Labyrinth Simulation - Coppliasim

Project Report

Eklavya mentorship programme

At

SOCIETY OF ROBOTICS AND AUTOMATION,
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ACKNOWLEDGMENT

We are really thankful that we got vedant and saharsh as our mentors for this programme.
Luckily we got one of the smartest mentors of SRA , who helped us every moment whenever we got stuck at any point during our tedious journey of this beautiful project .
We would like to especially thank Vedant as despite his extremely packed and busy schedule , he was always present to help us out . Many times there were doubts and errors which were not known to our mentors as well, still they took an extra mile , learned from their seniors or from some other source and made sure we were clear with the idea and concept of whatever is going on.

At the end we feel extremely fortunate to have them as our mentors and hope to receive help from them , even during our future quests and help us grow .

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PROJECT OVERVIEW

- Technology used in this project is V-REP(VIRTUAL ROBOT EXPERIMENTAL PLATFORM).
- This helps us create a virtual robot as the name suggests and helps us in testing and experimenting variations of code.
- This project is to create a robot that follows a line and reaches the end of the maze by traversing the minimum distance possible to reach its destination.

INTRODUCTION

- prerequisite->
  The project includes VREP and knowledge of basic C language with some basic knowledge of data structures and algorithms and their mechanisms.

- In this project we create a random maze and the robot has to explore the entire maze and store it in its memory and henceforth whenever next time it travels the same maze it can select the shortest path available and travel that.

- The primary tasks are to make a line following robot , in which the robot will follow a line.

- After it is able to follow the line properly then it should explore the maze properly.

- Knowledge -> Theory
  of algorithms such as dijkstra algorithm ,
  BFS , DFS and some data structures such as stacks or queues , Graphs and arrays.

- PID-> It is the major part of the project as when we are following a particular path with the help of sensor readings , if at any point of time our robot goes out of its way , with the help of PID we can get back our robot to our particular path.

- P->proportion -> if our robot is out of line ‘P’ tells us how much error is there and we can adjust the speed and direction of our robot similarly. We calculate error by having a proportional constant ‘kP’.

- I->integration -> It helps our accuracy get better in coming back on line instead of deviating more on the other side. It has a proportionality constant ‘kI’.

- D->differentiation ->D minimizes our correction error factor hence increasing efficiency .It has a proportional constant ‘kD’.

METHODS

- This project can be done in VREP simulation using coppliasim software , which is available for free .

- Other options available are by using Gazebo . The disadvantage of using gazebo is it is a bit lengthy and it is complex to understand and also requires us to have knowledge about ROSS.

- If someone wants to learn about ROSS then he/she can use gazebo , whereas if someone does not want to learn ROSS , VREP would be a preferred option.

EXPERIMENTS AND RESULTS

- Procedure ->

1] Create a robot in VREP
2] write code for line following
3] tune in PID for better efficiency
4] write code for exploration of maze
5] write code for shortest path of maze
6] make sure the robot has decent speed as VREP has a time limit else it stops working (unless this bug has been solved by VREP)(For more info check VREP-coppliasim discussion forum).

- It requires around 1000 or more testing cases for tuning in PID (P->proportion ; I->integration ; D->Differentiation) required so that the robot follows the line properly and does not deviate away easily.

- No. of test cases and trials required may vary from person to person depending upon its respective judgements and approximation.

- https://drive.google.com/drive/folders/1eSP-3xXszwSAsnhzS7qDY1lSUakNhVcd?usp=sharing

- The above shared link of google drive is the live working of our robot as to how it explores and covers the shortest path respectively.

CONCLUSION AND FUTURE WORK

- Efficiency for shortest path after exploration is 100% , while efficiency while exploration is not very effective yet and can be improved by a margin of around 15-20 % and accuracy while travelling the shortest path is again 100% and while exploration is around 65-70%.

- We achieved our final goal of making sure our robot travels the shortest path of the maze.
  As this project also requires a lot of testing for getting appropriate values at various points , it also helped us in being more patient towards bugs as it took us around 10/12 hours on average to debug everytime.

- Future aspects -> to make our robot more efficient and accurate while exploring and also to use wheel encoder in it.

REFERENCES

- PDF shared by SRA (LABYRINTH 2019 FINAL.pdf)
- Research paper by Shadman sakib(BANGLADESH)
- VREP tutorial on you-tube by Leopoldo armesto https://www.youtube.com/playlist?list=PLjzuoBhdtaXOoqkJUqhYQletLLnJP8vjZ
- Learn how to make a graph. https://www.youtube.com/watch?v=5hPfm_uqXmw
- Learn BFS(Breadth-First search Algorithm) , Dijkstra Algorithm .https://www.youtube.com/watch?v=pcKY4hjDrxk (BFS) https://www.youtube.com/watch?v=XB4MIexjvY0 (Dijkstra)(Shortest path algorithm)