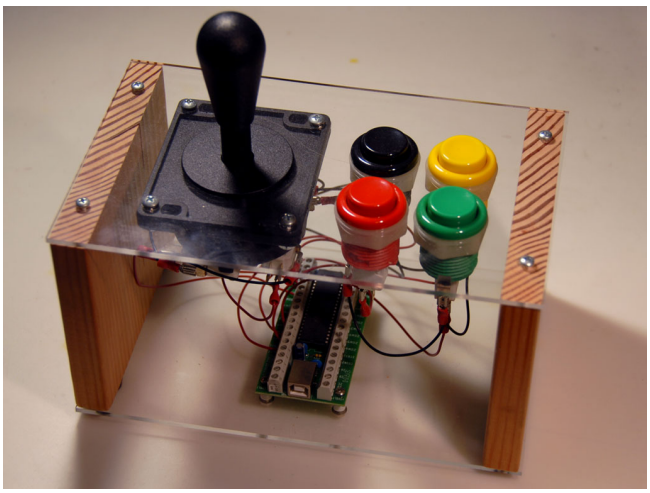
CS148: Introduction to Computer Graphics and Imaging

Input Technology



Topics

Keys and Keyboards

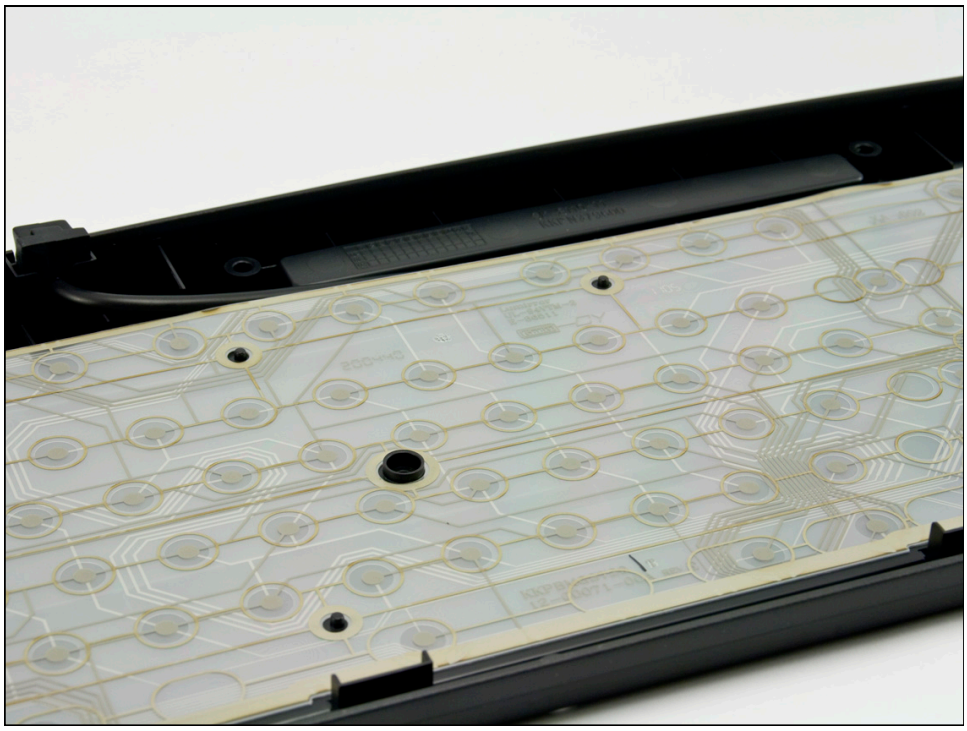
Pointing

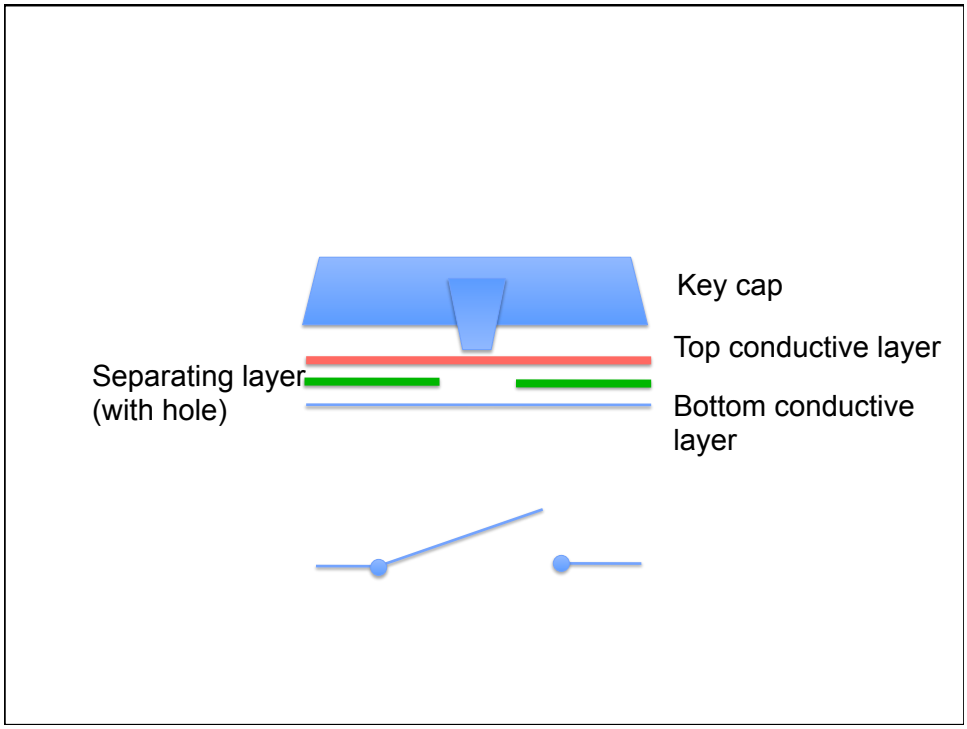
- Digital joystick
- D-pad
- Trackball
- Mouse
- Optical mouse
- Analog joystick

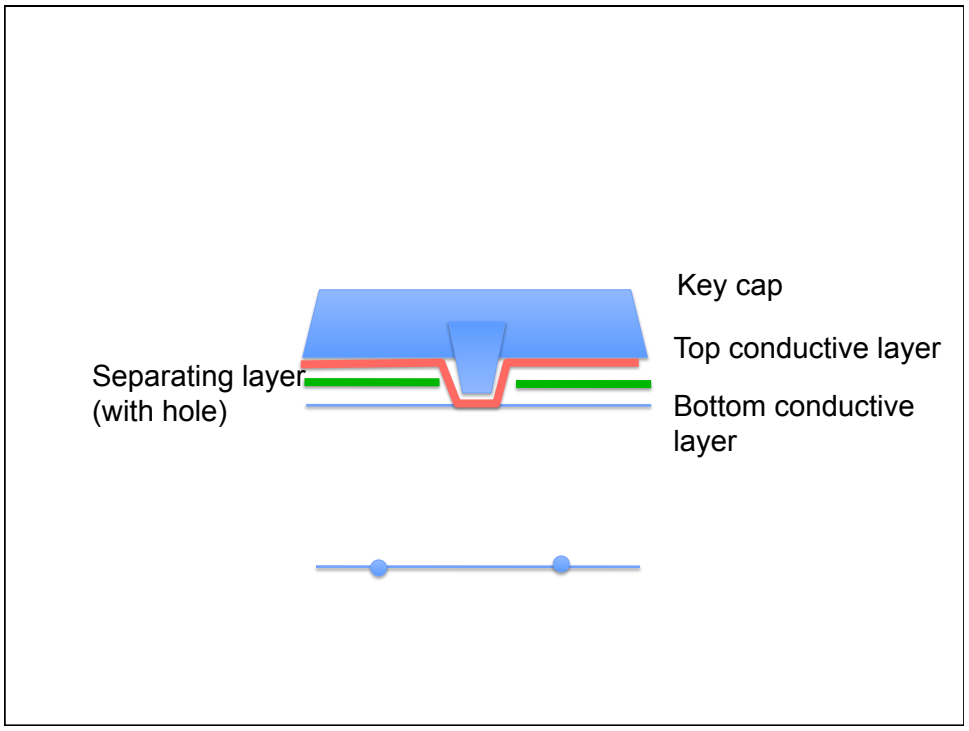
Game controllers

Emerging input technologies

Keyboards




Key cap
Top conductive layer
Separating layer
(with hole)
Bottom conductive
layer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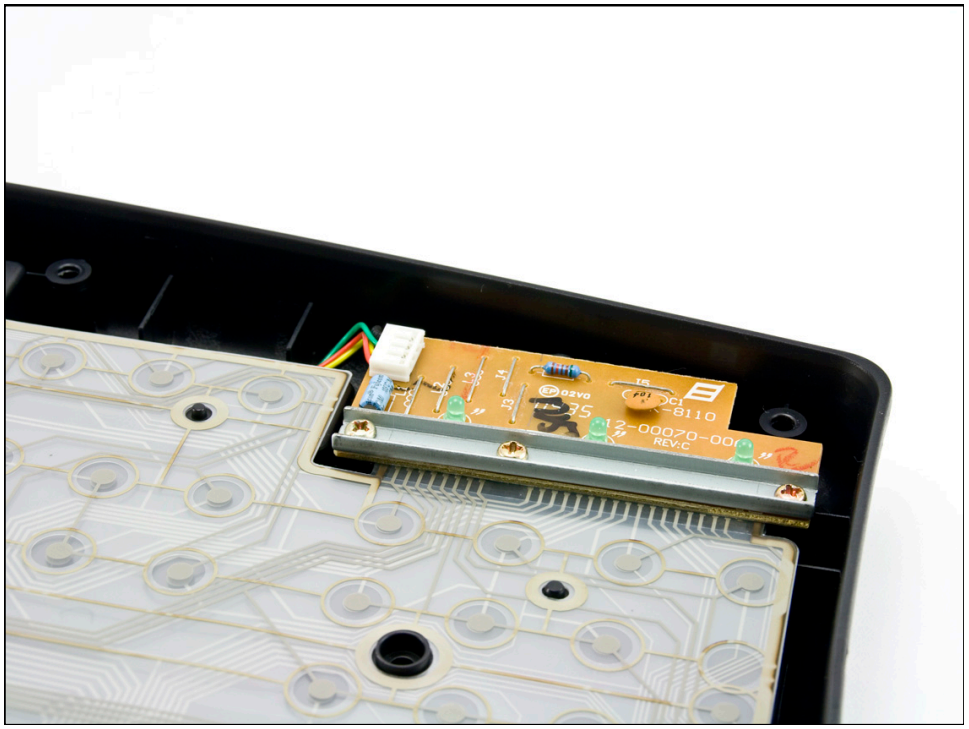
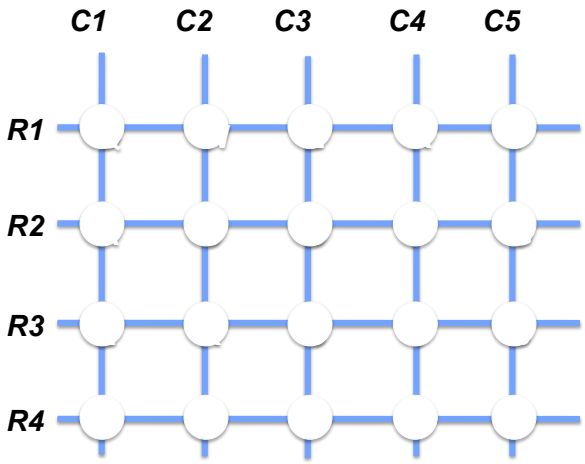


Row/Column Scanning



9 lines

20 keys

Keyboard Matrix

16 X 8 IBM Keyboard Matrix (columns are marked 'a' to 'p' and rows are marked '1' to '8')

	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11	a12	a13	a14	a15	a16
b1			esc		F4	G	F5	H	F6	"			#0	#.	Arrow up	L Alt
b2		L Shift	Tab	Cap Lock	F3	T	Bk Space	Y	[	F7	#4	#5	#6			
b3	L Ctrl		~	F1	F2	5	F9	6	=	-	F8	Del	Ins	Page Up	Home	
b4			1	2	3	4	F10	7	8	0	9	F11	F12	Page Down	End	Prnt Scrn
b5			Q	W	E	R		U	I	P	O	#7	#8	#9	#+	Scrol Lock
b6			A	S	D	F	\	J	K	;	L	#1	#2	#3	#Enter	
b7	R Ctrl	R Shift	Z	X	C	V	Enter	M	,	\	.	#num Loc	#/	#*	Pause	
b8						B	Space	N	/			Arrow Down	Arrow Right		Arrow Left	R Alt

Scan Codes

Make (onPress) and Break (onRelease) codes

http://www.computer-engineering.org/ps2keyboard/

Keys and Characters are not the Same

Modifier keys

- **[Shift] [Ctrl] [Alt/Option] [Cmd] [Fn]**
- **Capslock and Numlock**

Special keys

- **F1, …, F12**
- **Insert, Delete, Home, …**

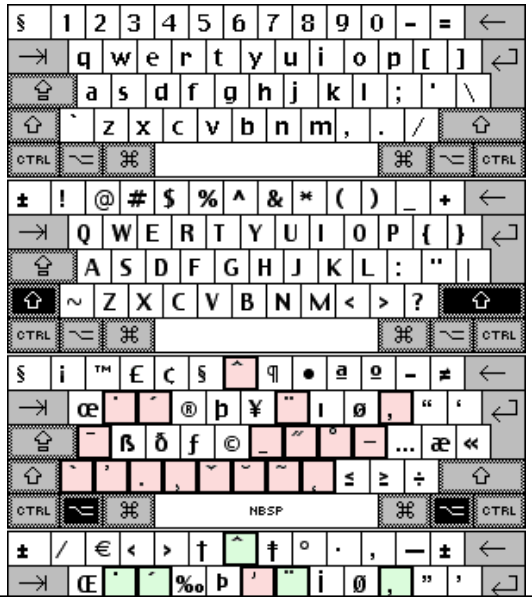
Duplicated keys

- **Numbers on keypad vs. keyboard**
- **Left-shift, Right-shift, Left-cmd, Right-cmd, …**

Multiple keys may be combined into a character

- **Accents …**

Keyboard Finite-State Machine



White: Normal key

Black: Modifier key

Pink: "Dead" key

Pat Hanrahan, Fall 2009

GLUT Keyboard Interface

ASCI keys

- **glutKeyboardFunc(func) // onDown**
- **glutKeyboardUpFunc(func) // onUp**
  - **func(unsigned char key, int mousex, int mousey);**

Non-ASCI keys (F1, …, F12, INSERT, …)

- **glutSpecialKeyFunc(func) // onDown**
- **glutSpecialKeyUpFunc(func) // onUp**
  - **func(unsigned char key, int mousex, int mousey);**

Int glutGetModifiers()

- **GLUT_ACTIVE_SHIFT|GLUT_ACTIVE_CTRL|GLUT_ACTIVE_ALT**

N.B. Need to track key state

Flash Keyboard Interface

Key class

- **addListener(proc) - call onUp and onDown**
- **getAscii() - return ASCII for the last key pressed**
- **getCode() - return virtual key code for last key**
- **isDown(key) - return state of key**
- **isToggled(key) - return change in state of key**

Note difference between

- **state (Up, Down) vs. transition (onDown, onUp)**

Position

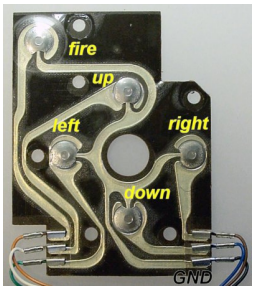
D-pad

Famicom Controller (1983)

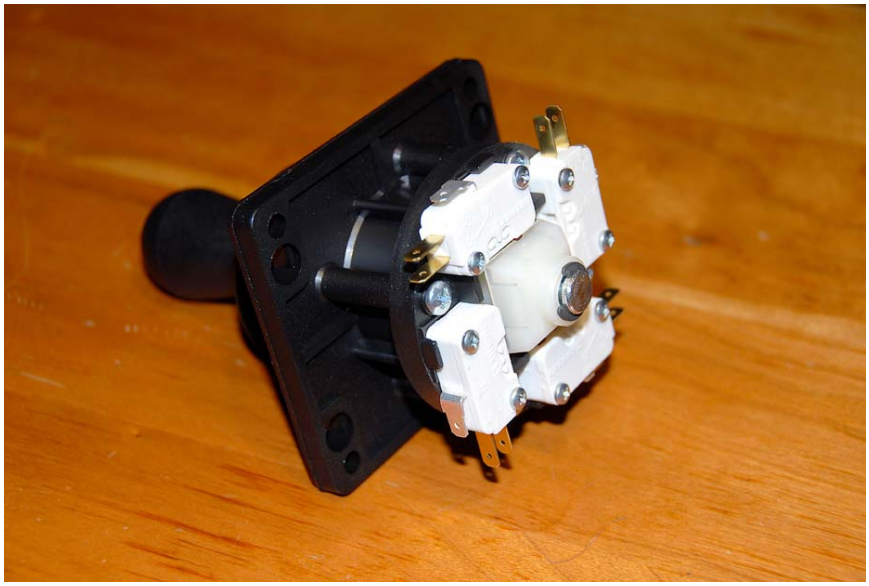
Atari CX40 Joystick

Just 5 switches!

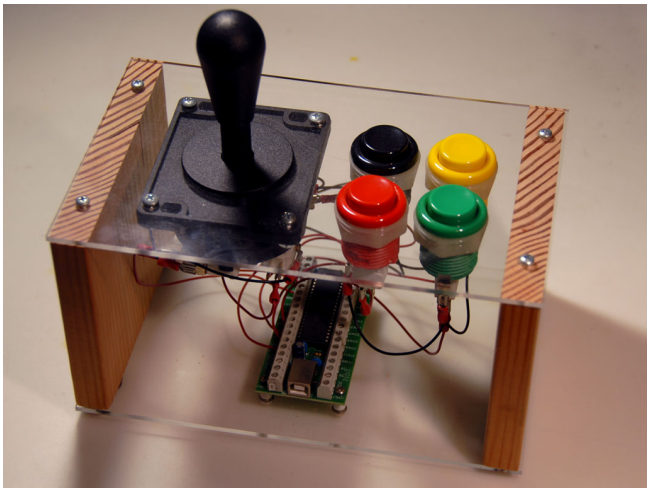
```
 _____________
\ o5 o4 o3 o2 o1/
 \ o9 o8 o7 o6 /
  \___________/

pin #
  1    Up
  2    Down
  3    Left
  4    Right
  5    unused
  6    Button
  7    unused
  8    Ground
  9    unused
```



4-way Joystick (Just 4 switches)

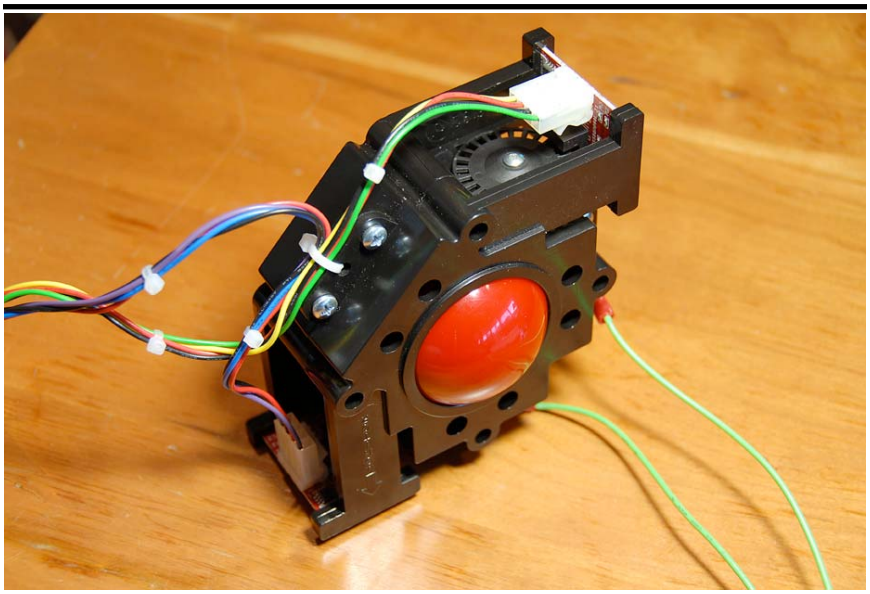


Demo

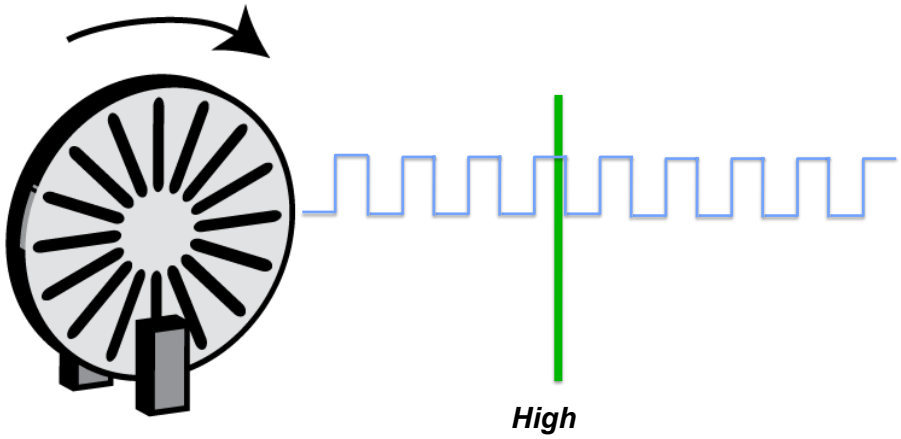


Trackball and Mouse
use
Rotary Encoders

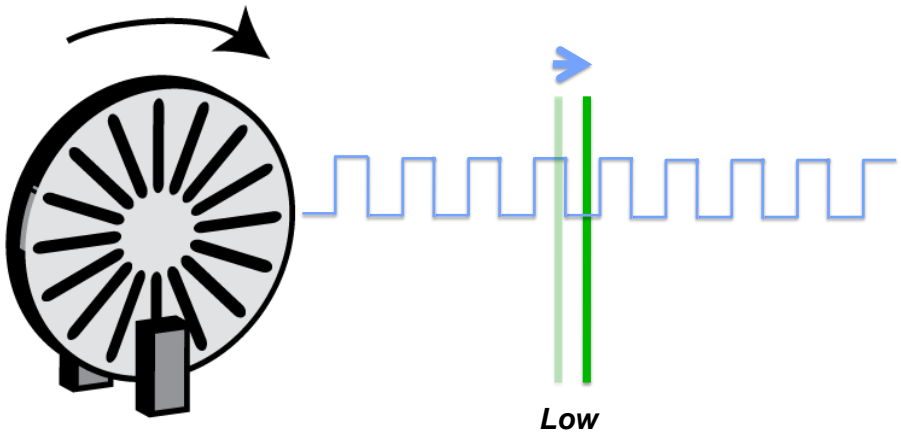
Trackball



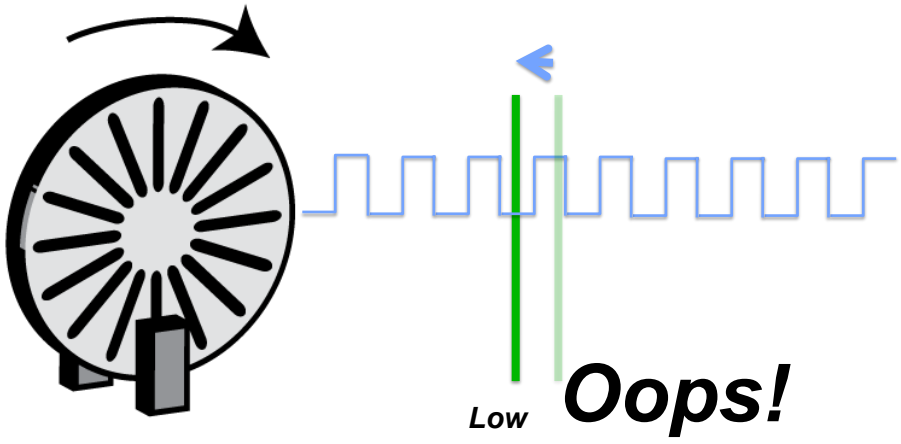
Sensing: Rotary Encoder



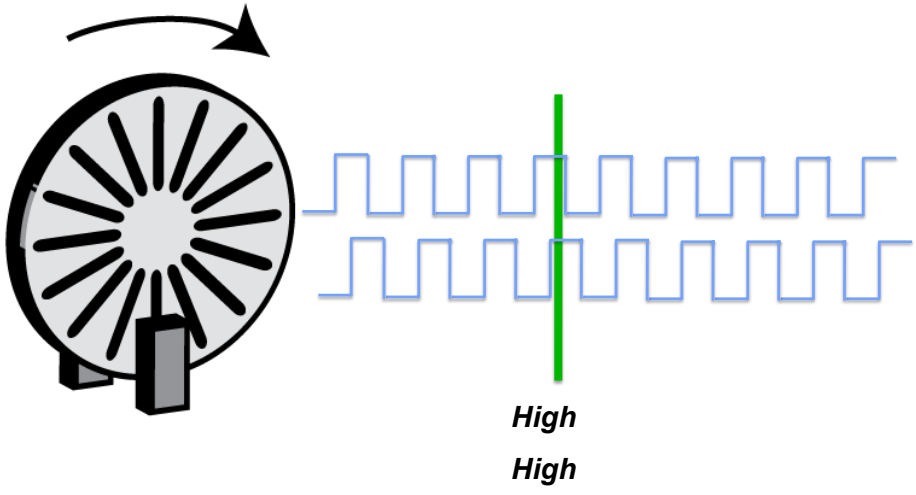
Sensing: Forward Rotation



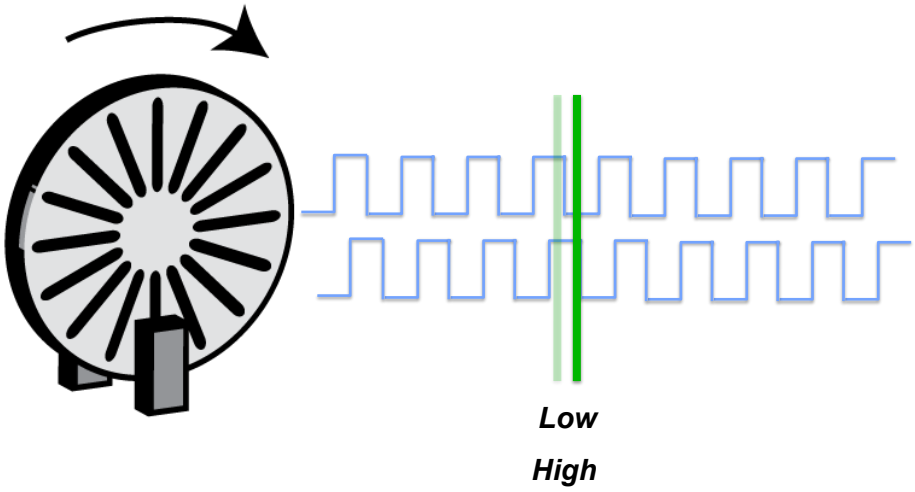
Sensing: Backward Rotation



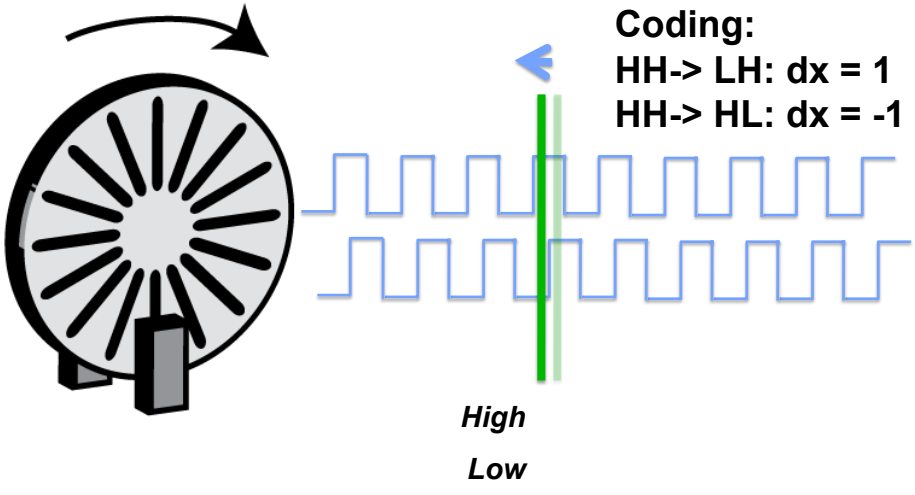
Solution: Use Two Detectors

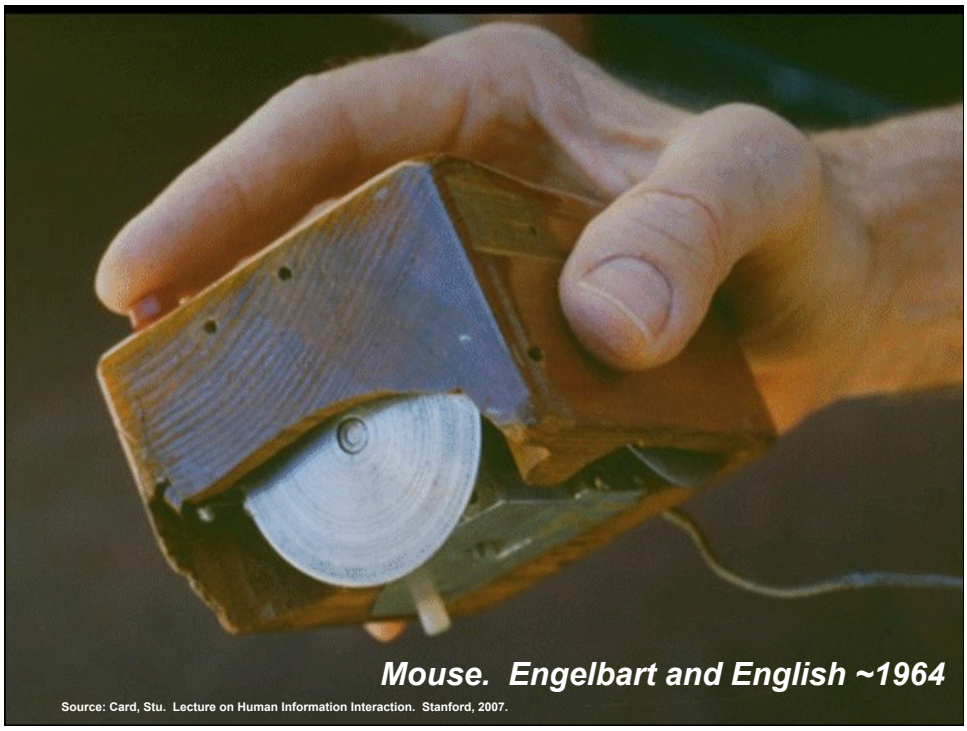


Sensing: Rotary Encoder

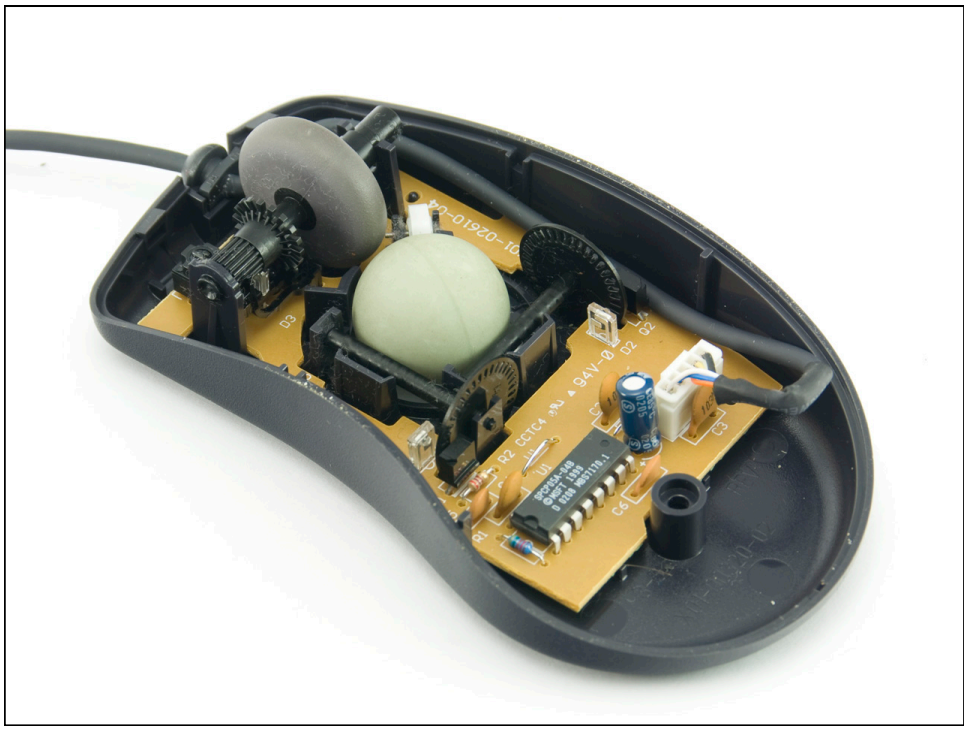


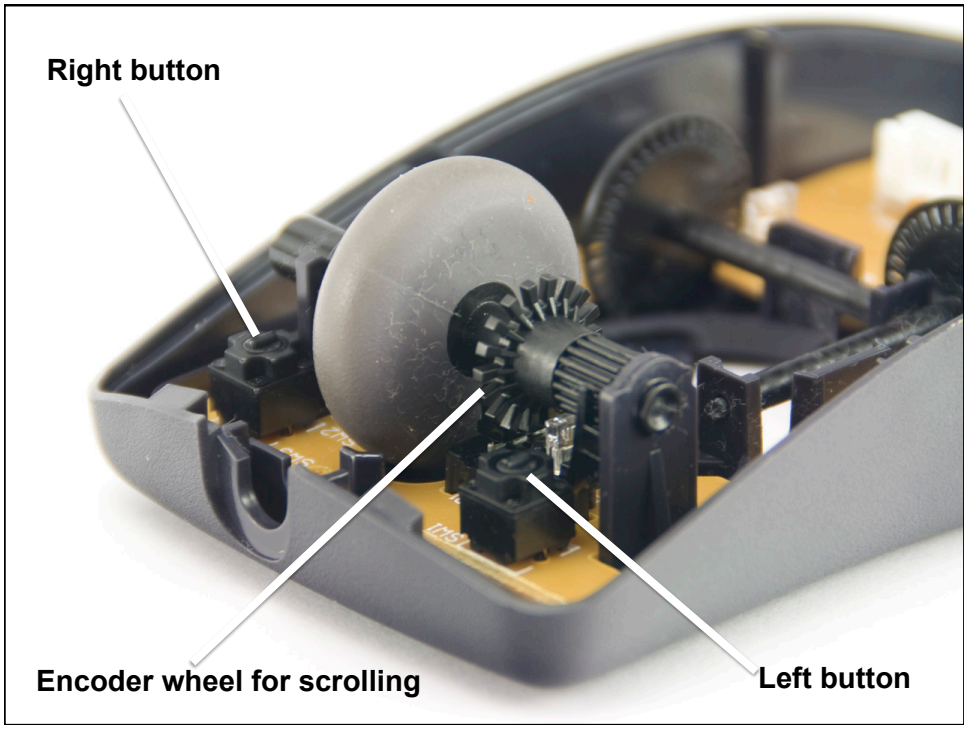
Sensing: Rotary Encoder

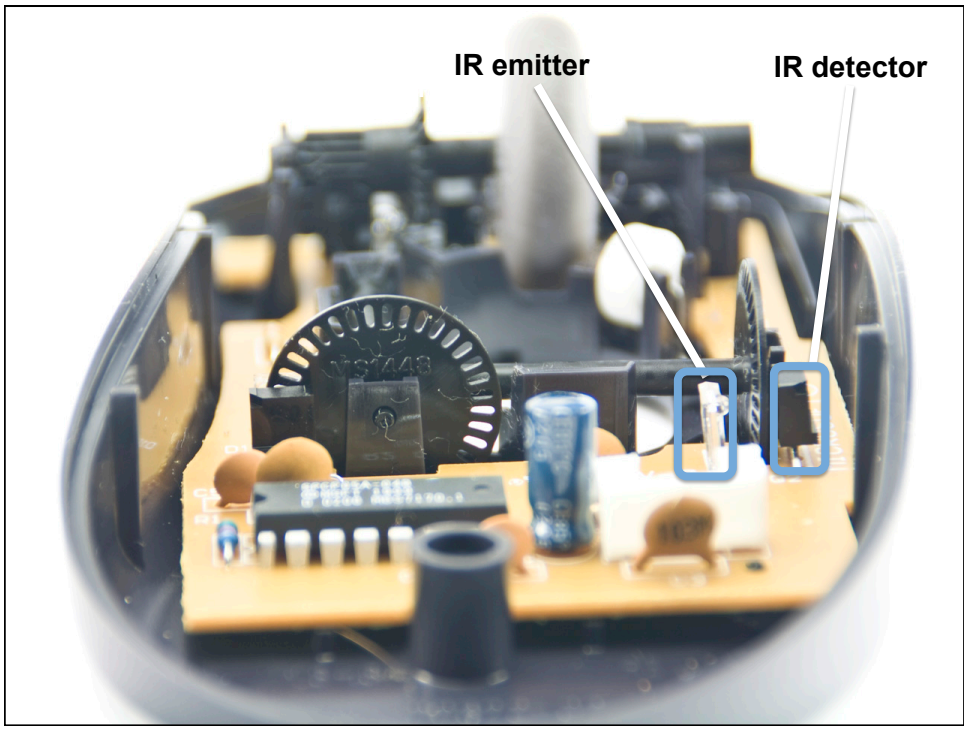



Mouse. Engelbart and English ~1964
Source: Card, Stu. Lecture on Human Information Interaction. Stanford, 2007.


DELL
by Microsoft




Right button
Encoder wheel for scrolling
Left button



Mouse Interface (PS/2)

Specifications

- Rate: 100 samples per second
- Resolution: 4 counts per mm

Encoding method

- Microcontroller tracks total movement between samples
- Sends x movement and y movement

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Y overflow	X overflow	Y sign bit	X sign bit	Always 1	Middle Btn	Right Btn	Left Btn
Byte 2	X Movement							
Byte 3	Y Movement							

Optical Mouse

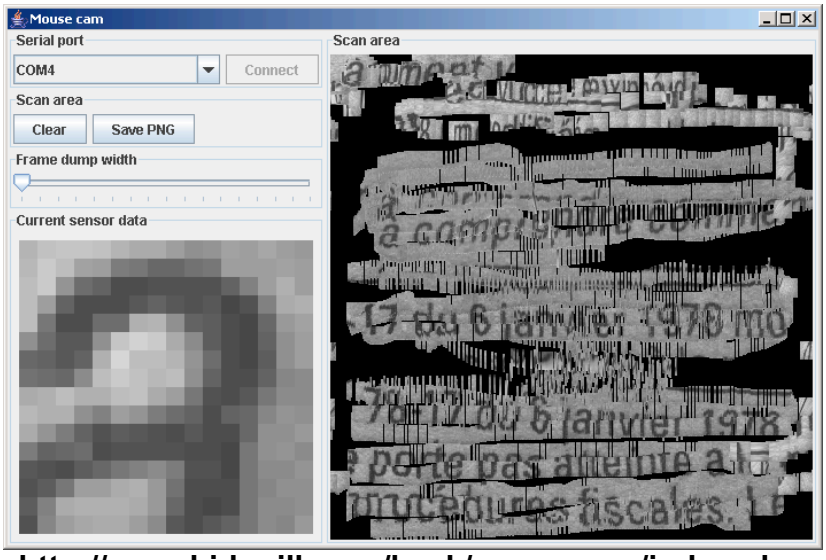
1st generation (Xerox)

- Led + photosensor over a grid of lines

2nd generation (Agilent)

- CMOS imager + DSP
  - 1500 frames per second
  - 16 x 16 pixel resolution
  - 300 counts per inch

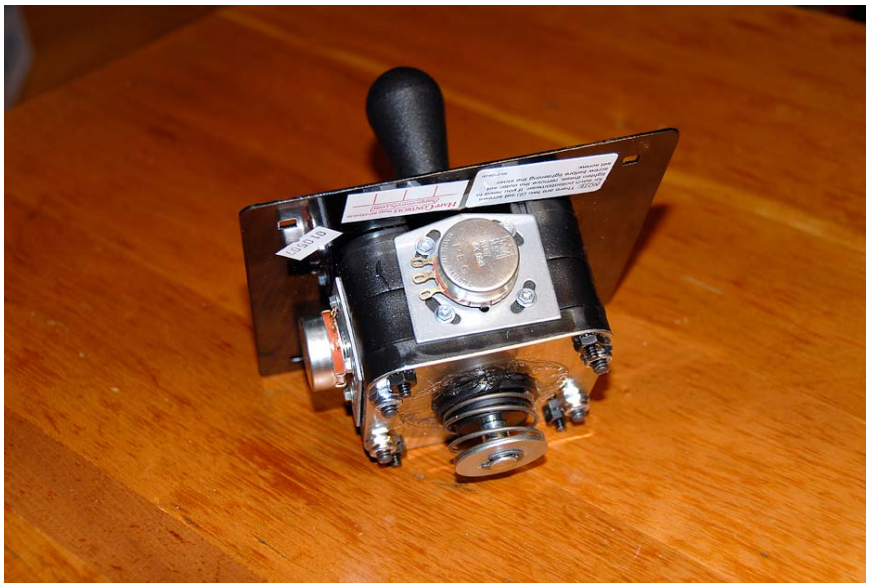
Mouse Cam



http://www.bidouille.org/hack/mousecam/index.php

Gamepads

Analog Joystick



Gamepads

SONY Playstation 3

Microsoft XBOX 360

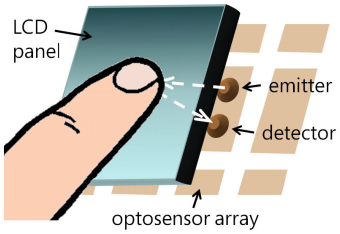
New Input Technologies

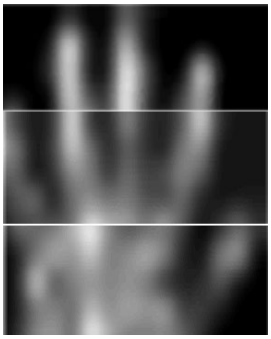
Nintendo Wii Controller

Sensors

- **Accelerameters**
- **IR sensor**

Thinsight





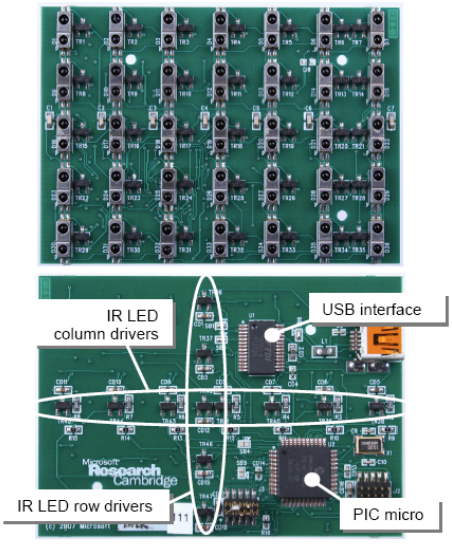
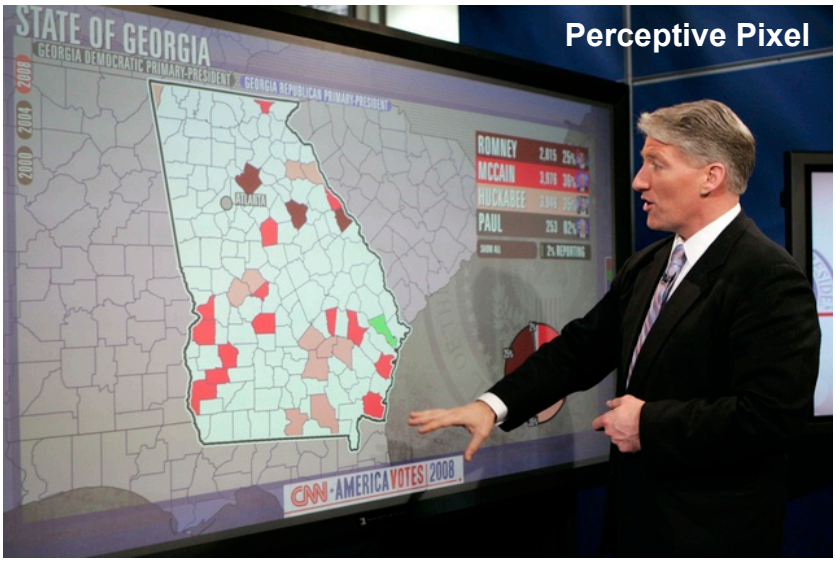


Figure 4: Top: the front side of the sensor PCB showing the 7x5 array of IR optosensors. The transistors that enable each detector are visible to the right of each optosensor. Bottom: the back of the sensor PCB has little more than a PIC microcontroller, a USB interface and the FETs that drive the rows and columns of IR emitting LEDs. Three such PCBs are used in our ThinSight prototype.

Multitouch Wall Displays



iPhone

Things to Remember

Keys and keyboards

- **Just switches**
- **Keys are not ASCII**
- **Keyboard event model**
- **D-pad and digital joysticks are just switches**

Position

- **Quadrature encoding**
- **Mechanical mice and trackballs**

Emerging devices: Wii, iPhone, Multitouch, …