Mensch-Maschine-Interaktion 2
Übung 5

Ludwig-Maximilians-Universität München

Wintersemester 2012/2013

Alexander De Luca, Aurélien Tabard

Capacitive and vision-based tracking

- Capacitive:
  - Tuned to finger touch
  - Speed
  - Supports limited screen size

Capacitive and vision-based tracking

- Capacitive:
  - Tuned to finger touch
  - Speed
  - Supports limited screen size
- Vision-based
  - Object tracking
  - Hand tracking
  - Supports larger size of screens

Today

Gestures

Outline

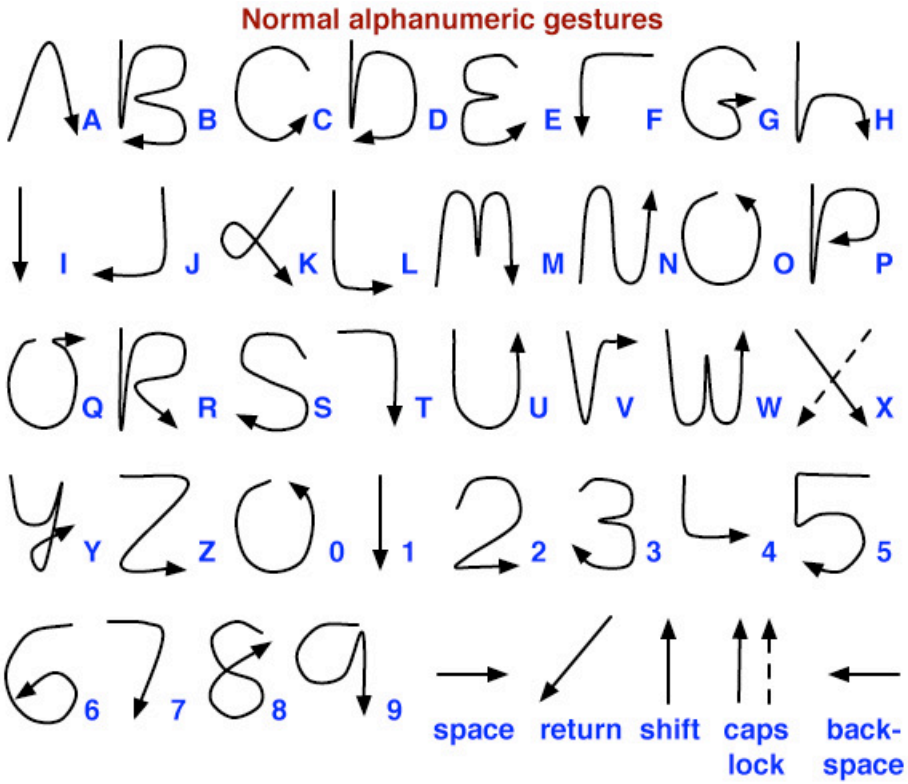
- Application of gestures
- Recognizers
  - Rubine
  - $1 Recognizer
- Exercise

Application of gestures

- Text input
- Authentication
- Issuing commands
- Body interaction

Application of gestures

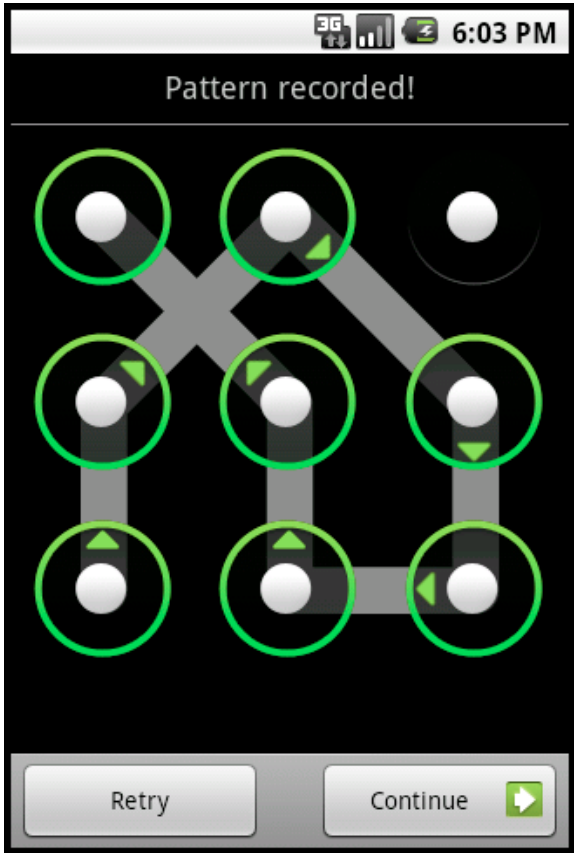
- **Text input**
  - Graffiti
- Authentication
- Issuing commands
- Body interaction



http://www.crossbrowser.net/415/whats-wrong-with-touch-typing/

Application of gestures

- Text input
- Authentication
  - Android’s unlock
- Issuing commands
- Body interaction



Application of gestures

- Text input
- Authentication
- Issuing commands
  - Apple trackpad
  - Dolphin browser ->
- Body interaction

http://gigaom.com/mobile/8-reasons-android-owners-should-try-dolphin-browser/

Application of gestures

- Text input
- Authentication
- Issuing commands
- Body interaction
  - Wii
  - Kinect

http://www.edailypost.com/nes-motion-control/

Outline

- Application of gestures
- **Recognizers**
  - Rubine
  - $1 Recognizer
- Exercise

Rubine

- Statistical classification algorithm for single stroke gestures (training / classification)
- A gesture G is represented as vector of P sample points
  $G = s_0, \ldots s_{P-1}$ with $s_i = x_i, y_i, t_i$
- Feature vector f extracted from G
  $f = f_1, \ldots f_F$

Rubine Features

$$f_1 = \cos\alpha = \frac{(x_2 - x_0)}{\sqrt{(x_2 - x_0)^2 + (y_2 - y_0)^2}}$$

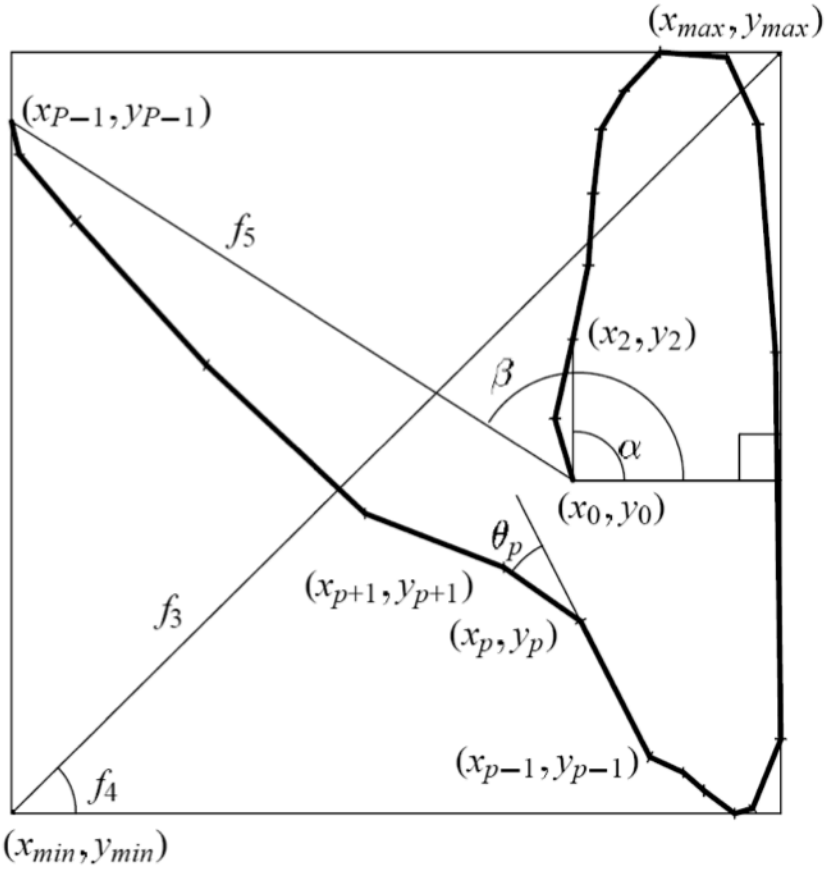
$$f_2 = \sin\alpha = \frac{(y_2 - y_0)}{\sqrt{(x_2 - x_0)^2 + (y_2 - y_0)^2}}$$

$$f_3 = \sqrt{(x_{\max} - x_{\min})^2 + (y_{\max} - y_{\min})^2}$$

$$f_4 = \arctan\frac{y_{\max} - y_{\min}}{x_{\max} - x_{\min}}$$

$$f_5 = \sqrt{(x_{P-1} - x_0)^2 + (y_{P-1} - y_0)^2}$$

$$f_6 = \cos\beta = \frac{(x_{P-1} - x_0)}{f_5}$$



Rubine Features ...

$$f_7 = \sin\beta = \frac{(y_{P-1} - y_0)}{f_5}$$

Let $\Delta x_i = x_{i+1} - x_i \quad \Delta y_i = y_{i+1} - y_i$

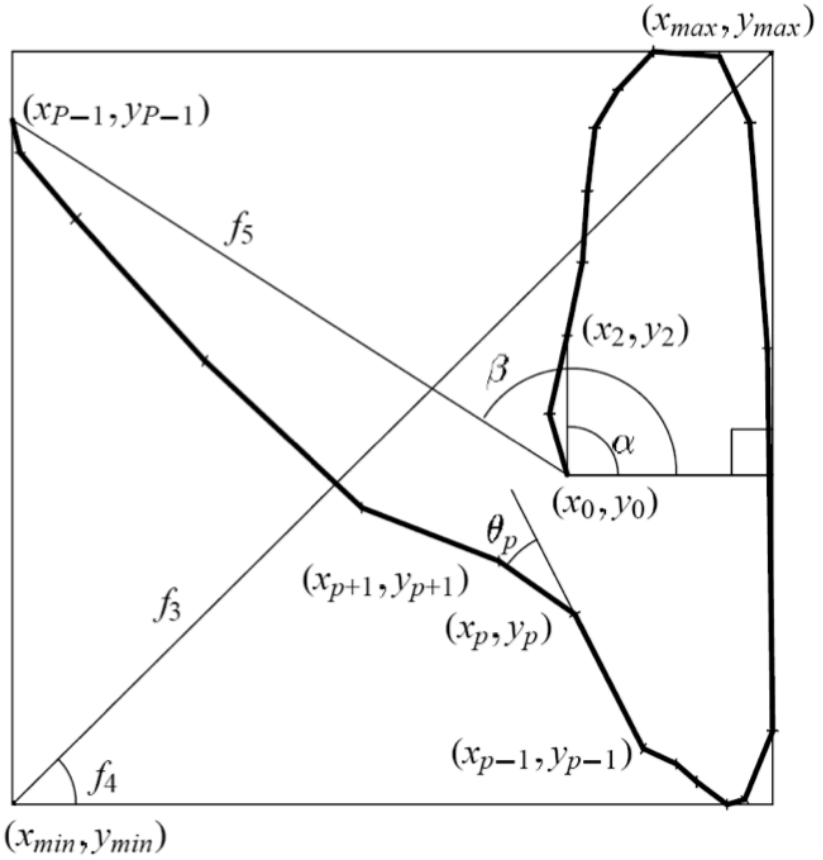
$$f_8 = \sum_{i=0}^{P-2} \sqrt{\Delta x_i^{\,2} + \Delta y_i^{\,2}}$$

$$\text{Let } \theta_i = \arctan \frac{\Delta x_i \Delta y_{i-1} - \Delta x_{i-1} \Delta y_i}{\Delta x_i \Delta x_{i-1} - \Delta x_i \Delta y_{i-1}}$$

$$f_9 = \sum_{i=1}^{P-2} \theta_i \quad f_{10} = \sum_{i=1}^{P-2} |\theta_i| \quad f_{11} = \sum_{i=i}^{P-2} \theta_i^{\,2}$$

$$\text{Let } \Delta t_i = t_{i+1} - t_i \quad f_{12} = \max_{i=0}^{P-2} \frac{\Delta x_i^{\,2} + \Delta y_i^{\,2}}{\Delta t_i^{\,2}}$$

$$f_{13} = t_{P-1} - t_0$$



Rubine Training / Classification

- Training phase

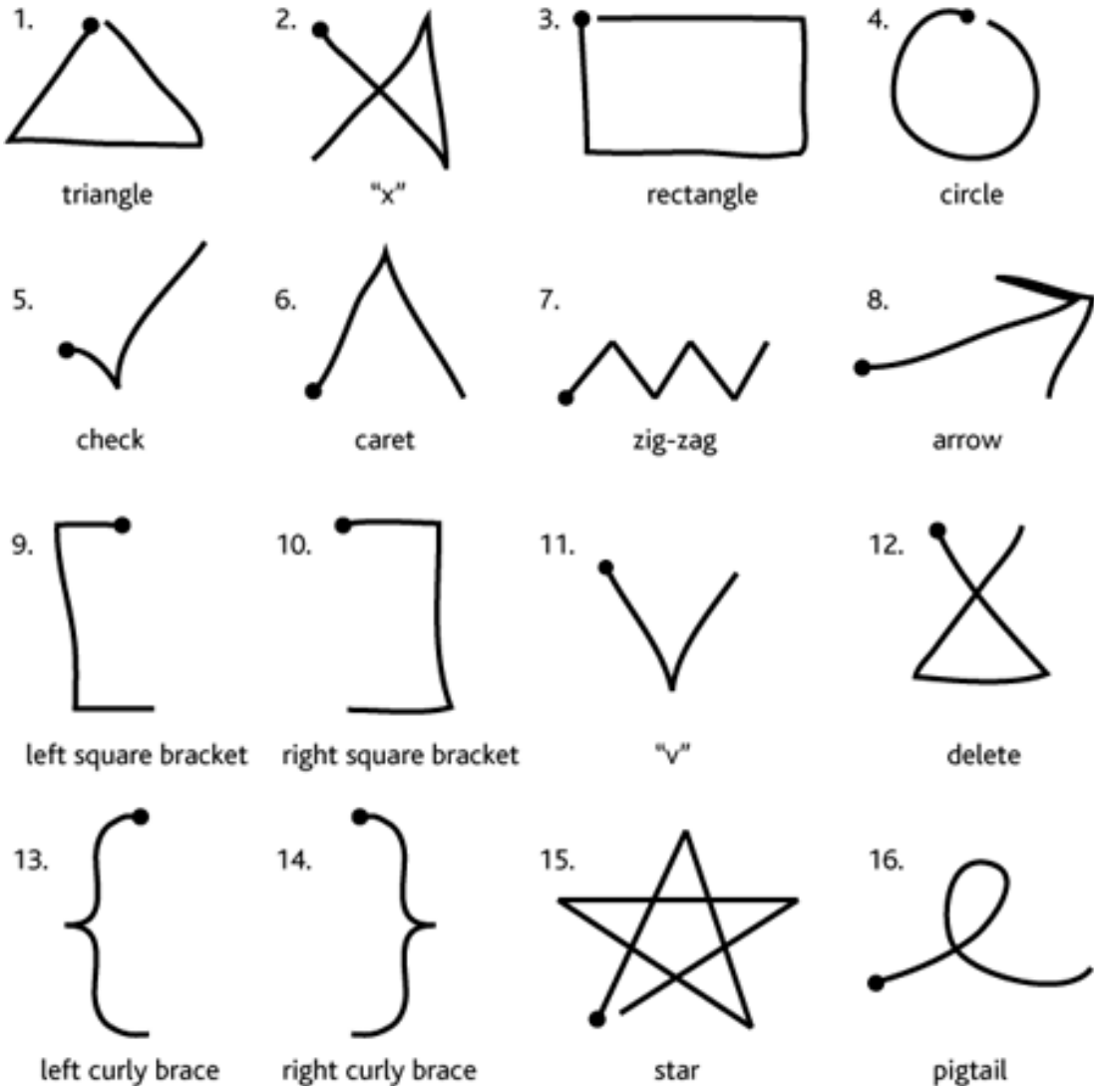
- Recognition / classification phase

$$v_{\hat{c}} = w_{\hat{c}0} + \sum_{i=1}^{F} w_{\hat{c}i} f_i$$

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

$1 recognizer

- Unistrokes
- Invariance
  - rotation
  - scale
  - position



$1 recognizer steps:

1. Resample the recorded path into a fixed number of points evenly spaced along the path.
2. Rotate the path so that the first point is directly to the right of the path's center of mass
3. Scale the path (non-uniformly) to a fixed height and width
4. For each reference path, calculate the average distance for the corresponding points in the input path. The path with the lowest average point distance is the match.

References

1. $1 Unistroke Recognizer. http://depts.washington.edu/aimgroup/proj/dollar/
2. Wobbrock, J.O., Wilson, A.D. and Li, Y. (2007). Gestures without libraries, toolkits or training: A $1 recognizer for user interface prototypes. Proceedings of the ACM Symposium on User Interface Software and Technology (UIST '07). Newport, Rhode Island (October 7-10, 2007). New York: ACM Press, pp. 159-168.
3. Dean Rubine, Specifying Gestures by Example, Proc. of ACM SIGGRAPH'91, 18th Intl. Conference on Computer Graphics and Interactive Techniques.

Exercise 5:

Defining and using custom gestures

Exercise 5

- 2 weeks
- Possible test on the Microsoft PixelSense tabletop (not mandatory).

- Update the unistrokeProcessor package from MT4J
- Download exercise bootstrapping code.
- Look at the code of the MT4J examples