PM - Differential Rovers

1/29/2024 - Update the paragraph below with a description of what this project is. You can use information from any links to Instructables or other tutorials

Mr. Burnham Notes

Lidar Links and questions:
https://www.amazon.com/s?k=Lidar+Sensor+for+raspberry+pi&i=electronics&crid=I61QZVIW34BT&sprefix=lidar+sensor+for+raspberry+pi%2Celectronics%2C122&ref=nb_sb_noss

Low cost Lidar recommendations for Raspberry Pi driven rovers

Hey All, jim The Steam Clown here, I'm working on a project to add some low cost Lidar to some Raspberry/Jetson Nano driven rovers my students build. I want to add some low-cost simple lidar capabilities. I'm looking to be able to range distant objects, and maybe do some mapping of a room. But I'm also looking for a low cost.

I'm looking for recommendations on low cost lidars. Searching for Lidar + Raspberry Pi stuff online, I can see some single point Lidars in the $25 to $35 dollar range. $50 range for some 360 ones. but most 360 are over $150

Mostly I'm looking to give my students some labs using a Lidar, and pulling data with Python, and or ROS features like SLAM. Stuff like map a room, find an object, range objects. I'm going to keep looking at Lidar Instructables and Tutorials, but most of these are using RPLidars and other Lidars in the $100 range... I'm hoping to have a fun solution in the $25-$40 range.

I might be convinced to go the cheaper route, and maybe mount a single point Lidar on a stepper or servo, and scan... 15, 30,45 degrees out front, but I don't have any experience to know if that's a dumb idea.

Thoughts? Recommendations? What cheap Lidars have folks used?

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< Replace This Text/Paragraph/Section With Your Introduction - Introduction and Story. This is where you do an "Elevator Pitch". The name is what people first see about your project and is the first indication of what it is. The elevator pitch allows you to provide a little more info to the reader in deciding whether they should click to view your project. Give them some love!: Tell an interesting story and give some compelling introduction as to why the reader should keep reading and eventually try to replicate your project. Here are some good tutorial resources: Robot Club - Instructables/Tutorial - Template - How to Create a High-Quality Project Tutorial - Content Guidelines - instructables

The following principles may help you to create a tutorial that is appropriate for online delivery of materials:

1. **Know your audience -** What makes a good tutorial for one person, may be way too complicated for another one. Decide who you think your audience is, and write it down. Most people who make tutorials tend to assume a lot about their audience. Creating tutorials that truly connect with your audience hinges on a fundamental principle: understanding their needs. Your tutorial's effectiveness depends on aligning its content with your readers' knowledge level and specific requirements. *Are they beginners seeking a basic understanding or experts looking for advanced insights?*
2. **Create a simulated conversation between learner and teacher** - Design the Tutorial as if it was a conversation.
3. **Involve learners actively** - It is now recognised that students learn when they are actively involved in solving problems. Treat this tutorial as if it was a discussion between you and the learner. Students do not learn simply by accessing information. Rather students construct their ideas and understandings of concepts through interactions with your tutorial, so make it hands on. Therefore, effective tutorials will include tasks for students to carry out that lets them try out your learning process.
4. **Work with what learners already know** - When we learn, we compare new information with what we already know. The theory of knowledge construction sees the learner not as an empty vessel into which pre-formulated knowledge can be poured undigested, but as someone with an existing knowledge structure

onto which they must fit their new learning. A constructivist approach will therefore begin with what the learner already knows (the known), and involve them in active engagement with the new (Mayes 1998).

5. **Manage the flow of the learning conversation** - This relates to the way that the tutorial guides the learner to think their way through the material. It is not sufficient simply to provide informative material - tutorials need to copy the Step by Step on how to construct and solve construction and creation processes. You are providing an outline, giving the aims of the tutorial, marking the beginning and ending of sections, drawing attention to salient points, making relevant links, summarizing etc. This also relates to how the content is structured - Sometimes you really have to "Show Them" how to do something. Theory and explaining works sometimes, but sometimes you really have to show them, do a deep dive into an explanation.
6. **Go from the particular to the general (at least sometimes)** - *."... the root of the true practice of education must start from the particular fact, concrete and definite for individual apprehension, and must gradually evolve towards the general idea."* -- Alfred North Whitehead. Depending on their learning style, many learners are happiest starting with concrete examples from which they can extract abstract principles, rather than the other way round. This approach fits well with the principle of active learning and allows new learning to be located in the real world and therefore in the known. Tell them how to do the specific task, step, or concept, but also provide some links to more background information about the specific task, step, or concept.
7. **"Are We Going To Have A Test?"** - Probably you are not going to give them a test, but you should think about what that looks like, because it will help you answer the questions and explain the steps in a way that they could take a test if needed. Imagine, after the tutorial, you will give them a test. Even if you don't, it's a good idea to think about a test. This will force you to think "what do I want the person who watches the tutorial to learn"
8. **ELI5 - Explain Like I'm 5** - Ask yourself what if someone non-technical had to read/watch the tutorial. You can't teach them all the prerequisites they may need, but you should keep all the concepts simple. No one wants 99 hours of prerequisites to 1 hour of the content you are teaching them… That's true, but imagine you're trying to simplify some explanation (esp. "why" they should bother), it can help to think ELI5 (explain it like I'm 5)
9. **Is There A Gap?** - How to write a tutorial that truly educates and entertains is a challenge many writers face. The importance of clear communication and engaging content is more critical than ever. Imagine pouring hours into tutorial

writing, only to be met with blank stares and bewildered criticism. The gap between your knowledge and your readers' understanding can be disheartening.

10. **Are Your Sources Valid, and Well Researched?** - By presenting a well-researched tutorial, you establish yourself as an authority in your field. As your tutorial gains traction and is shared, your reputation grows, earning you admiration and acknowledgment from your peers and readers alike.
11.

Have 1-3 project pictures, videos or other images that will capture the imagination of the reader.

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Date	As part of this description, add the link to the Instructable	Mr. Burnham Notes

Prerequisite & Baseline Knowledge:

< Replace This Text/Paragraph/Section With Your Explanation Of What The User Should Already Know - Provide an Example text here

- know how to do this ← the "this" should be a link to where to learn more
- and this…
- and also this would help

Explain any overarching concept that people need to know about this project.
Have you ever read a tutorial and realized midway through that it's beyond your level of experience? The author forgot to mention the skills you need to complete this tutorial, and now you're frustrated because you've wasted time on something you can't use yet.

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Parts & Software used in this project:

< Replace This Text/Paragraph/Section With Your Overview Or Introduction to the Parts and Software - This section and paragraph is to list out the parts and software, where to get them or how to access them. This paragraph is to say something about any hard to get or hard to access parts or software. You don't want the reader to jump into this project without understanding what parts may be hard to get or software to access.

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Hardware components

	Item	#	Description / Link
1			
2			
3			
4			
5			
6			

Software components

- List the software needed, with an explanation and likes of access, download, or sign up for a free /trial account.
- More links…
- Include and or link to github to point to software and other electronic files.

Additional Electronic Files and Links

- List the links to other files. These are items like 3D Print STL files, Laser cut files, code examples.
- More links…
- Include and or link to github to point to software and other electronic files.

< Replace This Text/Paragraph/Section With Your Explanation of the parts & software, how they work and what to think about when using them - Provide a brief explanation of the actual parts and what they do and how to use them so an explanation of how the particular sensor works or particular motor controller works or particular electromagnetic theories and how they work. **-- >**

Project Overview:

< Replace This Text/Paragraph/Section - Do a deep dive in explaining the purpose and goals of the project, and what the reader will know and be able to do… - This paragraph is an intro to getting started on a specific project. The reader has gotten this far, they are ready to start… get them going with some explanations and then jump into the steps.

Do the following in this introduction and/or in the steps:

- Think of any questions the reader will have, and try to answer them here in the introduction or in each of the steps. Remember, this is your 2-3 time thinking about and trying this lab/tutorial, but your audience may never have seen or learned about this topic. Try to proactively answer any questions they will have.
- On all of your images, make sure to provide a detailed caption that really tells the user what they're seeing and WHY.
- If you are posting code, make sure it is selectable if it is a small snippet, but if not make sure there is a link to a github site so your readers can cut and paste it.
- If a step seems too complicated or has multiple topics, then it probably should be split into multiple steps. It's OK to have lots of steps.
- Make sure you provide a time frame for each step. How long should it take your reader to do?

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Step 1: Soldier the Battery Connection

1. Cut the battery power red wire that is long enough to get to your switch and back to the terminal block then solder it.
2. Cut the black wire that will loop back to the terminal block and solder it

Step 2: <Step Title >

< Replace This Text/Paragraph/Section - Give an Overview for the Step - This paragraph is an intro to getting started on the specific project. The reader has gotten

this far, they are ready to start… get them going with some explanations and then jump into the steps.

Overview:
Give an overview for this step. Include a "Why are we doing this step in this order"
Tools, Components & Software Used:
List any tools, components or software used in this step. Describe how to prepare these items

Let's Get Started:
Now tell them what they are doing, and how to do it… This is the details of the step. This is probably a few paragraphs or sub-steps. It can be a mix or paragraphs and bullet points

What Should be Working/Done:
This is just a last paragraph to tell the reader what they should have accomplished, what should be complete, what should be working… AND how they will know. Is there some test to run, is there some mechanical capability the item should have? Just make sure they are done with this step before they move on.
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Software:

Related and "What's Next?"

< Replace This Text/Paragraph/Section With Your "Dig Deeper" Plan - This where you provide a paragraph on what you think your or reader should do next. Describe what your plan to do or what they should do to learn more, dig deeper, or how to expand their learning on this topic.

- List links
- list another…

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< Delete this before you are done > Project Parking Lot - "What's Next", Stuff To Save, Delete or Reorganize:

Each day you work on this project, you should spend some time here moving and organizing topics you have put here… Think of this as the "What am I doing next" section

- Save lots of Photos - Choose images that will be useful to illustrate your instructions
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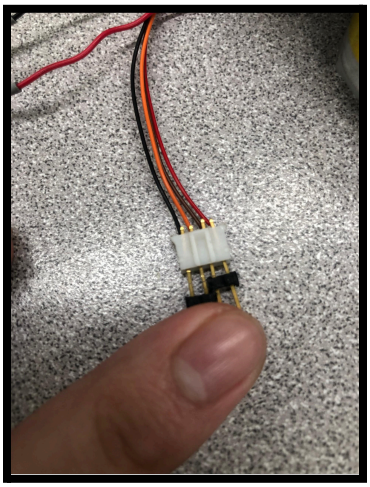
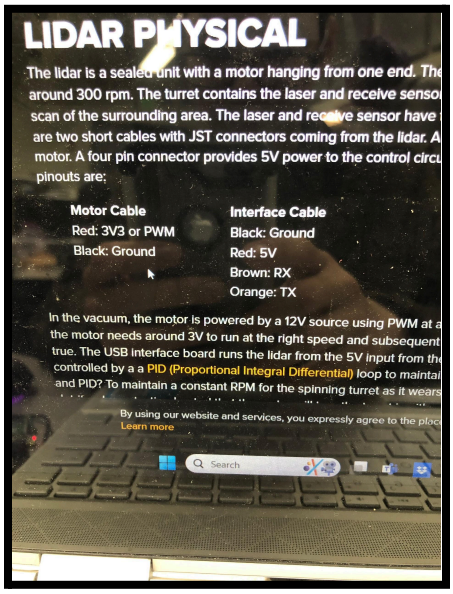
Daily Blog Of Work and Project Progress:

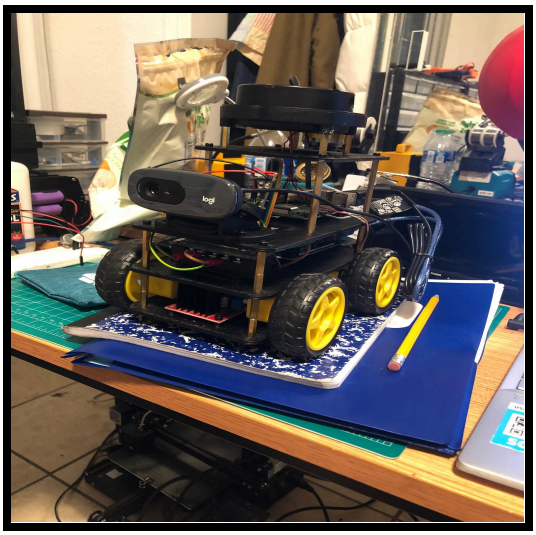
Tran Nguyen:

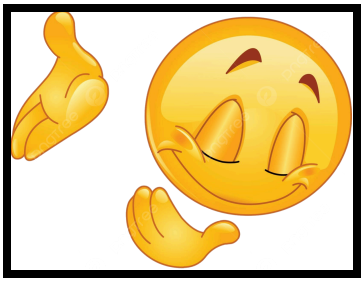
- **Day 1**: Neato XV-11 Lidar Pins





- **Day 2**: DIY Ros Robot named ROSSY, operate on Ubuntu 22.04 desktop and have Ros2 Humble desktop installed



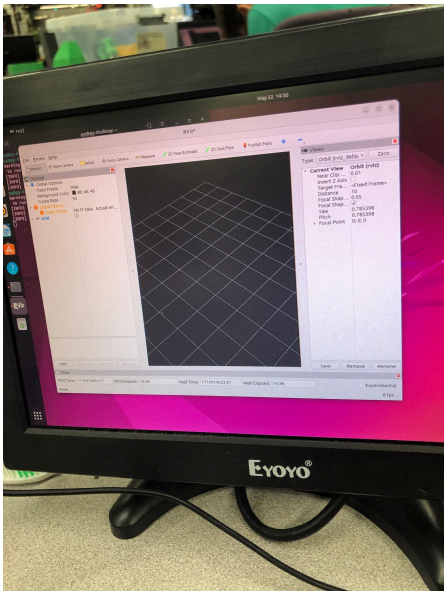


- **Day 5**: Searching how to connect the XV-11 lidar to the raspberry pi and running rviz2

Source:

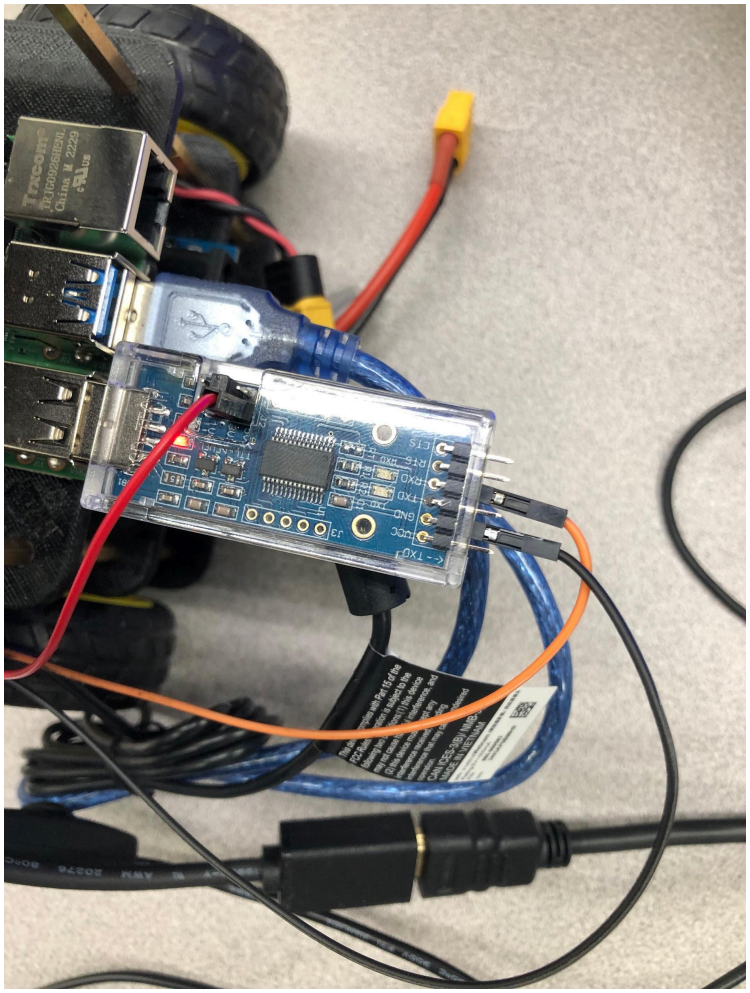
[Most Affordable LIDAR: Hacking Neato Robot Vacuum Laser Scanner for your Robot Project]

Rviz2:



- **Day 6**: Connecting XV-11 to FTDI and seeing the data.

FTDI: https://amzn.to/3JihBxI



CONNECTIONS:

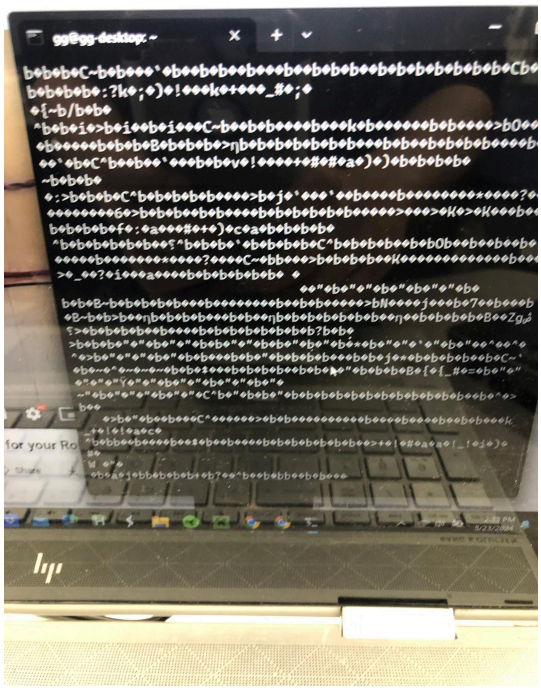
Red wire(VCC): 3.3V(Put the PCB Jumper on top of 3.3V on the FTDI and connect the red wire to the 5V pin)

Orange wire(TX): RX
Brown wire(RX): None
Black wire(GND): GND

MotorVCC: 3.3V
MotorGND: GND

Does it WORK?!

Enter the command `cat /dev/ttyUSB0` in the home directory, and if you see this.



IT WORKS! What you are seeing is the data from the lidar that is needed to be decoded.

- **Day 8**: How to shutdown the raspberry pi with a button.

Shutdown:

Sources:

[Raspberry Pi Safe Reboot and Shutdown Button - SparkFun Learn]

[ImportError: No module named RPi]

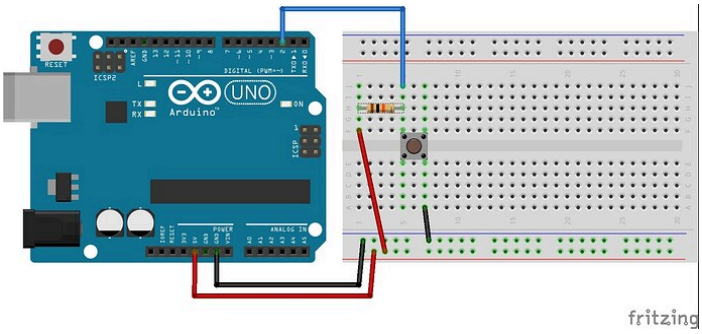
[Run Python script at startup in Ubuntu - Stack Overflow]

- 1st step(installing shutdown script):
  - Install this python script [safe_shutdown_Pi.py]
  - Follow this commands:
    - cd Downloads
    - mv safe_shutdown_Pi.py /~
    - cd ..
    - sudo chmod +x safe_shutdown_Pi.py
- 2nd step(installing python 3 and RPi gpio):
  - Follow this commands:
    - sudo apt-get install python-pip
    - pip freeze | grep RPi
    - sudo apt-get install python3-dev python3-rpi.gpio

- 3rd step(auto starting the script):
  - Follow this commands:
    - sudo cp -i home/username/safe_shutdown_Pi.py /bin
    - sudo crontab -e

Scroll to the bottom and add the following line (after all the # ' s):

    - @reboot python3 /bin/safe_shutdown_Pi.py &
    - Hit ctrl + O and hit Enter to save, and hit ctrl + x to exit
    - sudo reboot

- 4th step(connecting the button):
  - 

  - Connect the signal pin to GPIO 26

- 5th step(Test):

    - Connect your raspberry pi to your monitor, and press the button. If all goes well it should successfully shutdown the raspberry pi. If you were to do headless, please wait for several seconds or even a minute to ensure that your pi is completely shut down!

- 6th step(HELP! IT DOESN'T WORK! YOU LIE TO ME!):
    - Contacts:
        - Linkedin(https://www.linkedin.com/in/tran-nguyen-938520299/)
        - Gmail(babubear2007@gmail.com)

  I'll be happy to help you!

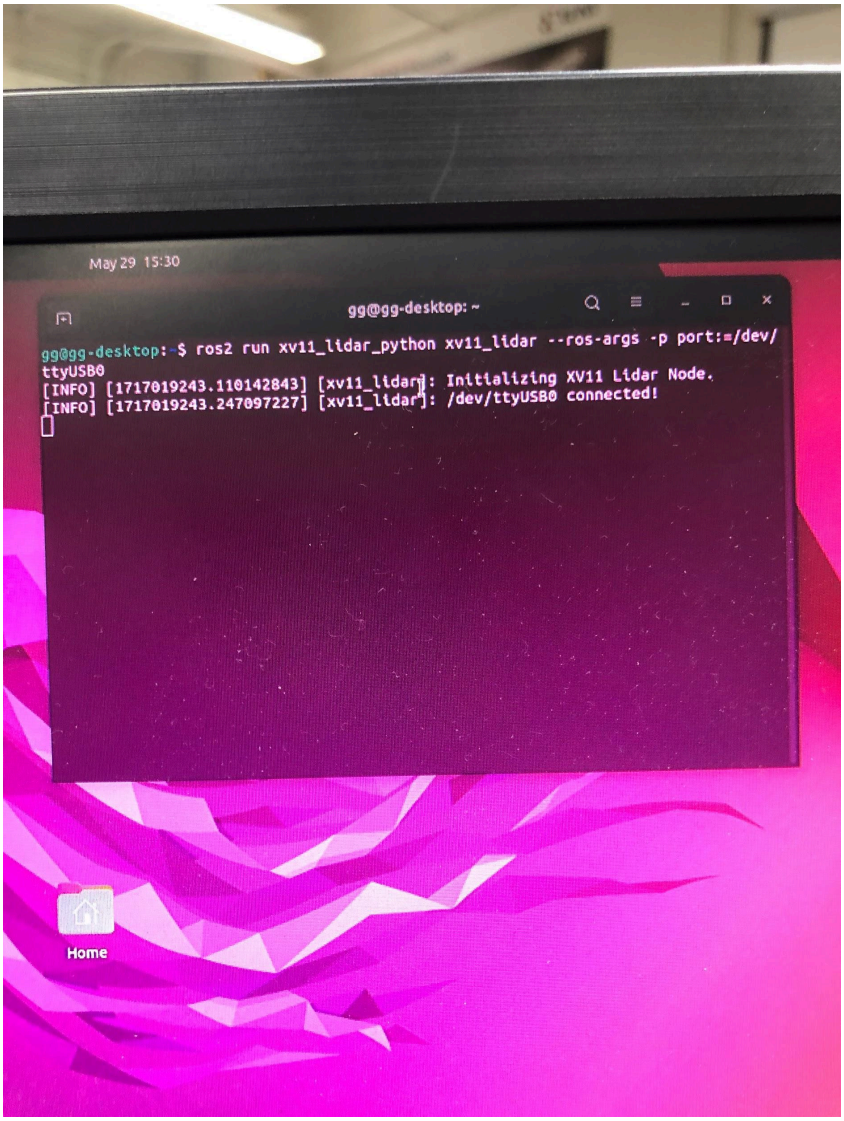
Day 11: Using RVIZ to see the lidar mapping

Source:
Most Affordable LIDAR: Hacking Neato Robot Vacuum Laser Scanner for your Robot Project

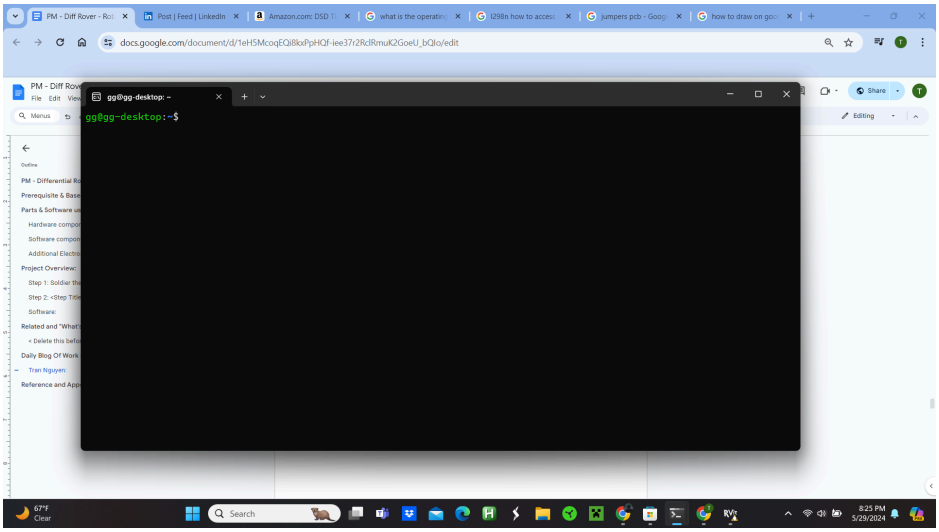
https://github.com/n1kn4x/xv11_lidar_python.git

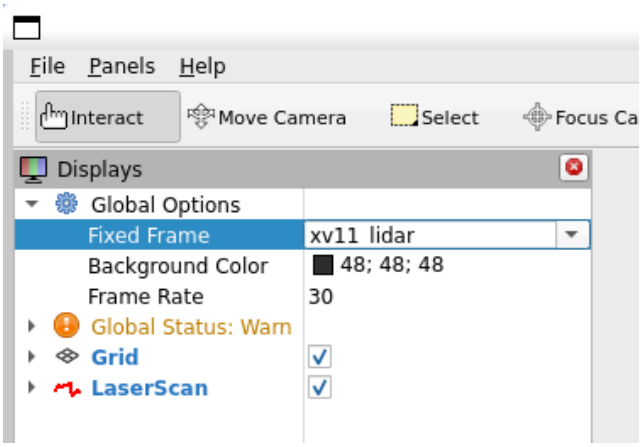
- 1st step(Create a ros2 workspace) :
    - Follow this tutorial: Create and Set Up a ROS2 Workspace - ROS2 Tutorial 3

- 2nd step(Place this repository in your ros2_ws workspace)
    - Follow this command:
        - cd ~/ros2_ws/src
        - git clone https://github.com/n1kn4x/xv11_lidar_python.git
        - cd ..
        - colcon build
        - source ~/.bashrc
        - ros2 run xv11_lidar_python xv11_lidar --ros-args -p port:=/dev/ttyUSB0 or you can change the default port to /dev/ttyUSB0 in the code
        - You should see this:

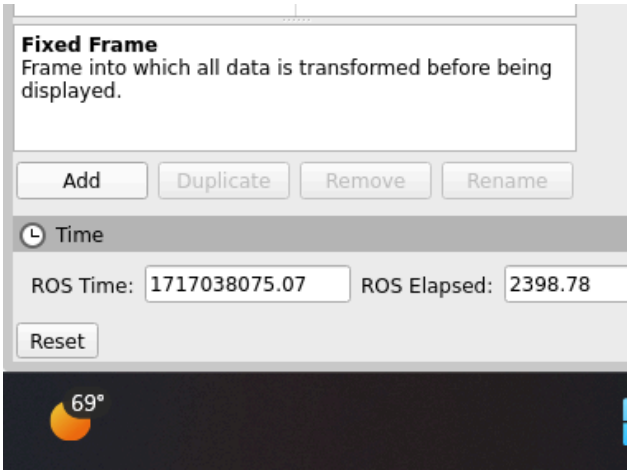
- 

- 3rd step(Using rviz2 to see the lidar mapping):
  - Open another terminal.

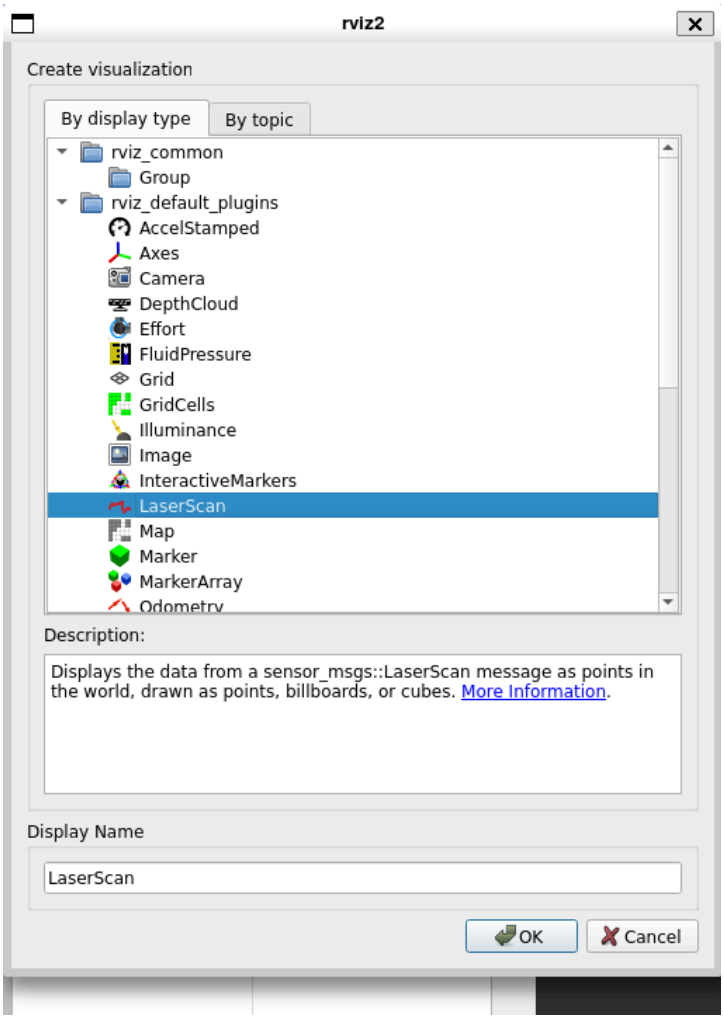
- 

- Source the environment `source .bashrc`
- Open RVIZ `ros2 run rviz2 rviz2`
- Fixed Frame → xv11_lidar
  - 

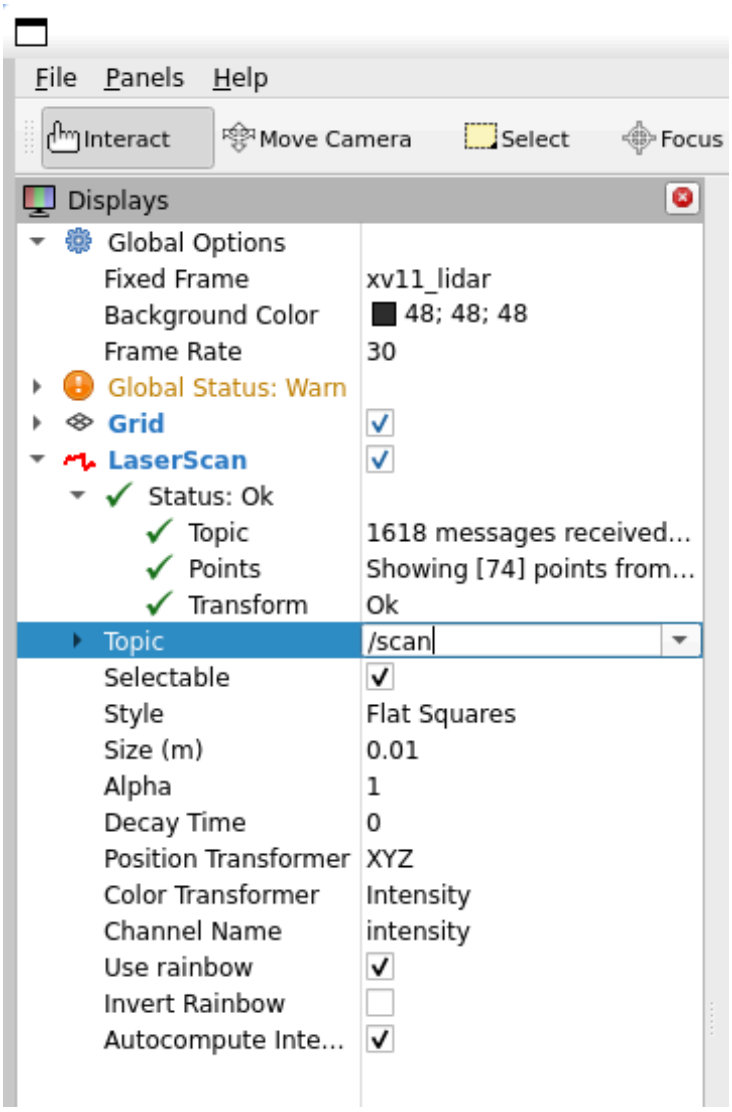
- Add LaserScan
  - On the bottom left corner, click on Add.

- 

- Click on LaserScan and click OK

- 

- Topic → /scan



- 4th step(FINISH):
  - Video of XV-11 Lidar working
    - https://www.linkedin.com/feed/update/urn:li:activity:7201726229505318912/

Day 13: ROS2 Connecting Multiple Machines

- 1st step(Download ubuntu 22.04 on virtual machine):
  - Install Ubuntu 22.04 on a Virtual Machine (VirtualBox)

- 2nd step(Attach network to bridge adapter):
  -

Reference and Appendix:

https://www.bristol.ac.uk/esu/media/tutorials/design-principles/page_08.htm

https://www.reddit.com/r/learnprogramming/comments/yf9zb2/what_makes_a_good_tutorial/

How to Make an Actually Good Tutorial
https://uwaterloo.ca/centre-for-teaching-excellence/catalogs/tip-sheets/key-strategies-effective-tutorials

https://www.webdew.com/blog/tutorial-video-examples

https://dailyblogtips.com/11-essential-tips-to-writing-the-ultimate-tutorial/

https://codingwriter.com/how-to-write-better-tutorials-part-1/

https://dev.to/savvasstephnds/in-your-own-opinion-what-makes-a-tutorial-beginner-friendly-mg4

https://medium.com/@keshidong.dev/how-to-format-code-in-google-doc-833e28b304f1

Notes Mr. Burnham Notes