MATLAB-ROS-Gazebo Simulation Platform

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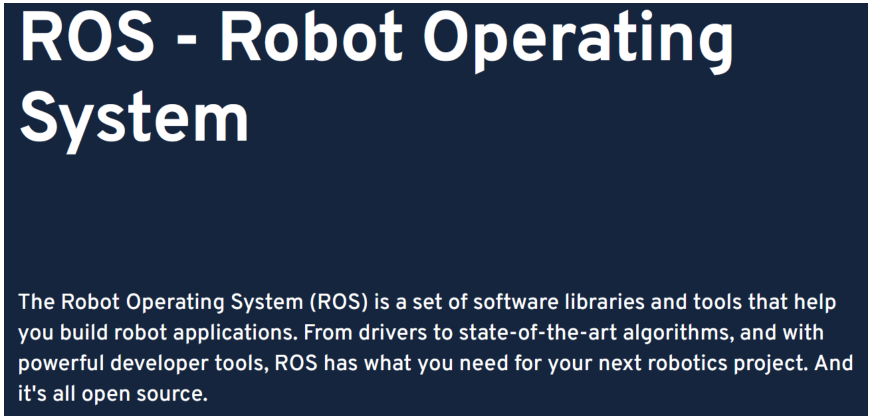
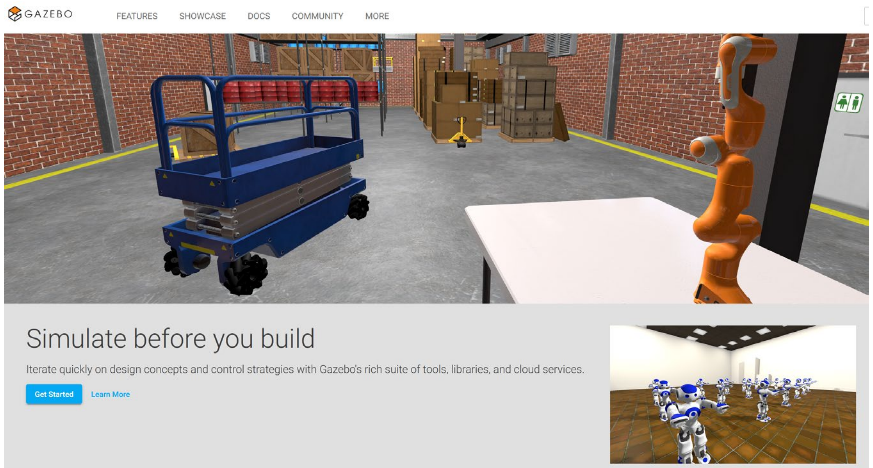
ROS and Gazebo

- **ROS**: Robot Operating System
- https://www.ros.org/



- Open source
- State-of-art algorithms
- Compatible to simulators & physical robots

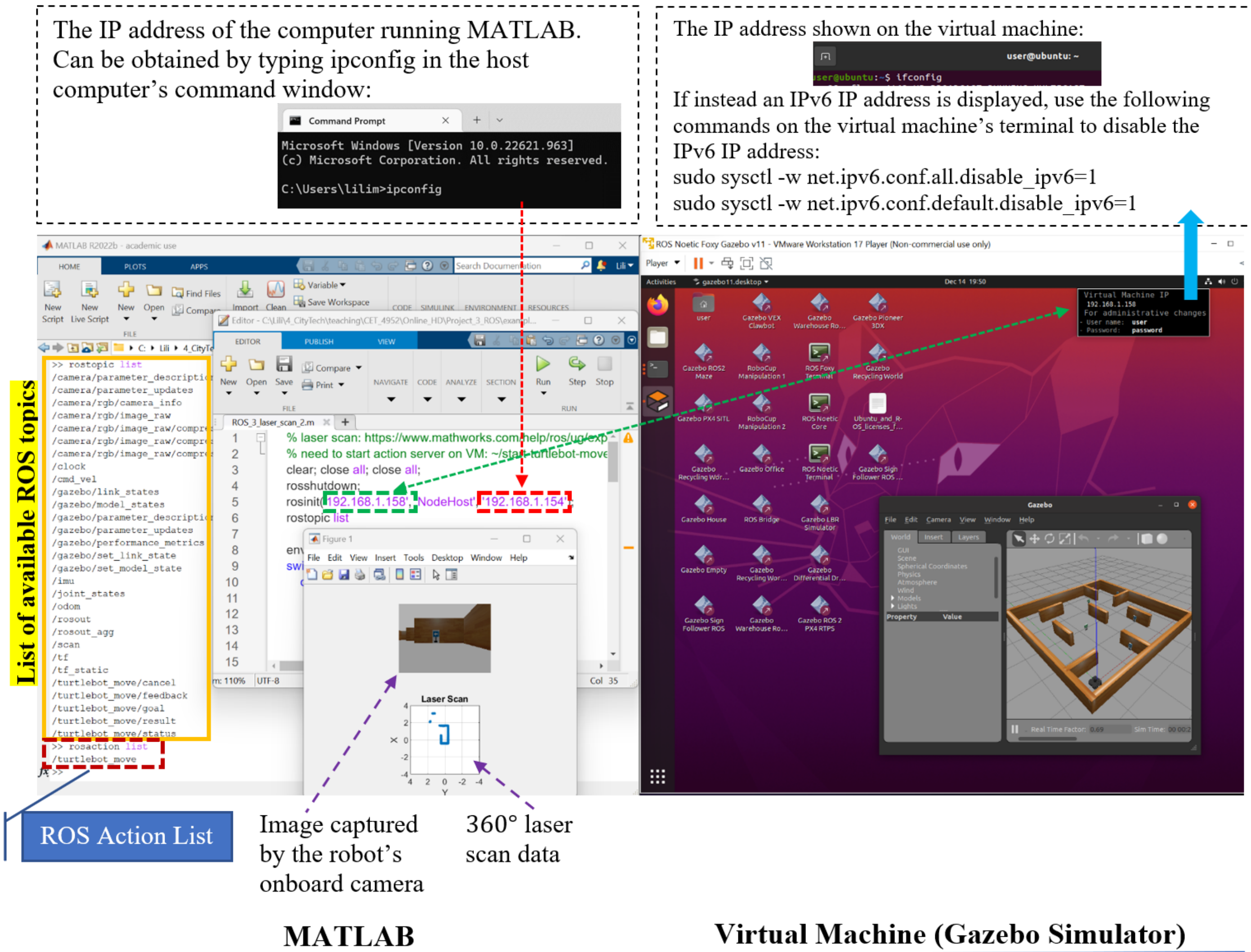
- Gazebo Simulator:
- https://gazebosim.org/home



- Complete toolbox of development libraries
- Realistic Environments
- Sensors of high fidelity

MATLAB-ROS-Gazebo

Control of a simulated robot in the Gazebo simulator on MATLAB utilizing MATLAB’s ROS toolbox



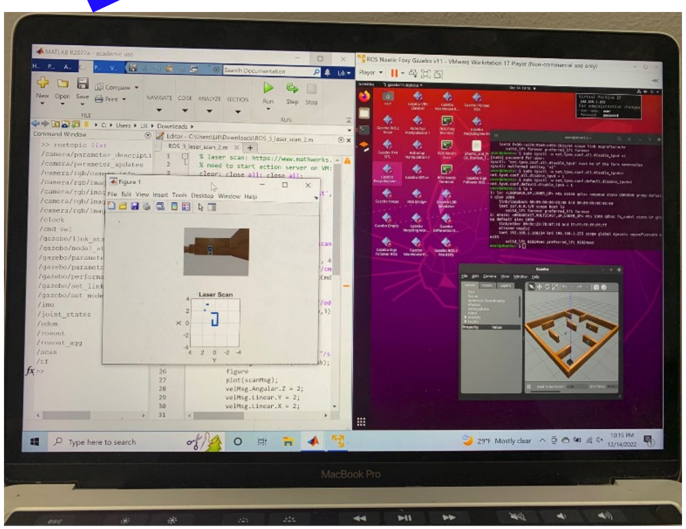
Setting Up the Platform

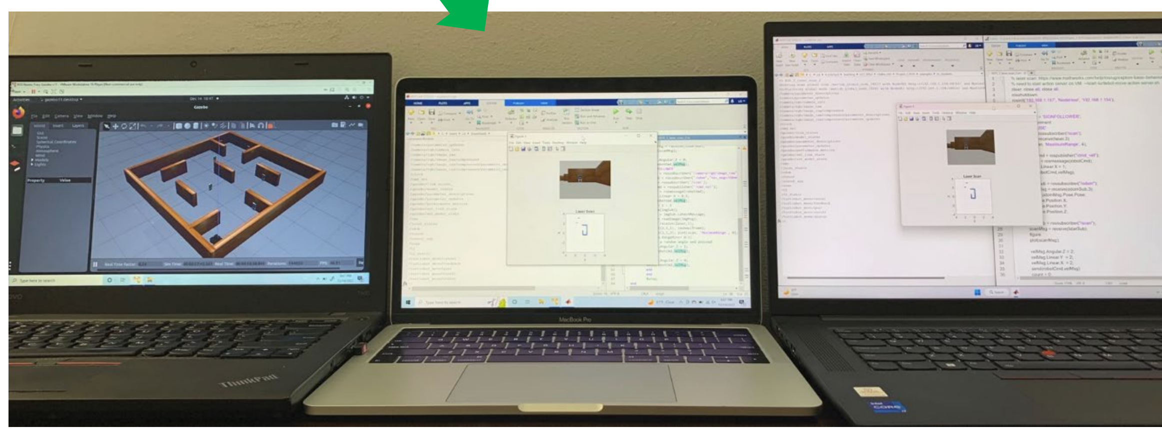
- https://www.mathworks.com/help/ros/ug/get-started-with-gazebo-and-a-simulated-turtlebot.html
- https://www.mathworks.com/support/product/robotics/ros2-vm-installation-instructions-v8.html

- Requires:
  - **MATLAB** with **ROS** toolbox
  - **WMware Player** that plays a **virtual machine**

Setting Up the Platform

- So far, I have setup on **Windows**
  - Both MATLAB and Gazebo on one computer running Windows
  - Both MATLAB and Gazebo on one Mac (Windows is installed via Bootcamp)
  - Gazebo on one computer with two other computers running MATLAB

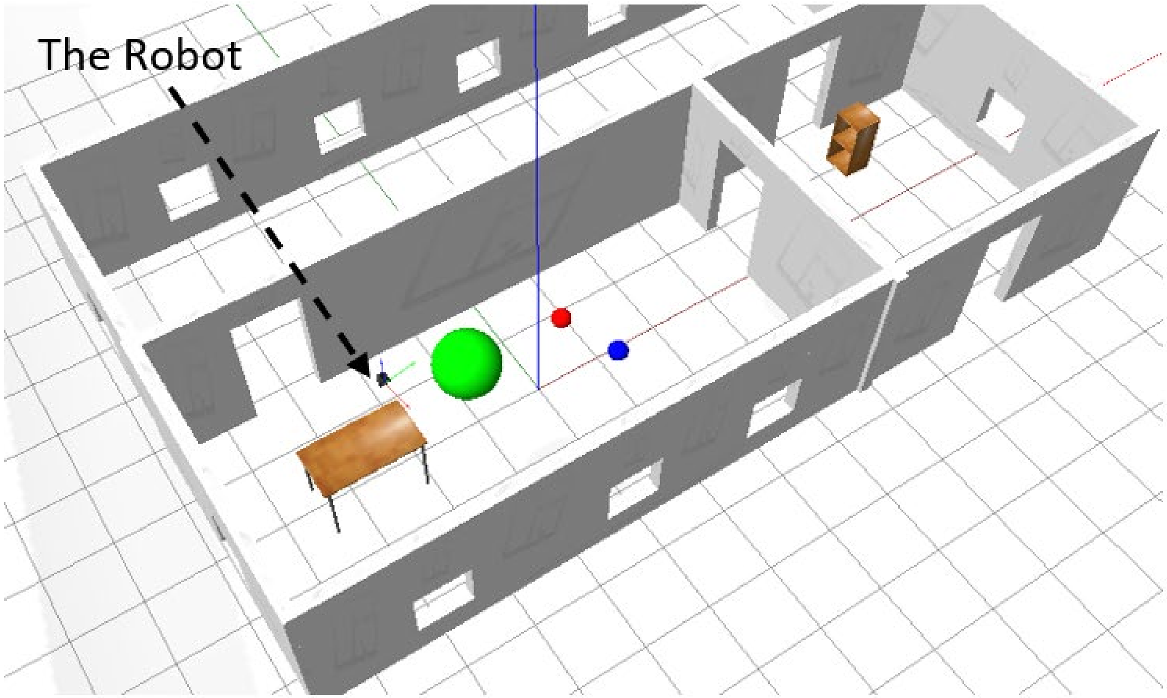


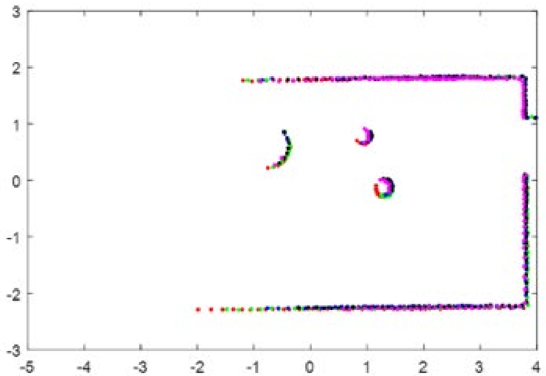


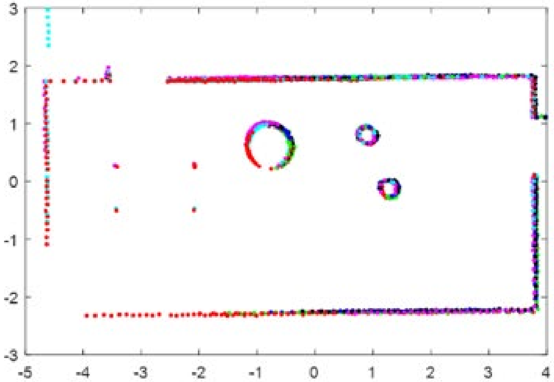
#1: Receiving Laser Scan Data

The **Office** environment:

1. The robot is commanded to move around.
2. The collected laser scan data are cumulated together, yielding a better representation of the robot's environment.

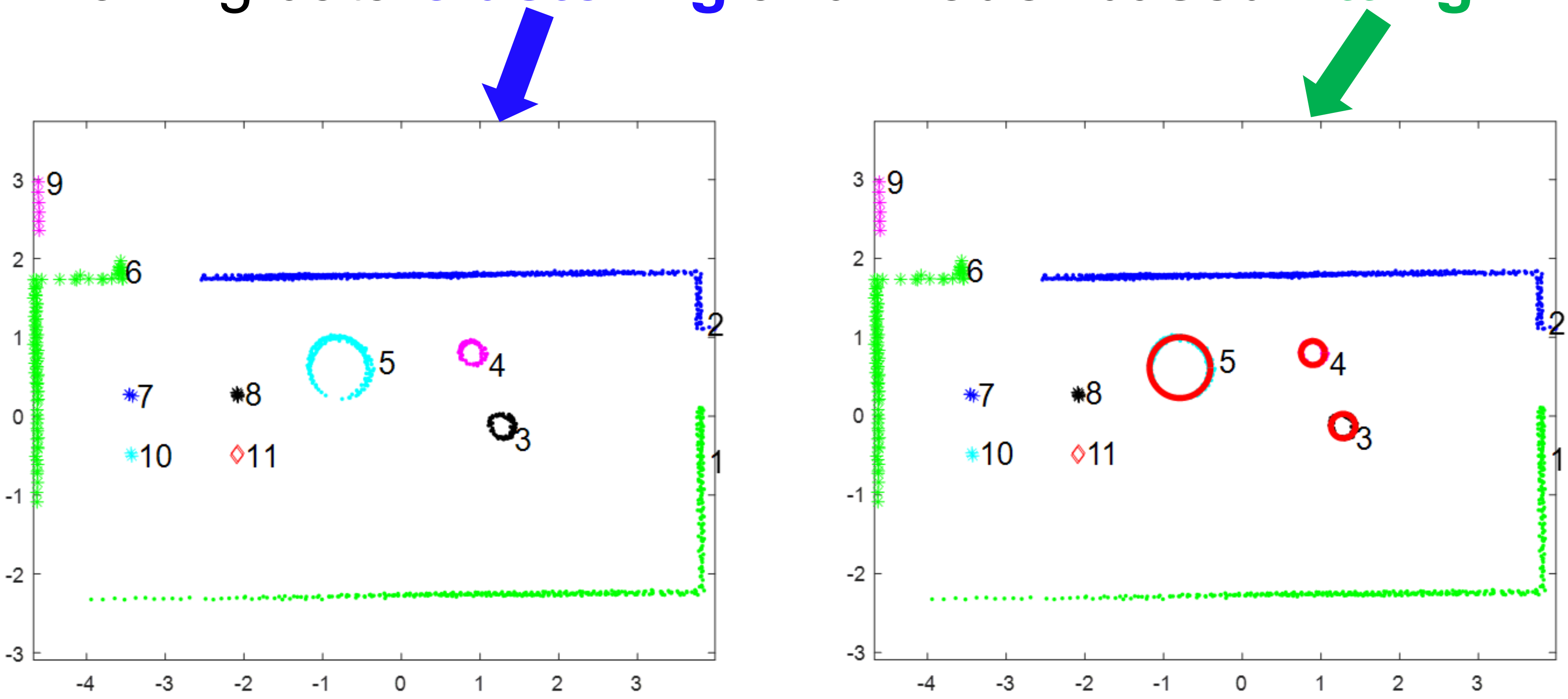






#1: Receiving Laser Scan Data

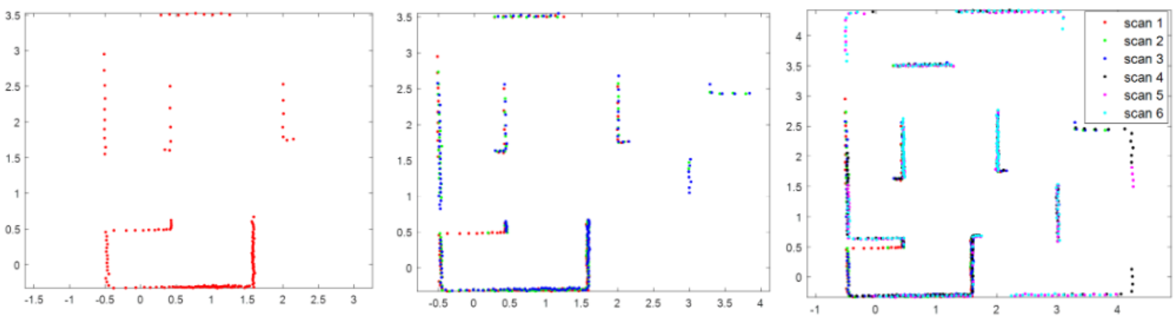
- Allowing data **clustering** and **model-based fitting**



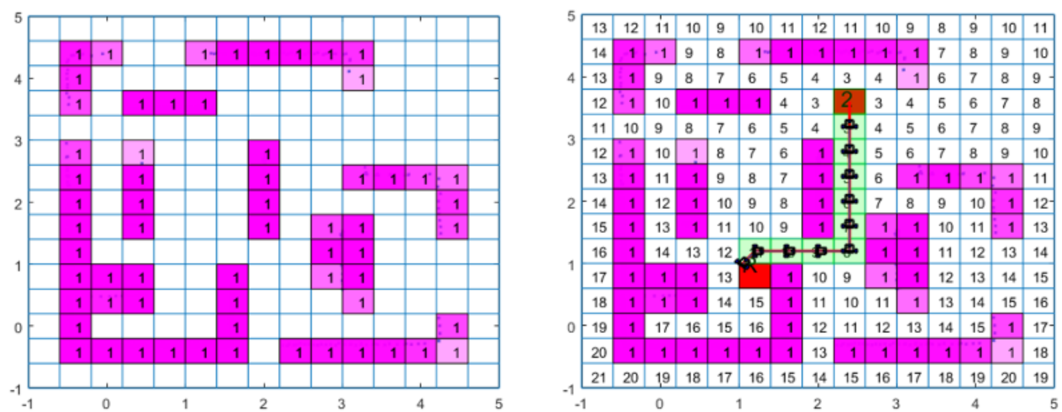
#2: Path Planning

The **Gazebo Sign Follower ROS** environment:

1. The robot moves around, collecting laser scans.
2. Implementation of home-made path planning algorithm
3. Command the robot to reach the goal location.

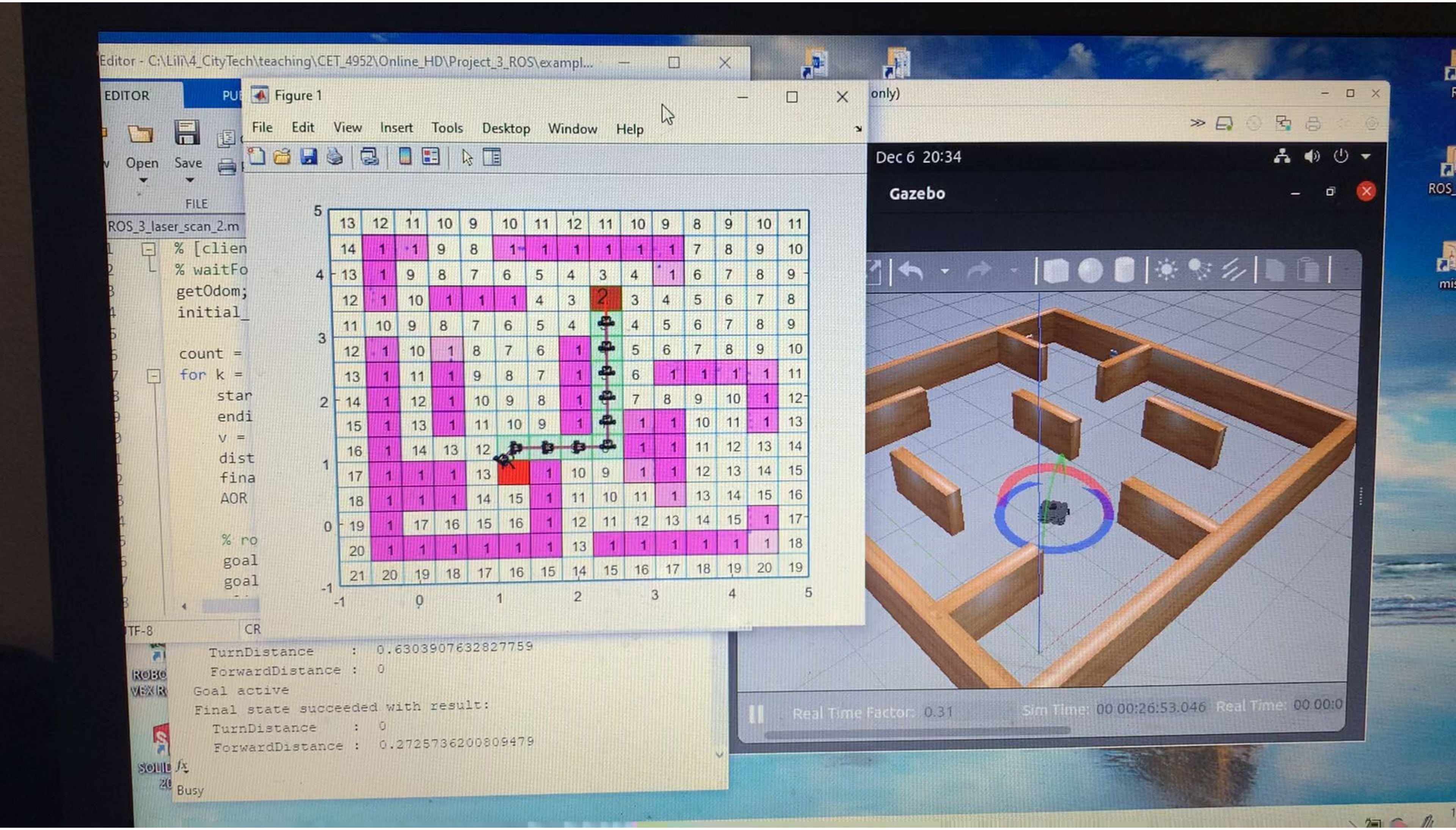


(a) 1 Scan (b) 3 Scans (c) 6 Scans



(a) Setting Up Wavefront Map (b) Wavefront Propagation

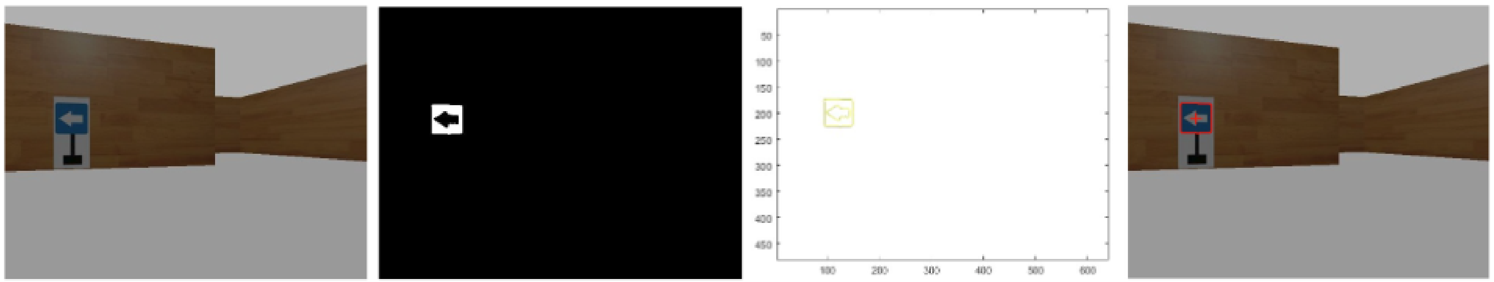
#2: Path Planning



#3: Vision-Based Control

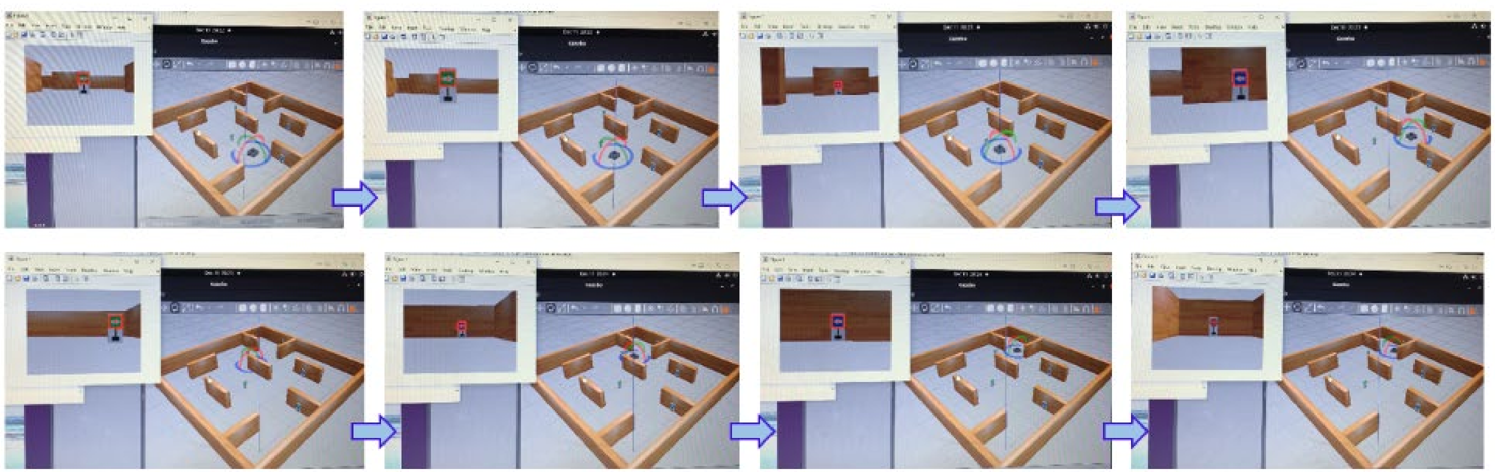
The **Gazebo Sign Follower ROS** environment:

1. The robot captures images using its onboard camera.



(a) Original Image (b) Thresholding Hue (c) Detected Contours (d) Center

2. The robot is controlled to turn left/right according to the sign



Physical Robots

- We have several VEX robots and one TurtleBot3.
- We are now working on controlling these physical robots via ROS.