Make Way Please!

Anna Wang Bonny Mahajan

Introduction

Navigation in dense cluttered environments is a challenging task for robots. Robots particularly those that are meant to function as assistants to humans or those that must interact with humans on a daily basis could benefit greatly if they could ask people around to make way when they are having problems while navigating.

When human beings are in a crowded room and are unable to find their way they usually ask those around them to get out of the way. This is what we want the Robots in our lab to do. Just as we 'understand' when we are completely surrounded by people and ask them to make way, the robot should do too. This would especially be useful when the robot is assigned a goal somewhere and because of it's crowded environment gets 'lost' i.e. can't find where it is and hence can't find it's way.

In this way we suggest a possible solution to the 'Freezing Robot Problem' i.e. the situations where the robot discovers that it can't go towards it's destination through any route and decides that all paths are unsafe.Hence it either stops or begins displays other maneuvers like spinning to localize itself and possibly find a way.

Our solution looks into the robot detecting that it is surrounded by people completely and 'realizing' that it can't find a way and hence asking the people around it to make way.

Technical Approach

For this project, we are focusing on robot movement and language. The choice that robots will make depends on situational awareness. Many times, the BWI robots used in the lab move and function normally considering the environment; however, when the robots are surrounded by people and/or objects and can not find any path out, the robots will start to spin in circles on the spot.

To achieve this, we propose using the cost map that the robot has and comparing multiple cost maps to recognize crowded surrounding. We also plan to use the Robot's speech capabilities to get it to tell people to move. This in our opinion will help robot navigate everyday-world surroundings like crowded rooms in a much better way.

We will be working on the BWI robots in the Robotics Lab at the University of Texas at Austin.

Possible Limitations

We'd like to address some possible challenges/problems that our approach may cause in the future. Our approach relies completely on the robot comparing cost-maps that it obtains from the surrounding to the cost map that it usually expects in that room. This in turn, relies heavily on the robot comparing the 'current' map to the right expected cost map - which is difficult to achieve as the robot sometimes mis-localizes itself. So we must ensure that the robot compares it's current map to the correct cost map before asking people around it to move away.

Another possible challenge to our approach may be the definition of being 'surrounded' by people for the robot. The robot may only see people around it as obstacles on the cost map. What then, stops the robot from saying 'Get out of the way', when it is completely surrounded by pieces of furniture? We plan on addressing this challenge using openCV to first let it detect people in the image in front of the robot and then process and compare cost maps. Though not fool-proof , this will at least ensure that the robot talks to people and not pieces of furniture around it.

What Exactly does 'crowded' mean?

A challenge encountered early on involves determining the amount of people that it would take to surround the robot and force the robot to ask for human help. Determining how many people around the robot would be called a "crowd" is difficult because of the subjectivity of the topic on hand. For the purpose of this project we are defining the term 'crowded' as being any situation when the robot is given a goal position but gets stuck on it's path due to the presence of too many obstacles. As noted in the possible Limitations section, we plan on employing openCV to ensure it is actual people block people's path and not inanimate objects.

Similar Work in Robotics

Some works that we came across in Robotics also employed interacting with human beings in order to solve the robot's problems. For instance in [1] the co-Bots actively seek human help in order to learn and successfully navigate their environments. Similarly in many cases rather than trying to replan it's routes in complex environments and getting confused, we propose the robot simply request the people nearby to give it one space to move. Doing so , in our opinion will not only improve the robot's navigation

in dense environments but will also make the Robot seem more natural and interactive in busy everyday environments.

In this symbiotic approach the Robot is aware of it’s limitations in human environments but rather than getting confused and spinning - it asks others to move out of the way.

Evaluating Results

We plan to evaluate results by testing the robot in crowded environments in the GDC like the 3rd floor lab.