Trackpoint II: The In-Keyboard Pointing Device

Ted Selker and Joseph Rutledge
IBM Corporation
Yorktown Heights, New York

Two of IBM's new ThinkPad notebook computers have keyboards that feature TrackPoint II, a unique, integrated pointing device. This novel design for a pointing device takes advantage of special behavioral motor research that gives the device unprecedented productivity improvements compared to using a mouse. This article describes TrackPoint II, how to use it, and the research behind its design.

Now there is a pointing device that occupies no space on a desk, increases productivity, does not have to be adjusted for left- or right-handedness, and has no moving parts. Called TrackPoint II, it is an innovative keyboard feature of IBM's newest notebook computer systems, the IBM ThinkPad 700 and 700C.

Without requiring users to move their hands away from the normal typing position, TrackPoint II provides smooth control when using popular graphical user interfaces that mix typing with pointing. It eliminates the loss of time and the distraction of reaching for another pointing device. TrackPoint II can be used equally well by either hand. All typing, pointing, selecting, and dragging now can be done on the keyboard. Users no longer need to carry an extra pointing device for their notebook computer systems, because TrackPoint II is built into the keyboard.

TrackPoint II is the first pointing device that outperforms a mouse for integrated typing and selection activities. In laboratory tests, it typically increases speed in tasks similar to text-editing by 25% compared to other pointing devices.

Using TrackPoint II

TrackPoint II, shown in Figure 1, consists of a small red rubber button that fits between a user's hands on the keyboard, and thumb-activated "mouse buttons" molded into the keyboard below the space bar. The red button is situated between the G and H keys, above the B key. It is positioned to be instantly available, yet it does not interfere with a touch typist's fingers. The user's hands can remain in the "home" typing position.

To use TrackPoint II, place an index finger on the red rubber button and press in the direction you want the cursor to move. The amount of pressure determines the speed at which the cursor moves to an icon, character, or even a pixel-sized target. You also can rest your finger lightly on the rubber cap without causing any action to take place.

To make a selection, press the appropriate "mouse button" (below the space bar) with either or both thumbs. It also is easy to press both buttons simultaneously with one thumb.

Dragging is just as easy. Hold the buttons down with one or both thumbs and use an index finger to control the motion. TrackPoint II works equally well for left- or right-handed people because either index finger can reach the rubber button while the thumbs use the mouse buttons.

Our research has shown that the act of taking one's hands off the keyboard, reaching for the mouse, and replacing the hands on the keyboard takes about 1.35 seconds. TrackPoint II eliminates this distraction and saves a substantial amount of time. Using TrackPoint II to make a single selection while typing saves 0.9 second.

You still can use your current mouse pointing device because both Track-Point II and a mouse can be active. However, you quickly will notice that the TrackPoint II is faster for making a single selection while typing. Many users find that after a week of using TrackPoint II, a mouse becomes unnecessary for most work.

Collaboration

For collaborative work, such as two people working jointly on a writing project, it is helpful if both can point to words on the screen without interfering with each other. A unique feature of TrackPoint II enables two users to take turns controlling the cursor. In this scenario, a mouse is connected to a notebook computer; one user is using the mouse while the other is using the keyboard with TrackPoint II. With this collaborative feature, the first pointing device that moves takes precedence. The person using the cursor retains control until a moment after completing an action. Because the second user is temporarily locked out, that user cannot inadvertently interfere with the first user's cursor action.

Designing the TrackPoint II

Two important innovations have been designed into TrackPoint II: the ability to integrate typing and selection, and – most important – an algo-

rithm that allows quick, precise selections.

Experiments were conducted using secretaries and other typists to test the placement and usefulness of pointing devices within or near a keyboard. We tested joystick pointers that lay in various positions: under the entire keyboard, under specific keys, above and below the keyboard, between the G and H keys, near the number pad, and so on. We found that the space between the G, H, and B keys worked best. Our extensive testing has shown that TrackPoint II does not interfere with normal typing, and that typists do not inadvertently move the cursor.

Still, no one had ever made a joystick-like device that could perform nearly as well as a mouse-like device. A force-sensitive control is appealing whenever space is limited, and the psychology and human factors literature over the last century records repeated efforts to use such a control. However, it always was hard to use – it could be adjusted to be either sluggish or skittish, or even both at once, but there seemed to be no middle ground.

TrackPoint II results from new comprehension of behavioral and motor issues at play while using rate-control devices. For example, if the cursor moves faster than the eye can track, the user loses sight of it; if the unsteadiness of the user's hand affects cursor speed, movement becomes unpredictable. These psycho-motor realities influenced our design of a special algorithm for using a rate-control device to guide a cursor. The algorithm enables the cursor to move across the screen in a tenth of a sec-
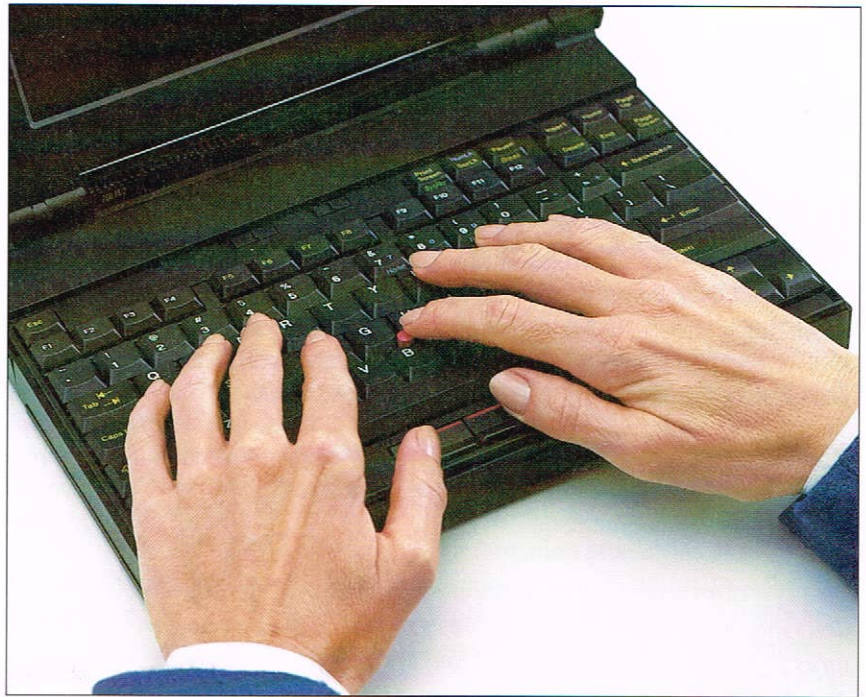

Figure 1. TrackPoint II

ond when the user pushes TrackPoint II relatively hard, yet it gives TrackPoint II a precise, firm feel when selecting icons, characters, and even pixels. The primary innovation here is the development of a joystick that gives users the feeling of smooth, positive control at all useful speeds.

Ted Selker is a research staff member at the IBM T. J. Watson Research Center in Yorktown Heights, New York, where he has been working for the last seven years on new paradigms for using computers. His recent successes include creating COACH, an adaptive interface that dramatically improves user performance, and the design of the Trackpoint II integrated pointing device. Ted previously worked at Xerox® Palo Alto Research Center (PARC) and at Atari's® Sunnyvale Research Center, and he also has taught at Stanford University. Ted holds a PhD from City University of New York.

Joseph Rutledge has been a research staff member in the Mathematical Sciences Department at IBM T. J. Watson Research Center since 1958, working mainly on the mathematical side of computer science, but with occasional forays into the "practical" world; TrackPoint II represents the most extensive and successful such excursion. He first met computers as one of the initial programmers of UNIVAC® I in 1950 and did logical design, systems architecture, and early programming language work before returning to school to acquire a PhD in mathematical logic from Cornell University.