Pedestrian routing of dynamic areas using Volunteered Geographical Information (OpenStreetMap)

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Pedestrians, contrasting with vehicles, do not take routes only over defined linear features. Routing networks have historically ignored that pedestrians have a higher degree of freedom, and can naturally move through open spaces [1]. On top of that, our real world is not static, it changes dynamically. Routing apps also fail in most cases to portray the varying character of the reality on the ground.

Combining both time dependent, and open areas I can define a complex scenario called Time Dependent Open Areas (TDOAs). There are no routing services I am aware of that can handle TDOAs.

When commercial solutions do not exist, or if they are not accessible for organizational, financial or other reasons, Volunteered Geographical Information (VGI), that is edited by individual users, can fill the gap in the availability of digital geographical information [2].

OpenStreetMap (OSM) is the most renown actor of VGI. The ecosystem of OSM applications provides a starting point for my solution, and paves the way for the development of derived work on an already established base.

METHODOLOGY

The tagging schema was extended and merged from current time dependent and open area highway OSM tagging. It has a base form for routing systems that cannot understand time dependency, together with an extended form with all the time dependent information.

ORS [3] and ORS TARDUR App [4] were extended following a divide-and-conquer (*divide et impera*) approach, that separates the problem into smaller easier subproblems. The code was contributed back to the original repositories in GitHub, so it can be freely used and extended in the future.

The schema and routing services were tested in real world examples. The places were surveyed, with the data being uploaded to OSM. Then, it is extracted with a script into a .pbf file. This file can be read by ORS to generate the routing graph.

CASE STUDY

Several real world examples were examined: one for time dependency, one for open areas, and two combined.

The routing results were compared in distance with the different options (time dependency routing, open areas routing, start date and time) values depending on the case study.

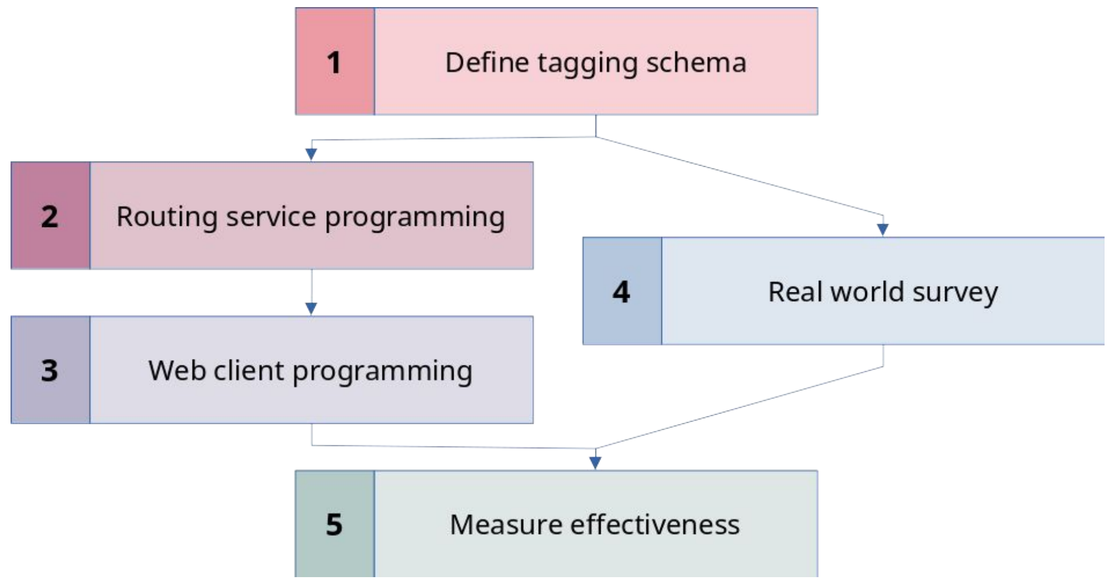

Fig.1: Workflow diagram, explaining the different steps of the project

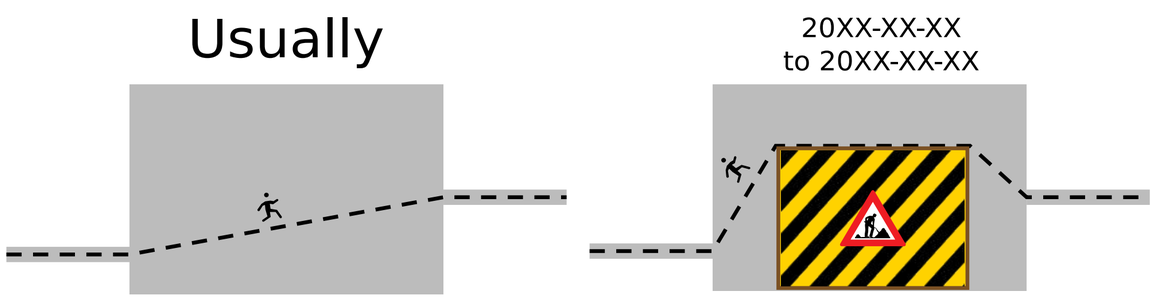

Fig.2: Example of a TDOA. A pedestrian square is usually fully traversable. During some days, there is some construction work, so a pedestrian would have to walk around the construction site to reach the opposite end of the square.

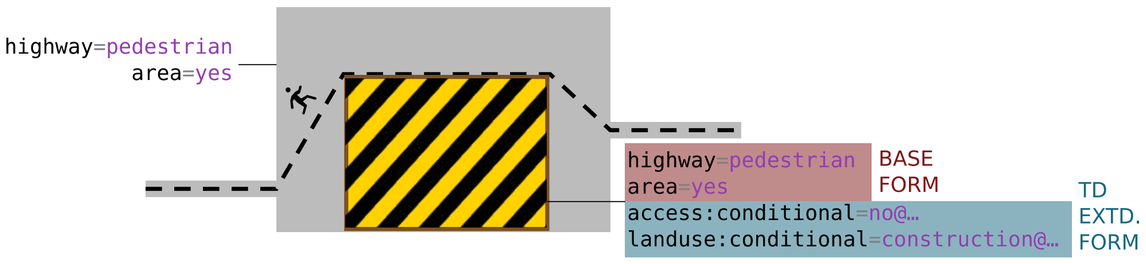

Fig.3: Proposed tagging schema, in use for a temporary construction site in the side of a square

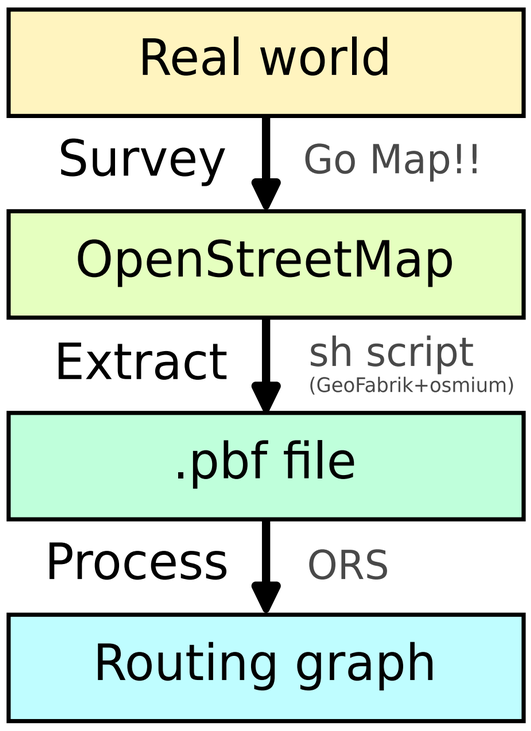

Fig.4: Data flow diagram, explaining the in/out data states, the processes and the tools used.

CONCLUSION

I introduced a new concept, TDOAs, hat could be expanded and developed further, starting a new era of routing where pedestrian realities are more accurately portrayed.

I managed to create a futureproof schema to represent those realities, while still preserving OSM philosophy.

This schema is understood by the routing system, and routes are correctly returned when in event times. However, an adjacent area problem was discovered with open area routing (visibility algorithm) as a whole, more visible with TDOAs. This problem affects the routes when not in event times.

This problem must be corrected in the future work, as well as the work extended with multipolygon routing and getting stakeholders involved in the project.

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KEYWORDS

VGI, LBS, OpenStreetMap, GraphHopper, routing, pedestrian, open areas, time dependent

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