

# Visualization and Communication of Indoor Routing Information

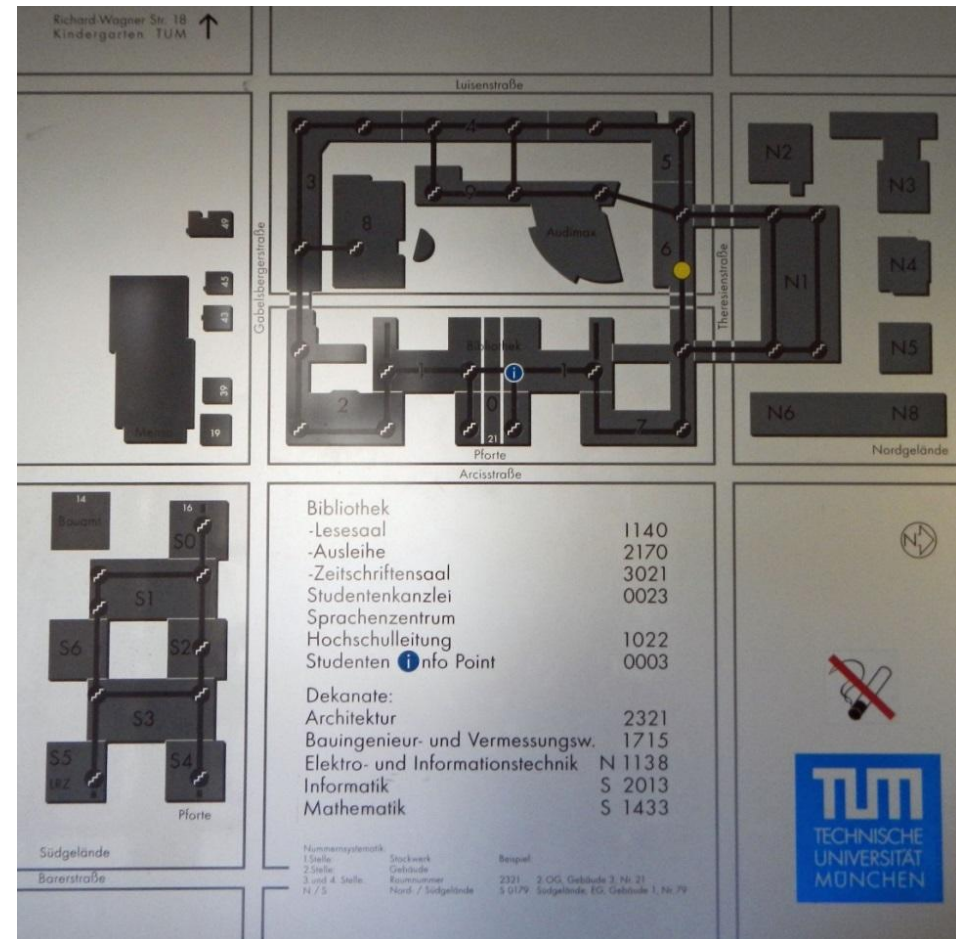
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# Motivation - „Classic“ indoor routing

- Indoor-Routing is one of the prominent areas in Location Based Services (LBS)
- Research, for example - How can computational or suggest a route that coincides with the “natural” way of walking indoors?



# serious Motivation - „Current“ indoor routing

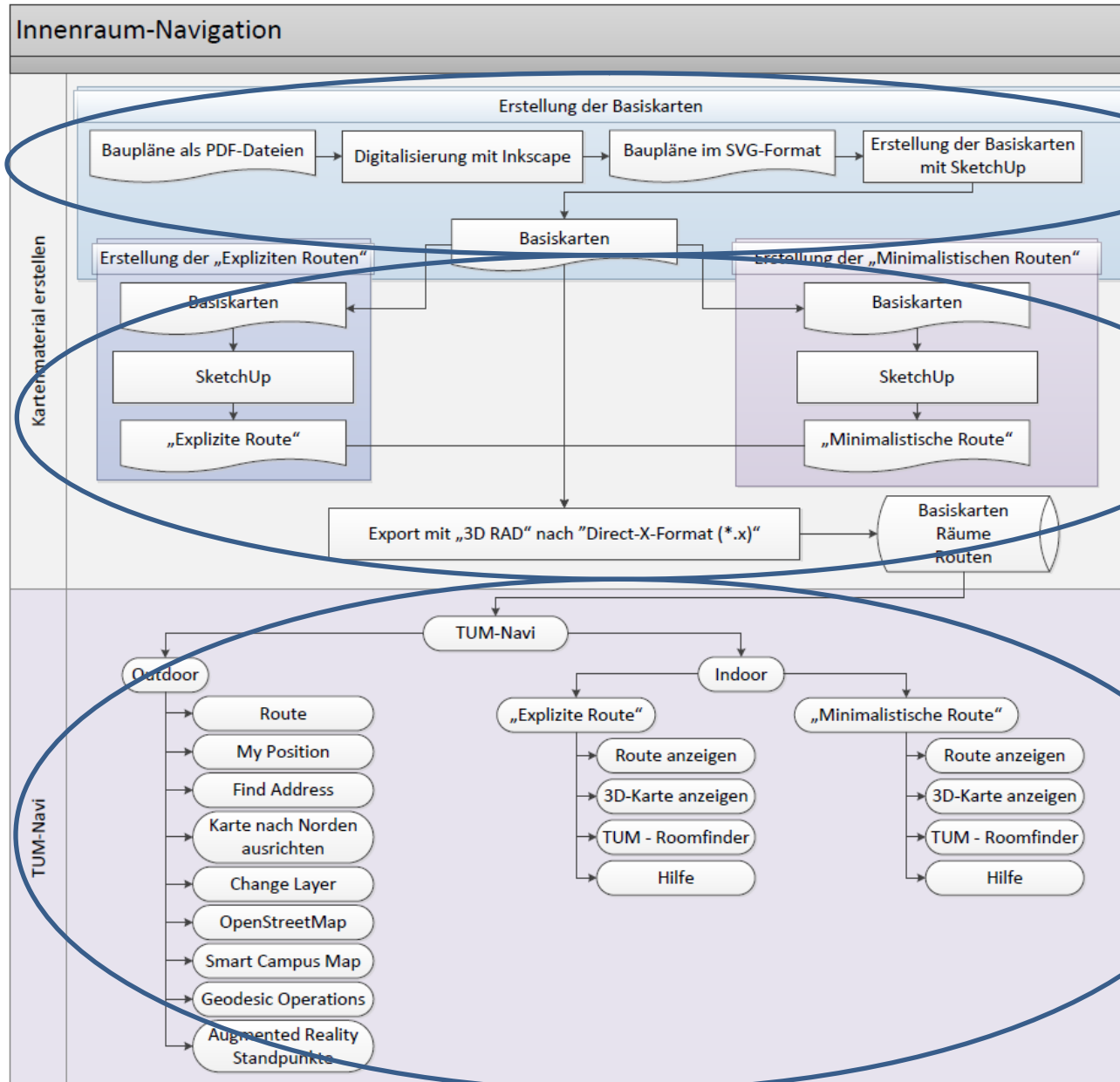
- New floor plans in 2013
- Evaluation - (MA thesis Fackler) – this plan does not work.



# Aim – functional routing indoor on a smart phone– “**low-tec**” approach -

- The approach with **pre-defined routes** is practical (somewhat „low-tech“)
  - No real-time position
  - Once the user gets lost, he/she has to go to the next POI (e.g. room number) + request a new route
  - No “dynamic” routing (with on the fly route computation)
  - pre-defined routes - in our case -not pictures, but a 3D model with the route displayed

# Conceptual design „indoor navigation“



**Data**

**Computation of  
pre-defined  
routes**

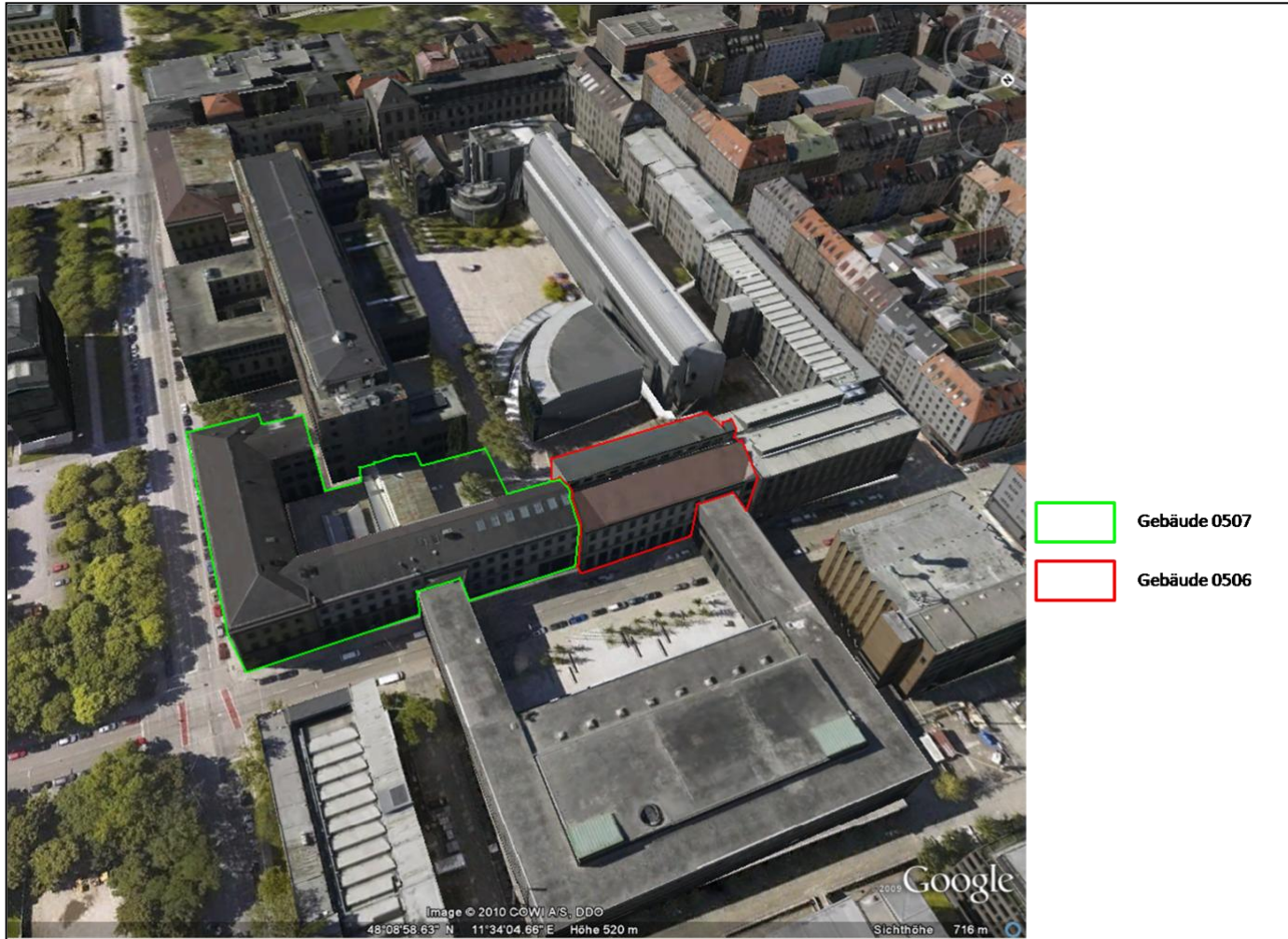
**GUI – App for  
selecting &  
displaying the  
pre-defined  
routes**



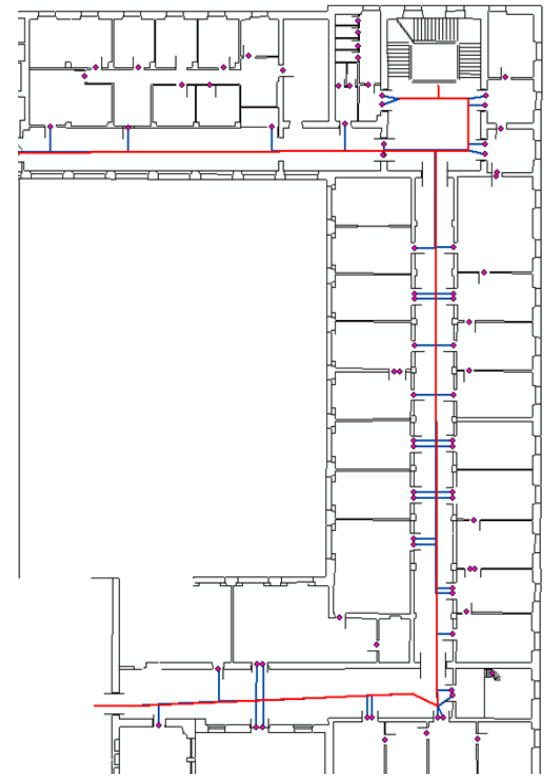
# Indoor data Challenge - Outdoor / Indoor Technical

## University Munich

In particular - CAD-floor plans in .dwg-format for the building parts 0506 und 0507



## Transformation of floor plans (e.g. polygon shapefiles with FME - Feature Manipulation Engine)



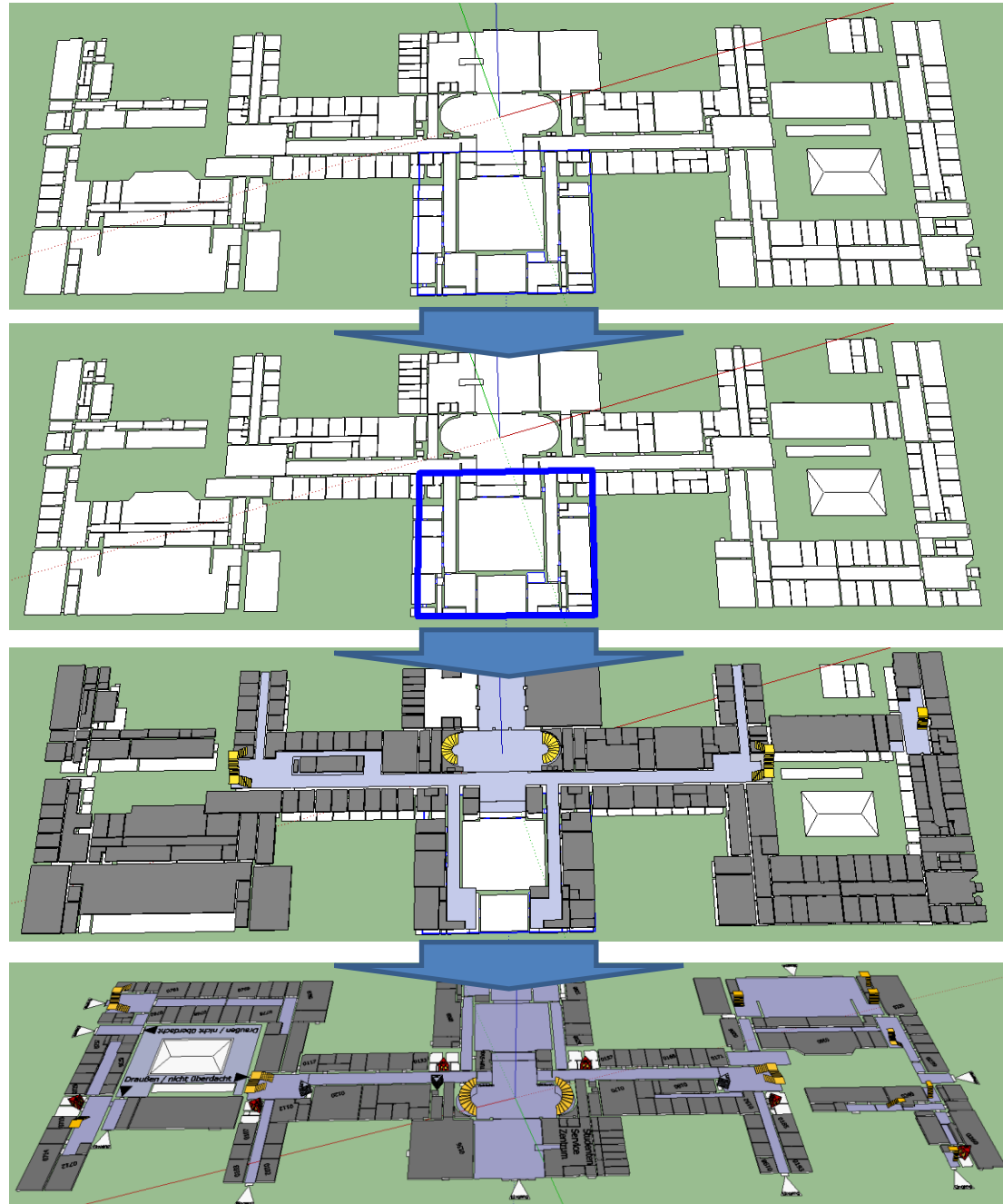
polygon-centerlines / polygon  
 center points used as a basis to  
 compute the network

- input .dwg floor plan
- Architectural floor plans
- .pdf and .dwg format
- Prints with hand annotations

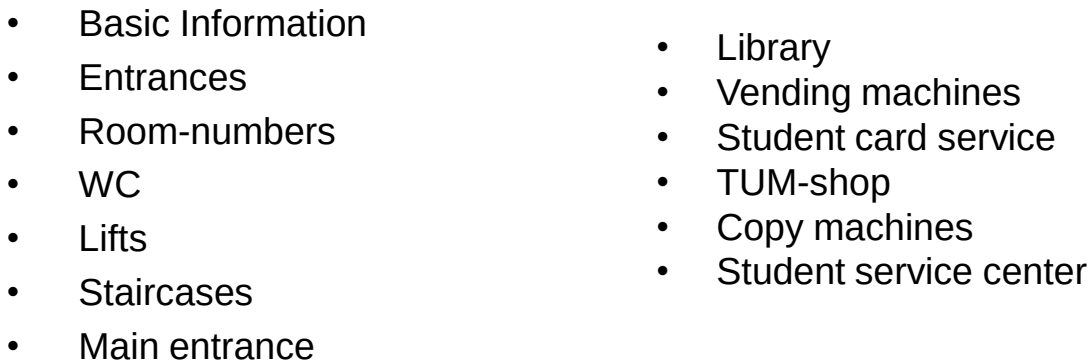
e.g. BERGER, T. & FRIEDEL, T. 2010. Vom CAD-Plan zum Routing-System: Schaffung einer Datengrundlage. . *Kartographisches Projekt. Lehrstuhl für Kartographie. Technische Universität München. (unpublished)*. ●

# Data

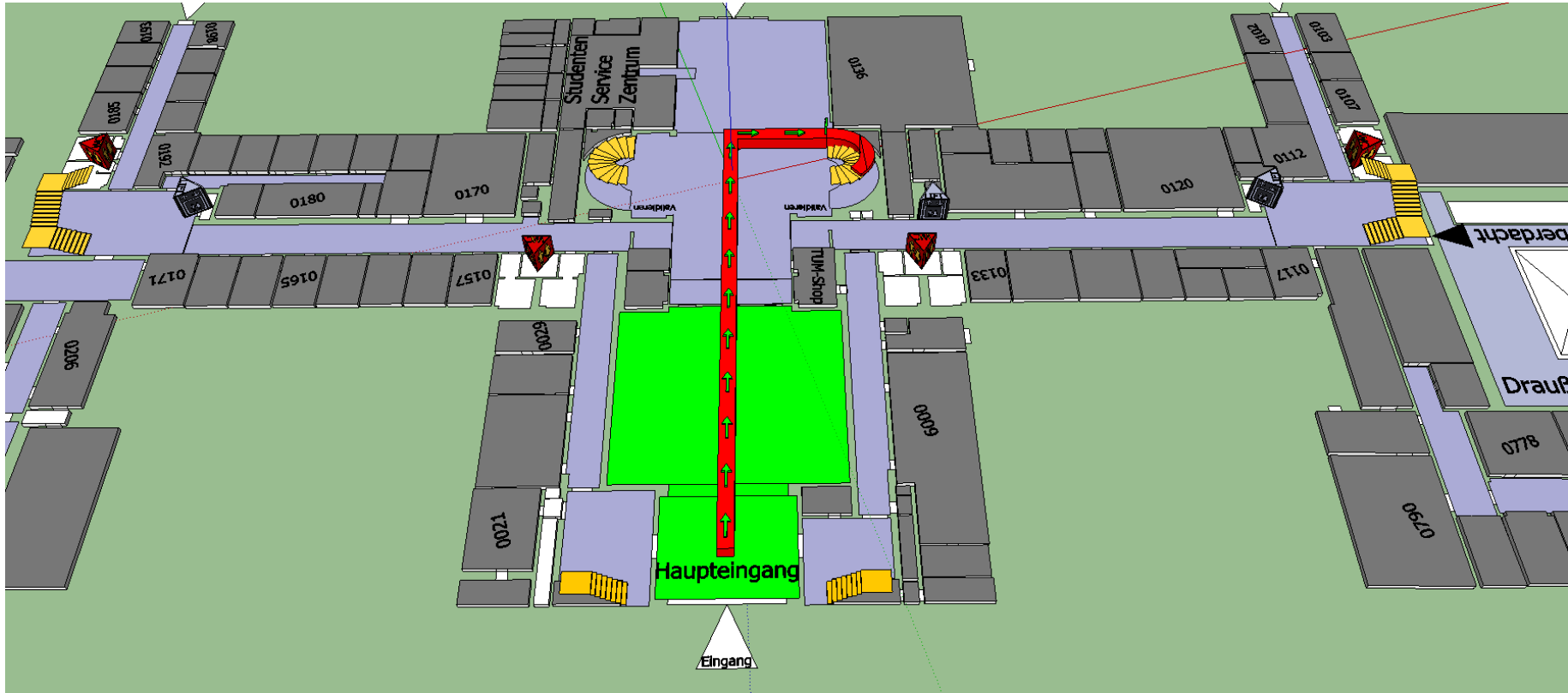
- Manual build-up of the indoor building model
- Manual addition of pre-computed routes





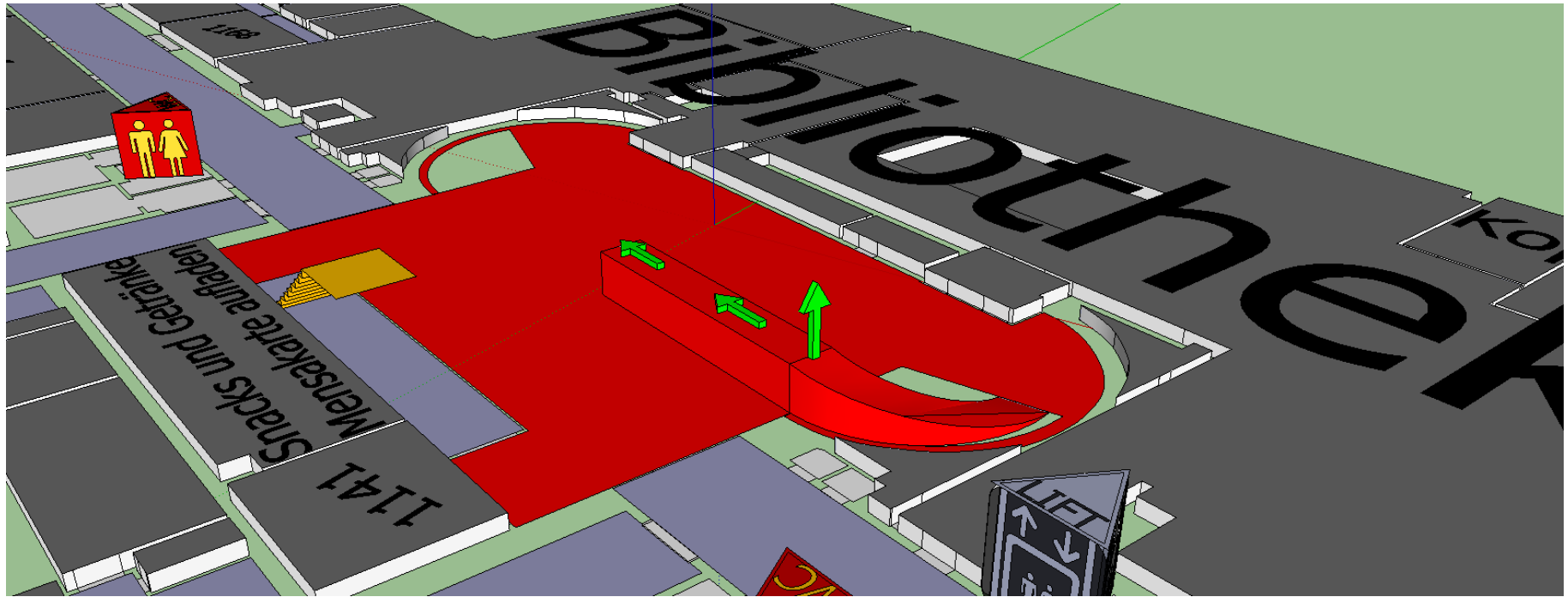


# Starting „Points“ vs Starting „Areas“

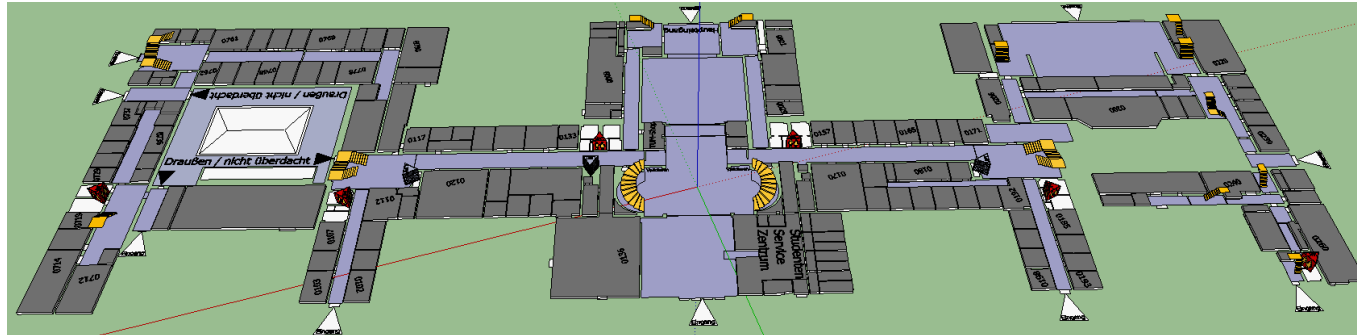


- Selected room numbers are only shown (+ at the beginning and the end of a corridor)
- Room numbers are not aligned parallel to walls

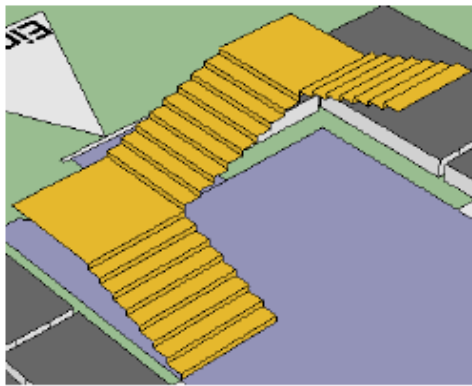
# Destination Area



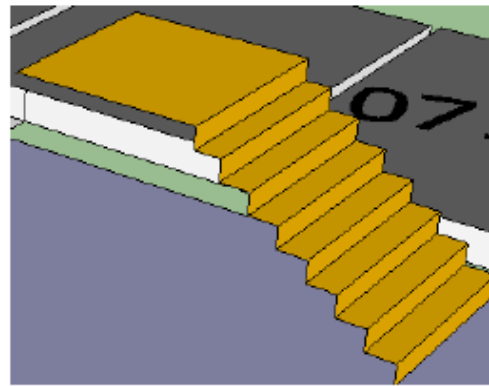
# Design details - indoor navigation



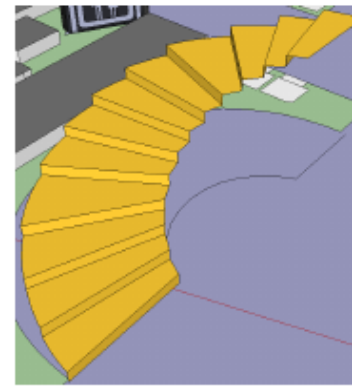
- “Significant indoor landmarks”
- Designed „by hand” (Google-SktechUp)
- Room numbers in 3D



(a) Treppe – Typ 1



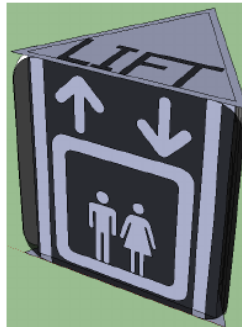
(b) Treppe – Typ 2



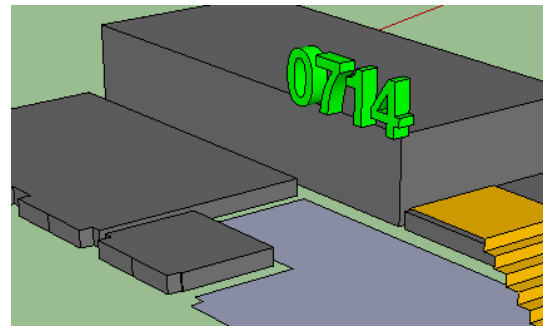
(c) Treppe – Typ 3



(a) Symbol – Toilette

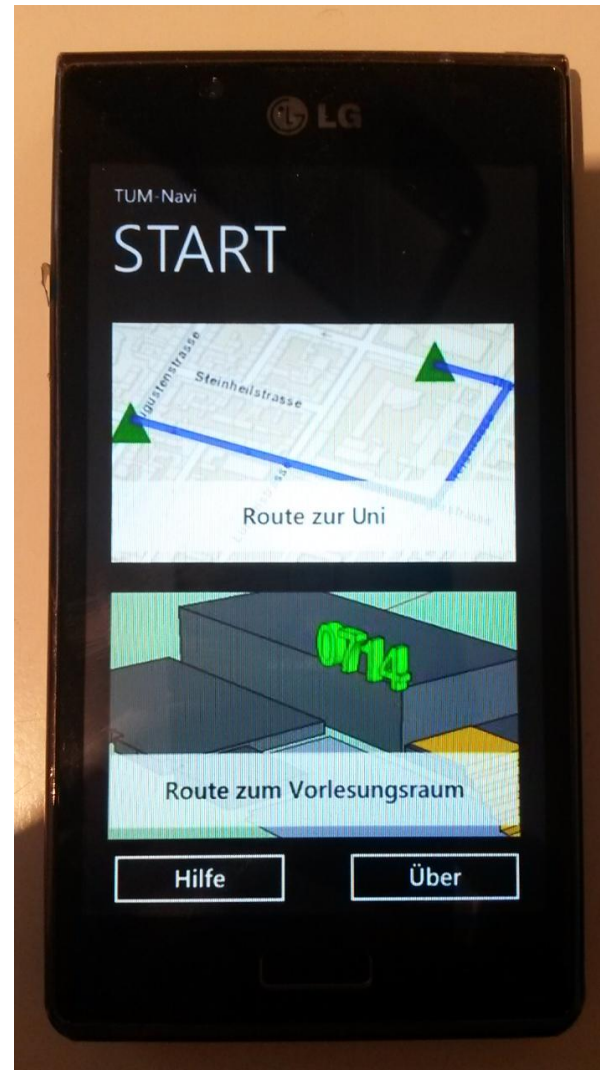


(b) Symbol – Lift



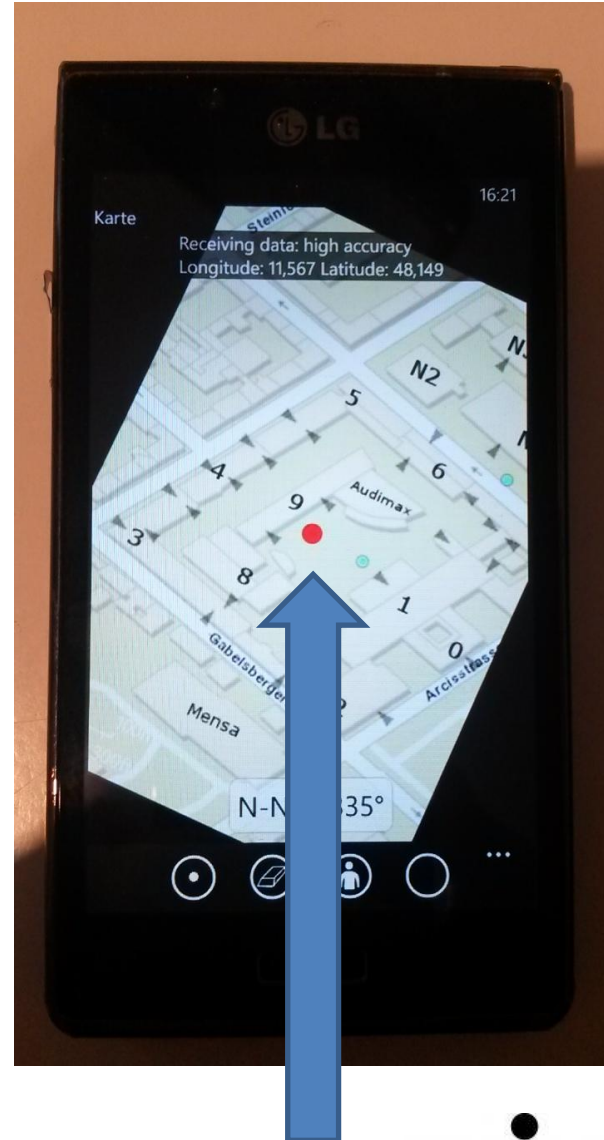
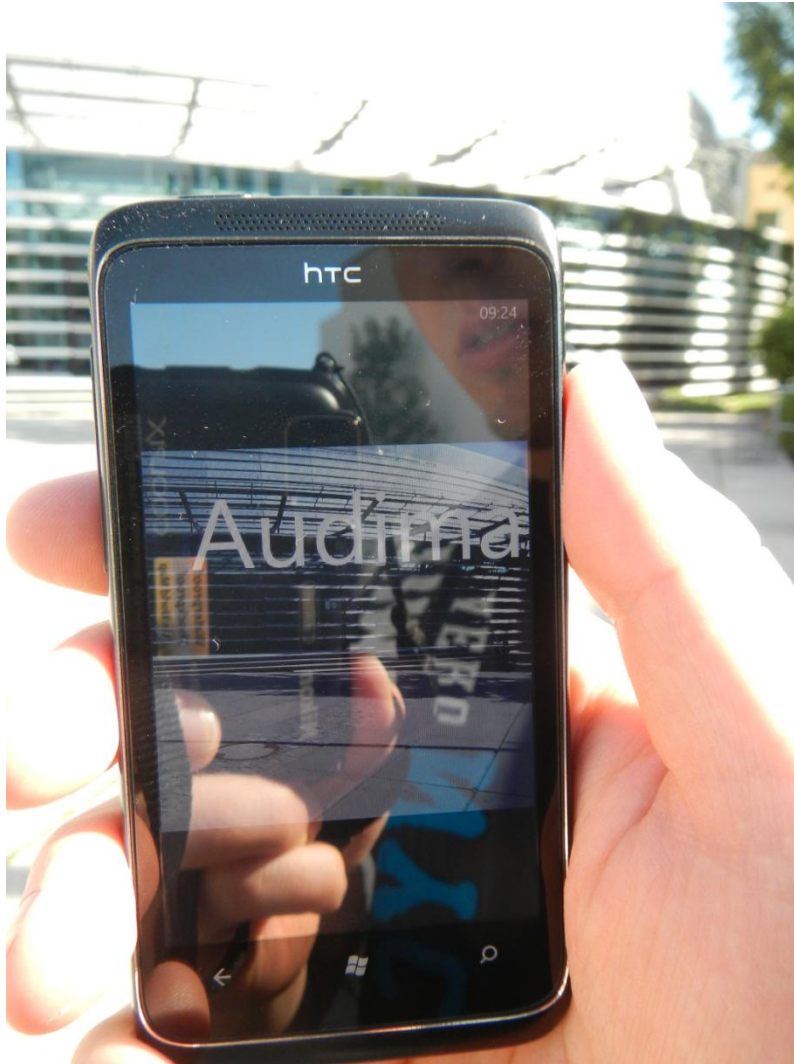
# GUI - Test-Application

- START
  - Route to the University „Outdoor“
  - Routing: „Indoor“
- On Windows Mobile 7.8



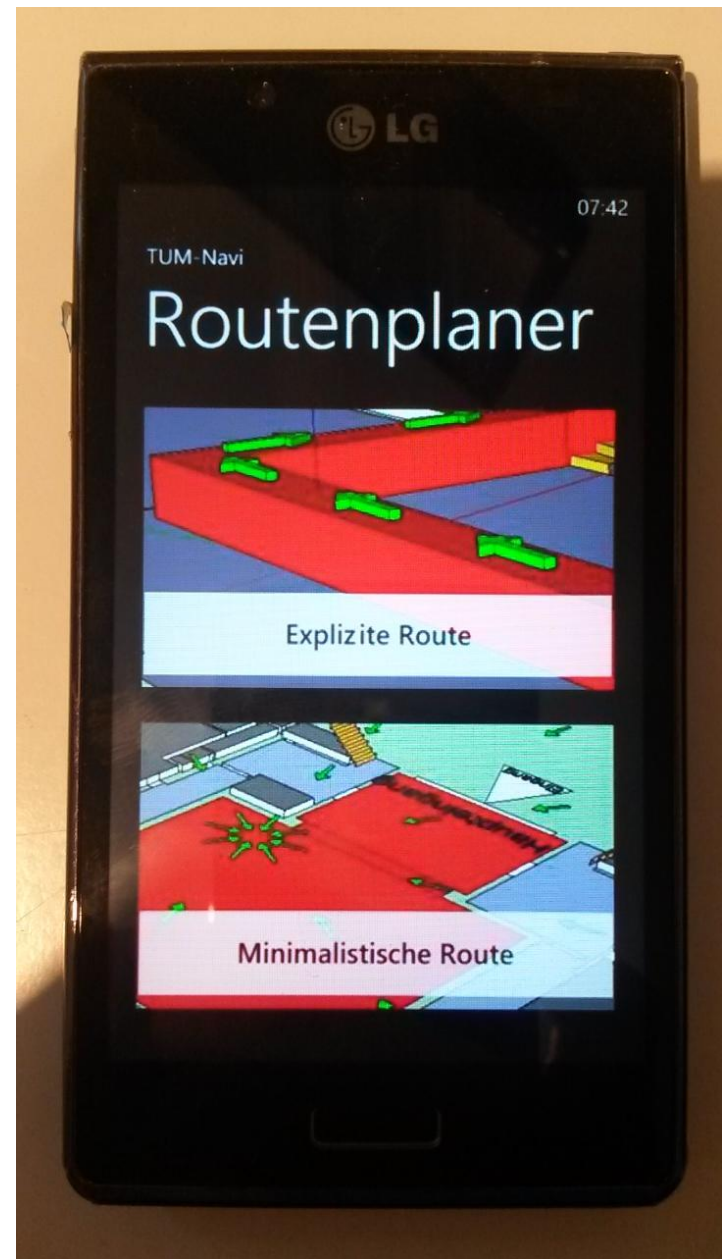


# Outdoor routes - Augmented Reality views from fix-points

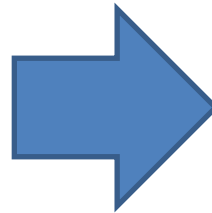


# Routing indoor

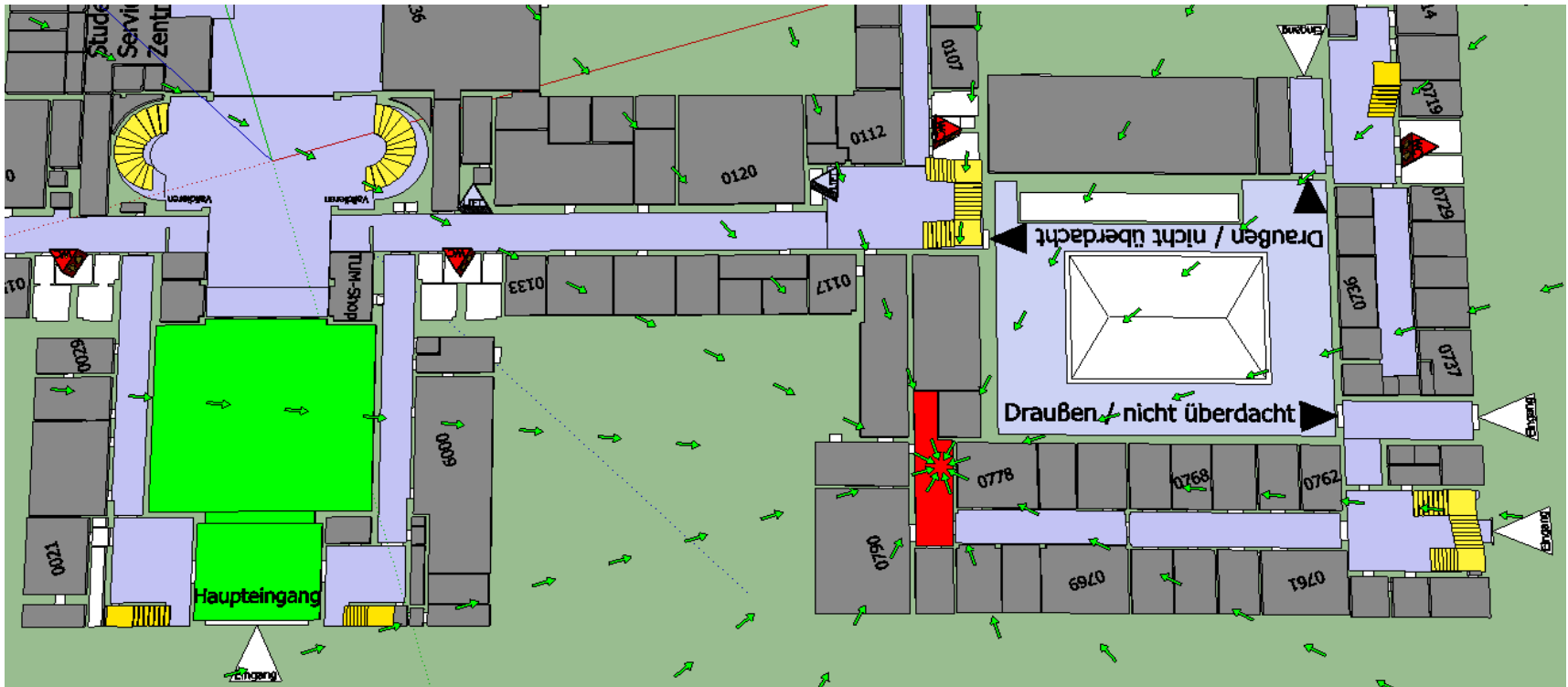
- Routing via
  - **Explicit Route**
  - **Minimalistic Route**
- Study Area
  - Route in the main building parts:
    - Bestelmeyer Süd
    - Institutsbau mit Verwaltungsbau
    - Bestelmeyer Nord
  - Test with **Main Entrance → 0714**



# Explicit Route



## Additionally – Tests with a „Minimalistic View” (arrows to the destination area)



- Room numbers are only shown at the beginning and the end of a corridor
- Room numbers are not aligned parallel to walls





# Does the system work ? - Initial user survey

- 8 participants
- 18 questions
- Outdoor part
- -- Indoor part (explicit & minimalistic view)
- Focus on explicit routes
- Informal test – e.g. walk from room 0714 to the main entrance

13. Wie bewerten Sie die optische Wirkung des 3D-Modells von „Explizite Route“?

|                                 | -3                       | -2                       | -1                       | 0                        | 1                        | 2                        | 3                        |
|---------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Farbwahl                        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3D-Gestaltung                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Detailgrad                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Symbolisierung der Lift/Aufzüge | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Symbolisierung der Toiletten    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Symbolisierung der Treppen      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| .....                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

14. Wie bewerten Sie die Routendarstellung von „Explizite Route“?

|                              | -3                       | -2                       | -1                       | 0                        | 1                        | 2                        | 3                        |
|------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Startbereich ist erkennbar   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Zielbereich ist erkennbar    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Route ist verständlich       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Insgesamt eindeutig und klar | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| .....                        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

# Visualization design

- ~ “only” 8 participants
- Generally positive (+3)
- **Symbolization very positive**
- Color design needs improvements (perhaps due to phone display)
- **3D presentation seems unfamiliar at first**

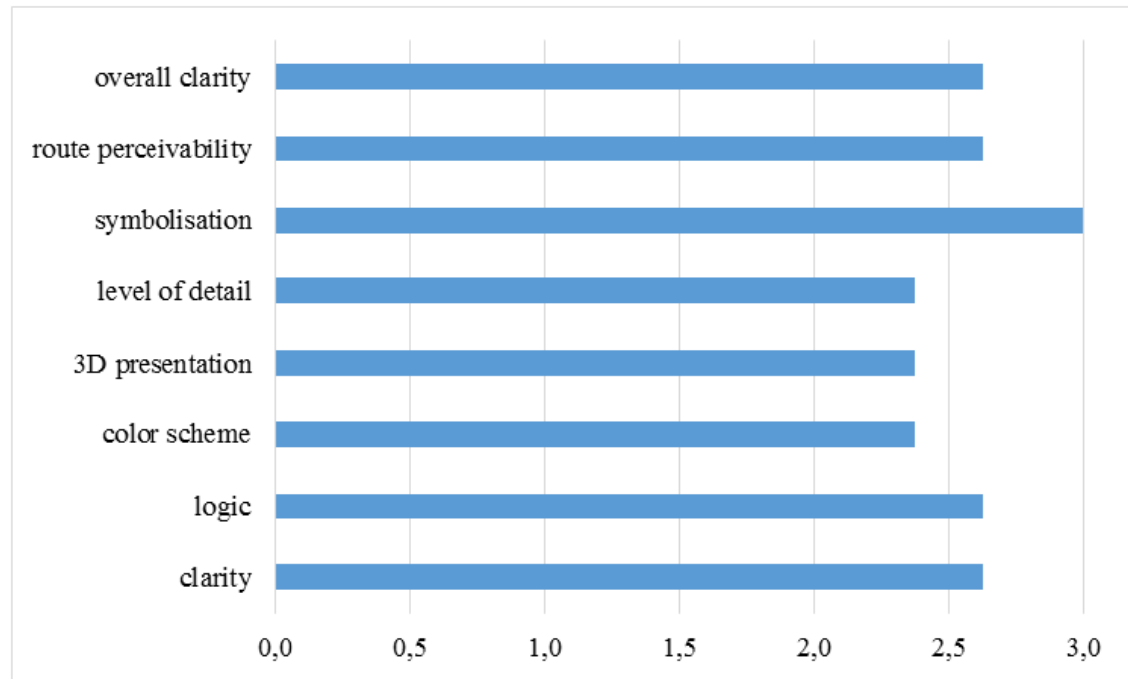
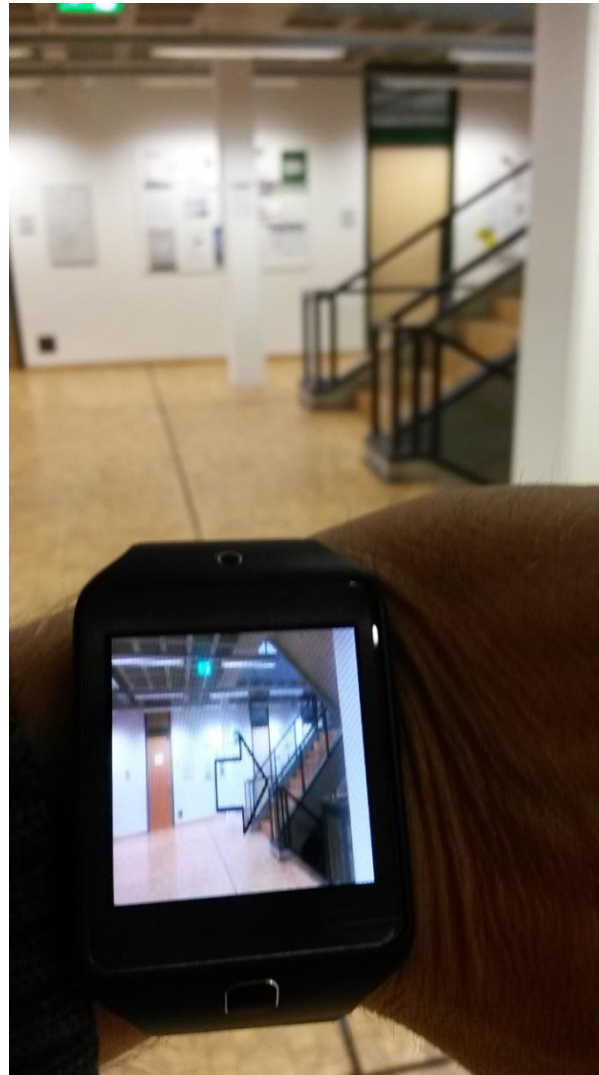


Figure 5. Selected questions and its average results from the initial user survey



# Conclusion & Challenges



- **Increasing diversity of technical systems** (e.g. route planner in Windows 7.8 – not available)
- **Increasing diversity of devices** (e.g. Smartwatches, Glasses)
- **“Sophisticated platform specific systems” vs “Universal “low-tec” web-based systems”?**

# Into the future



- Increasing amount of systems for pedestrian & indoor navigation
- Reduced content (again)?
- “Context” needed?

## Contact & Further information

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