

CAPACITANCE TOUCH SLIDER

RELATED APPLICATIONS

[0001] This application is a continuation of U.S. patent application Ser. No. 09/820,747, entitled "Capacitance Touch Slider," filed Mar. 30, 2001.

FIELD OF THE INVENTION

[0002] The present invention is directed generally to touch-sensitive pads and associated devices, and more particularly to capacitance touch sliders and methods for detection of the position of a pointing member thereon.

BACKGROUND OF THE INVENTION

[0003] Personal computers and other similar devices have a multitude of possibilities for providing user input. For instance, most computers today are used in conjunction with a mouse or similar pointing device for controlling the position of a cursor on a display. The mouse is also often used for scrolling in, e.g., word processing applications or other similar applications.

[0004] However, the mouse is not always an optimal device for controlling scrolling. Although some mice have scroll wheels, these wheels are also not ideal for some users, as they require substantial manual dexterity to be able to control the mouse, mouse wheel, and mouse buttons simultaneously. Another reason a mouse is not necessarily optimal for scrolling is that it requires a user who is typing on a keyboard to remove one of his or her hands from the keyboard to the mouse, and then back to the keyboard to continue typing.

[0005] There is therefore a need for an alternative device for controlling scrolling. To address the above problems, others have attempted to provide scrolling via the use of a two-dimensional touch pad such as that found on a typical laptop computer. For instance, the user can scroll by dragging a finger along an edge of the touch pad. However, the two-dimensional touch pad is not always convenient because of the tendency to not be able to place the finger accurately on the edge of the touch pad. Further, inaccurate touching of the touch pad will move the cursor instead of scrolling, causing frustration to the user.

[0006] There is also a need for a better way to sense the position of a finger on a touch sensitive position sensor that corrects for common-mode errors such as variations in finger pressure, fingertip size, moistness of the finger caused by hand lotion, and other factors.

SUMMARY OF THE INVENTION

[0007] An aspect of the present invention is directed to a device for detecting the position of a pointing member such as a human finger or other object on a touch-sensitive scrolling pad. The device may include a frequency ratio determinator, such as in the form of an electronic circuit, coupled to an arrangement of capacitive nodes such as conductive plates and/or conductive traces of a printed circuit board. The frequency ratio determinator may include dual independent oscillators used to generate pulses at frequencies dependent upon the capacitance of the conductors resulting from the position of the finger on the conductors. The frequency ratio determinator may count the pulses

from each oscillator over a time interval and/or determine the finger position from the ratio of the number of pulses counted from each oscillator. Measuring the ratio (i.e., a "ratio-metric" design) of the pulse counts results in the rejection of common-mode errors and drift that may be caused by, e.g., ambient temperature fluctuations, damage to the surface of the scrolling pad (caused, for example, by hand lotion or spilled beverages), finger size, and manufacturing tolerances.

[0008] According to another aspect of the present invention, the device may determine the relative pressure applied by the finger or other object according to the sum or average of the pulse counts from the two oscillators.

[0009] According to yet another aspect of the present invention, the conductors, which sense the finger or other object, may be of various shapes, preferably wedge-shaped such as triangular, and disposed in the touch pad of the device such that the finger covers both traces simultaneously when used properly. Moreover, more than two conductors may be used, such as by using multiple interdigitated conductors, to eliminate errors caused by the finger moving in a direction transverse to the intended axis of motion along the scrolling pad. By interdigitating the traces, potential errors caused when a finger is rolled in a direction transverse from movable axis can be minimized.

[0010] According to still another aspect of the present invention, the measuring portion may include a counting mechanism for counting the number of pulses generated by the oscillators. The counting mechanism may include a high frequency counter so that the pulses may be read quickly. This is helpful in reducing the effects of the environmental 60 Hz hum generated by the alternating current power source.

[0011] These and other features of the invention will be apparent upon consideration of the following detailed description of preferred embodiments. Although the invention has been defined using the appended claims, these claims are exemplary in that the invention is intended to include the elements and steps described herein in any combination or subcombination. Accordingly, there are any number of alternative combinations for defining the invention, which incorporate one or more elements from the specification, including the description, claims, and drawings, in various combinations or subcombinations. It will be apparent to those skilled in the relevant technology, in light of the present specification, that alternate combinations of aspects of the invention, either alone or in combination with one or more elements or steps defined herein, may be utilized as modifications or alterations of the invention or as part of the invention. It is intended that the written description of the invention contained herein covers all such modifications and alterations.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The foregoing summary of the invention, as well as the following detailed description of preferred embodiments, is better understood when read in conjunction with the accompanying drawings, which are included by way of example, and not by way of limitation with regard to the claimed invention. In the accompanying drawings, the same reference number in different drawings refers to the same element.