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(54) Data processing apparatus with user input feedback.

(57) Data processing apparatus is provided which employs feedback to provide an indication when a data input instrument (52) touches or comes within a predetermined distance of a data capture surface (12). The data capture surface (12) may include a transparent digitizer over a liquid crystal display, over a hard surface bearing printed indicia or over a cathode ray tube (35), or it may include a digitizer (36) with an overlying form (39) bearing printed indicia. A feedback actuator (20) provides tactile, aural, or visual feedback.

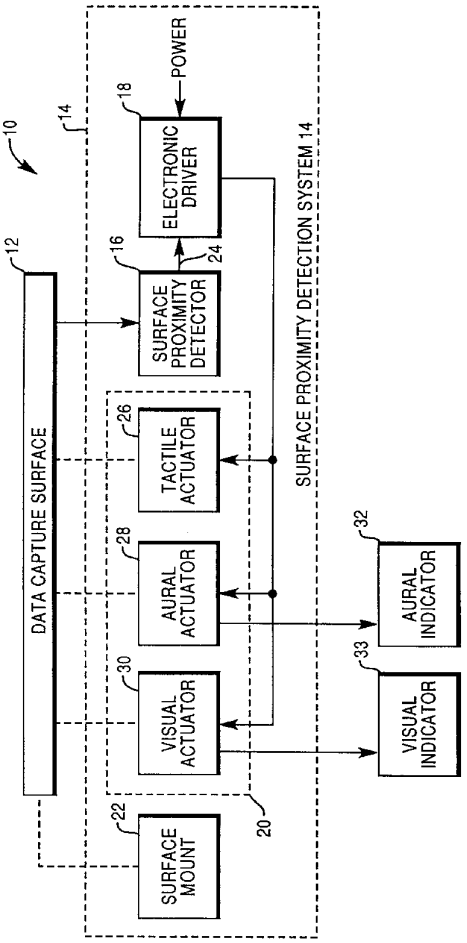

FIG. 1

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The present invention relates to data processing apparatus.

When manually inputting data into a machine or system, the benefits of feedback to the user are well known. This feedback can serve to indicate to the user that he has accomplished his objective.

Data capture surfaces may include a digitizer or a combination of a display and an overlying transparent digitizer. The digitizer responds to pressure from a finger or writing instrument by generating a signal which is filtered, processed, and measured to determine the position of the pressure source on the digitizer.

When the data capture surface comprises a rigid surface, for example when an overlying transparent display forms the data acapture surface, or when the surface is generally inflexible, a user is disadvantageously faced with the unfamiliar feel of a solid writing instrument such as a ballpoint pen or stylus against a hard and rigid surface.

It is an objet of the present invention to provide data processing apparatus which does not have the above disadvantage.

In accordance with the present invention, there is provided data processing apparatus having a data input surface and data input means for touching said surface so as to input data into said apparatus, characterized by detection means for providing a signal when said input means comes within a predetermined distance from said surface, and feedback means connected to said detection means for providing feedback to a user in response to receiving said signal.

It should be understood that the term within a predetermined distance as used in the preceding paragraph includes a value of zero distance, such as when the data input means touches the surface.

It is an advantage of the present invention that a data capture system is provided with feedback in the form of displacement of the data capture surface when a data capture instrument touches the data capture surface so that the surface moves in response to use of the instrument.

The invention is described further hereinafter, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 is a block diagram of apparatus embodying the present invention;

Fig. 2 shows a first type of data capture surface for use in the present invention;

Fig. 3 shows a second type of data capture surface for use in the present invention;

Fig. 4 shows a third type of data capture surface for use in the present invention;

Fig. 5 is a diagrammatic view of apparatus according to one embodiment of the present invention;

Fig. 6 is a diagrammatic view of apparatus according to another embodiment of the present invention; and

Fig. 7 is a diagrammatic view of apparatus according to a further embodiment of the present invention.

Referring now to Figs. 1-7, data capture system 10 of the present invention includes a data capture surface 12 and a surface proximity detection system 14. Data capture surface 12 may include a liquid crystal display with a transparent digitizer or one or more touch sensitive elements across its top surface (Figs. 5-7). It could be a touch sensitive element within a video monitor (Fig. 2). Alternatively, data capture surface 12 may be a hard surface with printed captions in blocks and a transparent digitizer or touch sensitive overlay to enable the selection of a particular block (Fig. 3). Finally, data capture surface 12 may be a resistive or other type of digitizer underneath an overlay containing printed indicia thereon (Fig. 4).

Surface proximity detection system 14 includes a surface proximity detector 16, an electronic driver 18, a feedback actuator 20, and a data capture surface mount 22. Surface proximity detector 16 senses when a data input instrument touches or comes within a predetermined distance of data capture surface 12 and provides a signal 24 to electronic driver 18.

Electronic driver 18 amplifies and rectifies signal 24 to a level sufficient to activate feedback actuator 20.

Feedback actuator 20 provides feedback to the user when a data input instrument touches or comes within a predetermined distance of data capture surface 12. Feedback actuator 20 may include a tactile actuator 26, an aural actuator 28, and a visual actuator 30.

Tactile actuator 26 displaces data capture surface 12 when a touch is applied to data capture surface 12. Displacement may assist or oppose the touch force. Preferably, tactile actuator 26 includes an electromagnet, and a metal plate affixed to data capture surface 12. Tactile actuator 26 works in conjunction with data capture surface mount 22 to displace data capture surface 12. Surface mount 22 may include a hinge at one end of data capture surface 12.

Aural actuator 28 actuates aural indicator 32 when a data capture instrument touches or comes within a predetermined distance of data capture surface 12.

Visual actuator 30 actuates visual indicator 33 when a data capture instrument touches or comes within a predetermined distance of data capture surface 12.

Turning now to Fig. 2, a touch sensitive element 34 is shown on a video monitor 35.

Turning now to Fig. 3, a transparent digitizer 36 is shown over a hard surface 37 having printed captions in blocks.

Turning now to Fig. 4, a resistive digitizer 38 is

shown underneath an overlay 39 containing printed indicia thereon.

Turning now to Fig. 5, a first embodiment 40 of data capture system 10 is shown in which data capture surface 12 is a transparent digitizer 41 over a liquid crystal display 45. Data capture surface mount 22 includes a hinge 42 coupled to one end 44 of data capture surface 41, 45. Hinge 42 is normally biased by a spring 43 at the other end 48 of the surface 41,45 so that data capture surface 12 is in an upward position. Data capture surface 12 moves in a downward direction during a touch when an electromagnet 50 attracts plate 46 mounted at end 48 of data capture surface 12.

In operation, when pressure is applied by writing instrument 52, data capture surface 12 rotates about hinge 42 in opposition to spring force from spring 43. End 48 deflects downward with the aid of the magnetic force from electromagnet 50. Thus, the user is provided with a sensation of having pushed data capture surface 12. Tactile feedback may be accompanied by an audible or visual indication from aural and visual indicators 32 and 33.

Preferably, downward travel of end 48 is limited to as small as about five thousandths of an inch (0.13mm) to minimize any adverse effects, if any, on the writing process. For data capture surfaces incorporating simple push-button motions, the limit of travel may be significantly greater to achieve an appropriate sensation.

Referring now to Fig. 6, a second embodiment 60 of data capture system 10 of the present invention is shown. Embodiment 60 is similar to embodiment 40, except that activated motion is in an upward direction, opposing the direction of the touch force. Embodiment 60 provides increased sensation to the user and tends to keep writing instrument 52 in contact with data capture surface 12.

Referring now to Fig. 7, a third embodiment 70 of data capture system 10 is shown. Instead of using hinge 42, embodiment 70 supports data capture surface 12 with a supporting frame 72. Springs 74 or some other type of resilient means bias the data capture surface 12 away from supporting frame 72 in an upward direction. Tactile actuator 26 includes a T-shaped armature 76, which moves upward to impact data capture surface 12 when electromagnet 50 is energized by contact from data capture instrument 52 with data capture surface 12. Magnitude and duration of tactile, aural, or visual sensations are established by the signal input to electromagnet 50, the weight and travel of armature 76, and the type of material from which the impacting surfaces are made. While embodiment 70 illustrates upward motion of armature 50, a downward direction of motion can be easily obtained by changes in the mechanical mounting of armature 76.

Claims

1. Data processing apparatus having a data input surface (12) and data input means (52) for touching said surface (12) so as to input data into said apparatus, characterized by detection means (16) for providing a signal when said input means (52) comes within a predetermined distance from said surface (12), and feedback means (20) connected to said detection means (16) for providing feedback to a user in response to receiving said signal.

2. Apparatus according to claim 1, characterized in that said feedback means (20) comprises displacement means (26) for displacing said surface (12) in response to said signal.

3. Apparatus according to claim 2, characterized in that said displacement means (26) includes a driver (18) for amplifying and rectifying said signal from said detecting means (16) and actuator means (26) coupled to said driver (18) for displacing said surface (12).

4. Apparatus according to claim 3, characterized by hinge means (42) at one end of said surface (12) and resilient means (43) at another end of said surface (12) for biasing said surface (12) in a predetermined direction.

5. Apparatus according to claim 3, characterized by a frame member (72) for displaceably supporting said surface (12) and resilient means (74) mounted between said surface (12) and said frame member (72) for outwardly biasing said surface (12).

6. Apparatus according to claim 3, 4 or 5, characterized in that said actuator means (26) comprises plate means (46) coupled to said data output surface (12) and electromagnetic means (50) for attracting said plate means and thereby displacing said surface.

7. Apparatus according to claim 3, 4 or 5, characterized in that said actuator means (26) comprises a plunger means (76) for displacing said surface (12) in a predetermined direction and electromagnetic means (50) for driving said plunger means (76).

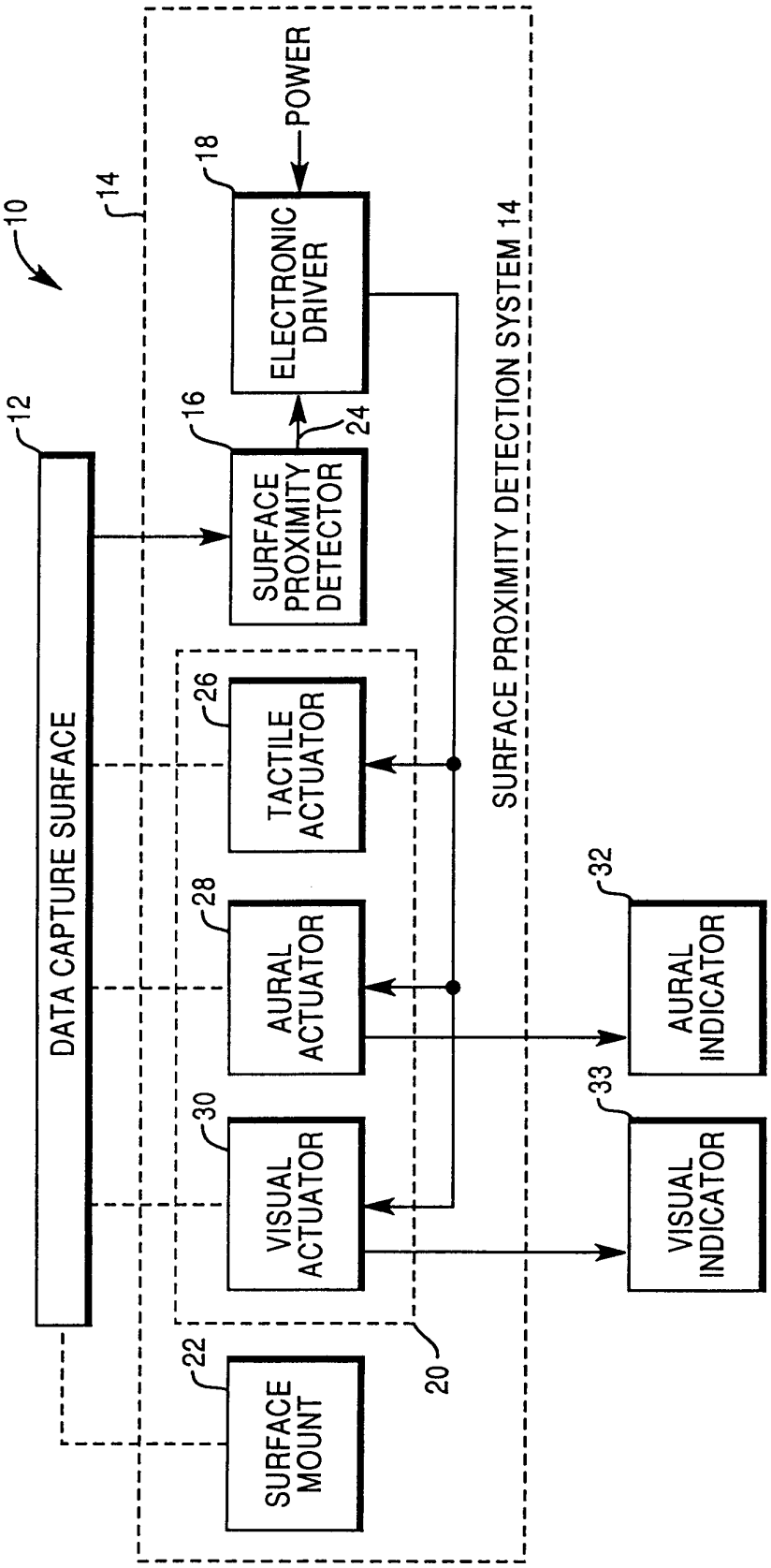
8. Apparatus according to any one of the preceding claims, characterized in that said data input surface (12) comprises a digitizer layer (41) and a display layer (45).

9. Apparatus according to any one of the preceding

claims, characterized by audio means (32) for providing an aural indication when said data input means (52) is within a predetermined distance from said data input surface (12).

10. Apparatus according to any one of the preceding claims, characterized by visual indication means (33) for providing a visual indication when said data input means (52) is within said predetermined distance from said data input surface (12).

FIG. 1



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