INFRARED TOUCHFRAME SYSTEM

RELATED APPLICATIONS

[0001] This application claims the benefit of provisional application Ser. No. 60/369,047, filed Mar. 27, 2002

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The invention relates generally to touchframe technology and, more particularly, to systems and methods for detecting a touch event within a touchframe perimeter.

[0004] 2. Description of the Related Art

[0005] The operation of a typical scanning infrared (IR) touchframe system is based on the creation of a grid of invisible IR light beams above the viewing surface of a CRT monitor or flat panel display and the recognition of the location at which individual beams within the grid are interrupted. As shown in **FIG. 1**, to create such a grid, rows of IR light emitting diodes (LEDs) are paired with opposed rows of phototransistors of IR receivers. Each pair of LEDs and IR receivers constitutes an opto-pair or physical beam. The plurality of pairs create a horizontal (x-axis) and a vertical (y-axis) array of beams. The two arrays of beams and their circuitry make up an opto-matrix touchframe. An IR controller associated with the touchframe sequentially pulses the LEDs to create a grid of IR light beams (depicted as arrow lines). When a stylus, such as a finger, enters the grid, it obstructs the beams thereby resulting in a touch event. One or more of the IR receivers detect the absence of light and transmit signals that identify the X and Y coordinates of the touch event.

[0006] As shown in **FIG. 2**, a touchframe system designed to function with a flat panel is composed of an opto-matrix touchframe, an IR-transparent protective bezel and a transparent filter. To complete the touchframe system, the touchframe is linked to a modular touch controller (not shown) via a modular digital interface (MDI), which is a standard 8-pin telephone-type plug attached to the touchframe by an 8-pin cable.

[0007] Since IR touchframe systems operate using the IR portion of light, ambient light in the touch environment, i.e., the area surrounding the touchframe system, has long been a source of concern. Ambient light has varying levels of IR radiation, depending on whether the source of visible light is IR rich, as is sunlight, or IR poor, as is fluorescent light commonly used in offices. Ambient light and other optical noise in the touch environment may cause the touchframe system to provide false readings. For example, noise may cause an IR receiver to provide an output indicative of an unobstructed or connected light beam when the light beam is in fact obstructed or blocked. Conversely, in the presence of noise the IR receiver may provide an output indicative of a blocked light beam when the light beam is in fact connected.

[0008] As previously mentioned, the touchframe system sequentially pulses the LEDs to create a grid of IR light beams. A problem with such operation is that infrared light emitted by the sequential, regular pulsing of LEDs may leak into the surrounding environment and inadvertently activate devices which are remotely controllable using infrared remote controls. This can be a significant problem if the touchframe is on a medical devices, such as a ventilator, and it inadvertently activate other medical devices nearby.

[0009] Those skilled in the art have recognized a need for a touchframe system that is immune to noise in the touch environment. The need for a touchframe system that does not output interfering IR signals has also been recognized. The invention fulfills these needs and others.

SUMMARY OF THE INVENTION

[0010] Briefly, and in general terms, the invention is directed to systems and methods for detecting a touch event within a touchframe perimeter.

[0011] In one currently preferred embodiment the invention relates to a touchframe system and method for determining the position of a touch event within a display area. The system includes a plurality of light emitting elements and a plurality of light receiving elements positioned around the perimeter of the display area. Each of the light receiving elements in combination with a plurality of the light emitting elements form a zone of light beam paths. The number and positioning of receivers is sufficient to form a plurality of partially overlapping zone pairs. These zone pairs are arranged relative to the display area such that any touch event lies within at least two zone pairs. The system also includes a processor that is programmed to monitor each of the zone pairs for blockage of at least one light beam path. Upon such blockage, the processor calculates the location of the touch event associated with the blockage based on the slopes and end points of at least two intersecting blocked light beam paths from a first zone pair and two intersecting blocked light beam paths from a second zone pair.

[0012] In a preferred detailed aspect of the invention, the processor monitors each of the zone pairs for blockage by randomly activating each of the light emitting elements, one at a time; and monitoring the output of each light receiving element associated with the activated light emitting element for an output indicative of a blocked light beam path. In a further detailed aspect, the light emitting elements are activated at pseudo random intervals and/or in a pseudo random sequence. In another detailed aspect, the light receiving element outputs a signal having a pulse edge upon receipt of light and the processor tags a light beam as blocked in the absence of a pulse edge in the light receiving element output.

[0013] In another currently preferred embodiment, the invention relates to systems and methods for determining the location of a touch event within a display area. Similar to the first embodiment, the display area is surrounded by a touch frame having a plurality of light emitting elements and a plurality of light receiving elements. These elements form a plurality of triangular zones of light beam paths each having a slope and endpoints. The number and positioning of receivers is sufficient to form partially overlapping zone pairs. For each of the plurality of triangular zones, the slopes and end points of each light beam path are stored in a memory device. The light emitting elements are activated one at a time in a random order. The output of each light receiving element associated with the activated light emitting element is monitored for blockage of a light beam path. If a blockage is detected, the location of the source of blockage is calculated using the slopes and end points of at least two intersecting blocked light-beam paths.