CS148: Introduction to Computer Graphics and Imaging

Input Technology

Topics

Keys and Keyboards

Pointing

- D-pad and digital joystick
- Trackball
- Mechanical and optical mice
- Analog joystick

Game controllers

Multitouch

Emerging input technologies
Keyboards
Row/Column Scanning

Keyboard Matrix (16 x 8)

Standard PS/2 keyboard has 104 keys
Scan Codes

Make (onPress) and Break (onRelease) codes

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

Keys & Characters are Not the Same

Special keys - interpreted by the OS or App
- F1, ..., F12
- Insert, Delete, Home, ...

Duplicated keys
- Numbers on keypad vs. keyboard
- Left-shift, Right-shift, Left-cmd, Right-cmd, ...
Keys & Characters are Not the Same

Modifier keys
- [SHIFT] [CTRL] [ALT/OPTION] [CMD] [FN]
- May be combined [CTRL]-[ALT]-A

Example: [Option] on Mac

Keyboard Finite-State Machine

[Option]-A = ⌼

[Option]-A a = ā

[NUMLOCK] and [CAPSLOCK] are also stateful
GLUT Keyboard Interface

ASCII keys
    glutKeyboardFunc(func) // onDown
    glutKeyboardUpFunc(func) // onUp
        func(unsigned char key, int mousex, int mousey);
Non-ASCII 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!

\[ \begin{array}{c} 05 \ 04 \ 03 \ 02 \ 01 \\ 09 \ 08 \ 07 \ 06 \end{array} \]

<table>
<thead>
<tr>
<th>pin #</th>
<th>...</th>
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<tbody>
<tr>
<td>1</td>
<td>Up</td>
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<tr>
<td>2</td>
<td>Down</td>
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<tr>
<td>3</td>
<td>Left</td>
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<tr>
<td>4</td>
<td>Right</td>
</tr>
<tr>
<td>5</td>
<td>unused</td>
</tr>
<tr>
<td>6</td>
<td>Button</td>
</tr>
<tr>
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</tr>
<tr>
<td>8</td>
<td>Ground</td>
</tr>
<tr>
<td>9</td>
<td>unused</td>
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**4-way Joystick (Just 4 switches)**
Demo

Trackball and Mouse use Rotary Encoders
Trackball

Sensing: Rotary Encoder
Sensing: Forward Rotation

Sensing: Backward Rotation

CS148 Lecture 5
Pat Hanrahan, Fall 2010
Solution: Use Two Detectors

Sensing: Rotary Encoder
Sensing: Rotary Encoder

Coding:
HH -> LH: dx = 1
HH -> HL: dx = -1

High
Low

Mouse. Engelbart and English ~1964
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

Multitouch
Capacitive Sensing - Button

Self-Capacitance

Capacitive button

Whirlpool Microwave Oven
Invented by B. Stumpe at CERN 1972

Mutual Capacitive Sensing

Pat Hanrahan, Fall 2010
Mutual Capacitive Sensing

Scan x and y to sense multiple points at once (ITO = Indium Tin Oxide = transparent conductor)

Multitouch Wall Displays

Perceptive Pixel
Microsoft Surface

New Input Technologies
iPhone Sensors

Camera(s)
Microphone
Touchscreen
Accelerometer
Proximity
Ambient light
GPS
Compass

Nintendo Wii Controller

Sensors
Accelerometers
IR sensor
Microsoft Kinect

Sensors
- Camera
- Depth camera (Z)
- Multi-Array Mic.

Things to Remember

Keys and keyboards
- Keys are not characters
- Keyboard event model
- D-pad and digital joysticks are just switches

Position
- Quadrature encoding
- Mechanical mice and trackballs
- Replaced with optical mice

Emerging devices
- Multitouch: iPhone, ...
- Many sensors: Wii, iPhone, ...