

Keeping a hand on the evolution of
cursor controls:
trendsetting mice of the past and what to do
if you get one today

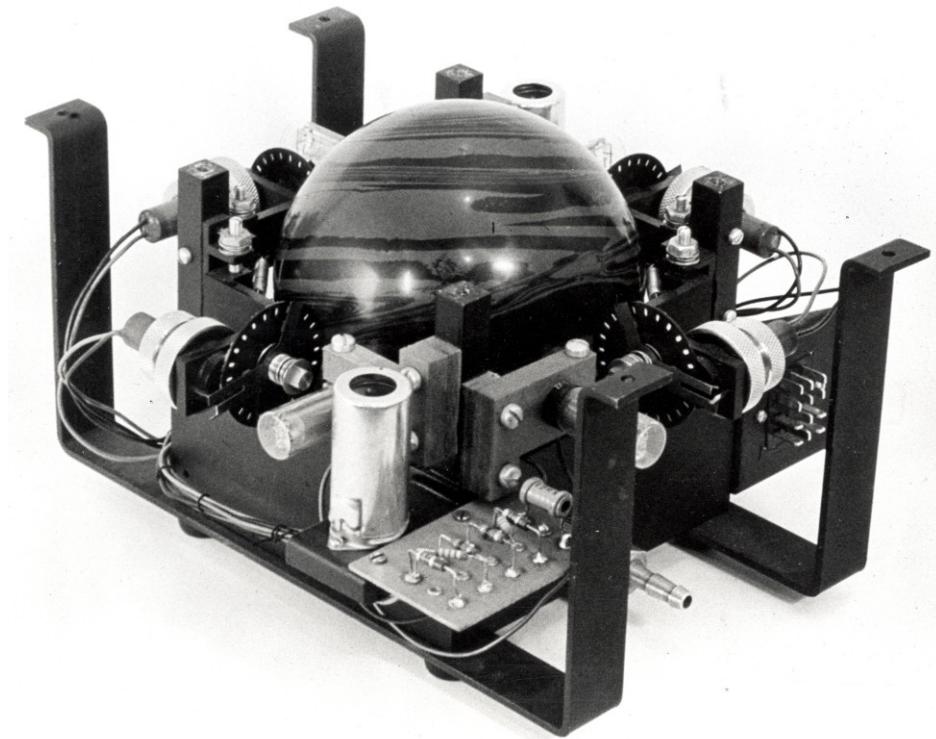
Examined cursor control devices

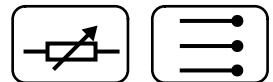
Mouse with mechanical encoder									
Mouse with optical encoder									
Optical mouse									
Analog mouse									
1970-s.	Alto 1								
1972									
1980	TRS-80 Deluxe		1980 Tandy	1980 TRS-80 Color	1980 Tandy				
1981	8010 Star								
	1981 Xerox								
1982	Nidd Valley DigiMouse			VisiOn mouse		Graphic / SMC Mouse			
	1982 green-eyed mouse		1982 Hawley Mark II X063X	1982 Mouse Systems	1982 Lisa mouse (M9M0050)	1982 M2	1982 Contriever		
1983	Microsoft		1983	Macintosh mouse M0100		Apple 46060A		Summagraphics SummaMouse	
	1984 Grey-eyed mouse		1984 HP	1984 Logitech	1984 Neos Mouse	1984 Series C7 Mouse		HP 6085 Optical 2-Button Mouse	1985 Optical 3-Button Mouse
1985	Microsoft		1985	Apple EC 1841	1985 Nihon Electronics	Logitech C7		Xerox Manager Mouse	AMX Mouse
1986	Commodore 1350 Mouse		1986 Commodore	1986 Honeywell	1986 USSR P7-3F	Desktop Bus Mouse		Atari ST mouse	Xerox
1987	PS/2 mouse		1987 IBM	1987 FastTRAP Trackball	1987 GM-6	1987 Laser III		Torrington Dove bar mouse	1985 AMX
	1988 Witty Mouse C-400		1988 ClearCase Mouse	1988 Midasonic Industrial	1988 Logitech	1988 Genius Kraft	1987 Quadram	1987 Mouse Systems	1987 Microsoft
1989	HeadStart Explorer		1989 Philips	1989 Abaton ProPoint Optical Trackball	1989 Aero IM-PC20		1989 ICA technology		
1990	PFS Mouse (KM10K)		1990 Key Tronic	1990 USSR EC 1845	1990 Roland MU-1	1990 Little Mouse		Suncom ICONtroller	1990 e-Mac Silhouette
	MM-8031		1990 NeXT N8003 mouse	1991 USSR Kidz Mouse	1990 IBM Kometa	1991 Quik QM-E1		1990 Felix PS/2	1990 Altra
1991	Super NES Mouse		1991 USSR	1991 IntelliMouse TrackBall	1991 USSR PCXAS-AA	1991 Prohance PowerMouse			
1992	Nintendo	1992 NeXT Computer	1992 Sun Compact mouse	1992 Turbo Mouse 4.0	1992 Microsoft Desktop Bus Mouse II	1992 DEC	1992 DuraPoint		
	1993	1993 Sub Microsystems	1993 Kensington	1993 Kensington TrackMan Stationary Mouse	1993 Logitech	1993 Apple	1993 Interlink Electronics		
1994	Serial Mouse 2.0		1994 Microsoft	1994 Honeywell					
	1994 ProAglo! Scrolling Mouse		1995 Mouse Systems	1995 Sunnyline	1995 TrackMan Marble		1995 Logitech		
1995	Turbo Mouse 5.0		1996 Kensington	1996 Logitech	1995 IntelliMouse ball mouse		1996 Microsoft		
	1996 ScrollPoint 3-Button Mouse		1997 IBM	1997 Memorex	1996				
1997	USB mouse (M4848)		1998 Apple	1998 A4 Tech	1997				
	1998 Wingman Force Feedback Mouse		1999 Logitech	1999 A4 Tech	1999				
2000 or later	Mouse-trak		2001 ITAC Systems	2003 Kensington	2004 Microsoft	2000 Pro mouse (M5769)	2005 Apple	Mighty Mouse (A1152)	2005 Apple

- Analysis of mice and trackballs for the period from 1970 to 2000, shown in the table on the left, allowed us to
 - draw conclusions about the evolution of the design features of cursor controls
 - highlight key devices that marked turning points in their development

1952 - trackball appearance

- Trackball prototype invented in 1952
- The trackball was used to interface with the Naval Tactical DATAR system developed for the Royal Canadian Navy





1966 - Douglas Engelbart's mouse

- Douglas Engelbart proposed the design of a computer mouse with wheels in 1963
- The author of the first prototype is engineer Bill English
 - It had sharp edged wheels and one button
 - When the mouse moves along one of the coordinate axes, one of the wheels rotates, transmitting changes in coordinates, while the other slides without moving
 - It is an “analog mouse”: wheels are connected to potentiometers, so coordinates are encoded by 2 analog signals

We'll see later how to **connect this mouse to USB**, if you have one – but, chances to have it are low :-)

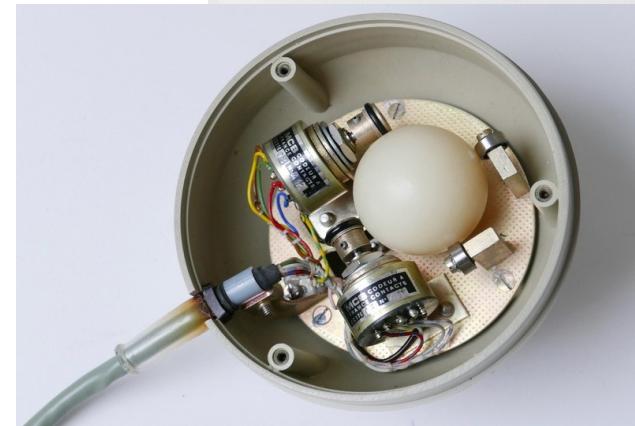


A late replica of Engelbart's mouse on display at the California Computer History Museum



1966 - Telefunken Rollkugel

- In 1966, Telefunken engineers “inverted” the trackball
- Used a ball rolling on the table
 - actually, a ping-pong sized ball :)
- The ball's movements were tracked using two friction wheels
 - It produced 4-bit Gray code for each axis
- This is how the ball mouse was invented

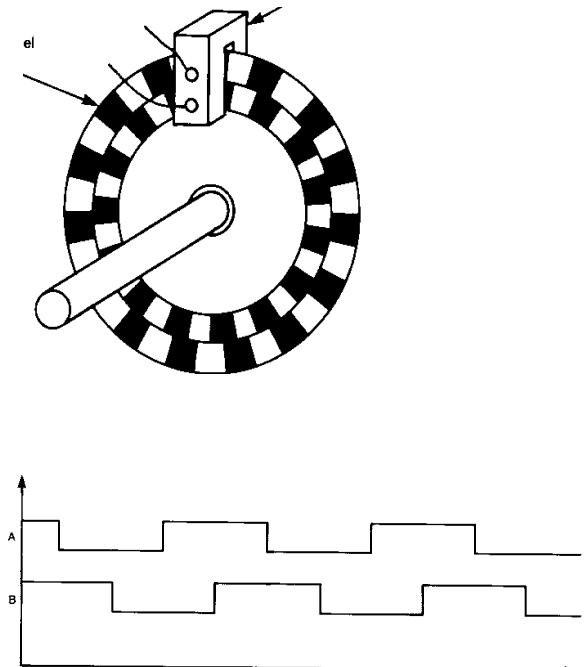


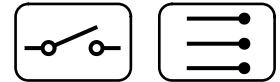
A working example from the collection of Jürgen Müller

There is even a USB converter based on ATtiny micro-controller with schematics and source code: e-basteln.de/computing/rollkugel/rollkugel

Quadrature mouse interface

- An electrical contact is closed on the disk segments and a series of voltage pulses appears at the output
- The second contact is shifted relative to the first one by one quarter of the period, and we have a quadrature output
- As a result, the quadrature signal of each coordinate is transmitted by two values A and B
 - In total, the quadrature mouse connection interface uses ground and power lines, 4 lines for transmitting movement (X_A , X_B , Y_A , Y_B) and one line for each mouse button





1973 - Xerox Alto mouse

- The first commercially available mouse, released in 1973 with the participation of 2 engineers: Bill English and Jack Hawley
- Jack Hawley's company continued to produce this mouse in several modifications almost until the mid-80s
- The user experience, by the way, wasn't very good :)



Hawley Mark II:

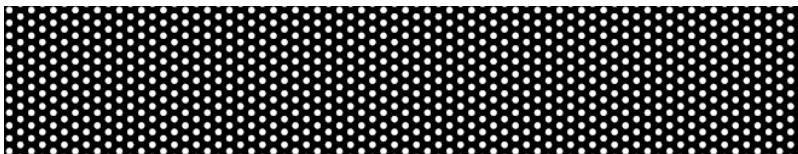
- These mice work with any quadrature Arduino-based USB converter
- We recommend one for Amiga: github.com/BleuLlama/AmigaInputToUSB License MIT
- You need a coupling connector (bitsavers.org/pdf/xerox/mouse/lyon_optical/Lyon_Mouse_Notes.txt for Alto in our case, <https://www.microsoft.com/buxtoncollection/a/pdf/Mouse%20House%20MK%20II%20Brochure.pdf> for Hawley Mark II)



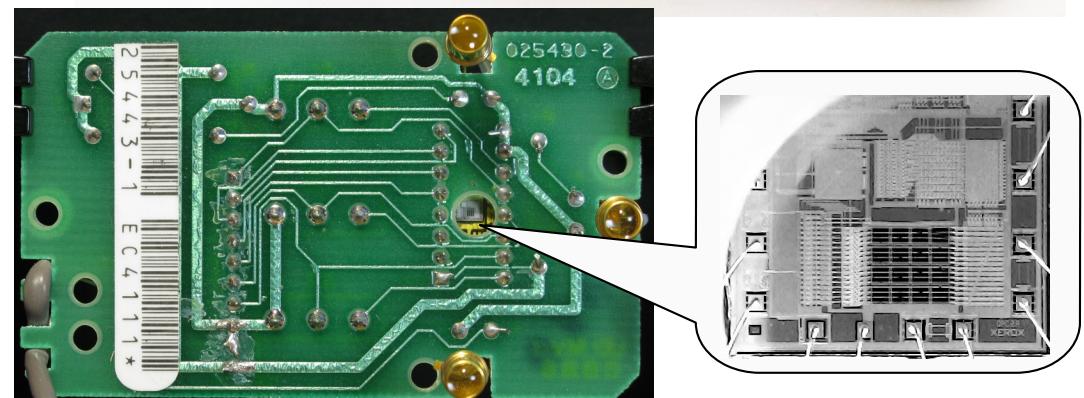


1981 – Xerox Star mouse

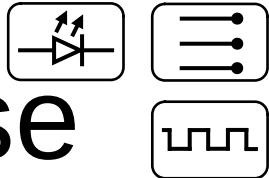
- The first optical mouse in the more or less modern sense is a mouse for Xerox Star computers
- This mouse had an optical matrix and required a mouse pad with alternating black and white spots
 - The pattern looks like this:



- Actually, any grained pattern was OK, even fabric

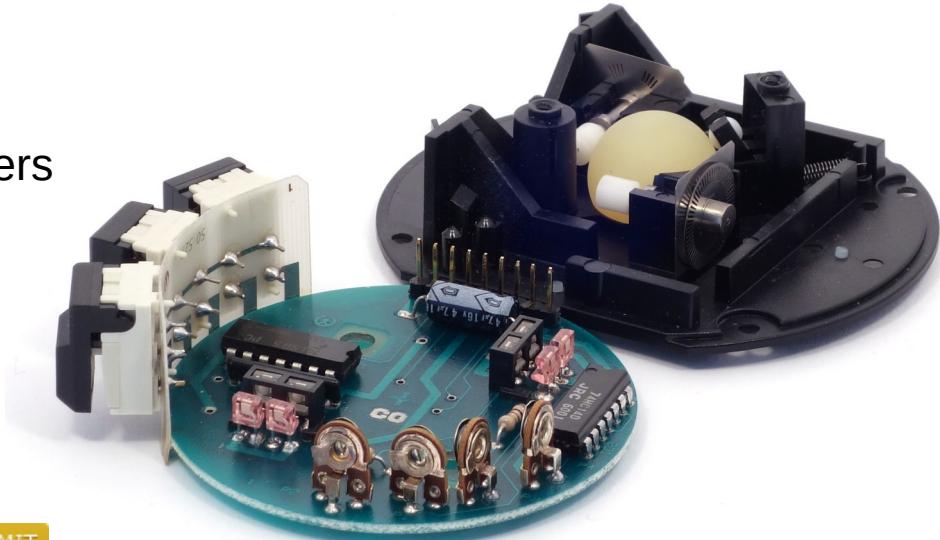
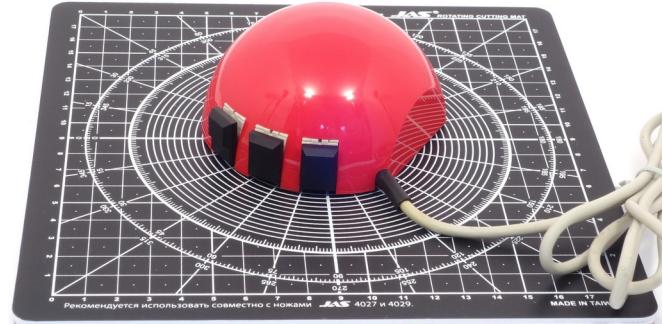


Coupling connector (for the later models like this one) is the most difficult part; aside of this it's a plain quadrature mouse



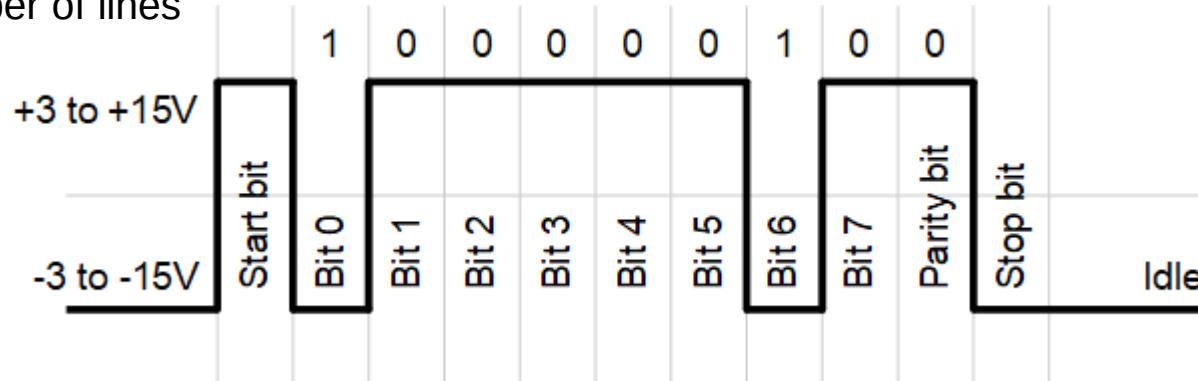
1982 – Depraz/Logitech P4 mouse

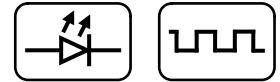
- The Swiss watch manufacturer Depraz had industrialized the mouse design from Swiss Federal Technology Institute of Lausanne, which combined the advantages of optical and mechanical mice through an optical encoder
 - it is cheaper
 - no special mouse pad required
 - no unreliable mechanical contact in the encoders
 - higher resolution is easier to achieve
- It was the first serial mouse (RS-232), but also had quadrature version...
 - ...which now has a dedicated converter:



Serial interface

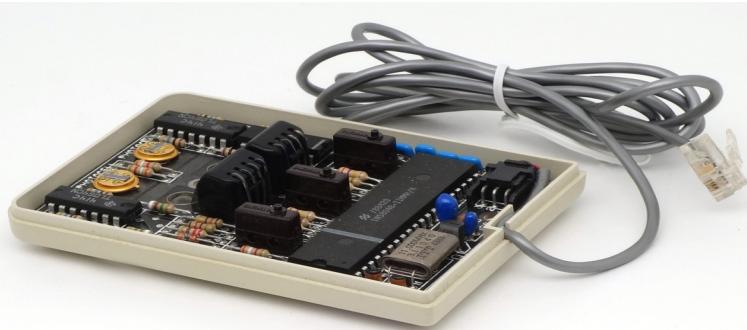
- Following Depraz, Mouse Systems and Microsoft almost simultaneously developed their own versions of the protocol for connecting a serial mouse to an IBM PC
 - This allows the existing IBM PC RS-232 port to be used instead of a separate adapter that would accept the quadrature signal
- In 1986, low-power LEDs appeared, but before that, serial mice needed an additional power source
 - RS-232 has signal lines only, and you can't get much power from them
 - sometimes it's a separate power supply, sometimes it's a cut-in into the keyboard cable
 - some companies had developed a special RS-232-based bus with an additional power supply circuit for their computer architectures (SUN, DEC)
- Changes in coordinates and button presses are encoded by a sequence of pulses, which allows to reduce the number of lines





1982 – Mouse Systems M1

- Mouse Systems' first optical mouse set the optical mouse standard for a decade
 - From 1982 (model M1) to 1988 (model M4) the mouse remained almost unchanged



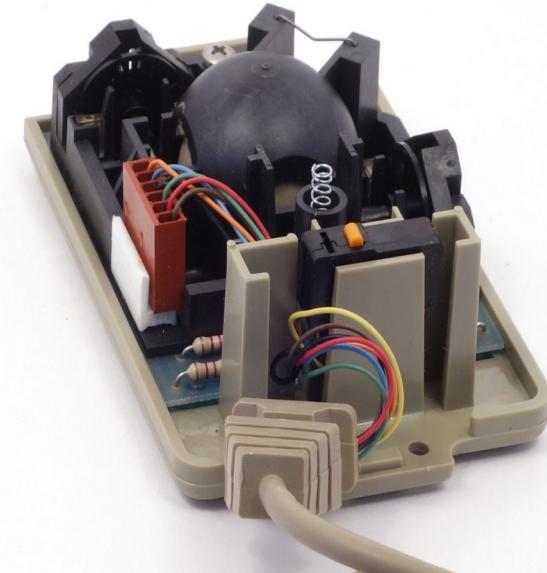
- It uses a cheaper design than Xerox and modern mice, invented by a student (Steve Kirsch)
 - A special reflective mouse pad and phototransistors are used instead of an optical matrix

Use USB–RS232 dongle and [inputtattach -mousesystems /dev/ttyUSB0](#) in Linux



1983 – Apple Lisa mouse

- The 1st computer mouse known to the wide audience
- Probably the 1st mouse with a rubber-coated metal ball
- Has typical optical encoder (nothing new)
- Works with any quadrature mouse converter and 9-pin D-SUB connector
 - we still prefer one for Amigas and Arduino
 - or you can use a dedicated Apple Mouse firmware and adapter from retronicdesign.com:



https://github.com/retronicdesign/USBJoystickAdapter_v3.3

License GPLv3

1984 – HP 46060A and HIL bus

- This mouse became Logitech's first major contract
- The mouse was developed for Hewlett-Packard, for HP 9000 workstations
 - All human interaction peripherals of these workstations were connected to the HIL bus
 - probably the earliest USB predecessor
- The bus had a frequency of 8 MHz and connected up to 7 devices in a daisy chain
 - keyboards, mice, trackballs, digitizers, tablets, barcode readers, rotary knobs, touch screens, etc.

HP HIL mice are supported (surprise!) by TMK and QMK firmware (an open source firmware for a variety of open keyboards like ErgoDox EZ) :)



Find converter at https://github.com/tmk/tmk_keyboard/tree/hphil/converter/hphil_usb

License GPL v2



1984 – mice imitating a joystick

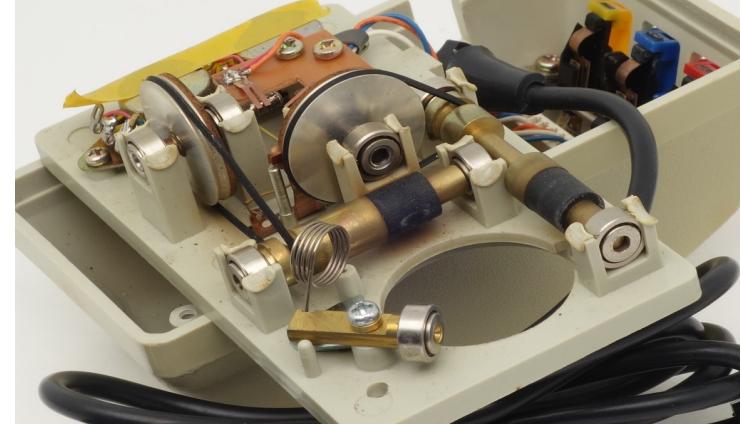
- In 1984 the original Engelbart's approach to use potentiometers had a new birth
- The mouse is an imitation of an analog joystick
 - It has limited “range” of the mouse in each direction
 - still, it’s cheap and found use in home computers that only had a game port
- A number of projects allows using Arduino or similar platform’s ADC to behave as USB HID joystick or mouse:
 - e.g. github.com/option8/RetroConnector/tree/master/Joystick-Shield ...
 - ...or docs.arduino.cc/built-in-examples/usb/JoystickMouseControl/



Color Mouse
for TANDY TRS-80
home computers (1984)



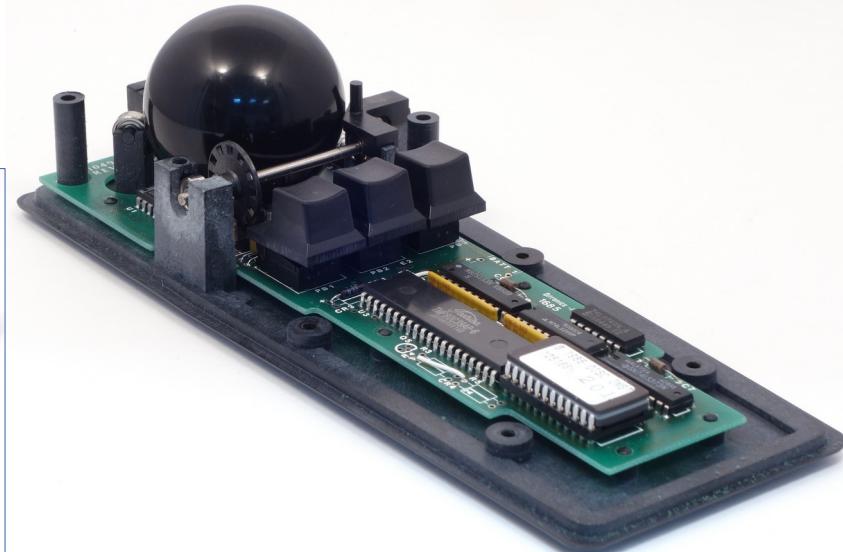
SMC Mouse for Commodore computers (1985)

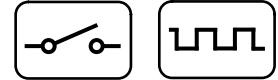




1986 – microLYNX trackball

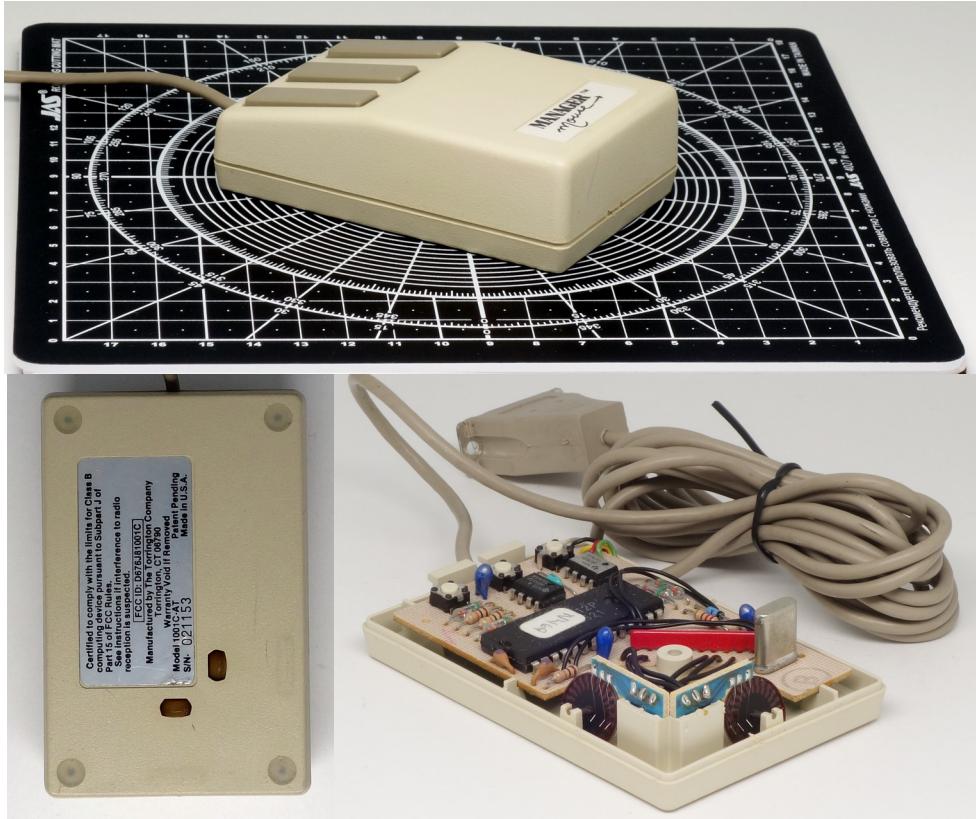
- Some other mice for such limited connectivity computers emulated even cheaper digital joystick
 - stick just closes contact (presses one or two internal buttons) when moved – just like cursor keys :)
 - the mouse had a typical mechanical or optical encoder, and only simulated these joystick contact closures over its interface lines
- Honeywell/Disc instruments microLYNX trackball went even further, presenting itself as an additional cursor keys keyboard
 - It is inserted between the keyboard port and the normal keyboard, and imitates cursor key presses on ball rotation
 - the trackball hears everything you type, and you can chat with it via your favorite text editor
 - ask about the configuration, set options, etc.





1986 – Manager mouse

- At the same time, two companies (Torrington and Hawley Mouse House) are trying to revive the idea of using wheels instead of a ball to reduce clogging and make the mouse cheaper
- The Manager mouse option is cheaper, but a small amount of debris still gets into the case
- A plain RS-232 mouse
 - it can be connected same way as Mouse Systems mice

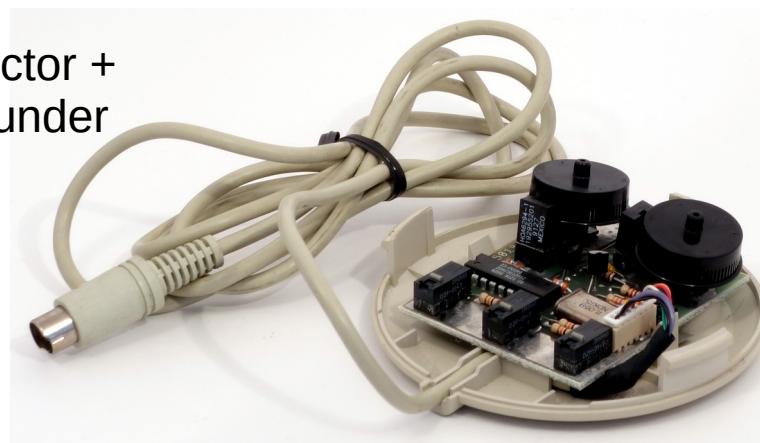


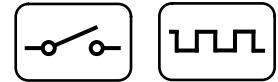
Use USB-RS232 dongle and [inputtattach --mousesystems /dev/ttyUSB0](#) in Linux



1986 – DEC Hawley

- Jack Hawley's version is more expensive, but the wheels are located outside the sealed body
 - the mouse collects no dust inside
- It works via the DEC ACCESS.bus
 - Electrically it's like RS-232 with additional power
- USB–RS232 dongle + coupling connector + power supply should make it working under Linux
 - “attaching a serial line to an input-layer device” (C) should do the job (but we didn't check)
 - `inputattach - -vsxxx-aa /dev/ttUSB0`

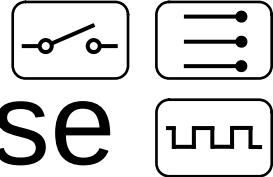




1987 – IBM PS/2 mouse

- First mouse for the PS/2 interface
- Actually made by ALPS Electric in Japan
 - Old-school closed mechanical encoders inside
- No one new yet that this interface will become so popular for computer mice, and PS/2 mice will be the easiest ones to use with the XXI century computers
 - you can find enough converters on the market, which present them as USB HID devices

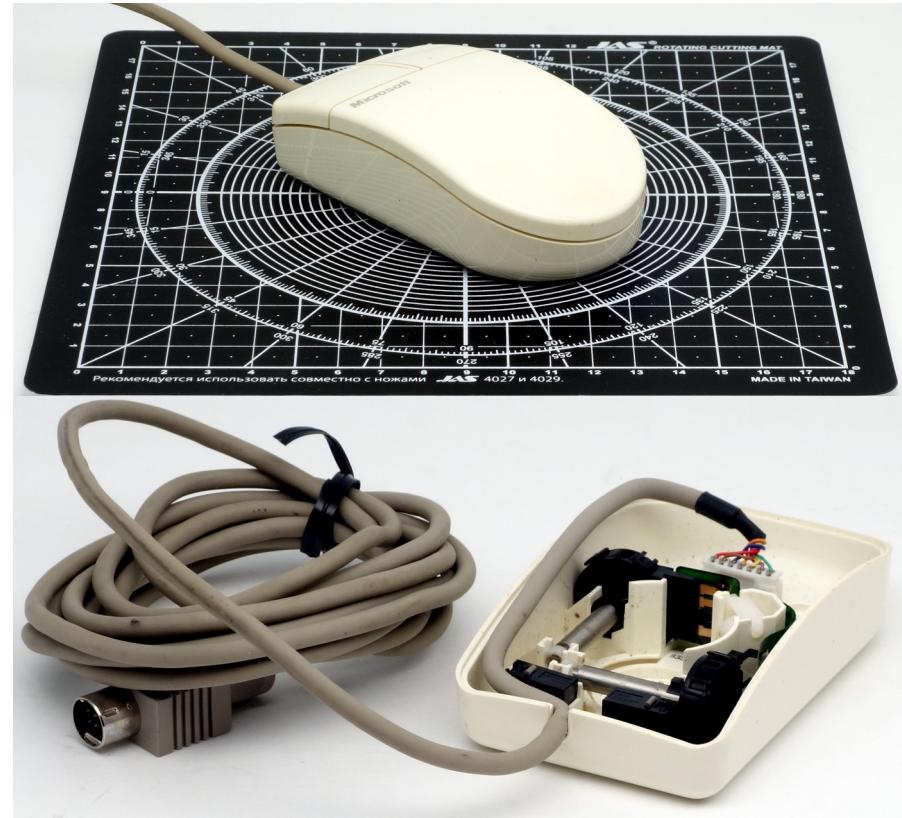


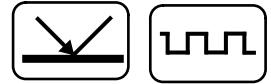


1987 – Microsoft “Dove bar” mouse

- The third generation of Microsoft mice was the first model to advertise an ergonomic design
- The prototype for the shape of this mouse was a sanding block

It has either serial interface or Microsoft InPort interface - which actually is quadrature, so any good quadrature converter (we still prefer Amigas!) with the connector coupler works





1995 – Logitech Trackman

- This model was the first optical trackball, based on the principle previously used only in computer mice
- The pattern on the ball acts as a special mouse pad, allowing the optical sensor matrix to read alternating light and dark spots as it rotates
- The use of an optical method for registering the rotation of the ball made it possible to replace the rollers with a low-friction point supports for easier rotation of the ball
- It was discovered that the design of the optical trackball is less sensitive to clogging and requires cleaning less often
- Fortunately, PS/2 mice are simpler than everything before, you can find enough converters on the market, which present them as USB HID devices





1995 – Mouse Systems scroll mouse

- ...or “ProAgio scroll mouse” - the first mouse with a scroll wheel
 - Although it would be more correct to call it a scroll roller :)
- The wheel was originally intended for zooming in spreadsheets
- But it quickly turned out to be ideal for scrolling documents
- For scrolling, a separate optical encoder and a belt drive were used
 - people didn't yet know that scrolling needs much lower resolution than cursor movements



Possibly, the scroll wheel is so comfortable, because we inherited the adaptation to the finger movement used for scrolling from our distant tree-climbing ancestors :)

- This made all already existing mice obsolete
- Any further attempts to re-invent scrolling (i.e. with a tiny joystick) had not much success

Conclusions

- Surprisingly, most of the significant mice can be easily connected to nowadays PC and used under GNU/Linux
 - Open source converters are doing an opposite task more often (use contemporary mice with old computer), but plugging a vintage mouse to USB-only PC or smartphone also works :)
 - Difficult mice with a dedicated system adapter are actually parallel quadrature devices
 - so they are the most easy to be revitalized
 - Mice imitating analog or digital joysticks are also easy because the idea of connecting a vintage joystick to a modern PC had brought into life enough converters projects :)
 - Some serial devices have both old converters, and modern open hardware ones (e.g. ADB-USB)
 - Some serial devices are also not very difficult cases because of the existing Linux port for their platforms
 - Hewlett-Packard compatible HIL mice was a tough case for a long time, until its appearance in TMK and QMK firmwares (in addition to ADB, serial, SUN mice)
- Connecting vintage mouse to the computer running an emulator of the old system helps to reproduce UX (user experience) much better than just dealing with today regular controls

Useful links

- L'histoire de la souris – smaky.ch:
<https://smaky.ch/chapitre-7-souris-douglas-engelbart/>
- Converters, supported by the TMK Keyboard Firmware:
https://github.com/tmk/tmk_keyboard/tree/hphil/converter
- The inputattach manual with the list of supported serial mouse protocols: <https://linux.die.net/man/1/inputattach>
- More on the above mice (and a number of other “mouses”):
<https://mouses.info> :)