Project 2: Autonomous Navigation

Due: 05/04/2023 @ 1:30 P.M.

Welcome to your second (final) project. The goal of this project is to autonomously navigate the robot that was built in the previous project. Your starting point and destination is indicated in the diagram attached in the end (page 3). You will be benefit by using the following ROS 2 packages. **Please aware that each team need to prepare a presentation for this project. The final presentation will start at 10:50 AM, Thursday, May 4th in LSCA-105.**

- rplidar_ros
- slam_toolbox
- navigation2

1 (30%) Gazebo Simulation

Simulate the robot, simulate the designated area in Lewis Science Center. Make the autonomous navigation happen in the simulation.
Requirement:

1. The robot model needs to comply with your actual robot in terms of size and weight. Each link of the model needs to have reasonable visual, collision, inertial and gazebo properties
2. Use *gazebo_ros_diff_drive* plugin to enable velocity control using */cmd_vel* topic and to publish */odom* topic.
3. Use *gazebo_ros_ray* plugin to simulate lidar and publish */scan* topic.
4. Create a gazebo simulated world that analogous to the designated area (as shown in the attached diagram on page 3) in Lewis Science Center.
5. Use *slam_toolbox* to create and save a map.
6. Use *nav2_bringup* to realize an autonomous navigation on the saved map.

2 (40%) Real World Navigation

Navigate the physical robot in Lewis Science Center.
Requirement:

1. Publish */odom* topic using monitored velocity information from a Raspberry Pi Pico micro-controller.
2. Use *rplidar_ros* package to drive an RPLidar A1 and publish */scan* topic.
3. Use *slam_toolbox* to create and save a map for the designated area in Lewis Science Center.
4. Use *nav2_bringup* to autonomously navigate the robot from starting point to the destination within the saved map.

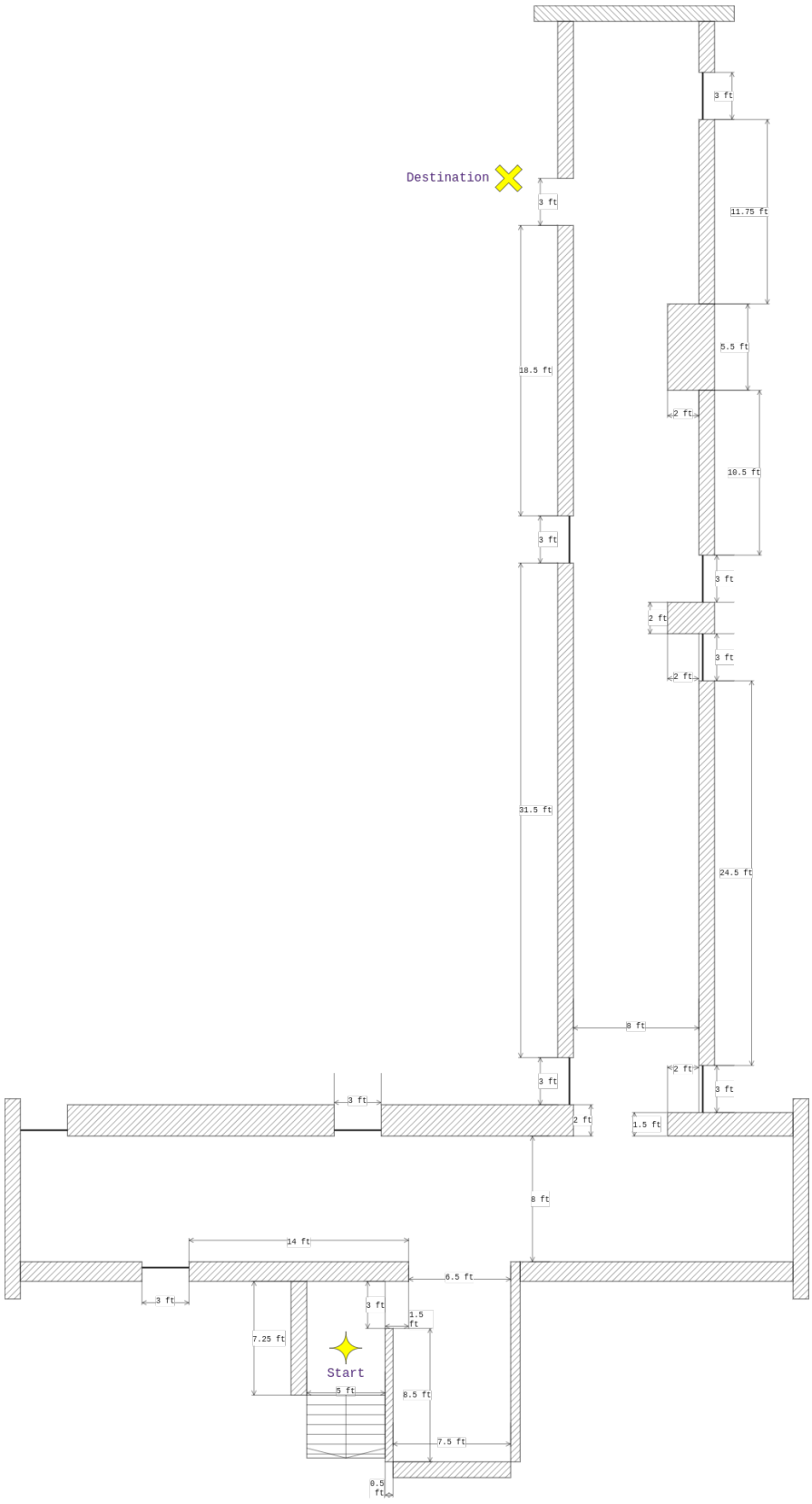
3 (20%) Analyses and Report

Update the report from previous project. Include your new findings and analyses.
Requirement:

1. Describe the workflow of your navigation.
2. Analyze the factors that affect the navigation most.
3. Wrap up the project with any interesting findings and ideas.

4 (10%) Presentation

Prepare a 15 minutes presentation to summarize the project. Every audience is expected to ask at least one project related question.


Destination
3 ft
11.75 ft
3 ft
5.5 ft
18.5 ft
2 ft
10.5 ft
3 ft
3 ft
2 ft
3 ft
2 ft
31.5 ft
24.5 ft
8 ft
3 ft
2 ft
3 ft
3 ft
2 ft
1.5 ft
8 ft
14 ft
6.5 ft
3 ft
3 ft
1.5 ft
7.25 ft
Start
5 ft
8.5 ft
7.5 ft
0.5 ft