NIP1 — NIP1 TASK 2

DISASTER RELIEF ROBOT

A. The environment simulated in the Coppelia Sim BubbleRob is that of a theoretical damaged building caused by anything from a fire, earthquake, tornado, etc. that could be dangerous for first responders to enter into without first understanding the room/building and possible hazards that could be within it. Cylinders are situated around the perimeter acting as walls of the now damaged building, as well as in random locations throughout the rest of the area to simulate damage or debris that the robot would be unable to traverse.

B. The robot I created can improve disaster recovery by helping first responders learn the layout of a potentially dangerous environment without risking their lives needlessly. The robot can help them find safe passageways to and from the disaster recovery scenario as well as help find survivors within the environment and report their location to the first responders.

C. I made a few small adjustments to the build of BubbleRob. First off, I added a separate sensor that's only purpose is to report the location of a potential victim when the robot finds them. In this simulation, that "victim" is the red sphere. Whenever the disc-like proximity sensor finds the sphere, it will print to the system that a potential victim was found. First responders watching the path that the tobot took to get there would then be able to pinpoint the location of that person. I also added two more forward facing proximity sensors to BubbleRob. In order to sense a wide enough angle in front of the robot so that nothing would unknowingly collide with it, constant intersection with the floor in front of the robot was a problem. I resolved to fix this by instead having three smaller angled sensors facing forwards at a wide spread to cover all possible angles that could have something that would collide with the robot. Next, to optimize the bot's ability to efficiently search the damaged area, I added a slight curve to the general pathway that the robot travels. I did this by reducing the speed of the right wheel by 5%. This allows the robot to hug the right wall, making it into tight spaces along the right wall, and once it encounters a wall that cuts into the space, the robot will also search the middle of the building as well.Finally, I reduced the amount of time the robot backs up once encountering an object that it will collide with. For one, it reduces the chance the robot will collide with something behind it and become immobile, but it also allows the robot to turn more gradual curves around corners. During testing, the robot would miss entire sections because it would find something in the way and turn at too sharp of an angle to make it into areas of the simulation. Now, the robot will back up and turn in shorter bursts, allowing more of an opportunity to make it into the tight spaces.

D. This prototype has been optimized for a relatively specific disaster recovery scenario. It is able to detect collisions and potential disaster victims, and act upon that gathered information accordingly. An improvement could be made to allow it's pathway to be saved in the bot's memory for mapping out the environment and finding safe passages to potential victims within that environment. The robot has been programmed to move around the environment in a simple manner, namely a slight curve to the right to make sure it also searches the tight corners of the room or building. In spite of all of it's sensors, the robot does not have a complete understanding of the environment it is in. The good thing about this robot is that it does not need to know everything about the environment to be effective and successful in its goals.

E. There are plenty of advantages to using a robot like the BubbleRob in a disaster recovery environment. This robot can enter into buildings that first responders know nothing about, providing those emergency personnel with vital information about the hazardous environment without having to put themselves at risk and further worsen the situation. However, this prototype is far from perfect. There are several limitations that this robot simply can't handle, such as moving around in an environment that could be constantly changing due to deteriorating walls and floors. These problems could damage the robot or cause it to get stuck, further extending the time to reach the disaster victims in need of rescue. The robot's success can be easily measured by understanding its goals: find potential victims of a disaster and gather locational data of an unknown and potentially dangerous environment. With it's sensors and ability to react to potential collisions, the robot has the ability to do just that.

F. Testing the BubbleRob in real world scenarios could prove to be very difficult and dangerous for the prototype. There are many unknown variables that exist in the real world that could make testing a very tedious process. I would recommend continuing to test the robot within the simulated environment, tweaking the behavior code to further grow its ability to gather information from an environment. Adding reinforcement learning to the BubbleRob would be a great addition to the prototype, allowing it to more efficiently search the environment and gather more meaningful information from it. Once the robot can no longer learn from a simulation, bringing it into a real world controlled environment for supervised training would be ideal to continue fine tuning the bots behavioral code.

G. The BubbleRob prototype could be improved by giving it more sensors to derive information from the environment around it. Since I designed my robot to curve towards the right wall, a sensor that could indicate a space has just opened up on the right would be helpful for it to know to turn to the right so that it doesn't miss that section of the building. In addition, a method that would tell the robot that it has already explored a specific area would help it be even more efficient with its disaster recovery procedures.

H. The script for BubbleRob's behavior is located within this project folder.

I. The audio and video recording has been submitted along with the rest of the task 2 project files.

J. I did not use formal sources, besides the normal reading for the course, for my submission. However, to better understand the wording of the submission requirements, I did refer to the chapter in the reading between 25 and 26, named Focus: Robotics and Feature Engineering.