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Perceptual Computing
Computer Vision

Designing Physical Interaction with Sensor Drawbacks in Mind

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Simply bothering

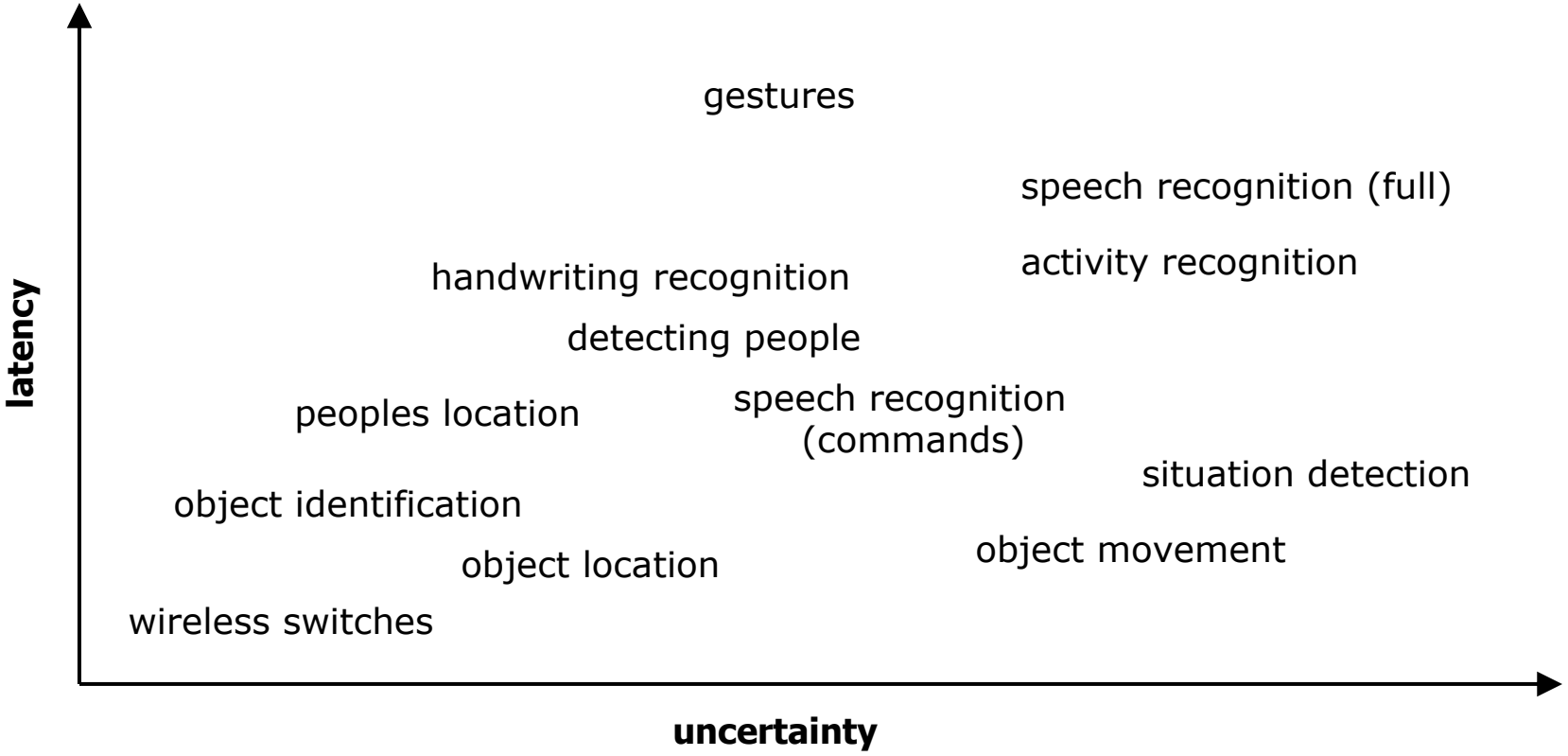
- automatic doors
  - only open when person is really close
  - open when they are not supposed to
  - 70% of people use their hand to activate train door
- automatic water faucets
  - can really bother when they don't work well

=>how can we make interaction better?

Outline

- what are the problems with perception?
- where do they come from?
  - => a model for perception
- what can we do to overcome these problems?
  - => techniques applied in classic HCI

Perception Tasks



- systems are **slow**
- systems are **not always right**

Example – Gesture Pen

Imagine a pen that you can write with and control your HiFi by performing gestures…

- gestures trigger certain actions of the HiFi
- pen has inertial sensor integrated to recognize the gestures
  (example: accelerometers and gyroscopes)

Perception Model

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Sensing system level	***example***
Task (for Application)	*HiFi Control*
Classification System	*Gesture Recognizer (HMM, statistical models …)*
Sensor	*Acceleration, Gyroscope*
Physical Signal	*3D hand movement*

Uncertainty aspects

Sensing system level
Task
Classification System
Sensor
Physical Signal

Robustness - How well does the system work when the external usage conditions change?

HiFi Control – can I control the HiFi while I am talking to another person ?

Uncertainty aspects

Sensing system level
Task
Classification System
Sensor
Physical Signal

Recognition Rate - How well does the system work under fixed external conditions? (evaluated on a set of experimental data)

Gesture Recognizer – how many percent of the gestures does a system recognize?

Uncertainty aspects

Sensing system level
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Precision - How well does sensor output represent the real world phenomenon?

Accelerometer – how big is the drift of the sensor, how high is the precision?

Uncertainty aspects

Sensing system level
Task
Classification System
Sensor
Physical Signal

Ambiguity - How well are different physical phenomena held apart?

hand movement – can two movements be held apart with the sensor in use?

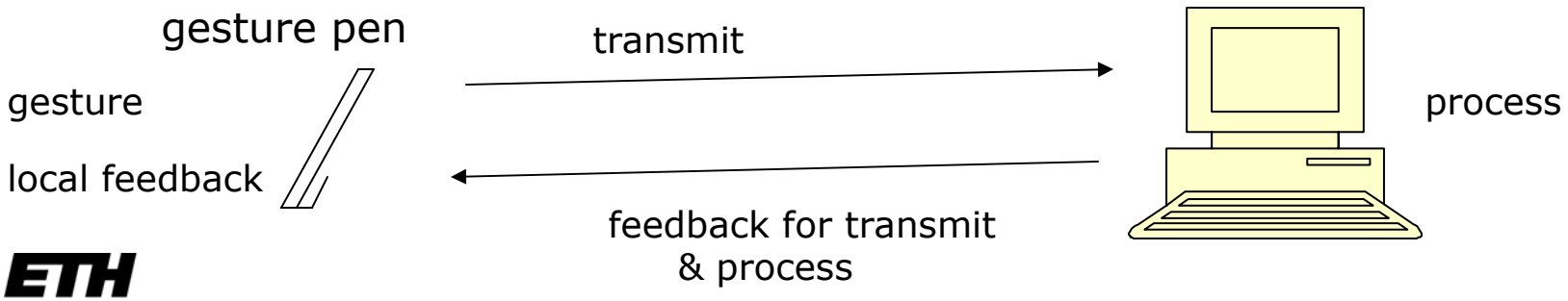
Drawbacks are here to stay

- **latency** will continue to be a problem
- Sensor **uncertainties** will always remain
- even human can not solve problems without errors

=> so what can we do to make interaction better?

Designing HCI (1)

- insufficient robustness:
  - voice dialing beside noisy road
  - GPS can't see enough satellites
- feedback chains – for error recovery
  - gesture pen: give subtle feedback for each step of the process, e.g. gesture recognized, transmitted , HiFi volume changed



Designing HCI (2)

- quasimodes – avoiding ambiguity
  - press button on the gesture pen while performing gesture
- non destructive presentation of results
  - example: handwriting recognition system adds recognized text beside handwritten text

Conclusions

- give the user a simple but correct **mental model**
- **principle of least surprise**

  => keep system causal
- **principle of fluid interaction**

  => don't disturb people with wrong results

=> need to be kept in mind while designing physical interaction

Thanks!

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