MicroGear™ Precision Scroll Wheel and SmartShift™ Technology

Existing methods of on-screen navigation no longer are adequate. Spreadsheets and word-processing documents are growing ever longer, while the number of digital photos and music files stored in hard-drive folders swells. On average, people have six applications open on their computer at any one time, and the active window switches or new windows open every 50 seconds in an eight hour day. To navigate the vast content at their disposal, people spin their mouse's scroll wheel approximately 26 feet in an eight-hour day.

To surmount these challenges, Logitech, the world's leading manufacturer of computer mice, achieved two breakthroughs in navigation, following more than two years of research. The MicroGear™ Precision Scroll Wheel allows both free-spin scrolling through thousands of spreadsheet rows, as well as the familiar click-to-click precision scrolling. SmartShift™ application- and task-sensing technology detects the active application and task at hand, instantly switching between the two scrolling modes as needed.

Together, these innovations provide computer users with a revolutionary range of scrolling capability, from exacting precision and line-by-line control to silky-smooth, long-distance navigation of the longest documents and file lists imaginable.

MicroGear Precision Scroll Wheel

Since its introduction in the mid-1990s to aid vertical navigation within a document, the scroll wheel has been the focus of continuous innovation. At Logitech, the refinement of click-to-click ratcheting and the replacement of mechanical rotational sensors with high-precision optics boosted scrolling accuracy significantly. Logitech's Tilt Wheel Plus Zoom™ technology, introduced in 2004, added side-to-side scrolling and zoom-in/zoom-out magnification capabilities, especially well-suited for navigating wide spreadsheets and complex images.

Though side-to-side scrolling and zooming elevated navigation to new heights, these advancements did not directly address the unique challenges posed by documents containing hundreds of pages or spreadsheets with thousands of rows. Similarly, navigating to find a specific music selection in a collection containing thousands of songs, or quickly selecting an individual file from a folder with hundreds of entries, remained problematic.

Logitech's MicroGear Precision Scroll Wheel conquers these shortcomings.

A new concept for navigating documents and folders, the MicroGear Precision Scroll Wheel operates in two distinct modes. In free-spin mode, the familiar ratchet-scrolling mechanism retracts, allowing the wheel to spin for up to seven seconds, providing hyper-fast, nearly

frictionless long-distance scrolling. In its normal click-to-click mode, the wheel allows users to navigate small distances with great precision, such as individual spreadsheet rows, or small vertical distances in a document or Web page. Switching between the two modes is either done manually or managed automatically by Logitech's SmartShift technology.
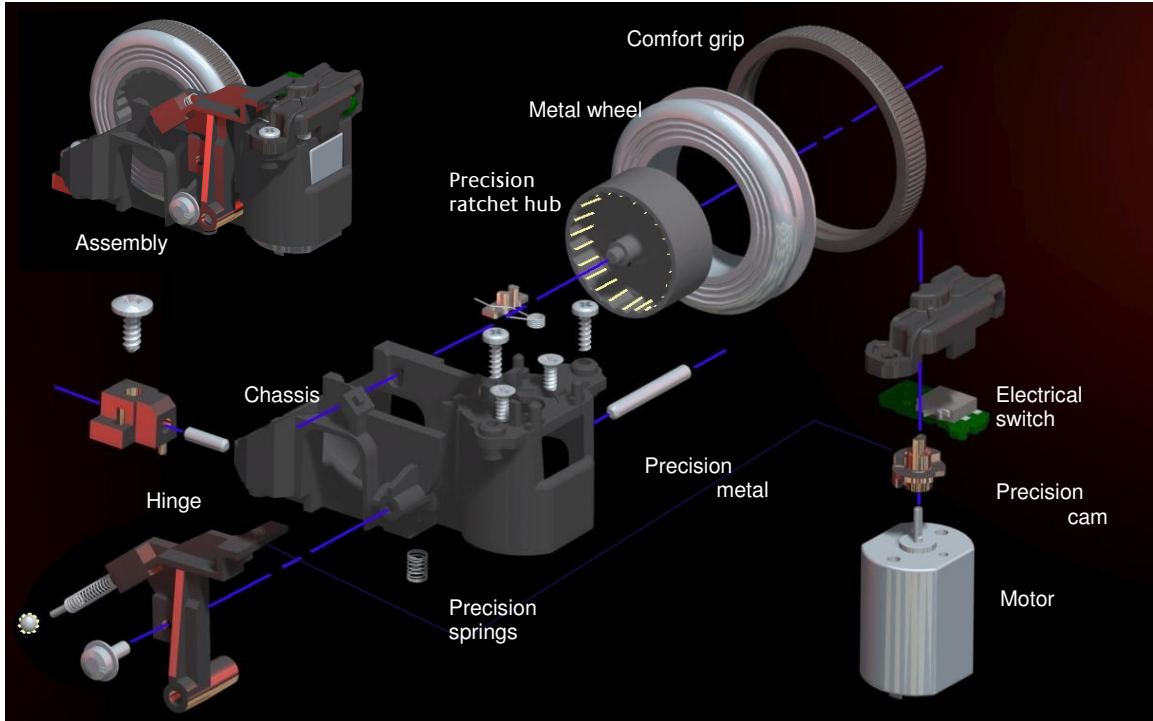
Exploded View of the MicroGear Precision Scroll Wheel

From the Wheel Up

To free-spin, the 2.4-gram injection-molded plastic and rubber-clad scroll wheel used in current Logitech products proved inappropriate. Its low-mass design did not provide the heft necessary to keep the wheel spinning for the engineering design specification of up to seven seconds.

Looking to the science of flywheels for an answer, Logitech engineers crafted a 14-gram machined alloy wheel, almost exactly the same weight as two one-euro coins or three U.S. nickel coins. Wrapped in a rubber comfort grip band and mated with a precision ratcheting hub, the alloy scroll wheel assembly is seated in an ultra-low-friction bearing mount incorporated into the precision-molded chassis.

The chassis floats on a series of pin-like hinges and a tiny calibrated compression coil spring – an automobile-like suspension system that enables both the tilt capability for side-to-side scrolling and the minute vertical travel needed for the wheel's push-to-click function. Though significantly heavier than other scroll wheels, the difference in use is undetectable, thanks to the upward counterbalancing force applied by the suspension system. This chassis-and-suspension combination yields additional benefits compared with previous designs, including greater structural stiffness for housing the horizontal-scrolling and push-to-click micro-switches, and significantly enhanced acoustical isolation for a quieter wheel.

SmartShift™ Technology

Simple though it might seem, shifting into hyper-fast mode is a complex engineering task. Devising a solution required reinventing not just the scroll wheel itself, but development of nearly a hundred individual components, including the wheel's supporting chassis and rotational sensors. The solution even required the introduction of a miniature low-power motor to retract the ratcheting mechanism for free-spinning – a first in a handheld pointing device. Controlling these integrated components required the development of highly specialized, and efficient, embedded logic.

Logitech's SmartShift technology detects the current active application window and automatically applies the scrolling mode that best fits the task at hand. For example, when a Microsoft Word® document is the user's focus, the wheel defaults to free-spin mode, but sets itself to click-to-click mode when the user is navigating photos in the My Photos folder. For some applications, such as Microsoft Excel®, Logitech's technology also senses the speed at which people spin the wheel – if it is spun fast, the wheel goes into free-spin mode; if it's spun more slowly, the wheel shifts into click-to-click mode. In addition, with Logitech's accompanying SetPoint® software, users can specify the start-up mode – free-spin or ratcheting – for virtually any application.

Shifting into the free-spin scrolling mode requires disengaging the internal ratchet mechanism, a small, hardened steel ball embedded in a spring-mounted ratchet arm. The steel ball rides up and over the molded detents in the wheel's hub, generating the high-precision click-to-click scrolling. When a user flicks the scroll wheel, this motion is detected instantly. SmartShift signals from the onboard microprocessor activate a solid-state switch, or H-Bridge, which allows the mouse's micro-processor to turn the motor on and off, as well as to reverse the rotation direction. Once activated, the H-Bridge applies a minuscule electric current to the miniature direct-current motor. Unlike typical motors spinning at hundreds or thousands of revolutions per second, this motor rotates its central shaft by only 275 degrees, just enough for a cam mounted on it to nudge the ratchet arm and its hardened steel ball clear of the molded wheel hub The transition process from click-to-click to free-spin mode typically takes less than 40 milliseconds (40-thousandths of a second – less than the blink of an eye!). The electrical current required for this operation is minute and does not constitute a noticeable cordless-mouse battery drain.

With the ratchet mechanism disengaged, the scroll wheel can spin freely, allowing the user to hyper-scroll great distances. In testing, scrolling vertically through up to 9,000 rows in a spreadsheet is easily achieved. Similarly, scrolling through hundreds of pages in a document is accomplished with ease. As the wheel comes to a stop, the cam rotates in the opposite direction, re-engaging the ratchet mechanism and returning the mouse to normal operation.

Conclusion

As documents continue to grow in length and content becomes more complex, navigation technology must evolve to keep pace. By rethinking the very nature of the scroll wheel – and the materials from which it is made – Logitech MicroGear Precision Scroll Wheel ensures that today's computer users navigate with the highest levels of efficiency.