A: DISASTER ENVIRONMENT

The simulated disaster recovery environment is an office floor on the fire.

The several cuboids on the layout represent the walls of the structure. These cuboids will prevent the robot from leaving the enclosed area. The green cylinders inside the area represent potential dangerous areas, furniture, and other blockages. The robot should identify obstacles using the sensors but should avoid touching them. The small red cube represents a person who is to be searched inside the disaster environment. The robot's mission is to locate the person and notify the rescuers using the console window. The bot is armed with two side sensors that detect the obstacles without touching them. The same sensors will also help the robot to make the turn when the path is blocked by obstacles. To make the searching process faster, a wide range sensor is added to the bot to scan on a bigger scale. When this sensor detects the red cube, it will send the output, " A human is found, evacuate immediately! " notification to the console window.

B: IMPROVED DISASTER RECOVERY

The disaster environment becomes hazardous and very unpredictable during the fire.

The disaster recovery robot can generate a map of the environment. Disaster recovery robots can function in such hazardous environments where humans can’t or have to risk their lives. The data collected through the robot’s sensor helps it to choose the better path and can be transferred to the rescue team momentarily. Moreover, the people detected in a hostile environment can be identified and communicated through the robot's attached cameras and sensors. If the robot is damaged, it can still share its last location letting the rescuers about the danger to prevent. While it might be difficult to assume the structural soundness of the building on the fire. The Disaster contributes greatly to the safety of rescue workers.

C: ARCHITECTURE

I improved the bot’s searching capability by adding three more sensors. In the beginning, I added two proximity sensors on the sides of the built-in vision sensor. The proximity sensors help the robot to navigate. The initial mechanism was too complex and caused the bot to move in a circle frequently. I modified the original script to minimize the turning penalty caused by each sensor activation. This modification resulted in a much smoother and faster experience for the bot’s movement. Now, I had a bot that was able to navigate in the disaster environment without the risk of driving into flames. Even with the proximity sensors, the robot was still taking too long to find a person. Then, I added a wide-angle sensor to allow the robot to scan in the wider and farther area while moving. Finally, the robot was performing far better as before the modification trials.

D: INTERNAL REPRESENTATION OF THE ENVIRONMENT

The Robot moves in a straight path until it encounters an obstacle in the way. When an obstacle blocks its way ahead, the robot will make small moves leftward continuously until the blockage is clear to move on. While moving abound, its attached sensors detect the distance to objects and time and display that information on the console window as a graph. Using that information rescuer can find a better path for their operation.

E: REASONING, KNOWLEDGE REPRESENTATION, UNCERTAINTY, AND INTELLIGENCE

* Reasoning: The robot predicts the path itself when its straight path is blocked ahead. The robot continuously searches the way to the left side until the blockage is clear.
* Knowledge Representation: The most important benefit of using a disaster robot over a human is the transfer of immediate and accurate information. The console window represents many of the findings of the robot in different formats. For example, The time and distance graph represent the distance to object from the robot's current position at the current time.
* Uncertainty: The limitation of the robot are the uncertainties that could arise from its limited capability. The robot cannot provide information about the degree the injury the detected person has. It also cannot detect the screaming human possibly looked in one of the rooms in a disaster environment.
* Intelligence: The robot is less likely is repeat its path. The robot gathers the object within a certain radius while moving. And with the processing of data collected, it finds the different paths to search later.

F: FURTHER IMPROVEMENTS

In a given simulation, the robot was tested in a known environment. The robot needed human interaction to do their job frequently. However, the real-life disaster environment can be the opposite. There might be very little or no information about the internal situation of the disaster environment. Some of the following AI tools and techniques can be used to increase the effectiveness of robots in real environments.

* Natural language processing (NLP): NLP refers to the AI method of communicating using a natural language such as English. Using NLP, The robot will be able to understand human voices, alphabets, and signs. It will provide robots more sources for data inputs, and therefore helps robots making better decisions.
* Advance Search algorithms: The robot missed the person very next to its straight path during simulation. The robot uses a very basic searching algorithm. A depth-first algorithm along with a wide-range sensor would certainly improve the result.
* Reinforcement learning: In a disaster environment, we will not always have enough information needed to accomplish the mission. To work in such uncertainty, we can train our robot to learn, “how to react in every situation?” on their own using reinforcement learning technique.

G: ROBOT CODE

Please see the attachments.

H: PANOPTO RECORDING

Please see the attachments.

I: [SOURCES](https://lrps.wgu.edu/provision/147882373)

Russell, S. J., & Norvig, P. (n.d*.). Artificial Intelligence: A Modern Approach, Ch. 21: Reinforcement Learning, Introduction.* Retrieved from https://wgu.ucertify.com/?func=ebook&chapter\_no=23#top