Input Technology

http://wiki.arcadecontrols.com/wiki/Main_Page

Topics

Keys and keyboards

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

Gamepads
Keyboards

Reverse Engineering a Keyboard

http://pupp.edgeemu.com/kbhack.htm
Matrix

http://pupp.edgeemu.com/kbhack.htm

Keyboard Matrix

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

<table>
<thead>
<tr>
<th>a1</th>
<th>a2</th>
<th>a3</th>
<th>a4</th>
<th>a5</th>
<th>a6</th>
<th>a7</th>
<th>a8</th>
<th>a9</th>
<th>a10</th>
<th>a11</th>
<th>a12</th>
<th>a13</th>
<th>a14</th>
<th>a15</th>
<th>a16</th>
</tr>
</thead>
<tbody>
<tr>
<td>b1</td>
<td>exc</td>
<td>F4</td>
<td>G</td>
<td>F5</td>
<td>H</td>
<td>F6</td>
<td>'</td>
<td>#0</td>
<td>#</td>
<td>Arrow up</td>
<td>L Alt</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b2</td>
<td>L Shift</td>
<td>Tab</td>
<td>Cap Lock</td>
<td>F3</td>
<td>T</td>
<td>Bk Space</td>
<td>Y</td>
<td>F7</td>
<td>#4</td>
<td>#5</td>
<td>#6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b3</td>
<td>L Ctrl</td>
<td>~</td>
<td>F1</td>
<td>F2</td>
<td>F9</td>
<td>6 =</td>
<td>-</td>
<td>F8</td>
<td>Del</td>
<td>Ins</td>
<td>Page Up</td>
<td>Home</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b4</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>F10</td>
<td>7</td>
<td>8</td>
<td>0</td>
<td>9</td>
<td>F11</td>
<td>F12</td>
<td>Page Down</td>
<td>End</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b5</td>
<td>Q</td>
<td>W</td>
<td>E</td>
<td>R</td>
<td>U</td>
<td>I</td>
<td>P</td>
<td>O</td>
<td>#7</td>
<td>#8</td>
<td>#9</td>
<td>+</td>
<td>Pmt Scn</td>
<td>Scrl Lock</td>
<td></td>
</tr>
<tr>
<td>b6</td>
<td>A</td>
<td>S</td>
<td>D</td>
<td>F</td>
<td>\</td>
<td>J</td>
<td>K</td>
<td>;</td>
<td>L</td>
<td>#1</td>
<td>#2</td>
<td>#3</td>
<td>#Enter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b7</td>
<td>R Shift</td>
<td>Z</td>
<td>X</td>
<td>C</td>
<td>V</td>
<td>Enter</td>
<td>M</td>
<td>,</td>
<td>.</td>
<td>#num Loc</td>
<td>#/</td>
<td>#*</td>
<td>Pause</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b8</td>
<td>R Ctrl</td>
<td>Space</td>
<td>B</td>
<td>Space</td>
<td>N</td>
<td>/</td>
<td>Arrow Down</td>
<td>Arrow Right</td>
<td>Arrow Left</td>
<td>R Alt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></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, ...
## Typical Keyboard Interface (Flash)

**Key class**
- `addListener(proc)` - call `onUp` and `onDown`
- `getAscii()` - return ascii for the last key pressed
- `getCode()` - return virtual key code for the last key
- `isDown(key)` - return state of given key
- `isToggled(key)` - return state of NumLock/CapsLock

**Note difference between**
- state (Up, Down) vs transition (onDown, onUp)

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### Position
4-way and 8-way Joystick

D-pad

Famicom Controller (1983)
Quadrature Encoder

Gray Code

0 0
1 0
1 1
0 1
Trackball

Douglas Engelbart Mouse (1964)
Mechanical Mouse

http://computer.howstuffworks.com/mouse2.htm

Mouse Interface (PS/2)

Encoding method (microcontroller sums movement)

<table>
<thead>
<tr>
<th>Bit 7</th>
<th>Bit 6</th>
<th>Bit 5</th>
<th>Bit 4</th>
<th>Bit 3</th>
<th>Bit 2</th>
<th>Bit 1</th>
<th>Bit 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y overflow</td>
<td>X overflow</td>
<td>Y sign bit</td>
<td>X sign bit</td>
<td>Always 1</td>
<td>Middle Btn</td>
<td>Right Btn</td>
<td>Left Btn</td>
</tr>
</tbody>
</table>

| Byte 2 | | | | | | | |
| X Movement |

| Byte 3 | | | | | | | |
| Y Movement |

Specifications

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

http://www.computer-engineering.org/ps2mouse/
Optical Mouse

1st generation (Xerox)
   LED + photosensor over grid of lines

2nd generation (Agilent)
   CMOS imager + dsp
   - 1500 frames per second
   - 16x16 pixel resolution
   - 300 count per inch (cpi)

Analog Joystick
**Anoto Pen**

http://www.tomshardware.co.uk/2005/12/19/pentop_computing_is_more_than_a_kidsuk/page2.html

**Gamepads**

SONY Playstation 3

XBOX 360
Wii Controller

Sensors
3 dof translation
3 dof rotation
pointing