Customized Constraint Based Indoor Path Planning for Handicap Users on Smartphones

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Constraints

The project does Localization and Planning processes on Android Nexus S Smartphone. Localization using WIFI and GSM Signal Strength Mapping along with available onboard sensors like accelerometer, magnetometer and Gyroscope gives the user's exact location on the map. Path Planning is done with implementing Dstar algorithm on a high level graph of rooms , hallways, floors and buildings followed by grid planning on only the En Route vertices given by higher level Path Planning.

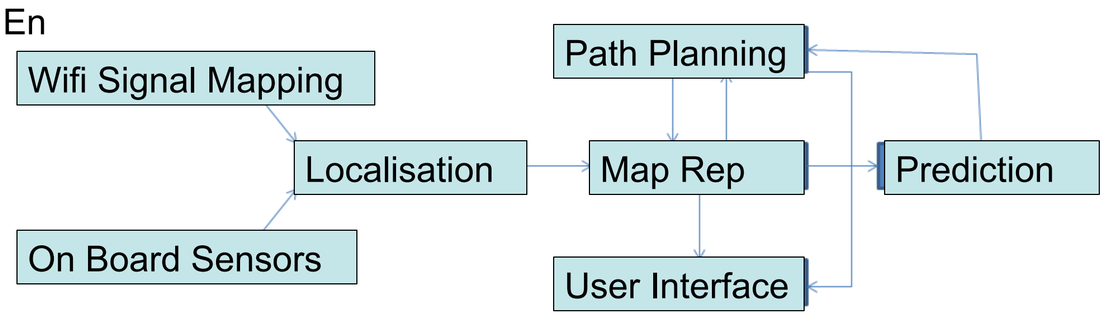
The problem statement addressed in this project includes constraints of two types :-

- User Constraints
- Localization Constraints

User Constraints are the different Handicaps considered.

- Size Constraint (Wheelchair Bound user)
- Structural Support Constraint (Visual Handicap)
- Ease of Instructions

All these problems are addressed by creating cost matrices and optimizing them using linear programming. In coming week extensive user testing is to be conducted.



Overview of NavPal Project.

User Constraints

Wheelchair bound users often face problems with constrained paths . Similarly blind users require high level of structural support as they prefer to keep their hands on neighboring walls on the path . Simultaneously the instructions provided to the user should not be too complex . Hence we need a tradeoff between all these costs to get the optimal path for the user.

Size Constraints:-

- Combination of raster and scalable vector graphics files is used to generate widths of doorways and hallways.
- For hallways the avg of min widths on all possible paths in a hallway is considered as the hallway width.

Structure Constraints :-

- A cost Matrix is initialized for the entire map with the cost function proportional to the distance from the closest wall.
- Dynamically according to the user orientation and hand preference these costs are altered accordingly.

Instructions Constraints:-

- An estimate cost for each of the rooms and hallways as an avg instruction cost of all possible paths is initialized and used during graph level path planning.
- Actual cost is calculated dynamically during grid level path planning .
- A Linear cost function is generated incorporating the variables like total no. of instructions , turns , doorways on the path.
- For visually handicapped users additional variables like no. of times a break in the structure of the environment occurs and the count of the unused doors on the way are also incorporated.

Localisation Constraints

Certain sectors of the map provide more accurate Localization readings than the others. Moreover certain areas are more prone to erroneous localization calculations. Empirical Data for the entire area is to be collected to initialize a localization cost matrix for the entire grid. Moreover these values would vary with different devices and different environments (variation in WIFI access points of different buildings) .

- Empirical data collected gives a default cost matrix .
- This is dynamically updated each time the application is used on the device, eventually converging to some value using Markov Chain .
- Random instantaneous jumps in localization or changes in the environment lead to path changes which are done with a timestamp based checkpoint rollback mechanism , thereby updating the cost matrix values of only a small portion of the entire grid.

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