Target Driven Visual Navigation in Outdoor Scenes

Group 18

Jerry Xu - [redacted]

Sai Charan Kotra [redacted]

Satya Sai Bharadwaj Manthri [redacted]

Vishnu Vardhan Reddy Kanamata Reddy [redacted]

Abstract

- Target-driven visual navigation in outdoor environments, making an agent utilize vision to navigate through the environment in order to achieve a user-specified objectives has become one of the major difficulties in robotics in recent years.
- We present a novel outdoor environment simulated in the Gazebo framework and RL (Reinforcement learning)
- We show that we were able to replicate real-world outdoor scenarios and successfully conducted experiments in which we were able to make the robot navigate and interact with the objects.
- This creates innovative application possibilities where intelligent agents could pick up on information from their environment and adapt to a variety of settings with little assistance from humans.

Target Driven Visual Navigation

Present Camera View

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Target Not Found

Navigate and Check

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Target Found

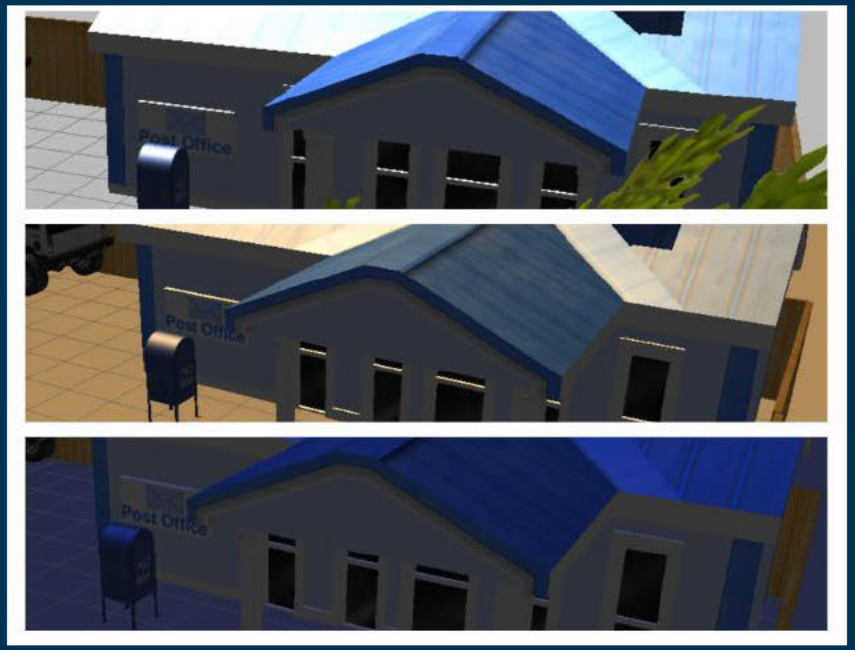
STOP

Main Goals

- Implement Target Driven Visual Navigation Concept

- Make Robot Work in Outdoor Environment With Target Driven Visual Navigation

- Test Robot for the following:
  - Changes in Lighting
  - Changes in Environment



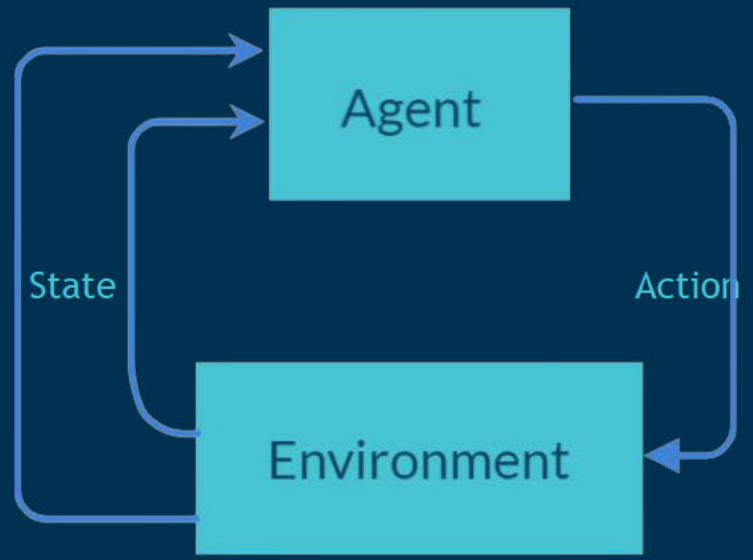
Technologies and Hardware Specifications

- ROS
  - Robot Operating System (ROS) is a set of software libraries and tools that help you build robot applications
  - It provides hardware abstraction, low-level device control, message-passing between processes, and package management.
- Gazebo
  - Gazebo is an open-source 3D robotics simulator.
  - It integrated the ODE physics engine, OpenGL rendering, and support code for sensor simulation and actuator control.
- Windows

Environment

Concept of Working

- We are using Model-free Reinforcement learning
- States = { Target Found: 1, Target Not Found: 0}
  - state also includes image that the robot sees (aka a rgb image)
- Action = { Left, Straight, Right }
- Reward Policy :
  - Collision => -100
  - Target Found => +100
- On collision, Episodes End
- Episodes - 50
- Action per Episode - 1000



Important points of Implementation

Each action has a special designated moves for itself:

- Move Ahead - Moves 1 unit towards front.
- Left and Right - Turn and Move 0.5 unit front.

Learning is done by the following formula:

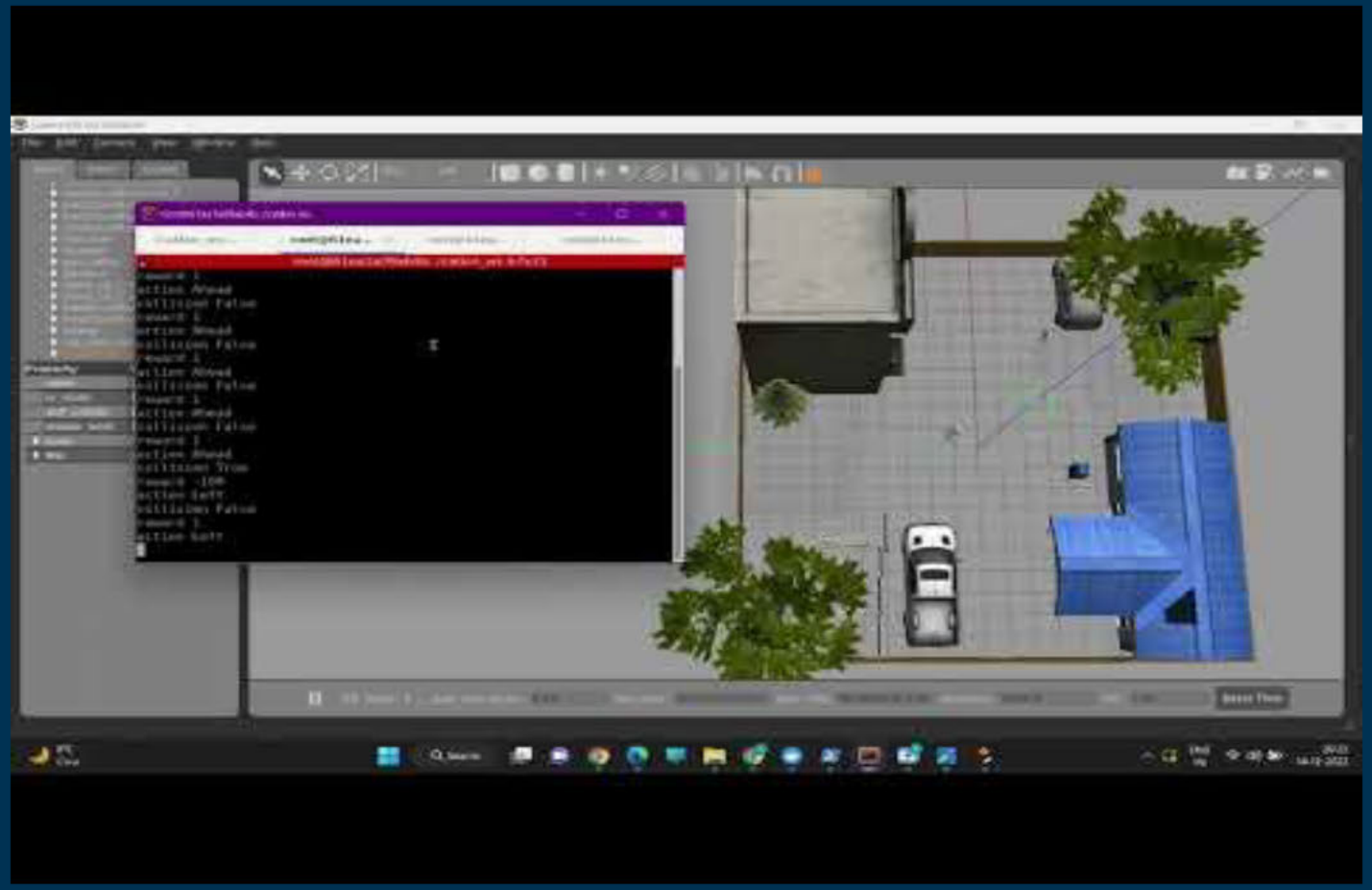
G [action] + = alpha (target - g[action])

Target + = reward

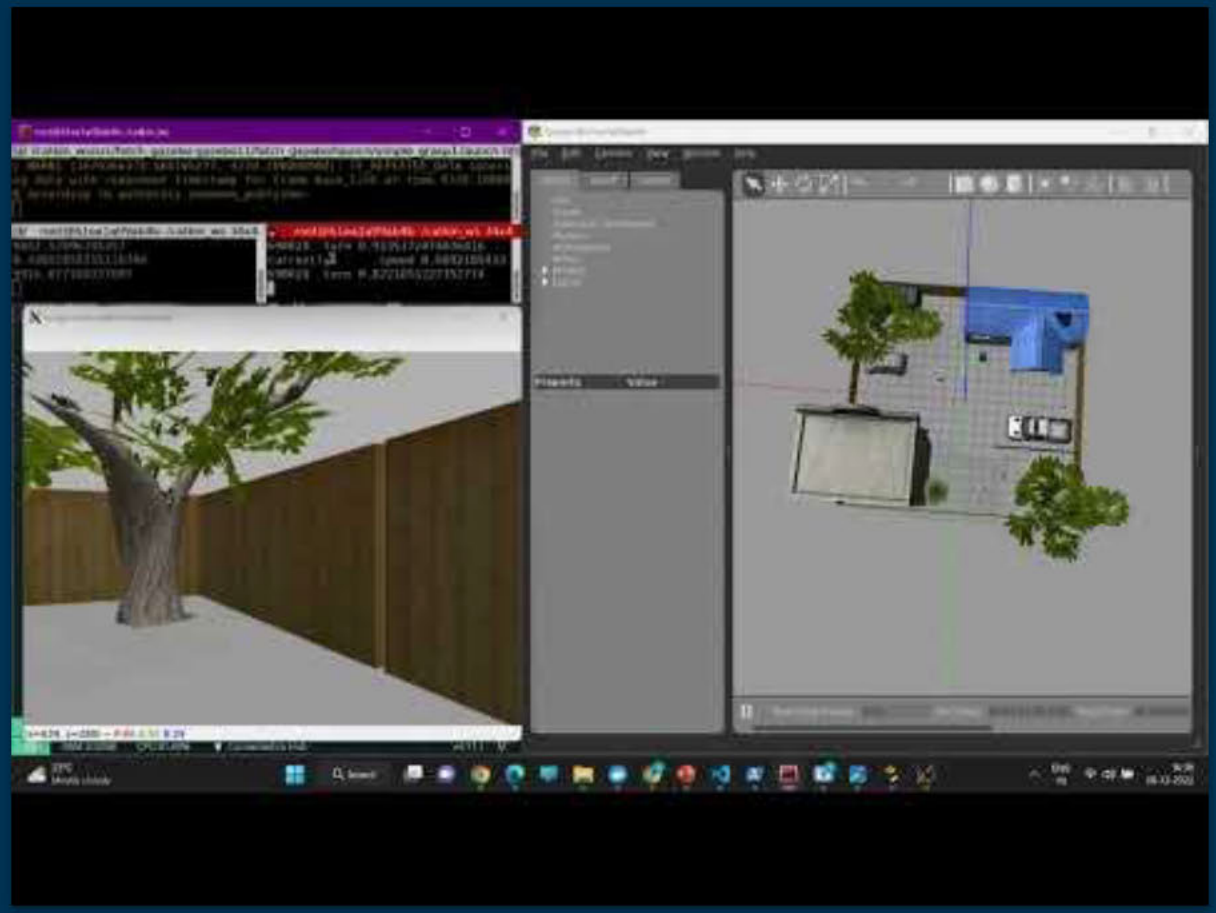
Collision and Target Detection

- Target Detection:
  - Present view of head camera is taken with the help of a ROS topic “/head_camera/rgb/image_raw” and CvBridge
  - Comparison of target and present view is done with the help of following scores:
    - Mean Square Error (MSE)
    - Structural Similarity Index Measure (SSIM)
- Collision Detection:
  - For moving the robot, we developed a code. While developing itself, we created cases to detect collisions by the following measures.

DEMO (Output)



DEMO (Expected output)



Expected output matches our output as seen in the previous slide - So, the navigation is successful

Thank You