



Investigation of barrier-free environment based on smart band technology



Quelle: Bodymonitor

Motivation

1. Inclusion of people with disablement
2. Demographic change and number of people with disablement
 - **Severely disabled:** 1995: 6,5 Million  2013: 7,5 Million
 - **Quantity of 60+:** 1960: 17,4 %  2060: 39,2% (source: Statistisches Bundesamt 2013)

Objective

1. Identify suitability of Smartband technology for barrier recognition



Quelle: Bodymonitor

2. Investigation of Barriers freedom of a test route

Psychophysiological Monitoring

- Psychophysiology is an **interdisciplinary science** from the branches of **Psychology** and **Physiology**
- Psychophysiological Monitoring enables registration of **physiological response patterns in ones body and Nervous system**, which are caused by **mental processes**
- The physiological signals of the body are measured in the places of action

Psychophysiological Monitoring

Perception of a barrier



Stress arises



Activation of the sweat glands



Registration at the places of action

Smartband

Sensors for tracing changes in:

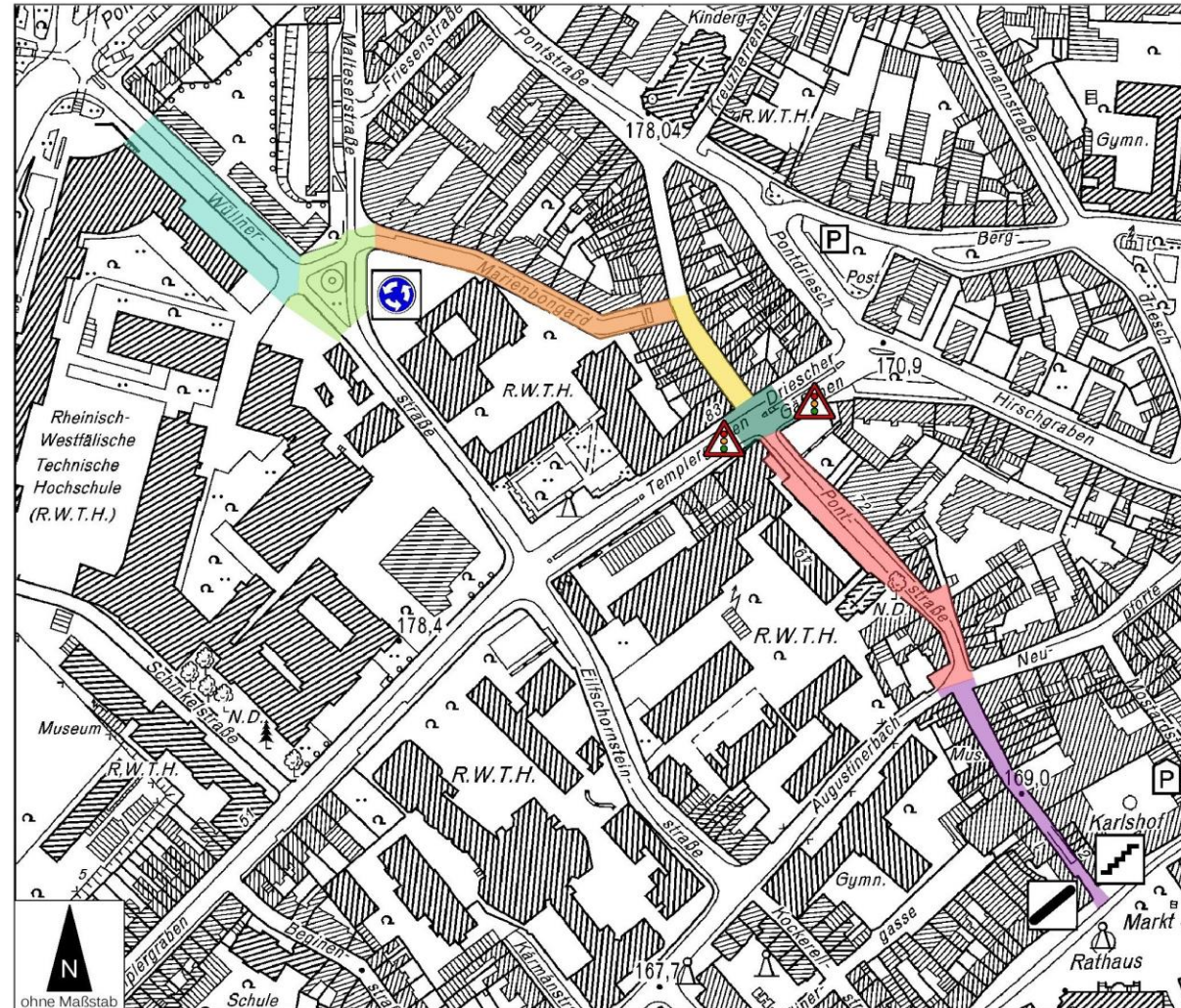
- Perspiration
- Skin temperature
- Outside temperature



Quelle: Eigene Darstellung

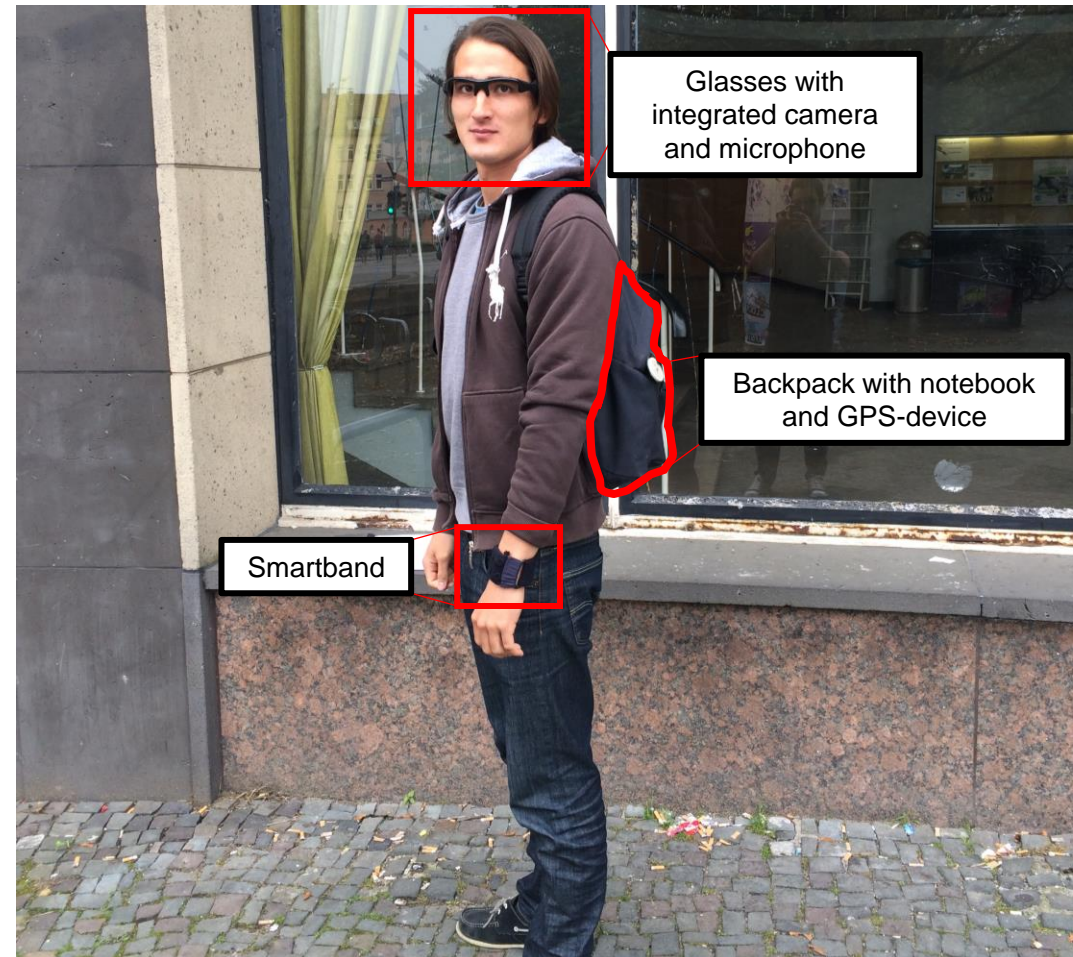
Test track

- Test track is split up in segments
- Urban analysis according to DIN-Norms



Quelle: Eigene Darstellung nach DGK 5

Messinstrumente



Quelle: Eigene Darstellung

Sample and course of the survey

- **29 Persons from Aachen aged from 18 to 76, of them:**
 - 12 wheelchair users
 - 3 blind
 - 14 People without disablement

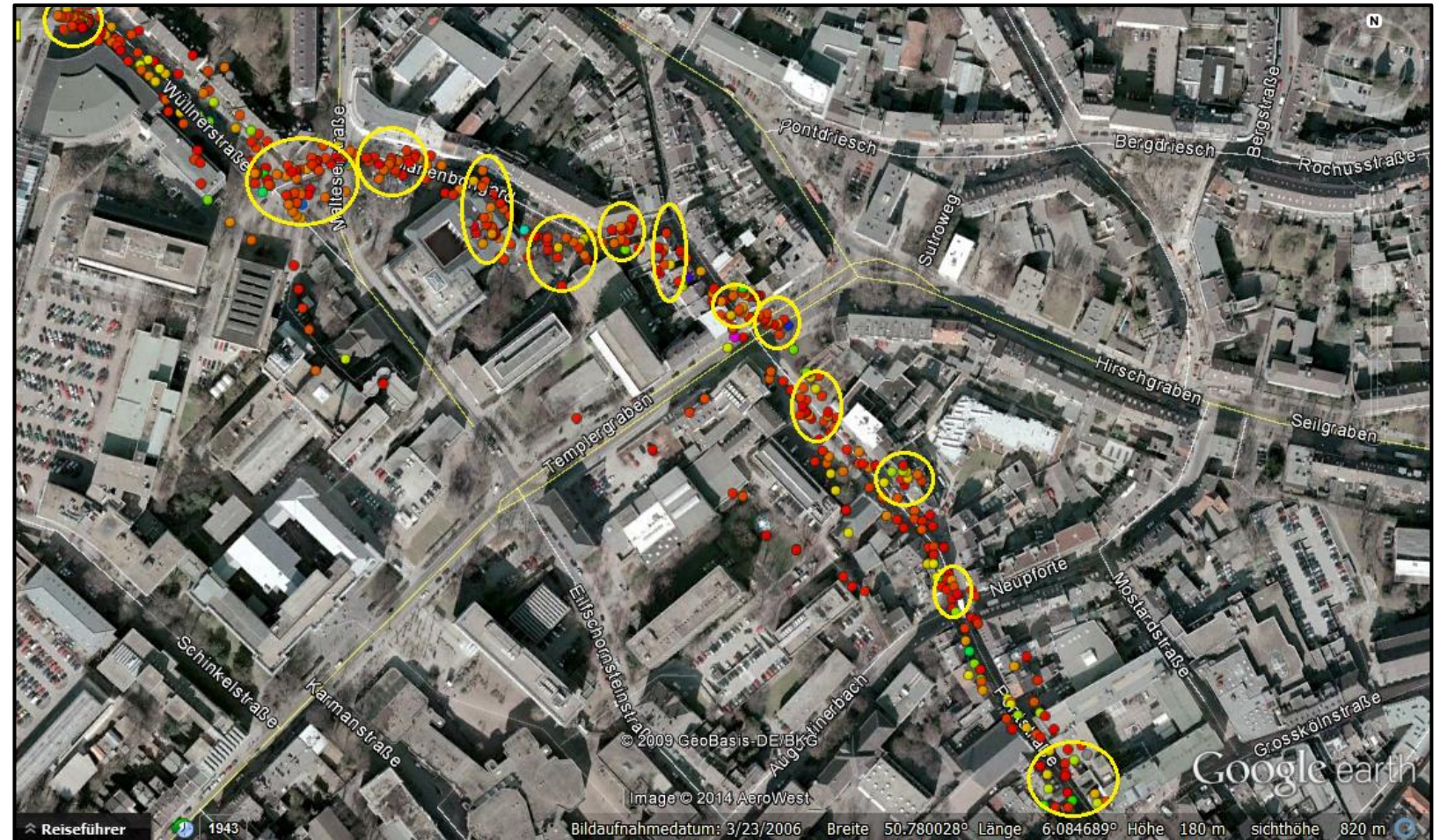
- Performed in three steps:
 1. Showing a calibration movie for emotional induction
 2. Committing the test track
 3. Filling in a questionnaire



Source: Bodymonitor

Initial visualization of the data

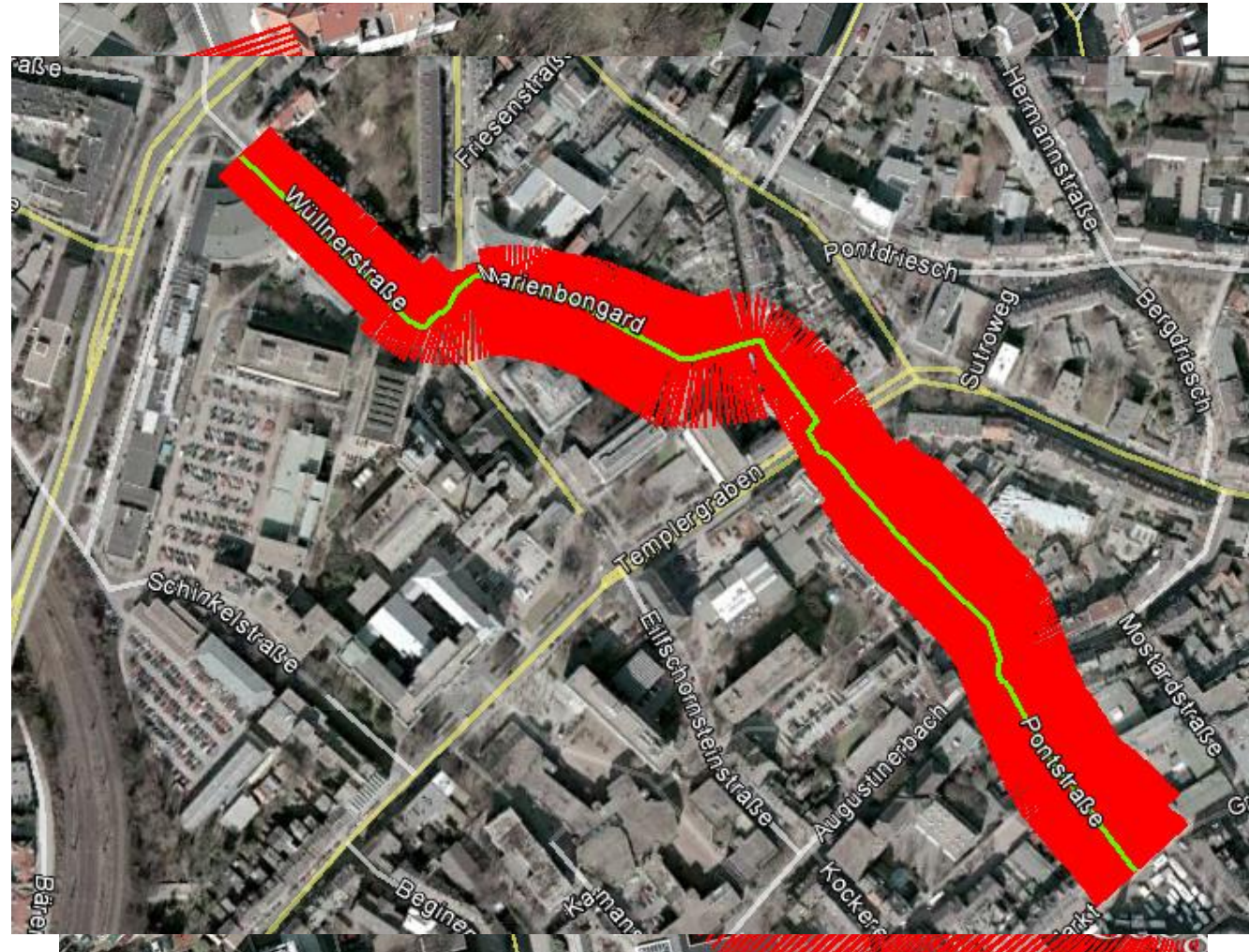
- Strong deviations of the GPS-Positions
- Only arbitrary statements about stress points can be made
- Generally heavy problems caused by GPS-equipment



Source: Google Earth

Precise segmentation

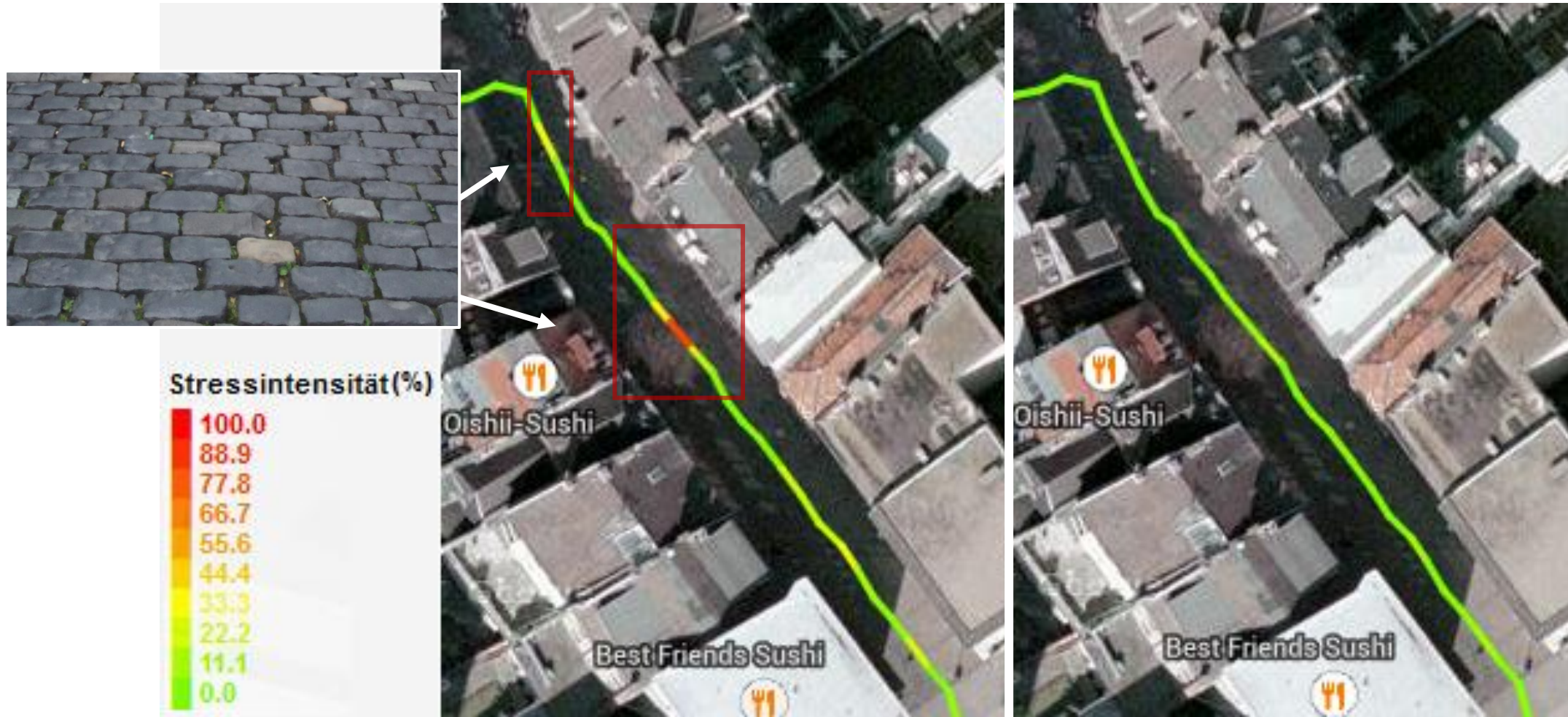
- Creation of fine segments with a width of 1,5 m
- Match GPS-Positions onto a projection path using the fine segments



Source: Google Earth

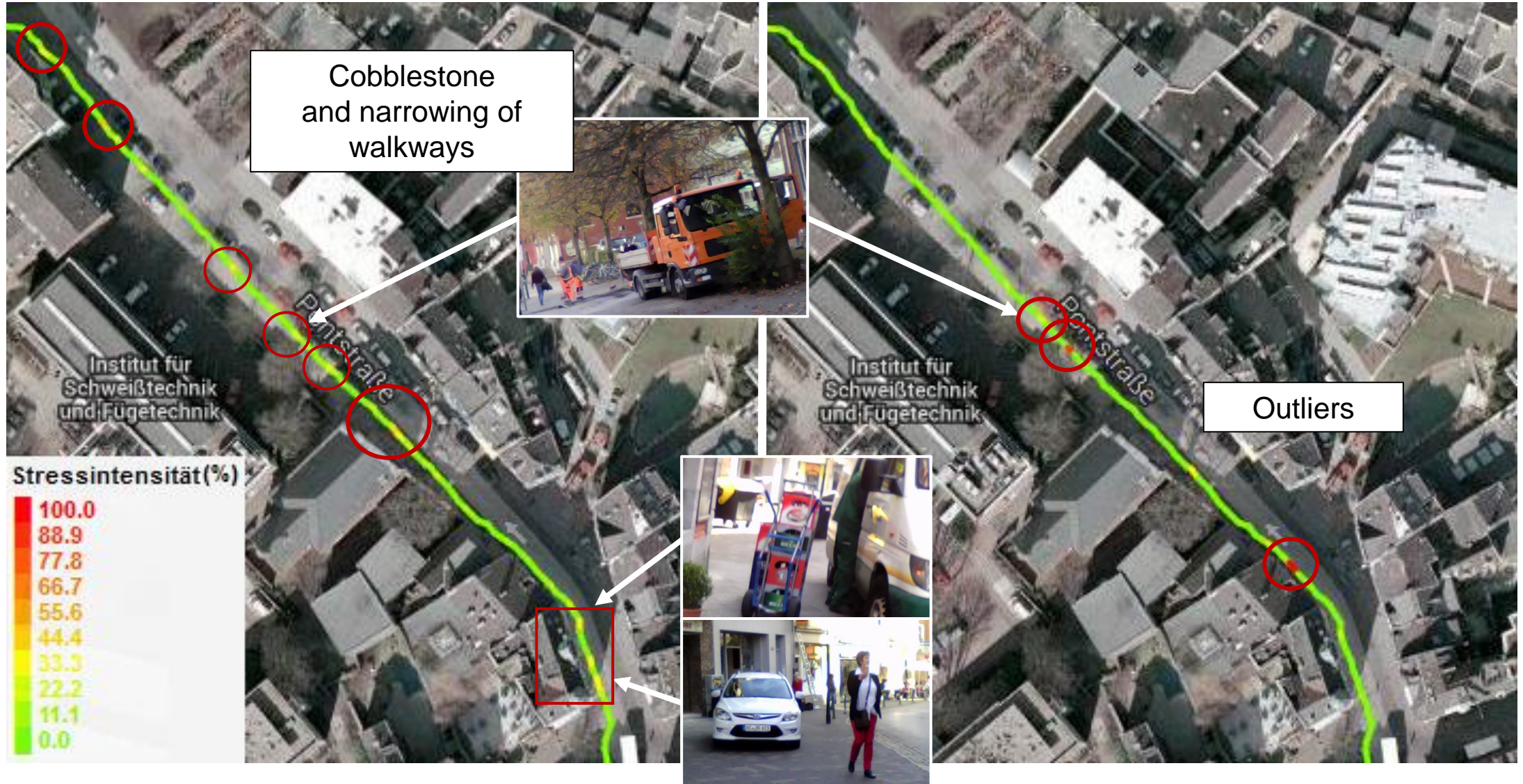
Wheelchair users

Non disabled



Wheelchair users

Non disabled

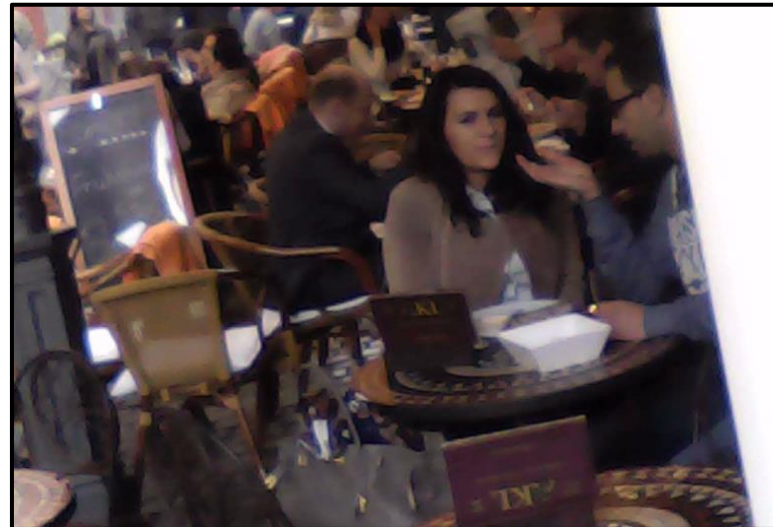


Wheelchair users

Non disabled



Blind



Main problem areas of the test track

People without disablement:

- Cobblestone uncomfortable

Wheelchair users:

- Driving over cobblestone
- Hand-operated wheelchair users not being able to cope with a slope
- Incline of slope too high for electric wheelchair as well

Blind and visual impaired people:

- Scanning cobblestone using a long pole
- Missing guide elements on the track
- Missing tactile surfaces at zero drops

Advantages:

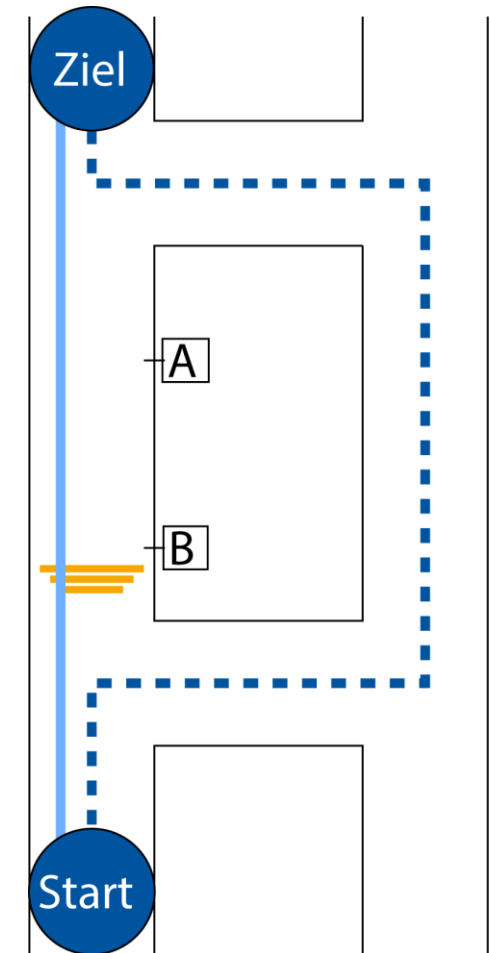
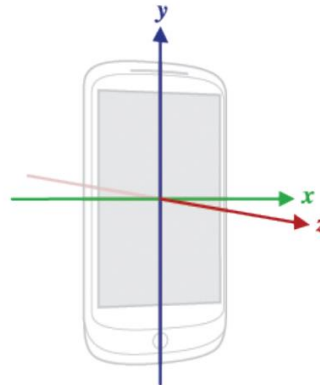
- Detailed identification of barriers
- Identification of unpleasant roads
 - Ideas of improvement

Disadvantages:

- Expensive non commonplace equipment
- A lot of equipment
- High evaluation effort
- Calibration required

Alternative: Crowdsourcing approach

- Barrier detection by analysis of users driving behavior
- Recording of the Z-axis acceleration to determine surface quality
 - Allocation rate up to 90%
 - Auto calibration



Conclusion

Test track

- The chosen test track has an exclusionary effect on people with impairment because of missing guide elements as well as the flooring type

Smartband-technology

- Produces valid and objective measurements
- Identifies barriers beyond urban analysis
- High evaluation effort

Thank you for you attention!

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