BubbleRob Documentation

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Introduction to Artificial Intelligence – C951

Task 2

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1. *Describe the disaster recovery environment and the obstacles you have added to the environment.*

Our environment represents an evacuation scenario. There are many situations that this environment can represent such as fire evacuation, tornado evacuation, or earthquake evacuation. In the environment the cylinders represent obstacles that the robot will navigate through. A human is placed near the end of the environment. The robot’s goal is to locate the human and lead him/her to the safe room. Walls are placed to obscure the robot’s vision from the human. At the end of the environment there is a safe room which acts as a finish line for the simulation.

1. *Explain how the robot will improve disaster recovery in the environment with two or more additional obstacles.*

The robot will be able to improve disaster recovery by navigating areas that are unsafe for humans. The force sensor on top of the robot will allow the rescue team to know if there is falling debris and the proximity sensor allows the robot to navigate through obstacles. In a fire evacuation the robot can navigate through fallen debris and locate survivors. Once the survivors are located the fire fighters are able to analyze the robot’s data and initiate a rescue plan. In the event of a tornado or earthquake evacuation, the robot will be able to be left behind and continue to warn people of the dangers to come.

1. *Justify the modifications you made to BubbleRob’s architecture, explaining how additional sensors will aid the disaster recovery effort.*

The robot is equipped with three sensors: a proximity sensor, a vision sensor, and a force sensor. I added a force sensor to BubbleRob to maximize his disaster recovery capabilities. In every scenario tested the force sensor proved to be beneficial. When a fire burns through a house, the house begins to fall apart. Debris begins to fall from above and can injury anyone in its path. BubbleRob is able to analyze the amount of falling debris by the force sensor on top of his head. In tornado evacuations the force sensor is able to measure the strength of the tornado and relay the data to people nearby. During an earthquake the force sensor can measure the seismic data.

1. *Explain how optimization principles are implemented in the prototype and how these optimization principles include the concepts of reasoning, knowledge representation, uncertainty, and intelligence.*

Optimization for the robot is focused on disaster evacuation situations. BubbleRob is programmed to navigate through environments logically. When faced with an obstacle the robot uses reason to back up and change course. Knowledge-representation is achieved by analyzing the data BubbleRob received from its sensors. The robot is optimized to solve complex problems in real time. Uncertainty is always present in disaster environments. Obstacles in every situation are unique that’s why the BubbleRob is equipped with a proximity sensor. No matter how uncertain the robot is of the area, it will always be able to determine a path. Intelligence for our robot is both programed and learned. The robot is programmed to navigate through fire, tornados, and earthquakes. After every mission the robot uses learned information to make improvements, thus gaining intelligence with every mission.

1. *Explain the advantages and limitations of the robot as well as the criteria for assessing the success of the prototype in solving the problem.*

The main advantage of our robot is that it successfully navigates through an unknown environment. This allows for the robot to be used in situation where a human might be injured. The ability for the robot to analyze and create map of the area is useful for the rescue team. BubbleRob was able to successfully locate a human and lead them to safety.

The main limitation of the robot’s current design is how slow the robot is to navigate a complex environment. The robot only makes left turns so when it is faced with an obstacle it might make a full rotation before it locates the correct path. The current build does not equip BubbleRob with a rear proximity sensor so it could back into things or people. The robot is also lacking a depth sensor to determine if the robot is on an edge.

1. *Outline a plan for the testing and implementation of the robot.*

The robot is currently being tested in a virtual environment. After many diverse scenarios have been completed, we would like to begin testing in a real-world environment. The current tests have proven the robot’s ability to navigate an environment. Our next round of tests will assess the robot’s ability to make judgement calls based on the severity of the situation. Once the robot passes these tests a functional prototype robot will be created. Then then robot will be implemented into evacuation missions.

1. *Explain how the prototype could be further improved, including how reinforced learning can optimize the prototype’s performance.*

The robot can be further improved by improving its maneuverability, adding more sensors, and implementing reinforced learning. Currently the robot makes a left turn when faced with an obstacle. We would like to improve the robot to look left and right to determine the best direction. By adding more sensors, the robot will become more capable. Increasing the amount of vision sensors will allow us to get a better image of the scene. Reinforced learning can be achieved by rewarding the robot every time it retrieves a human. It creates a game-like situation for the robot to take part in. This incentive will optimize the robots learning in complex environments.