ENPM690:Robot Learning

Project Proposal

Autonomous Delivery Robot Using Reinforcement Learning

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1 Goal or Objective: -

From automotive manufacturing plants to fulfillment centers and warehouses, delivery robots are being used to enhance the logistics and inventory management and hence increasing it's efficiency.

In a dynamic environment, where the pickup and drop off locations keep changing, the process of planning a path for the delivery robot is very arduous. Thus to address this problem, reinforcement learning is a viable option.

In this project we aim to train the delivery robot through reinforcement learning to remove the redundancy of planning a path everytime a pickup or dropoff location changes.

The objective is to train the agent (ADRURL Bot) using a basic RL algorithm known as Q-Learning. The task for the robot is to pickup packages from different pickup points and deliver them to any of the drop-off locations depending upon the requirement.

2 Machine Learning Method to be used

Reinforcement Learning (Q-Learning):

Deep Q-Network

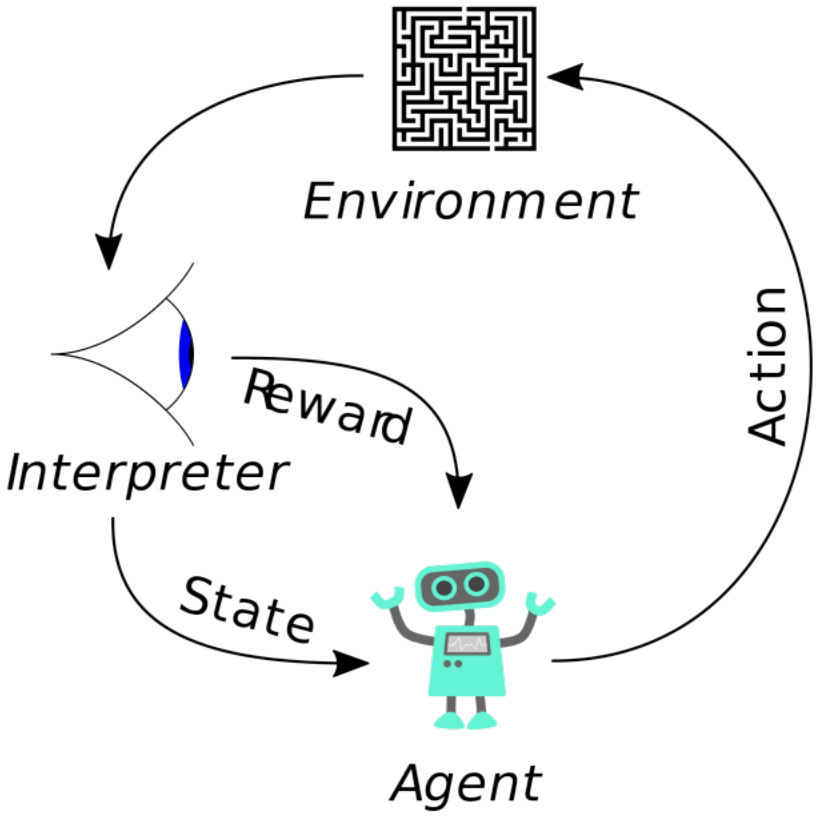

Figure 1: Reinforcement learning model

3 Robot

3.1 Robot Description

We will be using a custom designed robot which will be inspired from the Amazon fulfillment robots (refer Fig. 2).

3.2 Robot Specifications

Robot Name: ADRURL Bot
Drive Mechanism: Planar drive
Model Description:

- Wheel type: Omniwheel
- Sensors: Bumper, Encoders

Figure 2: Amazon fulfillment center robots

4 Simulation Environment

Simulation Software - Gazebo: Gazebo is a simulation platform which has real physics simulation, advanced 3D Graphics, sensors and noise plugins to model the real world.

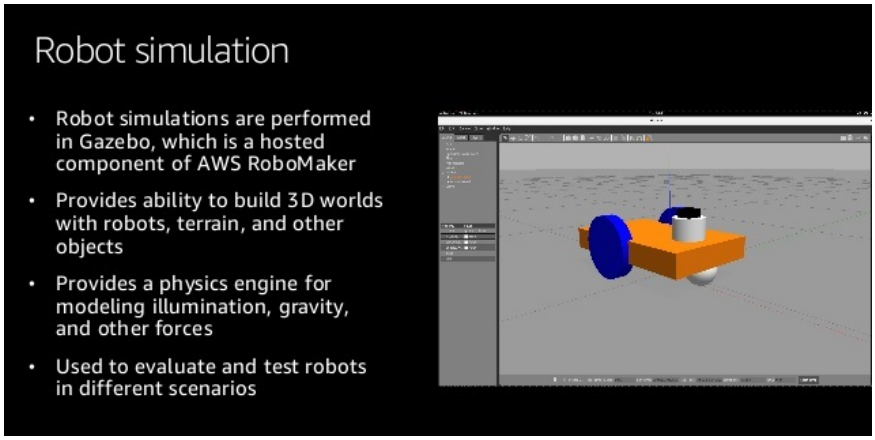

Figure 3: Gazebo

We will be using Gazebo to create the plant environment. The environment will be having different pickup locations. The pickup locations is where the robot is supposed to pick up the package from.

The robot then has to navigate through the maze, which will replicate the obstacles in the real world plant.

There will also be multiple drop-off locations where the robot has to deliver the package.

5 Method of Control to be used

To optimize the control policy for the robot, we first need to understand the Markov Decision Process.

The reinforcement learning problem for our case can be defined as a Markov Decision Process. For each state, the ADRURL bot will be applying an action for example - Moving Forward, Left and Right. The action will be chosen based on the current state as defined by the control policy.

The Markov decision process involves transitioning from one state to another state, using the set of states and actions.

The control policy will be formulated by the Q-Learning method. After each action applied for the current state, the agent will receive a reward based on the weighted reward function defined.

This will be used to update the Q-Table and hence will be used for choosing the appropriate action for the given state.

6 Programming Language

The programming language to be used for this project is Python.