A. Disaster Recovery Environment

The disaster recovery environment chosen for this project is that of a burning building that may contain humans caught in the fire. The burning building environment consists of four walls that enclose an area of space. In every building there are an abundance of obstacles that can be present at any given time. However, for the purpose of this project a common obstacle such as furniture has been selected for the model as well as an uncommon one that is specific to the scenario…a piece of burning debris that has fallen from the burning building. In the programming environment each of these obstacles is represented by a cylinder. It is not necessary for the robot to determine the type of obstacle it has met, only to determine that there is an obstacle in the way. The robot can record the obstacles’ location and then continue searching the area until the entire area has been searched and confirmation that no humans are present in the disaster area.

B. How the robot will improve disaster recovery.

Fires are a very dangerous environment for not only individuals experiencing a fire in a space that they are currently located, but rescue personnel as well. Smoke provides limited visibility as well as a potential for asphyxiation and the immense heat created by a fire also poses a significant threat to organic beings. Using robots to search an area, either solely or in tandem with rescue personnel, improves the search and rescue operations of fires that have occurred inside buildings. The robot can quickly determine if an encountered entity is an obstacle that is blocking its way or a human that requires assistance. The robot can record the location of each obstacle that it encounters, in the case of the current environment a piece of furniture and a fallen piece of burning debris and notate its location. Utilizing multiple robots in tandem can vastly increase the assessment of a building that is on fire and provide time critical information as to if humans are currently trapped in the fire, improving chances of survival.

C. Sensors

During this project two sensors were added to the robot. A smaller one that registers obstacles and provides sensor feedback to the robot for the robot to adjust its position and continue the search of the building that is on fire. This sensor is able to recognize the boundaries of the building or any obstacle present, in the case of this example two-cylinder shapes that represent furniture and fallen burning debris. The second sensor is larger and wider and is used to sense a human in the environment, in this case the cuboid shape. The larger size of the sensor allows for quicker scanning of the area for human life signs, increasing the chance that rescue will be successful.

D. Internal Representation of the Environment

The robot has two sensors at its disposal during deployment, a large sensor used to detect human entities in the disaster area as well as a smaller sensor to determine obstacles. When the larger sensor indicates the presence of a human inside the disaster area it sends out a message indicating that a human was found in the vicinity of the robot. The smaller sensor detects obstacles allowing the robot to then adjust its direction and movement of travel to avoid that obstacle and continue searching the building for humans.

E. Reasoning, Knowledge Representation, Uncertainty, and Intelligence

Reasoning: The robot utilizes two sensors during deployment. Each sensor is attuned to a particular element that may be present in the disaster environment. The smaller sensor is used solely to detect obstacles. Once an obstacle is detected the robot uses its internal functions to adjust position to avoid the obstacle and continue the search. The second sensor is larger and is utilized to detect the presence of a human in the disaster area. When a human is detected by this sensor a detected human message is broadcasted by the robot. Decisions made by the robot rely solely on whether an entity has been detected by either sensor.

Knowledge: The robot collects information utilizing two sensors. The first is a smaller sensor that determines obstacles. Once an obstacle is identified by the robot, the robot makes adjustments to its direction of travel. The second sensor is used to detect humans. When a human is detected in the disaster area a signal saying that a human was found is broadcasted.

Uncertainty: The robot requires zero knowledge of an environment it is entering. Its function is to travel through a burning building and identify anything it encounters and classify it as either an obstacle or a human that needs assistance. It will continue searching a building until its search is complete and all entities have been identified.

Intelligence: The robot utilizes a search pattern during deployment. While deployed, detection of entities within the environment provides critical information to the robot as to which functions should be utilized based on the specific entity encountered. If an entity is an obstacle, functions to avoid that entity are utilized. If an entity is determined to be human, functions alert rescue personnel to the presence of a human inside the disaster area and their location.

F. Future Improvements

The robot could be vastly improved by utilizing reinforced learning and advanced search algorithms. Firstly, rewards and punishments provided by reinforced learning can be utilized to improve the efficiency of the search pattern the robot utilizes while deployed in a disaster area. Advanced search algorithms would provide the robot with tools to implement a more strategic approach to searching an area when entering a disaster scenario. Used in tandem, they could greatly improve the efficiency of the robot when searching a building.