ECED 3901

Laboratory 1

Robot Quick Start

Date: January 14, 2026

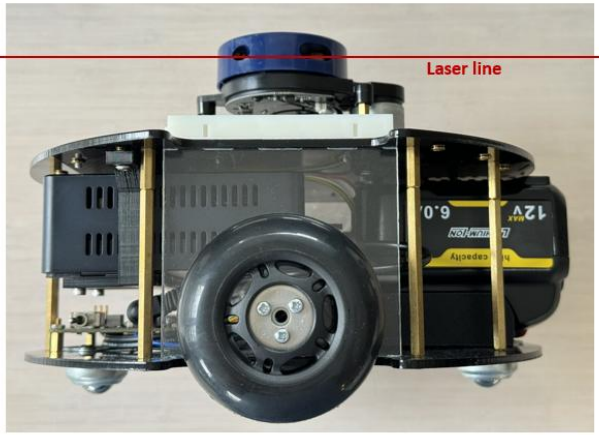
Version: 1.0

V. Sieben

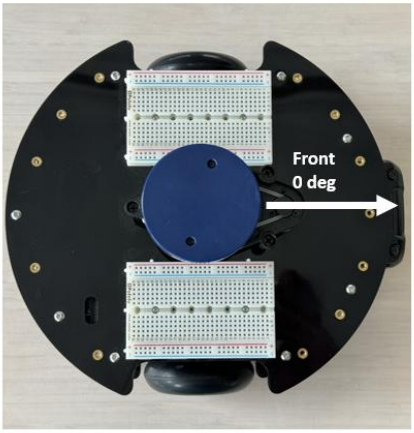
1. Robot Anatomy

DALiBOT – The ECED3901 Robot

Side



Top

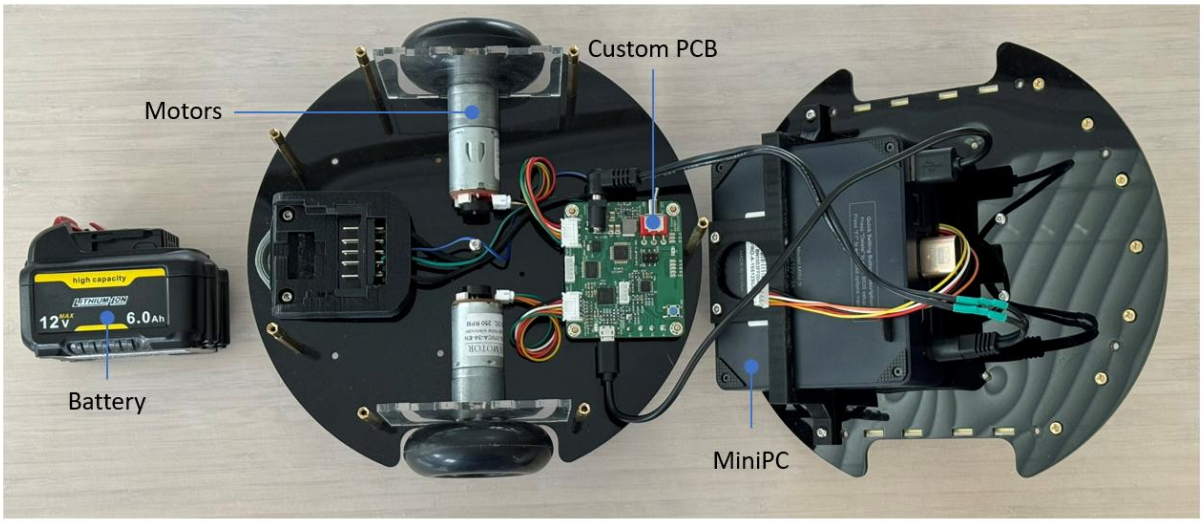


Front

Back

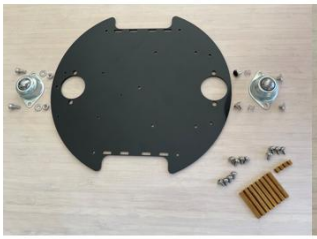
Sieben Custom Robot Platform

Under the Hood



Key Robot Parts

2D - 360° LiDAR
Mapping and Navigation
YDLiDAR X2



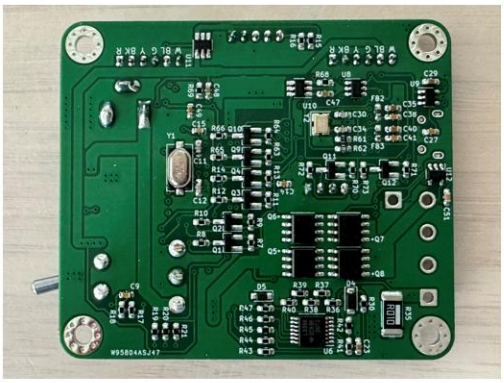
Custom
Laser-cut Chassis
Platform and HW

Motors and Encoders
Odometry
ES Motor
25SG-370CA-34-EN

Swappable Extra Capacity
DeWalt or Similar
Lithium Ion Battery
3S2P with BMS
10.8-12.9V, 5-6Ah

Beelink Mini PC S12 Pro
Intel 12th Gen 4-Core
N100 3.4 GHz
16 GB DDR4 Ram
500 GB SSD
Dual 4k HDMI, Gig. Ethernet

Key Robot Parts - Custom PCB



ATmega 328P (same as Arduino Nano) – Microcontroller
TB6612FNG – H-bridge or Motor Driver
BNO055 – Inertial Measurement Unit or IMU
MP2338GTL – 5V 3A regulator
Level Shifters for UART comms, e.g. LiDAR.

Schematics and datasheets on Brightspace

Power supply when not using battery (only runs MiniPC, not custom PCB). Good for restoring MiniPC OS image, simulating with ROS2, and writing code.

2. Charging the Robot

a. Engage the clip and pull on the battery to dismount from Robot. Should come out easy, do not force.
b. When lights are FLASHING red, battery pack is charging. When lights are SOLID red, battery pack is charged.
c. The DCB115 is a relatively fast charger at 4A supply to the battery pack and will take approximately 1.5-2 hours to recharge the robot battery. Plan accordingly.
d. When complete, disconnect battery pack from the charger, and re-insert on the robot.
e. Both the battery gauge on the pack and on the robot should read full.

3. Connect to the Robot with Keyboard, Mouse, and HDMI

You can physically connect to the MiniPC as any other personal computer.

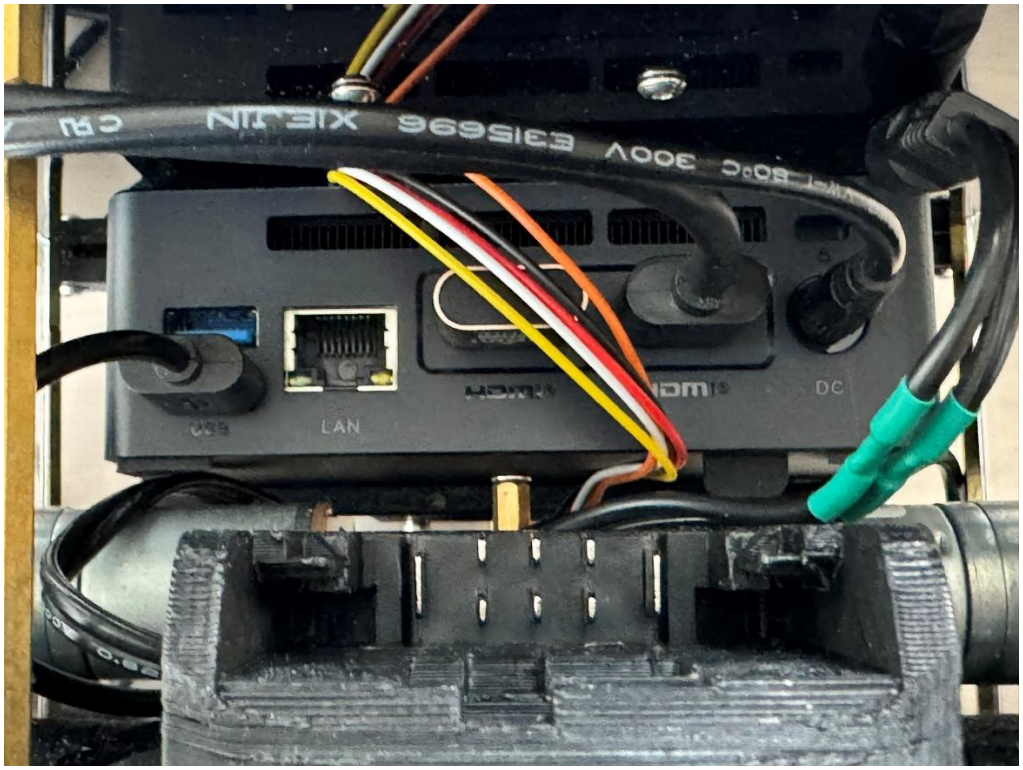
The Wireless Keyboard and Mouse allow you to type and navigate the OS (Ubuntu) pre-installed on every robot. **You DO NOT need to install nor configure any OS; the robot works out of the box.**

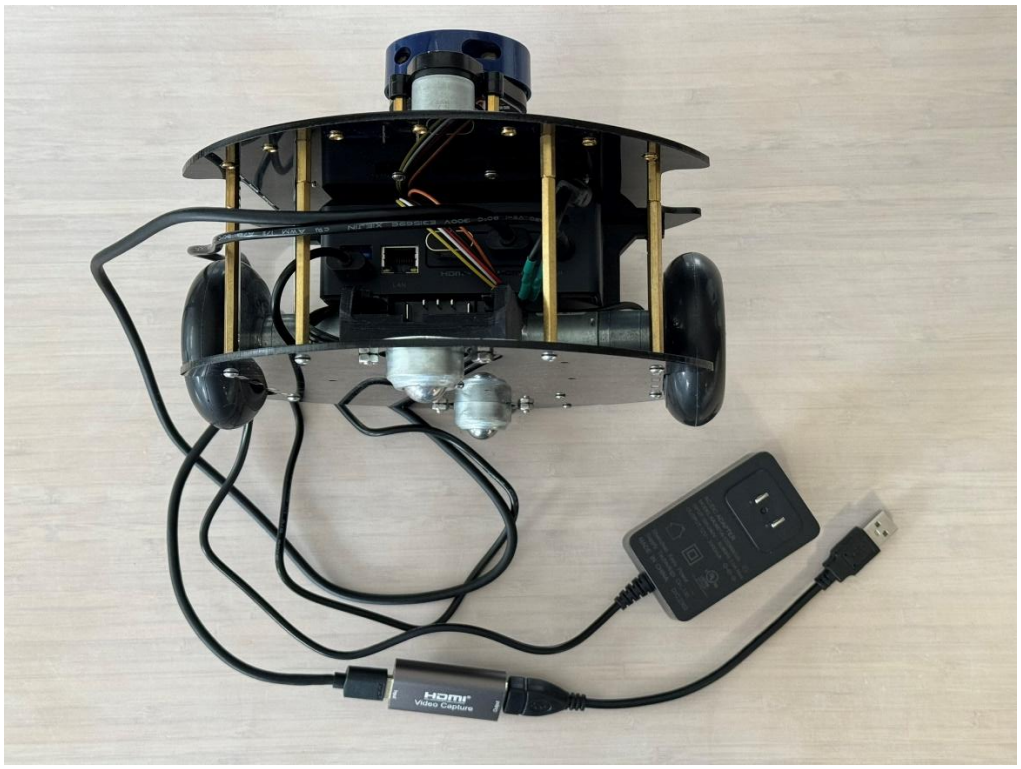
The HDMI-to-USB allows you to broadcast the monitor output of the MiniPC to a USB port that can use a program like "Camera" in Windows for acting as the monitor to the Robot.

a. Remove the battery pack.
b. Connect the power supply 12V 3000mA MiniPC shown above to the MiniPC using the barrel connector.
c. Connect the KB/Mouse USB dongle to the MiniPC, any open port will do, but we recommend one of ports by the Ethernet Port.
d. Connect the HDMI cable to MiniPC using the **HDMI port closest to the Barrel Connector** (power).

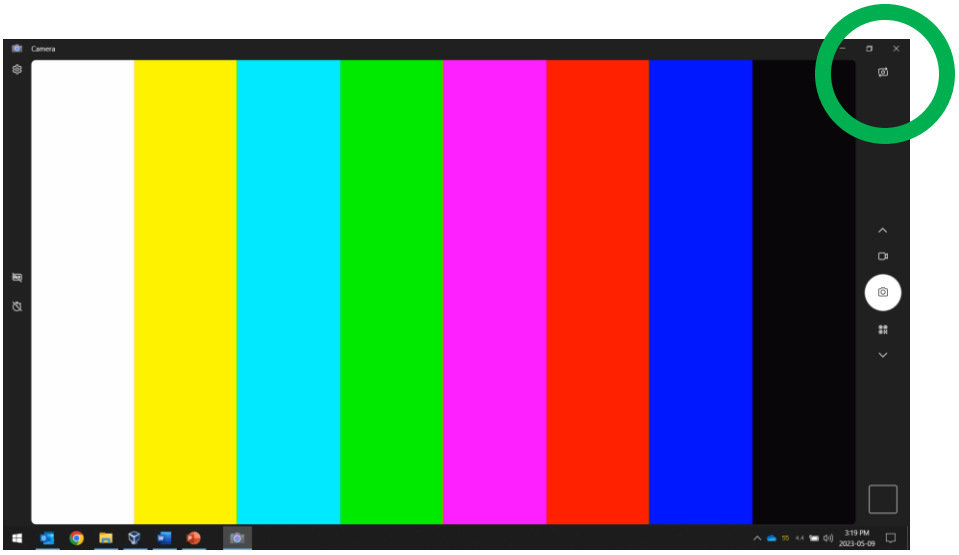
> FYI: The other HDMI port should be occupied by a "Dummy" HDMI device (gold thing that looks like a memory stick), which allows the OS to boot without a monitor attached to the MiniPC for remote access, discussed later.

e. Connect the other end of the HDMI cable to the HDMI-to-USB adapter and then plug the USB into your laptop or desktop PC.
f. The setup on the back of the MiniPC should resemble this:



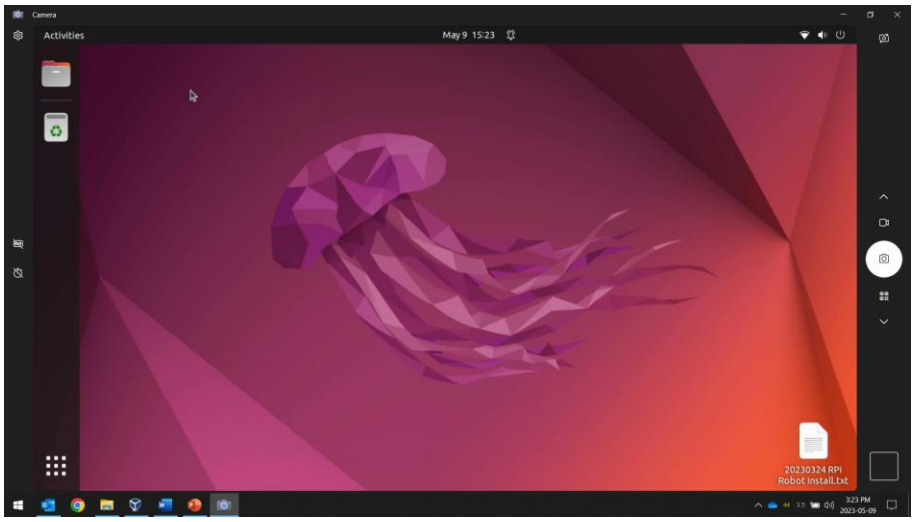


g. Open the Camera program in Windows or a similar WebCAM application. If using Camera, press the Windows key, type “Camera”, and hit enter. It should look like this before the OS / Robot is powered on. You might need to switch the video source/input, circled in green below.



h. Press the MiniPC power ON switch for the robot to start.

i. Wait for the OS to boot and observe the CAMERA application. When UBUNTU loads, it should show up like below.



j. Congratulations the Robot MiniPC is running Ubuntu and is ready for your commands.

k. Again, this is useful for simulating and coding, and if need arises, restoring the MiniPC image. **You cannot run the robot motors from this configuration.**

ROBOT ID: You must change your robot ID

l. Press and hold “ctrl + alt + t” to open a terminal.

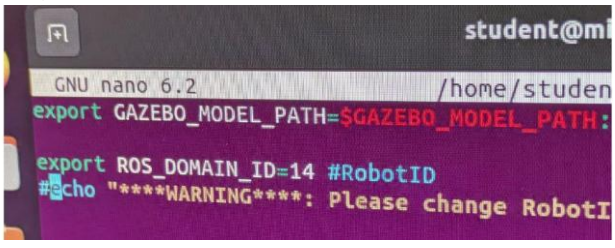
m. Edit the file ~/.bashrc; for instance, to bring up the nano editor you can type:

$ sudo nano ~/.bashrc

Password is: **DALECED3901**

n. Change the default RobotID (30) to your group #, e.g. for 14.

o. Comment out (use a #) or delete the echo. The file should resemble:



p. Save and exit; press “ctrl + o”, enter, followed by pressing “ctrl + x” returning to prompt.

q. To highlight that the device is operational, you can start lab5 simulation.

Check ECED3901 content

r. Type “ros2 launch eced3901 lab5.launch.py” and press enter.

s. You should see the simulation start.

t. Close the simulation by holding “ctrl + c”.

POWER DOWN

u. Type “sudo poweroff” and press enter.

v. Type the password: “DALECED3901” press enter.

w. The MiniPC should now be off.

x. Unplug the HDMI cable and barrel power connector from the MiniPC

y. Reconnect the robot’s power barrel connector and re-insert a charged battery pack.

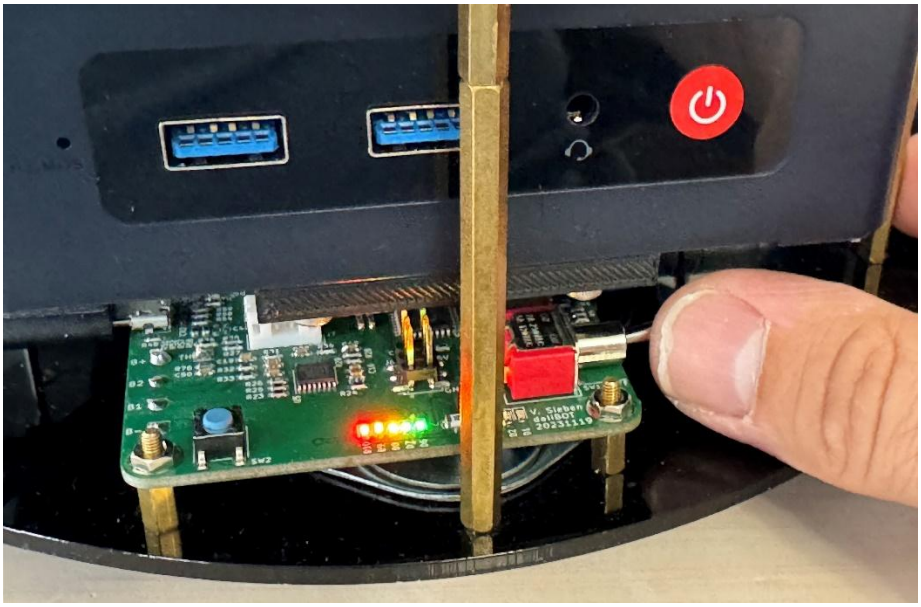
4. Power on the Robot from Battery and run from Remote Desktop

a. Ensure a charged battery pack is installed. When inserting the pack, you should hear a satisfying "click" when it engages correctly.

b. Turn on the Robot Power Switch.

Switch notation: toward the Robot Center is ON, toward the operator is OFF.

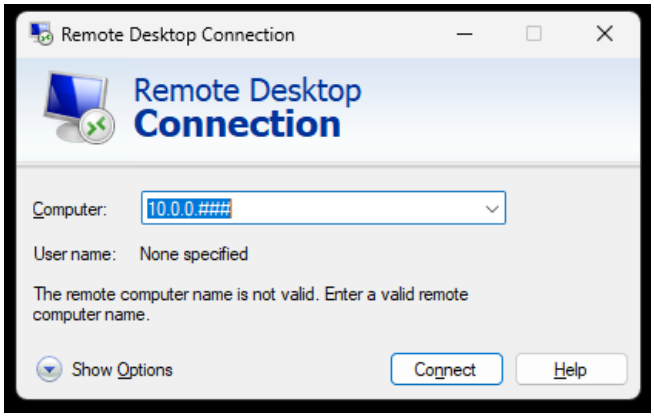
You should immediately see the gauge to indicate the battery pack charge state.



c. Press the big red power on button on the MiniPC to start the robot's computer. The MiniPC blue power LED should light up. Give it approximately 1 minute to boot.

d. Open "Remote Desktop" on a Windows Machine in the lab or another computer that is connected to the Wireless-LAN: ECED3901.

- Press the "Start" button in windows
- Type "Remote Desktop Connection"
- Press Enter.



e. Type in the IP address of your robot. The MiniPC will automatically log onto ECED3901 wireless network and have an IP address of 10.0.0.###, where ### is your group +200. For example, group or team 20, would enter "10.0.0.220".

f. Press "Connect"

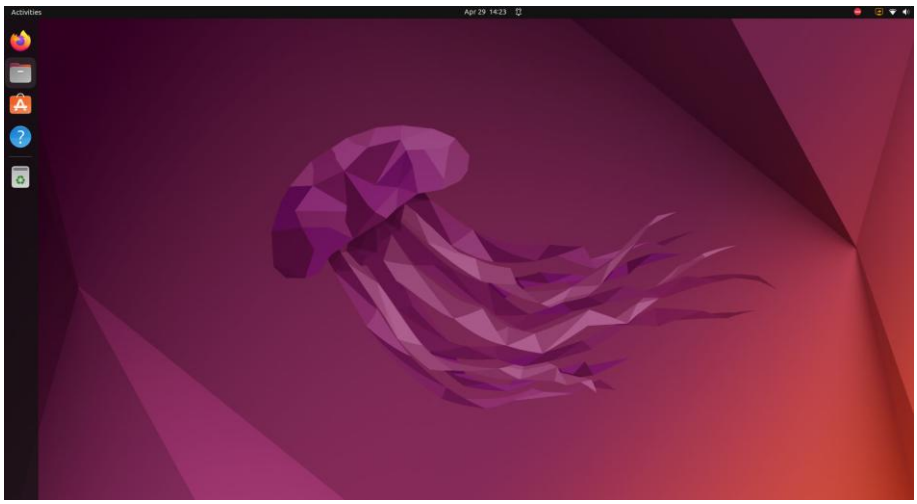
g. Enter Username and Password:

User: student

Password: DALECED3901

h. Press Ok. Click "Yes" and check-off "Do not show again…" if prompted.

i. The MiniPC should displaying through the remote desktop connection application.



5. Start Robot Hardware Nodes

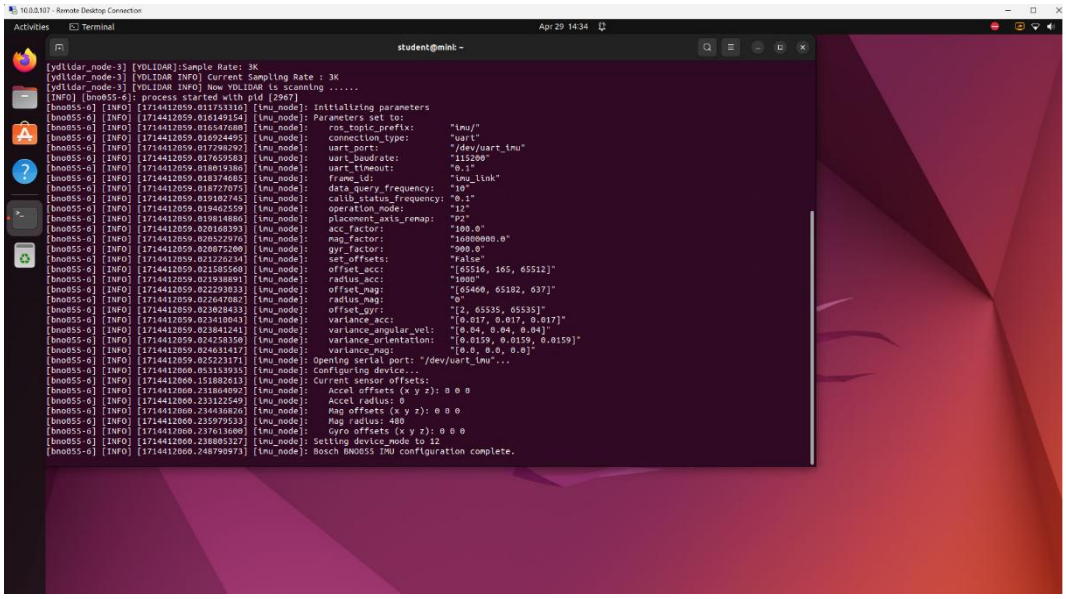
a. Ensure you are up and running from above, i.e. step 4i shows Ubuntu.

b. Open a new terminal; simultaneously press “ctrl + alt + t” to open a terminal.

c. Type the following command to load the hardware nodes.

```
ros2 launch dalmotor robot.launch.py
```

When the nodes load correctly, it will appear as follows. You will also notice that the LIDAR is spinning, and blue lights are flashing on the custom PCB.



d. Congratulations, the robot is ready for commands.

e. If you want to confirm, open a new terminal and type “ros2 topic list”. It should show all the hardware nodes up and running!

6. Remote Control and Test Robot Hardware

a. **Place the robot on a pedestal.** If the wheels move, we do not want the Robot to fly off our desk.

b. Ensure the robot is running the hardware nodes correctly from step 5.

c. Open a new terminal; simultaneously press “ctrl + alt + t” to open a terminal.

d. Type the following command to load the teleop package for remote control of the robot.

```
ros2 run teleop_twist_keyboard teleop_twist_keyboard
```

e. If you hit key “j”, the robot should spin clockwise. If you hit key “i” the robot will drive forward, and so on. “k” will stop the robot.

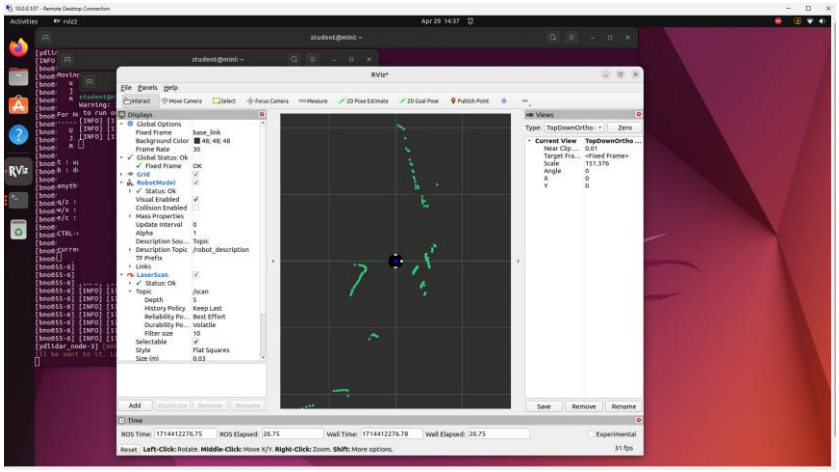
f. Congratulations. The robot is ready for driving/testing.

g. Have fun and teleop the Robot from your group’s C-234 lab machine.

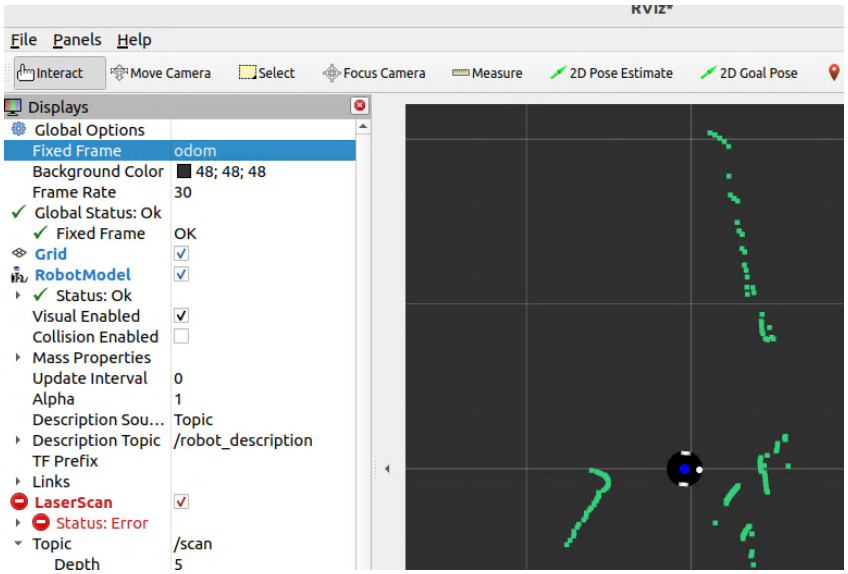
h. To confirm the LiDAR is working, type the following command in a new terminal.

```
ros2 run rviz2 rviz2
```

Your screen should resemble this and when you move objects around the LiDAR field of view, the ranging dots should change in the RVIZ2 program.



i. To test if the IMU is operating correctly, change the “Fixed Frame” from “base_link” to “odom”, as highlighted in blue below.



j. If you now manually turn the robot with your hands, the RVIZ2 robot model should rotate correctly. You will see plenty of “error” messages in the terminal and this is normal as we are just performing a check of the hardware.

k. If the robot moves as expected, the LiDAR data changes as expected, and the rotation is picked up by the IMU, then congratulations, the robot hardware is up and running.

7. Powering Off the Robot

a. **DO NOT TURN OFF THE ROBOT WITH THE SWITCH.** We have to properly shut down the Ubuntu Operating System and unmount the filesystem.

b. Hold “Ctrl + c” to kill all programs and ROS2 nodes/launch files running. It is recommended that you work your way backward to the HW nodes. I.e. kill rviz2 in the terminal, then kill teleop, then kill the HW nodes.

c. Close all terminal windows except 1 of them.

d. In the last terminal, type “sudo poweroff”.

e. When you see the MiniPC power LED (blue) turn off, then you can turn off the switch and power off the robot. All gauge LEDs should turn off.

f. When storing the robot, it is recommended that the battery be disconnected/removed from the robot.

8. Safety Considerations and Emergency Numbers

a. Never use the ROBOT outside of Dalhousie Laboratories, C-234 and B-233. The lithium-ion batteries are hazardous if not treated correctly. They can spontaneously explode and emit fire and toxic gasses. Never expose the robot to direct sun or temperatures. Do not place near water and no significant shock and vibrations/drops. Please refer to the slides on the ECED3901 regarding battery safety before operating your robot.

b. In the event of an emergency, these numbers should be called to deal with the situation**. Save yourself and others first. Do not try to put out the fire or handle the robot.** Call a TA/Instructor/Staff member.

Know Responder Numbers

911 emergency responders
811 non-emergency health services

Ambulance:	1 – 888 – 346 – 9999	
Police:	902 – 490 – 5020	
Fire:	902 – 490 – 5530	(@DAL)
Dalhousie Security	902 – 494 – 4109 902 – 494 – 6400	

Dr. Sieben: 902 440 4134

Appendix A – Restore MiniPC Image

1. Complete section 3 above, and “Connect to the Robot with Keyboard, Mouse, and HDMI”
2. Plug in the SAMSUNG USB flash drive given to you at the start of the term.
3. Power on the MiniPC.
4. It should land on the “Clonezilla” boot menu.
5. Then follow these instructions to restore the image. **CAUTION this will ERASE everything on the MINIPC**.
    a) Clonezilla live (option 1)
    b) en_US.UTF-8 English. Enter
    c) Keep the default kb layout
    d) Start_Clonezilla
    e) device-image
    f) local_dev
    g) Enter, ctrl+c
    h) sda2 exfat USB
    i) no-fsck
    j) tab to done, enter, enter
    k) beginner
    l) RESTOREDISK
    m) accept default name and press enter
    n) enter to accept target
    o) -k0, use partiion table from image
    p) -scr NO, skip checking the image before restoring
    q) -p poweroff Shutdown when complete, Enter
    r) Enter to continue, y, y
6. After the MiniPC powers down when the image is fully restored, you can remove the USB flash drive.
7. Remove the Wall Power supply, HDMI.
8. Return the Battery power supply and battery pack.
9. Boot the robot according to section 4 above (Power on the Robot from Battery and run from Remote Desktop), everything should be as it was on Day 1 of the course.