C951 Task 2

Section A – Environment and obstacles

The environment simulated in this disaster recovery program is a fire in a business office. The two main obstacles in this environment for the robot are the walls which it will need to watch out for and the office desks which are placed on the floor. The objective of the robot is to use its sensors to avoid the walls and desks to find any people still trapped inside the building. The people in this situation are the blue cylinders randomly placed in the room.

Section B – Disaster Recovery Improvement

The real-life environment of an office fire can be very dangerous for all parties involved including the employees and rescuers. Having a disaster recovery robot can aid search and rescue teams by having the added functionality of mapping its surroundings with its sensors. These mappings can then be viewed by rescuers before they go in which will reduce the potential risk of stumbling into dangerous areas. In this case, the robot will be able to find the safest route because of its programming allowing it to avoid any walls or obstacles on the ground such as desks. This route will be displayed on the sensor map and rescue professionals will know exactly what to look for when they go in.

Section C – Architecture

This disaster recovery robot was designed using the Bubble Rob robot architecture. For the robot specifically, additional proximity sensors were added which allow it to travel more freely through the environment without crashing or going through obstacles. Without these additional sensors, the scanning diameter was narrower than the bot itself so it would clumsily run into the obstacles without seeing them too well. A second modification made to the robot was the addition of a sensor to detect any remaining people in the room. This sensor has a much wider range than the environment scanners and will have an easier time identifying the victim cylinders in the training map. If a person is found, a message will be relayed informing that a person has been identified in the building which can then be rescued.

Section D – Internal Representation

With the modifications to the sensors on the robot and refining the code, the robot is better able to accurately maintain the internal representation of the environment. The robot is programmed to drive straight until it encounters an obstacle which will force it

to incrementally turn left until it is in the clear again to continue along its path. It will continue on the path with this basic functionality until any disaster victims are found. The vision sensor on the front will display everything that the robot sees in the environment to give responders a view of what is going on in the building and make quick decisions.

Section E – REASONING, KNOWLEDGE REPRESENTATION, UNCERTAINTY, AND INTELLIGENCE

- Reasoning – The decision-making process of the robot is relatively simple. It will continuously drive forward until it reaches an obstacle which will cause it to turn left until the path is clear again. It will repeat this process until a person is found.

- Knowledge representation – The disaster robot can accurately transfer data about its current position through a console window that displays a visual representation of the environment. This allows responders to see what is happening in real-time in the room. There is also a time-distance graph in the program which represents how far objects are from the robot at any given time.

- Uncertainty – With the algorithm it has currently, the robot will always be able to eventually navigate through the environment and around all of the obstacles. However, due to its limited functionality, there are a few areas where uncertainty will arise. The primary uncertainty is that all of the disaster victims will be found in a timely manner as it is up to how fast the robot can navigate the area.

- Intelligence – The robot is less likely to take the same path as it continues to survey the area. This will ensure that the robot will find a person after a given time. The robot is also aware of when to alert when it finds a person which makes it appear more intelligent.

Section F – Further Improvements

This robot is in its early stages and has great potential for future improvements to become more efficient. Machine learning would be a great practice to implement because it will help the robot make faster decisions and get to disaster victims sooner. In the current environment, we can make corrections to the robot and modify the code to get it to do what we want. However, in real-world applications, we will need to use

learning reinforcement to be able to take the data that it gets and be able to do more with it and adapt to the situation. When it successfully finds people and shortens its search time there will be a rewarding process for it at every step.

Another relevant improvement that should be implemented is a more advanced search algorithm. There are several times in the testing where the robot would find one person but miss another person who was close by. Implementing a more advanced search algorithm like a greedy algorithm would be good in this case since the robot maps the area it could then use that map to calculate areas to search within it. This will prevent it from missing any nearby people as it travels.

Section G – Code

All code provided in the Zip folder.

Section H– Panopto Recording

Robot demonstration link submitted in drop box.

Section I – Sources

No outside sources were quoted, paraphrased, or summarized.