Mouse (computing)

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In the context of computing, a mouse (plural (generally): mice, also mouses) consists of a hand-held pointing device, designed to sit under one hand of the user and to detect movement relative to its two-dimensional supporting surface. In addition, it usually features buttons and/or other devices, such as "wheels", which allow the user to perform various system-dependent operations. Extra buttons or features can add more control or dimensional input.

The mouse's 2D motion typically translates into the motion of a pointer on a display.

The name "mouse", coined at the Stanford Research Institute, derives from the resemblance of early models (which had a cord attached to the rear part of the device, suggesting the idea of a tail) to the common small rodent of the same name.[1]

Because the computer mouse has long dominated the world of pointing devices in computing, people often refer to any generic computer pointing-device as a mouse.

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Mouse

Early mice

Douglas Engelbart of Stanford Research Institute invented the mouse in 1963 after extensive usability testing. Engelbart's team called it a "bug" — one of several experimental pointing-devices developed for Engelbart's oN-Line System (NLS). The other devices were designed to exploit other body movements — for example, head-mounted devices attached to the chin or nose — but ultimately the mouse won out because of its simplicity and convenience.

The first mouse, a bulky device (pictured) used two gear-wheels perpendicular to each other: the rotation of each wheel translated into motion along one axis. Engelbart received patent US3541541 on November 17, 1970 for an "X-Y Position Indicator for a Display System". At the time, Engelbart envisaged that users would hold the mouse continuously in one hand and type on a five-key chord keyset with the other.

Mechanical mice

Bill English invented the so-called ball mouse in the early 1970s while working for Xerox PARC. The ball-mouse replaced the external wheels with a single ball that could rotate in any direction. Perpendicular wheels housed inside the mouse's body detected in their turn the motion of the ball. This variant of the mouse resembled an inverted trackball and was the predominant form used with personal computers throughout the 1980s and 1990s. The Xerox PARC group also settled on the modern technique of using both hands to type on a full-size keyboard and grabbing the mouse as needed.

Modern computer mice took form at the École polytechnique fédérale de Lausanne (EPFL) under the inspiration of Professor Jean-Daniel Nicoud and at the hands of engineer and watchmaker André Guignard. A spin-off of EPFL, Logitech, launched the first popular breed of mice.
The major movement-translation techniques employed in computer mice involve optical, mechanical and inertial sensors.

Honeywell produced another short-lived type of mechanical mouse. Instead of a ball, it had two plastic "feet" on the bottom which sensed movement.

## Optical mice

An **optical mouse** uses a light-emitting diode and photodiodes to detect movement relative to the underlying surface, rather than moving some of its parts — as in a mechanical mouse.

Early optical mice, circa 1980, came in two different varieties:

1. Some, such as those invented by Steve Kirsch of Mouse Systems Corporation, used an infrared LED and a four-quadrant infrared sensor to detect grid lines printed on a special metallic surface with infrared absorbing ink. Predictive algorithms in the CPU of the mouse calculated the speed and direction over the grid.

2. Others, invented by Richard F. Lyon and sold by Xerox, used a 16-pixel visible-light image sensor with integrated motion detection on the same chip ([1](http://smithsonianchips.si.edu/augarten/i60.htm) and tracked the motion of light dots in a dark field of a printed paper or similar mouse pad ([2](http://www.digibarn.com/collections/devices/xerox-mousepad/index.html)).

These two mouse types had very different behaviors, as the Kirsch mouse used an x-y coordinate system embedded in the pad, and would not work correctly when rotated, while the Lyon mouse used the x-y coordinate system of the mouse body, as mechanical mice do.

As computing power grew cheaper, it became possible to embed more powerful special-purpose image processing chips in the mouse itself. This advance enabled the mouse to detect relative motion on a wide variety of surfaces, translating the movement of the mouse into the movement of the pointer and eliminating the need for a special mouse-pad. This advance paved the way for widespread adoption of optical mice.

Modern surface-independent optical mice work by using an optoelectronic sensor to take successive pictures of the surface on which the mouse operates. Most of these mice use LEDs to illuminate the surface that is being tracked; LED optical mice are often mislabeled as "laser mice". Changes between one frame and the next are processed by the image processing part of the chip and translated into movement on the two axes using an optical flow estimation algorithm. For example, the Agilent Technologies ADNS-2610 optical mouse sensor processes 1512 frames per second: each frame is a rectangular array of 18×18 pixels, and each pixel can sense 64 different levels of gray.

Optomechanical mice detect movements of the ball optically, giving the precision of optical without the surface compatibility problems, whereas optical mice detect movement relative to the surface by examining the light
reflected off it.

**Laser mice**

As early as 1998, Sun Microsystems provided a laser mouse with their Sun SPARC Station servers and workstations.

In 2004, Logitech, along with Agilent Technologies, introduced the **laser mouse** with its *MX 1000* model. This mouse uses a small infrared laser instead of an LED, which according to the companies can increase the resolution of the image taken by the mouse, leading to around 20× more sensitivity to the surface features used for navigation compared to conventional optical mice, via interference effects. Gamers have complained that the MX 1000 does not respond immediately to movement after it is picked up, moved, and then put down on the mouse pad. Newer revisions of the mouse do not suffer from this problem, which results from a power-saving feature (almost all optical mice, laser or LED based, also implement this power-saving feature, except those intended for use in gaming, where a millisecond of delay becomes significant). Engineers designed the laser mouse — as a wireless mouse — to save as much power as possible. In order to do this, the mouse blinks the laser when in standby mode (8 seconds after the last motion). This function also increases the laser life.

**Optical versus mechanical mice**

Optical mice supporters claim that optical rendering works better than mechanical mice, that it requires no maintenance and that optical mice last longer due to having no moving parts. Optical mice do not normally require any maintenance other than removing debris that might collect under the light emitter, although cleaning a dirty mechanical mouse is fairly straightforward too.

Mechanical mice supporters point out that optical mice generally cannot track on glossy and transparent surfaces, including many commercial mouse-pads, causing them to periodically "spin" uncontrollably during operation. Mice with less image-processing power also have problems tracking extremely fast movement, though high-end mice can track at 1 m/s (40 inches per second) and faster.

As of 2006, mechanical mice have lower average power demands than their optical counterparts. This typically has no practical impact for users of cabled mice (except possibly those used with battery-powered computers, such as notebook models), but has an impact on battery-powered wireless models. A typical mechanical model requires 25 mA at +5 V (= 0.125 W), or less, whereas an optical model draws 100 mA at +5 V (= 0.5 W) (for a 4 : 1 ratio).

Since optical mice render movement based on an image which the LED illuminates, use with multi-colored mousepads may result in unreliable performance. However, optical models will outperform mechanical mice on uneven, slick, squishy, sticky or loose surfaces, and generally in mobile situations lacking mouse pads. The advent of affordable high-speed, low-resolution cameras and the integrated logic in optical mice provides an ideal
laboratory for experimentation on next-generation input-devices. Experimenters can obtain low-cost components simply by taking apart a working mouse and changing the optics or by writing new software.

Inertial mice

Inertial mice detect movement, through a gyroscope, for every axis supported. Usually cordless, they often have a switch to deactivate the movement circuitry between use, allowing the user freedom of movement without affecting the pointer position.

Buttons

In contrast to the motion-sensing mechanism, the mouse's buttons have changed little over the years, varying mostly in shape, number, and placement. Engelbart's very first mouse had a single button; Xerox PARC soon designed a three-button model, but reduced the count to two for Xerox products. Apple reduced it back to one button with the Macintosh in 1984, while Unix workstations from Sun and others used three buttons. Commercial mice usually have between one and three buttons, although in the late 1990s some mice had five or more.

The two-button mouse has become the most commonly available design. As of 2006 (and roughly since the mid 1990s), users most commonly employ the second button to invoke a contextual menu in the computer's software user interface, which contains options specifically tailored to the interface element over which the mouse pointer currently sits. By default, the primary mouse button is located on the left hand side of the mouse, for the benefit of right-handed users.

On systems with three-button mice, pressing the center button (a middle click) often conveniently maps a commonly-used action or a macro. In the X Window System, middle clicking pastes the contents of the primary buffer at the pointer's position. Many two-button mice are configured to emulate a three-button mouse by clicking both the right and left buttons simultaneously. Middle-clicks are often used as a spare button in case a function is not allocated easily.

Additional buttons

Manufacturers have built mice with five or more buttons. Depending on the user's preferences, the extra buttons may allow forward and backward web navigation, scrolling through a browser's history, or other functions. As with similar features in keyboards, however, these functions may not be supported by all software. The additional buttons are generally more useful in computer games, where quick and easy access to a wide variety of functions (for example, weapon-switching in first-person shooters) can be very beneficial. Because mouse buttons can be mapped to virtually any function, keystroke, application or switch, they can make working with such a mouse more efficient and easier to use.

In the matter of the number of buttons, Douglas Engelbart favored the view "as many as possible". The prototype that popularised the idea of three buttons as standard had that number only because "we couldn't find anywhere to fit any more switches".

Wheels

The scroll wheel, a notably different form of mouse-button, consists of a small wheel that the user can rotate to provide immediate one-dimensional input. Usually, this input is translated into "scrolling" up or down within the active window or GUI element. This is especially helpful in navigating a long document. The scroll wheel can often be pressed too, thus being in fact a third (center) button. Under many Windows applications, the wheel pressure activates autoscrolling and in conjunction with the control key (Ctrl) may zoom in and out (applications which support this feature include Microsoft Word, Internet Explorer, Opera and Mozilla Firefox). Scroll wheels may be referred to by different names by various manufacturers for branding purposes; Genius, for example, usually brand their scroll wheel-equipped products "Netscroll".
Genius introduced the scroll wheel commercially in 1995, marketing it as the Mouse Systems ProAgio and Genius EasyScroll. Microsoft released the Microsoft IntelliMouse in 1996, and it became a commercial success in 1997 when the Microsoft Office application suite and the Internet Explorer browser started supporting its wheel-scrolling feature. Since then the scroll wheel has become a norm in some circles.

Some newer mouse models have two wheels, assigned to horizontal and vertical scrolling. Designs exist which make use of a "rocker" button instead of a wheel — a pivoting button that a user can press at the top or bottom, simulating "up" and "down" respectively.

A more recent form of mouse wheel, the tilt-wheel, features in some of the higher-end Logitech and Microsoft mice. Tilt wheels are essentially conventional mouse wheels that have been modified with a pair of sensors artculated to the tilting mechanism. These sensors are mapped, by default, to horizontal scrolling.

A third variety of built-in scrolling device is the scroll ball, which is essentially a trackball embedded in the upper surface of the mouse. It is used to scroll in all possible directions very much the same way as the actual mouse, and in some mice, can be used as a trackball. Apple's Mighty Mouse and the IOGEAR 4D Web Cruiser Optical Scroll Ball Mouse, are two mice that feature a scroll ball.

3D mice

In the late 1990s Kantek introduced the 3D RingMouse. This wireless mouse was worn on a ring around a finger, which enabled the thumb to access three buttons. The mouse was tracked in three dimensions by a base station. Despite a certain appeal, it was finally discontinued because it did not provide sufficient resolution.

Connectivity and communication protocols

To transmit their input, typical cabled mice use a thin electrical cord terminating in a standard connector, such as RS-232C, PS/2, ADB or USB. Cordless mice instead transmit data via infrared radiation (see IrDA) or radio (including Bluetooth).

The electrical interface and the format of the data transmitted by commonly available mice has in the past varied between different manufacturers.

PS/2 interface and protocol

For more details on this topic, see PS/2 connector.

With the introduction of the IBM PS/2 personal-computer series in 1987, IBM introduced the eponymous PS/2 interface for mice and keyboards, which was rapidly adopted by other manufacturers. The most visible change was the use of a round 6-pin mini-DIN, in lieu of the former 5-pin connector. In default mode (called stream mode) a PS/2 mouse communicates motion, and the state of each button, by means of 3-byte packets.

Extensions: IntelliMouse and others

A Microsoft IntelliMouse relies on an extension of the PS/2 protocol: the ImPS/2 or IMPs/2 protocol (the abbreviation combines the concepts of "IntelliMouse" and "PS/2"). It initially operates in standard PS/2 format, for backwards compatibility. After the host sends a special command sequence, it switches to an extended format in which a fourth byte carries information about wheel movements. The IntelliMouse Explorer works analogously, with the difference that its 4-byte packets also allow for two additional buttons (for a total of five).

The Typhoon mouse uses 6-byte packets which can appear as a sequence of two standard 3-byte packets, such as:

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00 00 00 00 00 00
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that ordinary PS/2 driver can handle them.

Mouse-vendors also use other extended formats, often without providing public documentation.

For 3D or 6DOF input, vendors have made many extensions both to the hardware and to software. In the late 90's Logitech created ultrasound based tracking which gave 3D input to a few millimeters accuracy, which worked well as an input device but failed as a money making product.

Other input devices, such as PhaseSpace's 3D optical tracking, have been used to create VR and AR input devices, and are being experimented on at Cambridge, Cardiff, UCSC and other universities as well as government labs. This type of input device tracks multiple LED sources to provide sub millimeter tracking for input to control tools and robots in a real or virtual space as well as computer training.

**Apple Desktop Bus**

In 1986 Apple first implemented the Apple Desktop Bus allowing the daisy-chaining together of up to 16 devices, including arbitrarily many mice. Featuring only a single data pin, the bus used a purely polled approach to computer/mouse communications and survived as the standard on mainstream models until 1998 when the iMac began a switch to USB. The PowerBook G4 retained the Apple Desktop Bus for communication with its built in keyboard and trackpad until early 2005.

**Common button uses**

- Single-click
- Select
- Right-select
- Double-click
- Cut
- Paste
- Triple-click

**Tactile mice**

In 2000, Logitech introduced the "tactile mouse", which contained a small actuator that made the mouse vibrate. Such a mouse can augment user interfaces with haptic feedback, such as giving feedback when crossing a window boundary. But optical mice cannot use this feature, making widespread adoption unlikely.

Other unusual variants have included a mouse that a user holds freely in the hand, rather than on a flat surface, and that detects six dimensions of motion (the three spatial dimensions, plus rotation on three axes). Its vendor marketed it for business presentations in which the speaker stands or walks around. So far, these mice have not achieved widespread popularity.

**Mouse speed**

The computer industry often measures mouse sensitivity in terms of DPI (dots per inch), the number of pixels the
mouse cursor will move when the mouse is moved one inch. However, software tricks like changeable mouse sensitivity can be used to make a cursor move faster or slower than its DPI, and the use of cursor acceleration can make the cursor accelerate when the mouse moves at a constant speed. This makes "DPI" (confusing (http://www.ida.net/users/oe1k/OpticalMouse/) ), and Apple and several other vendors have suggested adopting a replacement metric: "CPI" (counts per inch).

A less common unit, the "Mickey"[3] (http://catb.org/jargon/html/M/mickey.html), takes its name from Mickey Mouse. It is not a traditional unit of measurement because it indicates merely the number of "dots" reported in a particular direction. Only when combined with the DPI of the mouse does it become an indication of actual distance moved. In the absence of acceleration, the Mickey corresponds to the number of pixels moved on the computer screen.

Additionally, operating systems traditionally apply acceleration, referred to as ballistics, to the motion reported by the mouse. For example, versions of Windows prior to Windows XP doubled reported values above a configurable threshold, and then optionally doubled them again above a second configurable threshold. These doublings applied separately in the X and Y directions, resulting in very nonlinear response. Windows XP and many OS versions for Apple Macintosh computers use a smoother ballistics calculation that compensates for screen-resolution and has better linearity.

"Mice" and "mouses"

The fourth (current as of 2006) edition of The American Heritage Dictionary of the English Language endorses both computer mice and computer mouses as correct plural forms for computer mouse. The form mice, however, appears most commonly, while some authors of technical documents may prefer the form mouse devices. The plural mouses treats mouse as a "headless noun", as discussed in the English plural article.

Accessories

Mousepad

The mousepad, the most popular mouse accessory, is mostly used with mechanical mice since, to roll smoothly, the ball requires more friction than common desk surfaces usually provide. Special "hard mousepads" for gamers also exist.

Optical and laser mice do not require the pad, and its usage is mostly a matter of personal taste. An exception is when the desk surface creates problems for the optical or laser tracking. Other exceptions are when a desk or table surface needs to be kept from scratches and deterioration; when the grain pattern on the surface causes inaccurate tracking of the pointer, or when the mouse user desires a more comfortable mousing surface to work on and reduced collection of debris under the mouse.

Foot covers

Mouse foot covers (or foot pads) are made from low-friction or polished plastic. This makes the mouse glide with less resistance over a surface. Some higher quality models have teflon feet to further decrease friction.

Cord managers

Accessories for managing the cord of a mouse come in different forms. They aim to help manage excess cord length, avoiding interference with normal operation.

Wrist- rests

Cushioning pillows made from silicone gel, neoprene or other spongy material have also become popular
accessories. The padding provides for a more natural angle of the wrist, in order to reduce fatigue and avoid excessive strain. However, some people believe that wrist rests relieve strain only because they change your mousing posture, and that they do not necessarily correct anything.

Mice in the marketplace

Around 1981, Xerox included mice with its Xerox Star, based on the mouse that had been used in the 1970s on the Alto computer at Xerox PARC. Sun Microsystems, Symbolics, Lisp Machines Inc., and Tektronix also shipped workstations with mice, starting in about 1981. Later, inspired by the Star, Apple Computer released the Apple Lisa, which also used a mouse. However, none of these products achieved large-scale success. Only with the release of the Apple Macintosh in 1984 did the mouse see widespread use.

The Macintosh design, successful and influential, led many other vendors to begin producing mice or including them with their other computer products. The widespread adoption of graphical user interfaces in the 1980s and 1990s made mice indispensable for computer use. As of 2000, Dataquest estimated that mice for a total cost of US$1.5 billion were sold annually worldwide.

Alternative devices

- Trackball – the user rolls a ball mounted in a fixed base.
- Touchpad – detects finger movement about a sensitive surface — the norm for modern laptop computers. At least one physical button is normally included, but users can also (configurably) generate a click by tapping on the pad. Advanced features include detection of finger pressure, and scrolling by moving one's finger along an edge.
- Pointing stick – a pressure sensitive nub used like a joystick on laptops, usually found between the g, h, and b keys on the keyboard
- Consumer touchscreen devices exist that resemble monitor shields. Framed around the monitor, they use software-calibration to match screen and cursor positions.
- Mini-mouse – a small egg-sized mouse for use with laptop computers — usually small enough for use on a free area of the laptop body itself.
- Camera mouse – a camera tracks the head movement and moves the onscreen cursor. Natural pointers track the dot on a person's head and move the cursor accordingly.
- Palm mouse – held in the palm and operated with only 2 buttons; the movements across the screen correspond to a feather touch, and pressure increases the speed of movement.
- Foot mouse – a mouse variant for those who do not wish to or cannot use the hands or the head; instead, it provides footclicks.
- Tablet – pen-like in form, but used as a mouse. It is held like a normal pen and is moved across a special pad. The thumb usually controls the clicking on a two-way button on the top of the mouse.
- Eyeball controlled – A mouse controlled by the user's eyeball/retina movements, allowing the cursor to be manipulated without touch.
- Finger-mouse – An extremely small mouse controlled by two fingers only; it can be held in any position.

Applications of mice in user interfaces

Usually, computer users utilize a mouse to control the motion of a cursor in two dimensions in a graphical user interface. Files, programs or actions can be selected from a list of names, or in graphical interfaces through pictures called "icons" and other elements. For example, a text file might be represented by a picture of a paper notebook, and clicking while the pointer hovers this icon might cause a text editing program to open the file in a window. (See also point-and-click)

Users can also employ mice gesturally; that is, a stylized motion of the mouse cursor itself, called gesture, can be used as a form of command and mapped to a specific action. For example, in a drawing program, moving the
mouse in a rapid "x" motion over a shape might delete the shape.

Gestural interfaces occur more rarely than plain pointing and clicking; and people often find them more difficult to use, because they require finer motor control from the user. However, a few gestural conventions have become widespread, including the drag-and-drop gesture, in which:

1. The user presses the mouse button while the mouse cursor hovers over an interface object
2. The user moves the cursor to a different location while holding the button down
3. The user releases the mouse button

For example, a user might drag and drop a picture representing a file onto a picture of a trash-can, indicating that the file should be deleted.

Other uses of the mouse's input occur commonly in special application domains. In interactive three-dimensional graphics, the mouse's motion often translates directly into changes in the virtual camera's orientation. For example, in the first-person shooter genre of games (see below), players usually employ the mouse to control the direction in which the virtual player's "head" faces: moving the mouse up will cause the player to look up, revealing the view above the player's head.

When mice have more than one button, software may assign different functions to each button. Often, the primary (leftmost in a right-handed configuration) button on the mouse will select items, and the secondary (rightmost in a right-handed) button will bring up a menu of alternative actions applicable to that item. For example, on platforms with more than one button, the Mozilla web browser will follow a link in response to a primary button click, will bring up a contextual menu of alternative actions for that link in response to a secondary-button click, and will often open the link in a new tab or window in response to a click with the tertiary (middle) mouse button.

One, two or three buttons?

The issue of whether a mouse "should" have exactly one button or more than one has attracted a surprising amount of controversy. From the first Macintosh until late 2005, Apple shipped computers with a single-button mouse, whereas most other platforms used a multi-button mouse. Apple and its advocates promoted single-button mice as more efficient, and portrayed multi-button mice as confusing for novice users. The Macintosh user interface is designed so that all functions are available with a single button mouse. Apple's Human Interface Guidelines still specify that all functions need to be available with a single button mouse. However, X Window System applications, which Mac OS X can also run, were designed with the use of two or even three button mice in mind, causing even simple operations like "cut and paste" to become awkward. Mac OS X natively supports multi-button mice, so some users of older Macs choose to use third-party mice on their machines. On August 2, 2005, Apple introduced their Mighty Mouse multi-button mouse, which has four independently-programmable buttons and a "scroll ball" which allows the user to scroll in any direction. Since the mouse uses touch-sensitive technology (rather than having visible divisions into separate buttons), users can treat it as a one-, two-, three-, or four-button mouse, as desired.

Advocates of multiple-button mice argue that support for a single-button mouse often leads to clumsy workarounds in interfaces where a given object may have more than one appropriate action. Several common workarounds exist, and even some widely-used Macintosh applications that otherwise conform to the Apple Human Interface Guidelines occasionally require the use of one of them.

One such workaround involves the press-and-hold technique. In a press-and-hold, the user presses and holds the single button, and after a certain period, the

button press is not perceived as a single click but as a separate action. This has two drawbacks: first, a slow user may press-and-hold inadvertently. Second, the user must wait while the software detects that the click is actually a press-and-hold, otherwise their press might be interpreted as a single click. Furthermore, the remedies for these two drawbacks conflict with each other: the longer the lag time, the more the user must wait; and the shorter the lag time, the more likely it is that some user will accidentally press-and-hold when meaning to click.

Alternatively, the user need to hold down a key on the keyboard while pressing the button (Macintosh computers use the ctrl key). This has the disadvantage that it requires that both the user's hands be engaged. It also requires that the user perform two actions on completely separate devices in concert; that is, pressing a key on the keyboard while pressing a button on the mouse. This can be a very daunting task for a disabled user. Studies have found all of the above workarounds less usable than additional mouse buttons for experienced users.

Most machines running Unix or a Unix-like operating system run the X Window System which almost always encourages a three-button mouse. In X, the buttons are numbered by convention. This allows user instructions to apply to mice or pointing devices that do not use conventional button placement. For example, a left handed user may reverse the buttons, usually with a software setting. With non-conventional button placement, user directions that say "left mouse button" or "right mouse button" are confusing. The ground-breaking Xerox Parc Alto and Dorado computers from the mid-1970s used three-button mice, and each button was assigned a color. Red was used for the left (or primary) button, yellow for the middle (secondary), and blue for the right (meta or tertiary). This naming convention lives on in some SmallTalk environments, such as Squeak, and can be less confusing than the right, middle and left designations.

**Mice in gaming**

Mice often function as an interface for PC-based computer games and sometimes for video game consoles. They are often used in combination with the keyboard. In arguments over which is the best gaming platform, the mouse is often cited as a possible advantage for the PC, depending on the gamer's personal preferences.

**First-person shooters**

A combination of mouse and keyboard provides a popular way to play first-person shooter (FPS) games. Players use the X-axis of the mouse for looking (or turning) left and right, leaving the Y-axis for looking up and down. The left mouse button is usually for primary fire. Many gamers prefer this over a gamepad or joystick because it allows them to turn quickly and have greater accuracy. If the game supports multiple fire-modes, the right button often provides secondary fire from the selected gun. In games supporting grenades it can serve to throw grenades, or, such as in Call of Duty 2, it allows users to look down the barrel of the gun for better aiming.

A scroll wheel is used for changing weapons, or controlling scope zoom magnification. On most FPS games, these functions may also be assigned to thumb buttons. A keyboard is usually used for movement (for example, WASD, for moving forward, left, backward and right, respectively) and other functions like changing posture. Since the mouse is used for aiming, a mouse that tracks movement accurately and with less lag will give a player an advantage over players with less accurate or slower mice.

An early technique of players, circle strafing, saw a player continuously strafing while aiming and shooting an opponent by walking in circle around the opponent with the opponent at the center of the circle. Players could achieve this by holding down a key for strafing while continuously aiming the mouse towards the opponent.
Games using mouses for input have such a degree of popularity that many manufacturers, such as Belkin, Logitech and Razer USA Ltd, make premium peripherals such as mice and keyboards specifically for gaming. Such devices frequently feature (in the case of mice) adjustable weights, high-resolution optical or laser components, additional buttons, ergonomic shape, and other features such as adjustable DPI.

**Invert mouse setting**

Many games, such as first- or third-person shooters, have a setting named "invert mouse" or similar (not to be confused with "button inversion", sometimes performed by left-handed users) which allows the user to look downward by moving the mouse forward and upward by moving the mouse backward (the opposite of non-inverted movement). This control system resembles that of aircraft control sticks, where pulling back causes pitch up and pushing forward causes pitch down; computer joysticks also typically emulate this control-configuration.

After id Software's Doom, the game that popularized FPS games but which did not support vertical aiming with a mouse (the y-axis served for forward/backward movement), competitor 3D Realms' Duke Nukem 3D became one of the first games that supported using the mouse to aim up and down. It and other games using the Build engine had an option to invert the Y-axis. The "invert" feature actually made the mouse behave as users now regard as non-inverted. Soon after, id Software released Quake which introduced the invert feature as we now know it.

Other games using the Quake engine have come on the market keeping to this standard, likely due to the overall popularity of "Quake".

**Super Nintendo**

In the early 1990's, the Super Nintendo Entertainment System video game system became the first commercial gaming-console to feature a mouse in addition to its controllers. The game Mario Paint in particular used the mouse's capabilities.

**See also**

- Trackball
- Touchpad
- Pointing stick
- SpaceBall
- Footmouse
- Mousepad
- Mouse gesture
- Repetitive strain injury
- Computer accessibility
- Graphics tablet
- Mouse keys

**Notes**

1. ^ See, for instance: "mouses" vs "mice" (http://alt-usage-english.org/excerpts/fxmouses.html).

**References**

- Squeak Wiki (16 March 2004). FAQ: Mouse Buttons (http://minnow.cc.gatech.edu/squeak/897.version)
- Inertial mouse system (http://www.freepatentsonline.com/4787051.html), United States Patent 4787051

External links

- The Earliest Computer Mice (http://www.oldmouse.com/mouse/)
- The Xerox Alto ball mouse (http://www.oldmouse.com/mouse/xerox/alto.shtml) and Star optical mouse (http://www.oldmouse.com/mouse/xerox/star8010.shtml)
- Primary Material on the Apple Mouse (http://library.stanford.edu/mac/mouse0.html)
- Optical Mouse technology review: Tech specs on current optical mice (http://www.ida.net/users/oe1k/OpticalMouse)
- A review of a modern laser-based mouse: the MX1000 (http://www.dvhardware.net/review70_logitech-mx1000.html)
- SRI mouse (http://www.sri.com/about/timeline/mouse.html)
- MouseSite (http://sloan.stanford.edu/MouseSite/) including 1968 demonstration (http://sloan.stanford.edu/MouseSite/1968Demo.html)
- Mouse Interrupts in DOS (http://writeka.com/emage/mouse_events.html)
- The PS/2 mouse interface (http://www.computer-engineering.org/ps2mouse/) – Detailed description of the data protocol, including the Microsoft Intellimouse wheel-and-five-buttons extensions
- PC mouse information (http://users.tkk.fi/~then/mytexts/mouse.html) – some information on mouse interfaces and communication protocols
- HwB: Atari Mouse/Joy Connector (http://www.hardwarebook.net/connector/userinput/atarimousejoy.html)
- Repair4Mouse (http://repair4mouse.org/) - A survey of do-it-yourself guides about repairing and modding computer mice.
- howstuffworks.com article on how computer mice work (http://computer.howstuffworks.com/mouse.htm)
- English Russia » The Manipulator For Graphical Information (http://englishrussia.com/?p=270#more-270), Russian mice

Game controller styles

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