Input Technology

Topics

Keys and Keyboards

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

Game controllers
Keyboards

Reverse Engineering a Keyboard

http://pupp.edgeemu.com/kbhack.com
2D Array of Switches

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

Keyboard Matrix

<p>| 16 x 8 IBM Keyboard Matrix (columns are marked 'a' to 'h' and rows are marked '1' to '8') |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|</p>
<table>
<thead>
<tr>
<th>a1</th>
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CS148 Lecture 5  Pat Hanrahan, Winter 2009
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, ...
**Keyboard Finite State Machine**

- **Black**: Modifier key
- **White**: Normal key
- **Pink**: "Dead" key

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**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)

Encoder - Relative Angular Pos/Velocity
Quadrature Encoder
Trackball

Exploded View of the HAP Trackball
Douglas Engelbart Mouse (1964)

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

Mechanical Mouse

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

<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>

<table>
<thead>
<tr>
<th>Byte 2</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>X Movement</td>
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</table>

<table>
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<tr>
<th>Byte 3</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Y Movement</td>
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</tbody>
</table>

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
Analog Joystick

Gamepads

SONY Playstation 3

Microsoft XBOX 360
Nintendo Wii Controller

Sensors
Accelerameters
IR sensor

iPhone
Multitouch

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, …