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Dunthorn

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[54] **VIRTUAL BUTTON FOR TOUCH SCREEN**

[76] Inventor: **David I. Dunthorn**, 908 W. Outer Dr., Oak Ridge, Tenn. 37830

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[51] **Int. Cl.**[4] **G06F 3/02**

[52] **U.S. Cl.** **364/900**; 364/927.2; 364/927.64

[58] **Field of Search** 364/200, 300, 900

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,911,215	10/1975	Hurst et al.	178/18
4,220,815	9/1980	Gibson et al.	178/18
4,763,356	8/1988	Day, Jr. et al.	364/900 X

OTHER PUBLICATIONS

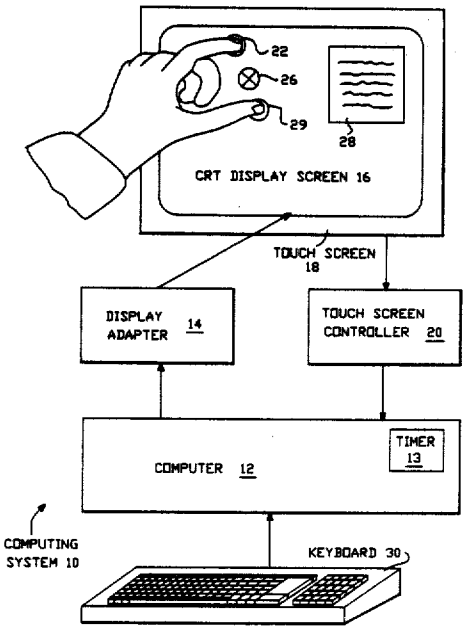
Elographics, *Prelim. IntelliTouch Systems Manual*, 3/19/88, pp. 1–10.

Primary Examiner—Raulfe B. Zache
Attorney, Agent, or Firm—David B. Harrison

[57] **ABSTRACT**

Apparatus and methods for creating a virtual push button comprise a touch sensitive orthogonal data field input device useably connected within a computing system in which a touch action at the device generates a stream of data related to the location within the field of the touch action. The orthogonal data field input device includes circuitry for sensing the onset of a first touch action and for monitoring the continuity thereof; and the computing system including a second condition sensor for sensing the occurrence of a second predetermined condition; and, computing circuitry for generating the virtual push button upon the concurrence of touch action continuation and the occurrence of the second predetermined condition.

22 Claims, 2 Drawing Sheets



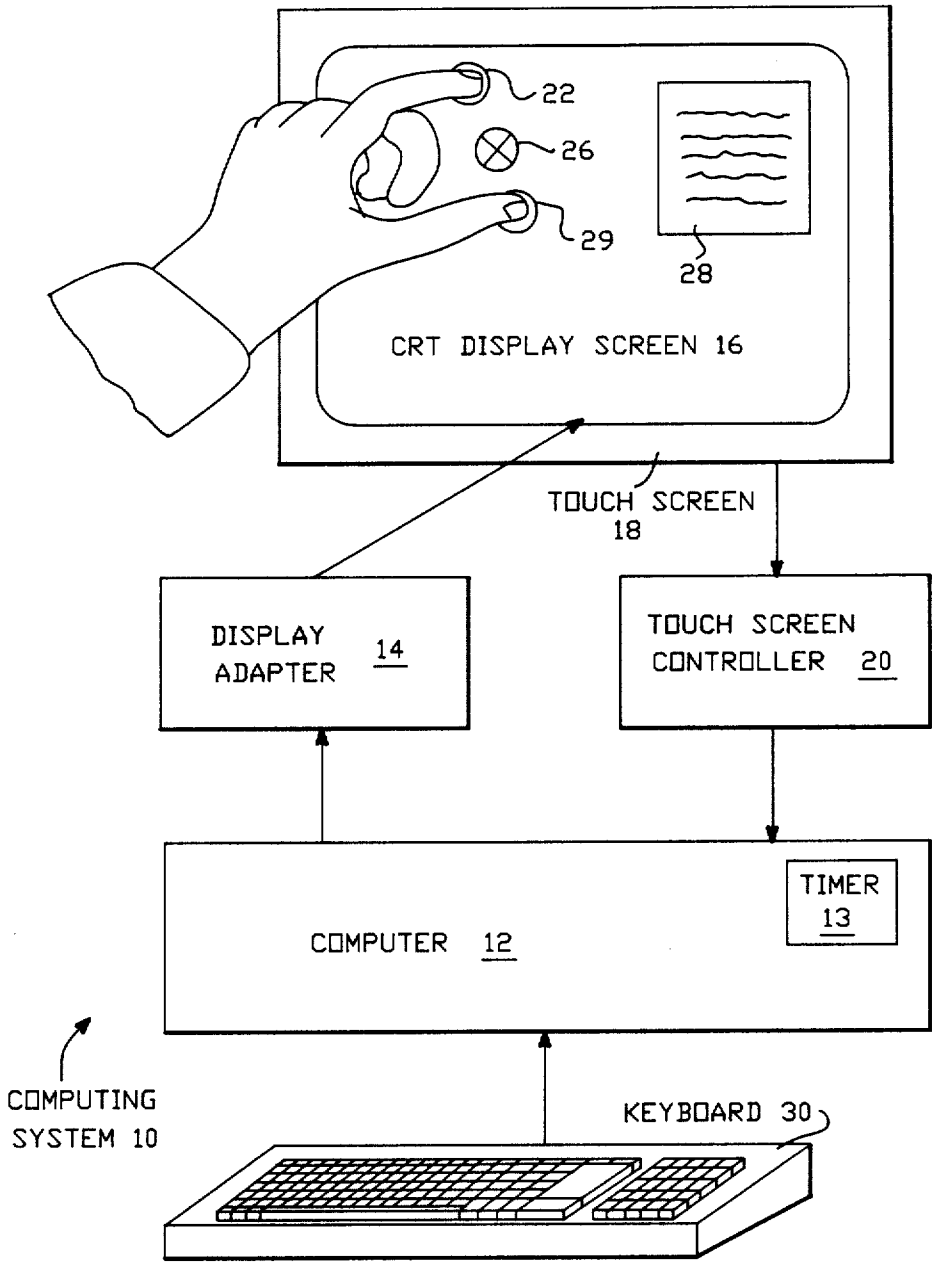


FIG.-1

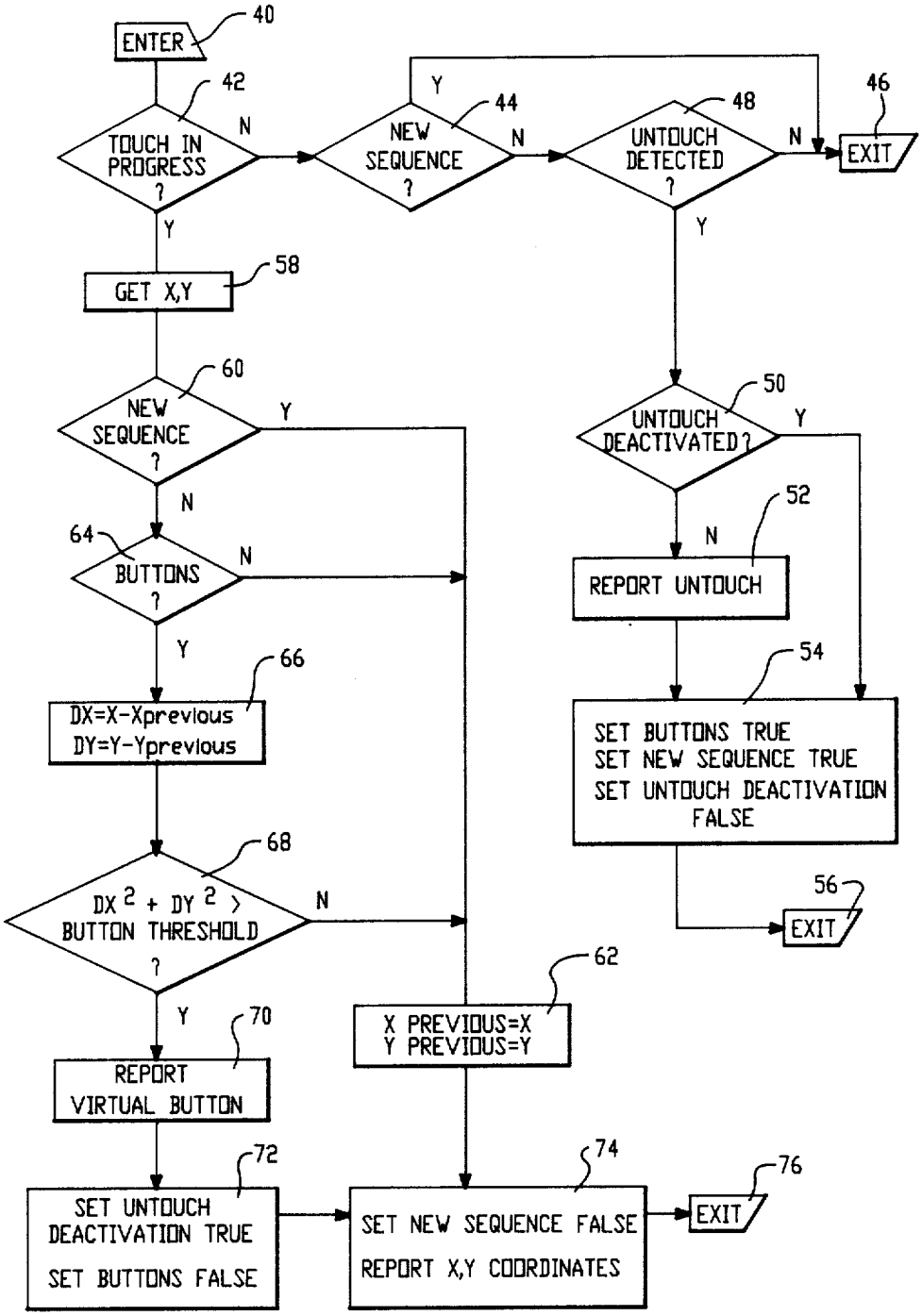


FIG.-2

VIRTUAL BUTTON FOR TOUCH SCREEN

FIELD OF THE INVENTION

The present invention relates to methods and apparatus for data input to computing systems. More particularly, the present invention relates to methods and apparatus for creating a virtual button for a touch screen or touch pad orthogonal field data input device.

BACKGROUND OF THE INVENTION

Touch pads and touch screens responsive to localized depression pressure have been provided to create "buttons" for data input. A touch pad device is disclosed, for example, in U.S. Pat. No. 3,911,215; and, a transparent touch screen for overlayment and use with the display screen of a cathode ray tube is disclosed, for example, in U.S. Pat. No. 4,220,815, the disclosures of both of these patents being incorporated by reference herein.

These previously patented devices rely upon resistive sheets in which uniform orthogonal electric fields are generated in two-phase sequences, for example, as shown in FIG. 1 of the referenced '215 patent. When a low resistance or ground connection is established at a particular location on the sheet, as by depressing an overlying, low resistance ground or signal return sheet into electrical contact with the resistive sheet, precise orthogonal field (x,y) pinpointing of the location of depression may be provided. Thus, these prior devices have been utilized in conjunction with a computer system to create "push-buttons". When a particular push-button (i.e. location on the resistive sheet) is depressed ("touch"), or released ("untouch"), the computer has sensed this occurrence and has responded operationally thereto.

Other technologies have been applied to create touch screens and pads, including surface accoustic wave technology; and these screens and pads have also been used with computing systems to create push-buttons. The surface accoustic wave touch screen has the additional capability of reporting a z-coordinate indicative of the velocity or force with which the screen or pad is touched.

Traditionally, touch screens or pads have accomplished push-button sensing either through a touch, i.e. when the operator's finger or a stylus first touches the screen; or, an untouch, i.e. when the finger or stylus is released from the screen or pad. "Touch" is the most natural action for a novice user, because it represents activation on contact, just like the expected action of a conventional electromechanical push-button. For example, with a touch screen implementation, a user touches a labelled, delineated area on the screen, and a resulting action and acknowledgement are then given e.g. by an appropriate display on the screen.

For "untouch", the touch step (which of course must come first) usually initiates some form of visual feedback, such as highlighting a screen area or option. The area or option is not actually selected to perform its action until the user "untouches" the screen. Thus, with "untouch" the slightly more experienced user can move finger or stylus on the screen to be sure the proper area is highlighted and then untouch or remove finger or stylus in order to complete the selection process. This approach enables a far greater precision in selection of desired areas on the screen.

The "touch" and "untouch" procedures are satisfactory for many applications, but they have significant

shortcomings. Often it is very desirable or necessary to display the visual feedback following a user's finger around the screen while not forcing the user actually to make a selection upon the untouch action. To achieve this feedback using normal touch screen operations, it is necessary to completely divorce the untouch action from selection. An operation with visual feedback is first used to determine a position on the screen, but the untouch action does not cause a selection to be made. A second touch/untouch operation is then required on the screen (or via some other input device such as a keyboard) in order to perform the select operation.

This prior requirement for two disparate actions to perform a single selection is not satisfactory. In order to accomodate the occasional time when an untouch action will not lead to a selection, the user's attention must be diverted for each such action. This inconvenience becomes intolerable when dealing with a sequence of operations as typically encountered in computer aided design (CAD) or even in simple word processing applications. One way of further illustration of this inconvenience is by drawing an analogy to a hypothetical typewriter which would require the typist to strike a ribbon advance key after each symbol key was struck merely to advance the ribbon during typing, a function automatically performed by conventional typewriters.

This inconvenience in prior art touch screens and touch pads has not been experienced with other position-reporting devices, such as computer "mice", "tablets", and "light pens" which usually have actual push-buttons present on the mechanism manipulated by the user's hand during operations. Thus, the user is able to manipulate a computer mouse to a desired orthogonal (x,y) position typically followed by a visual cursor on the display screen and then to actuate one of a plurality of switches on the mouse to initiate or discontinue a particular function.

Thus, a hitherto unsolved need has arisen for the provision of a "virtual" push button for use with touch screens or touch pads which functionally extends the capability thereof to match the capability of other position reporting devices, such as computer "mice", "tablets", and "light pens" which usually have electromechanical push-buttons present on the mechanism for manipulation by the user's hand during positioning operations thereof.

SUMMARY OF THE INVENTION WITH OBJECTS

A general object of the present invention is to overcome functional and operational drawbacks hitherto associated with touch screen and touch pad devices by enabling generation of virtual push-buttons as a function of activation of at least one actual push button location on the screen or pad.

A specific object of the present invention is to extend the functionality of touch screen and touch pad orthogonal data input devices to match that achievable with computer mice, tablets, light pens and the like.

In accordance with the principles of the present invention, methods and apparatus are provided for creating a virtual push button at a touch sensitive orthogonal field data input device used in conjunction with a computing system in which a touch action at the device generates a stream of data related to the location within the field of the touch action. The methods and the apparatus embodying the methods carry out the steps of:

sensing the onset of a first touch action at the device and monitoring the continuity thereof,

sensing the occurrence of a second predetermined condition,

generating the virtual push button upon the concurrence of touch action continuation and the occurrence of the second predetermined condition.

In one specific aspect of the present invention, the step of sensing the occurrence of the second predetermined condition comprises the step of sensing the onset of a second touch action at the device.

In a second specific aspect of the present invention, the step of sensing the onset of a second touch action at the device includes the step of determining the direction of the second touch action relative to the location of the first touch action and wherein the virtual push-button is generated as a function of the determined direction.

In a third aspect of the present invention, the step of sensing the onset of a second touch action at the device includes the step of determining the distance of the second touch action from the location of the first touch action and wherein the virtual push-button is generated as a function of the determined distance.

In a fourth aspect of the present invention, the step of sensing the occurrence of a second predetermined condition comprises sensing an increase in applied pressure at the touch point.

In a fifth aspect of the present invention, the step of sensing the occurrence of the second predetermined condition comprises the step of detecting elapse of a predetermined time interval and detecting an untouch action at the first location after the predetermined time interval has elapsed.

In a sixth aspect of the present invention, the step of sensing the occurrence of the second predetermined condition comprises the steps of detecting elapse of predetermined time intervals and comprising the further step of generating and displaying to the user a sequence of virtual push-buttons with a virtual push-button being displayed during each time interval, the step of generating the virtual push button occurring upon detection of an untouch action at the first location during display of a preferred one of the virtual push-buttons.

In a seventh aspect of the present invention, the step of sensing the occurrence of the second predetermined condition comprises the step of sensing an input at another input device functionally connected to the computing system.

In an eighth aspect of the present invention, the step of sensing an input at another input device comprises the step of sensing actuation of a key of a keyboard device.

These and other objects, advantages and features of the present invention will be more fully understood and appreciated upon considering the following detailed description of preferred embodiments, presented in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the Drawings:

FIG. 1 is a somewhat diagrammatic block diagram of a computing system including a touch screen input/display device configured in accordance with the principles of the present invention.

FIG. 2 is a flowchart of one preferred embodiment of the method of the present invention when used in conjunction with the hardware depicted in FIG. 1.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

It has been discovered that when a resistive touch screen or pad of the type described in the referenced patents is touched in two places at the same time, the screen returns a single position which is located about half way between the two positions actually being touched. This untouched, single position is therefore available to serve as a virtual push-button.

Also, when the screen or pad is being touched at one point and is then touched at another point as well, there is a sudden large change or discontinuity in reported position which is more sudden and discontinuous than would be produced by a rapid motion of the finger or stylus across the screen or pad. Since there will have been no detected untouch action prior to this large, discontinuous change, its occurrence is distinct, and may therefore be distinguished as abnormal from other functional activities at the touch screen/touch pad. Therefore, the action of touching the screen/pad at a second touch point without first releasing a still active first touch point thereby creates one form of virtual push-button.

Although the present invention has been developed for use with a glass resistive touch screen, the present techniques may be effectively used with any touch screen or touch pad which, when touched at two different points, will return a position significantly different than for either point actually being touched.

The activation of a virtual push-button not only indicates that a sudden change in position has take place, but also reports the direction and amount of that change. Thus, it is easily possible to determine whether the second touch was above, below, to the right or to the left of the original touch. Finer distinctions of angular direction are also easily implemented In particular, the implementation of four distinct virtual buttons, one for each of the cardinal directions, is both easy to implement and easy for an operator to remember. It is also possible to differentiate different virtual push-buttons in the same direction on the basis of the distance between the two simultaneous touch actions giving rise to the virtual push-button.

In addition to enabling abortion of a normal touch-untouch operation, virtual push-buttons have other very useful properties. On a touch screen or touch pad, actual or assigned push buttons are usually defined by establishment of a function (push-button) at a particular location. Usually, visual information is provided to identify each actual button's position and function. Touch screens in particular are often implemented so that the visual information presented at the screen changes as required in order to match redefined button positions. However, within any given visual presentation, the location of each actual push button will be fixed.

A virtual push-button, on the other hand, is not fixed to any position on the screen, but is defined at a position related to the positions of two simultaneous touch actions giving rise to the virtual push-button. Thus, virtual push buttons may coexist with and even overlie actual push button locations without creating any interference with the functions normally assigned to those actual push button locations. This feature is particularly useful for buttons which are to retain common and useful functions regardless of the information presented on the screen; functions such as "cancel" and "confirm".

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