

INPUT DEVICE**Technical Field**

[0001] Various embodiments relate to an input device. In particular, various embodiments relate to an input device, such as a mouse device, for a processor-based device (e.g. a computer).

Background

[0002] In the realm of computer peripherals, the pursuit of enhanced user experience remains ongoing. Central to this pursuit is the design and functionality of computer mice, which serve as tools for navigating digital interfaces. However, despite considerable advancement in technology, there remains a demand for improved mouse designs, especially concerning scroll button functionality.

[0003] Traditional computer mice designs have long been centered on incorporating mechanical switches for primary button functionalities, such as left and right clicks. Yet, challenges persist in optimizing the performance of scroll buttons. These challenges often stem from issues like misalignment or space constraints within the computer mice housing.

[0004] Misalignment issues can lead to inconsistent button responses, compromising overall performance and user experience.

[0005] In addition to misalignment issues, space constraints within the computer mice housing pose another issue. The design of modern computer mice often prioritizes compactness and sleek aesthetics, limiting the integration of components, such as traditional switches which may be bulkier in size.

[0006] Recognizing these challenges, there may be a need for an improved input device, such as an improved computer mouse device, which addresses at least the above issues.

Summary

[0007] According to various embodiments, there may be provided an input device. The input device may include a housing. The input device may further include a scroll wheel mounted to the housing in a manner which exposes a part of the scroll wheel for user access, the scroll wheel being rotatable relative to the housing about a rotational axis extending through a center of the scroll wheel and being depressible relative to the housing along a movement axis that is non-parallel to the rotational axis. The scroll wheel may include an axle portion that extends along the rotational axis from the center of the scroll wheel. The input device may further include a switch disposed within the housing. The input device may further include a plunger disposed within the housing between the axle portion of the scroll wheel and the switch, the plunger being movable along its longitudinal axis relative to the switch. The plunger may include an axle-engagement portion at a first longitudinal end to engage the axle portion of the scroll wheel and a switch-engagement surface at a second longitudinal end, opposite the first longitudinal end, for actuating the switch. According to various embodiments, a depression motion of the scroll wheel along the movement axis may cause the axle portion of the scroll wheel to impart the depression motion of the scroll wheel to the plunger via the axle-engagement portion at the first longitudinal end of the plunger to move the plunger along its longitudinal axis towards the switch to actuate the switch.

Brief description of the drawings

[0008] In the drawings, like reference characters generally refer to the same parts throughout the different views. The drawings are not necessarily to scale, emphasis instead generally being placed upon illustrating the principles of the invention. In the following description, various embodiments are described with reference to the following drawings:

FIG. 1A shows a front-sectional view of an input device in the form of a mouse, according to various embodiments;

FIG. 1B shows a side-sectional view of the input device in the form of the mouse, according to various embodiments;

FIG. 1C shows a front perspective close-up view of the scroll wheel of the input device mounted to a housing of the input device, according to various embodiments;

FIG. 1D shows a rear perspective close-up view of the scroll wheel mounted to the housing, according to various embodiments;

FIG. 1E shows a close-up side view of a plunger of the input device, according to various embodiments;

FIG. 2A shows a front perspective view of the input device of FIG. 1A having a plunger with an elongated switch-engagement surface for engaging a switch, according to various embodiments; and

FIG. 2B shows a rear perspective view of the input device having the plunger of FIG. 2A, according to various embodiments.

Detailed description

[0009] Embodiments described below in context of the apparatus are analogously valid for the respective methods, and vice versa. Furthermore, it will be understood that the embodiments described below may be combined, for example, a part of one embodiment may be combined with a part of another embodiment.

[0010] It should be understood that the terms “on”, “over”, “top”, “bottom”, “down”, “side”, “back”, “left”, “right”, “front”, “lateral”, “up” etc., when used in the following description are used for convenience and to aid understanding of relative positions or directions, and not intended to limit the orientation of any device, or structure or any part of any device or structure. In addition, the singular terms “a”, “an”, and “the” include plural references unless context clearly indicates otherwise. Similarly, the word “or” is intended to include “and” unless the context clearly indicates otherwise.

[0011] Various embodiments generally relate to an input device, such as a computer mouse device, capable of integrating switches, such as mechanical switches or microswitches, for scroll wheel functionality, while effectively mitigating any potential misalignment issues and/or overcoming any space constraints.

[0012] Microswitches, recognized for their reliability, tactile feedback, and precise actuation, when incorporated into the input device (e.g. computer mouse device), may enhance user experience.

[0013] The input device, according to the various embodiment, may include a scroll wheel (or a scroll button) having an axle portion that may be linked (e.g. indirectly

connected) to a switch (e.g. a microswitch) via a connecting member of the input device. Particularly, the connecting member may correspond to, operate, and/or function as a plunger, which may be moved or driven by the axle portion of the scroll wheel, as the scroll wheel is depressed by a user. In particular, according to the various embodiments, depressing the scroll wheel may lead to the axle portion of the scroll wheel transmitting the depression motion to the plunger, thereby moving the plunger along its longitudinal axis towards the switch to actuate the switch. Notably, according to the various embodiments, the plunger, the switch, and the scroll wheel may be configured and/or arranged to ensure that even if the scroll wheel were to be misaligned relative to the housing, a depression motion of the scroll wheel would still lead to the switch being activated or actuated.

[00014] In various embodiments, different switches of the input device, which may be associated with different buttons (e.g. primary left and right buttons and/or the scroll button) of the input device, may be disposed on different planes (e.g. reference planes) within the input device housing. For instance, these switches may be mounted or attached on distinct or different circuit boards within the housing, enabling a stacked and/or staggered and/or alternating and/or offset arrangement of these switches within the input device housing. According to various embodiments, this arrangement of the switches within the input device housing may optimize use of space within the housing and allow for an efficient component layout.

[00015] FIG. 1A shows a front-sectional view of an input device 100 in the form of a mouse 100, according to various embodiments.

[00016] FIG. 1B shows a side-sectional view of the input device 100 in the form of the mouse 100, according to various embodiments.

[00017] In addition to being in the form of the mouse 100 as illustrated in the various figures, it is envisaged that the input device 100 according to various embodiments may also, or alternatively, be in the form of a joystick, a handheld controller, a control pad, a keyboard, or the like.

[00018] As shown in FIG. 1A and FIG. 1B, the input device 100 in the form of the mouse 100 may include a housing 101. The housing 101 may include an exterior casing of the mouse 100. In particular, the housing 101 may include a cover portion and a base portion. The cover portion and the base portion may be, but are not limited to being, two separate parts of the housing 101. The cover portion of the housing 101 may

be a top case cover of the exterior casing of the mouse 100. The base portion of the housing 101 may be a bottom case cover of the exterior casing of the mouse 100. According to various embodiments, when the cover portion and the base portion are assembled together, the housing 101 may define an inner cavity to house or encase internal components of the mouse 100.

[00019] According to various embodiments, the internal components of the mouse 100 may include an electronic circuit assembly, a motion detection assembly, as well as various mechanical assemblies configured for operating the mouse 100. The electronic circuit assembly may include one or more circuit boards 161, 162 (e.g. printed circuit boards) and/or any other suitable electronic circuit. The electronic circuit assembly may be connected to a processor-based device, such as a computer, for example, via a cable 105 or via wireless communication. The motion detection assembly may include optical sensors, or laser sensors, or track ball mechanism, or any other electronic or mechanical components that may be configured to detect movement of the mouse 100. The motion detection assembly may further be configured to be in communication with the electronic circuit module such that the detected movement of the mouse 100 may be transmitted to the processor-based device (e.g. computer), which the mouse 100 may be connected to.

[00020] According to various embodiments, the housing 101 of the mouse 100 may include a base surface at the base portion of the housing 101. The base surface may be configured to face a tracking surface on which the mouse 100 may be placed. Accordingly, the base surface of the housing 101 may be an exterior surface of a substantially flat section of the base portion of the housing 101. Thus, the mouse 100 may be placed with the base surface of the base portion of the housing 101 substantially flat against or substantially parallel with a mouse 100 pad, a tabletop, or any other suitable tracking surfaces on which the mouse 100 may be used.

[00021] Further, the base portion of the housing 101 of the mouse 100 may include a window (not shown). The window may be an opening or a transparent portion of the base portion. Accordingly, the window may allow the motion detection assembly of the mouse 100 to detect relative movement between the mouse 100 and the tracking surface on which the mouse 100 may be placed and moved.

[00022] As shown, the cover portion of the housing 101 may include one or more buttons 113, 114 (e.g. two main or primary buttons) and a scroll wheel 110. The one

or more buttons 113, 114 and the scroll wheel 110 may be configured to interact with the electronic circuit assembly of the mouse 100 for a user to provide inputs to the processor-based device, which the mouse 100 may be connected to, via clicking or depressing the one or more buttons 113, 114 as well as scrolling and/or depressing the scroll wheel 110. According to various embodiments, the one or more buttons 113, 114 may be located at any desired region of the cover portion as desired.

[00023] According to various embodiments, the scroll wheel 110 may be configured for a user to perform scrolling of a page of an application running in the processor-based device to which the mouse 100 is connected. For example, the user may use the scroll wheel 110 to scroll through lines of texts or various graphical objects on the page of the application. As shown in FIG. 1A and FIG. 1B, the scroll wheel 110 may be mounted (e.g. rotatably and depressibly / movably mounted) on the housing 101 in a manner so as to be rotatable about a rotational axis 110a extending through a center of the scroll wheel 110 and to be depressible (or movable) about a movement axis 110b (e.g. a linear or substantially linear movement axis 110b) that is non-parallel (e.g. perpendicular or substantially perpendicular) to the rotational axis 110a. Accordingly, the scroll wheel 110 may be capable of functioning as a “scroll button”.

[00024] As shown, the scroll wheel 110 may be mounted to the housing 101 in a manner so as to be partly exposed from the housing 101, with the exposed part being accessible to a user of the mouse 100. Accordingly, a user may manipulate (e.g. rotate and/or depress) the scroll wheel 110 via the exposed part of the scroll wheel 110.

[00025] Furthermore, the scroll wheel 110 may be located between the two main buttons 113, 114 (e.g. depressible buttons) at a front portion of a cover surface of the cover portion of the housing 101 of the mouse 100. The scroll wheel 110 may also be at least substantially perpendicular to the cover surface of the cover portion of the housing 101 of the mouse 100 such that the rotational axis 110a may be at least substantially parallel with a portion of the cover surface of the cover portion which the scroll wheel 110 may be mounted to. It is envisaged that, in various other embodiments, the scroll wheel 110 may be mounted to other portions or surfaces of the housing 101 of the mouse 100. For example, according to various other embodiments (not shown), the scroll wheel 110 may be mounted to a side portion or a side surface of the housing 101.

[00026] According to various embodiments, the scroll wheel 110 may include an axle portion 111 extending from the center, or a central region, of the scroll wheel 110. In particular, the axle portion 111 may be elongated in shape (e.g. resembling a cylindrical shaft) and oriented along or is coincident with the rotational axis 110a. According to various embodiments, the axle portion 111 may be an integral (e.g. integrally formed or integrally connected) portion or part of the scroll wheel 110. Accordingly, as the user scrolls the scroll wheel 110, the entire scroll wheel 110, including the axle portion 111, may rotate accordingly. It is envisaged that, in various other embodiments, a wheel portion 112 of the scroll wheel 110 may be freely rotatable relative to the axle portion 111 of the scroll wheel 110. In other words, in various other embodiments, the wheel portion 112 of the scroll wheel 110 may rotate independently of the axle portion 111. Accordingly, in various other embodiments, the axle portion 111 may be stationary while the wheel portion 112 rotates. According to various embodiments, the axle portion 111 of the scroll wheel 110 may be mounted to the housing 101 in a manner such that the axle portion 111 provides a fixed point of rotation for the scroll wheel 110. As such, according to various embodiments, the axle portion 111 may serve as a central anchor for rotational motion of the scroll wheel 110 about the rotational axis 110a.

[00027] Furthermore, according to various embodiments, the axle portion 111 may move in a same direction as a depression motion of the scroll wheel 110 (or the wheel portion 112). In particular, the axle portion 111 of the scroll wheel 110 may be movable in tandem with the wheel portion 112 of the scroll wheel 110. Accordingly, according to various embodiments, the entire scroll wheel 110 may be movable as a single unit.

[00028] FIG. 1C shows a front perspective close-up view of the scroll wheel 110 mounted to the housing 101, according to various embodiments.

[00029] FIG. 1D shows a rear perspective close-up view of the scroll wheel 110 mounted to the housing 101, according to various embodiments.

[00030] As an example, with reference to FIG. 1C and FIG. 1D, the housing 101 may include a mounting frame 102 for supporting or mounting the scroll wheel 110. Specifically, as shown, the mounting frame 102 may include a pair of plate members 102a which include a pair of parallel or substantially parallel slots 102b for accommodating the axle portion 111 of the scroll wheel 110. The axle portion 111 of the scroll wheel 110 may be inserted into these slots 102b. The portions of the plate members 102a which delineate these slots 102b may serve to guide the axle portion 111

of the scroll wheel 110 and, by extension, the entire scroll wheel 110, to be movable (e.g. depressible) along a linear or substantially linear trajectory.

[00031] According to various embodiments, referring back to FIG. 1A and FIG. 1B, the input device 100 may further include a switch 120 that is associated with the scroll wheel 110. According to various embodiments, the input device 100 may be configured such that a depression motion of the scroll wheel 110 would cause the switch 120 to be actuated.

[00032] As shown in FIG. 1C and FIG. 1D, according to various embodiments, the input device 100 may further include a plunger 130. The plunger 130 may be disposed within the housing 101 and may be configured to connect or link the axle portion 111 of the scroll wheel 110 to the switch 120. In particular, the plunger 130 may be disposed between the axle portion 111 of the scroll wheel 110 and the switch 120 and may be configured to transfer a depression force applied at the scroll wheel 110 to the switch 120 to actuate the switch 120. According to various embodiments, the plunger 130 may be, but is not limited to being, a single, integral unit. Furthermore, the plunger 130 may be a discrete component from the scroll wheel 110 (including its axle portion 111) and the switch 120.

[00033] According to various embodiments, the plunger 130 may be configured (e.g. mounted to the housing 101, for example, to the mounting frame 102 of the housing 101, in a manner which enables the plunger 130 to be displaceable or movable, along its central axis or longitudinal axis 130a (e.g. a linear central axis or a linear longitudinal axis 130a, extending between a first end 131 and a second end 135 of the plunger 130), in a first direction (e.g. a first linear direction) towards the switch 120 or in an opposite second direction (e.g. a second linear direction) away from the switch 120. Particularly, the plunger 130 may be disposed over (e.g. directly over or above) the switch 120 and may be aligned with the switch 120 (e.g. with a switch button 121 thereof), for example, vertically aligned and/or aligned along the central axis or longitudinal axis 130a of the plunger 130. Accordingly, the plunger 130 may be displaceable or movable relative to the switch 120, along its central axis or longitudinal axis 130a (or in a linear direction parallel to its central axis or longitudinal axis 130a). Herein, the terms “central axis” and “longitudinal axis”, with respect to a “plunger”, may be used interchangeably.

[00034] According to various embodiments, the plunger 130, the switch 120, and the axle portion 111 of the scroll wheel 110 may be configured (e.g. to cooperate) in a

manner such that a depression motion of the scroll wheel 110 along the movement axis 110b of the scroll wheel 110 may cause the axle portion 111 of the scroll wheel 110 to impart the depression motion of the scroll wheel 110 to the plunger 130 to move the plunger 130 along its longitudinal axis 130a towards the switch 120 to actuate the switch 120. In particular, the plunger 130, the switch 120, and the axle portion 111 of the scroll wheel 110 may be configured (e.g. to cooperate) in a manner such that even if the scroll wheel 110 were to be misaligned (e.g. offset forward or backwards) relative to the housing 101, a depression motion of the scroll wheel 110 would still move or drive the plunger 130 along its longitudinal axis 130a towards the switch 120 to actuate the switch 120.

[00035] FIG. 1E shows a close-up side view of the plunger 130, according to various embodiments.

[00036] To illustrate, with reference to FIG. 1E, according to various embodiments, the plunger 130 may have a first end 131 (e.g. a first longitudinal end) and a second end 135 (e.g. a second longitudinal end). As shown, the second end 135 may be opposite (e.g. directly opposite) the first end 131. Accordingly, the first end 131 and the second end 135 of the plunger 130 may both be aligned along the longitudinal axis 130a of the plunger 130. According to various embodiments, the first end 131 of the plunger 130 may include an axle-engagement portion 133 (or region) configured to engage (e.g. contact, or inter-engage or inter-mate with) the axle portion 111 of the scroll wheel 110. The second end 135 of the plunger 130, on the other hand, may include a switch-engagement surface 137 for actuating the switch 120. As shown, the switch-engagement surface 137 may be opposite (e.g. directly opposite) the first end 131 of the plunger 130. In particular, the switch-engagement surface 137 may be a bottommost surface of the plunger 130, intersecting the longitudinal axis 130a of the plunger 130.

[00037] With reference to FIG. 1C and FIG. 1D, as an example, according to various embodiments, the axle-engagement portion 133 at the first end 131 of the plunger 130 may include an axle-engagement surface 134 for engaging (e.g. contacting) the axle portion 111 of the scroll wheel 110. As shown, the axle-engagement surface 134 may be a surface at the first end 131 of the plunger 130 that faces (or is directed towards) a side surface of the axle portion 111 of the scroll wheel 110. Accordingly, the axle-engagement surface 134 of the plunger 130 may engage at least a side surface segment of the axle portion 111 of the scroll wheel 110. According to various embodiments, the

axle-engagement surface 134 may be elongated in shape and may be oriented with a longitudinal axis thereof extending in a direction non-parallel to the axle portion 111 of the scroll wheel 110 (or non-parallel to the rotational axis 110a along which the axle portion 111 of the scroll wheel 110 is extending). In particular, according to various embodiments, the axle-engagement surface 134 may be at least elongated in a direction that is perpendicular or substantially perpendicular to the direction of extension of the scroll wheel 110. In this manner, even if the scroll wheel 110 and its axle portion 111 were to become misaligned (e.g. offset forward or backwards relative to the housing 101), the axle portion 111 of the scroll wheel 110 may still engage the axle-engagement surface 134 of the plunger 130. Accordingly, even if the scroll wheel 110 were to be misaligned relative to the housing 101, a depression motion of the scroll wheel 110 may still move or drive the plunger 130 along its longitudinal axis 130a (e.g. via the axle-engagement surface 134 of the plunger 130) towards the switch 120 to actuate the switch 120. As some non-limiting examples, the axle-engagement surface 134 of the plunger 130 may be a planar or a flat surface, a curved surface, such as a convex-shaped surface (as shown in FIG. 1C) or a concave-shaped surface (not shown), or a surface having any other contour or profile. According to various other embodiments, the axle-engagement surface 134 may be configured for enhanced grip against the side surface of the axle portion 111 of the scroll wheel 110. For instance, according to various other embodiments, the axle-engagement surface 134 may be a roughened surface, which may include one or more grooves, protrusions, and/or indentations, etc.

[00038] With reference to FIG. 1E, as an example, according to various embodiments, the plunger 130 may be elongated in shape. In particular, as shown, the plunger 130 may include a head portion 132 and a shaft portion 136 extending from the head portion 132. An upper surface (e.g. topmost surface) of the head portion 132 may serve as the axle-engagement surface 134. The shaft portion 136 may be extending from a bottom surface of the head portion 132 opposite the axle-engagement surface 134. A free or exposed end surface (e.g. a bottommost end surface) of the shaft portion 136, opposite the head portion 132, may serve as the switch-engagement surface 137 of the plunger 130 for engaging and actuating the switch 120 (e.g. via imparting a depression motion to the switch button 121).

[00039] According to various embodiments, a size (e.g. area, width and/or length) of the axle-engagement surface 134 (e.g. at the head portion 132) of the plunger 130 may

be, but is not limited to being, larger than a size (e.g. area, width and/or length) of the switch-engagement surface 137 (e.g. at the shaft portion 136) of the plunger 130. Correspondingly, according to various embodiments, a cross-sectional area of the head portion 132 may be larger than a cross-sectional area of the shaft portion 136. As an example, shown in FIG. 1C and FIG. 1D, the head portion 132, having a larger cross-sectional area than the shaft portion 136, may include a pair of cantilever end regions extending outwards from a central region thereof that is immediately adjoined to the shaft portion 136. As shown, the pair of cantilever end regions of the head portion 132 may be extending in a non-parallel (e.g. perpendicular or substantially perpendicular) direction with respect to the rotational axis 110a.

[00040] In addition, with reference to FIG. 1E, according to various embodiments, the plunger 130 may be arranged such that the switch-engagement surface 137 of the plunger 130 may be between the axle-engagement portion 133 (or the axle-engagement surface 134) of the plunger 130 and the switch 120. Specifically, the axle-engagement portion 133 (or the axle-engagement surface 134) of the plunger 130, the switch-engagement surface 137 of the plunger 130, and the switch 120 may be aligned (e.g. linearly or substantially linearly and/or vertically). In this manner, the depression force applied at the scroll wheel 110 may be transmitted in a linear or substantially linear path through (or along) the plunger 130 to the switch 120.

[00041] According to various embodiments, the housing 101 may support or guide the plunger 130 to be movable in a linear fashion. For instance, the housing 101 may include a guide element 103 for guiding the plunger 130 to be movable along a linear or substantially linear path. With reference to FIG. 1E, the mounting frame 102 of the housing 101 may include or define the guide element 103. As an example, shown in FIG. 1E, the guide element 103 may include or may be a linear channel (e.g. a through-hole or bore) configured to accommodate and receive (e.g. slidable receive) at least a portion (e.g. the shaft portion 136) of the plunger 130. In this manner, the plunger 130 (e.g. at least the shaft portion 136 of the plunger 130) may be slidable in a linear fashion in a direction along a hole axis of the linear channel of the guide element 103. According to various embodiments, the linear channel of the guide element 103 may be oriented such that its hole axis coincides with the longitudinal axis 130a of the plunger 130 (e.g. when the longitudinal axis 130a of the plunger 130 is parallel or substantially parallel with the movement axis 110b of the scroll wheel 110).

Accordingly, according to various embodiments, the longitudinal axis 130a of the plunger 130 may be parallel or substantially parallel with the movement axis 110b of the scroll wheel 110. According to various embodiments, the guide element 103 may ensure that the plunger 130 is displaceable or movable along a predetermined (or desired) linear or substantially linear path, along its longitudinal axis 130a. As shown, according to various embodiments, a portion (e.g. the head portion 132) of the plunger 130, having a larger cross-sectional area than the shaft portion 136 of the plunger 130, may serve as a stopper or limit for preventing excessive movement of the plunger 130 towards or against the switch 120. Additionally, as shown in FIG. 1E, a portion (e.g. the shaft portion 136) of the plunger 130 may include a further stopper 138 configured to engage the mounting frame 102 to prevent the plunger 130 from dislodging from the guide element 103 in a direction away from the switch 120. As an example, shown in FIG. 1E, the further stopper 138 may include or may be a protrusion protruding sideways from the side surface of the shaft portion 136 of the plunger 130. According to various embodiments, the mounting frame 102 of the housing 101 may include a catch 108 (e.g. a receptacle) for receiving (or catching) the protrusion (i.e. the further stopper) 138. Additionally, as shown in FIG. 1E, the mounting frame 102 of the housing 101 may include a slit 106 starting from an opening 107 to the linear channel (e.g. at an upper end of the guide element 103), with an opposite end of the slit 106 leading or opening to the catch 108 (e.g. the receptacle) for the protrusion (i.e. the further stopper) 138. Accordingly, the shaft portion 136 of the plunger 130 may be inserted into the linear channel from the opening 107 (e.g. at the upper end of the guide element 103) by maneuvering the protrusion (i.e. the further stopper) 138 along the slit 106 until the protrusion reaches the end of the slit 106, then rotating the plunger 130 about its longitudinal axis 130a until the protrusion 138 may be accommodated within the catch 108 (e.g. the receptacle).

[00042] According to various embodiments, the input device 100 may further include a biasing member 150 configured to bias the plunger 130 in a direction away from the switch 120. In particular, the biasing member 150 may be disposed within the housing 101 and may be operatively coupled to the plunger 130 in a manner so as to bias the plunger 130 in the direction away from the switch 120. Accordingly, when the plunger 130 includes the further stopper 138 (e.g. the protrusion described above), the biasing member 150 may urge the further stopper 138 into the catch 108 of the mounting frame

102 of the housing 101. As an example, shown in FIG. 1E, the biasing member 150 may include or may be a spring which may be, for example, a coil spring, a leaf spring, a torsion spring, a V-spring, etc. It is envisaged that the biasing member 150 may include or may be any other type of biasing member 150, for example, memory foam, an elastic band, etc. According to various embodiments, one end of the biasing member 150 (e.g. the spring) may be engaged with (or urged against) the plunger 130 (e.g. the head portion 132 of the plunger 130) while another end of the biasing member 150 may be engaged with (or urged against) the housing 101 (e.g. the mounting frame 102 of the housing 101). As shown, when the biasing member 150 includes or is a coil spring, the coil spring may be coiled around the shaft portion 136 of the plunger 130.

[00043] In addition, according to various embodiments, the biasing member 150 may be configured to urge the axle-engagement portion 133 of the plunger 130 against the side surface of the axle portion 111 of the scroll wheel 110, thereby ensuring that the axle-engagement portion 133 of the plunger 130 may constantly maintain contact with the axle portion 111 of the scroll wheel 110 (e.g. even when no depression force is being applied at the scroll wheel 110).

[00044] According to various embodiments, the switch 120 (i.e. associated with the scroll wheel 110) may include or may be a microswitch (also known as a micro switch, a micro-switch, or a miniature snap-action switch). Referring back to FIG. 1A and FIG. 1B, the switch 120 (e.g. a microswitch) may include a switch body 122 (e.g. a rectangular-shaped body or casing) and a switch button 121 (see FIG. 1B) protruding from a surface (e.g. an upper surface) of the switch body 122 for actuating the switch 120. Additionally, according to various embodiments, the switch button 121 may be elongated in shape and may be oriented with a longitudinal axis thereof extending in a widthwise direction of the switch body 122. In other words, a longitudinal axis of the elongated switch button 121 may be parallel or substantially parallel to a width of the switch body 122 or it may be perpendicular or substantially perpendicular to a longitudinal axis of the switch body 122. According to various embodiments, the switch 120 may be disposed within the exterior casing of the housing 101 of the input device 100 in a manner such that the elongated switch button 121 may be parallel or substantially parallel with the rotational axis 110a of the scroll wheel 110. Furthermore, according to various embodiments, the switch button 121 may be, but is not limited to being, aligned (e.g. vertically aligned) with the axle portion 111 of the scroll wheel 110.

According to various embodiments, the switch 120 may be arranged in a manner such that a longitudinal axis of the switch body 122 (e.g. an elongated or rectangular switch body 122) may be parallel or substantially parallel with a longitudinal axis of the mouse 100 (i.e. extending along a length of the mouse 100 between a front and rear of the mouse 100).

[00045] According to various embodiments, with reference to FIG. 1A, the input device 100 may further include one or more other switches 123, 124 (herein referred to as “depressible-button switches”) associated with one or more buttons 113, 114 of the input device 100. In particular, the input device 100 may include at least two depressible-button switches 123, 124 respectively associated with a first depressible button 113 (e.g. a left-click button) and a second depressible button 114 (e.g. a right-click button) of the input device 100. According to various embodiments, these depressible-button switches 123, 124, akin to the switch 120 associated with the scroll wheel 110, may be microswitches (e.g. featuring a similar or identical form factor, shape, and/or size, and/or orientation or arrangement as the microswitch described earlier, i.e. associated with the scroll wheel 110). The depressible buttons 113, 114 may be depressibly mounted on the housing 101 in a manner so as to be depressible relative to the housing 101 to actuate the depressible-button switches 123, 124 disposed within the housing 101. Specifically, the first depressible button 113 may be operatively coupled to the first depressible-button switch 123, and the second depressible button 114 may be operatively coupled to the second depressible-button switch 124. Accordingly, the first depressible button 113 may be depressible to actuate the first depressible-button switch 123, while the second depressible button 114 may be depressible to actuate the second depressible-button switch 124. As an example, shown in FIG. 1A, the first depressible button 113 may be, but is not limited to being, in direct contact or engagement with and/or above the first depressible-button switch 123, and the second depressible button 114 may be, but is not limited to being, in direct contact or engagement with and/or above the second depressible-button switch 124.

[00046] According to various embodiments, the various switches 120, 123, 124 of the input device 100 may be disposed on different circuit boards within the housing 101.

[00047] To illustrate, with reference to FIG. 1A and FIG. 1B, the input device 100 may include at least two circuit boards within the housing 101. The circuit boards may

be discrete (or individual) circuit boards, which may be electronically connected to each other. One of the circuit boards (herein referred to as “first circuit board”) 161 may be on (e.g. directly attached to or mounted onto) the base portion of the housing 101, while another circuit board (herein referred to as “second circuit board”) 162 may be disposed over or above the first circuit board 161. As shown in FIG. 1B, the first circuit board 161 may be parallel or substantially parallel with the base portion of the housing 101, while the second circuit board 162 may be non-parallel, inclined, or at an angle with respect to the base portion of the housing 101 (or with respect to the first circuit board 161). Specifically, the second circuit board 162 may be oriented in a manner corresponding to a slope or inclination at a front region of the cover portion of the housing 101. In turn, as shown in FIG. 1B, the first circuit board 161 may be perpendicular or substantially perpendicular to the movement axis 110b of the scroll wheel 110 and/or the longitudinal axis 130a of the plunger 130, while the second circuit board 162 may be non-perpendicular and non-parallel with respect to the movement axis 110b of the scroll wheel 110 and/or the longitudinal axis 130a of the plunger 130.

[00048] According to various embodiment, with reference to FIG. 1A, the switch 120 (i.e. associated with the scroll wheel 110) may be disposed on (e.g. directly disposed or mounted on or attached to) the first circuit board 161. The second circuit board 162 may be between the first circuit board 161 and the axle portion 111 of the scroll wheel 110. Accordingly, according to various embodiments, as shown in FIG. 1E, a through-hole (or a via) traversing the second circuit board 162, from its base surface (i.e. that is facing the first circuit board 161) to its upper surface (i.e. that is facing the axle portion 111 of the scroll wheel 110) may be formed. This through-hole may facilitate an extension of the plunger 130, specifically, a portion of the plunger 130, such as the shaft portion 136 of the plunger 130, across the second circuit board 162, enabling the plunger 130 to reach the switch 120 on the first circuit board 161 from the upper side of the second circuit board 162 which faces the axle portion 111 of the scroll wheel 110.

[00049] Referring to FIG. 1A, according to various embodiments, the first and the second depressible-button switches 123, 124, on the other hand, may be disposed on the second circuit board 162, above the first circuit board 161. Hence, the first and the second depressible-button switches 123, 124 associated with the first and the second depressible buttons 113, 114 may be on a different circuit board and, in turn, on a

different plane (e.g. reference plane), from the switch 120 associated with the scroll wheel 110.

[00050] According to various embodiments, disposing the switches 120, 123, 124 onto different reference planes or circuit boards may optimize use of space within the housing 101 and allow for efficient component layout.

[00051] It is envisaged that, in various other embodiments (not shown), the switch 120 (i.e. associated with the scroll wheel 110) may be on the second circuit board 162, while the first and the second depressible-button switches 123, 124 (i.e. associated with the first and the second depressible buttons 113, 114) may be on the first circuit board 161. In this configuration, the second circuit board 162, which is between the first circuit board 161 and the first and the second depressible buttons 113, 114, may include a pair of through-holes for the first and the second depressible buttons 113, 114 to extend across and engage the first and the second depressible-button switches 123, 124, respectively.

[00052] It is also envisaged that, in various other embodiments (not shown), the switch 120 (i.e. associated with the scroll wheel 110) as well as the first and the second depressible-button switches 123, 124 (i.e. associated with the first and the second depressible buttons 113, 114) may be on a same circuit board (or a same plane). For example, these switches 120, 123, 124 may all be on the first circuit board 161, or they may all be on the second circuit board 162. It is also envisaged that, in various other embodiments, the input device 100 may include only a single (or a main) circuit board for all the switches 120, 123, 124 to be disposed thereon.

[00053] FIG. 2A shows a front perspective view of the input device 100 having a plunger 230 with an elongated switch-engagement surface 237 for engaging the switch 120, according to various embodiments.

[00054] FIG. 2B shows a rear perspective view of the input device 100 having the plunger 230 of FIG. 2A, according to various embodiments.

[00055] According to various embodiments, the plunger 230 of FIG. 2A and FIG. 2B may be a variant of the plunger 130 of FIG. 1A to FIG. 1E. Accordingly, according to various embodiments, one or more features of the plunger 230 of FIG. 2A and FIG. 2B may be combined with or incorporated into the plunger 130 of FIG. 1A to FIG. 1E, or vice versa.

[00056] With reference to FIG. 2A and FIG. 2B, the plunger 230, similar to the plunger 130 of FIG. 1A to FIG. 1E, may be configured to connect or link the axle portion 111 of the scroll wheel 110 to the switch 120. In particular, the plunger 230 may be disposed between the axle portion 111 of the scroll wheel 110 and the switch 120 and may be configured to transfer a depression force applied at the scroll wheel 110 to the switch 120 to actuate the switch 120. Furthermore, the plunger 230 may be configured to be displaceable or movable, along its longitudinal axis 230a (e.g. linear longitudinal axis 230a), in a first direction towards the switch 120 or in an opposite second direction away from the switch 120. Particularly, the plunger 230 may be disposed over or above the switch 120 and may be aligned (e.g. vertically aligned) with the switch 120 (or with a switch button 121 thereof). Accordingly, the plunger 230 may be displaceable or movable relative to the switch 120, along the longitudinal axis 230a of the plunger 230 (or in a linear direction parallel to the longitudinal axis 230a of the plunger 230).

[00057] Further, the plunger 230, similar to the plunger 130 of FIG. 1A to FIG. 1E, may have a first end 231 (e.g. a first longitudinal end) and a second end 235 (e.g. a second longitudinal end) opposite the first end 231. The first end 231 and the second end 235 of the plunger 230 may both be aligned along the longitudinal axis 230a of the plunger 230. According to various embodiments, the first end 231 of the plunger 230 may include an axle-engagement portion 233 (or region) configured to engage the axle portion 111 of the scroll wheel 110. The second end 235 of the plunger 230, on the other hand, may include a switch-engagement surface 237 for actuating the switch 120. The switch-engagement surface 237 may be opposite (e.g. directly opposite) the first end 231 of the plunger 230. In particular, the switch-engagement surface 237 may be a bottommost surface of the plunger 230, intersecting the longitudinal axis 230a of the plunger 230.

[00058] With reference to FIG. 2A and FIG. 2B, the plunger 230 may differ from the plunger 130 of FIG. 1A to FIG. 1E in that the axle-engagement portion 233 at the first end 231 of the plunger 230 may be configured to inter-engage or inter-mate with the axle portion 111 of the scroll wheel 110. Specifically, as shown, the axle-engagement portion 233 at the first end 231 of the plunger 230 may include a hole, which may be a blind hole (not shown in FIG. 2A and FIG. 2B) or a through-hole (as shown in FIG. 2A and FIG. 2B). The hole may have a hole axis that is aligned along or is coinciding with

the rotational axis 110a of the scroll wheel 110. Furthermore, the hole may be sized to accommodate the axle portion 111 of the scroll wheel 110 (or at least a segment thereof). Accordingly, the axle portion 111 of the scroll wheel 110 may be inserted into the hole so that the axle portion 111 of the scroll wheel 110 and the axle-engagement portion 233 of the plunger 230 are inter-engaged or inter-mated with each other. According to various embodiments, the hole may be sized to form a snug-fit engagement with the axle portion 111 of the scroll wheel 110, for instance, when the wheel portion 112 of the scroll wheel 110 is configured to rotate independently of the axle portion 111. It is envisaged that, in various other embodiments, the hole may be sized to form a loose-fit engagement with the axle portion 111 of the scroll wheel 110. It is also envisaged that, in various other embodiments, the input device 100 may include one or more bearings (e.g. ball bearings) (not shown) disposed between the axle portion 111 of the scroll wheel 110 and an inner surface at the first end 231 of the plunger 230 surrounding the hole, for facilitating rotation of the axle portion 111 of the scroll wheel 110 relative to and independent from the plunger 230.

[00059] As shown in FIG. 2A and FIG. 2B, according to various embodiments, the switch 120 (i.e. associated with the scroll wheel 110) may be disposed on (e.g. directly on) the second circuit board 162, in contrast to being disposed on the first circuit board 161 as previously described with reference to FIG. 1A to FIG. 1E.

[00060] As shown, according to various embodiments, the switch button 121 of the switch 120 may be elongated in shape and may be oriented with a longitudinal axis thereof extending in a direction parallel or substantially parallel to the rotational axis 110a of the scroll wheel 110.

[00061] According to various embodiments, the switch-engagement surface 237 at the second end 235 of the plunger 230 may be elongated in shape and may be oriented with a longitudinal axis thereof extending in a direction that is non-parallel (e.g. perpendicular or substantially perpendicular) to the switch button 121 (e.g. to a longitudinal axis of the elongated switch button 121). As shown, the entire switch-engagement surface 237 may be aligned with (e.g. directly overhead or above) the switch button 121. Furthermore, according to various embodiments, the switch-engagement surface 237 of the plunger 230 may be, but is not limited to being, a flat or planar (or substantially flat or planar) surface.

[00062] Accordingly, according to various embodiments, a depression motion of the scroll wheel 110 along the movement axis 110b of the scroll wheel 110 may cause the axle portion 111 of the scroll wheel 110 to impart the depression motion of the scroll wheel 110 to the plunger 230 via the axle-engagement portion 233 at the first end 231 of the plunger 230 to move the plunger 230 along its longitudinal axis 230a towards the switch 120 to actuate the switch 120. In particular, according to various embodiments, even if the scroll wheel 110 were to be misaligned relative to the housing 101 (e.g. offset forward or backwards relative to the housing 101), a depression motion of the scroll wheel 110 may still move or drive the plunger 230 along its longitudinal axis 230a towards the switch 120 to actuate the switch 120 (e.g. via the switch-engagement surface 237 at the second end 235 of the plunger 230).

[00063] Additionally, with reference to FIG. 2A and FIG. 2B, according to various embodiments, the plunger 230 may be arranged such that the switch-engagement surface 237 of the plunger 230 may be between the axle-engagement portion 233 of the plunger 230 and the switch 120. Specifically, the axle-engagement portion 233 of the plunger 230, the switch-engagement surface 237 of the plunger 230, and the switch 120 may be aligned (e.g. linearly or substantially linearly and/or vertically). In this manner, a depression force applied at the scroll wheel 110 may be transmitted in a linear or substantially linear path through (or along) the plunger 230 to the switch 120.

[00064] According to various embodiments, with reference to FIG. 2A and FIG. 2B, the biasing member 150 may be in the form of a V-spring (or V-shaped torsion spring). As shown, the biasing member 150 (e.g. V-spring) may be operatively coupled to the plunger 230 in a manner so as to bias the plunger 230 in the direction away from the switch 120. As an example, shown in FIG. 2A and FIG. 2B, the V-spring may be coiled around a protruding portion of the plunger 230 (e.g. protruding parallel to the hole axis of the hole at the first end 231 of the plunger 230), and the V-spring may include a pair of arm segments which may be supported or placed against the mounting frame 102 of the housing 101. Specifically, as an example, shown in FIG. 2A and FIG. 2B, the mounting frame 102 of the housing 101 may include a pair of cantilever arm members 102c for the V-spring to sit therebetween.

[00065] Various embodiments have thus described an input device capable of incorporating a microswitch for scroll wheel functionality while addressing potential misalignment issues as well as overcoming space constraints within the input device.

[00066] Additionally, the configuration and/or arrangement of the various components of the input device, such as the axle portion of the scroll wheel and the plunger, which facilitate the transfer of depression force from the scroll wheel to the associated switch, may be optimized for force transfer efficiency.

[00067] The input device having a microswitch for scroll wheel functionality may elevate user experience and offer users the reliability, tactile feedback, and precision afforded by microswitch technology.

[00068] While the invention has been particularly shown and described with reference to specific embodiments, it should be understood by those skilled in the art that various changes, modification, variation in form and detail may be made therein without departing from the scope of the invention as defined by the appended claims. The scope of the invention is thus indicated by the appended claims and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced.

CLAIMS

1. An input device comprising:
 - a housing;
 - a scroll wheel mounted to the housing in a manner which exposes a part of the scroll wheel for user access, the scroll wheel being rotatable relative to the housing about a rotational axis extending through a center of the scroll wheel and being depressible relative to the housing along a movement axis that is non-parallel to the rotational axis,
 - wherein the scroll wheel comprises an axle portion that extends along the rotational axis from the center of the scroll wheel;
 - a switch disposed within the housing; and
 - a plunger disposed within the housing between the axle portion of the scroll wheel and the switch, the plunger being movable along its longitudinal axis relative to the switch, wherein the plunger comprises an axle-engagement portion at a first longitudinal end to engage the axle portion of the scroll wheel and a switch-engagement surface at a second longitudinal end, opposite the first longitudinal end, for actuating the switch;
 - whereby a depression motion of the scroll wheel along the movement axis causes the axle portion of the scroll wheel to impart the depression motion of the scroll wheel to the plunger via the axle-engagement portion at the first longitudinal end of the plunger to move the plunger along its longitudinal axis towards the switch to actuate the switch.
2. The input device of claim 1,
 - wherein the axle-engagement portion of the plunger comprises an axle-engagement surface in engagement with a side surface segment of the axle portion of the scroll wheel, wherein the axle-engagement surface is elongated in shape and is oriented with a longitudinal axis thereof extending in a direction that is non-parallel to the rotational axis along which the axle portion is extending.
3. The input device of claim 1 or claim 2,

wherein the plunger comprises a head portion with the axle-engagement surface and a shaft portion extending from the head portion opposite the axle-engagement surface;

wherein a free end surface of the shaft portion, opposite the head portion, serves as the switch-engagement surface of the plunger.

4. The input device of any one of claims 1 to 3,
wherein the housing comprises a guide element configured to guide the plunger to be movable linearly along its longitudinal axis.
5. The input device of claims 3 and 4,
wherein the guide element comprises a linear channel configured to receive the shaft portion of the plunger.
6. The input device of any one of claims 1 to 5,
wherein the movement axis of the scroll wheel is parallel with the longitudinal axis of the plunger.
7. The input device of any one of claims 1 to 6, further comprising:
a biasing member disposed within the housing and operatively coupled to the plunger in a manner so as to bias the plunger in a direction away from the switch.
8. The input device of claim 7,
wherein the biasing member comprises a spring.
9. The input device of any one of claim 1 or claims 6 to 8,
wherein the first longitudinal end of the plunger comprises a hole with its hole axis coinciding with the rotational axis of the scroll wheel;
wherein the axle portion of the scroll wheel is inserted into the hole.
10. The input device of any one of claims 1 to 9,
wherein the switch comprises a switch button for actuating the switch;

wherein the switch button is elongated in shape and is oriented with a longitudinal axis thereof extending in a direction parallel with the rotational axis of the scroll wheel.

11. The input device of any one of claims 1 to 10,
wherein the switch-engagement surface of the plunger is elongated in shape and oriented with a longitudinal axis thereof extending in a direction that is non-parallel to the switch button.
12. The input device of any one of claims 1 to 11,
wherein the switch is a microswitch for a mouse device.
13. The input device of any one of claims 1 to 12, further comprising:
a first depressible button and a second depressible button respectively depressibly mounted on the housing;
a first depressible-button switch and a second depressible-button switch respectively disposed within the housing;
wherein the first depressible button is operatively coupled to the first depressible-button switch and is depressible to actuate the first depressible-button switch, and the second depressible button is operatively coupled to the second depressible-button switch and is depressible to actuate the second depressible-button switch; and
a circuit board disposed within the housing;
wherein the first depressible-button switch, the second depressible-button switch, and the switch associated with the scroll wheel are disposed on the circuit board.
14. The input device of any one of claims 1 to 12, further comprising:
a first depressible button and a second depressible button respectively depressibly mounted on the housing;
a first depressible-button switch and a second depressible-button switch respectively disposed within the housing;

24

wherein the first depressible button is operatively coupled to the first depressible-button switch and is depressible to actuate the first depressible-button switch, and the second depressible button is operatively coupled to the second depressible-button switch and is depressible to actuate the second depressible-button switch;

a first circuit board disposed within the housing; and

a second circuit board disposed within the housing, over the first circuit board;

wherein the first depressible-button switch and the second depressible-button switch are disposed on the first circuit board; and

wherein the switch associated with the scroll wheel is disposed on the second circuit board.

15. The input device of claim 14,

wherein the second circuit board is non-parallel to the first circuit board.