Accessible Maps

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Accessible Indoor Maps:
Information Need and Automated Solutions to Address Gaps in Maps for People with Disabilities

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Who we are

The AccessibleMaps Consortium

- International and interdisciplinary team of the **Dresden University of Technology** and the **Karlsruhe Institute of Technology** are working together on innovative and new solutions to improve mobility within buildings.

- **AccessibleMaps** aims to develop software that automatically generates indoor maps enriched with accessibility features

- Web: **http://accessiblemaps.de**

Topics of today's presentation
Outline

1. Motivation

1. Understanding the Needs and Abilities of People with Disabilities

1. Current Situation - Where are we now
    - Data Basis
    - Accessible Representation
    - Challenges

1. Possible Solutions
   For the Collection and Representation of Accessibility Information

Motivation
Accessible Indoor Maps

- **Social relevance:** Independent travelling and mobility is challenging for people with visual and mobility impairment [PC18]

- Many and diverse barriers in buildings, e.g. ground level objects not detectable for blind people using a cane.

- Why Indoor and why maps?

Source: TV report of our project Range-IT

Modelling Physical Accessibility

Understand the Needs and Abilities of People with Disabilities I

- People with disabilities need granular information about the **layout**, **orientation features** (i.e. landmarks), **barriers** and **temporal relations** to find their way independently [FBC19].

Information need	Mobility impaired people	Visually impaired people
potential barriers	narrow doors or passages, lack of or non-functioning elevators and escalators, lack of handrails, uneven walking surfaces and heavy doors [TWD04]	handrails and wayfinding information (in complex and confusing buildings), or buildings with bad lighting conditions [TWD04]
accessibility features	slope of a path, floor covering, manual or automatic opening of doors, or accessibility of restrooms	availability and location of braille signs [AA15] and tactile pavings

Modelling Physical Accessibility

Understand the Needs and Abilities of People with Disabilities II

- Diverse information need for planning a trip and its implementation [EMC20]
- **Problem:** No common approach to collect and makes information about physical accessibility of buildings available for different user groups and for all parts of the travel chain.
- Accessible indoor maps can be a solution!

Table 1. Relevance of features for blind people (BL) and people with low vision (LV) when planning and implementing a trip [EMC20]

Classes	Features	Properties	Planning		Implementation	
			BL	LV	BL	LV
Metadata	Address of building		98.41 %	90.70 %	71.43 %	72.09 %
	Opening hours		87.30 %	79.07 %	68.25 %	72.09 %
	Room name at destination		96.82 %	86.05 %	98.42 %	93.02 %
	Size of the building		38.09 %	51.16 %	46.03 %	55.81 %
	Number of floors		41.27 %	46.51 %	57.14 %	51.16 %
Building description	Floor plan of building	existence	44.45 %	44.18 %	49.21 %	46.52 %
		location	-	-	65.07 %	55.81 %
	Textual descriptions	location	65.08 %	48.83 %	82.54 %	32.56 %
	Tactile maps	location	44.45 %	27.91 %	30.23 %	30.23 %
Indoor landmarks	Entrances	main [loc.]	84.12 %	81.39 %	81.40 %	81.40 %
		accessible [loc.]	23.81 %	34.89 %	28.57 %	37.21 %
		entrances/exits [loc.]	34.92 %	44.19 %	39.69 %	46.52 %
	Type of doors	sliding/swinging	-	-	50.79 %	46.51 %
	Stairs and staircases	location	71.43 %	53.49 %	88.89 %	75.42 %
		type	33.34 %	23.25 %	47.62 %	32.56 %
	Elevator	location	41.27 %	53.49 %	53.97 %	58.14 %
	Toilets	location	63.49 %	62.79 %	74.60 %	74.42 %
	Temporary barriers		79.37 %	69.77 %	77.78 %	72.09 %
Outdoor landmarks	POIs such as shops, cafes		53.96 %	44.19 %	41.27 %	41.86 %
	Parking lots	location	14.28 %	9.31 %	14.28 %	20.93 %
	Neigbouring buildings		36.50 %	27.91 %	26.99 %	23.25 %

Data Basis of Indoor Maps

Collecting, Validating, and Modelling

Case Study // Current State of Indoor Maps in OSM

Quantitative Analysis

Comparison of all objects with SIT tags and SIT complete buildings in Vienna. Overpass Turbo: http://overpass-turbo.eu/, Access date: 06.05.2020

- Currently there are no widely accepted open standards for the expression of accessibility information in indoor maps

- **Methodology**: Requests for the Overpass API were formed based on tags specific for the mapping of indoor areas in OSM using Simple Indoor Tagging (SIT) - the currently used tagging schema for indoor maps in OSM
  - Minimum of required tags: *min_level, max_level, level*
  - Tags for a complete indoor map: *room, area, wall, corridor*

Quantitative Analysis Results [SLS20]

- The number of mapped indoor environments is sparse, regardless of the used indoor tagging schema.
- Even though SIT is the tagging schema currently chosen for indoor mapping by the OSM community, only a small percentage of objects have SIT associated tags.
- In four major European cities on average only one building had a completely mapped indoor environment

Case Study // Current State of Indoor Maps in OSM

Qualitative Analysis

(state: 10.04.2020)

Comparison of two buildings with mapped indoor environments following the SIT schema. OpenLevelUp: https://openlevelup.net, Access date: 11.06.2020

City	Berlin	Rome	Vienna	Paris
Buildings (SIT minimal)	6	9	7	5
Buildings (SIT complete)	1	0	3	0
Buildings with features for PMI	1	0	3	0
Buildings with features for PVI	0	0	0	0
Buildings with features for PMI & PVI	0	0	0	0

PMI: People with mobility impairments, PVI: People with visual impairments

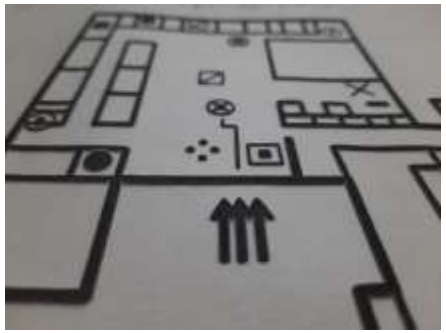
Accessible Representations of Indoor Maps

Address Diversity

State of the Art

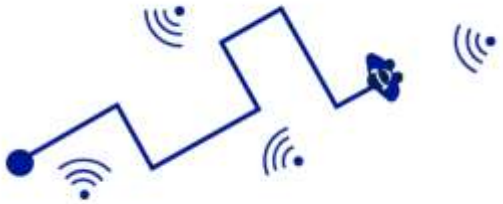
Techniques to Make (Indoor) Maps Accessible for People with VI

Tactile Maps
Most frequently used approach; effective for learning spatial structures [EUO98, GOL18]



Example: Indoor map created on swell paper

Virtual Acoustic Map
Conversion of map items into different sounds



Example: Microsoft Soundscape - A map delivered in 3D sound
https://www.microsoft.com/en-us/research/product/soundscape/

Audio-Tactile Maps
Multimodal interaction techniques to augment maps with information

Example: Tactile Maps on the Hyperbraille Display
https://tu-dresden.de/ing/informatik/ai/mci/forschung/forschungsgebiete/tactile-maps

Accessible Indoor Maps

Challenges to be Addressed

Possible Solutions

For the Collection and Representation of Accessibility Information

(Semi)-Automatically creating indoor maps containing accessibility features of buildings

Specification of indoor mapping schema with accessibility features

Transformation of existing maps to new schema

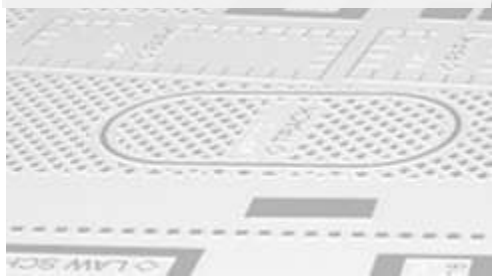
Analysis Tools for the quality of accessibility information in indoor maps

(Semi)-Automatic & Crowdsourcing based approaches for data collection and map creation

Automatically creating accessible and individualised representations of indoor maps

Visual on Mobile or Desktop

Tactile Printout



Specific AT

Mobile Interaction

Summary

It is currently a very good time to consider the aforementioned levels properly and to take accessibility into account at an early stage in the development of standards for web-based maps.

Our envisaged contribution:

1. Dedicated **user research** on mobility in unknown buildings
2. Software to significantly **improve the coverage of indoor maps**
3. Solutions for **barrier-free map representations** for different contexts of use

Get in touch with us for collaborations and contributions on this topic:

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