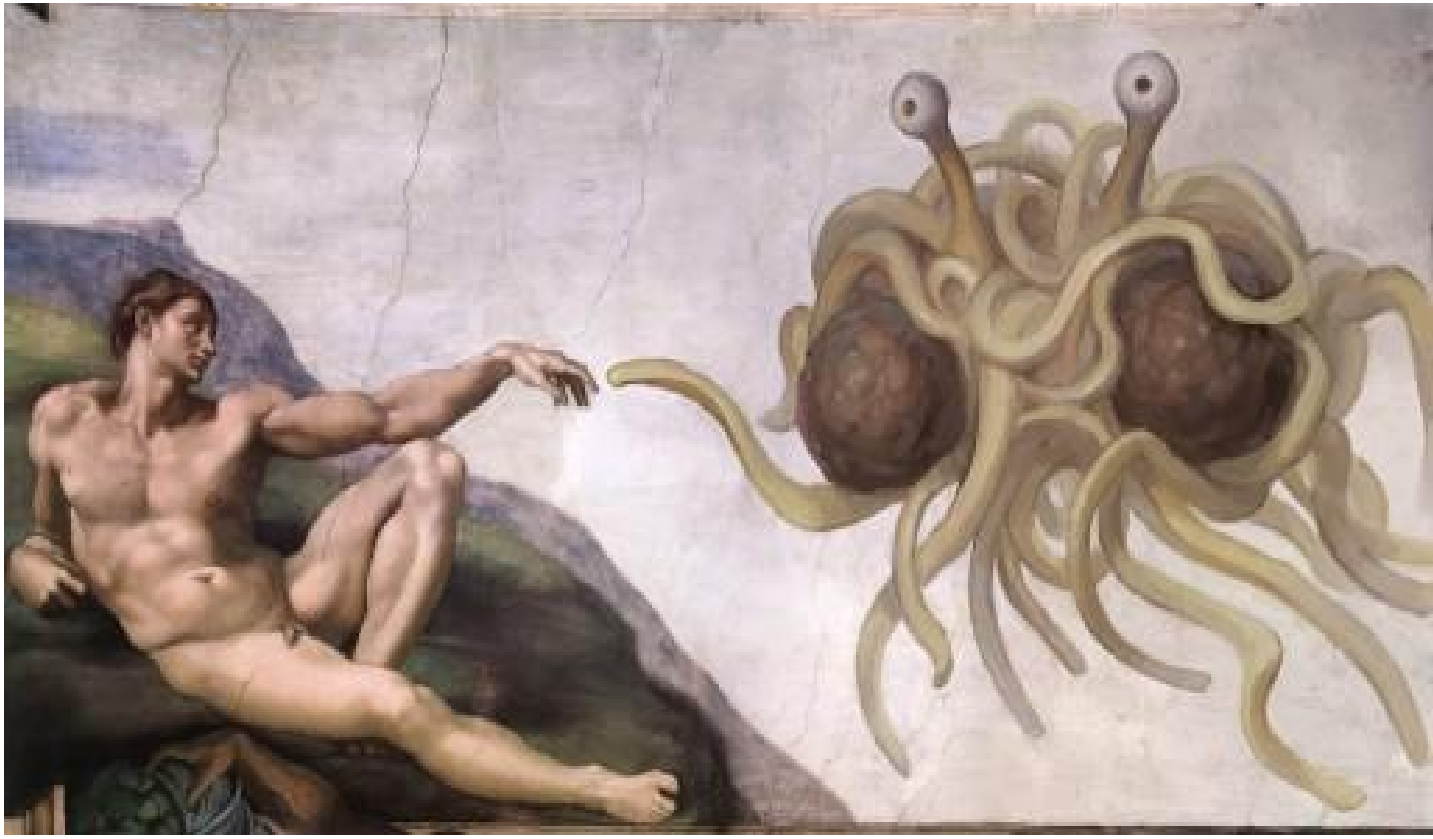
Multimodal Interfaces

lecture 03: Gestural Interfaces



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++ definitions

“A gesture is a motion of the body the contains information. Waving goodbye is a gesture. Pressing a key on a keyboard is not a gesture because the motion of a finger on it’s way to hitting a key is neither observed nor significant. All that matters is which key was pressed”. (Kurtenbach and Hulteen, 1990)

Gesture: motion

Posture: static

Perform *recognition* of something that moves, leaving a "trajectory" in space and time.

++ natural gestures

body language
unintentional & subconscious body gestures
http://www.youtube.com/watch?v=6P5SshxJZz4

hand gesticulation
e.g. italian hand gestures
http://www.youtube.com/watch?v=jVCuyrPk7P4

sign language
full language vocabulary and grammar for hearing disabled
http://www.youtube.com/watch?v=BAB4n84F1og

imitation
Conductor: http://www.youtube.com/watch?v=FqRFa2R7zgA

OR: gorilla arm
minority report: http://www.youtube.com/watch?v=NwVBzx0LMNQ
underkoffler: http://oblong.com/

++ application examples

accessibility
sign language recognition
http://www.youtube.com/watch?v=KQotk5nWU2Y

human computer interaction
text input: hand writing recognition
http://www.youtube.com/watch?v=j1ZT7i1fZkQ

stage interaction (dance & theatre)
usually body motion tracking
http://www.youtube.com/watch?v=xiRQss_TiN4

musical control
usually hand motion tracking
http://vimeo.com/10907372

++ gesture types: body parts

drawing gesture
finger/touch, stylus, mouse

hand gesture
symbols (communication), movements (control), pointing (action)
Gmail: http://www.youtube.com/watch?v=Bu927_ul_X0
Faast: http://www.youtube.com/watch?v=Lfso7_i9Ko8

body gesture
skeleton movements: head, limbs, joints
http://www.youtube.com/watch?v=tAGnSrdOfyA
http://vimeo.com/22982344

facial gesture
eyes, mouth, ears(?), head movement
Opera: http://www.youtube.com/watch?v=kkNxbyp6thM

++ gesture types: Cadoz (1994)

Semiotic

Gestures used to communicate meaningful information

Ergotic

Gestures used to manipulate the physical world and create artifacts

Epistemic

Gestures used to learn from the environment through tactile or haptic exploration

++ gesture types: Rime & Schiaratura (1991)

symbolic gestures

gestures that, within each culture, have come to have a single meaning. An Emblem such as the “OK” gesture is one such example, however American Sign Language gestures also fall into this category.

deictic gestures

These gestures most generally seen in HCI and are the gestures of pointing, or otherwise directing the listeners attention to specific events or objects in the environment. Example: when someone says “Put that there”.

iconic gestures

As the name suggests, these gestures are used to convey information about the size, shape or orientation of the object of discourse. They are the gestures made when someone says “The plane flew like this”, while moving their hand through the air like the flight path of the aircraft.

pantomimic gestures

These are the gestures typically used in showing the use of movement of some invisible tool or object in the speaker’s hand. When a speaker says “I turned the steering wheel hard to the left”, while mimicking the action of turning a wheel with both hands, they are making a pantomimic gesture.

++ Kendon's gesture continuum

Gesticulation
spontaneous movements of hands and arms that accompany speech

Language-like gestures
gesticulation integrated into spoken utterance, replacing particular spoken word or phrase

Pantomimes
gestures that depict objects or actions, with or without accompanying speech

Emblems
familiar gestures such as "V for victory", "thumbs up", and assorted rude gestures (these are often culturally specific)

Sign languages
Linguistic systems, such as American Sign Language, which are well defined.

++ Meaning of Gestures, Hummels & Stappers

Spatial information
Where a gesture occurs, locations a gesture refers to

Pathic information
The path which a gesture takes

Symbolic information
The sign that a gesture draws

Affective information
The emotional quality of a gesture

++ Gesture Recognition

Data acquisition

Sensor data from body positions and movements
(coordinates,angles,velocities, ...)

Feature extraction

Data analysis and processing
Relevant data representation within multi-dimensional feature vectors

Gesture classification

Comparing acquired feature vector with gesture data base
Retrieving matching (most probable) results

Action/Event

Execute associated action according to the recognized gesture
Pass relevant gesture attributes to application layer

++ data acquisition

+ computer vision

RGB cameras (e.g. wearing colored gloves)

infrared tracking (e.g. wearing active or reflective IR markers)

Stereo or depth cameras: Zcam, Kinect

air guitar: http://www.youtube.com/watch?v=0Xj462GY3Ww

+ motion tracking devices

head tracker, motion tracker (flock of bird)

game controllers: wiimote

smart phones (with built in accelerometers, gyroscopes, compass)

Wiigee: http://vimeo.com/4615950

+ wearable tracking devices

data gloves, body suits, exoskeletons

Measuring muscular activity

suguru goto: http://vimeo.com/12157028

++ gesture classification

+ pattern matching

simple: calculate error by comparing bitmaps

more advanced: compare stroke path

other: dynamic time warping (DTW)

Example: 1$ gesture recognizer

- Resample (reduce no. of samples, interpolate)
- Rotate (initial point around centroid)
- Scale & Translate (normalize)
- Calculate Gesture-Template distance (all points)

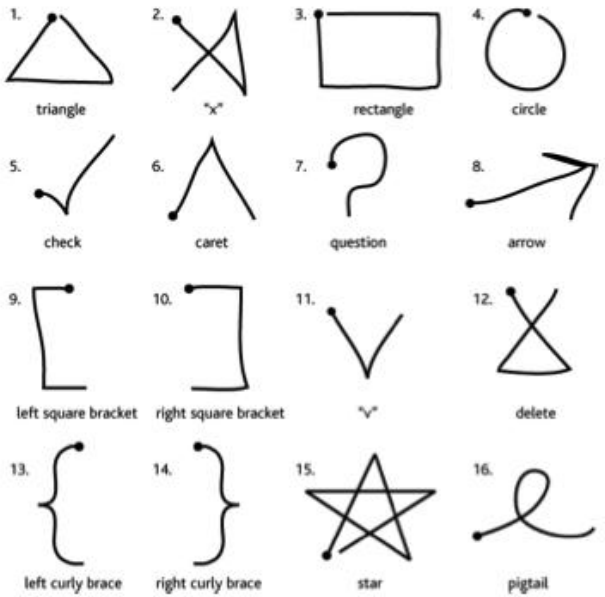
+ machine learning

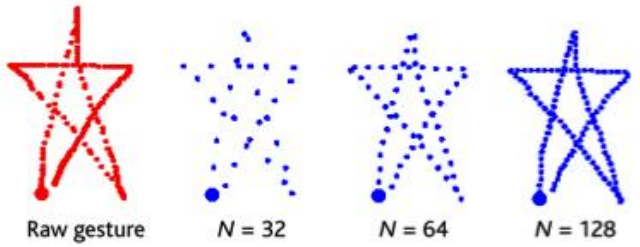
HMM: Hidden Markov Models (stochasic model)

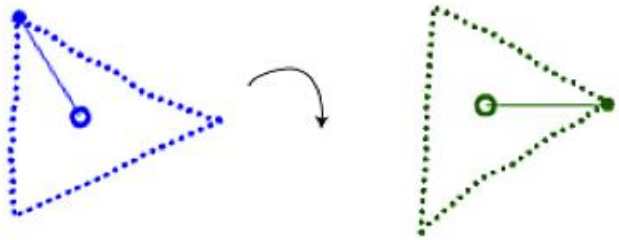
Neural Networks (artificial intelligence)

++ graffiti/unistroke

++ 1$ gesture recognizer (*Wobbrock et. al.)*







$$d_i = \frac{\sum_{k=1}^{N} \sqrt{\left(C[k]_x - T_i[k]_x\right)^2 + \left(C[k]_y - T_i[k]_y\right)^2}}{N} \qquad (1)$$

$$score = 1 - \frac{d_i^*}{\frac{1}{2}\sqrt{size^2 + size^2}} \qquad (2)$$

++ gesture recognition toolkits

+ Wiigee

Wiimote gesture recognition engine

http://www.wiigee.org/

+ FAAST

Kinect (OpenNI) gesture recognition engine

http://projects.ict.usc.edu/mxr/faast/

+ 1$ Unistroke Recognizer

http://depts.washington.edu/aimgroup/proj/dollar/

+ Others

GART: https://wiki.cc.gatech.edu/ccg/projects/gt2k/gt2k
https://code.google.com/p/gesture-recognition-processing/

HandVU: http://www.movesinstitute.org/~kolsch/HandVu/HandVu.html

iGesture: http://www.igesture.org/

Midas: http://soft.vub.ac.be/~lhoste/dokuwiki/doku.php/research/midas

++ Kinect Hacking

+ OpenKinect

Open Source Community drivers: http://openkinect.org/
Source: https://github.com/OpenKinect/libfreenect/
Open Frameworks: https://github.com/ofTheo/ofxKinect
Processing: http://www.shiffman.net/p5/kinect/
MaxMSP: https://github.com/jmpelletier/jit.freenect.grab

+ OpenNI

Official PrimeSense drivers and middleware: http://www.openni.org/
Drivers:
http://www.openni.org/downloadfiles/openni-binaries/20-latest-unstable
Middleware:
http://www.openni.org/downloadfiles/openni-compliant-middleware-binaries/33-latest-uns
Hardware:
http://www.openni.org/downloadfiles/openni-compliant-hardware-binaries/31-latest-unsta

+ Examples

TuioKinect: https://code.google.com/p/tuiokinect/
OpenNI2TUIO: http://www.patriciogonzalezvivo.com/blog/?p=289
KinectTouch: https://github.com/robbeofficial/KinectTouch
Therenect: https://code.google.com/p/therenect/