The Route Planning Services Approach for People with Disability

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“Journey planner service for disabled people (Social Navigator)”

The project aims to improve quality of life of people with disabilities by addressing issues related to social exclusion, accessibility and mobility of disabled people by means of advanced ICTs.
The aim and objectives

Information Infrastructure

mobile and web services
data resources filled by authorities and volunteers

Accessibility passport
Accessibility Map
Route Planning Service
Audio Assistant
Other services
Social Navigator service is a route planning service adapted for disabled people which include:

- Collection of data on obstacles and “trouble places”
- Route planning provides optimal route based on the navigation algorithm
- Route sharing between friends using social networks
- Audio-assistance provides the information about obstacles and objects around during the trip
Social Navigator service

Standard navigation and route planning libraries:

- The Google Directions API
- JavaScript API Yandex.Map
- The Open Source Routing Machine (OSRM)

Solutions for disabled people:

- several services provides route taking into account wheelchair accessibility

Mathematical approaches:

- finding a smooth, obstacle-avoiding curve on the plane
- polygonal path taking into account simple obstacles in a form of intersecting polygons
Social navigator general architecture

Social Navigator Application → GeTS → Web Interface, GeTS Suppliment

GeTS → OSM Storage → OpenStreetMap
Social Navigator supplement

is a module to collect the data in real time on the location.

New obstacle is stored into user's private space and can be copied to the public space and/or shared with friends.

We take into account several types of obstacles and access the accessibility of them.
Social Navigator architecture

- Common ContentService module
- Geo2tag LBS platform support
- GraphHopper library support
Social Navigator architecture

- GeofencesManager
- RoutingService
- LocationReceiver
- BlockingWeighting
- GraphHopper
- BlockedEdge
- CustomGraphHopper
Social Navigator architecture

PointsService

PointsDatabase

PointsProvider

GetsProvider

KML

CategoriesContent

GetsResponse
Social Navigator Algorithms

[Diagram showing the process of social navigation using various components such as Device, Application, OSM_Storage, GeTS, and GraphHopper. The diagram includes loops and steps for requesting coordinates, getting lists of maps, categories, points, creating routes, and checking routes, with notifications and stop navigation.]
The approach to route estimation

The route \( r \in R \) contains \( m \) edges with distances \( l_k \).

The weight of edge \( k \) for category \( i \) of disabled person:

\[
  r^i_k = \sum_{j=1}^{N_k} \omega_{ij} p^i_{kj}, \quad i = 1, n, \quad k = 1, m; \quad j = 1, N_k
\]

\( p^i_{kj} \) — an assessment of obstacle \( j \) of the edge \( k \);

\( \omega_{ij} \) — the weight of obstacle \( j \) of category \( i \)

\( N_k \) — the number of obstacles on the edge \( k \).

The accessibility level of route \( r \) for category \( i \):

\[
  l^i(r) = \sum_{k=1}^{m} r^i_k
\]

The obtained level is used to inform user on the route which can be more appropriate to him.
Service implementation

The start and end points selection

Route information – obstacles list

Navigation interface
Evaluation of service

The several assessments of the service:

- Regions: Oulu and Karelia
- 2000+ obstacles in DB
- 14 volunteers in Petrozavodsk
- 77 downloads of application from store
Conclusion

- The service aggregates the approaches, technologies, modules and data investigated and elaborated during the Project.
- The routes are described as a graph with weighted edges, the weights are the accessibility of the path.
- For route building issue the Dijkstra method implemented in GraphHopper library was used.
- The Geo2Tag platform are used for storing and manipulating the data.