Smart Mobility

WheelScout - a navigation system for mobility-impaired people

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What is Wheel Scout?
=> a navigation system for mobility-impaired people

- calculation of a barrier-free route on the basis of a personal profile
- customization
- adding barriers and other POI to the map
- outdoor / indoor
- speech interface
- available as website and mobile app (Android)
barriers
barriers are found OUTDOORS as well as INDOORS
User Group

Mobility Impaired Users
User Group
Mobility Impaired Users

- people with... wheelchairs
- walkers
- strollers
- crutches, canes
- ...

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User Group Study : numbers

EU
• population > 500 million
• 9.3 million wheelchair users
• 1.86% of total EU population

Germany
• population ~ 82 million
• 1.6 million wheelchair users
  = 1.95% of total population [1]
• 4.6 million mobility impaired
  = 5.6%

US facts & figures:

US Census Bureau (2014)

- population ~ 316 million
- 3.6 million wheelchair users
- 1.14% of total US population
- 11.6 million people with canes, crutches, walkers
- 3.7% of total US population
- => ~ 5%
Mobile Computation of Barrier-free Routes for Mobility Impaired Users via Voice Control

- Motivation & user-group study
- Navigation tools
- WheelScout features
- Implementation
- Future
Navigation tools

TomTom

Google Maps

Garmin

GraphHopper Maps

OpenStreetMap
Navigation tools

Powered by Google Maps

Salem St, Lafayette, IN, USA
W Stadium Ave, West Lafayette, IN, USA

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Navigation tools
(OSM map material)
Navigation tools
Navigation tools
Modification of navigation device
We have presently defined 3 different „default“ profiles, but 1 (or more) individual profile(s) can be added:

- active,
- electric,
- help dependent
• Motivation
• Navigation tools
• WheelScout - features
• Implementation
• Future

http://wheelscout.fbi.h-da.de/
an intelligent computation of a detour
in case the chosen route contains barriers
an intelligent **computation of a detour**
in case the chosen route contains barriers

wheelchair users need to take the detour
pedestrians can take the stairs
an intelligent **computation of a detour**
in case the chosen route contains barriers

**West Lafayette : walk through town (pedestrian)**
an intelligent computation of a detour in case the chosen route contains barriers

West Lafayette: walk through town (wheelchair)
an intelligent computation of a detour in case the chosen route contains barriers

West Lafayette: walk across campus (pedestrian)
an intelligent computation of a detour in case the chosen route contains barriers

West Lafayette: walk across campus (wheelchair)
an intelligent computation of a detour in case the chosen route contains barriers

West Lafayette: walk across campus_2 (pedestrian)
an intelligent computation of a detour in case the chosen route contains barriers

West Lafayette: walk across campus_2 (wheelchair)
barriers that we include in our computation

- ramp / incline
- narrow passage
- stairs
- tilt
- construction site
- temporary construction site
- elevator out of order
- surface condition
adding (and deleting) barriers
Outdoor **AND** indoor routing

a true-to-scale floorplan needs to be drawn (on the basis of fire evacuation plans)
indoor routing

possible routes need to be added to the plan (manually)
indoor routing
here: from an outdoor start position to an indoor goal
indoor routing **across floors**
here: starting point on the ground floor (or outside of the building)
indoor routing **across floors**
here: end point (goal) is on the 2nd floor
Speech Features
1. Text to Speech

extraction of (textual routing directions) -> speech

-> this includes „WheelScout“ landmarks, such as bakeries, gas stations, „at the 3rd traffic light“, tall trees, etc.
2. Speech recognition (Speech-to-text)

- on the mobile device, the user can start his routing query via speech input
- partner: EML European Media Laboratory GmbH, Heidelberg

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Voice Control: finding a route via Speech Recognition

(speech to text to speech)

Steps of processing:
• speech signal is transcribed to text
• speech recognition can be trained to enhance recognition rate
• limited corpus (show me the way from... to..., navigate me to ..., I want to go to ...; etc.)
• patterns, keywords

Navigating from Darmstadt Hauptbahnhof to Darmstadt Luisenplatz

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Voice Control
finding a route via Speech Recognition

Voice recognition: EML / GOOGLE

WebView

1. Audio

2. XML / Text

3. URL

4. Show Route

Wheelscout Server

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Additional Features
changing the language

External partner:
Libera Associazione Provinciale
Invalidi Civili
(Free Provincial Association Of Civil Invalids)
Southern Tyrol / Italy
Communicating with *WheelScout* via Voice

- Motivation
- Navigation tools
- *WheelScout* features
- Implementation
- Future
Future & Next Steps

• intensify the test phase with our end users
• enhance speech recognition to speech responses during routing (adding more “landmarks”)
• enhance the speech dialogue in case the input didn’t get transcribed or recognized correctly
• correct the (speech) input in case a non-existing start or goal was recognized (“intelligent phonetic spell-aid”)
• add functionalities:
  o barrier-free means of public transportation along the routes and
  o barrier-free locations of common interest, such as cafés, restaurants, or supermarkets (possibly in cooperation with wheelmap.org)
Questions ?