CmpE 434 Introduction to Robotics Term Project: The Legend of EV3

Deadline: January 9, 2018

1 Introduction

In this project, a brave princess will save the prince that Yhorm the Bad Giant has imprisoned. Yhorm the Bad Giant is the leader of the giant tribe who can only be killed by a magical weapon which is located in the maze where the giant lives. The brave princess should take the weapon, kill the giant leader and save the prince.

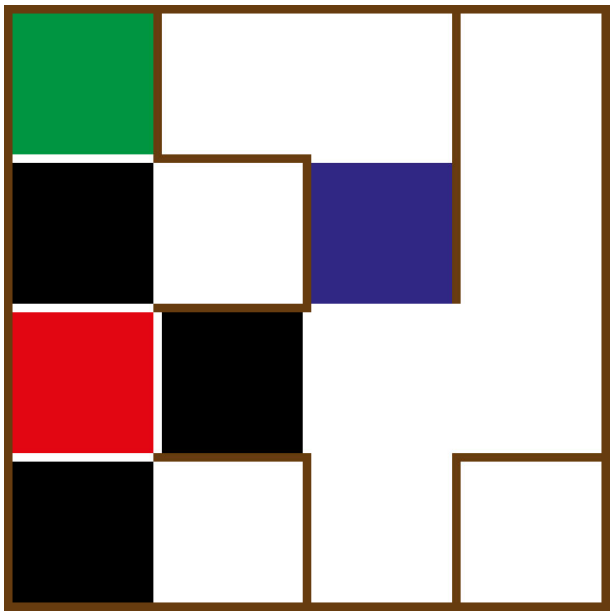

Figure 1: The environment specification of the project

To help the princess, you will need to implement a mapping and localization algorithm in a 132 cm $\times$ 132 cm grid maze given in Figure 1. The grid cell sizes will be 33cm $\times$ 33cm. Yhorm the Bad Giant is denoted with a **red** cell. However, the smell of the giant reaches the other cells which are directly connected to the giant and these cells are denoted with **black** cells. The magical weapon is denoted with a **blue** cell and the prince is denoted with a **green** cell. The robot should

not go to the red cell without a magical weapon.

The project has two stages:

- **The Mapping Stage:** the brave princess sends a scout to locate the giant, the magical weapon and the prince (if it is possible) (the prince can be at a cell which cannot be reached without killing the giant). Therefore, the robot will create the map of the environment and store the map.
- **The Task Execution Stage:** the princess is teleported into the maze, but teleportation magic is not accurate and the princess can end up in any cell. The robot should carry the magical weapon and kill the giant and save the prince.

The project consists of the following parts:

1. Localization
2. Path Planning
3. Mapping
4. Grasping Ability

2 Scenario

In the first stage of the scenario, the robot will be placed in a grid cell which is randomly selected. The robot should travel across the maze to find the important locations. Also, the robot should show the map of the environment with the important locations on the PC screen. When the robot wants to announce the completion of the mapping of the maze, the robot should make *3 beeping sounds*.

In the second stage of the scenario, the robot again will be placed in a grid cell which is randomly selected. While the robot travels, the possible location(s) of the robot should be displayed on the PC screen. The magical weapon for this project is a ball and this ball will not be placed in the first stage of scenario, but in the second stage, the ball will be placed on the **blue** cell. The robot should grasp the magical weapon and it should kill the giant. In order to kill giant, the robot should make *1 long beeping sound* on the **red** cell.

After the giant is killed, the robot should find the **green** cell and save the prince by making *3 beeping sounds*, and thus the robot will complete the scenario.

3 Specifications

The environment specifications are as follows:

- The size of the map shall be 132 cm $\times$ 132 cm and shall be constructed using cardboard on level **B** of the department.
- You shall have a grid world of 4 $\times$ 4 of the floor grid cells. The size of the cells shall be 33 $\times$ 33 cm.
- The height of the walls shall be 33 cm.
- The robot shall be positioned at a random grid cell with a random orientation (one of the four main directions), but the robot shall be at the center of the cell.
- The magical weapon shall be at the center of a cell.
- The *prince location*, the *magical weapon location* and the *giant location* shall be determined at the time of final demo.
- You shall implement a button interface where you assign a task for three of the buttons and one of the buttons shall switch to the idle state which we shall use to reset the execution. (See Section 4)
- If the robot hits one of the obstacles or the wall and the obstacle moves more than 5 cm, the robot shall be stopped with the button interface and shall be positioned at the previous start position.
- The task completion of the robot shall be determined when the robot stops and plays a sound acknowledging the completion of the task.

Notes:

- Without taking the magical weapon, and going to the **red** cell will fail the current phase and you will start that phase again. You can restart the phase at most two times.
- You should save the map of the environment in a file because restarting the second phase should not reset the map of the first phase.

4 Button Interface

- *UP* button shall run the *Mapping* task.
- *DOWN* button shall run the *Task Execution*.
- *ENTER* button shall start the *Idle* state.
- *ESCAPE* button shall *Reset* the current task.

5 Deliverables

You need to submit:

- Design document (20 percent) : December 12, 2017
- Preliminary demo (15 percent) : December 12,2017
- Final demo (45 percent): January 9, 2018
- Final report (20 percent): January 9, 2018