Semiautomatic Floor Maps Editor with Automatic Beacons Net Generator

Gabriel TAKÁCS[*], Miroslav TAKÁCS[*], Matúš DEMKO[*],
Samuel PECÁR[†], Juraj MARÁK[†], Ondrej ČERMAN[†]

Slovak University of Technology in Bratislava
Faculty of Informatics and Information Technologies
Ilkovičova 2, 842 16 Bratislava, Slovakia
indoornav10@gmail.com

Indoor position tracking is still a challenge even today. In outdoor environment is often used GPS, but it cannot be used indoor, since the satellite signal is too weak to penetrate the walls of buildings. This can be solved by different approaches (e.g. using Wi-Fi signal), but they are not always sufficient [3]. More appropriate is Bluetooth LE technology utilized by Bluetooth beacons - tiny transmitters of low energy signal, which are located in the building. To make such localization enough accurate, we need to solve these problems:

- Have a good *floor maps editor* (for every new building are new maps needed)
- Have a good *beacons net generator* within these floor maps, integrated in floors maps editor
- Have a good *localization algorithm*, that can calculate user's position according received signal strength from beacons (in a mobile application)

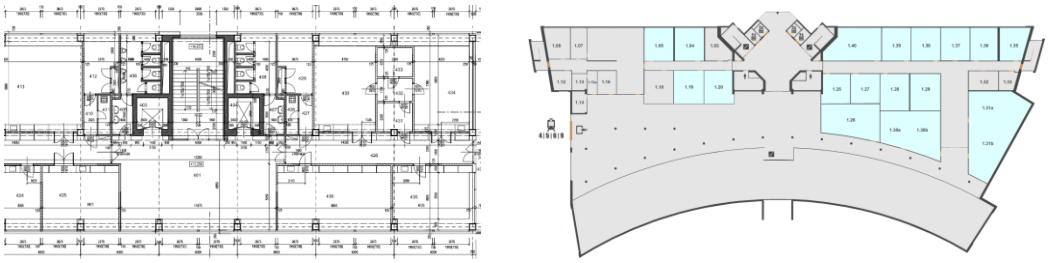
The most time consuming task is creating a detailed map usable in generator or later suitable for users. A tool that could be used for reducing this time and simplify this task would allow easier and faster portability to any building. The generator itself is also very useful, since it can optimize the number of used beacons. Current solutions are not well optimized, therefore we decided to create our editor and generator as a supporting system for deploying any beacon based indoor navigation mobile application. The localization algorithm is developed by our colleagues [4].

We developed a prototype of such supporting system. The key part of our application is a web editor, which allows users to upload building floor plans (see Figure 1, left image) and semi-automatically creates simplified floor plans (see Figure 1, right image). It also allows users to easily define rooms in map by adding metadata to shapes (e.g. number of the room, or parameters of beacons). This web editor provides guaranteed scalability for the application deployment. The biggest advantage is that the user does not have to draw a map from scratch, so it can save a lot of time.

Buildings usually have their floor plans available in DWG format (a binary AutoCAD native file format), which can be easily and quickly converted to DXF format (can be read with any text

[*] Master degree study programme in field: Software Engineering
† Master degree study programme in field: Information Systems
Supervisor: Dr. Alena Kovárová, Institute of Informatics and Software Engineering, Faculty of Informatics and Information Technologies STU in Bratislava

editor). However, these files contain unnecessary amount of information and data, e.g. descriptions of various markings, points, quotas etc. These elements are necessary for the builders and architects of the building, but useless for indoor navigation application. For this reason, our web editor allows to remove or edit those elements easily.



a) *b)*

Figure 1. a) Building floor plan, b) Expected output of our editor

When the map is complete, beacons have to be added to the map. Our system is able to suggest a net of beacons and mark it on the map. Current solutions for beacons placement requires too many beacons, which is cost ineffective [1]. Ideal solution needs to balance the number of required beacons and the signal coverage in a building. To find optimal solution, we used the floor map, model the beacons and run the calculations. To calculate, we used a simplified version of Farkas' algorithm [2]. Its result is automatic beacon placement suggestion within each floor. Suggested placement reduces number of required beacons, which will also reduce cost of final application deployment. Suitability of suggested placement of beacons will be tested within the building of our faculty using VirtualFIIT application [5].

VirtualFIIT is deployed for Android OS using PhoneGap and its server runs on Node.js and Redis technologies. Our prototype runs on Angular and Node.js frameworks using the same server.

Wi-Fi routers can be added to beacons in future work as well as other important information, which influence the beacons signal propagation.

Acknowledgement: This work was partially supported by the Science and Technology Assistance Agency under the contract No. VEGA 1/0752/14 and by Tatra Banka Foundation NTB 2015et009.

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