Human-aware Navigation in Populated Environment with Special Focus on Group Interactions

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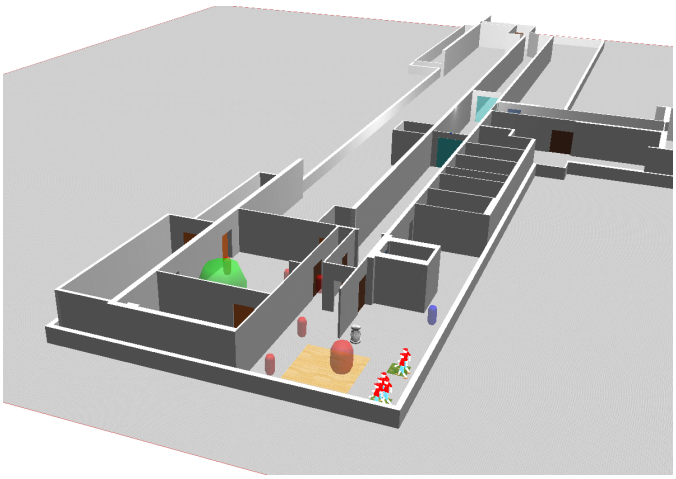
Human-aware navigation in environments shared with people is one of the main requirements for any social mobile robot. There exist different types of environments with varying degrees of complexity in terms of dynamicity, clutters and human population each posing specific challenges that should be considered by social robots. In this project we are interested in extending an already existing human-aware navigation behavior of MOnarCH robots for operating in complex environments containing many people. To do that, we can record real data and build a simulation, but it will require lot of ressources. An other approach consist of using Pedsim, which is a pedestrian simulator. Thus we can study the robot behavior in crowded environment.

For this purpose, I modified some existing code in order to use Pedsim and Webots jointly. I designed a tutorial to explain how to use them. Additionally, we can use Rviz to have a better understanding of the Monarch behavior. But it remains some minor changes to be fully operational.



Main interface of the Webots software

In terms of Human-Aware Navigation, I reviewed the most common methods for localization, identification and modeling of people. Actually, using gaussians seems the best way to model people and groups interactions. Each gaussian will model a particular constraint.

The way of modeling persons is highly influenced by the time it will require to update the costmap and how it will constraint it. By playing on the parameters like the number of gaussians or the variance, we can adjust these constraints in order to find the best compromise between accuracy and computational cost.

Concerning the performances, Pedsim, Webots and Rviz allow us to make some assumptions on the time required to update the path planning on the robot. But it is important to notice that it is intrinsically linked to the computer used to run the simulation.

During this project I stressed each software to see in which measure these assumptions are coeherent. It appeared that Webots get slow with 35 people on the IpolMap. Then, we can assume that the robot will get slow after 35 people detected, even more as Webots is a robotic software which consumes computational resources.

Concerning Rviz, it is very slow and seems not adapted to visualize the costmap in real time. But it remains a useful tool to verify the coherence of the constraints applied to the robot.