CSE-5364

AUTONOMOUS ROBOTS

Project 1- Fall 2018

Navigating a known Obstacle Course with the Lego Robot.

TEAM: DEXTER ***(GROUP 7)***

Team members:

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OBJECTIVE: To navigate a mobile robot through an obstacle course to a goal location. The start position of the robot as well as the locations of all obstacles and that of the goal are given before the robot is started.

WORKSPACE: It is a rectangular area, 4.88 m x 3.05 m in size (this corresponds to exactly 16 x 10 floor tiles in the lab). The black circle with a radius of 0.305 m is the goal. Obstacles are black cardboard squares 0.305 m x 0.305 m in size (the size of 1 floor tile).

ROBOT BUILT: Differential drive robot.

Design:

We built the robot by assembling Lego EV3 Robo kit, with two free wheels & one small bearing wheel for extra support, without any sensors. As two motors have different characteristics, it will always have slight offset when following straight path.

Path Planning Strategy:

As we know Start position, goal position, position of obstacles & width of tiles as well as obstacles, we have divided available workspace in 10X16 matrix of grids. In order to determine the path to navigate robot from start to goal we have employed potential field approach based on which we calculated Manhattan distance potential from goal to start position. Where goal will have Zero potential & it will increase as we move away.

Coding Strategy:

We have divided entire workspace as follows:
Total grids = 10X16 + (18+10) X 2 = 216 grids
Where all grids at boundaries are considered as obstacles.

-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	23	-1	-1	-1	-1	10	9	8	-1	-1	-1	-1	3	4	5	6	-1
-1	22	-1	-1	-1	-1	9	8	7	-1	-1	-1	-1	2	3	4	5	-1
-1	21	20	19	18	17	-1	-1	6	5	4	3	2	1	2	3	4	-1
-1	20	19	18	17	16	-1	-1	5	4	3	2	1	0	1	2	3	-1
-1	19	18	17	16	15	-1	-1	6	5	4	3	2	1	2	3	4	-1
-1	18	17	16	15	14	-1	-1	7	6	5	4	3	2	3	4	5	-1
-1	17	16	15	14	13	-1	-1	8	-1	-1	5	4	3	4	5	6	-1
-1	16	15	14	13	12	11	10	9	-1	-1	6	5	4	5	6	7	-1
-1	17	16	15	14	13	12	11	10	-1	-1	7	6	5	6	7	8	-1
-1	18	17	16	15	14	13	12	11	-1	-1	8	7	6	7	8	9	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

‘Fillgrid’ function:

All the boundary grids & obstacles are marked with potential ‘-1’. Whereas, remaining traversable grids are marked with potential ‘55’.

‘Findpath’ function:

Goal is assigned ‘0’ potential & we propagate in increasing distances to neighboring cells. The path from start position (high potential) to the goal position (0 potential) is determined.

‘ExecutePath’ function:

The path which has been recorded in ‘findpath’ function is realized by giving commands to the motors of the robot such as moving forward, rotate by +/-90 degree.

Challenges encountered:

There were many algorithms to choose from, for path planning. But then with mutual consent we chose Manhattan Distance Potential algorithm as it will always give correct paths, if available, with no dead ends.

We tested with different goal locations amongst which there were locations for which the robot executed the path accurately that is, it landed in that location precisely, but as we increased the complexity of the location from start position, the robot tends to accumulate error and the precision reduced drastically.

This was handled by testing different combinations of speed and wait time of the motors and by hit and trial method, we inclined to agree to some degree of precision.

Code is attached with report.