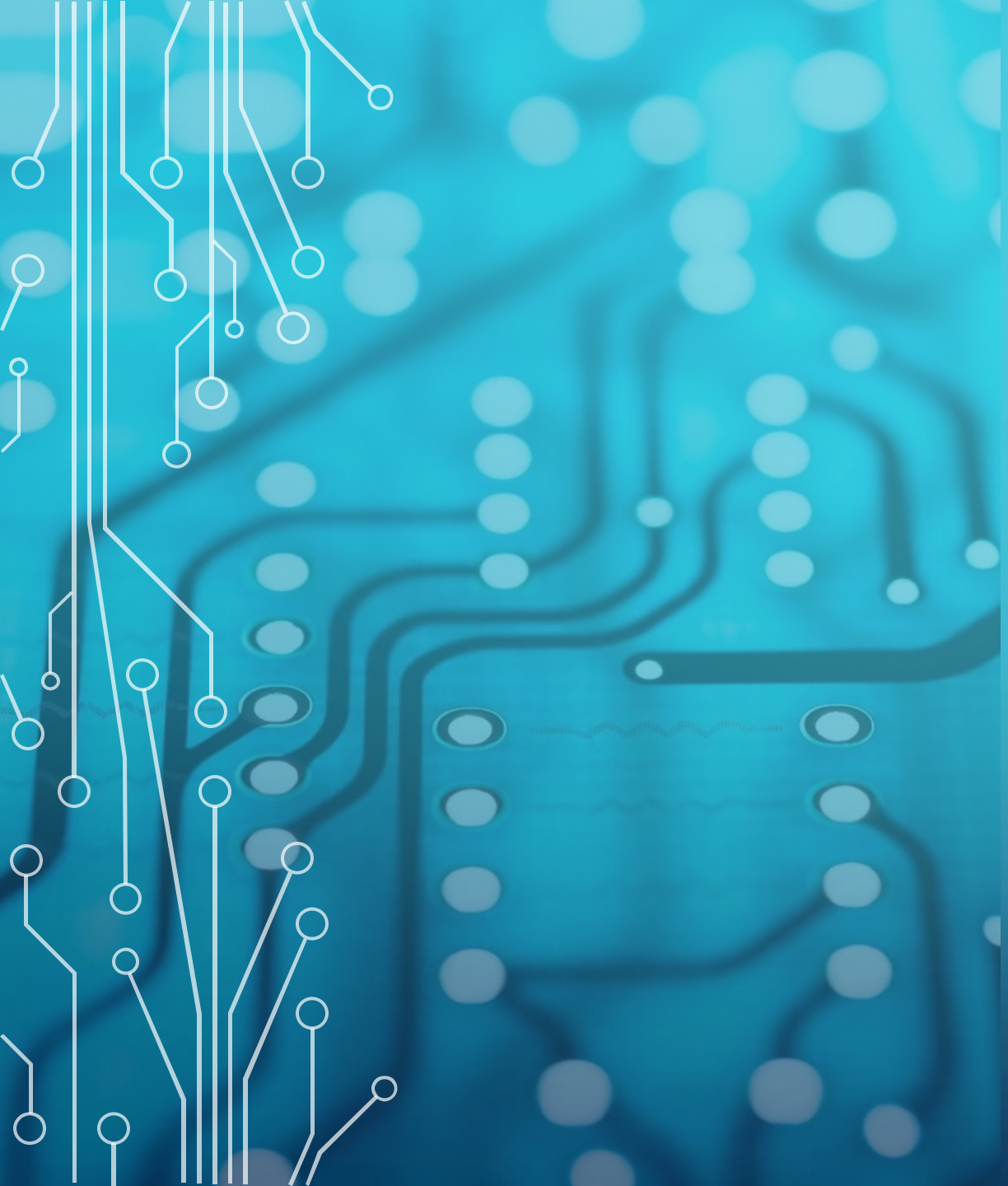
INTRODUCTION TO LIDAR

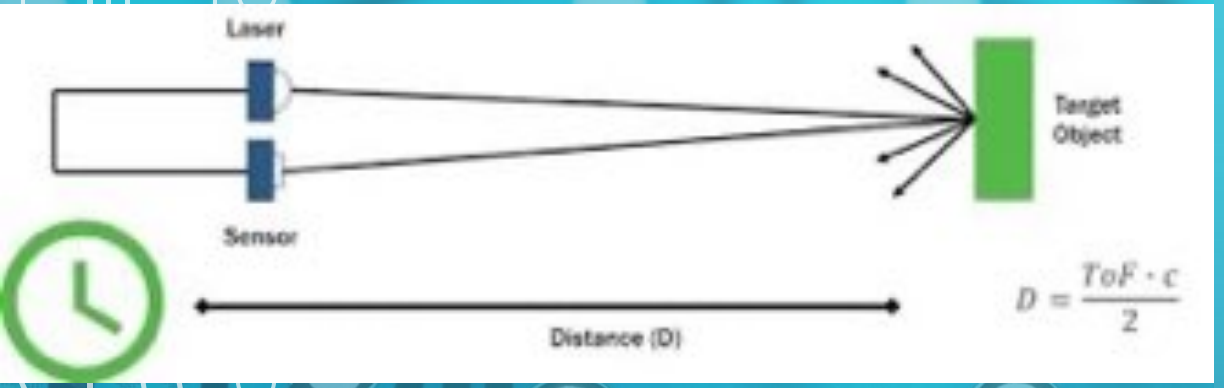
JOSHUA NJAU



Content

- LiDAR Introduction and Definition
- Purpose, functionality and application of LiDAR
- RPLiDAR by Slamtech
- Setup on PC
- Setup on Raspberry Pi

WHAT IS LIDAR?



Light Detection and Ranging.

A technology that is used to measure distances by emitting light pulses and measuring the time taken to receive of these pulses reflections off of objects.

Similar technologies include:

- SoNAR
- RaDAR

Qn. Why use LiDAR over these?

WHAT IS THE PURPOSE OF LIDAR IN THE COMPETITION?

- Detection of walls during:
  - Mapping (SLAM)
  - Autonomous Navigation

RPLIDAR

Stands for Robust and Precise LiDAR

Specifically using RPLiDAR a1 model

2D scanner

Head rotates at 5.5Hz

Sample rate of up to 8000 times per second

Range of 0.15 to 12m

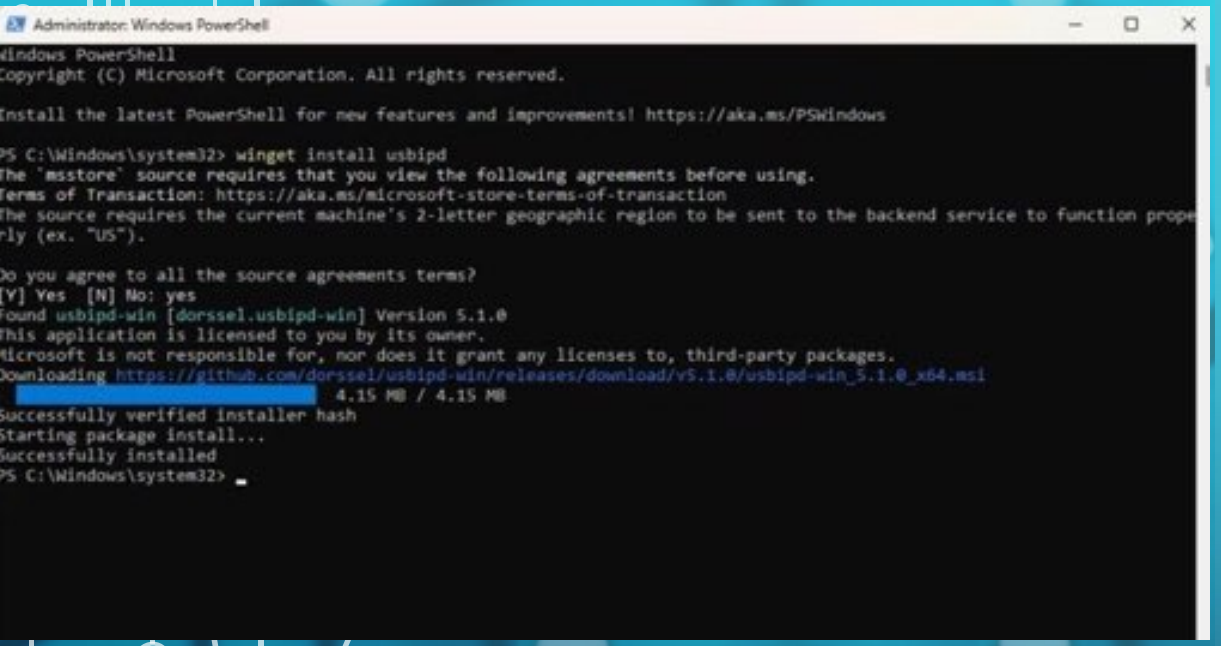
RPLiDAR a1

RPLiDAR a2

RPLiDAR a3

Feature	RPLIDAR A1	RPLIDAR A2	RPLIDAR A3
Model	A1M8	A2M12	A3M1
Dimensions	98.5mm x 70mm x 60mm	76mm x 76mm x 41mm	76mm x 76mm x 41mm
Weight	G.W 170g	G.W 190g	G.W 190g
Battery	Exclude	Exclude	Exclude
Distance Range	0.15 - 6m, White objects	0.2 - 12m, Based on white objects with 70% reflectivity	White object: 25 meters; Black object: 10 meters
Angular Range	0-360 Degree	0-360 Degree	0-360 Degree
Distance Resolution	<0.5mm	<0.5mm	N/A
Angular Resolution	≤1 Degree	0.225 degree	0.225° or 0.36°
Sample Duration	0.5ms	0.25ms	N/A
Sample Frequency	2000~2010Hz	16000Hz	16 kHz
Scan Rate	1~10Hz, Typical 5.5Hz	5~15Hz, Typical 10Hz	Typical value: 15 Hz (adjustable between 5 Hz~20 Hz)
Communication Interface	USB	USB	TTL UART
Typical Applications	Small-scale robotics, educational purposes, hobbyist applications	Robotics navigation, 3D mapping, terrain modeling, industrial automation	Autonomous vehicles, drone navigation, industrial robotics, high-performance applications

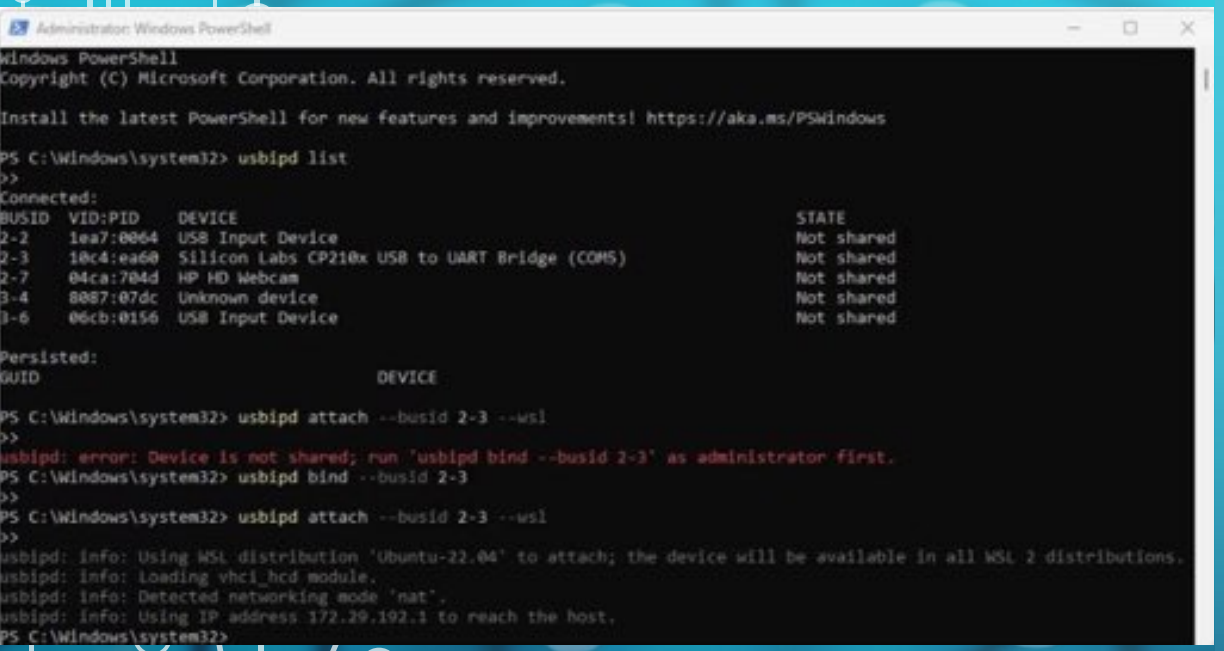
RPLIDAR SETUP ON PC



Connect the RPLiDAR to the PC via USB

On Windows PowerShell:

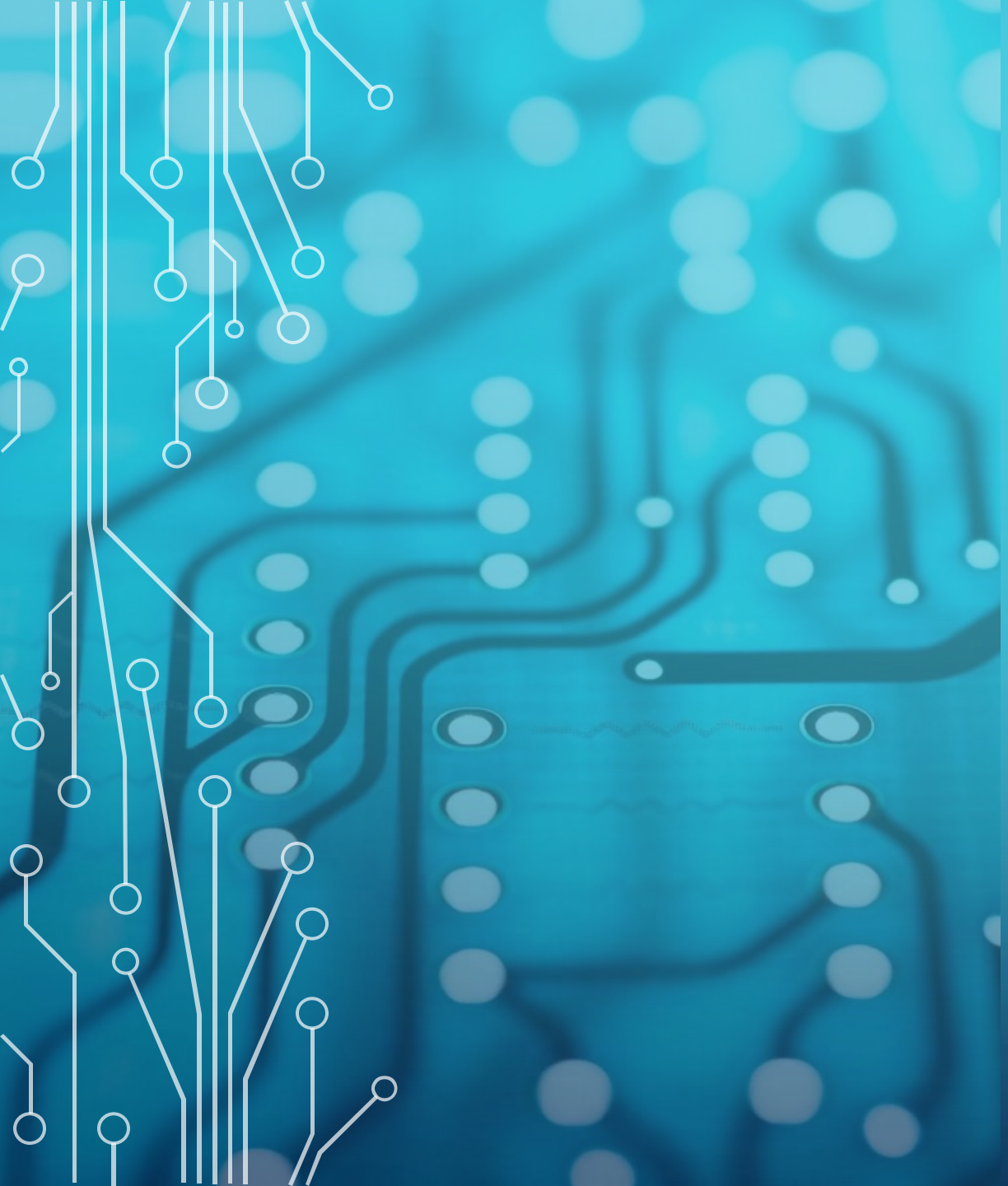
- Install usbipd. This is a tool that enables sharing of USB devices over networks.
  - Run `winget install usbipd`
  - Restart your PC



Start another PowerShell session.

Share COM5 to allow access of USB/IP to WSL

- Run `usbipd list`
- Note the bus ID (BUSID) with COM5 (usually 2-3)
- Run `usbipd bind --busid 2-3`
- Run `usbipd attach --busid 2-3 --wsl`

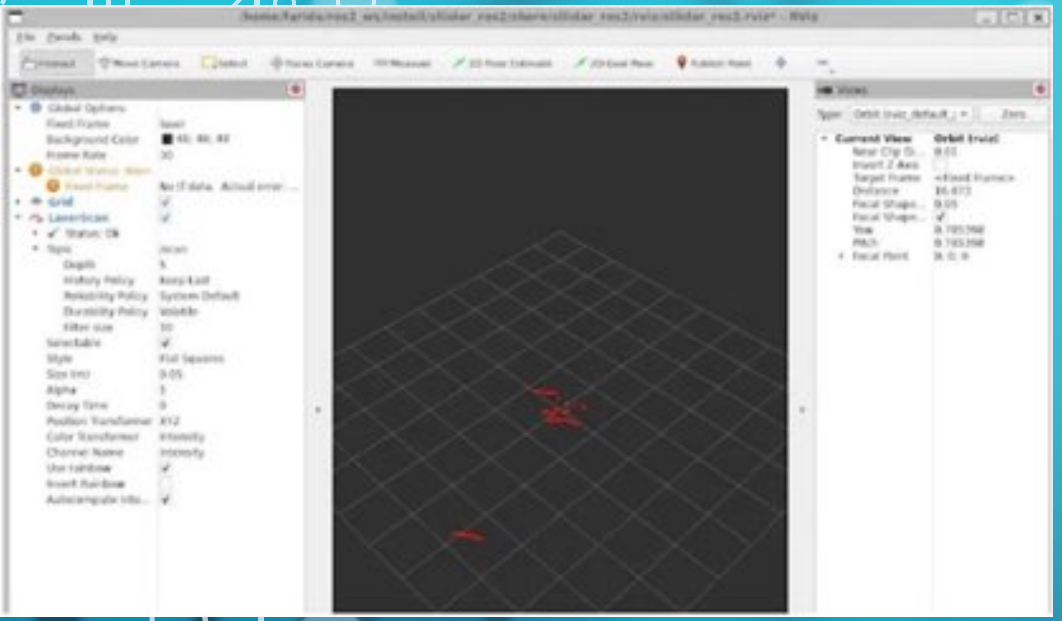


On WSL, run `ls /dev/ttyUSB*`

You should be able to see an output port such as `/dev/tty/USB0`

Clone the Slamtec sllidar_ros2 repository from github into a workspace within WSL

- `mkdir -p ros2_ws/src`
- `cd ~/ros2_ws/src`
- `git clone https://github.com/Slamtec/sllidar_ros2.git`
- `cd ~ros2_ws`
- `colcon build`
- `source install/setup.bash`



Finally, run:

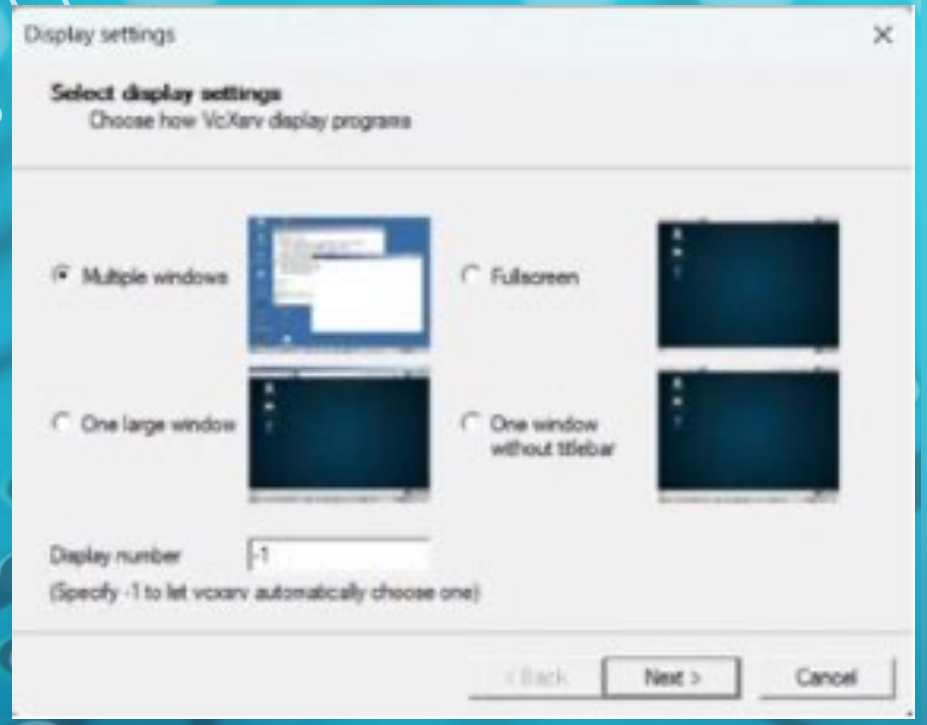
- `ros2 launch sllidar_ros2 view_sllidar_a1_launch.py serial_port:=/dev/ttyUSB0`

RViz will automatically open and the LiDAR output be visible as red dots within the Rviz grid.

RPLIDAR SETUP ON RASPBERRY PI

X11 forwarding

- It is a method used to remotely run graphical applications on a Linux system and view the output on a separate display such as a local PC.
- This is achieved by running a server called an X server locally on the PC.



ON PC

VcXsrv is the recommended X-server for Windows users.

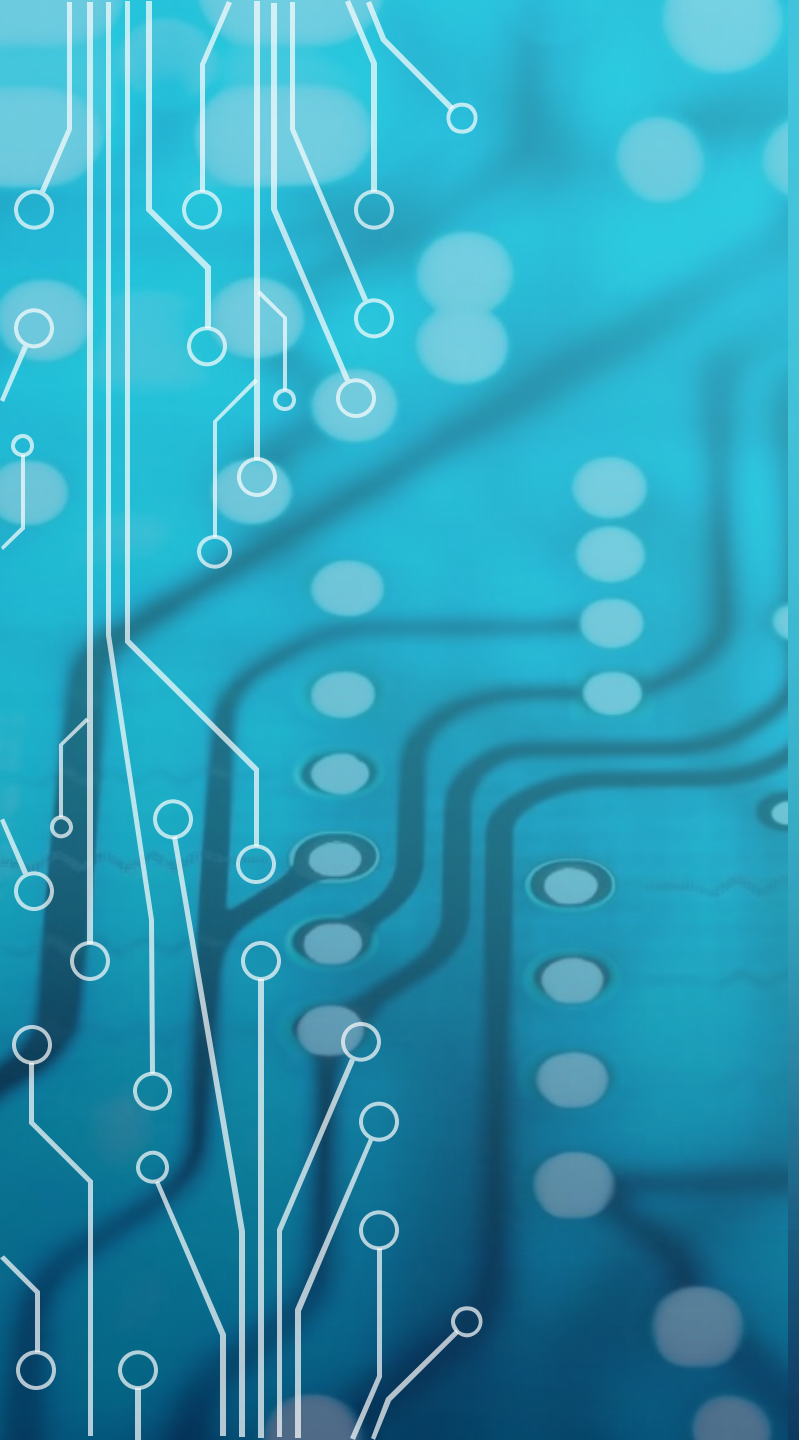
- Download the installer from sourceforge.net and run it to install VcXsrv
- Search for Xlaunch and open it

Ensure the following options are chosen as you go select 'next’:

- Multiple Windows
- Start no client
- Clipboard
- Primary selection
- Native opengl
- Disable access control, then select ‘Finish’.

ON RASPBERRY PI

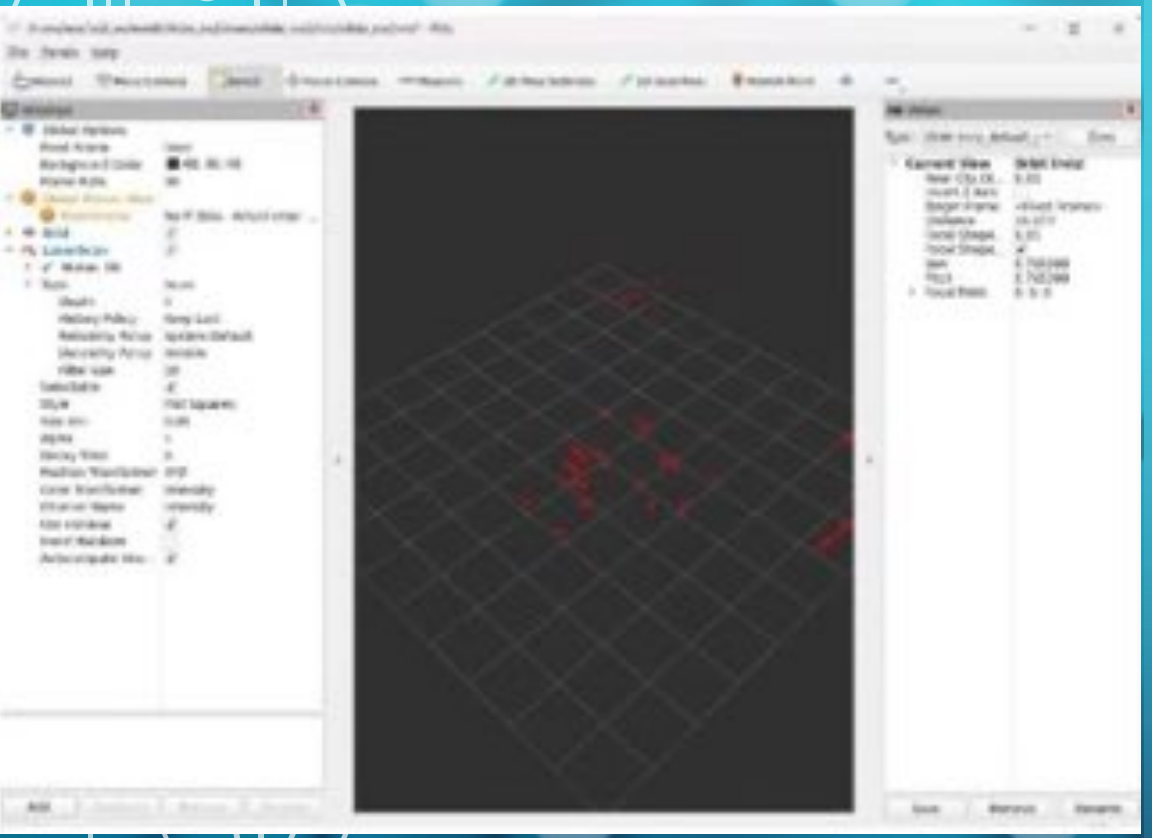
- Access the Raspberry Pi on your PC by running `ssh raspberry@pi.local`
- Open a file called `sshd_config` by running `sudo nano /etc/ssh/sshd_config`
- Scroll to the of the code in the file with the text `#X11 Forwarding no` or similar. Uncomment the line by deleting the '`#`' and change it to `X11 Forwarding yes`. Save and exit



Run the command `export DISPLAY=PC_IP_Address:0`, replacing `PC_IP_Address` with your PC's IP address. You could get your PC's IP address by running `ipconfig` on a Windows CMD terminal. The address is usually under `IP4V` at `Wireless LAN adapter Wi-Fi`

Clone the Slamtec sllidar_ros2 repository from github into a workspace within the Raspberry Pi

- `mkdir -p ros2_ws/src`
- `cd ~/ros2_ws/src`
- `git clone https://github.com/Slamtec/sllidar_ros2.git`
- `cd ~ros2_ws`
- `colcon build`
- `source install/setup.bash`



Confirm the port where your LiDAR is connected by running `ls /dev/tty/USB*`

Finally, run:

```
ros2 launch sllidar_ros2
view_sllidar_a1_launch.py
serial_port:=/dev/ttyUSB0
```

RViz will automatically open and the LiDAR output be visible as red dots within the Rviz grid.

References:

- RPLiDAR Setup on Windows PC
- RPLiDAR setup on Headless Raspberry Pi
- Troubleshooting Tips When Setting Up the RPLiDAR a1
- X11 Forwarding

THANK YOU