

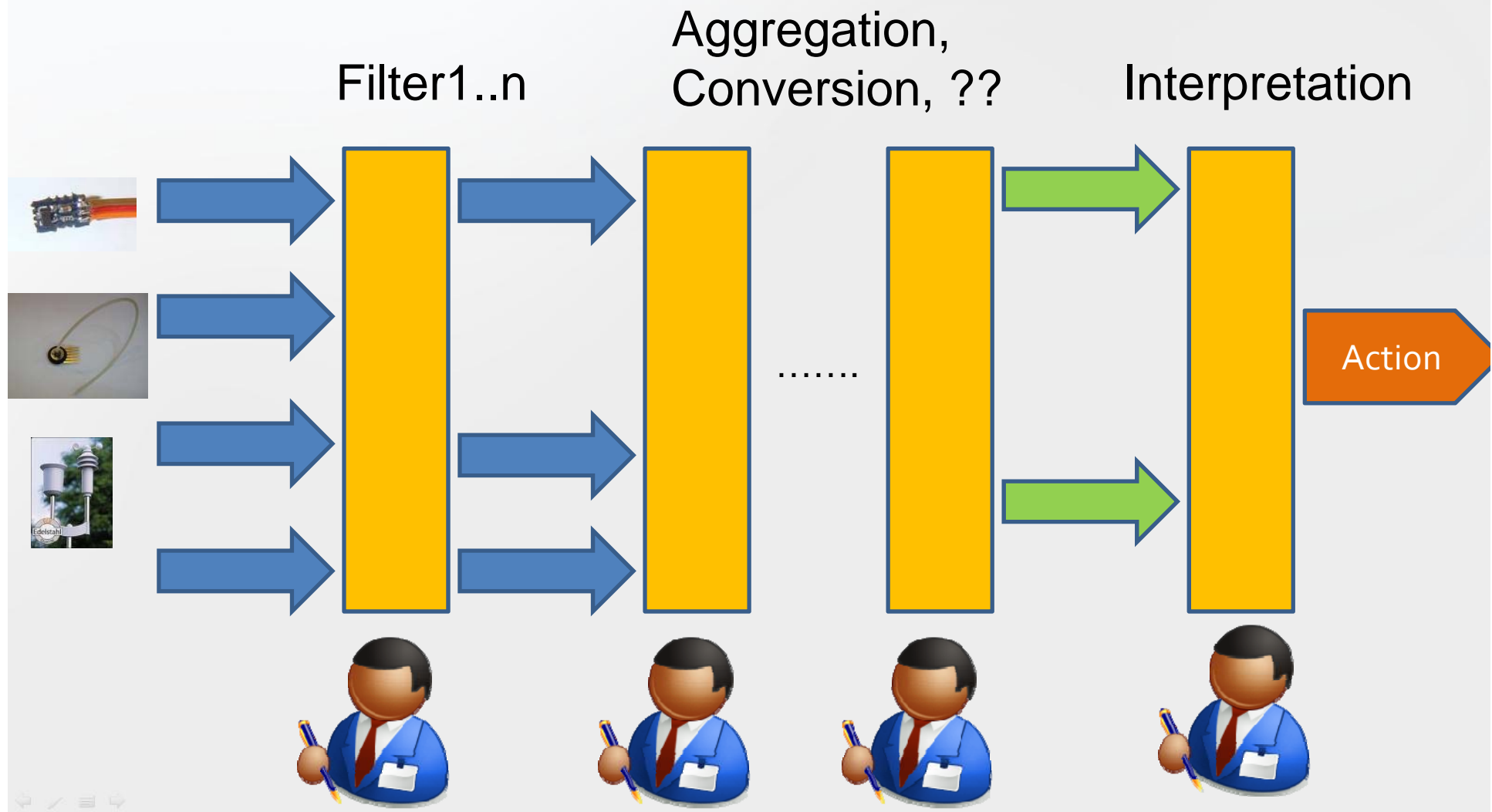


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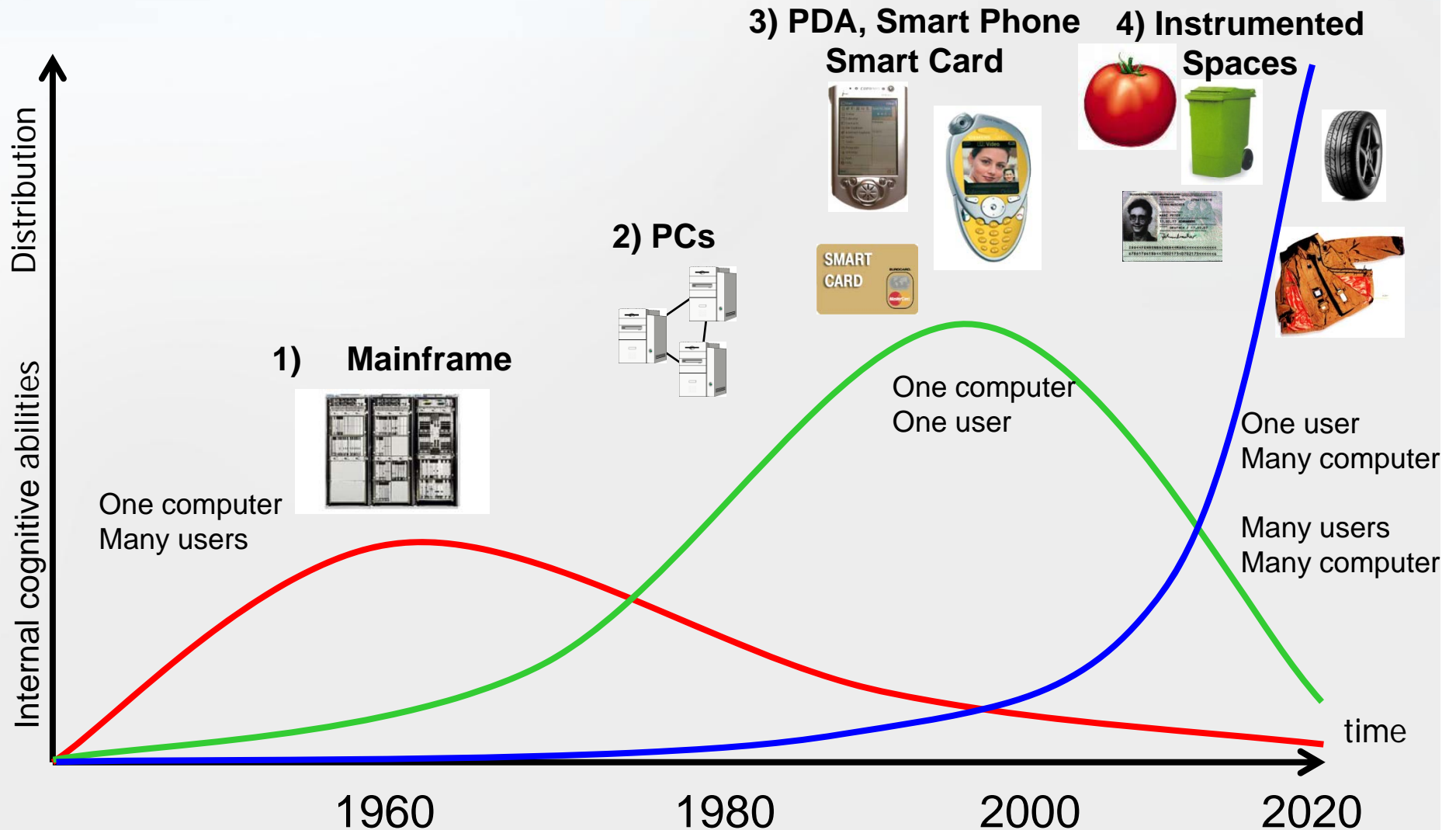
## Humans in the sensor food chain

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# The sensor food chain (SFC)



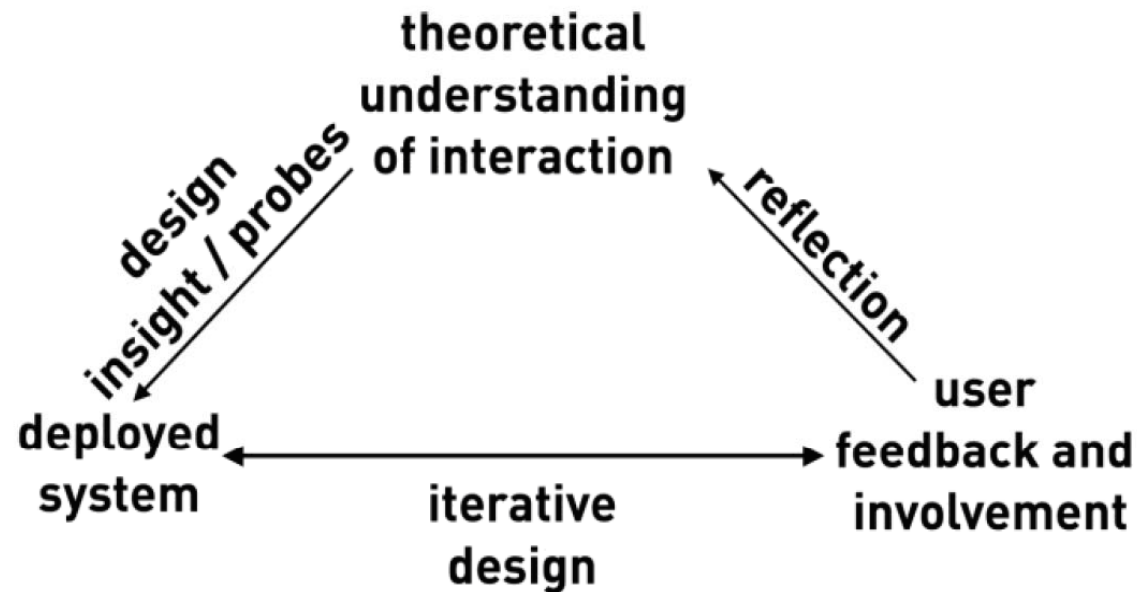
# Technological background: Ubiquitous Computing



Following the late Mark Weiser

# Research Methodology

- Deployment-based research
  - Building prototypes (mostly software, but also hardware)
  - Lab studies, (longitudinal) field studies





# Spatial distribution of resources and interaction capabilities



Smartphones / -watches



Public Displays

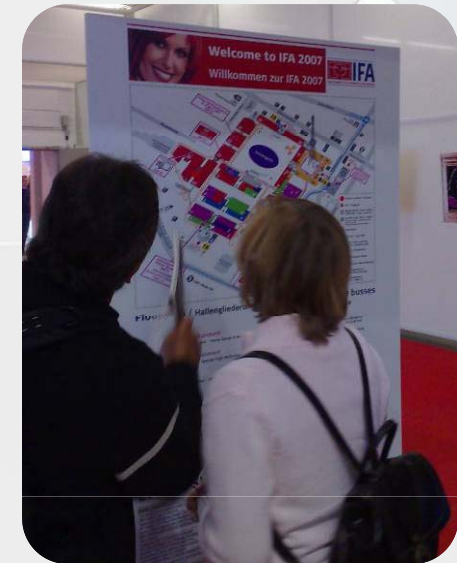


## Some(what) related stuff we've done before.....

- Using Camera Phones as Magic Lenses to digitally augment paper maps (**Wikeye**)
- Using mobile snapshots of you-are-here maps to navigate in local environments (**Photomap**)
- Using large-scale multitouch surfaces to investigate spatial data (**Münster Multi-Touch-Wall**).

# Public Maps are Everywhere

- Show streets, buildings, places of a city
- Thematic maps
- Tools for navigating local area, getting overview
- Printed wall maps, printed foldable maps, electronic maps
- Navigation in unfamiliar areas
  - long term navigational information



# Combining advantages of paper and digital maps

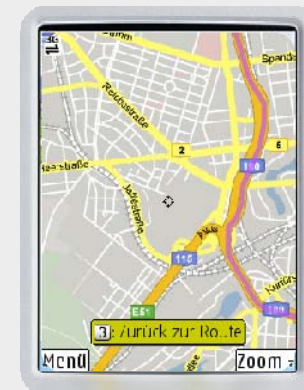


- Trailer of the film „Babylon AD“

# Electronic Maps on Mobile Devices



- Map presentation on mobile devices limited by small display sizes (a few cm<sup>2</sup>)
  - low level of detail
  - difficult to get overview
  - difficult to scroll through map
- Advantages
  - electronic maps are up to date
  - additional geo-referenced information and services
  - location-based services (GPS, GSM cell ID)
- Navigation in familiar areas
  - up-to-date information on events, services





# Timmi – is Mobile Map Interaction

- Combing the advantages of a mobile device with the advantages of a paper map.
- Using the mobile device like a “magic lens” (Video-See-Through-Device) over the map.





# Current Prototype: Wikeye

- **Application areas:**
  - Tourist information
  - Flight/train schedules
  - Shopping and advertisement
  - Consumer information



IDProjectWikeye.mp4



# Recent development: Projector Phone





# Projector Phone

- Video

# Photomap

- Main idea: Use a map snapshot on a GPS and Camera-enabled phone to navigate!
- Joint Work with Keith Cheverst (Lancaster University)
- Winner of the Runner-up-Price of the Nokia-Contest "Calling all Inventors" at the Mobile World Congress 2009





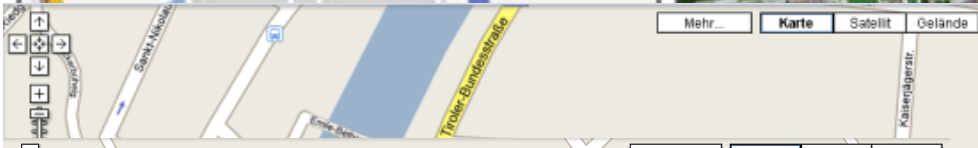
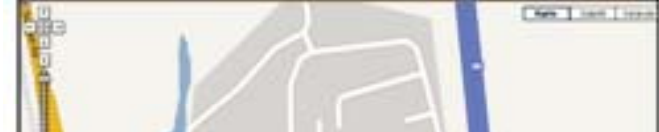
# Botanischer Garten

Wilhelms-Universität Münster



Motivation: Vanilla Map Data of Web Services





# Idea Photomap



# Idea Photomap



## Georeferencing



**Botanischer Garten**  
Wilhelms-Universität Münster



Scenario Photomap: Examples





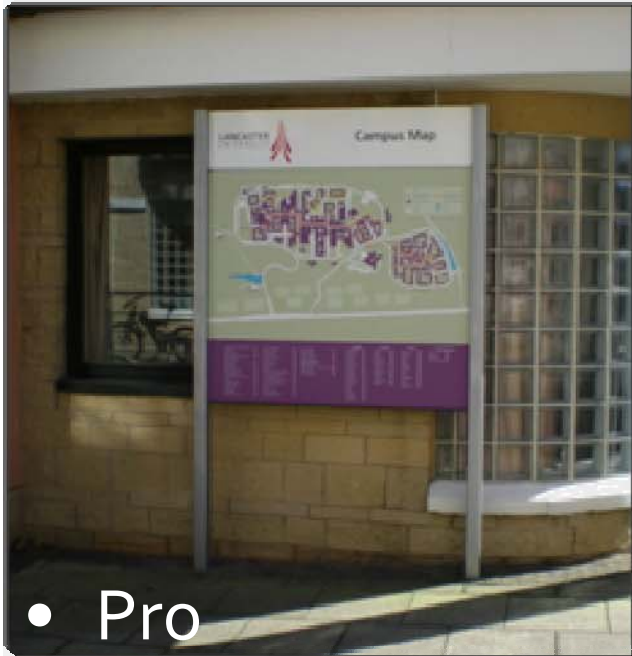
– Line 6:  $F$ : y-coordinate of the center of the upper left pixel

- Use both for navigation on mobile device

1



# Approaches for Georeferencing



- Pro

- Few User Interaction
- Precise georeferencing

- Con

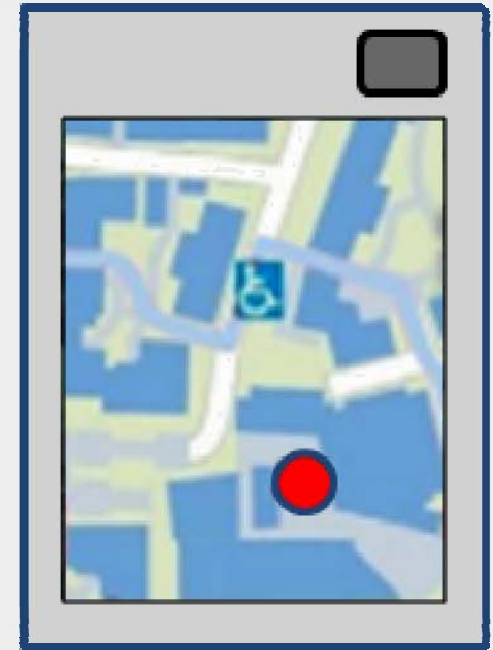
- infrastructure is need
- marker need to be a part of map design



2



## Approaches for Georeferencing



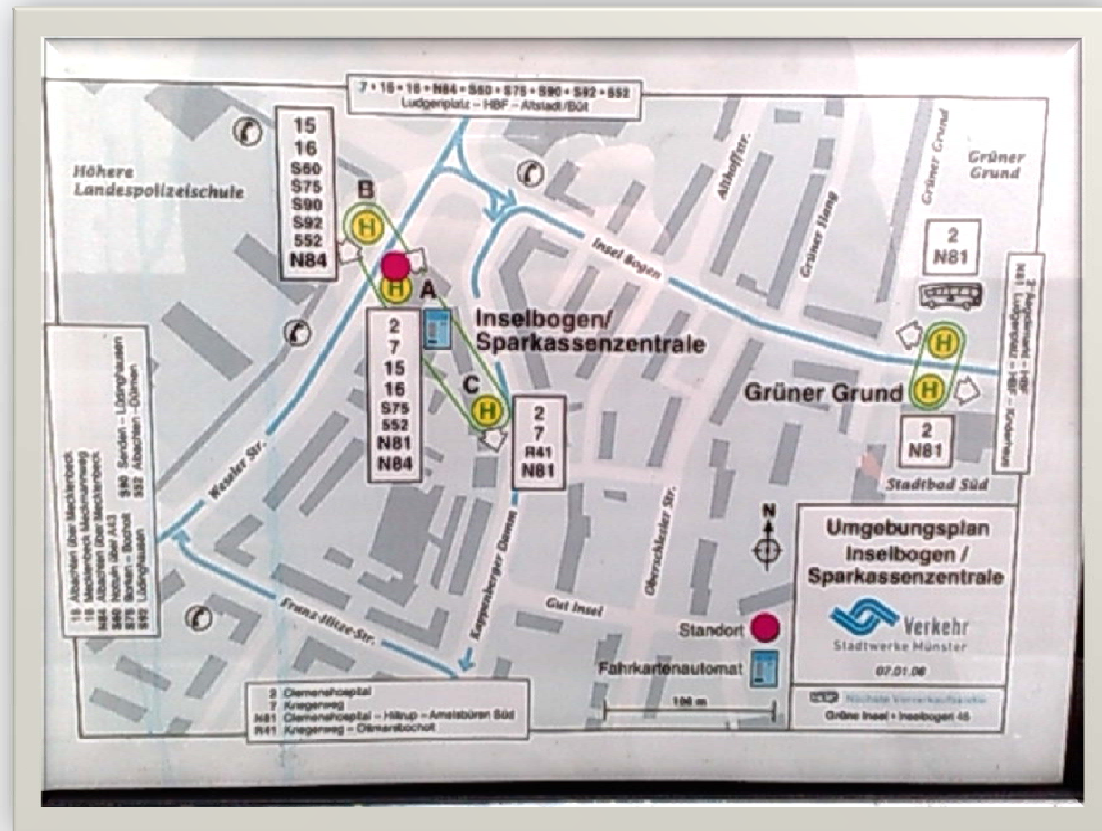
- Using a simple 2 point georeferencing process
- Involving the user in the georeferencing approach
  - 3 Clicks



# 2



## Approaches for Georeferencing





# 2

## Approaches for Georeferencing

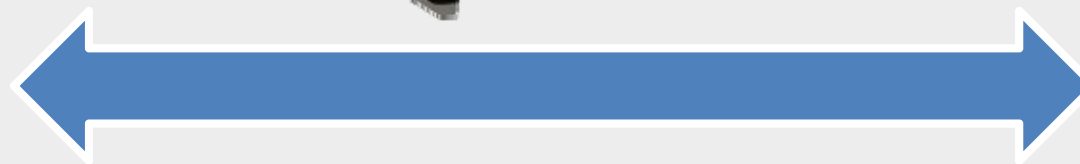




2



# Approaches for Georeferencing



25m - 100m

# 2



## Approaches for Georeferencing



# 2



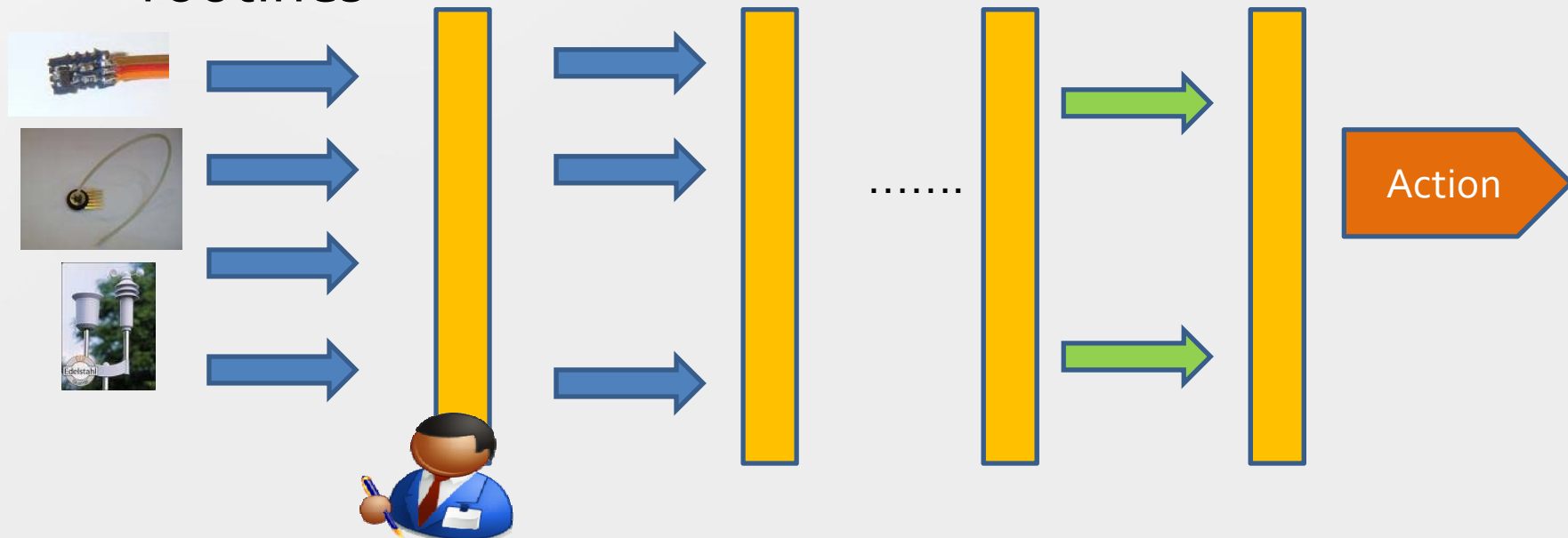
## Approaches for Georeferencing

- Accuracy Map (From white to dark: 0-20m)



# What has this to do with the SFC?

1. Use mobile technology (i.e. phones) to report sensor readings and to provide feedback
2. Perform ethnographic studies to understand the users routines and adapt the technology to those routines



# Münster Multi Touch Wall

- Low-cost, large-scale (1.8 x 2.2 meter) multi-touch surface that utilizes the principles of frustrated total internal reflection (FTIR)
- Jeff Han @ TED 2006

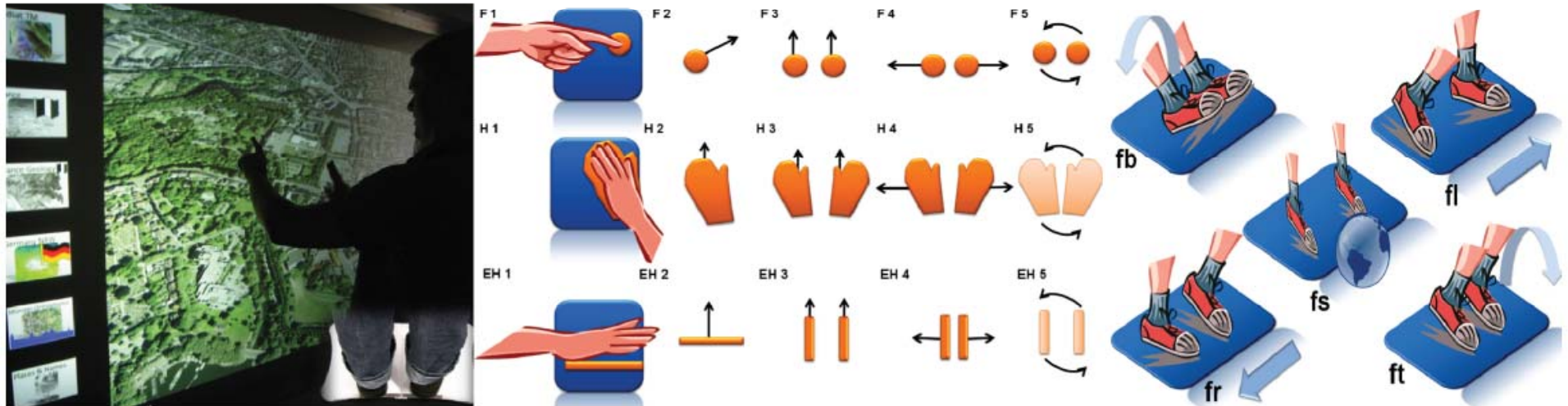




# Multi-Modal gestures for geospatial tasks



## Gesture Primitives



## Interaction Space

	World (Geo-) Objects					Symbols		
	Globe	Plain	Point	Line	Polygon	Point-Symbols	Labels	Layer
POINT	F1	F1	F1	EH1	H1	F1	F1	F1
ZOOM	F4	F4	-	F4	F4	F4	F4	(F4)
PAN	H2 , fr, fl	H2 , fr, fl	F2, fr, fl	EH2, fr, fl	H2, fr, fl	F2	F2	-
ROTATE	F5	F5	-	F5	F5	F5	F5	-
TILT	ft, fb	ft, fb	-	-	-	-	-	-
CUT				EH1, EH3	EH1, EH3			-



# Multi-touch Wall Video

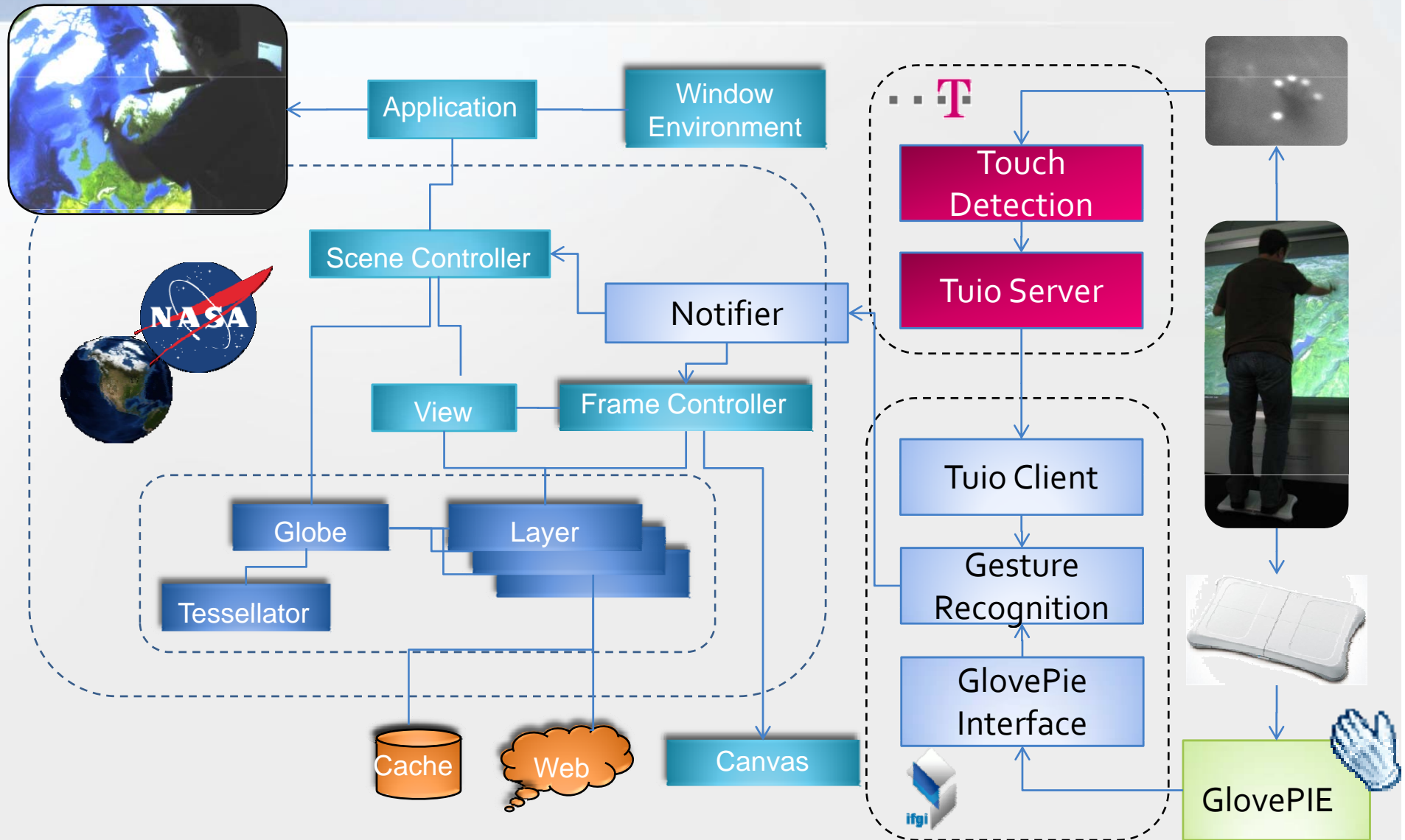
- Interacting with geospatial data
- Combining hand and foot gestures



ICMI2008Small.mov



# System Overview



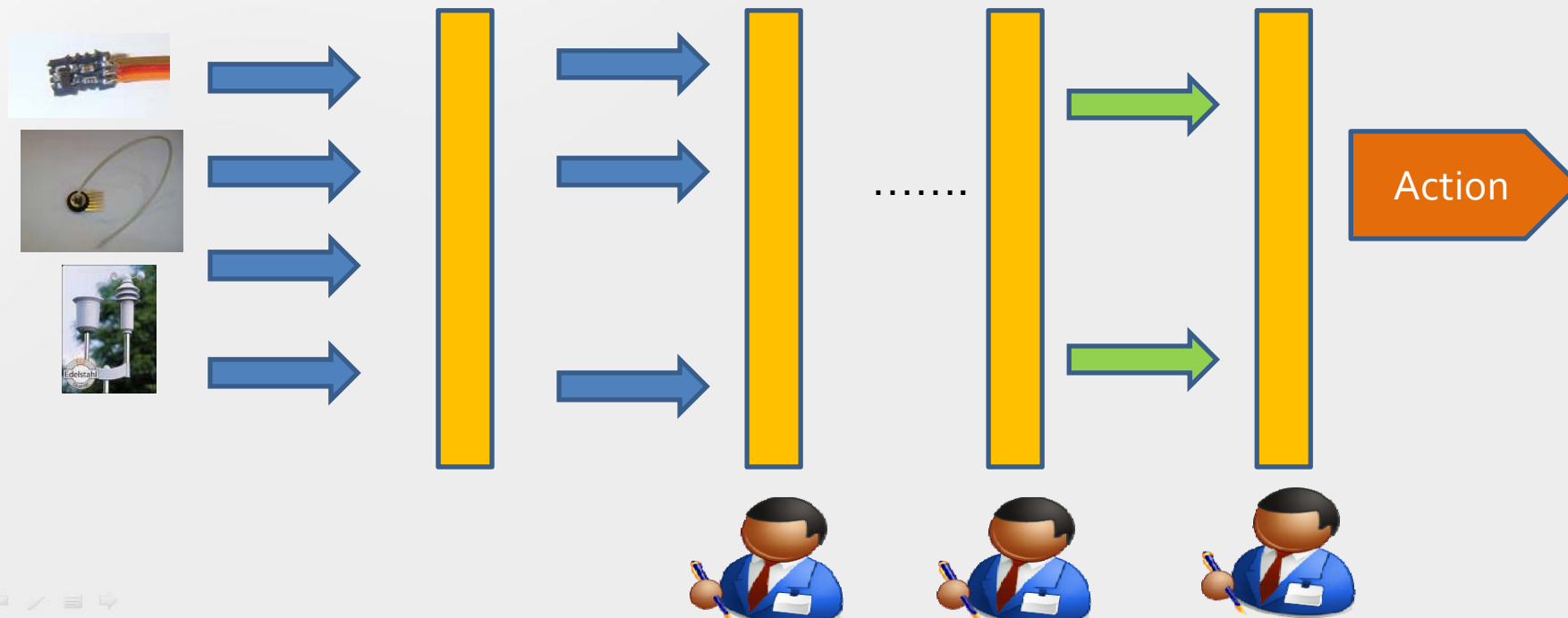


# Hightech Underground: A public installation

- Video of an technology exhibition in October 2008 in the city of Münster, Germany

# What has this to-do with the SFC?

- Help decision makers to explore the data, aggregate information and finally make decisions
- Help other stakeholders to understand, why decisions have been made





# My Suggestions

- Investigate user participation and involvement in the sensor food chain at various levels.
- Design technologies to support humans in the sensor food chain.
- Develop Guidelines of deployment to support humans in the food chain.

# Thank you for your attention



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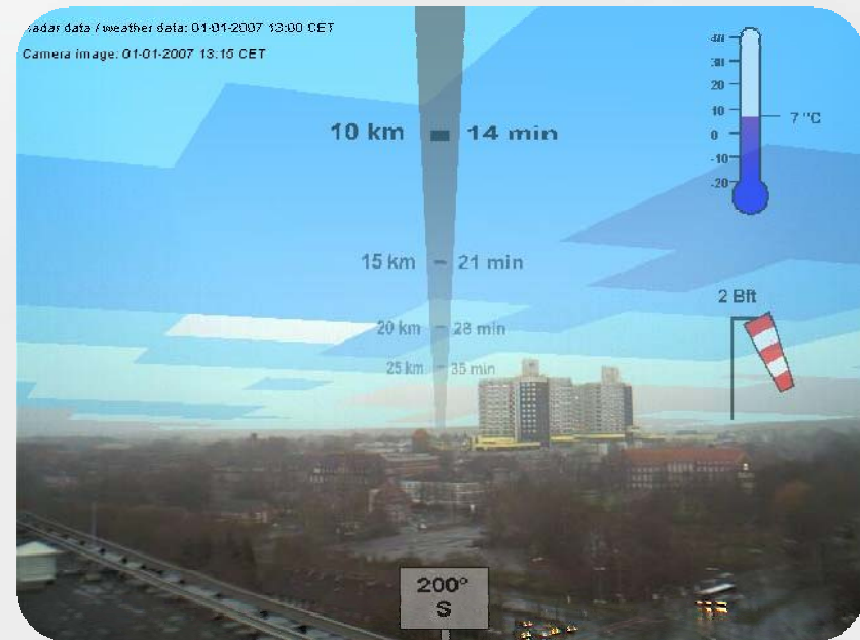
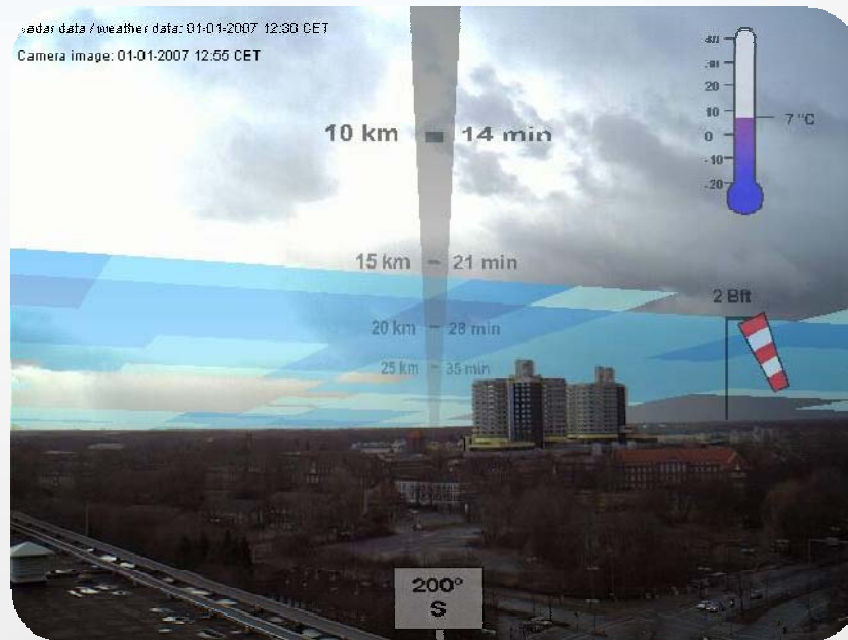


Alexander  
Walkowski



Markus Löchtefeld

# Augmented Reality Weather Cam



(Krüger, Schöning, Gliet & Klemm, AVI 2008)



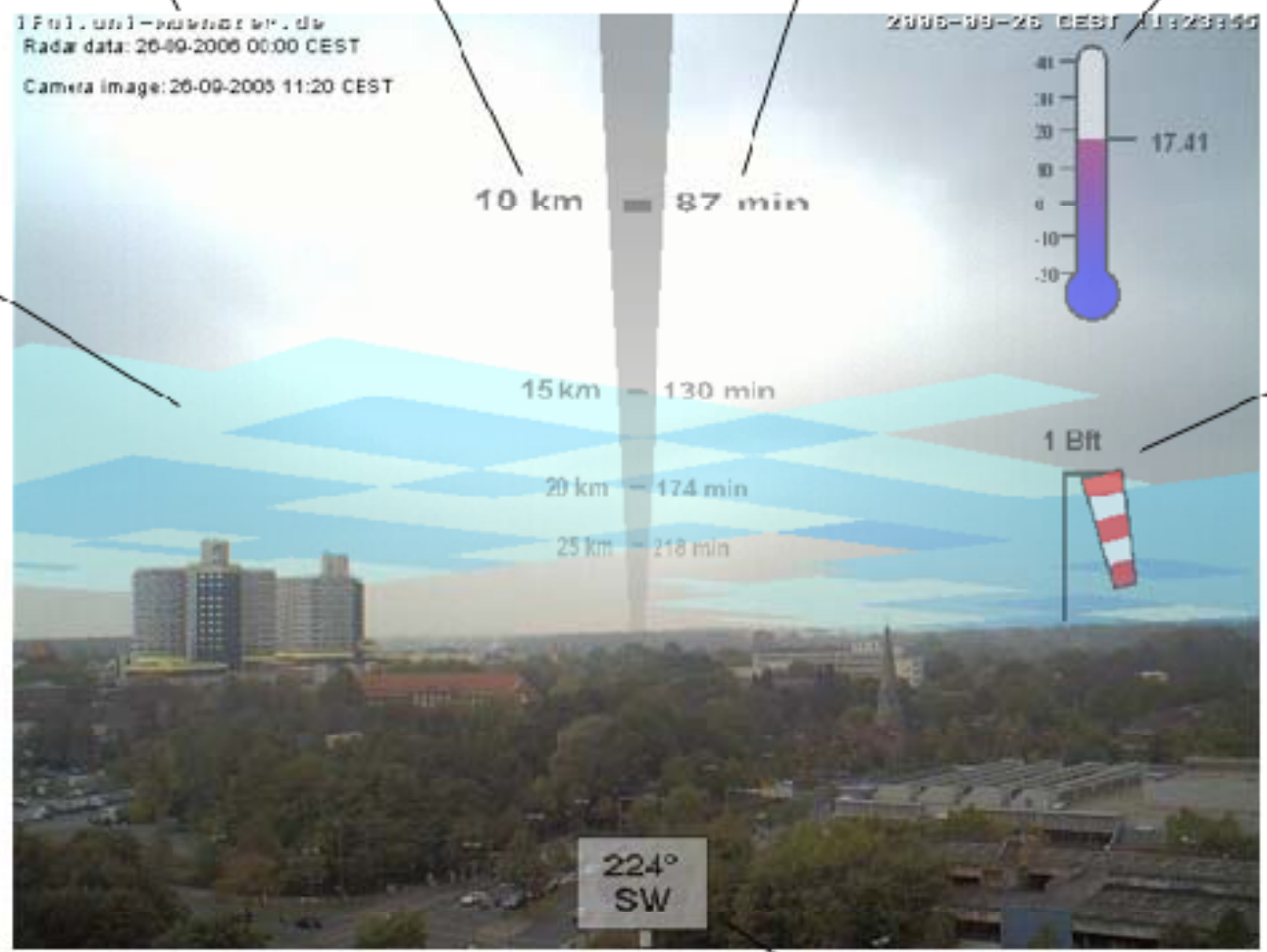
# Example:

distance between rain clouds and camera

approximate time the rain clouds need to arrive at the camera position

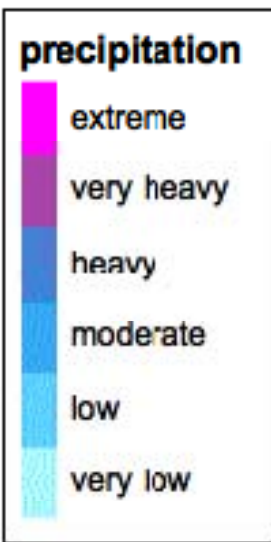
latest time stamp

temperature



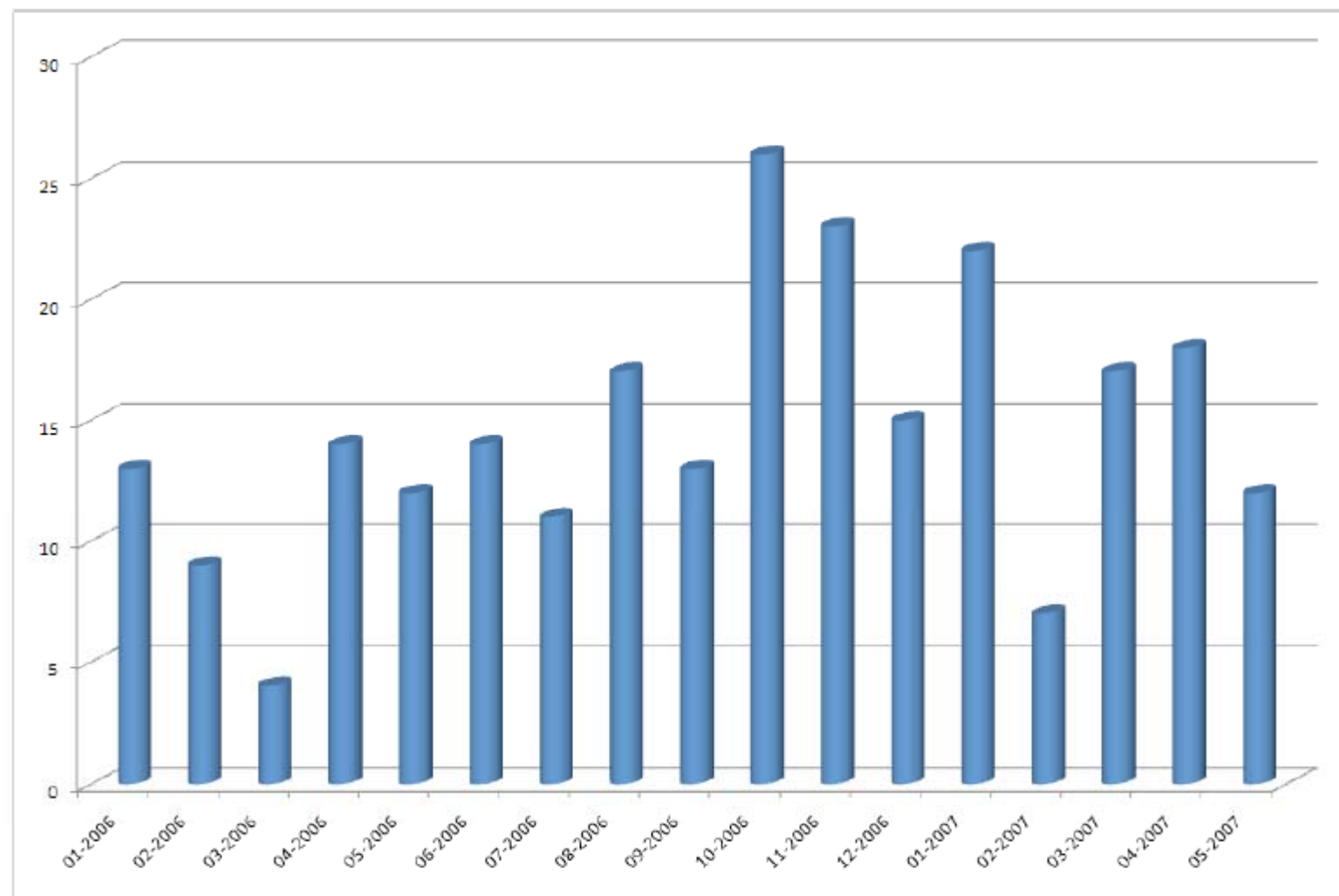
rain clouds / precipitation

wind speed



direction of view (according to wind direction)

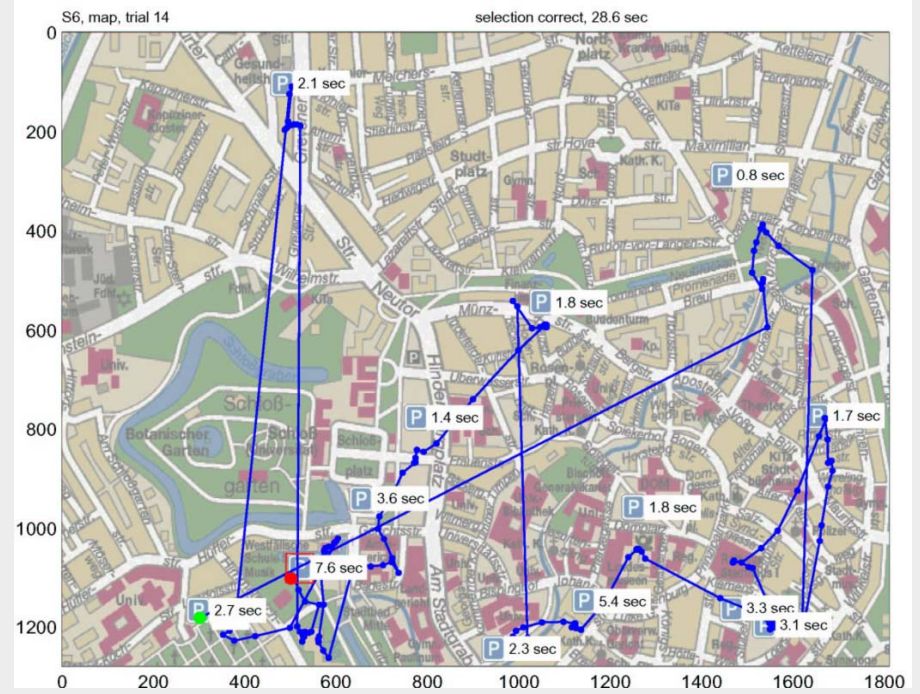
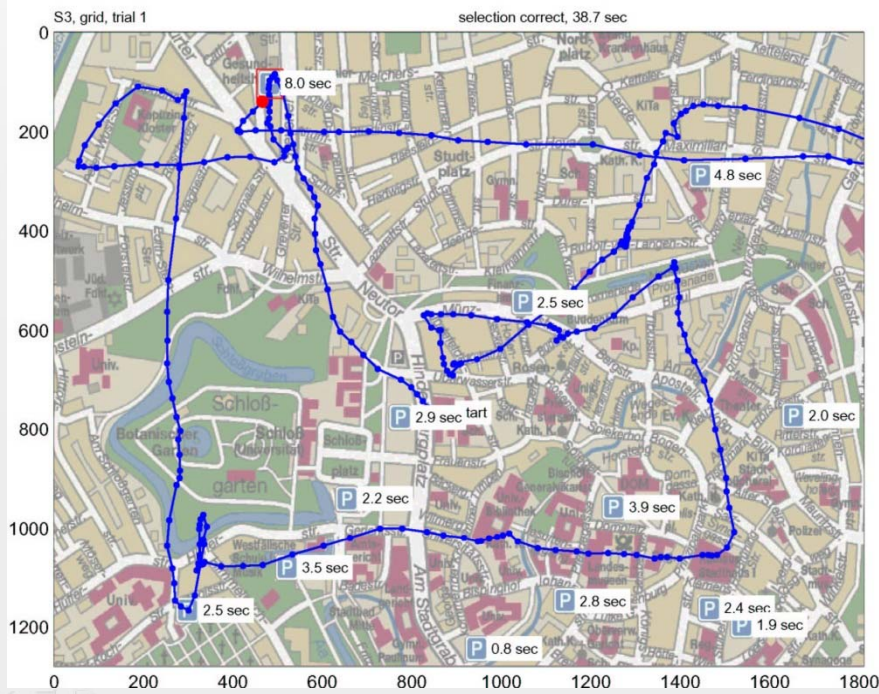
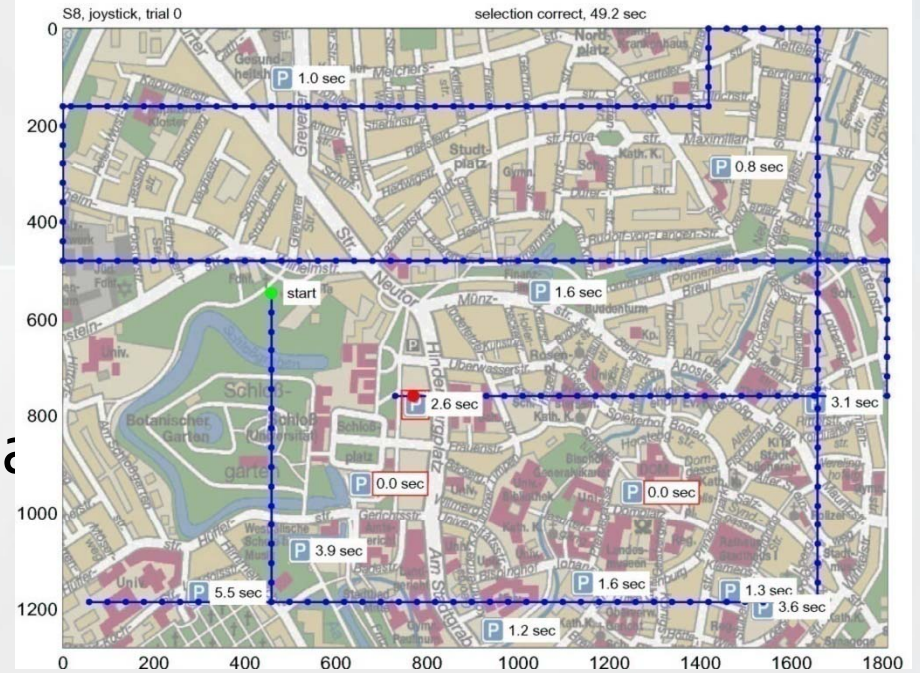
# User acceptance iDisplays





# User Study I

- Device/Map Movement Pa





# Eyetracker-based study

## Partner: T-labs

- Search task: find cheapest parking lot
- Independent variables:
  - Background style: pattern, map
  - Size of background: small, large
- Dependent variables:
  - Searchtime, gazeshifts, map coverage, movement patterns, learning rate

