers **42**. The infrared LEDs **24** emit light beams to detect touches and operate in the wavelength of the IrDA receivers **42**, which in one embodiment is between 850-900 nm. The infrared LEDs **24** are of the surface mount type, such as those manufactured by Stanely (part number DNP1102F), and are positioned around the perimeter of the touchframe **14** in six rows of contiguous LEDs. One row of LEDs **24** is centered across the top **26** of the touchframe, one across the bottom **28** of the touchframe, two on the left side **32** and two on the right side **34**.

[0039] In an exemplary embodiment, there are thirty-eight LEDs **24** in the top **26** row of LEDs and thirty-eight LEDs in the bottom **28** row of LEDs. These LEDs **24** emit light beams across the large (vertical) X-axis **30** of the touchframe **14**. There are fifty-six LEDs **24** along the left side **32** of the touchframe and fifty-six LEDs **24** along the right side **34** of the touchframe. These LEDs **24** emit light beams across the small (horizontal) Y-axis **36**. The LEDs **24** on each side of