

fulcrum 32. These embodiments can be achieved by molding the button assemblies from a plastic material, such as acrylonitrile butadiene styrene ("ABS") or other plastic, with the button assembly typically snapped or glued into place within the housing of the device. ABS plastic is particularly desirable because of its strength, resiliency, ease of fastening to the housing, and molding properties. The spring constants can be selected according to the thickness and length of the hinge/fulcrum section for a particular material, with a thinner section producing a lower spring constant.

[0026] Thus, the present invention enables a selective force profile for a button assembly from an increasing force profile, an essentially constant force profile, or a decreasing force profile moving along the external surface of the button assembly 38 from first fulcrum 28 to the second fulcrum 32. In a constant force profile implementation, a 3.1 cm wide by 3.5 cm long (palm to finger direction) button assembly has an electronic switch with an actuation force of 0.60 N. The finger force needed to activate ("click") the button is 0.6 N along the centerline of the button from the first fulcrum to the second fulcrum with a force variation of about ± 0.15 N or less, and a force variation along the transverse direction of about ± 0.15 N.

[0027] An example of an increasing force profile with a two-cantilever button assembly is given below in Table 2. The external surface of the button is 3.1 cm wide and 3.5 cm long (palm to finger direction). The button assembly contacts an electro-mechanical switch that has an actuation force of 0.60 N located at 2.0 cm. The transverse variation in force is about ± 0.15 N or less. An increasing force profile may be desirable for persons with larger hands because the higher force provides greater tactile feedback and thus better control over button actuation.

TABLE 2

Distance (cm)	Force (N)
0.0	0.60
1.0	0.65
1.5	0.70
2.0	0.75
2.5	0.85
3.0	1.00
3.5	1.20

[0028] FIG. 3 is a simplified partial cross section of a computer pointing device 50 with a reverse cantilever button assembly 52 according to an embodiment of the present invention. The mouse includes a palm portion 54 configured to fit into the hand of a user. In use, the user's fingers extend from the palm portion 54 to the distal end 56 of the finger portion 38 of the button. The button includes a first fulcrum 58 near the palm section typically under the metacarpalphalangeal joint and a second fulcrum 60 near the distal end of the button which typically resides under or beyond the end of the user's fingertip. In this embodiment the button plunger 62 and associated electronic switch 12 with movable switch element 22 is not centered in the finger portion of the button. A cable 64 is provided to connect the device to a computer, but a wireless connection could be provided.

[0029] 3. An Exemplary Trackball

[0030] FIG. 4 is a simplified top view section of a button assembly 70 inside a conventional trackball pointing device. An electronic switch 12 is placed behind a thumb pad (switch button) 72 on a thumb button 74 movable in a small arc about a fulcrum 76 relative to the trackball housing 78. The fulcrum is proximate to a palm portion 80 of the trackball housing, thus the force required to be applied to the thumb pad 72 in order to actuate the switch decreases as one moves further from the palm portion of the device.

[0031] FIG. 5 is a simplified top view section of a button assembly 90 inside a trackball pointing device according to another embodiment of the present invention. In this instance the fulcrum 92 is distal from the palm portion 80' of the trackball housing 78' i.e. nearer the thumb tip. Thus the force required to be applied to the thumb pad 72' increases as one moves from the palm end of the thumb pad to the distal end of the thumb pad. This increasing profile is more consistent with ergonomic considerations, for example, allowing a person with smaller and presumably weaker hands to more easily actuate the button, and providing more tactile feedback for persons with larger hands.

[0032] FIG. 6 is a simplified section of a trackball pointing device 100 according to another embodiment of the present invention. A trackball 102 is in a housing 104 having a palm portion 106 configured to accept a hand. The fingers manipulate the trackball, and a thumb switch button 108 is configured to be actuated by the user's thumb. Like the button assembly shown in FIG. 5, above, the button has a fulcrum (not shown as it lies within the housing) between the thumb switch button and a distal end 110 of the trackball housing. Thus, the actuating force necessary to apply to the thumb switch button decreases with increasing distance from the distal end. In other words, when a user's hand is resting on the palm portion 106 of the trackball housing, a user with a shorter thumb can advantageously actuate the thumb switch with less applied force than would be required if the fulcrum was on the opposite side (from the distal end) of the thumb switch button.

[0033] While the invention has been described above with reference to specific embodiments, modifications and equivalents may be apparent or become apparent to those skilled in the art. For example, while an electronic switch with a simple plunger is illustrated, other types of electronic switches, such as a levered microswitch where switch, lever, and small roller (all contained on the switch unit), could be used. Similarly, the fulcrums have been shown as being live spring hinges, but could be pivots or be movable fulcrums to change the stiffness of the beam assemblies. While specific embodiments are molded from plastic, other materials, such as metals, could be used for some or several of the components, such as the fulcrum and beam. These and other variations are intended to fall within the scope of the invention; therefore, the invention is to be limited only as recited in the following claims.

I claim:

1. A button assembly comprising:

- a first cantilevered beam (30) having a first end and a second end, the first end being configured to be attached to an electronic input device through a first fulcrum (28) at the first end;