Sensors in 3D UI

7/12/2011
The Wiimote Device

• Wiimote features
  – Uses Bluetooth for communication
  – Senses acceleration along 3 axes
  – Optical sensor for pointing (uses sensor bar)
  – Provides audio and rumble feedback
  – Standard buttons and trigger
  – Uses 2 AA Batteries

• Supports 2-handed interaction
Degrees of Freedom

• Degrees of Freedom (Mechanics)
  – The set of independent translations and/or rotations that specify completely any change in position or orientation of a body.

• A rigid body that moves in 3-D space has 3 translational components as DOF’s and 3 rotational components as DOF’s = 6 DOF.
  – For example, a plane has roll, pitch, and yaw as well as X, Y, Z
  – Whereas, a car only has translation on one plane, 2 DOF, and rotation along one axis to face any heading – 1 DOF = 3 DOF.
Wiimote – Motion Data

• Data from 3-axis accelerometer
  – Senses instantaneous acceleration on device (ie force) along each axis.
  – Units (+/- 3g)
  – Always sensing gravity
    • At rest acceleration is g (upward)
    • Freefall acceleration is 0
  – Finding position and orientation
    • At rest – roll and pitch can be calculated easily
    • Cannot calculate yaw because there is no change in gravitational force.
    • In motion – math gets more complex
    • Error accumulation causes problems
    • Often not needed – gestures sufficient
  – Advantages
    • Easily detect course motions
    • Mimic many natural actions
  – Disadvantages
    • Ambiguity issues
    • Player cheating
    • Not precise (Not a 6 DOF tracker)
WiiMote Accelerometer
Wiimote – Optical Data

• Data from optical sensor
  – Uses sensor bar
    • 10 LED lights (5 on each side), accurate up to 5 meters
    • Triangulate to determine depth
      – Distance between two points on image sensor (variable)
      – Distance between LEDs on sensor bar (Fixed)
    • Roll (with respect to ground) angle can be calculated from angle of two image sensor points.
  – Advantages
    • Provides a pointing tool
    • Gives approximate depth
  – Disadvantages
    • Line of sight, infrared light problems
    • Only constrained rotation understanding.
Wii Motion Plus

• Multi-axis gyroscope
  – Provides information on changes to the Wiimote’s orientation.
  – Combined with the accelerometer and sensor bar, allows more comprehensive tracking of a user’s arm position and orientation – giving 6 DOF.
iPhone accelerometer
Kinect

• Camera tech has been around for about 15 years
  – available at huge expense up until very recently.
• It’s made of two main parts:
• A projector
  – That bounces out a laser across the entire field of play
• And IR VGA camera.
  – The camera picks up the laser feedback to separate you from your sofa on what’s called a ‘depth field.’
  – It’s essentially all the pixels that Kinect gets back as IR noise measured in varying color dependant on how close they are to the system.
  – That way bodies appear a bright shade of red, green etc, and things further away appear grey.
Kinect

– The software takes this image and runs it through filters so that Kinect can work out what’s a person and what’s not.

– The system follows a basic system of guidelines
  • such as ‘a body is from x-foot tall to x-foot tall’ and ‘a person has two arms and two legs’ to work out that your coffee table or dog aren’t extra players.
  • It’s also taught to be able to pick you out if you’re wearing baggy clothes or have hair coming over your shoulders.
  • Sorts out body parts.
  • Once that’s sorted, it converts body part identification into a skeleton with moving joints.
  • Kinect is preloaded with 200 common poses