Input Technology

Topics

Keys and Keyboards

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

Game controllers
Emerging input technologies
Keyboards
Row/Column Scanning

![Keyboard Matrix](image)

**Keyboard Matrix**

<table>
<thead>
<tr>
<th>16 X 8 IBM Keyboard Matrix (columns are marked 'a' to 'p' and rows are marked '1' to '8')</th>
</tr>
</thead>
<tbody>
<tr>
<td>a1 a2 a3 a4 a5 a6 a7 a8 a9 a10 a11 a12 a13 a14 a15 a16</td>
</tr>
<tr>
<td>b1 esc F4 G F5 H F6 &quot;</td>
</tr>
<tr>
<td>b2 L Shift Tab Cap Lock F3  T Bk Space Y { F7 #4 #5 #6</td>
</tr>
<tr>
<td>b3 L Ctrl ~ F1 F2 5 F9 6 = - F8 Del Ins Page Up Home</td>
</tr>
<tr>
<td>b4 1 2 3 4 F10 7 8 0 9 F11 F12 Page Down End Pmt Scrn</td>
</tr>
<tr>
<td>b5 Q W E R U I P O #7 #8 #9 # + Scroll Lock</td>
</tr>
<tr>
<td>b6 A S D F J K L #1 #2 #3 # Insert</td>
</tr>
<tr>
<td>b7 R Ctrl R Shift Z X C V Enter M , \ . Form Loc #/ # # Pause</td>
</tr>
<tr>
<td>b8 B Space N / Arrows Down Arrows Right Arrows Left R Alt</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Black: Modifier key</th>
<th>Pink: “Dead” key</th>
<th>White: Normal key</th>
</tr>
</thead>
<tbody>
<tr>
<td>$</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>↑</td>
<td>q</td>
<td>w</td>
</tr>
<tr>
<td>◎</td>
<td>a</td>
<td>s</td>
</tr>
<tr>
<td>◎</td>
<td>‘</td>
<td>z</td>
</tr>
</tbody>
</table>

### GLUT Keyboard Interface

**ASCI keys**

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

**Non-ASCI keys (F1, ..., F12, INSERT, ...)**

```c
int glutSpecialKeyFunc(func) // onDown
int 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
Sensing: Rotary Encoder

Sensing: Forward Rotation
Sensing: Backward Rotation

Oops!

Solution: Use Two Detectors

High

High
Sensing: Rotary Encoder

Coding:
- HH→ LH: $dx = 1$
- HH→ HL: $dx = -1$

Low
High

Sensing: Rotary Encoder

Low
High

High
Low
Mouse. Engelbart and English ~1964

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
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 opitposensors. The transistors that enable each detector are visible to the right of each opitposensor. 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

Perceptive Pixel

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, …