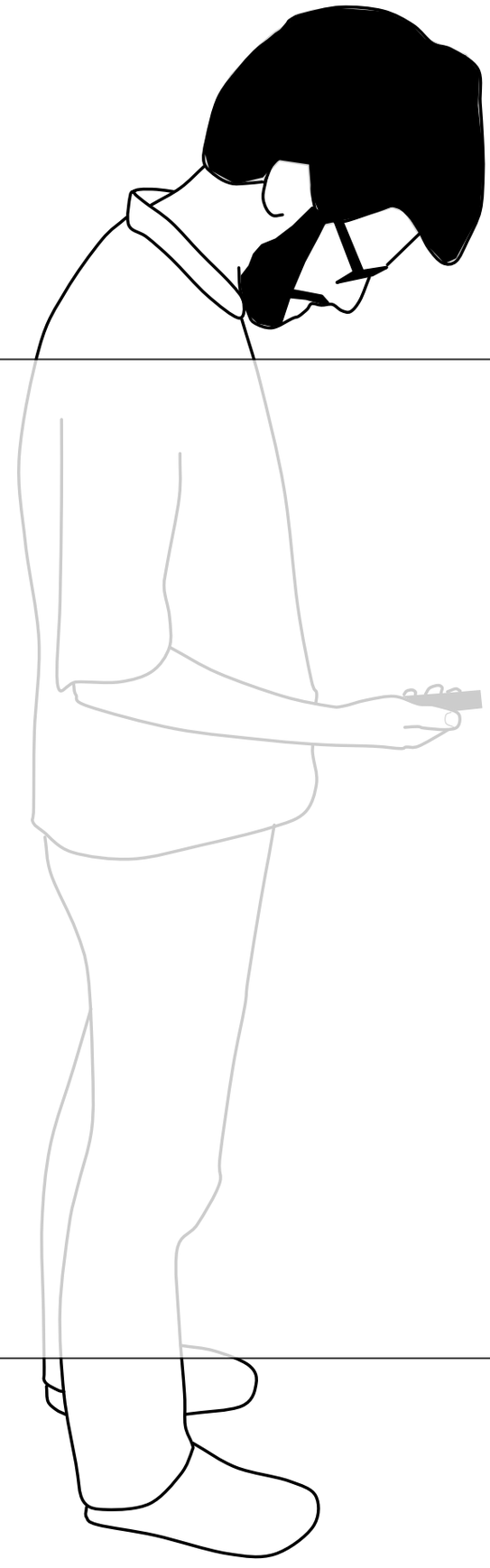
Reminder Ted's talk

- Ted Selker
  - "what is a human computer input sensor?"
- 2.15 pm, BU101 Öttingenstrasse 67

Mobile Technologies



context and task

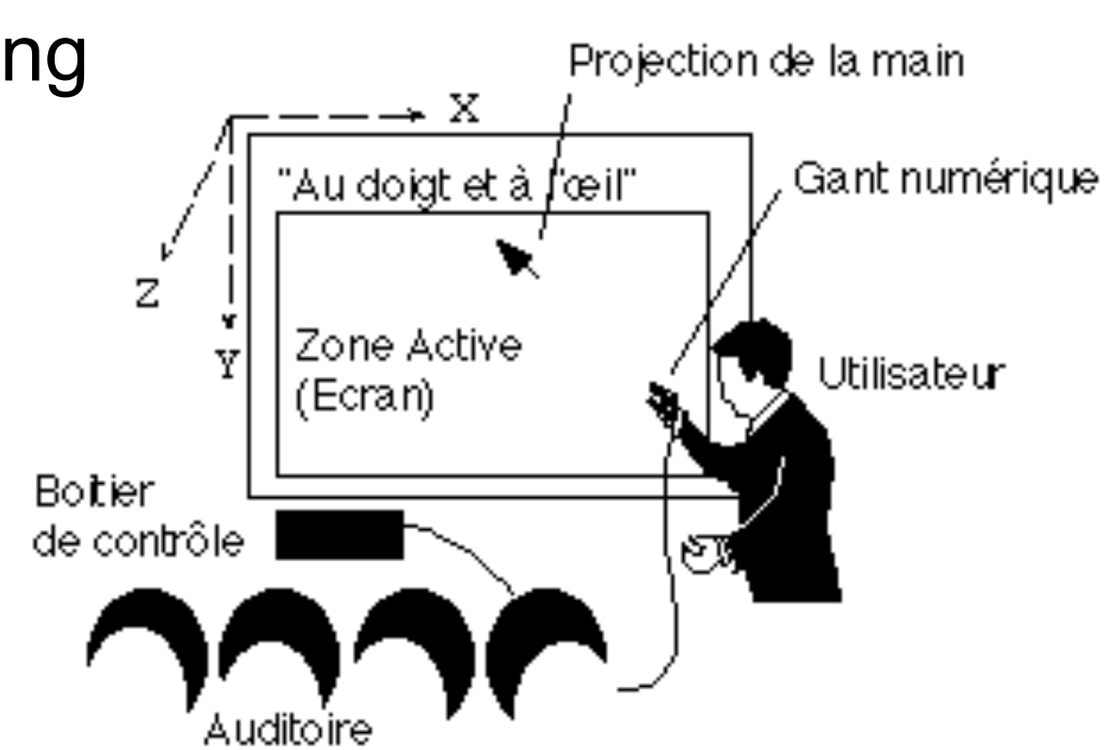
theory

interaction techniques

in/output technologies

Taxonomy of Gesture styles

- sign language
- gesticulation
  - communicative gestures made in conjunction with speech
  - know how your users gesture naturally and design artificial gestures that have no cross-talk with natural gesturing



http://thomas.baudel.name/Morphologie/These/images/VI11.gif

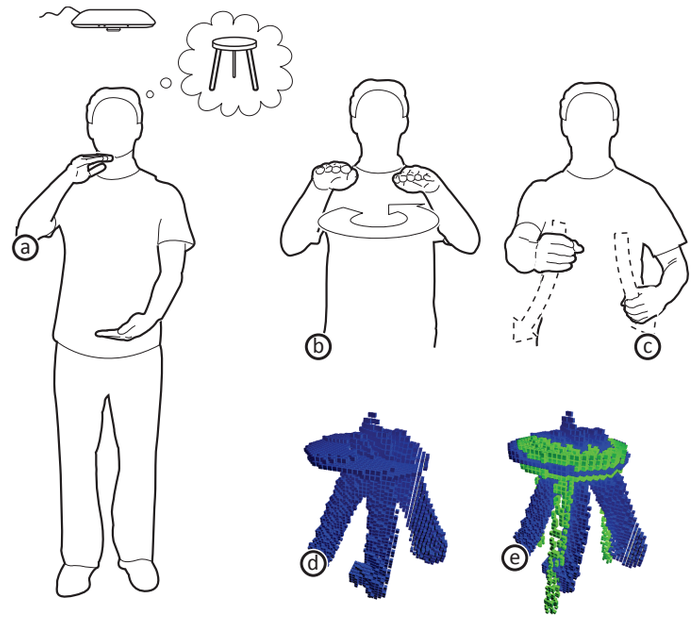
Literature: Baudel et al. Charade: remote control of objects using free-hand gestures, Communications of the ACM 1993

Taxonomy of Gesture styles

- manipulative
  - gestures which tightly related movements to an object being manipulated
    - 2D Interaction: mouse or stylus
    - 3D Interaction: free-hand movement to mimic manipulations of physical objects
- deictic gestures (aimed pointing)
  - establish identity or spatial location of an object.
- semaphoric gestures (signals send to the computer)
  - stroke gestures, involve tracing of a specific path (marking menu)
  - static gestures (pose), involving no movement
  - dynamic gestures, require movement

Taxonomy of Gesture styles

- pantomimic gestures:
  - demonstrate a specific task to be performed or imitated
  - performed without object being present.
- iconic
  - communicate information about objects or entities (e.g. size, shapes and motion path)
    - static
    - dynamic

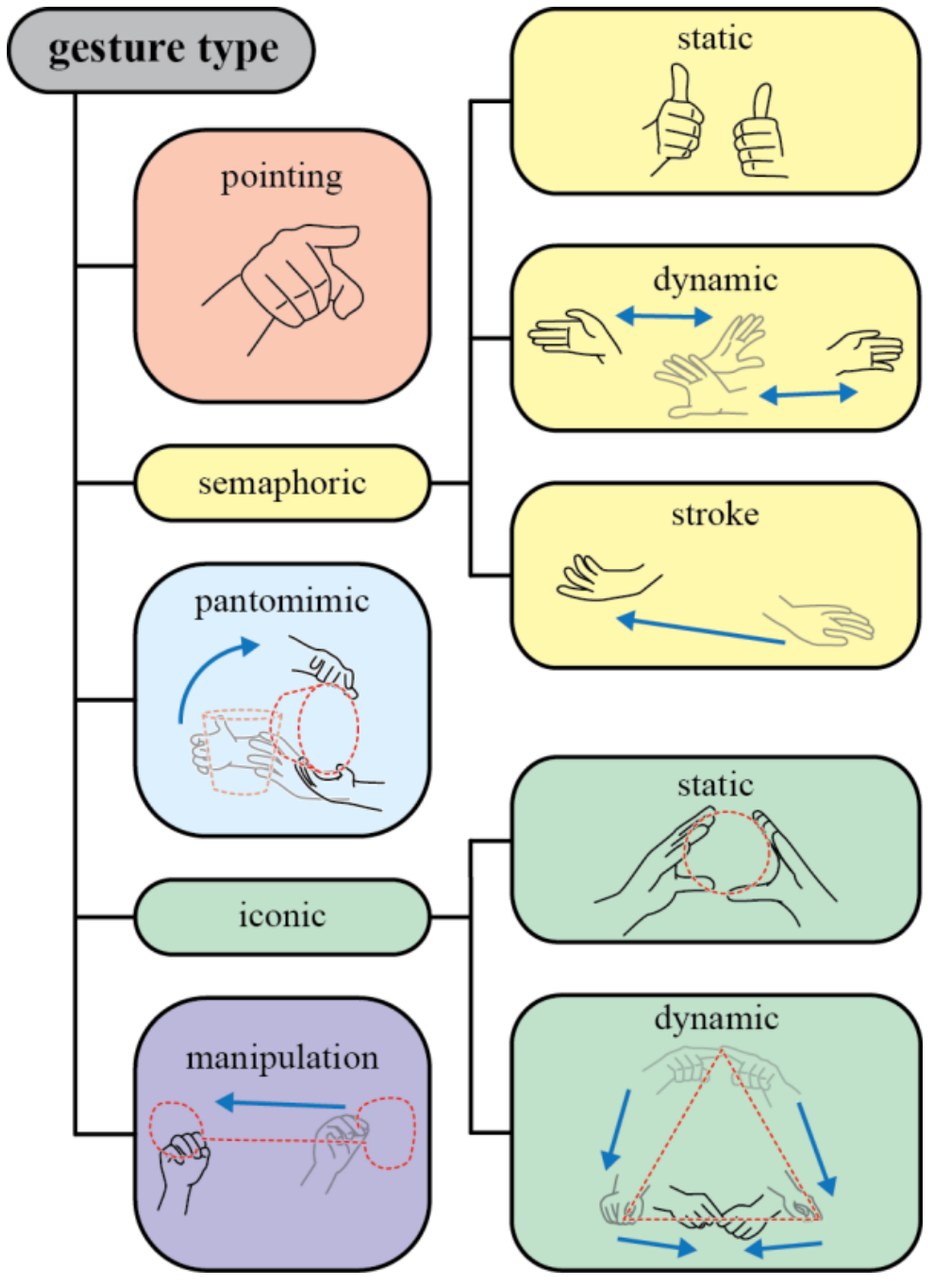


Literature: Aginer et al.: Understanding Mid-air Hand Gestures: A Study of Human Preferences in Usage of Gesture Types for HCI, Tech Report Microsoft Research

Literature: Holz et al. Data Miming: Inferring Spatial Object Descriptions from Human Gesture, CHI 2011

- context and task
- theory
  - bimanual interaction
  - pointing
  - **gestures**
- interaction techniques
- in/output technologies

Taxonomy of Gesture styles



Literature: Aginer et al.: Understanding Mid-air Hand Gestures: A Study of Human Preferences in Usage of Gesture Types for HCI, Tech Report Microsoft Research

three gesture phases

- registration phase
- continuation
- termination

- easy to detect for touch sensitive surfaces
- what about freehand gestures?

Gestural Input vs. Keyboard+Mouse

- loosing the hover state
- gesture design
  - ‘natural’ gestures
    - dependent on culture
  - multi-finger chords (what does that remind you of?)
- memorability, learnability
  - short-term vs. long-term retention
- gesture discoverability
- missing standards
- difficult to write, keep track and maintain gesture recognition code
  - detect/resolve conflicts between gestures
- and how to communicate and document a gesture?

MORE INFORMATION

Windows system key combinations

- F1: Help
- CTRL+ESC: Open **Start** menu
- ALT+TAB: Switch between open programs
- ALT+F4: Quit program
- SHIFT+DELETE: Delete item permanently
- Windows Logo+L: Lock the computer (without using CTRL+A

Windows program key combinations

- CTRL+C: Copy
- CTRL+X: Cut
- CTRL+V: Paste
- CTRL+Z: Undo
- CTRL+B: Bold
- CTRL+U: Underline
- CTRL+I: Italic

Mouse click/keyboard modifier combinations

- SHIFT+right click: Displays a shortcut menu containing alter
- SHIFT+double click: Runs the alternate default command (th
- ALT+double click: Displays properties
- SHIFT+DELETE: Deletes an item immediately without placin

General keyboard-only commands

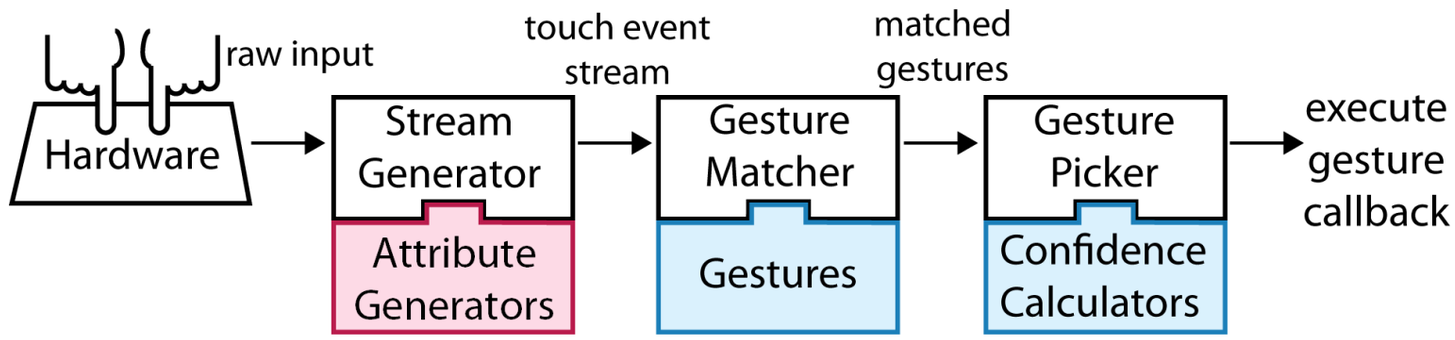
- F1: Starts Windows Help
- F10: Activates menu bar options
- SHIFT+F10 Opens a shortcut menu for the selected item (thi
- CTRL+ESC: Opens the **Start** menu (use the ARROW keys to
- CTRL+ESC or ESC: Selects the **Start** button (press TAB to
- CTRL+SHIFT+ESC: Opens Windows Task Manager
- ALT+DOWN ARROW: Opens a drop-down list box
- ALT+TAB: Switch to another running program (hold down the

Proton++

- declarative multitouch framework
- enables Multitouch gesture description as regular expression of touch event symbols
- generates gesture recognizers and static analysis of gesture conflicts
- note:
  - “*” kleene star indicates that a symbol can appear zero or more consecutive times.
  - “|” denotes the logical *or* of attribute values
  - “ · ” wildcard, specifies that an attribute can take any value.

Literature: Kin,K. et al. ”Proton++: A Customizable Declarative Multitouch Framework”, UIST 2012

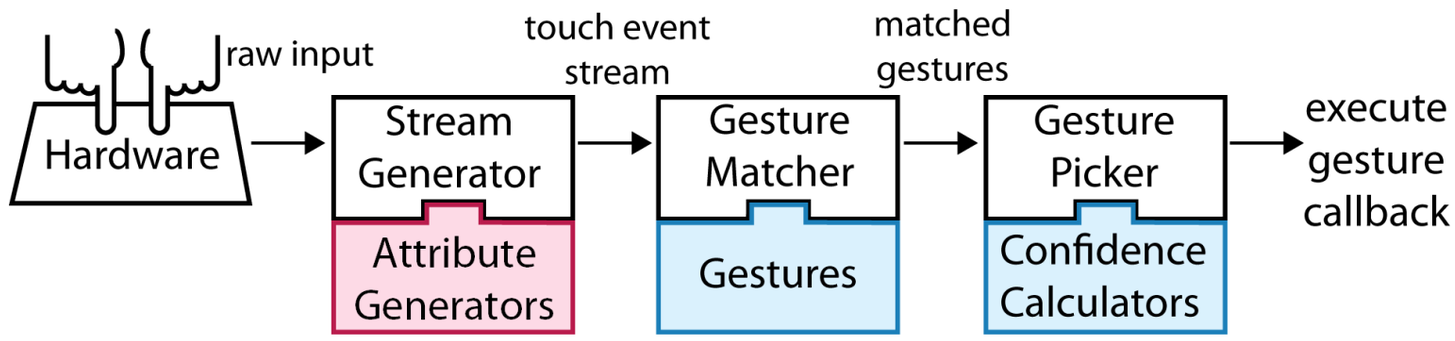
Proton++ - formal description language



- touch event:
  - touch action (down, move, up)
  - touch ID (1st, 2nd, etc.)
  - series of touch attribute values
    - direction = NW, hit-target = circle

Literature: Kin,K. et al. ”Proton++: A Customizable Declarative Multitouch Framework”, UIST 2012

Proton++



- stream generator
  - converts each touch event into a touch symbol of the form

$$E_{T_{ID}}^{A_1:A_2:A_3\ldots}$$

where E ∈ {D,M,U}, attribute values A_1:A_2:A_3, A_1 corresponds to first attribute etc.

$$M_1^{s:W}$$

move-with-first-touch-on-star-object-in-west-direction

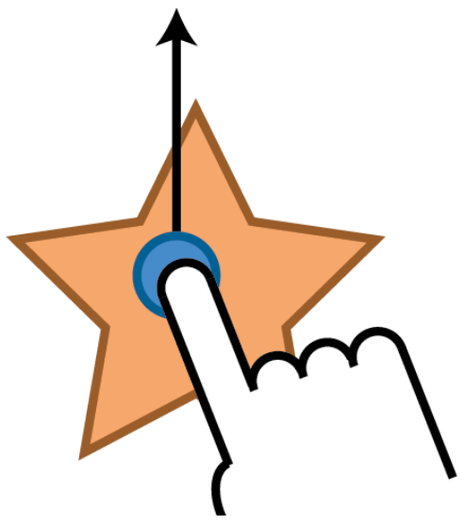
Literature: Kin,K. et al. ”Proton++: A Customizable Declarative Multitouch Framework”, UIST 2012

Proton++ Gesture

- describe a gesture as regular expression over these touch event symbols

$$E_{T_{ID}}^{A_1:A_2:A_3\ldots}$$

where E ∈ {D,M,U}, attribute values A_1:A_2:A_3, A_1 corresponds to first attribute etc.



consider attributes:
hit-target shape,
direction

$$D_1^{s:N} M_1^{s:N} * U_1^{s:N}$$

Literature: Kin,K. et al. ”Proton++: A Customizable Declarative Multitouch Framework”, UIST 2012

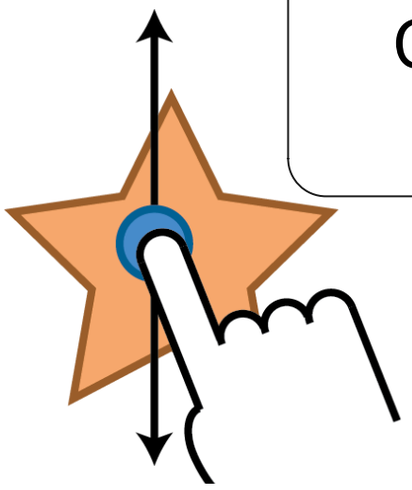
Proton++ Gesture

- describe a gesture as regular expression over these touch event symbols

$$E_{T_{ID}}^{A_1:A_2:A_3...}$$

where E ∈ {D,M,U}, attribute values A_1:A_2:A_3, A_1 corresponds to first attribute etc.

1 Minute Micro Task:
Create the regular expression for this gesture



consider attributes:
hit-target shape,
direction

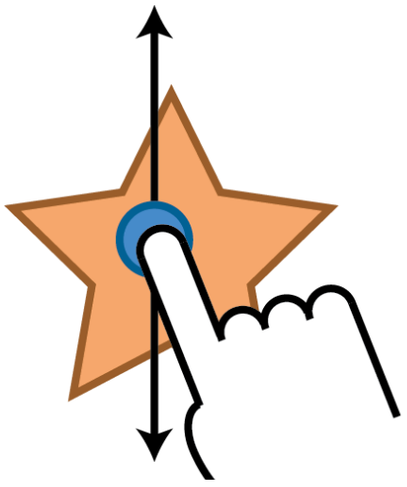
Literature: Kin,K. et al. ”Proton++: A Customizable Declarative Multitouch Framework”, UIST 2012

Proton++ Gesture

- describe a gesture as regular expression over these touch event symbols

$$E_{T_{ID}}^{A_1:A_2:A_3\ldots}$$

where E ∈ {D,M,U}, attribute values A_1:A_2:A_3, A_1 corresponds to first attribute etc.



consider attributes:
hit-target shape,
direction

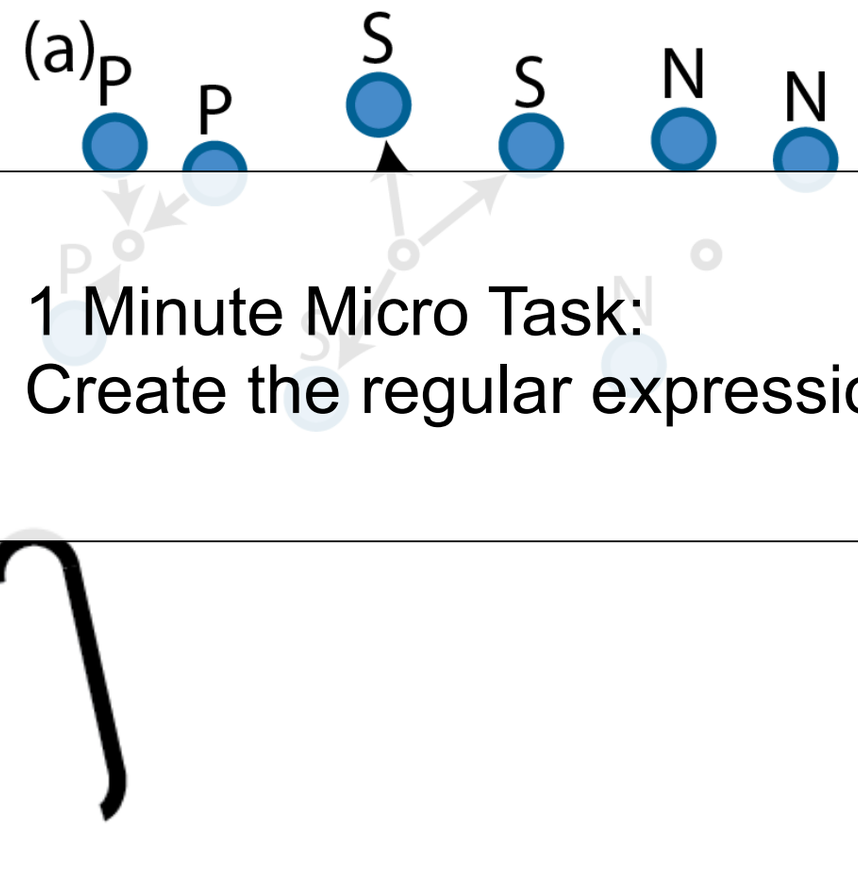
$$D_1^{s:N|S} M_1^{s:N|S} * U_1^{s:N|S}$$

$$(D_1^{s:N}|D_1^{s:S})(M_1^{s:N}|M_1^{s:S})*(U_1^{s:N}|U_1^{s:S})$$

Literature: Kin,K. et al. ”Proton++: A Customizable Declarative Multitouch Framework”, UIST 2012

Custom Attributes

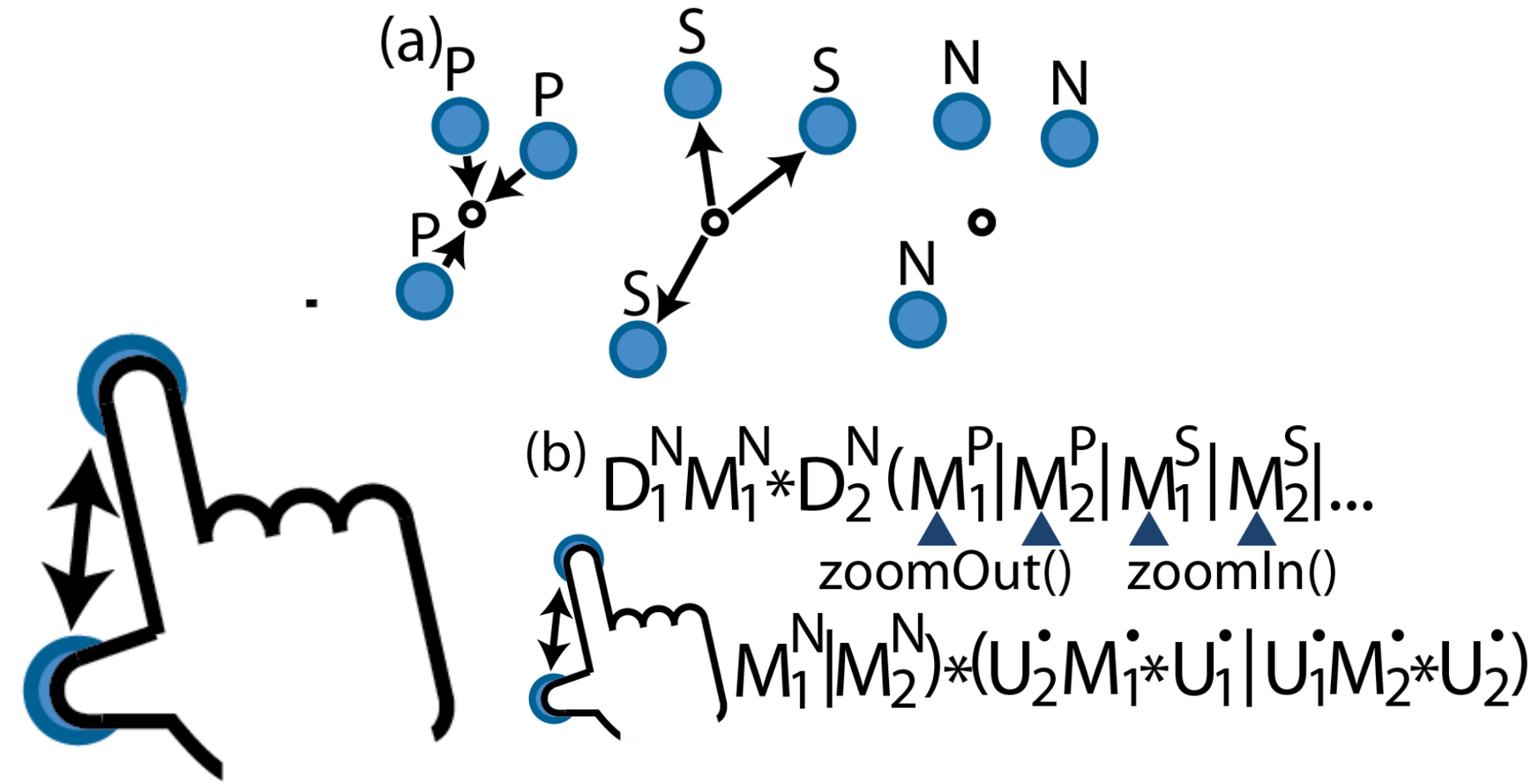
- for example a pinch attribute:
  - relative movements of multiple touches
  - touches are assigned a ‘P’ when on average the touches move towards the centroid, an ‘S’ when the touches move away from the centroid and an ‘N’when they stay stationary



1 Minute Micro Task:
Create the regular expression for this gesture

Custom Attributes

- for example a pinch attribute:
  - relative movements of multiple touches
  - touches are assigned a ‘P’ when on average the touches move towards the centroid, an ‘S’ when the touches move away from the centroid and an ‘N’when they stay stationary



Further Attributes

- Direction Attribute
- Touch Area Attribute
- Finger Orientation Attribute
- Screen Location Attribute

→ Let's practice that in the exercise

Discussion

- How would you come up with a gesture set for a drawing application on your tablet?

Elicitation studies

- type of participatory design
  - come up with a gesture set
  - understanding mental modal
- guessability study methodology (theater approach) that presents the effects of a gesture to the participant and elicits the causes meant to invoke them.
- Wobbock and colleagues combined it with think-aloud protocol and video analysis
  - detailed picture of user-defined gestures and mental model performance that accompany them

Wobbrock et al.: User-Defined Gestures for Surface Computing, CHI'09

Procedure

- randomly present X referents to participants
- For each referent, ask participant to perform a 1-handed and a 2-handed gesture (or other factors that you want to include...)
- show a Likert scale and ask them to rate
  - goodness
  - ease
  - comfort
  - etc.

Procedure

- you collect
  - user-defined gesture set
  - performance measures
  - subjective responses
  - qualitative observations
  - gesture taxonomy!
    - what are the aspects/patterns that are shared by different gestures for a referent?

Taxonomy of Surface Gestures

TAXONOMY OF SURFACE GESTURES		
Form	*static pose*	Hand pose is held in one location.
	dynamic pose	Hand pose changes in one location.
	static pose and path	Hand pose is held as hand moves.
	dynamic pose and path	Hand pose changes as hand moves.
	one-point touch	Static pose with one finger.
	one-point path	Static pose & path with one finger.
Nature	*symbolic*	Gesture visually depicts a symbol.
	physical	Gesture acts physically on objects.
	metaphorical	Gesture indicates a metaphor.
	abstract	Gesture-referent mapping is arbitrary.
Binding	*object-centric*	Location defined w.r.t. object features.
	world-dependent	Location defined w.r.t. world features.
	world-independent	Location can ignore world features.
	mixed dependencies	World-independent plus another.
Flow	*discrete*	Response occurs *after* the user acts.
	continuous	Response occurs *while* the user acts.

Table 2. Taxonomy of surface gestures based on 1080 gestures. The abbreviation “w.r.t.” means “with respect to.”

Wobbrock et al.: User-Defined Gestures for Surface Computing, CHI’09

Agreement

- group gestures within each referent
- agreement score A
  - reflects in a single number the degree of consensus among participants.

$$A = \frac{\sum_{r \in R} \sum_{P_i \subseteq P_r} \left(\frac{|P_i|}{|P_r|} \right)^2}{|R|}$$

r is a referent in a set of all referents R

P_i is a subset of identical gestures from P_r

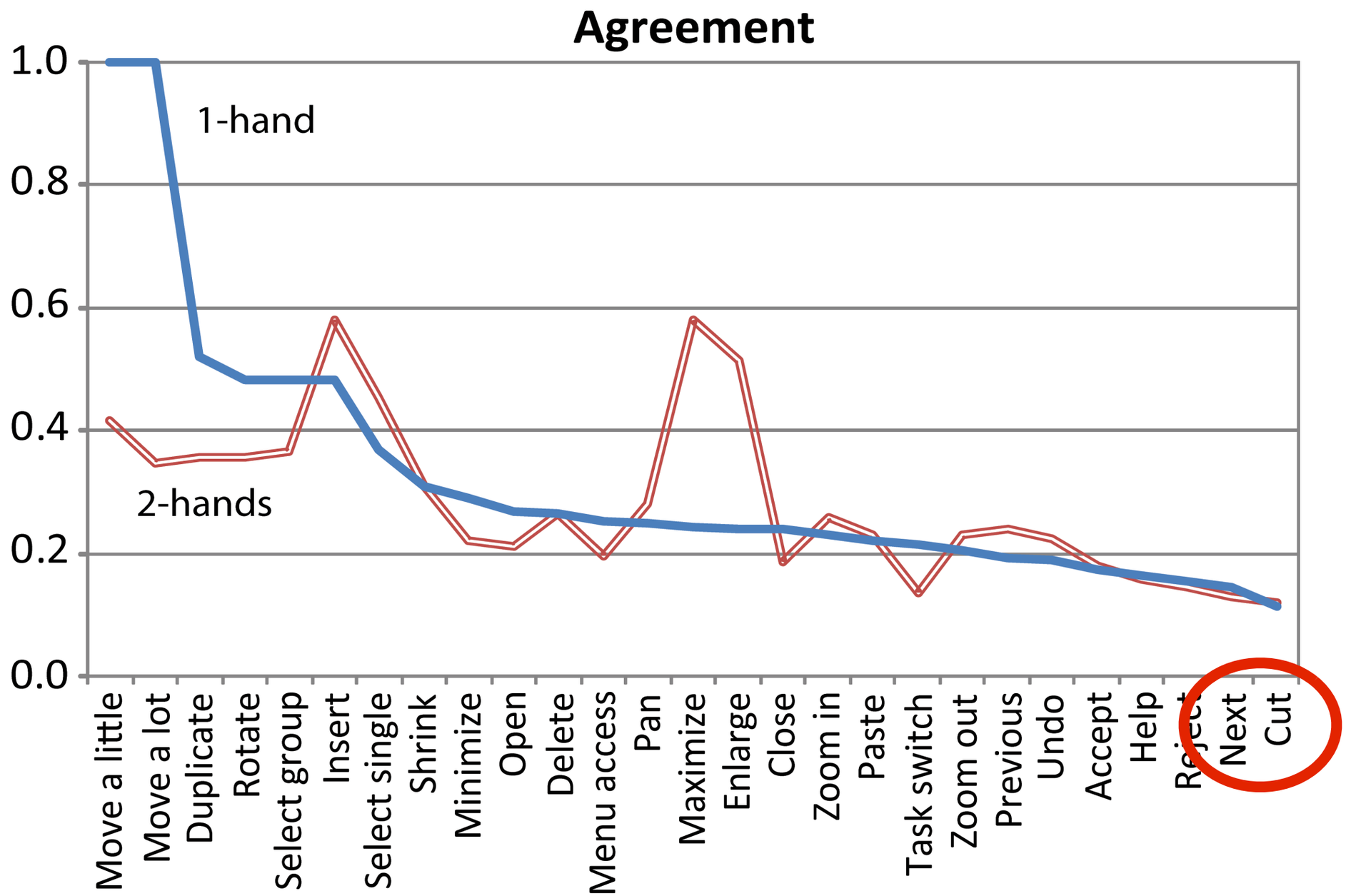
  - e.g. gesture agreement of “move a little” (2 hands) across 20 participants showed four groups of identical gestures: 12, 3, 3, 2

$$A_{move\ a\ little} = \left(\frac{12}{20}\right)^2 + \left(\frac{3}{20}\right)^2 + \left(\frac{3}{20}\right)^2 + \left(\frac{2}{20}\right)^2 = 0.42$$

Wobbrock et al.: User-Defined Gestures for Surface Computing, CHI’09

Mobile

- context and task
- theory
  - bimanual interaction
  - pointing
  - **gestures**
- interaction techniques
- in/output technologies



Wobbrock et al.: User-Defined Gestures for Surface Computing, CHI'09

user-defined gesture set

- take the largest groups of identical gestures for each referent.
- if same gesture was proposed for two commands, a conflict occurred
  - resolve this, the referent with largest group won the gesture.
  - they came up with a conflict-free set that covers 57% of all proposed gestures.

Wobbrock et al.: User-Defined Gestures for Surface Computing, CHI'09

Discussion

- do ‘natural’ gestures exist?

Gestural Input vs. Keyboard+Mouse

- loosing the hover state
- gesture design
  - ‘natural’ gestures
    - dependent on culture
  - multi-finger chords (what does that remind you of?)
- memorability, learnability
  - short-term vs. long-term retention
- **gesture discoverability**
- missing standards
- difficult to write, keep track and maintain gesture recognition code
  - detect/resolve conflicts between gestures
- and how to communicate and document a gesture?

MORE INFORMATION

Windows system key combinations

- F1: Help
- CTRL+ESC: Open **Start** menu
- ALT+TAB: Switch between open programs
- ALT+F4: Quit program
- SHIFT+DELETE: Delete item permanently
- Windows Logo+L: Lock the computer (without using CTRL+A

Windows program key combinations

- CTRL+C: Copy
- CTRL+X: Cut
- CTRL+V: Paste
- CTRL+Z: Undo
- CTRL+B: Bold
- CTRL+U: Underline
- CTRL+I: Italic

Mouse click/keyboard modifier combinations

- SHIFT+right click: Displays a shortcut menu containing alter
- SHIFT+double click: Runs the alternate default command (th
- ALT+double click: Displays properties
- SHIFT+DELETE: Deletes an item immediately without placin

General keyboard-only commands

- F1: Starts Windows Help
- F10: Activates menu bar options
- SHIFT+F10 Opens a shortcut menu for the selected item (thi
- CTRL+ESC: Opens the **Start** menu (use the ARROW keys to
- CTRL+ESC or ESC: Selects the **Start** button (press TAB to
- CTRL+SHIFT+ESC: Opens Windows Task Manager
- ALT+DOWN ARROW: Opens a drop-down list box
- ALT+TAB: Switch to another running program (hold down the

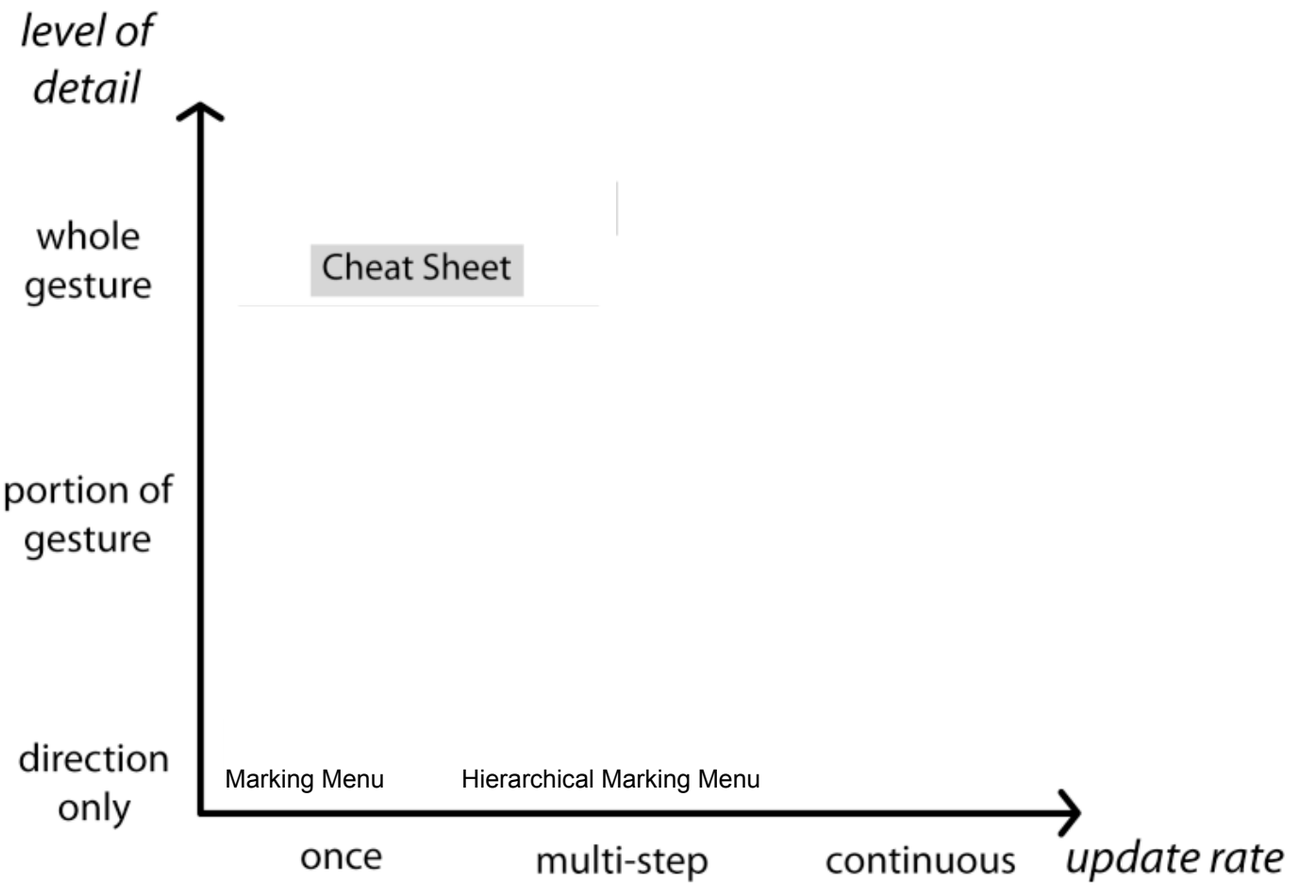
gesture communication

- Feedforward mechanisms provide information about a gesture's shape and its association with a command prior to execution (similar to self-revealing gestures)
  - physical help card
  - pop-up cheat sheet
    - take screen space
- Feedback mechanisms provide low-level information about recognition process, either during or after execution
  - repetition and choice
  - shape beautification
    - modify users hand drawn input to illustrate perfect instance of a given gesture class.

Bau et al.: OctoPocus: A Dynamic Guide for Learning Gesture-Based Command Sets, UIST'08

Feedforward Mechanism Classification

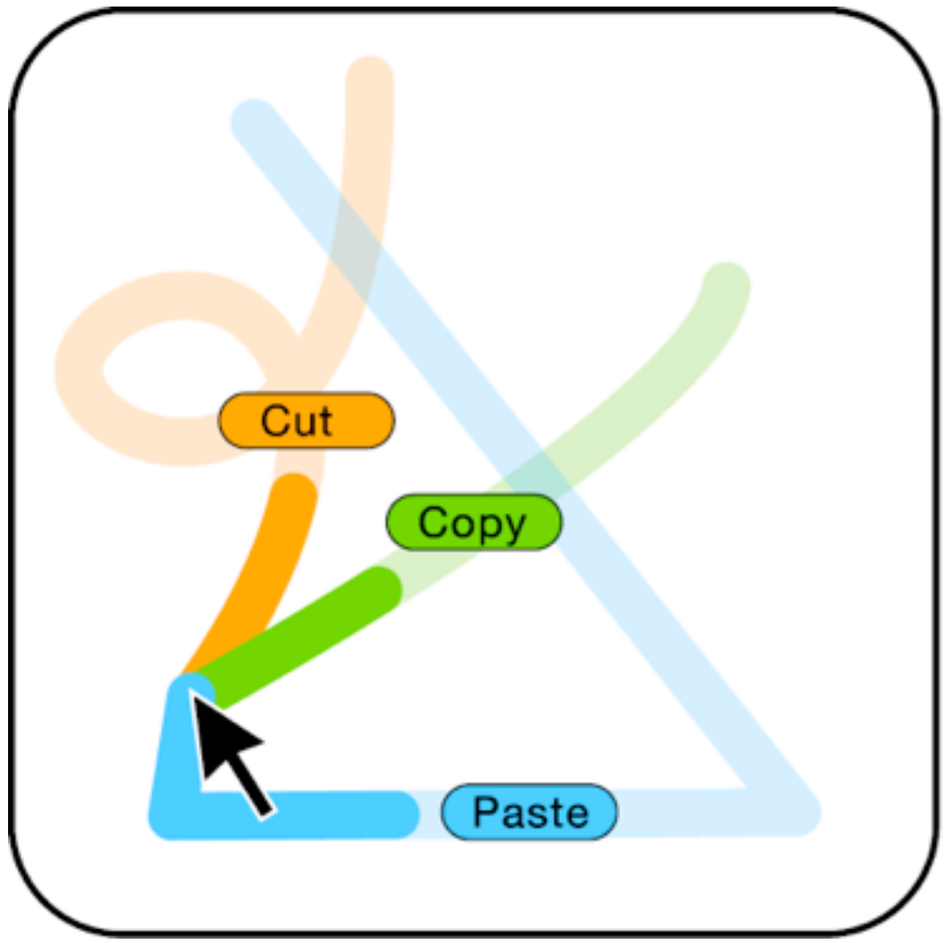
- Level of detail: a minimal hint - a portion of a gesture - whole gesture
- Update rate: once prior to execution - discrete intervals to continuously during execution

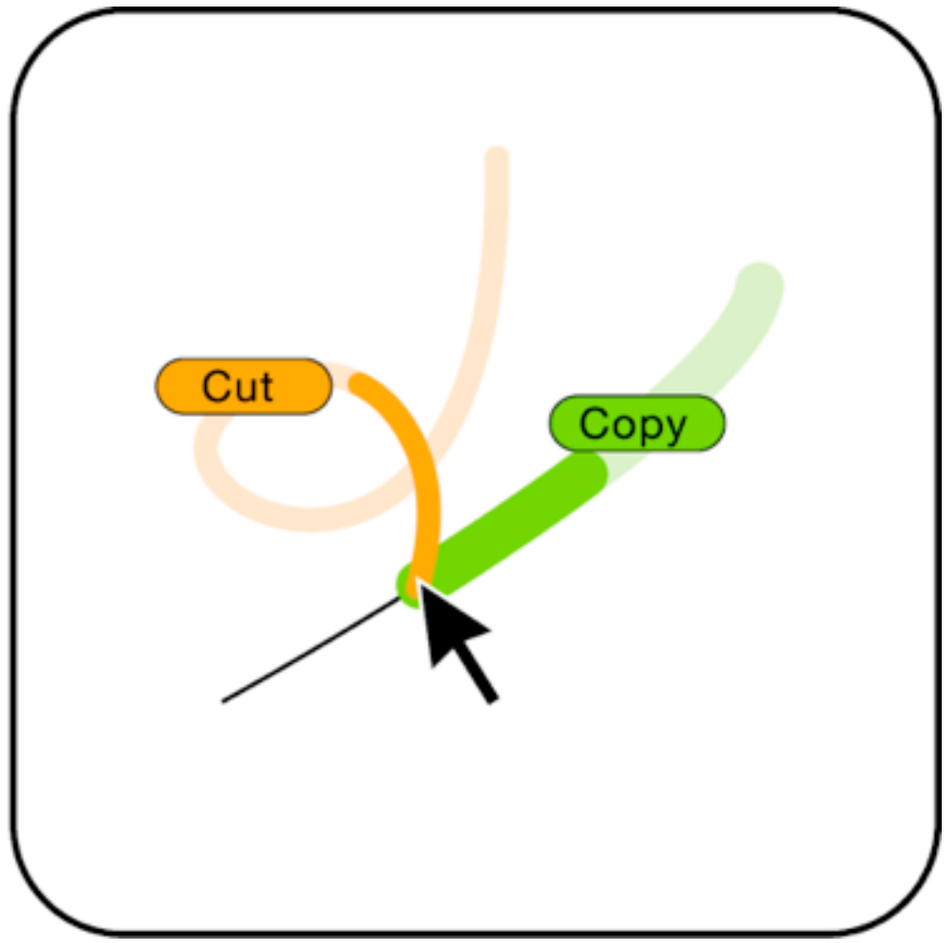


Bau et al.: OctoPocus: A Dynamic Guide for Learning Gesture-Based Command Sets, UIST'08

Example Feedforward Mechanism

- OctoPocus





http://vimeo.com/2116172