YUJIN ROBOT

YUJIN 3D LiDAR

YRL3V2 Series

YRL3V2-05 / YRL3V2-10 / YRL3V2-25

User Guide

Revision: 1.0
Date: 2022/04

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The information in this guide is subject to change without notice during the product's life cycle. The printed version of the guide is updated periodically. Some details may be omitted or inaccurate when compared to current product information. Even in the hypothetical event that Yujin Robot was aware of the possibility of any damages ahead of time, Yujin Robot assumes no responsibility for errors, omissions, or damages that may arise from the information contained in this document.

Doc. No. YRL3V2_UM_EN_V1.0

Change History

The following table contains version information for this document and a history of significant changes.

Version	Date of Writing	Changes
V1.0	03/07/2022	First Rlease

Table of Contents

1. Safety Information

1.1 Definition

The guidelines below are provided to ensure user safety and prevent property damage. Please read the information carefully to ensure the safe use of the product.

Warning
Users must follow these guidelines to prevent hazardous situations that can lead to serious injury or death.

Caution
Users must follow these guidelines to prevent situations that can lead to minor injury or product damage.

Note
Users must follow these guidelines to prevent situations that may cause property damage.

1.2 General Safety

Read this guide and familiarize yourself with the features before using the product.

- Product information and data can also be found on our website.
  http://www.yujinrobot.com

1.2.1 Precautions for Installation

- Only qualified technicians should install the product and perform electrical work.
- The wiring of the supply cable from the customer's power system must be designed in accordance with the applicable standards. Ensure compliance with national and local regulations.
- The power supply must be disconnected before connecting or disconnecting the product's power connection.
- Use the product at the specified voltage and power range. Failing to do so can cause fire or damage to the product.
- Do not apply heat or pressure to the product. Failing to do so can cause fire or damage to the product.
- Do not use the product in the presence of flammable, explosive or corrosive gas or in a situation with the potential to cause harm. Doing so can cause product malfunction or damage to the product and threaten user safety.
- The product should only be used for the purpose indicated in the system introduction and may not be used as a weapon or for military purposes.
- This product is not a safety sensor. Do not use this product in a place where there is a risk of personal injury, life or property damage.

1.2.2 Precautions for Use

- Do not disassemble the product during operation. Failing to do so can cause fire or damage to the product.
- Do not drop or subject the product to impact.
- The product may become hot when used for a long period. Do not touch any hot surface. Doing so may cause burns.
- Do not step on or put heavy objects on the product. Failing to do so can cause fire or damage to the product.

- Do not use this product in places that may cause injury, death, or property damage.
- Interference or contact between different laser light sources may cause abnormal operation of the sensor.
- Do not use it in outdoor environments, dusty places, humid places, or in direct sunlight.
- Fasten the product firmly in places where there is a lot of vibration.
- Use of controls, adjustments, or performance of procedures other than those specified herein may result in hazardous radiation exposure.
- Use the product only in the environment specified in this guide. (Refer to "7. Product Specifications" page 31)

2. Introduction

2.1 Product Overview

YRL3V2 is a single-channel 360-degree 3D scanning ToF (Time of Flight) laser sensor. It measures the distance to surrounding objects and provides point clouds for accurate mapping. YRL3V2 provides 4 scanning modes for autonomous mobile robots (AMRs) to optimize SLAM based mapping and navigation. Three types of LiDARs are available with different ranges:

Type (Name)	Range
YRL3V2-05	5m
YRL3V2-10	10m
YRL3V2-25	25m

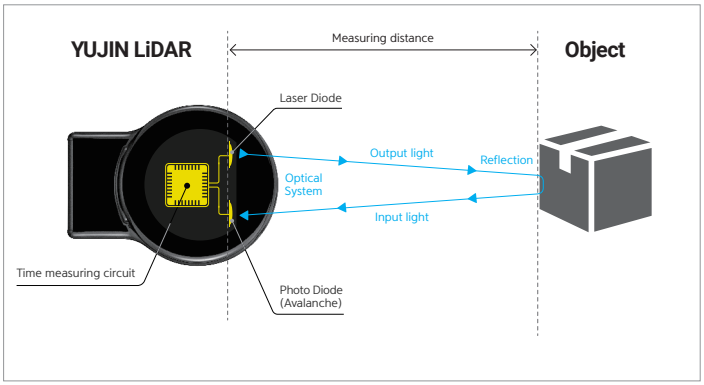


Fig. 1: Principle of ToF (Time of Flight)

2.2 Product Features

- Supports single channel 360-degree 3D scanning for distance measurement
- Supports 4 scanning modes optimized for autonomous mobile robots (AMRs) (Max 360 degrees horizontal x 80 degrees vertical)
- Applied single channel ToF (Time of Flight) technology
- Supports ROS (Robot Operating System) 1/2
- Provides LiDAR Viewer S/W
- Obtained IP67, RoHS, and CE certifications

2.3 Applications

- Measures the distance to surrounding objects
- Creates accurate maps
- Detects objects and avoids obstacles
- Used for commercial robots/service robots/logistics robots

2.4 System Diagram

The YRL3V2 system consists of YRL3V2, power supply, and Customer PC or Mobile Robot. YRL3V2 is provided with a power cable (1 m) and an Ethernet cable (1 m). The power supply, PC or Mobile Robot must be purchased separately by the user. LiDAR Viewer, a software for running LiDAR, is also available. With the LiDAR Viewer, you can monitor the status of the LiDAR and configure basic settings.
To operate the YRL3V2 system correctly, connect it as specified below.

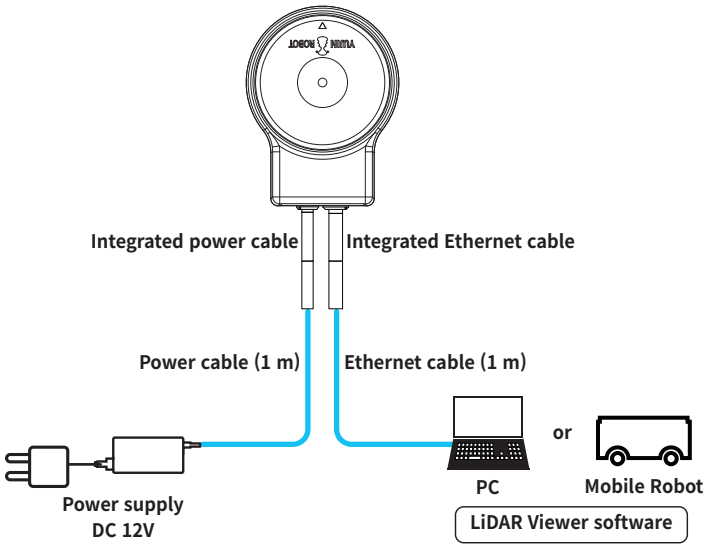


Fig. 2: YRL3V2 System Diagram

3. Before Using YUJIN LiDAR

3.1 Measurement information

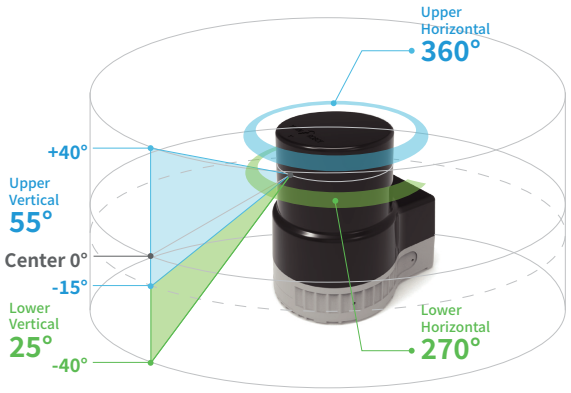
YRL3V2 can collect more than 30,000 point clouds per second. One point cloud contains the following information:

- Horizontal Angle: Horizontal angle measured (-180°–+180°)
- Vertical Angle: Vertical angle measured (-40°–+40°, max 80°)
- Range: Distance to an object (Measured based on the time taken by the light to travel back and forth to the object)
- Intensity: Reflection intensity measured
- Coordinate Value: Point cloud coordinates measured (X/Y/Z)
- System Time: Absolute time (based on the OS)
- Time Stamp: Timestamp indicating relative time between point clouds

Note
Please refer to "8.1 Appendix A. Driver Interface (API)" page 33 for details of the output data.

3.2 Scanning Range (4 Scanning Modes)

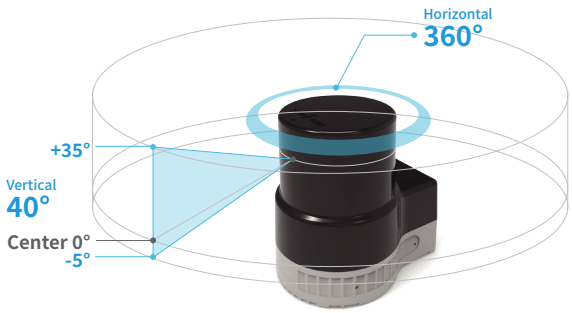
YRL3V2 supports 4 scanning modes optimized for autonomous mobile robots (AMRs). Please refer to the horizontal and vertical scanning ranges in each mode.



Mode 1

General scanning mode(Default)

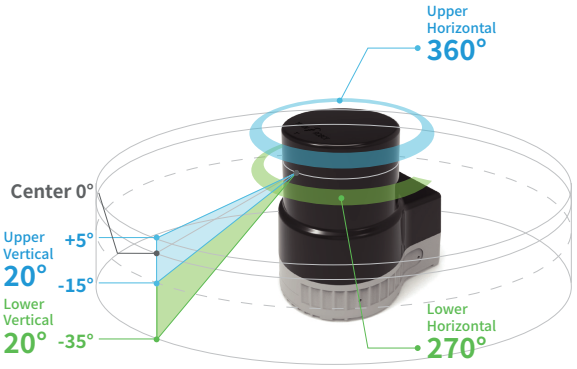
- Mapping and object detection
- AMR, PCR, Service Robot



Mode 2

Upward scanning mode

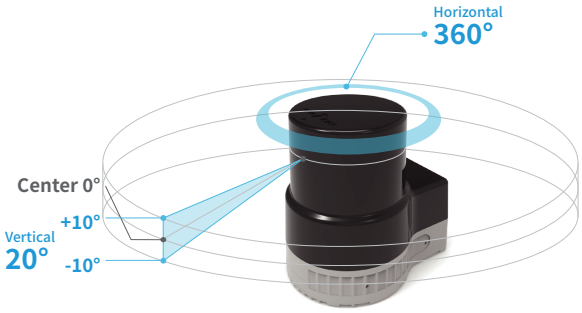
- Mapping and object detection
- AMR, PCR, Service Robot



Mode 3

Downward scanning mode

- Mapping and object detection
- AMR, PCR, Service Robot



Mode 4

Fast scanning mode

- Object detection, collision avoidance, positioning

Scanning Mode	Mode 1 General scanning mode(Default)	Mode 2 Upward scanning mode	Mode 3 Downward scanning mode	Mode 4 Fast scanning mode
FoV: Horizontal x Vertical	Upper 360° x 55° (+40°/-15°), Lower 270° x 25° (-15°/-40°)	360° x 40° (+35°/-5°)	Upper 360° x 20° (+5°/-15°), Lower 270° x 20° (-15°/-35°)	360° x 20° (+10°/-10°)

4. Installing YRL3V2

4.1 Components

The components are packaged in individual boxes. Please check the components upon arrival of the product.

- YRL3V2 series product
- 1 m power cable
- 1 m ethernet cable
- Quick start guide

Note
Please contact us or the store where you purchased the product for any product faults or inconveniences.

4.2 Product Dimensions

Refer to the product dimensions below when installing the LiDAR.

(Unit. mm)

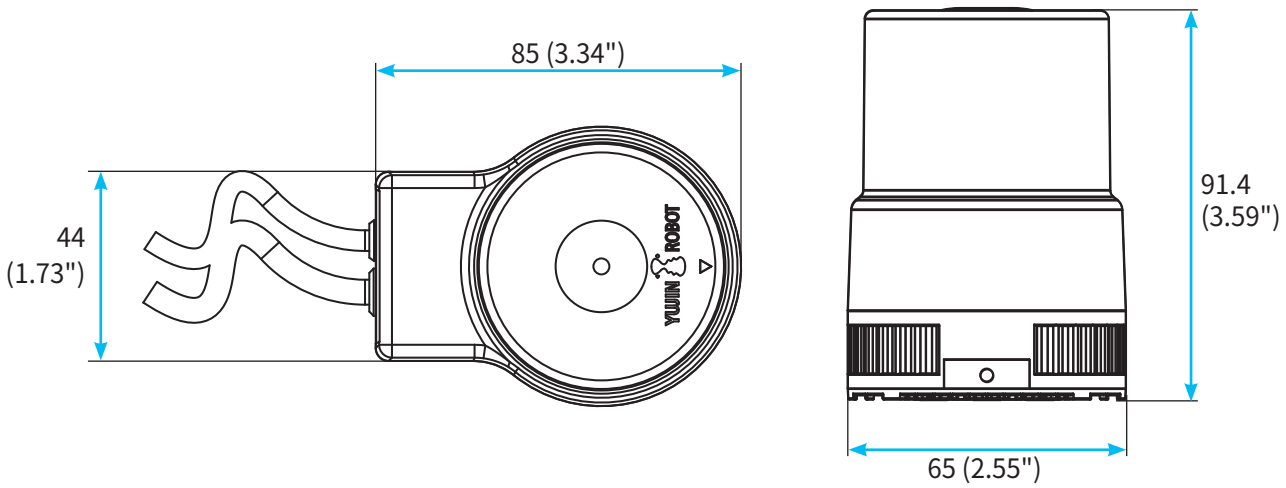


Fig. 3: YRL3V2 Dimensions

4.3 Component Details

The product consists of optical section and bottom section, and please refer to the diagram below for details.

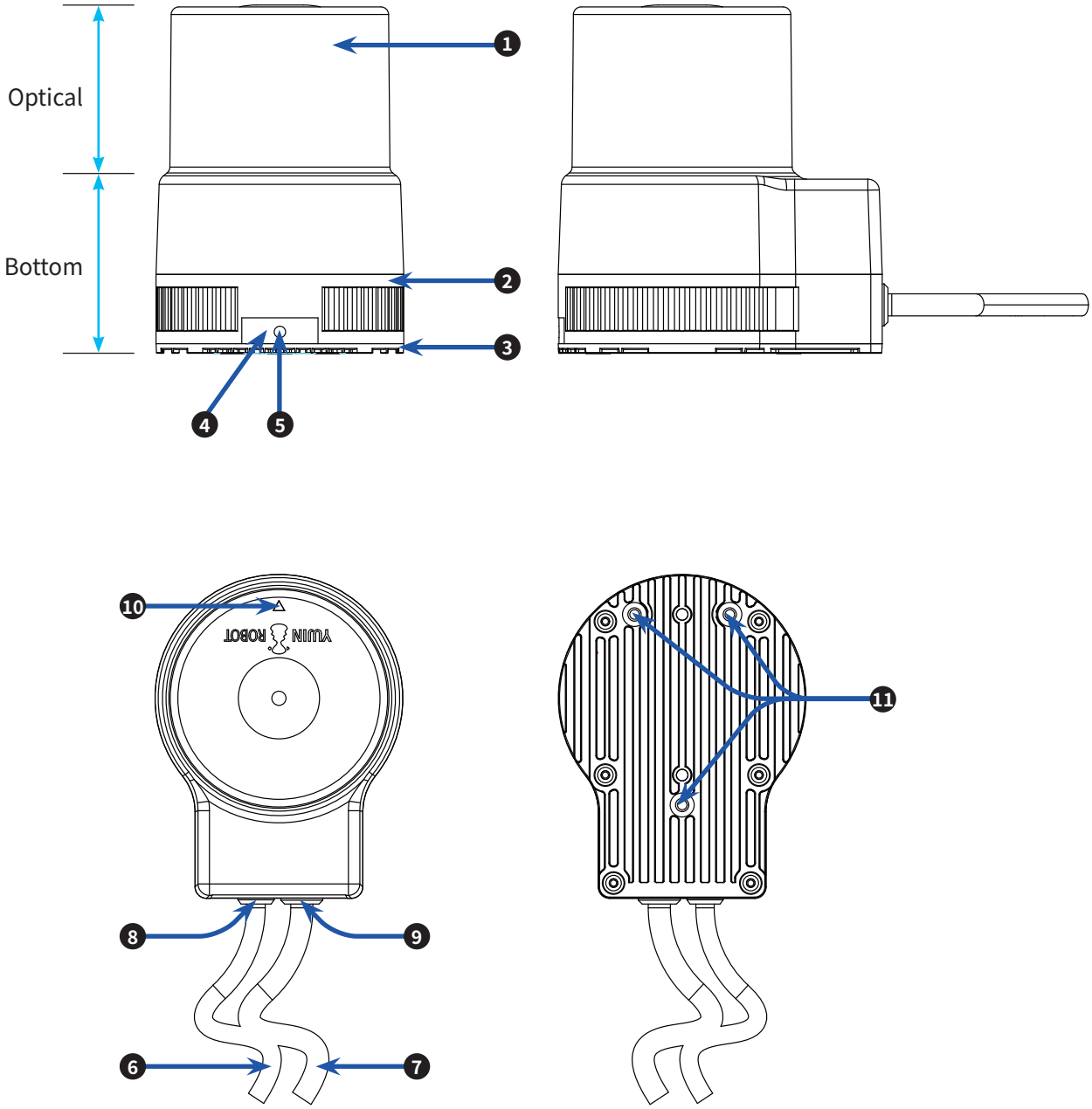


Fig. 4: YRL3V2 Component Details

1	Optical screen	7	Ethernet cable
2	Central cover	8	Power cable gland
3	Bottom cover	9	Ethernet cable gland
4	LED label	10	Axis adjustment mark (0° axis)
5	Status Indicator	11	Bolt holes M3 (Depth: 4 mm)
6	Power cable		

4.4 Installing the Product

4.4.1 Choosing the installation location

In order to achieve optimal performance, we recommend you install the LiDAR in a place that meets the requirements below.

- For efficient heat dissipation, install the product on materials with high thermal conductivity (aluminum alloys are recommended).
- To reduce noise from vibration, install the product on a clean surface without debris. When installing the product on an uneven surface, use a bracket (provided by the customer) under the LiDAR.
- Protect the sensor from sunlight.

4.4.2 Installing the LiDAR

The LiDAR has three bolt holes for fixing the unit on the bottom. Install the LiDAR in the desired location with appropriate bolts (3ea). When fixing the LiDAR's bottom surface, do not tighten the bolt excessively. Doing so may damage the bottom surface of the LiDAR.

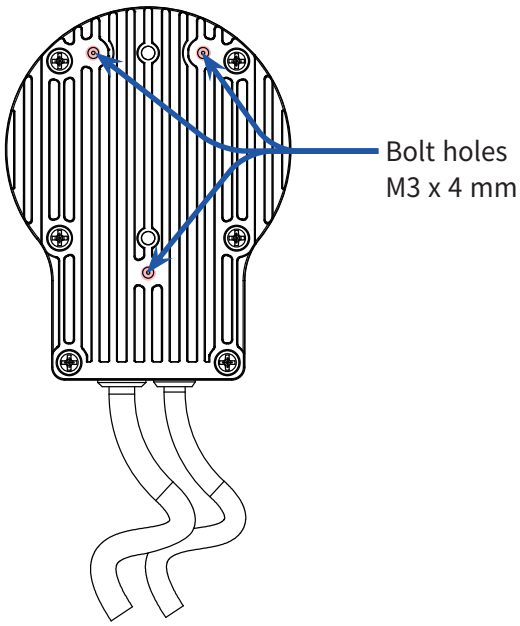
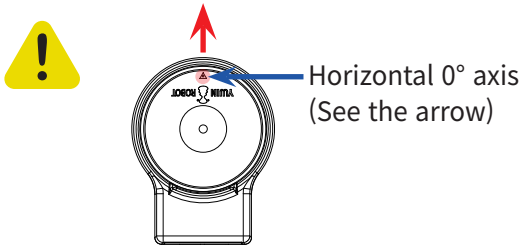


Fig. 5: Bolt holes at the bottom of YRL3V2

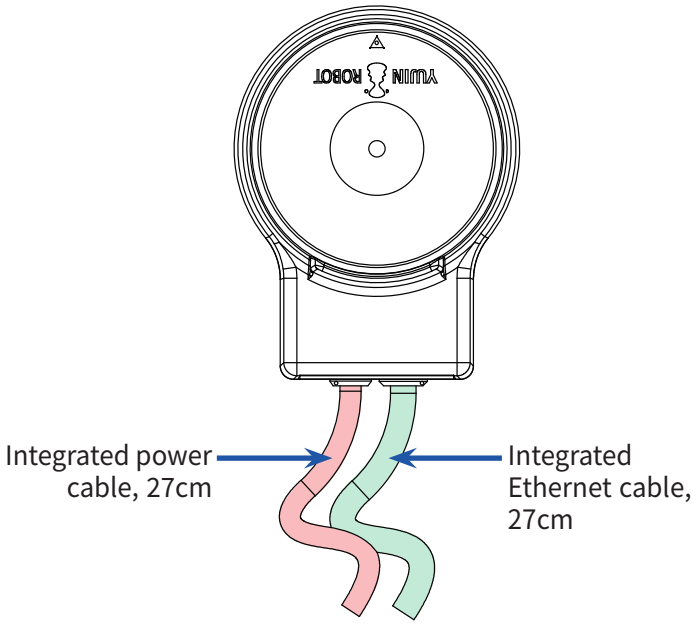
Caution

Align the horizontal 0° axis of the lidar sensor (as indicated by the arrow on the lidar cover) to the center of the area to be monitored.



4.5 Connecting the Cables

YRL3V2's two integrated cables are 27 cm long and can be used by connecting them with the power cable (1 m) and Ethernet cable (1 m) provided with the product. If you need to extend the cable, please contact our Technical Support.



4.5.1 Connecting the Power Cable and Ethernet Cable

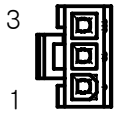
1. Connect the power cable to the integrated power cable connector of the LiDAR.
2. Connect the Ethernet cable to the integrated Ethernet cable connector of the LiDAR.
3. You can check the power status of the LiDAR from the front LED indicator. Check if the LED indicator has turned green (powered ON).

- Green: Powered ON
- No light: Powered OFF

Caution
When connecting **the cable** by processing the power cable wire, check the cable information to connect it correctly. Please refer to "4.5.2 Cable Pinout Guide" page 16.

4.5.2 Cable Pinout Guide

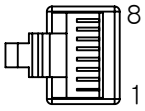
- Power Input Connector



MOLEX: 39-01-4030

Pin No.	Signal	Color
1	+12V	Red & White
3	GND	Black

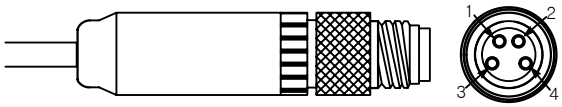
- Ethernet RJ45 Connector



RJ45

Pin No.	Signal
1	TX+
2	TX-
3	RX+
6	RX-

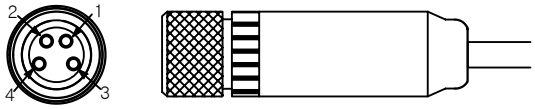
- IP PWR Connector



L102-M8-H0401 (Male)

Pin No.	Signal
1	+12V
2	+12V
3	GND
4	GND

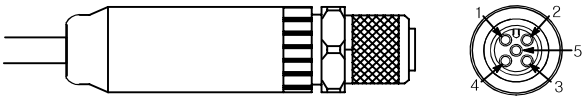
- IP PWR EXTENSION Connector



L102-M8-T0402-01 (Female)

Pin No.	Signal
1	+12V
2	+12V
3	GND
4	GND

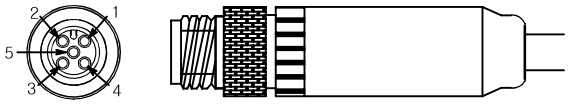
- IP Ethernet Connector



L102-M12-R05A02 (Female)

Pin No.	Signal
1	TX+
2	TX-
3	RX+
4	RX-
5	GND

- IP Ethernet EXTENSION Connector



L102-M12-R05A01 (Male)

Pin No.	Signal
1	TX+
2	TX-
3	RX+
4	RX-
5	GND

4.6 How to Start/Stop LiDAR

LiDAR maintains a standby state until it is connected to the host PC and does not operate. You can connect through the LiDAR Viewer or LiDAR driver to start the operation.

1. To start LiDAR:

- Click the [Create IP Connection] button on the LiDAR viewer software to connect LiDAR to the host PC's network.

2. To stop LiDAR:

- Click the [Close] button at the top right of the LiDAR viewer window to quit the viewer.
- Enter “ctrl + c” in the Terminal window where the viewer is running to quit the viewer.

Note

If an error occurs while using LiDAR, follow the procedure below.

1. Reboot LiDAR by disconnecting the power cable and connecting it again.
2. Close the viewer and launch it again.

5. Using LiDAR Viewer

5.1 LiDAR Viewer Overview

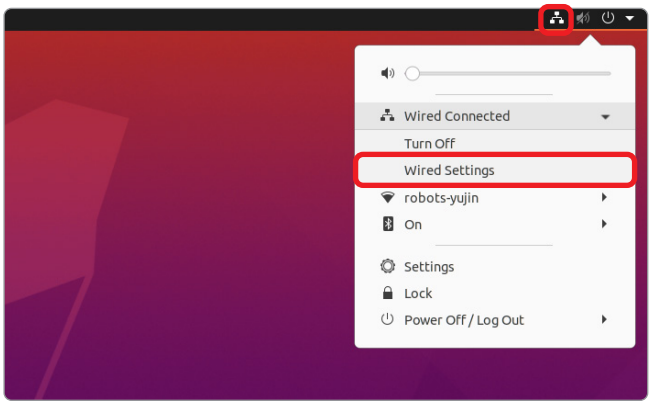
LiDAR Viewer Software displays YRL3V2's point cloud data on the screen in real time.

You can use the software in Ubuntu OS.

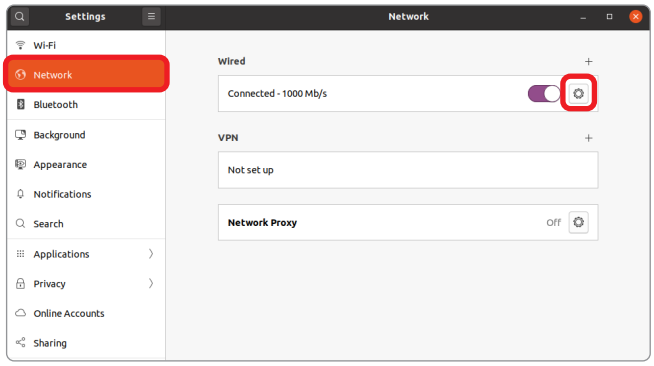
- How to enter commands in Ubuntu OS: Run "ctrl +alt + t" on the desktop to enable the Terminal window and enter the desired command.
- PC requirements: Ubuntu 20.04 or above

5.2 Setting Up the Network

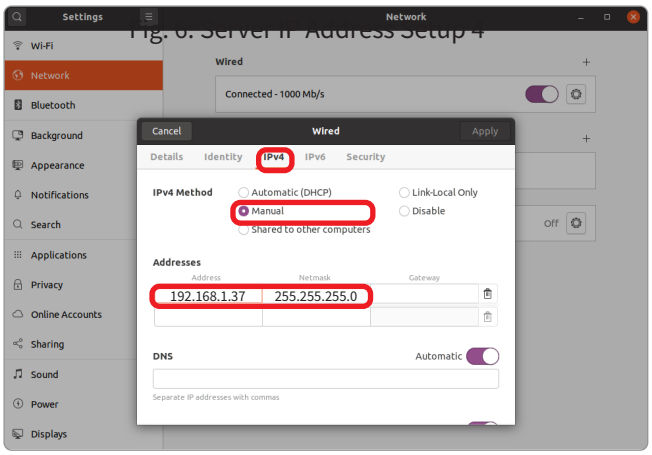
1. Click the [Network] icon in the upper right corner of the monitor screen. Select [Wired Settings].



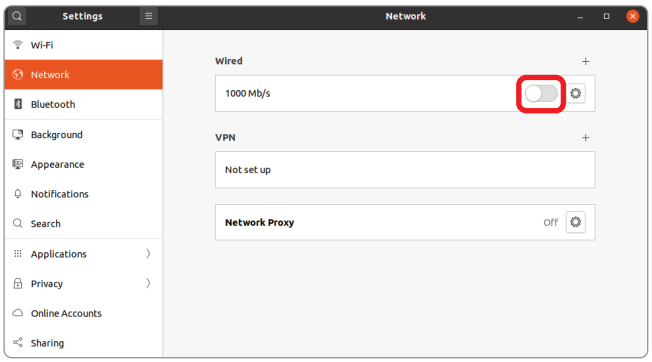
2. Click [Network] in the menu on the left. Click the [Settings] icon in the Wired menu.



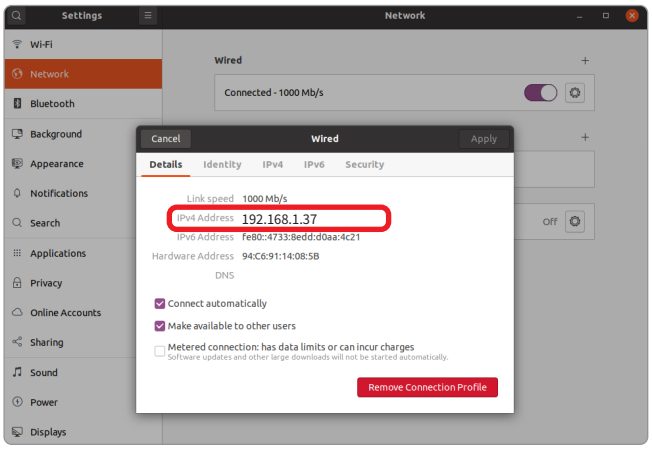
3. Select [IPv4] from the top menu. Select [Manual] and enter the Address and Netmask information you're going to use. Contact your network administrator to obtain this information. (Example: Address: 192.168.1.37)



4. Set the ON/OFF switch to OFF and set it back to ON to reset the network .



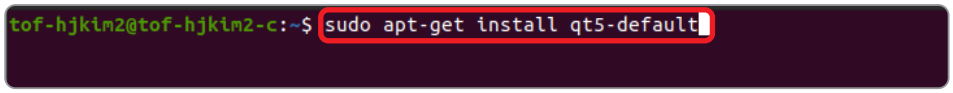
5. View the newly assigned static IP address.



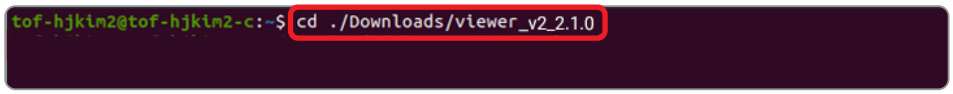
5.3 Running LiDAR Viewer

Enable the Terminal window on the desktop and enter the LiDAR Viewer execution command.

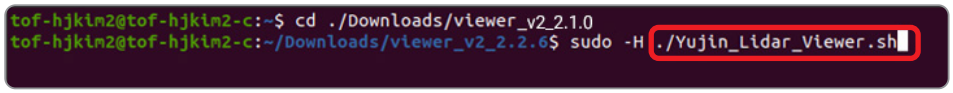
1. Launch the Terminal window and enter the command below to install QT5.
- sudo apt-get install qt5-default



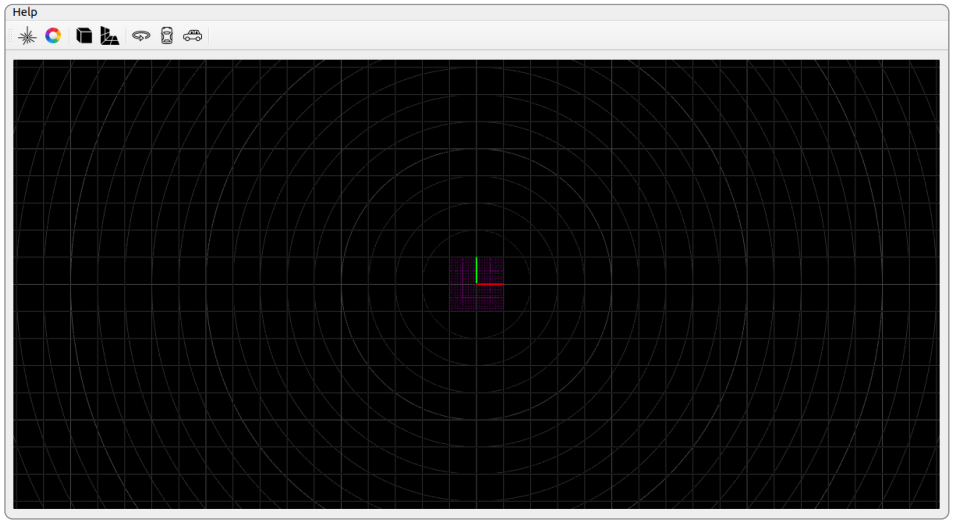
2. Go to the provided LiDAR Viewer software location.
- Command: cd ~/Downloads/viewer_v2_x.x.x/ (where LiDAR Viewer was installed by the user)



3. Run the LiDAR Viewer software.
- Command: ./Yujin_Lidar_Viewer.sh



4. Check if the software runs normally as shown below.



5.4 Connecting LiDAR

Caution
The default network setting the value of LiDAR was set to 192.168.1.250 at the factory. When connecting multiple LiDARs, each LiDAR must be connected to the Host and then assigned a different IP address.

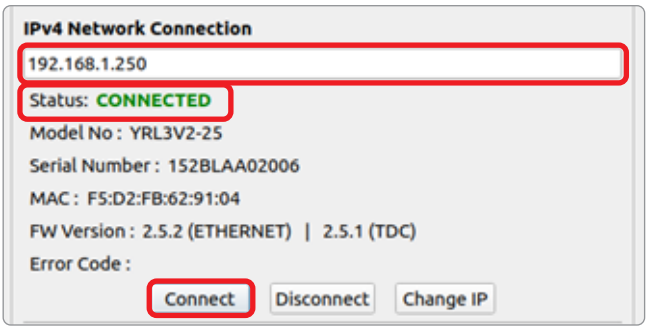
1. Once LiDAR is connected to power, the bottom LED indicator will start blinking and the green light will turn on. (takes approx. 8 seconds)
2. **Run** LiDAR Viewer.
3. **Enter the IP address** in the IPv4 Network Connection screen. The default IP address for the front LiDAR and the rear LiDAR are different. Please check the following information.

- Front LiDAR: **192.168.1.250**
- Rear LiDAR: **192.168.1.251**

4. **Press [Connect]** to connect LiDAR. (takes approx. 5 seconds)

- Disconnect Button: Disconnects LiDAR. In the following cases, press [Connect] after pressing [Disconnect].
  - When LiDAR is turned off
  - When LiDAR is disconnected from Ethernet
  - When connecting another LiDAR
- Change IP Button: Changes the IP address when LiDAR is connected. Enter a new IP address and click [Change IP].

Caution
When connecting two LiDAR units, designate two different IP addresses to specify each LiDAR's IP.



5. When successfully connected, the status will change to CONNECTED, and the Model No., Serial Number, MAC, FW Version, and Error Code (optional) will be displayed. If the connection fails, please check LiDAR's power, data (Ethernet) cable connection, LiDAR's IP address, and the computer's IP address.

5.5 User Interface

When you launch LiDAR Viewer, the following user interface screen will appear:
When the viewer is connected to LiDAR, point cloud data is displayed on the screen in real time. Users can set the data to be displayed on the screen.

Item		Description
1	Top bar	Provides Firmware updates and Help.
2	Menu tab	Selecting a tab opens a new window for the selected feature.
3	Viewer screen	Displays the status of the feature selected in the menu tabs on the viewer screen.

5.6 Firmware Update

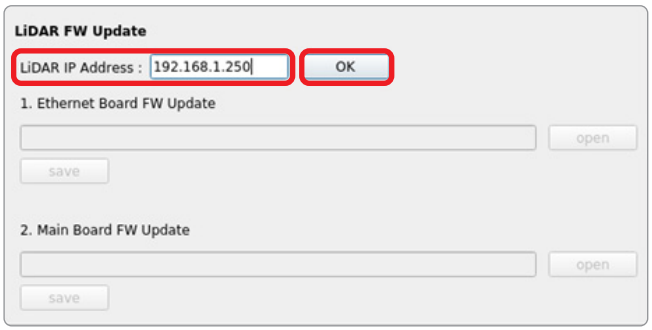
You can update the firmware by clicking [Help] - [FW Update] on the upper toolbar. To update the firmware, download the necessary files using the following link:

- Link: https://yujinrobot.com/knowledge-resources/downloads/
- Firmware File Name: [Board + version + date] (example: V2_App_Ethernet_V2.5.1_0321.hex, V2_App_Main_V2.5.1_0321.hex

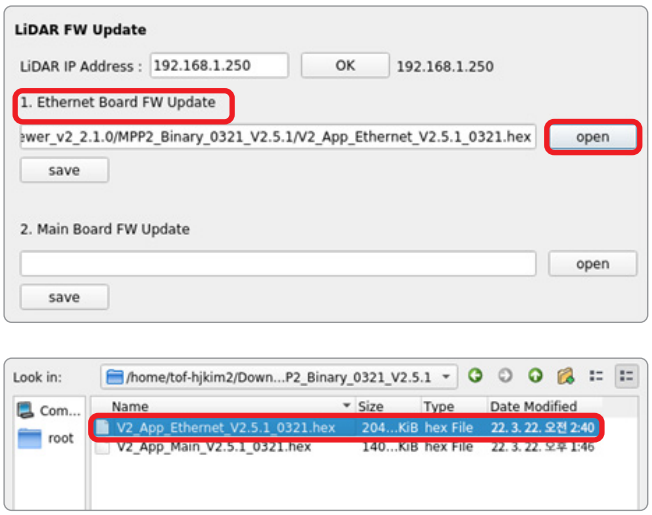
Caution
Update firmware before connecting LiDAR. If LiDAR is already connected, disconnect LiDAR and update the firmware.

5.6.1 Ethernet Board Firmware Update

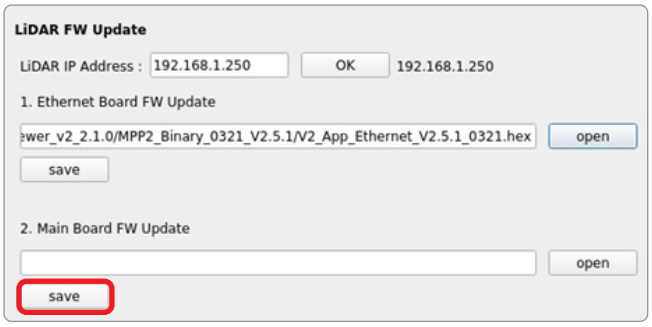
1. Enter LiDAR IP Address and click [OK].



2. Click [open] under Ethernet Board FW Update. Select the downloaded Ethernet Board Firmware file.

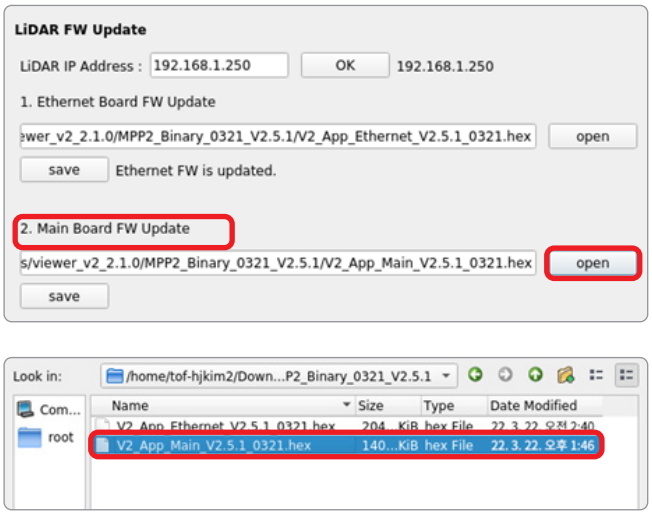


3. Update the Ethernet Board Firmware by clicking [Save].

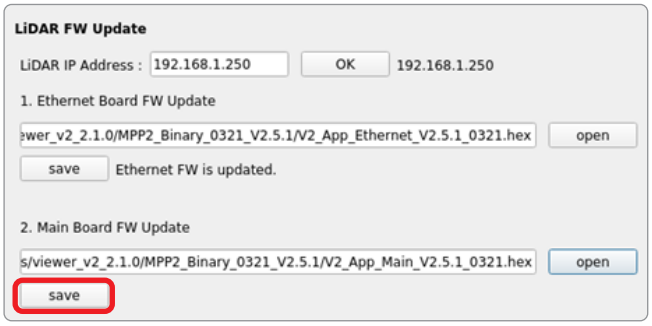


5.6.2 Main Board Firmware Update

1. Click [Open] under the Main Board FW Update. Select the downloaded Main Board Firmware file.



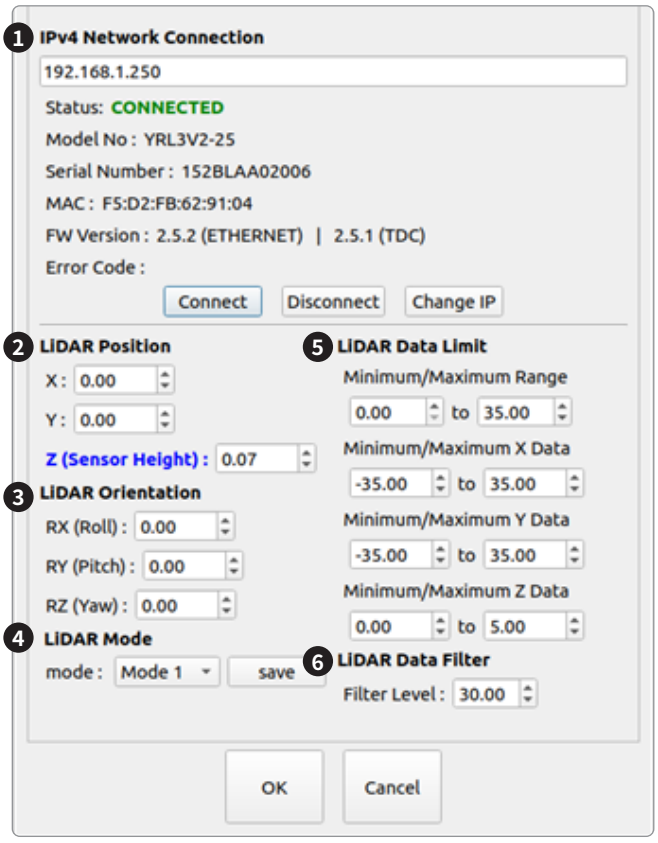
2. Update the Main Board Firmware by clicking [Save].



5.7 Sensor Configuration

You can connect to YRL3V2 and set the sensor data to be displayed on the viewer.

Select the following tab to open a new window where you can make detailed settings:



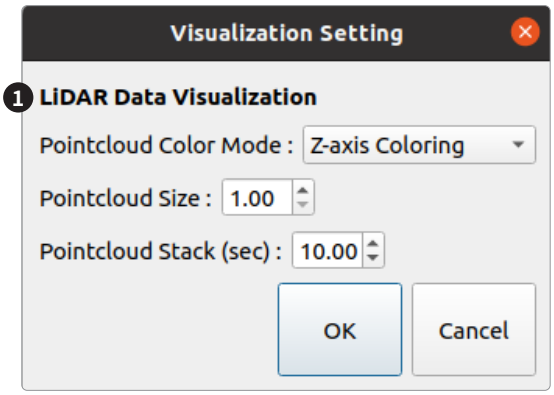
Item		Description
❶	IPv4 Network Connection	Set the IP address to use. (Initial value: **192.168.1.250**) If the connection is established normally, the status value changes to “Connected,” and you can check the serial number and firmware version information. If the connection cannot be made, check the power to LiDAR, data (Ethernet) cable, LiDAR IP address, and computer IP address. • Create IP Connection: Enter the IP address, click the “Create IP Connection” button to connect to the network and start running LiDAR. • Change IP: Change LiDAR’s IP address.

Item		Description
❷	LiDAR Position	Set the LiDAR position to be displayed on the viewer screen. Use the arrow key or keypad to adjust the settings. The relative position of the LiDAR from the origin of the coordinate plane on the viewer screen is displayed. • X: X-coordinate value (m) - Default: 0.00, Min: -100, Max: +100 • Y: Y-coordinate value (m) - Default: 0.00, Min: -100, Max: +100 • Z: Z-coordinate value (m). The distance from the ground. e.g., If the LiDAR is placed on the floor, the height of the sensor is 0.06 m. - Default: 0.07, Min: -100, Max: +100 Click the [OK] button to apply the settings. Click the [Cancel] button to cancel the settings.
❸	LiDAR Orientation	Set the LiDAR orientation for the data to be displayed on the viewer screen. Use the arrow key or keypad to adjust the settings. • RX (Roll): Clockwise rotation about the X-axis (in degrees). - Default: 0.00, Min: -360.00, Max: +360.00 • RY (Pitch): Clockwise rotation about the Y-axis (in degrees). - Default: 0.00, Min: -360.00, Max: +360.00 • RZ (Yaw): Clockwise rotation about the Z-axis (in degrees). This value can be stored in the LiDAR. (Initial RZ value: 0) - Default: 0.00, Min: -360.00, Max: +360.00 Click the [OK] button to apply the settings. Click the [Cancel] button to cancel the settings.
❹	LiDAR Mode	Supports 4 scanning modes optimized for autonomous mobile robots (AMRs). • Mode 1: General Mode • Mode 2: Upward Mode • Mode 3: Downward Mode • Mode 4: Narrow Mode The LiDAR's FoV values, horizontal scanning frequency, and vertical scanning frequency are preset in 4 scanning modes. Click the drop-down button to select the desired scanning mode. Please refer to "7.2 Performance" page 31. *FoV (Field of View) : LiDAR determines the distance to an object by targeting the object with a laser and measuring the time for the reflected light to return to the receiver. FoV is the horizontal/vertical angle covered by the LiDAR sensor.
❺	LiDAR Data Limit	Set the range of points to be displayed on the LiDAR viewer. Use the arrow key or keypad to adjust the settings. • Min/Max Range (m) - Min: 0, Max: +100 • Min/Max X Data, Min/Max Y Data, Min/Max Z Data (m) - Min: -100, Max: +100 Click the [OK] button to apply the settings. Click the [Cancel] button to cancel the settings.
❻	LiDAR Data Filter	Removes noise point data displayed on the LiDAR viewer. Higher filter values remove more data. - Default: 30, Min: 0, Max: 40

5.8 Visualization Settings

You can set the point cloud data to be displayed on the LiDAR viewer.

Select the following tab to open a new window where you can make detailed settings:



Item		Description
❶	LiDAR Data Visualization	• Point cloud Color Mode: Set the color mode for the point cloud. **Note:** This feature helps users easily recognize the surrounding situation using changes in color and vertical data. Select and use the color settings that suit your needs. - Z-axis Coloring: Default option. Displays the reference axis (Z-axis) and color change. Colors include red, orange, yellow, green, blue, indigo, and violet. The smaller the Z value, the closer to red. The larger the Z value, the closer to violet. - Intensity Coloring: The color displayed depends on the intensity of the reflected laser. Colors include red, orange, yellow, green, blue, indigo, and violet. The greater the intensity, the closer to red. The smaller the intensity, the closer to violet. • Point cloud Size: Adjust the size of the point cloud. - Default: 1, Min: 1.00, Max: 10.00 • Point cloud Stack (sec): Accumulate the point cloud data for the set time and visualize it in real time. The greater the stack value, the higher the resolution of the displayed data. - Default: 10, Min: 0.05, Max: 100

5.9 View Settings

You can make settings for the viewer screen.

5.9.1 Orthographic Projection/Perspective Projection settings

Select the projection mode from the menu tab.

Item		Description
1	Orthographic Projection	Displays the 3D environment without a sense of depth. Used to measure LiDAR performance.
2	Perspective Projection	Default option. Displays the 3D environment with a sense of depth. Provides a more realistic view.

5.9.2 Rotational View/Top View/Side View settings

Select the location and direction of the camera for the point cloud in the 3D coordinates. You can click on the mouse or scroll the screen to view the data.

Item		Description
1	Rotational View	Coordinates: (0, 0, 0). Rotational view about the Z-axis.
2	Top View	Coordinates: (0, 0, 10). View from the top.
3	Side View	Coordinates: (0, 10, 0). View from the side.

6. Maintenance and Troubleshooting

6.1 Cleaning and Maintenance

LIDAR requires periodic inspection and maintenance.

- Maintenance activity: Remove water and dust from the surface of LiDAR with a soft clean cloth.
  - Be careful not to cause damage (scratches or nicks) to the laser cover while performing maintenance.
- Interval: Every 3 months or as needed.

6.2 Troubleshooting

If you have any problems with your product, please call us at 032-550-2322 (in Korea) or +82 32 550 2322 (from overseas) or send an e-mail to sales@yujinrobot.com.

7. Product Specifications

7.1 Basic Specification

Model Name	YRL3V2-05	YRL3V2-10	YRL3V2-25
Detection Range	5 m (90% light remission)	10 m (90% light remission)	25 m (90% light remission)
Size	65 mm x 85 mm x 91.4 mm (2.55" x 3.34" x 3.59")		
Weight	410 g (0.90 lbs)		
Power Consumption	6 W		
Supply Voltage	DC 12V		
Light Source	Laser Diode		
Laser Class	Class 1, eye safe (IEC 60825-1:2014)		
Laser Wavelength	905 nm		

7.2 Performance

Scanning Mode	Mode 1 General scanning mode(Default)	Mode 2 Upward scanning mode	Mode 3 Downward scanning mode	Mode 4 Fast scanning mode
FoV: Horizontal x Vertical	Upper 360 ° x 55 ° (+40 °/-15 °), Lower 270 ° x 25 ° (-15 °/-40 °)	360 ° x 40 ° (+35 °/-5 °)	Upper 360 ° x 20 ° (+5 °/-15 °), Lower 270 ° x 20 ° (-15 °/-35 °)	360 ° x 20 ° (+10 °/-10 °)
Horizontal Scan Frequency	20 Hz			
Vertical Scan Frequency	15.5 Hz			10.7 Hz
Horizontal Angular Resolution	0.24°			
Vertical Angular Resolution	0.1°	0.05°		
Range Resolution	<10 mm			
Data Packet Rate	30,000			
Response Time	>50 ms per layer			
Accuracy	Within 15 m: ± 50 mm, 15 m or more: ± 100 mm			

7.3 Interface

Communication Interface	100 Mbps Ethernet
Optical Indicators	1 x LED (Green: Available, Red: Error)
Protocol	UDP packet
Configuration Software	YUJIN LiDAR Viewer
Output Data	Horizontal Angle, Vertical Angle, Range, Intensity, Cartesian coordinates (x, y, z)
Electrical Connection	1 x M8 for Power, 1 x M12 for Data
Materials	Top window cover (PC), Bottom cover (AL)
Enclosure Rating (IP)	IP67

7.4 Environmental Specifications

Electromagnetic Compatibility (EMC)	KN 61000-6-3, KN 61000-6-1 EN61000-6-1:2007, EN61000-6-3:2007/A1:2011 EN61000-4-2:2009, EN61000-4-3:2006 +A1:2008 +A2:2010 EN61000-4-4:2012, EN61000-4-6:2014, EN61000-4-8:2010
Vibration Resistance	EN60068-2-6:2007 (10 to 55Hz, double amplitude 1.5mm each 2 hrs in X, Y and Z directions)
Impact Resistance	EN 60068-2-27:2008 : 908m/s2(100G) X, Y and Z directions each 3 times
Temperature Resistance	-10 ° ~ 50 °C
Operating Humidity	95 %
Storage Temperature	-20 ° ~ 70 °C
Storage Humidity	0 ~ 85 % RH
Ambient Light Immunity	LED light: 100,000 Lux
Certificate	KC, CE, RoHS

*Specifications and design are subject to change without any prior notice.
*Warning: When operating after storing the sensor at sub-zero temperatures, the sensor needs about 15 minutes to warm up after turning on the power.

8. Appendix

8.1 Appendix A. Driver Interface (API)

The API provided when the YRL3V2 driver is installed can be used for processing and collecting the scanned data.

8.1.1 Parameters

The descriptions of the values used by the API are as follows.

No.	Parameter Name	Default	Description
1	mIPAddrParam	192.168.1.250	IP address for creating the communication socket. LiDAR address.
2	mPortNumParam	1234	Port number for creating the communication socket
3	mMinZParam	0	Z-axis lower limit for processing output data (Unit: m)
4	mMaxZParam	5	Z-axis upper limit for processing output data (Unit: m)
5	mMinYParam	-35	Y-axis lower limit for processing output data (Unit: m)
6	mMaxYParam	35	Y-axis upper limit for processing output data (Unit: m)
7	mMinXParam	-35	X-axis lower limit for processing output data (Unit: m)
8	mMaxXParam	35	X-axis upper limit for processing output data (Unit: m)
9	mMinRangeParam	0	Data range lower limit for processing output data (Unit: m)
10	mMaxRangeParam	35	Data range upper limit for processing output data (Unit: m)
11	mExtrinsicTransformMatParam	1 0 0 0 0 1 0 0 0 0 1 0.07	Transform Matrix for processing output data
12	mSensorCoordX	0	LiDAR X coordinate for processing output data (Unit: m)
13	mSensorCoordY	0	LiDAR Y coordinate for processing output data (Unit: m)
14	mSensorCoordZ	0.07	LiDAR Z coordinate for processing output data (= LiDAR height. The default height when the product is placed on the floor: 0.07 m) (Unit: m)
15	mSensorCoordRX	0	LiDAR roll rotation for processing output data (Unit: degree)
16	mSensorCoordRY	0	LiDAR pitch rotation for processing output data (Unit: degree)
17	mSensorCoordRZ	0	LiDAR yaw rotation for processing output data (Unit: degree)

No.	Parameter Name	Default	Description
18	mMaxVertiAngleParam	pi*2/9	Vertical angle upper limit for processing output data (Unit: radian)
19	mMinVertiAngleParam	–pi*2/9	Vertical angle lower limit for processing output data (Unit: radian)
20	mMaxHoriAngleParam	pi	Horizontal angle upper limit for processing output data (Unit: radian)
21	mMinHoriAngleParam	-pi	Horizontal angle lower limit for processing output data (Unit: radian)
22	mNoiseFilterLevelParam	30	Filter level for processing output data (Unit: degree) Removes data that doesn't look like that for a real object Range: 0–45 (degree)

8.1.2 Parameter Input/Output

These features are used to import or change values through the API.

No.	Parameter Name	Unit	Description
1	void SetIPAddrParam (const std::string &ipAddr)	N/A	Set the IP address for creating the communication socket
	string GetIPAddrParam()	N/A	Get the IP address for creating the communication socket
2	void SetPortNumParam (const unsigned short int portNum)	N/A	Set the port number for creating the communication socket
	unsigned short int GetPortNumParam ()	N/A	Get the port number for creating the communication socket
3	void SetMinZParam (const float z_min)	m	Set the Z-axis lower limit for processing output data
	float GetMinZParam ()	m	Get the Z-axis lower limit for processing output data
4	void SetMaxZParam (const float z_max)	m	Set the Z-axis upper limit for processing output data
	float GetMaxZParam ()	m	Get the Z-axis upper limit for processing output data
5	void SetMinYParam (const float y_min)	m	Set the Y-axis lower limit for processing output data
	float GetMinYParam ()	m	Get the Y-axis lower limit for processing output data
6	void SetMaxYParam (const float y_max)	m	Set the Y-axis upper limit for processing output data
	float GetMaxYParam ()	m	Get the Y-axis upper limit for processing output data
7	void SetMinXParam (const float x_min)	m	Set the X-axis lower limit for processing output data
	float GetMinXParam ()	m	Get the X-axis lower limit for processing output data
8	void SetMaxXParam (const float x_max)	m	Set the X-axis upper limit for processing output data
	float GetMaxXParam ()	m	Get the X-axis upper limit for processing output data
9	void SetMinRangeParam (const float range_min)	m	Set the data range lower limit for processing output data
	float GetMinRangeParam ()	m	Get the data range lower limit for processing output data
10	void SetMaxRangeParam (const float range_max)	m	Set the data range upper limit for processing output data
	float GetMaxRangeParam ()	m	Get the data range upper limit for processing output data

No.	Parameter Name	Unit	Description
11	void SetExtrinsicTransformMatParam (const float x, const float y, const float z, const float rx, const float ry, const float rz)	m, degree	Set the Transform Matrix for processing output data
	void GetExtrinsicTransformParam (float &x, float &y, float &z, float &rx, float &ry, float &rz)	m, degree	Get the Transform Matrix for processing output data
12	void SetMaxVertiAngleParam (const float verti_angle_max)	radian	Set the vertical angle upper limit for processing output data
	float GetMaxVertiAngleParam ()	radian	Get the vertical angle upper limit for processing output data
13	void SetMinVertiAngleParam (const float verti_angle_min)	radian	Set the vertical angle lower limit for processing output data
	float GetMinVertiAngleParam ()	radian	Get the vertical angle lower limit for processing output data
14	void SetMaxHoriAngleParam (const float hori_angle_max)	radian	Set the horizontal angle upper limit for processing output data
	float GetMaxHoriAngleParam ()	radian	Get the horizontal angle upper limit for processing output data
15	void SetMinHoriAngleParam (const float hori_angle_min)	radian	Set the horizontal angle lower limit for processing output data
	float GetMinHoriAngleParam ()	radian	Get the horizontal angle lower limit for processing output data
16	void SetNoiseFilterLevelParam (const float filter_level)	degree	Set the filter level for processing output data
	float GetNoiseFilterLevelParam ()	degree	Get the filter level for processing output data

8.1.3 Data Output

These features are used to check the status and data of YRL3V2 through the API.

No.	Output Function Name	Explanation
1	int GetCartesianOutputsWithIntensity(double _SystemTime, std::vector <float>& _IntensityArray, std::vector <float>& _XCoordArray, std::vector <float>& _YCoordArray, std::vector <float>& _ZCoordArray);	Get the reflection intensity measured and 3D orthogonal coordinates
2	int GetSphericalOutputsWithIntensity(double _SystemTime, std::vector <float>& _IntensityArray, std::vector <float>& _RangeArray, std::vector <float>& _HorizontalAngleArray, std::vector <float>& _VerticalAngleArray);	Get the reflection intensity measured and 3D spherical coordinates
3	void GetDPR(float &dpr)	Get the data packet rate

No.	Output Function Parameter Name	Unit	Description
1	_SystemTime	sec	timestamp
2	_IntensityArray	N/A	Intensity
3	_RangeArray	m	Range
4	_HorizontalAngleArray	radian	Horizontal angle
5	_VerticalAngleArray	radian	Vertical angle
6	_XCoordArray	m	X coordinates
7	_YCoordArray	m	Y coordinates
8	_ZCoordArray	m	Z coordinates

8.2 Appendix B. Problems and Solutions

Describes the problems and solutions that may occur while using the robot.

8.2.1 Error Code

Classification	Symptom	Solution	User Error Code
Error	Power Error	Contact Customer Service	A
Error	Horizontal Operation Error	Contact Customer Service	B
Error	Vertical Operation Error	Contact Customer Service	C
Error	Sensor Communication Error	Contact Customer Service	D
Warning	Outside Normal Operating Temperature	Change sensor’s ambient temperature to appropriate ambient temperature	E
Warning	User Communication Error	Reset	F

8.2.2 How to Deal with Firmware Update Failures

Symptom	Error Message	Solution
LiDAR reset failed	'LiDAR reset failed. Save again.'	Perform the 'Firmware Update Procedure' below
Failed to read the firmware file	'Cannot open the file.'	Download the firmware file to be updated and run it again
Failed to download the firmware file to LiDAR	'No response from lidar. Save again.' or 'Invalid response from LiDAR. Save again.'	Perform the 'Firmware Update Procedure' below

<Firmware Update Procedure>

1. Disconnect the power to the LiDAR to turn it off.
2. Exit the LiDAR Viewer (completely exit the FW update window) and then re-run the LiDAR Viewer.
3. Update the firmware by clicking [Help] - [FW Update] on the upper toolbar of the LiDAR Viewer.
4. Select files that failed to update.
5. Connect the power to the LiDAR to turn it on. Click the [Save] button as soon as the LiDAR is powered on.
6. Check that the firmware download is complete.

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