Edit on GitHub

23. Appendix #LDS-01

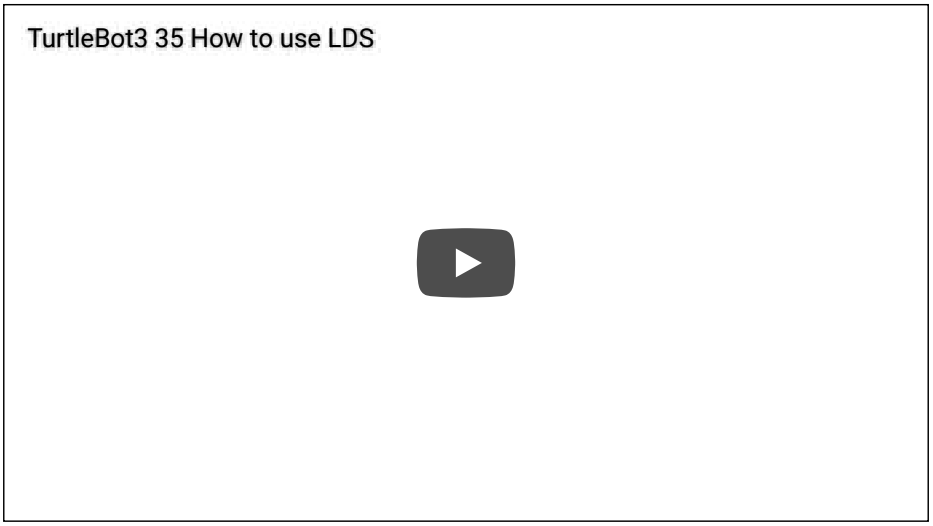
23. 1. Overview

- 360 Laser Distance Sensor LDS-01 is a 2D laser scanner capable of sensing 360 degrees that collects a set of data around the robot to use for SLAM (Simultaneous Localization and Mapping) and Navigation.
- The LDS-01 is used for TurtleBot3 Burger, Waffle and Waffle Pi models.
- It supports USB interface(USB2LDS) and is easy to install on a PC.
- It supports UART interface for embedded baord.

23. 2. Introduction Video

[Video #01] How to use the LDS-01

- Contents
  1. Specification
  2. ROS
  3. Windows, Linux, macOS
  4. Embedded Board
  5. SLAM and Navigation
  6. Self-Parking
  7. 3D Sensing
  8. for Makers



[Video #02] Laser Distance Sensor (LDS) Example.

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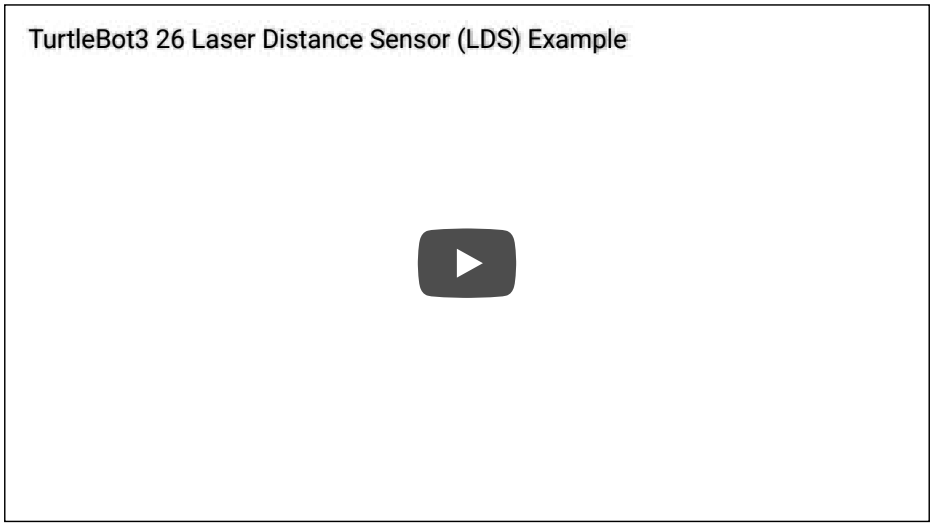
TurtleBot3



[Video #03] ROS Hector SLAM demo using only a 360 Laser Distance Sensor LDS-01 made by HLDS (Hitachi-LG Data Storage).

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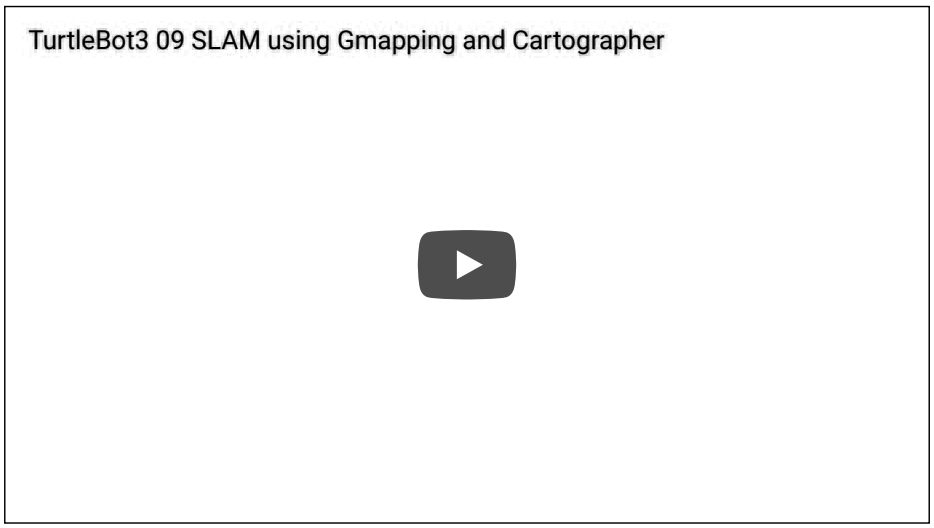
[Video #04] ROS Gmapping and Cartographer SLAM demo using TurtleBot3 and 360 Laser Distance Sensor LDS-01.



23. 3. Specifications

23. 3. 1. General Specifications

Items	Specifications

TurtleBot3

Items	Specifications
Operating supply voltage	5V DC ±5%
Light source	Semiconductor Laser Diode(λ=785nm)
LASER safety	IEC60825-1 Class 1
Current consumption	400mA or less (Rush current 1A)
Detection distance	120mm ~ 3,500mm
Interface	3.3V USART (230,400 bps) 42bytes per 6 degrees, Full Duplex option
Ambient Light Resistance	10,000 lux or less
Sampling Rate	1.8kHz
Dimensions	69.5(W) X 95.5(D) X 39.5(H)mm
Mass	Under 125g

23. 3. 2. Measurement Performance Specifications

Items	Specifications
Distance Range	120 ~ 3,500mm
Distance Accuracy (120mm ~ 499mm)	±15mm
Distance Accuracy(500mm ~ 3,500mm)	±5.0%
Distance Precision(120mm ~ 499mm)	±10mm
Distance Precision(500mm ~ 3,500mm)	±3.5%
Scan Rate	300±10 rpm
Angular Range	360°
Angular Resolution	1°

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23. 4. Detail Specification Document

The following link contains information about basic performance, measurement performance, mechanism layout, optical path, data information, pin description and commands.

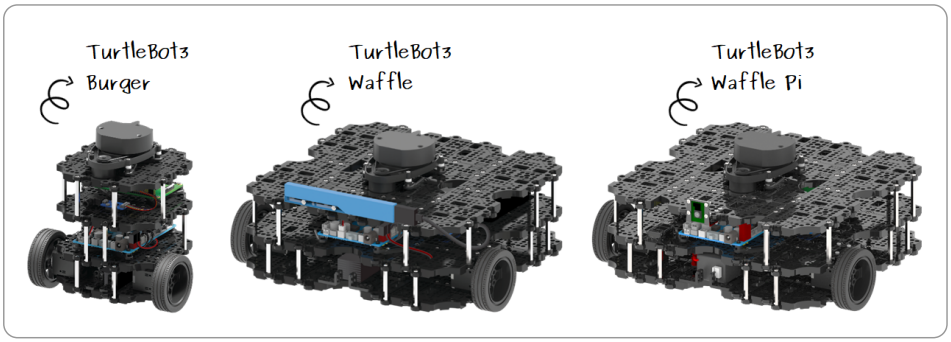
Here is the detail specification document : PDF

> Note The 360 Laser Distance Sensor LDS-01 for TurtleBot3 uses molex 51021-0800 and 53048-0810 instead of the basic housing and connector.

- [for LDS] Molex 51021-0800
- [for USB2LDS] Molex 53048-0810

23. 5. LDS for TurtleBot3

The LDS-01 is used for TurtleBot3 Burger, Waffle and Waffle Pi models.



23. 6. User Guide (for ROS)

TurtleBot3

We are offering ROS package for LSD. The hls_lfcd_lds_driver package provides a driver for "HLS(Hitachi-LG Sensor) LFCD LDS(Laser Distance Sensor)".

> Note Due to firmware update (after buy it on Oct. 2017), the sensor is running directly when power in on.

23. 6. 1. Installation

```
$ sudo apt-get install ros-kinetic-hls-lfcd-lds-driver
```

23. 6. 2. Set Permission for LDS-01

```
$ sudo chmod a+rw /dev/ttyUSB0
```

23. 6. 3. Run hlds_laser_publisher Node

```
$ roslaunch hls_lfcd_lds_driver hlds_laser.launch
```

23. 6. 4. Run hlds_laser_publisher Node with RViz

```
$ roslaunch hls_lfcd_lds_driver view_hlds_laser.launch
```

23. 7. User Guide (for Driver)

- In addition to ROS, the LDS-01 supports Windows, Linux, and MacOS development environments for general purposes.
- The software requirement is:
  - GCC (for Linux and macOS), MinGW (for Windows)
  - Boost library (Lib for boost system, tested on v1.66.0)

23. 7. 1. Download

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- Download the LDS-01's driver

```
$ git clone https://github.com/ROBOTIS-GIT/hls_lfcd_lds_driver.git
```

or you can download directly on web browser at github repository below:

https://github.com/ROBOTIS-GIT/hls_lfcd_lds_driver

- Install dependent software and libraries for each development environment
  - GCC (for Linux and macOS), MinGW (for Windows)
  - Boost library

23. 7. 2. Build

```
$ cd hls_lfcd_lds_driver/applications/lds_driver/
$ make
```

The makefile used here is set for Linux. Windows and macOS should be changed according to their development environment.

23. 7. 3. Run

```
$ ./lds_driver
r[359]=0.438000,r[358]=0.385000,r[357]=0.379000,...
```

You can see the raw data in the terminal when you run the driver of LDS-01. Please check the source code for details.

23. 8. User Guide (for GUI)

TurtleBot3

- We provide a basic GUI tool for visually checking the data of the LDS-01.
- It supports Linux, Windows, and macOS.
- The software requirement is:
  - Qt Creator and Libs (tested on Qt Creator v4.5.0 and Qt Libs v5.10.0)
  - GCC (for Linux and macOS), MinGW (for Windows), This can be installed together while installing Qt.
  - Boost library (Lib for boost system, tested on v1.66.0)

23. 8. 1. Download

- Download the LDS-01's driver and GUI source code.

```
$ git clone https://github.com/ROBOTIS-GIT/hls_lfcd_lds_driver.git
```

or you can download directly on web browser at github repository below:

https://github.com/ROBOTIS-GIT/hls_lfcd_lds_driver

- Install dependent software and libraries for each development environment
  - Qt - Open Source Version
  - GCC (for Linux and macOS), MinGW (for Windows)
  - Boost library

23. 8. 2. Build

- Run the Qt Creator
- Open file (`Ctrl-O`) the lds_polar_graph.pro file (hls_lfcd_lds_driver/applications/lds_polar_graph/lds_polar_graph.pro)
- Change the input your portname of source code
- Build all (`Ctrl-Shift-B`)

23. 8. 3. Run

- Run the application (`Ctrl-R`)

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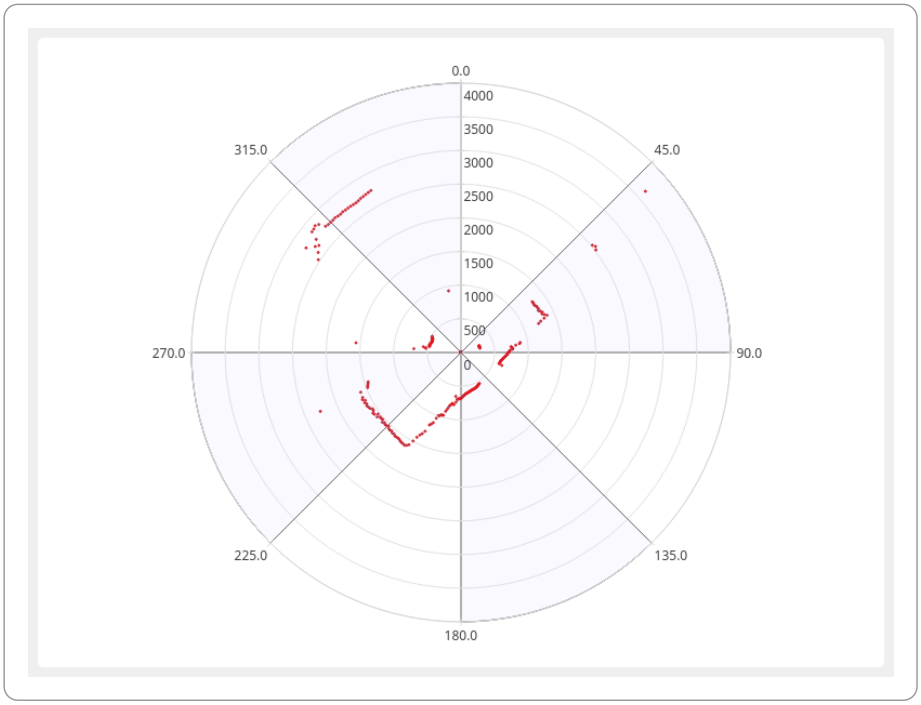

23. 9. User Guide (for Embedded Board)

- We provide a way to connect to an embedded board.
- The data of the LDS-01 can be used on the embedded board like OpenCR and Arduino, and it can be confirmed on the LCD as a graph like below.

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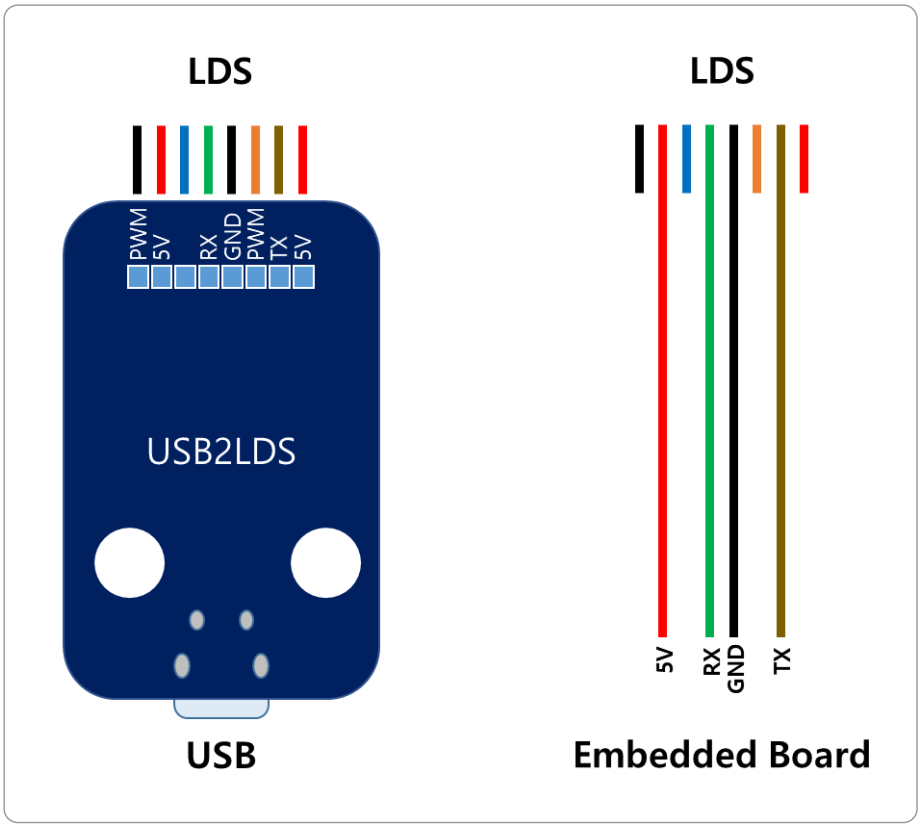
23. 9. 1. Preparations

- It does not provide a dedicated interface board, but you can connect it to the power and UART of the embedded board as shown below.



- OpenCR develops and downloads firmware through the Arduino IDE. Therefore, you must install the Arduino IDE in advance and install the OpenCR board package. Install through the following link document.
  - Install Arduino IDE and OpenCR

23. 9. 2. Download firmware and run

1. After connecting USB to PC, select Tools -> Board -> OpenCR Board in Arduino IDE.
2. Change Tools-> Port to the port to which the board is connected.
3. In the Arduino IDE Examples, select the firmware for LDS (File -> Examples -> OpenCR -> Etc -> LDS -> drawLDS).
4. Click on the icon in the Arduino IDE that displays the red circle to build and download the firmware. When the download is completed, the firmware is automatically executed.

TurtleBot3

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