ECED 3901

Laboratory 5:   Design Task 2

Map an unknown environment

Date Handed Out: January 28, 2026
Code, Simulation, and Live Demonstration Due: February 04, 2026

Desired Outcomes:

Design Task 2 will have you use ROS2 to command a robot to start-up automatically, map an unknown environment, and save the output image/files. Simulation, code, and your robot performing the task will be graded by a TA.

Prerequisites:
- Completion of Laboratories 1 to 4; completion of Design Task 1.

Requirements:
1) Code must be your team's own work as relates to the challenge.
2) Create a ROS2 launch file that starts the nodes for purposeful motion, mapping, and saving the resultant map.
3) The launch file must establish nodes that subscribe to /odom, /scan and publish motor commands to /cmd_vel.
4) It is recommended that you establish a square motion node, from DT1, a SLAM mapping node, and a saving/timed node.
5) Prove your program works in the Gazebo simulation environment and show validation on your own robot.
    - Simulation demo is required for the team.
    - Experimental evidence of the robot performing the task is required.
6) If time is limited, only 3 trial attempts are permitted for demonstration.
7) Git version control must be used; it will be evaluated when code is demonstrated.
8) The robot starts at the origin (0.3 m x 0.3 m, 0° yaw).
9) The robot shall make a 1.0 m x 1.0 m square, completing a map while moving. The square should be completed counterclockwise from the origin, initiating with forward movement as the first step.
10) Robot shall not travel faster than 0.2 m/s, nor rotate faster than 1.0 rad/s.
11) The final map is to be saved in your package directory after motion is executed.

Suggested first steps.

1. You will require two terminals when you attempt this design task in simulation. Eventually, you will use a different Launch File #1 that calls up the real robot hardware drivers.

   Launch File 1 (Virtual World, Virutal Robot):

   a. Bring up Gazebo.
   b. Bring up Emulated robot.

   Launch File 2:

   c. Initiate the SLAM node.
   d. Initiate square movement, the node from DT1.
   e. Trigger a map save after motion.

2. Read about launch files. Up until this point, we have been using premade launch files provided. However, in order to combine ROS2 nodes/programs/scripts with your own ROS2 software developments, you will need to dive into the launch files and learn how ROS2 nodes are called. It will be worth your time to look into and understand the structure of launch files.

   https://docs.ros.org/en/humble/Tutorials/Intermediate/Launch/Creating-Launch-Files.html

3. Run Launch File 1 in one terminal.

   ```
   $ ros2 launch eced3901 lab5.launch.py
   ```

   This should spin up Gazebo an the Emulated Robot.

4. Run Launch File 2 in another terminal.

   ```
   $ ros2 launch eced3901 lab5dt2.launch.py
   ```

   This should spin up the SLAM toolbox via NAV2 by default now.

5. Now that you have a initial setup, it is your time to start reshapping the launch file! Remember to use GIT and track via your developments via version control.