Today’s Lecture

- Gesture-Based Interactions
  - Video
  - Major Concepts
- Paper Prototyping
  - Brief Discussion
- Almost Done
  - 3 Lectures to Go

Reminders
- Blog Post (Week)
- Project 3
- Final Project
- Paper Proto Sum
CIFS – Course Feedback

☐ Reminder

- It’s open
- Don’t let your grades be held up
- As of Wednesday (0/20) responses
Paper Prototyping

☑ Discussion

- Was it helpful?
- Should we have done it earlier?
  - On this project – before break?
  - On Project 2?
- How did the folks observing, computing, facilitating feel?
Video – Smart Phone

http://www.firstelse.com
Gestures

- Definition
  - Expressive, meaningful body motions
  - Involve
    - Fingers
    - Hands
    - Arms
    - Head
    - Face
    - Body
  - Goals
    - Convey meaningful information
    - Interact with environment
Gestures vs. Hashing

- Many to one mapping
  - Pigeonhole principle
- What does that mean?
  - Ambiguity
  - Incomplete specification
- Hence
  - Statistics
    - Hidden Markov Chains
  - Soft Computing
    - Data Mining / Heuristics -> Best Guess
Gesture Detection

- 2-D -> Fail
  - Virtual Environment -> 3D+

- Better
  - Fine-grained sensing
    - Gloves
    - Cameras
    - Skin Sensing
Gesture Types

- Overall
  - Static vs. Dynamic
  - Temporal Meaning
  - Context
  - Language / Culture

- Broad Types
  - Hand / Arm
  - Head / Face
  - Body
Gesture Decomposition

☐ Spatial
  ■ Where it occurred

☐ Pathic
  ■ What path it takes

☐ Symbolic
  ■ The sign it makes

☐ Affective
  ■ Emotional connotations
Example

- Facial gesture
  - Facial landmarks for features
  - Posed vs. spontaneous
  - Intensity
  - Subtle cues
    - Hands, Muscles, Pupil Dilation

- Key: Across Gestures
  - How you sense it
Sensing

- Dimensions
  - Accuracy
  - Resolution
  - Latency
  - Range of Motion
  - User Comfort
  - Cost
Discussion

☐ Vision
  ■ Occlusion

☐ Tracking
  ■ General type of motion
  ■ Texture / color
Tools – Gesture Recognition

- Many, many different approaches
  - PCA – Principle Component Analysis
  - HMM – Hidden Markov Model
  - Kalman Filtering
  - FSM – Finite State Machine
HMM – Hidden Markov Model

- Markov Property
  - Conditional probability density (given all present / past), depends on jth most recent event
  - Most recent event – first order Markov process

- Quick / fast summary
  - Finite state machine with probabilistic transitions

Hidden -> Just observe vs. know all states
HMM

- Generalized
  - Ergodic -> Any state to any state

- Gestures
  - Use time -> left to right

- Practice
  - Learning / observation → Classifier
  - Classifier helps w/boundaries

- Components
  - Evaluation
  - Training / estimation
  - Decoding
Particle Filtering / Condensation Maps

☐ Non-Linear, Non-Gaussian Systems
  ■ Remember your stat?

☐ What is it?
  ■ Lots of samples
  ■ Model via probability densities
  ■ Bayes-like reasoning
Hand / Arm Gestures

- **Gesticulation**
  - Spontaneous movement of hands / arms
  - 90% of gestures
  - Even the blind gesticulate

- **Language-like gestures**
  - Replace words / phrases

- **Pantomimes**
  - Depict objects / actions

- **Emblems**
  - V for victory, other gestures

- **Sign language**
  - Well-defined linguistics
Detection - Hand

- Gesture spotting
  - Segmentation ambiguity
    - When did it start?
  - Spatio-temporal variability
    - Was the whole thing one or were there gesticulations in the middle?
Face / Head Gestures

- Face detection
  - Very little effort
  - What goes into it?
    - Viewing conditions
    - Facial expression
    - Aging
    - Gender
    - Occlusion
    - Distractions – Glasses, Hair, Disguise
Uncanny Valley

http://www.youtube.com/watch?v=CNdAlPoh8a4
Uncanny Valley – Part 2

See website for link
Detection

- Major Markers
  - Eyes / Irises
  - Nose
  - Eyebrows
  - Mouth
  - Ears

- Many, many, many approaches
Tinker w/Recognition

- Ink Canvas – WPF
  - Strokes
    - Set of geometries
  - Weaknesses
    - Does not have rate, only position

- Example App
  - WPF Word Find -> Example Code

- Word Recognition
  - Use built-in tools via .NET
Questions?

- Weekly Blog
- Project 3
- Paper Prototype
- Final Project