C951 Introduction to Artificial Intelligence
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C951 Task 2 – Disaster Robot Write-Up

A. Describe the disaster recovery environment you chose and the two obstacles you have added to the environment.

In lieu of the recent invasion of Ukraine, our world is in more need than ever of disaster recovery robots. Places where robots can go that wouldn't be safe for human volunteers. Places that include the currently war-torn Kiev, whose buildings have been ravaged by missiles. Robots that scour these missile-ravaged buildings will come into two primary obstacles: Walls, and Rubble; during their search for humans in need of rescue.

B. Explain how the robot will improve disaster recovery in the environment from part A after you have added the two obstacles from part A.

In wars fought prior to the 21st century, rescue teams would consist of humans, often unarmed, and equally as vulnerable as their survivor counterparts, being unable to navigate structures in the face of explosions, poison gas, or fire. DisasterBot remedies all that, by being immune to toxic gas, far more durable than a human, and without any of that pesky fire-loving clothing. If a room with a survivor inside is filling with toxic gas, only a robot can go in and navigate the walls and rubble without succumbing to the poison.

C. Justify the modifications you made to CoppeliaSim's robot architecture, including two sensors you chose to add, and explain how these sensors will aid the disaster recovery effort.

The default robot was functional yet slow and in-optimal. With only one sensor, the robot only knew if it had obstacles in the very front, with no information about its surroundings. So every time it backed it, it backed up to the right, and moved left. In order to inform the robot's direction-choosing, I added three more proximity sensors in the middle, left, and right of the main sensor.

These extra sensors gave me the tools I needed to modify the code. I changed the detection subroutine to measure the values of the left and right sensors as well as the middle. Depending on which side has more space, the robot will now dynamically pick a direction to back up into, successfully avoiding obstacles more efficiently than the prior code and prior single sensor model

D. Describe how the robot maintains an internal representation of the environment.

The robot can "see" a view of the environment in front of it, as well as the distance between itself and the objects to the front, front-left, and front-right of it. It uses this information to navigate into open areas where survivors could be hiding

E. Explain how the robot implements the following four concepts to achieve its goal:

- reasoning

The DisasterBot uses information about its environment to inform decisions about the direction it should move/turn in. For example, if obstacles are detected on the left, the robot moves back and to the right slowly before moving forward again.

- knowledge representation

DisasterBot has four sensors in total, all of which provide raw data about it's environment. This information is processed by the bubbleRob code to become environmental knowledge that the bot can access when making decisions.

- uncertainty

Since DisasterBot is autonomous, every environment it interacts with is a new, uncertain one. DisasterBot is programmed to explore, rather quickly as their job is usually time sensitive, and read information through its sensors until it can traverse the environment well enough to find any survivors

- intelligence

In order to properly assist any human rescue teams, DisasterBot has to have a reasonable amount of functions and utility to be worth the cost. Because the ultimate goal of DisasterBot is survivor discovery, its main functions revolve around navigation and obstacle avoidance. In order to do this, the bot must be able to detect and navigate around obstacles in an uncertain environment. This involves gathering data with the proximity sensors and processing it into knowledge about the environment. The bot uses that info to reason out the best decision to make, e.g. direction to move in.

F. Explain how the prototype could be further improved, including how reinforced learning and advanced search algorithms can improve the prototype's performance and learning.

No budget was given for this prototype so it was created under a relatively constrained assumption of cost. An easy way to improve performance is to purchase and install more sensors of varying ability. A robot with 360 degree vision is more capable than a robot with 90 degrees of visions.

In addition to/an alternative to more sensors, is improved data processing via machine learning. Currently our system uses a rather primitive proximity-based model, but if the budget allows, we could train a neural network on disaster images to help improve image recognition beyond just obstacles and survivors. Our bot currently doesn't use any search algorithms, with added sensors/processing, we could construct a digital map of the room and apply path-tracing algorithms to optimally cross them, instead of bumping around in the dark with our budget DisasterBot

G. Submit the robot code that you created.

*attached

H. Provide a Panopto video recording that describes the robot and demonstrates its functionalities to stakeholders who are nonpractitioners

https://wgu.hosted.panopto.com/Panopto/Pages/Viewer.aspx?id=4ff910ff-1023-49b4-ab3b-aeb400765192