



N10 PLUS

User Manual

V2.0.2 2022.12



Safety Instruction

Before using the product, please read and follow the instructions of this manual carefully, and refer to relevant national and international safety regulations.

ΔAttention

Please do not disassemble or modify the Lidar privately. If you need special instructions, please consult our technical support staff.

ΔLaser Safety Level

The laser safety of this product meets the following standards:

- IEC 60825-1:2014
- 21 CFR 1040.10 and 1040.11 standards, except for the deviations (IEC 60825-1, third edition) stated in the Laser Notice No. 56 issued on May 8, 2019. Please do not look directly at the transmitting laser through magnifying devices (such as microscope, head-mounted magnifying glass, or other forms of magnifying glasses).

Eye Safety

The product design complies with Class 1 human eye safety standards. However, to maximize self-protection, please avoid looking directly at running products.



ΔSafety Warning

In any case, if the product is suspected to have malfunctioned or been damaged, please stop using it immediately to avoid injury or further product damage.

Housing

The product contains high-speed rotating parts, please do not operate unless the housing is fastened. Do not use a product with damaged housing in case of irreparable losses. To avoid product performance degradation, please do not touch the photomask with your hands.

Operation

This product is composed of metal and plastic, which contains precise circuit electronic components and optical devices. Improper operations such as high temperature, drop, puncture or squeeze may cause irreversible damage to the product.

Power Supply

Please use the connecting cable and matching connectors provided with the lidar to supply power. Using cables or adapters that are damaged or do not meet

the power supply requirements, or supply power in a humid environment may cause abnormal operation, fire, personal injury, product damage, or other property loss.

Light Interference

Some precise optical equipment may be interfered with by the laser emitted by this product, please pay attention when using it.

Vibration

Please avoid product damage caused by strong vibration. If the product's mechanical shock and vibration performance parameters are needed, please contact us for technical support.

Radio Frequency Interference

The design, manufacture and test of this product comply with relevant regulations on radiofrequency energy radiation, but the radiation from this product may still cause other electronic equipment to malfunction.

Deflagration and Other Air Conditions

Do not use the product in any area with potentially explosive air, such as areas where the air contains high concentrations of flammable chemicals, vapours or particles (like fine grains, dust or metal powder). Do not expose the product to the environment of high-concentration industrial chemicals, including near evaporating liquefied gas (like helium), so as not to impair or damage the product function.

Maintenance

Please do not disassemble the Lidar without permission. Disassembly of the product may cause its waterproof performance to fail or personal injury.

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1 Product Profile

1.1 Overview

Based on TOF (time of flight), the N10 PLUS lidar can conduct 360° two-dimensional scan and detection of the environment. The lidar uses wireless power supply and wireless communication internally, and the pulse repetition frequency (PRF) is 5.4 KHz. The lidar reaches a measurement accuracy of ± 3 cm with a maximum range of 15 m. With such high performance, the lidar mainly applies to scenarios that require precise location and obstacle avoidance, including indoor service robots, AGV, cleaning and sterilization robots, drones, and more.

1.2 Mechanism

1.2.1 Time of Flight

Based on the TOF (time of flight) methodology, the N10 PLUS lidar measures the distance between a target object and the sensor, by calculating the difference between the emission and return times of modulated laser. The laser emitter sends out the modulated pulse laser, and an internal timer starts timing(t_1). The laser encounters the target object, part of the energy returns. When the lidar receives the return laser signal, the timer will stop timing(t_2). The formula for distance between the lidar and the target object:

$$\text{Distance} = \text{Velocity of Light} * (t_2 - t_1) / 2$$

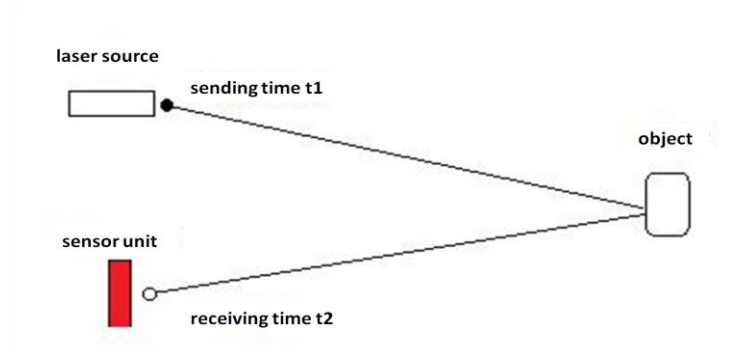


Figure 1.1 Mechanism of N10 PLUS

1.2.2 Grid Map Presentation

You can get the 2D grid map information of the surrounds across 360° within the detecting distance, based on the combination of the distance value calculated in real-time by the signal processing unit embedded in the N10 PLUS and the angle information output by the highly accurate self-adjusted angle measuring module.

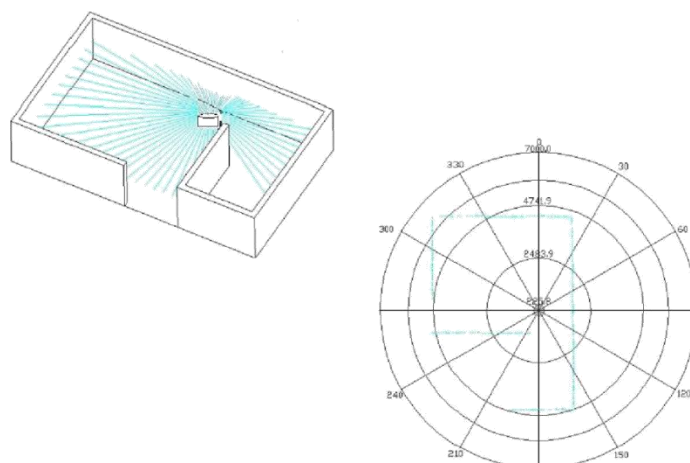


Figure 1.2 Demonstration of Ranging Function

***Note:** The figures only demonstrate the function of the distance measuring system. They are not proportional.

1.3 Specifications

Table 1.1 Specifications of N10 PLUS

Model	N10 PLUS
Wavelength	905 nm
Laser Safety Level	CLASS I
scanning angle	360°
PRF	5.4 KHz
Angular Resolution	0.4°~0.8°
Scanning Rate	6 Hz ~ 12 Hz
Measurement Accuracy	±3 cm @70%
Detection Range	0.02 m ~ 15 m @70%
Data Content	Azimuth, Distance, Intensity
Network Power Supply	5 VDC (4.75 V ~ 5.25 V)
Operating Temperature	-10°C ~ 40°C
Storage Temperature	-30°C~70°C
Maximum Acceptable Ambient Light Intensity	> 80K Lux

Motor	Built-in Brushless Motor
Communication Interface	Standard Serial Port (Baud Rate: 460800 bps)
IP Grade	IPX-4
Dimensions	Φ52*36.1 mm
Weight	About 60 g
Echo Mode	Dual echo

1.4 Dimensions

A set of laser transmitting and receiving devices is fixed to the rotor of the lidar, which is rotated by an internal motor to achieve a 360° scan in the horizontal direction.

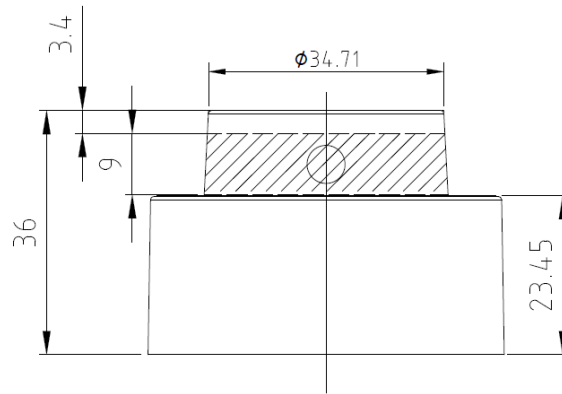


Figure 1.3 Optical Window (unit: mm)

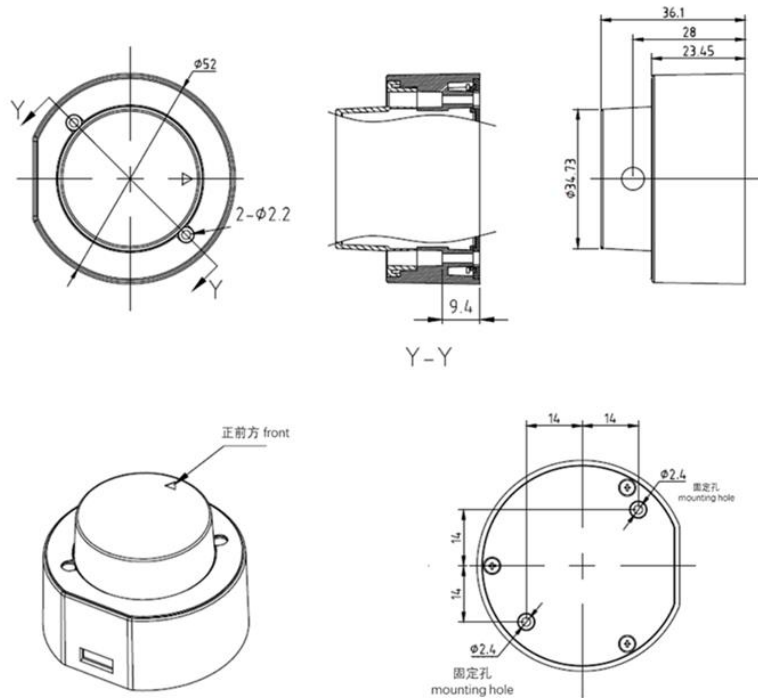


Figure 1.4 Lidar Mounting and Mechanical Dimensions (unit: mm)

1.5 Interface Definition

The specification of N10 PLUS's base connector is A1257H-5P (male), A1257WR-S-5P-LCP (female).

1.5.1 LiDAR Base Connector

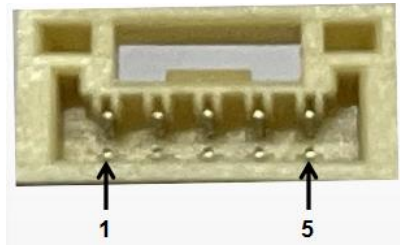


Figure 1.5 Lidar Base Connector

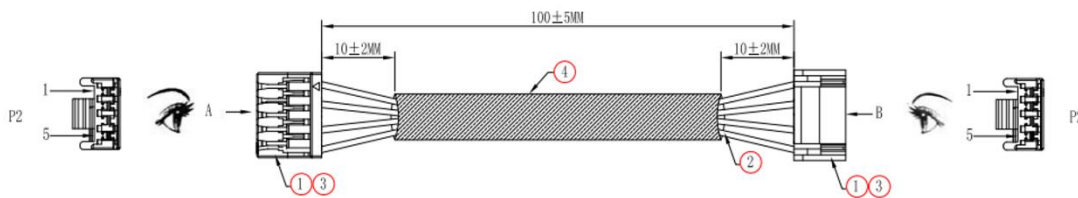


Figure 1.6 Lidar Cable

Table 1.2 Wire Definition

S/N	PIN	Color	Definition	Minimum	Recommended	Maximum
1	GND	Black	Power-	0V	0V	0V
2	TX	Yellow	Lidar data output	0V	3.3V	3.5V
3	RX	Green	Function control	0V	3.3V	3.5V
4	VCC	Red	Power+	4.75V	5V	5.25V
5	NetP1_1	Blue	Connect to the lidar shell	-	-	-

1.5.2 Adapter Board

A TTL to Type-C USB adapter module is available for the N10 PLUS series lidar to enable TTL to USB data conversion. This adapter board is not a necessary accessory for lidar operation. The function of each interface of the adapter board is described as follows.

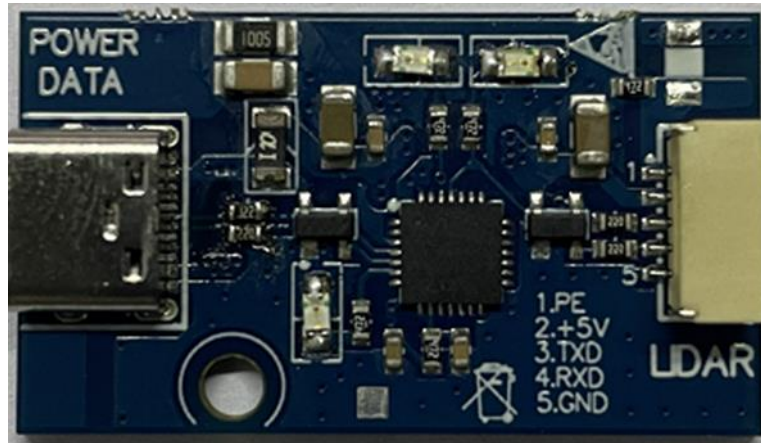


Figure 1.7 Adapter Board

Note:

POWER DATA: data communication and system power supply.

LIDAR: connection to lidar.

2 Electrical Parameters

The N10 PLUS lidar communicates with serial port of 3.3 V. An N10 PLUS lidar is made of a high frequency ranging core, a wireless transmission system, and a rotating subsystem. The rotating subsystem is driven by a brushless DC motor spinning inside the system. The signal cable of N10 PLUS can be interfaced with the UART port of the FPGA/DSP/ARM/SCM without the need for the conversion of RS232, 422 chips. You connect an external system and the lidar and follow the communication protocol of the lidar system to obtain the scanned point cloud data, device information and status, and set the working mode in real-time.

Table 2.1 Electrical Parameters

Item	Min.	Recommended	Max.	Note
Power Supply Voltage	4.75 V	5 V	5.25 V	The power supply not in the range may lead to inaccurate ranging or irreversible damage.
Voltage Ripple	-	100 mV	-	By default, powered by USB
Operating Current	-	340 mA 360 mA	-	
Power Consumption	-	1.7 W	-	
High Signal Level	2.9 V	3.3	3.5 V	
Low Signal Level	-0.3 V	-	0.4 V	
Baud Rate	-	460800 bps	-	Square signal; note the stability of the data communication
Pitch Angle	0°	0.3°	1.5°	

3 Communication Protocol

When the N10 PLUS is working, each set of data is output through the communication interface. The output data has uniform message formats. If you need the detailed communication protocol, please contact LSLiDAR support.

4 Optical Features

4.1 Laser Feature

Dependent on a 905 nm laser, N10 PLUS emits high-frequency pulsed lasers through the optical assembly, receives the laser signal through the optical assembly, and completes the photoelectric conversion by the receiver board. The distance value calculation is completed by the master control chip and the laser optical parameters are as follows:

Table 4.1 Laser Optical Parameters

Item	Min.	Recommended	Max.	Note
Wavelength	895 nm	905 nm	915 nm	-
Peak Power	-	25 W	-	-
Average Power	-	5.5 mW	-	-
Laser Pulse Width	-	1.6 ns		-
FDA	Class I			IEC 60825-1: 2014

4.2 Light Spot

The light spot of the N10 PLUS lidar is a vertical oval. Its vertical divergence angle is 11.4 mrad, and the horizontal divergence angle is 8.4 mrad. The spot size at any distance can be calculated by multiplying the divergence angle by the distance.

For example, the calculation of a spot at 10 m is as follows:

Vertical direction at 10 m: $10 \times 11.4 \times 10^{-3} = 114$ mm

Horizontal direction at 10 m: $10 \times 8.4 \times 10^{-3} = 84$ mm

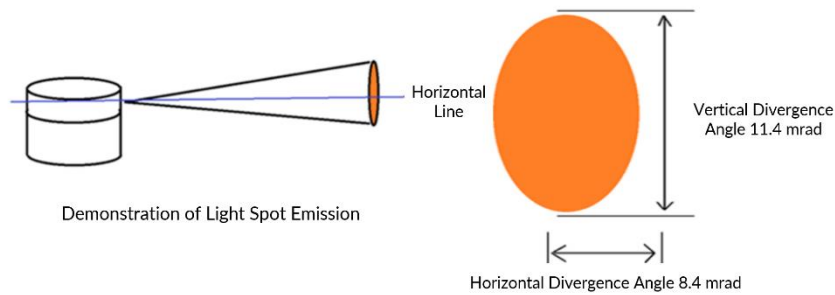


Figure 4.1 Light Spot Demonstration

4.3 Optical Structure

The N10 PLUS lidar uses a telescopic optical structure with the receiver and transmitter placed horizontally side by side. When designing the lidar installation and robot system integration, it is necessary to focus on the internal optical structure of the lidar so that the effective detection angle of the lidar can be designed accurately. To facilitate your use, especially in terms of the calculation of geometric relationships, LSLiDAR defines a polar coordinate system with the center point of the lidar as the pole, clockwise as positive, and the triangle mark as the zero-degree angle.

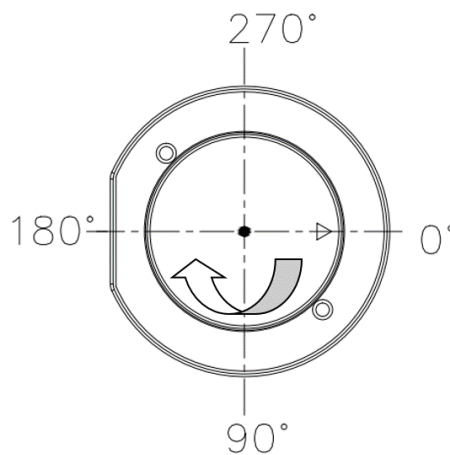


Figure 4.2 Lidar's Polar Coordinate (Top View)

5 Development Tools and Supports

Made for the N10 PLUS lidar, LSLiDAR provides you with the SDK capable of processing scan data in real-time and displaying it as an image. This SDK


facilitates you to get familiar with the lidar and helps to shorten the project development cycle. At present, LSLiDAR only provides SDK for Linux, ROS, and Windows X86. We will release versions for Android, Mac OS, and other platforms later. Please follow the official website of LSLiDAR for the latest information.

5.1 Point Cloud Display Software on Windows

This section introduces the point cloud display and software usage of N10 PLUS lidar on Windows OS. This point cloud display software can be used for parameter configuration, simple lidar testing, etc.

5.1.1 Software Interface Introduction

The software interface contains a menu area, a toolbar area, a 3D view area, a data table area, a company website link, etc.

Click the icon  to open the software. The initial interface is shown below

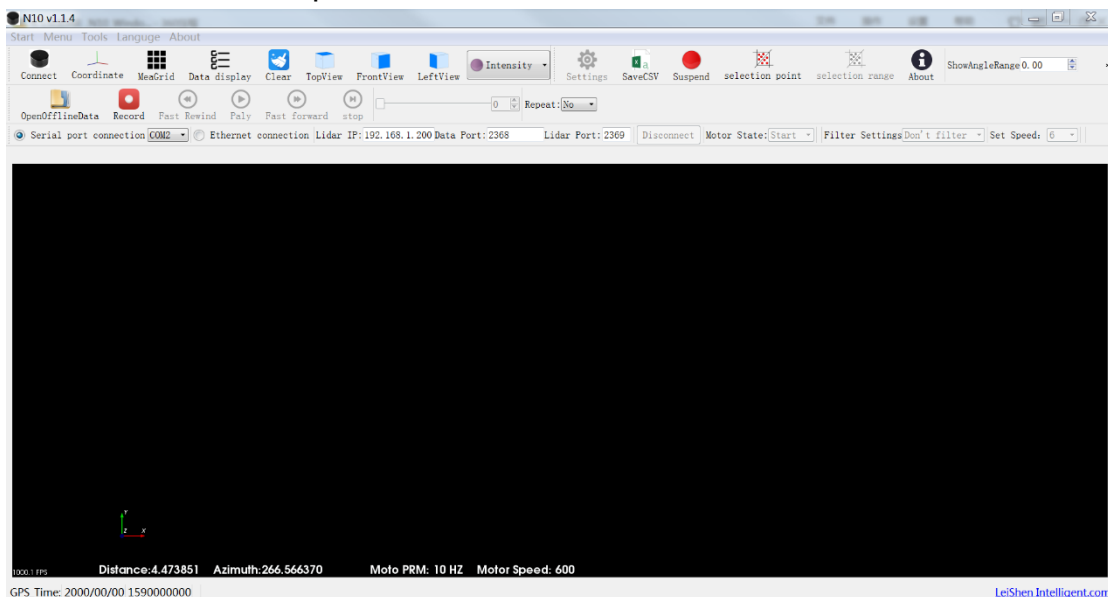




Figure 5.1 Software Interface

5.1.2 Software Operation

Choose the designated serial port  to receive data. After the connection of lidar's power supply and serial cable, click  to receive the data in real-time.

The data table contains PointID, Points_m_XYZ, Azimuth, Distance, Intensity, Laser_id, and timestamp. PointID is the point number and Points_m_XYZ is the

spatial x, y, and z coordinates. Azimuth indicates the azimuth angle, Distance indicates the distance between the lidar and the measured target, Intensity indicates the reflection intensity of the measured target, Laser_id indicates which laser channel, and timestamp indicates the time.

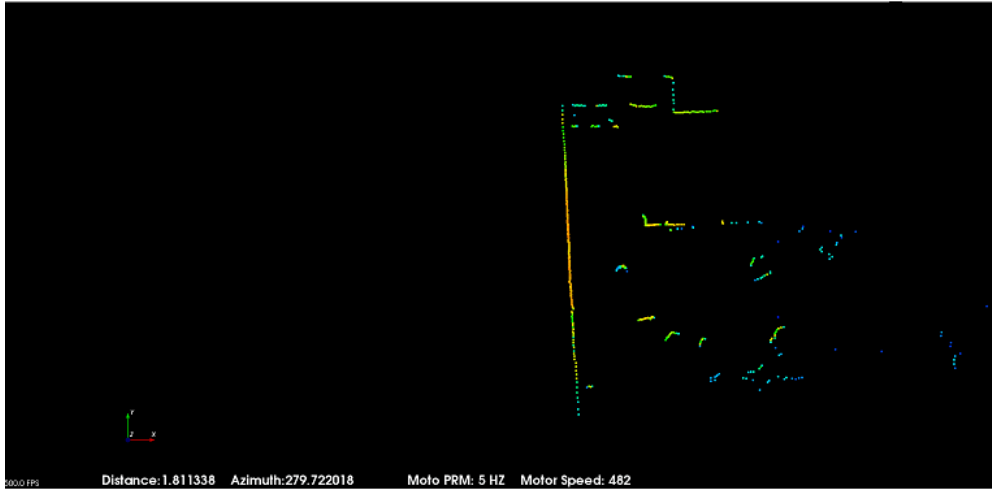


Figure 5.2 Real-time Point Cloud Image

5.1.3 Menu Function Description

■ Introduction to Point Cloud Display



The point cloud display interface supports the following actions:

















- 1) Scroll the mouse wheel to zoom in/out the display image; you can also hold the right mouse button and drag the image up/down to zoom in/out the display image.
- 2) Hold the left mouse button and drag the display image to adjust the viewing angle.
- 3) Hold the mouse wheel and drag the image to move the display image; you can also hold both the shift key on the keyboard and the left mouse button to move the display image.

■ Introduction to Menu Bar Buttons

- Lidar Menu











Table 5.1 Lidar Menu Button Description

Button	Description
	Click to start receiving and displaying data
	Show/hide the measurement grid

 Select	Mark the selected points in the point cloud image; Select point clouds from different angles
 SelectRange	Set the range
	Pause the live point cloud image and data
	Clear screen
	Show/hide the coordinate
	Show/hide the data column on the left
	Three-view option: set the observation angle from top, front, and left.
	Set the display mode of the point cloud
	Choose whether to filter or not
	Set speed
	Choose to start or stop
	Stop data parsing
	View the software version
	Open lidar parameter form
	Save the data in .csv format
	Select the angle of view, the software will only display the set angle point cloud, with the ability to accumulate multiple frames

● **Offline Menu**

Table 5.2 Offline Menu Button Description

Button	Description
	Open offline data
	Start/Stop saving data, available only when the lidar receives data in real-time
	Skip to the beginning
	When paused, view the previous frame;
	When playing, rewind (click multiple times to select 2x, 3x, 1/2x, 1/4x and 1x speed)
	Click to start playing after the point cloud file is loaded;
	When playing, click to pause
	When paused, view the next frame;
	When playing, fast forward (click multiple times to select 2x, 3x, 1/2x, 1/4x and 1x speed)
	Skip to the end
	Drag the progress bar or enter the frame number to skip to the specified position

5.2 Notes

■ Notice about the Lidar setting and usage

- 1) It is not possible to use the N10 PLUS Windows client to receive data in two processes (open twice at the same time) on the same computer. The port occupancy of the PC is generally exclusive, so after a process is bound to a specified port number, the other software using the same process or the same port number cannot work normally. When the N10 PLUS Windows client detects that the port is occupied, it will prompt that the communication network port configuration has failed, and automatically close the software. You need to close the software process that occupied the port, and reopen the N10 PLUS Windows client to use it normally.
- 2) Meanwhile, since Qt is adopted in the low-level software development, please create English paths when naming files and path folders.

■ Notice about computer graphics settings

The information about dual graphics cards can be viewed in the computer configuration. In My Computer > Right Click > Properties > Device Manager, you can see the computer's display adapter information:

You need to manually set a high-performance discrete graphics card as the applicable graphics card of the software. The setting steps are as follows:

- 1) Take a laptop with Intel(R)HD Graphics 530 integrated graphics and NVIDIA GeForce GTX 960 discrete graphics as an example. Right-click on a blank space on the desktop to pop up a right-click menu and select "NVIDIA Control Panel".
- 2) Select the "Manage 3D Settings" in the NVIDIA Control Panel interface.
- 3) Click the "Program Settings" button in the Manage 3D Settings interface.
- 4) Click the "Add" button on the Manage 3D Settings interface.
- 5) Click the "Browse" button in the pop-up interface.
- 6) Find the application file (.exe file) of the software according to its installation path in the pop-up browsing interface.
- 7) Click "OK" to automatically return to the NVIDIA control panel, select the high-performance NVIDIA processor in the combo box of the preferred graphics processor for this program in Option -2., and click "Apply" in the lower right corner. After the computer application is set, close the NVIDIA Control Panel to complete the setting.

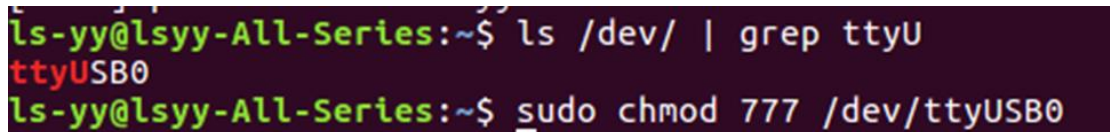
6 ROS Driver Operation Under Linux OS

This section introduces the point cloud display and driver usage of LSLiDAR N10 PLUS lidar on Linux. You can acquire the ROS driver from LSLiDAR technical support. The N10 PLUS ROS driver is applicable for point cloud display, parameter configuration, etc.

6.1 Check Serial Connection & Read/Write Permission

Settings

Check in the /dev directory to see if there is a corresponding USB device connected, and give the device read and write access.



```
ls-yy@lsyy-All-Series:~$ ls /dev/ | grep ttyU
ttyUSB0
ls-yy@lsyy-All-Series:~$ sudo chmod 777 /dev/ttyUSB0
```

Figure 6.1 /dev directory

6.2 ROS Driver Operation Example

1) Establish a workspace and build a compilation environment

```
mkdir -p ~/leishen_ws/src
```

Note: The workspace can be named arbitrarily. (But the path of workspace shall be in English only.) For example, “leishen_ws” can be changed to any name.

2) Download the LiDAR ROS driver

The ROS driver can also be obtained directly from our website or customer service. Copy the obtained driver file to the newly created workspace “src”, and use the “tar-xvf” order to decompress it.

3) Compile and package

```
cd ~/leishen_ws
```

```
catkin_make
```

4) Run the program

```
source devel/setup.bash
```

```
roslaunch lsn10_plus .launch
```



```

* /lsn10/scan_topic: scan
* /lsn10/serial_port: /dev/ttyUSB0
* /roscdistro: kinetic
* /rosversion: 1.12.17

NODES
 /
  lsn10 (lsn10/lsn10)

auto-starting new master
process[master]: started with pid [28871]
ROS_MASTER_URI=http://localhost:11311

setting /run_id to d4b52e9e-070e-11ec-bfd1-88d7f6424ca2
process[rosout-1]: started with pid [28884]
started core service [/rosout]
process[lsn10-2]: started with pid [28891]
port = /dev/ttyUSB0, baud_rate = 230400
open_port /dev/ttyUSB0 ERROR !

```

Figure 6.2 open_port /dev/ttyUSB0 ERROR !

Note: The appearance of “open_port /dev/ttyUSB0 ERROR !” means that the USB device cannot be opened. Please check whether the USB device is connected and whether read and write permissions are granted.

Open a new terminal and execute the command: rviz

5) Display the data detected by the LiDAR

In the “Displays Window” that pops up, modify the value “Fixed Frame” to “laser_link”. Click the “Add” button at the same time, and click “LaserScan” under “By topic” to add a single-beam point cloud node.

6) Set parameters

In the /src/lsn10_plus_ros/launch/lsn10_plus.launch file, you can set the corresponding serial device name, topic, etc.

7 LiDAR Maintenance

Shipping Requirements

LSLiDAR has customized the package for the N10 PLUS lidar to withstand a certain amount of vibration and impact. Special packages must be used for long-distance transportation to avoid irreversible damage during transportation.

Installation

Fix the lidar to the base using screws that meet the specifications, and pay attention to the base heat dissipation. Wear powder-free and clean gloves when installing, so as not to cause the optical window to be dirty, and not to cause mechanical damage to the optical window.

Storage

The storage temperature of N10 PLUS series products is $-30^{\circ}\text{C} \sim 70^{\circ}\text{C}$. It is recommended to store the products in a ventilated and dry place where the temperature is $23 \pm 5^{\circ}\text{C}$, and the relative humidity is $30\% \sim 70\%$. Do not store in environments where humidity, pH, etc. exceed the protection level.

Cleaning

When using the lidar, if the optical window is polluted by fingerprints, mud, leaves, insect corpses, etc., it will affect the lidar ranging effect. Please follow the following steps for cleaning.

Tools: PVC gloves, dust-free cloth, anhydrous ethanol (99%)

Environment: ventilated and dry, away from fire sources

- 1) Wear the PVC gloves and secure the lidar base with your fingers; For a stain that is not stubborn, use a dust-free cloth to gently wipe it off or dry air to blow it off.
- 2) For a stubborn stain, fill the spray bottle with ethanol, spray evenly on the stain, wait for a while until the stain is dissolved, and then use a dust-free cloth dipped in ethanol to gently wipe the optical window. If the dust-free cloth is polluted, replace it immediately. After cleaning off the stain, use a new dust-free cloth to wipe off the remaining liquid.

Revision History

Rev.	Release Date	Revised Content	Issued/Revised By
V2.0.0	2022-09-14	Initial version	LS1286
V2.0.1	2022-11-07	Modification of <i>Table 1.2 wire definition</i>	LS1286
V2.0.2	2022-12-12	<i>Optical Window added; Lidar Mounting and Mechanical Dimensions modified</i>	LS1286



Make Safer Driving, Smarter Machine, and Better Life!

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