Autonomous Delivery Robot v100

Operating manual

v2023_01_07

www.marvelmind.com

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Version changes

V2023_01_07

- Minor formatting updates

V2021_01_29

- Marvelmind Robot's SW update chapter described
- Launch robots in the custom map chapter improved
- New delivery option described (One box)
- New assembling detail – collapsible vertical beams

V2020_10_09

- Testing SW link added (Test launch chapter)

V2020_09_24

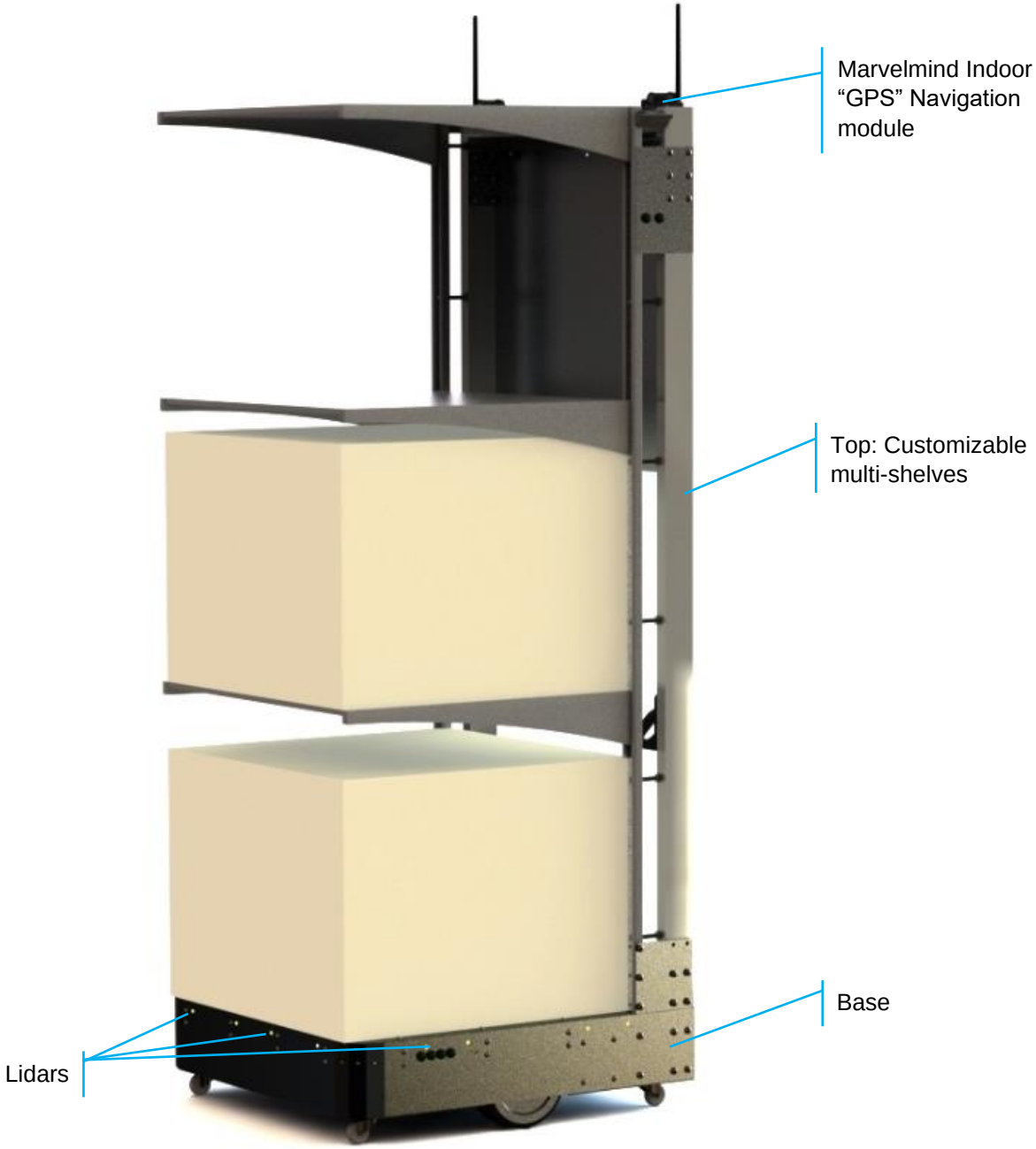
- Assembling the robot chapter described
- Testing launch chapter described
- What's in the box chapter improved

V2020_03_19

- Initial release

1. Executive summary

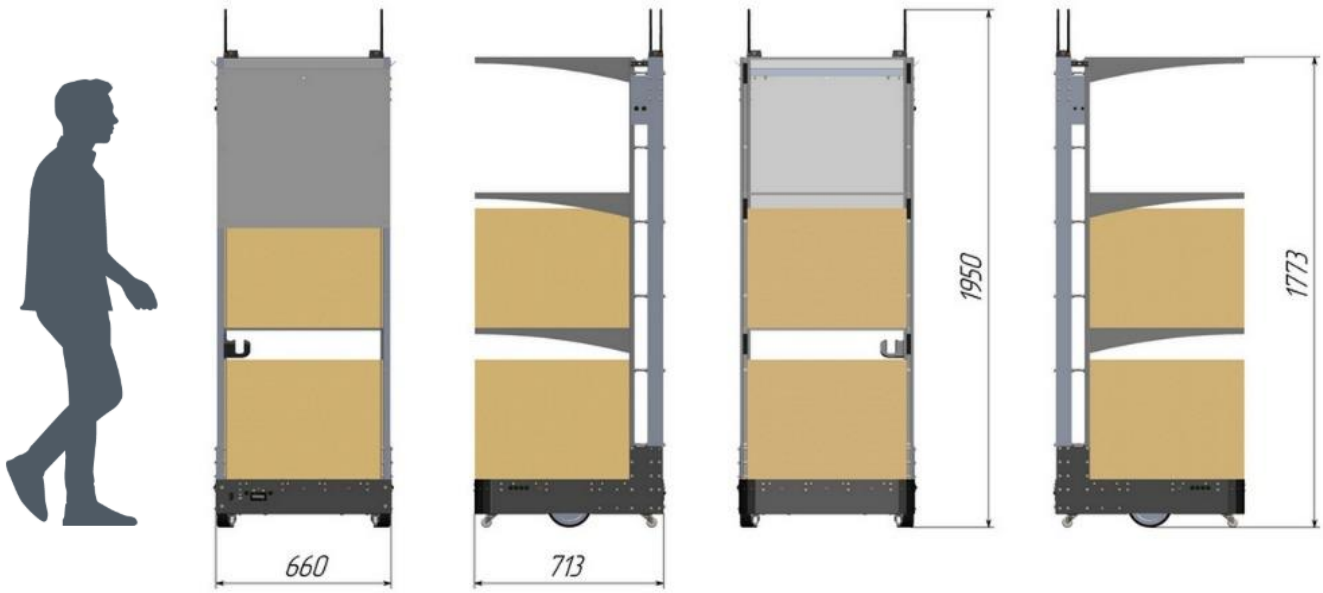
- Marvelmind Autonomous Delivery Robot v100 is a fully autonomous, economically viable, and safe delivery robot of small-size goods for warehouse, retail, and industrial applications
- Fully autonomous delivery between any points covered by Marvelmind Indoor "GPS"
- Up to 100kg payload
- Driving time of more than 16h on a single charge (not with the maximum load)
- Automatic obstacle avoidance and detection
- The delivery route can be reconfigured by 1 button click in 1 second
- Charging time is less than 4h. So, 2-shift work (16h) and 1 shift (8h) charging is supported
- Re-configurable capacity: 1 large box of up to 65x65x160cm to up to 8 boxes of 65x65x15cm - one shelf vs. multiple shelves



- Up to 250 robots per system
- Reconfigurable multi-shelves top
- It is also can be equipped with a QR scanner to eliminate errors in the delivery of goods

Key specs:

Parameter	Technical Specifications
Navigation	Marvelmind Indoor “GPS”
Top speed	<5 km/h
Payload	Up to 100 kg
Driving time	More than 16h on a single charge with 60+kg payload
Charging time	Less than 4h with a quick charger
Safety	Multiple 1D LIDARs for emergency stop and obstacle avoidance



1.1 Legend

The legend chapter contains small icons and signs to highlight some text's key points.

- Important
- For experienced users
- Demo or Help video
- Useful link

2. What's in the box

This chapter describes the contents of the box you receive buying the robot.

2.1 Parcel 1: Disassembled Autonomous delivery robot without batteries

Marvelmind Autonomous delivery robot comes in two parts: a box with a base and other parts and vertical beams or just in one box with collapsible beams (as shown in the pictures below)

How to assemble:

Help video: [Autonomous Delivery Robot v100 - assembly guide]

Option A: Box and vertical beams (Robots 01-05)

Option B: One box with collapsible beams inside (Robot 06 and newer)

2.2 Parcel 2: Marvelmind batteries and charger

The batteries and the charger come in the second parcel.

Use only Marvelmind-supplied chargers

3. System elements

3.1 Marvelmind Autonomous Delivery Robots

Robot v100 relies on Marvelmind Indoor “GPS” navigation system. The robot is equipped with additional sensors for detecting and avoiding obstacles. It has a long battery life and high load capacity.

- Fully autonomous delivery unit from Marvelmind Robotics
- Can be flexibly tuned with the number of levels and cargos space
- Shockproof housing
- Bright lights
- Noticeable sound
- Programmable hardware buttons
- **Base** with a multi-shelves **top** example:

3.1.1 Powertrain

Our team brought together capacious batteries, powerful motors, and smart controllers in one device, making it budget and very productive.

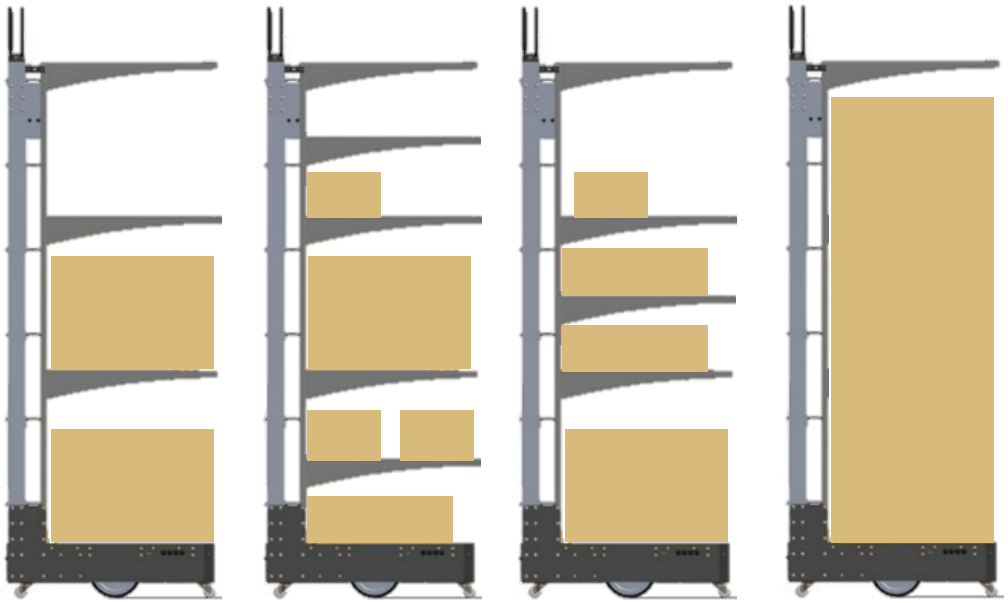
It gives the perfect balance between battery life and performance.

- Up to 16 hours driving with a full payload of 60kg
- Emergency stops with breaks
- Suspension with smart weight distribution
- Recuperation (future optional)

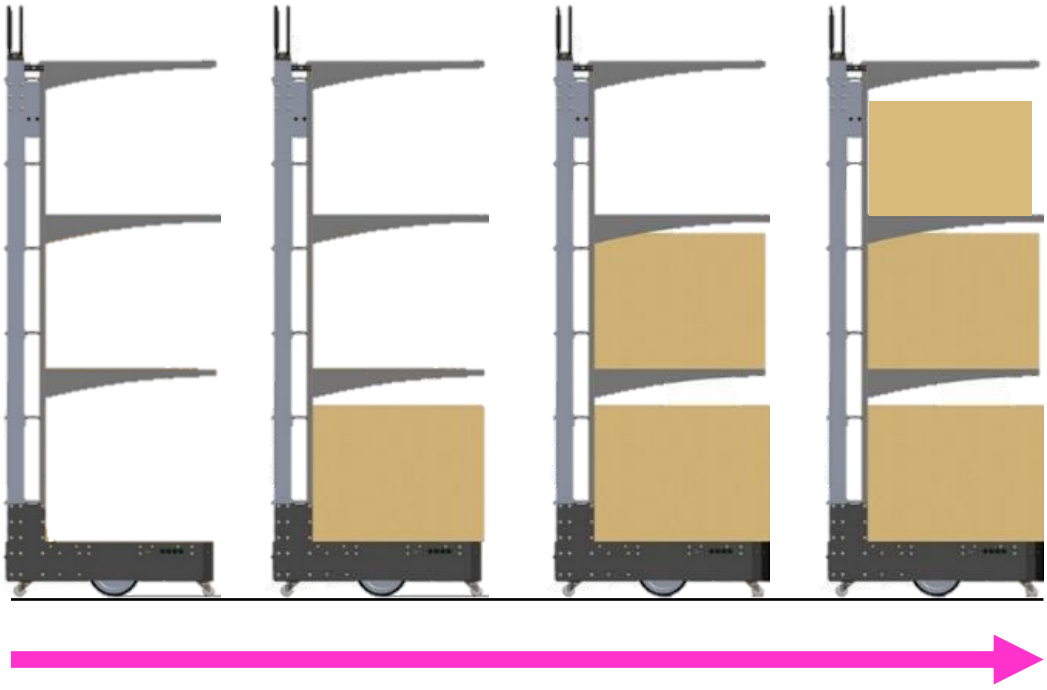
3.1.2 Multi-shelves top

Marvelmind delivery robot has a customizable multi-shelf top. That means you can configure it as you need; it comes with 3 shelves in its base configuration. If you need more shelves – write to info@marvelmind.com.

- You can configure it as you need and change configurations in a minute.
- Up to 1650mm useful space height



Loading cargo should be done starting from the bottom shelves and ending with the top ones for correct weight distribution and avoiding a rollover



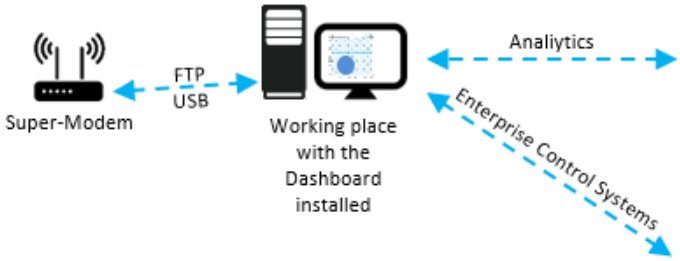
3.2 Marvelmind Indoor “GPS” system

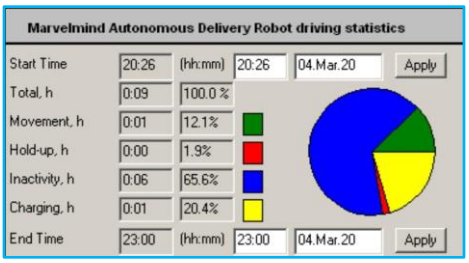
Marvelmind Indoor Navigation System is an off-the-shelf indoor navigation system that provides precise (±2cm) location data to autonomous robots, vehicles (AGV), and copters. It can also track moving objects via mobile beacons attached to them. Other applications include, for example, forklifts, virtual reality (VR) systems, helmets for construction workers or miners, etc.

The navigation system consists of a network of stationary ultrasonic beacons interconnected via a radio interface in a license-free band.

3.3 Control system

The control system allows you to configure the system, receive various data, and collect statistics. The center of the control system is Dashboard. It communicates with the modem, receives data from it, and can send data in various formats.





4. Robot’s controls and basic operations description

This chapter describes interactions with basic robot controls.

4.1 Controls

4.1.1 Bottom control panel

4.1.2 Top control panel

4.1.3 Break lever

Break lever (on each wheel)

Lower for long parking, storage, and charging. Lift before starting work.

4.2 Charging

Lower the brake levers and connect the cable to the charging port. Time until the full battery is 5 hours. Operating time at the full battery is 16 hours.

Use only Marvelmind-supplied chargers

5. Setting up the autonomous robots

The steps below describe setting up the system with Marvelmind Autonomous Robots.

Notice that Marvelmind Autonomous Robots relays upon Inverse Architecture.

5.1 Assembling the robot

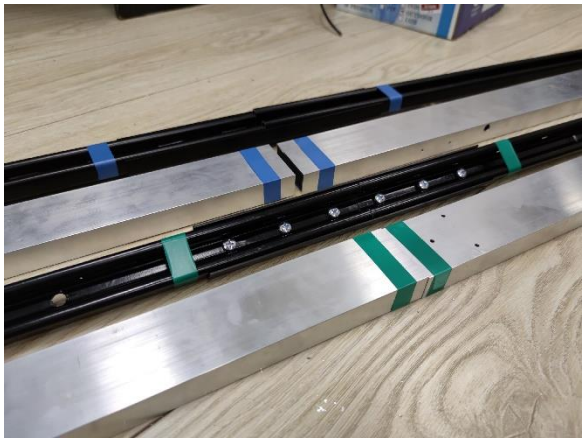
First thing after receiving and unpacking the robot – assembling.

How to assemble:

Help video: Autonomous Delivery Robot v100 - assembly guide

Please notice that if you have **Robot 06 or newer**, it will come with collapsible vertical beams. One of the steps to assemble – is to assemble vertical beams. Do not switch sides (R and L); they marked with colored duct tape to distinguish

Pay attention to the position of the wires when assembling vertical beams. If they do not reach the connectors, move the wires



If you have questions about assembling, you can write directly to info@marvelmind.com.

5.2 Test launch

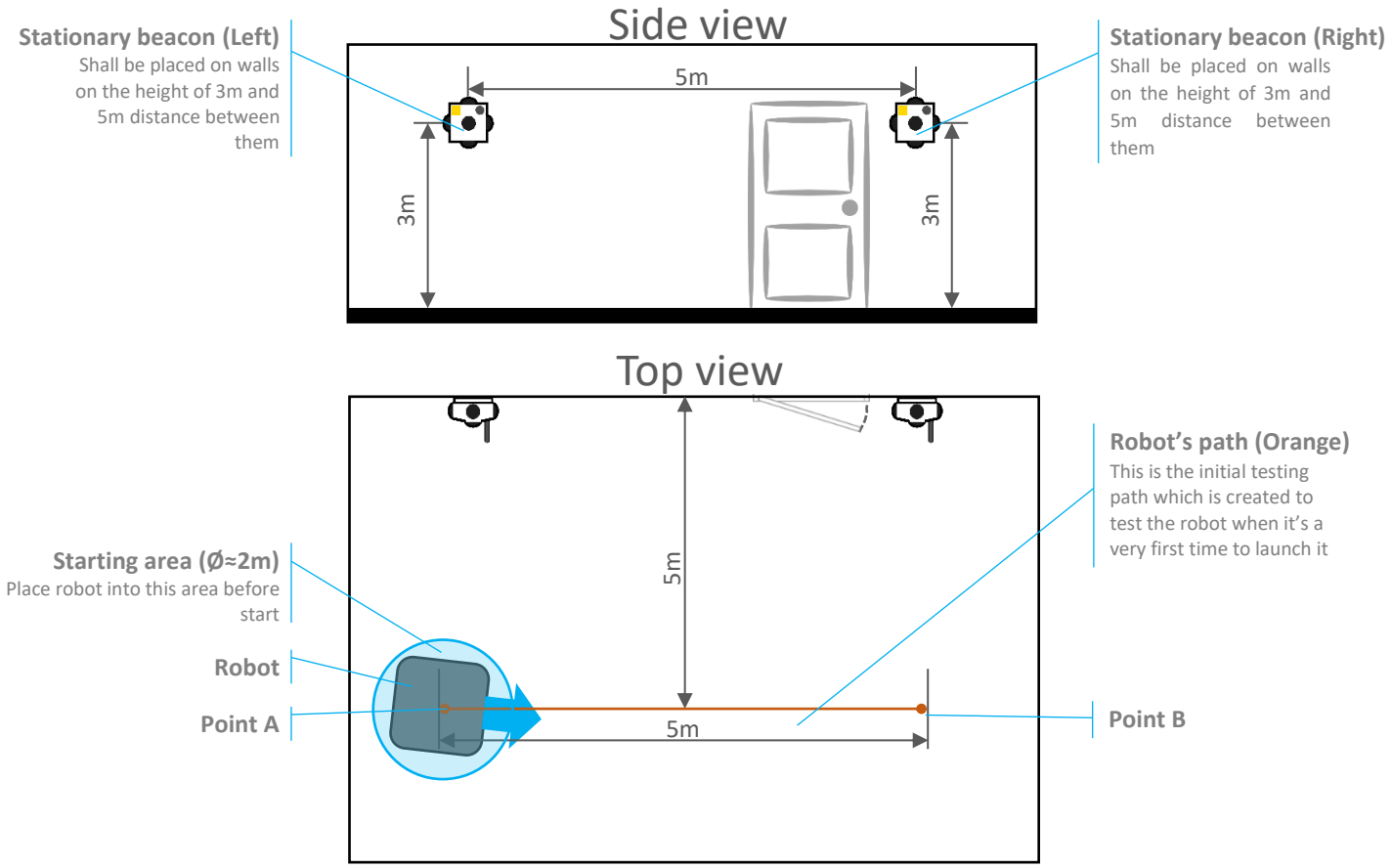
The test launch is a process of testing for Autonomous Delivery Robot v100. The test launch consists of 5 autonomous rides from point A to point B and back. If you are experienced enough, you can skip this part and go to the “Launching robots in custom maps” chapter.

When you received the Marvelmind Autonomous delivery robot, you also got 2 stationary Super-Beacons and Modem.

It is included to make it possible to do a test launch of the robot and ensure that the robot works correctly.

How to:

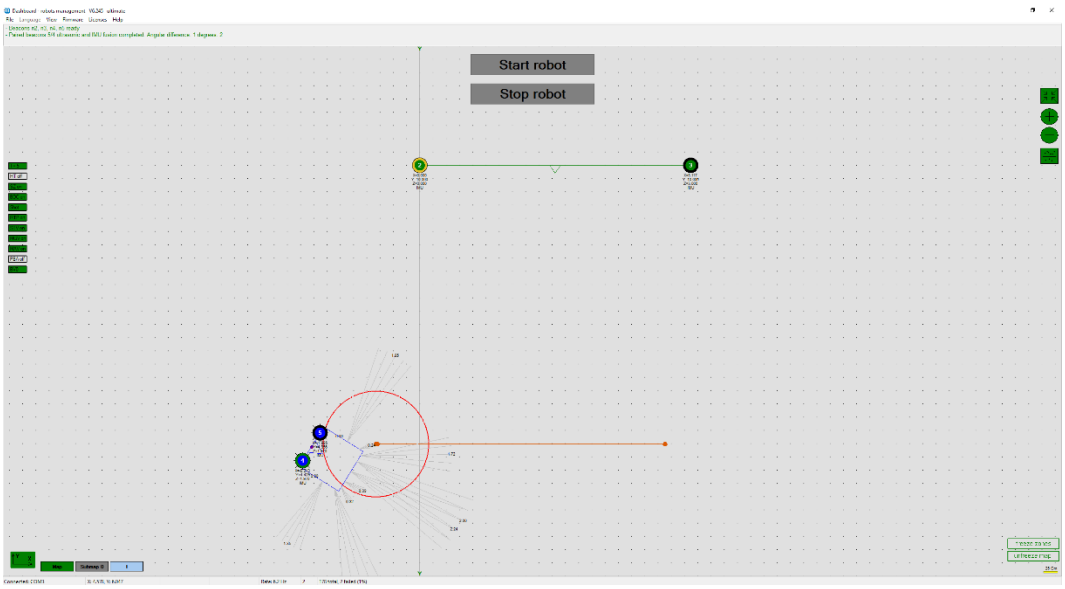
1) Place stationary beacons as described in the picture below

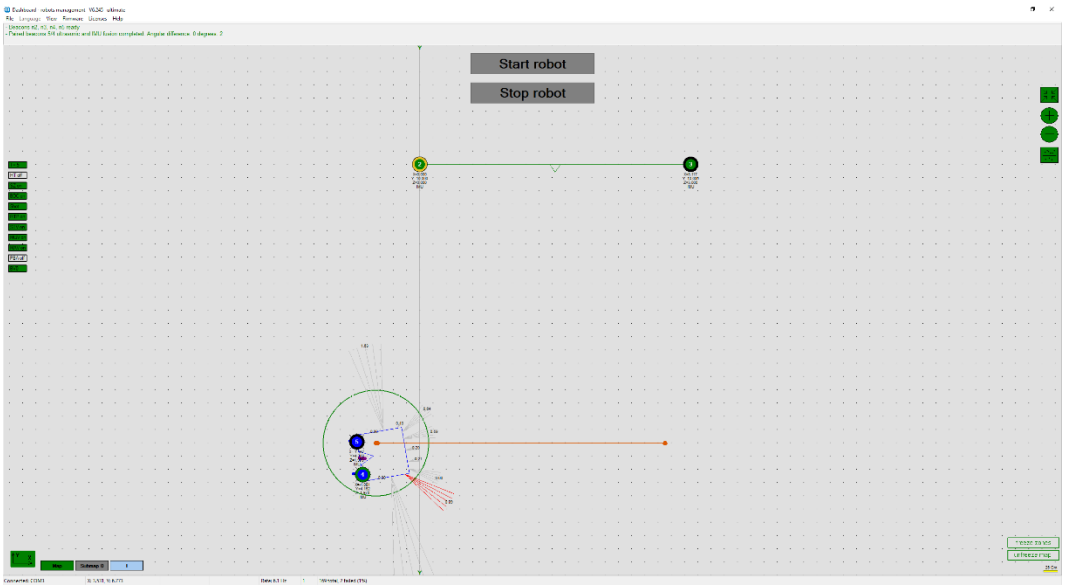


2) Install and launch [Marvelmind Robot Testing Dashboard SW]

3) Connect the Modem to your PC via USB

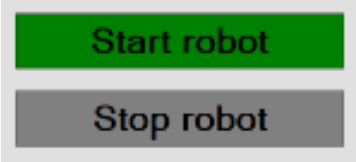
4) Place the robot into starting area (If placed correctly – the area should be colored green)



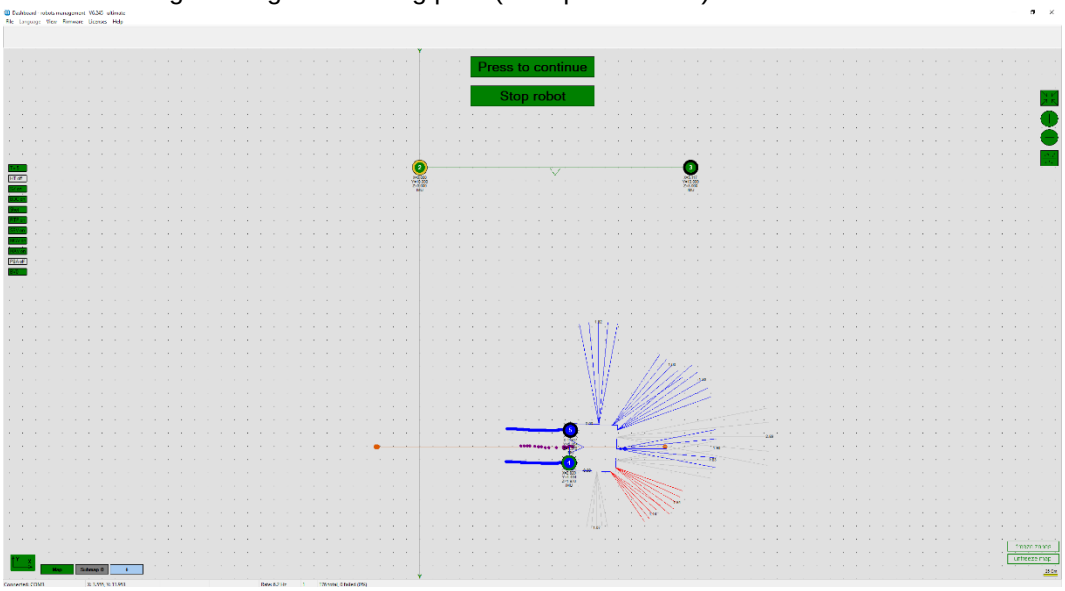


Make sure that you have enough space for the test launch.

5) When the robot is ready to go, and everything is automatically checked by the system, the “Start robot” button will color green



6) Press the “Start robot” button to launch the robot
The robot will go through the testing path (from point A to B) and back five times

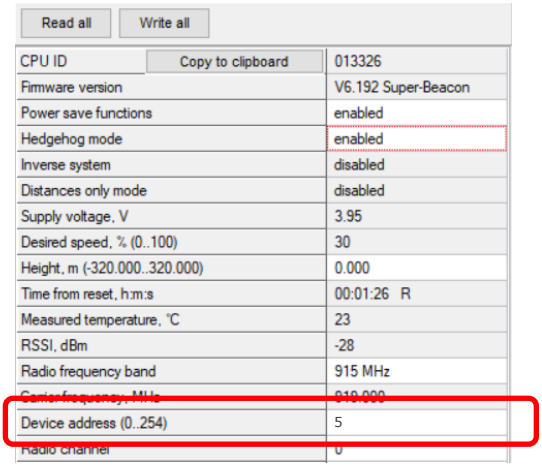


- To pause the movement – press the **“Press to pause”** button while moving
- To continue the movement – press the **“Press to continue”** button while stopped
- To stop the movement – press the **“Stop robot”** button

7) Test launch complete. Now, you can build your custom maps and launch the robot in it

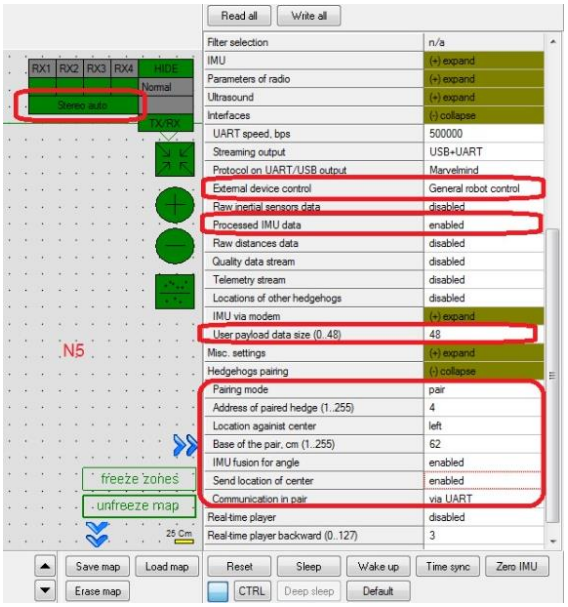
Robots from the first batch (Robot 02 and Robot 03) come with no pre-flashed SW for stationary Super-Beacons. The initial steps before the test launch:

1) Flash left-side Super-Beacon on the robot via Dashboard (Open Dashboard -> Firmware -> Upload firmware), press the Default button (In the right bottom corner), and apply the following settings:

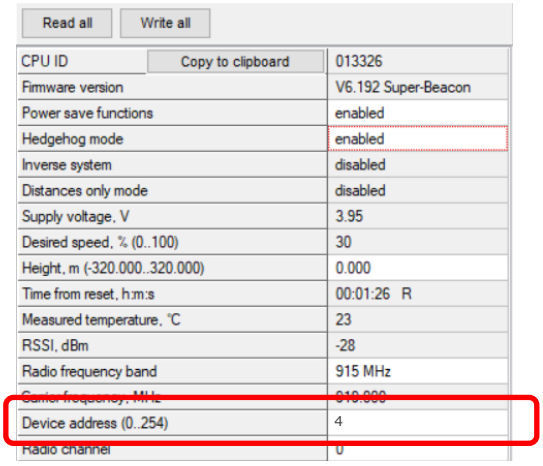


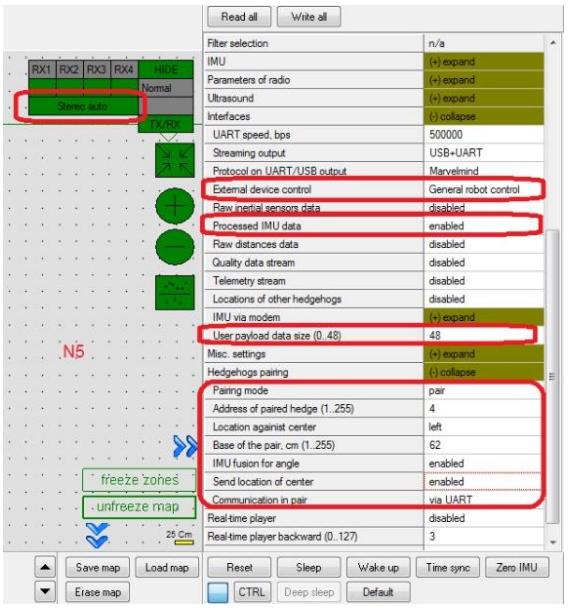
Read all | Write all

CPU ID	Copy to clipboard	013326
Firmware version		V6.192 Super-Beacon
Power save functions		enabled
Hedgehog mode		enabled
Inverse system		disabled
Distances only mode		disabled
Supply voltage, V		3.95
Desired speed, % (0..100)		30
Height, m (-320.000..320.000)		0.000
Time from reset, h:m:s		00:01:26 R
Measured temperature, °C		23
RSSI, dBm		-28
Radio frequency band		915 MHz
Carrier frequency, MHz		910.000
Device address (0..254)		5
Radio channel		0



2) Flash right side Super-Beacon on the robot via Dashboard (Open Dashboard -> Firmware -> Upload firmware), press the Default button (In the right bottom corner), and apply the following settings:





3) Flash the left-side Stationary beacon via Dashboard (Open Dashboard -> Firmware -> Upload firmware), press the Default button (In the right bottom corner), and apply the following settings:

RSSI, dBm	-28
Radio frequency band	915 MHz
Carrier frequency, MHz	919.000
Device address (0..254)	2
Radio channel	0

4) Flash the left-side Stationary beacon via Dashboard (Open Dashboard -> Firmware -> Upload firmware), press the Default button (In the right bottom corner), and apply the following settings:

RSSI, dBm	-28
Radio frequency band	915 MHz
Carrier frequency, MHz	919.000
Device address (0..254)	3
Radio channel	0

5) Flash Modem via Dashboard (Open Dashboard -> Firmware -> Upload firmware)

6) Now, continue with the instructions given at the beginning of the chapter

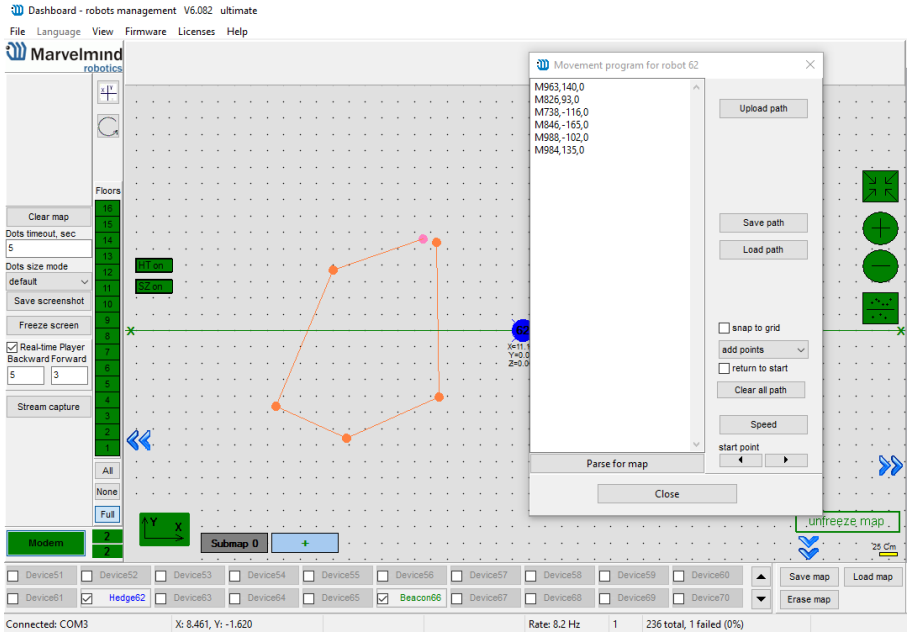
5.3 Launching robots in the custom map

When you make a test launch of the robot and succeed, you can build more complex maps and launch the robot in them.

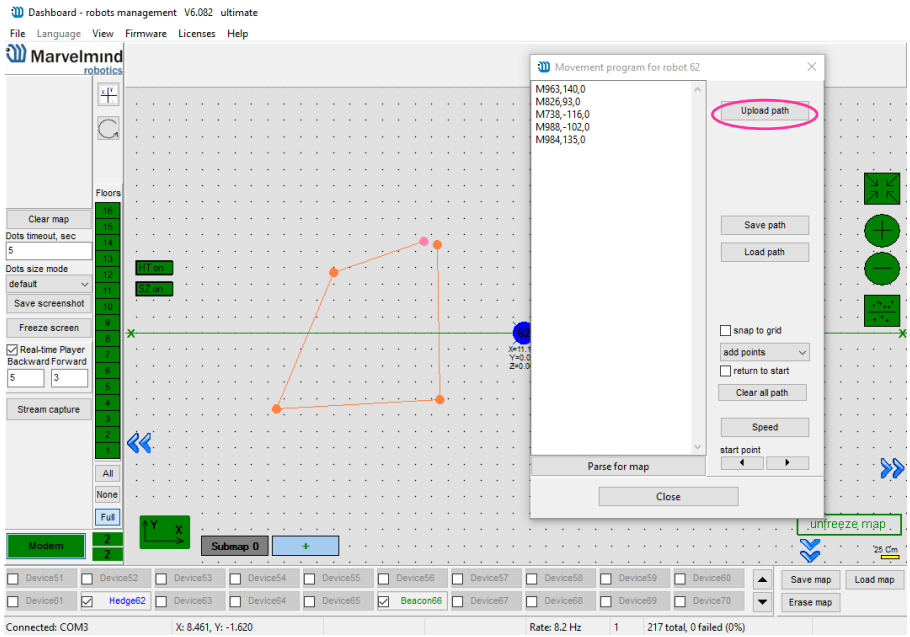
How to:

1) Set up the Marvelmind Indoor “GPS” system. It’s detailed described in the [Operating Manual – Sending Path to Robot chapter]

2) Configurate paths and start/end points (Use **Shift+Left mouse button click** to create a point, click on point – to remove)



3) Upload path to the robot (**Upload path** to send it to robot)



4) Reset the modem and connect it to the network.

5) Wait 30 seconds after connecting (keep the modem and antenna vertically).

6) Position the robot on the driving zone/path.

7) Press the blue button (go to point 2 - endpoint).

8) After arrival at the end point, press the black button (go to point 1 - start point)

5.4 Marvelmind Robot's SW update

This chapter describes the SW update steps for Marvelmind Robot.

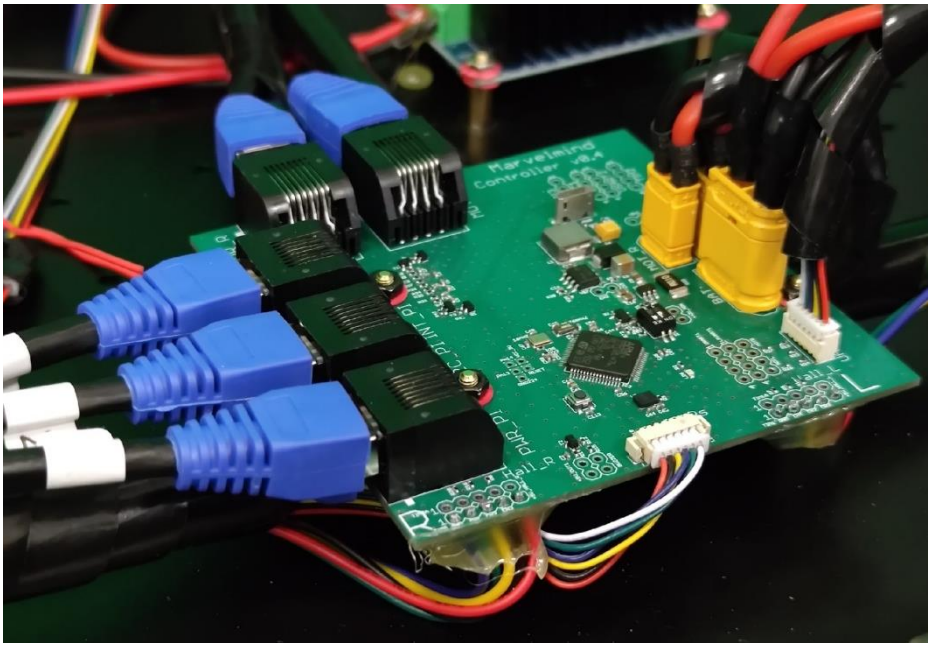
Please notice that you shouldn't do SW update just when you receive the robot. Do it if necessary

SW update for the Robot consists of 2 parts:

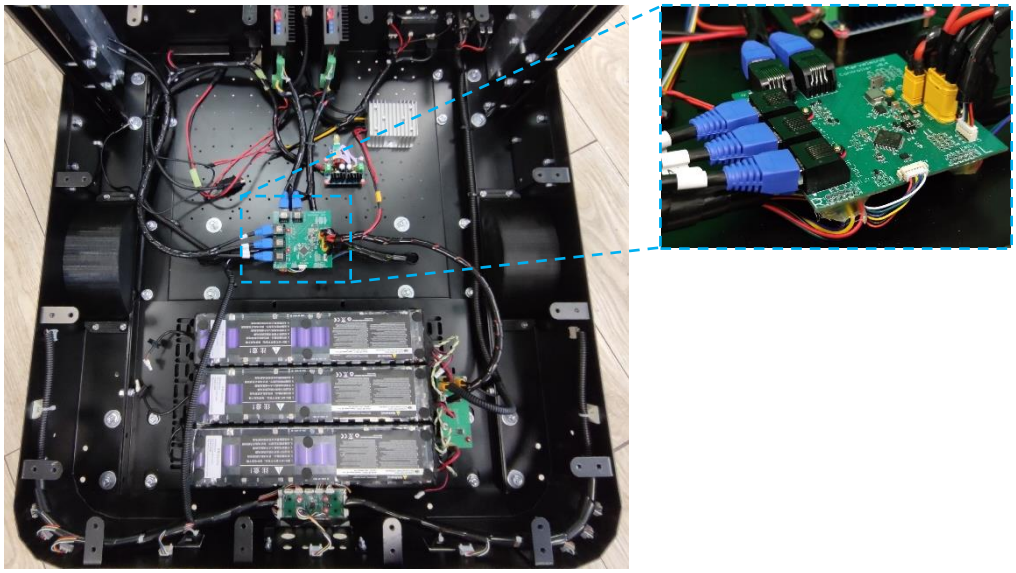
1) Encoder central board SW update
2) Raspberry board SW update

Follow the instructions below to do an SW update for the Robot

5.4.1 Encoder central board SW update

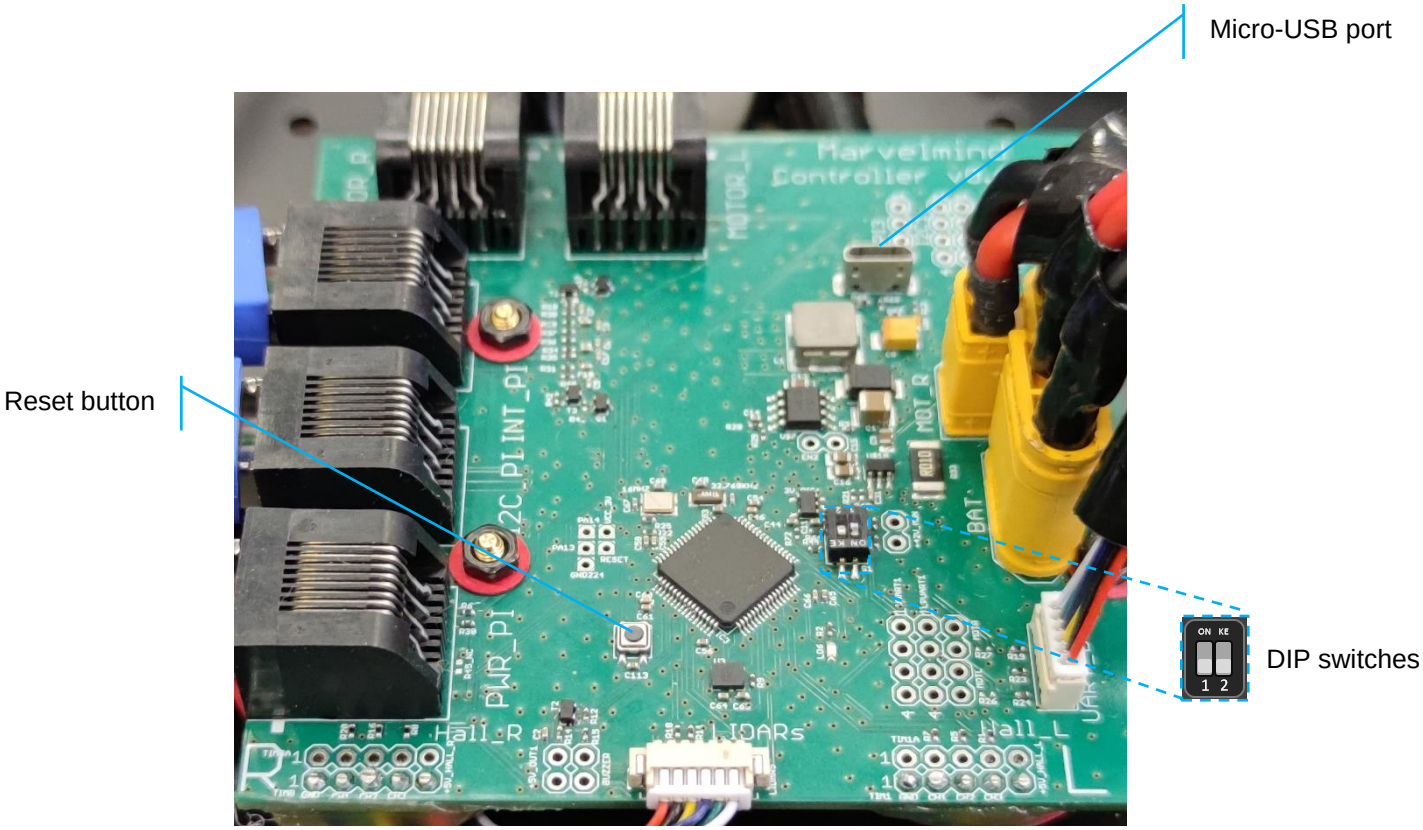


Encoder central board is placed in the Robot's base. To reach it, you should take off the top cover.



How to update:

The update for the encoder board has the same principle as the DFU update for any Marvelmind device.

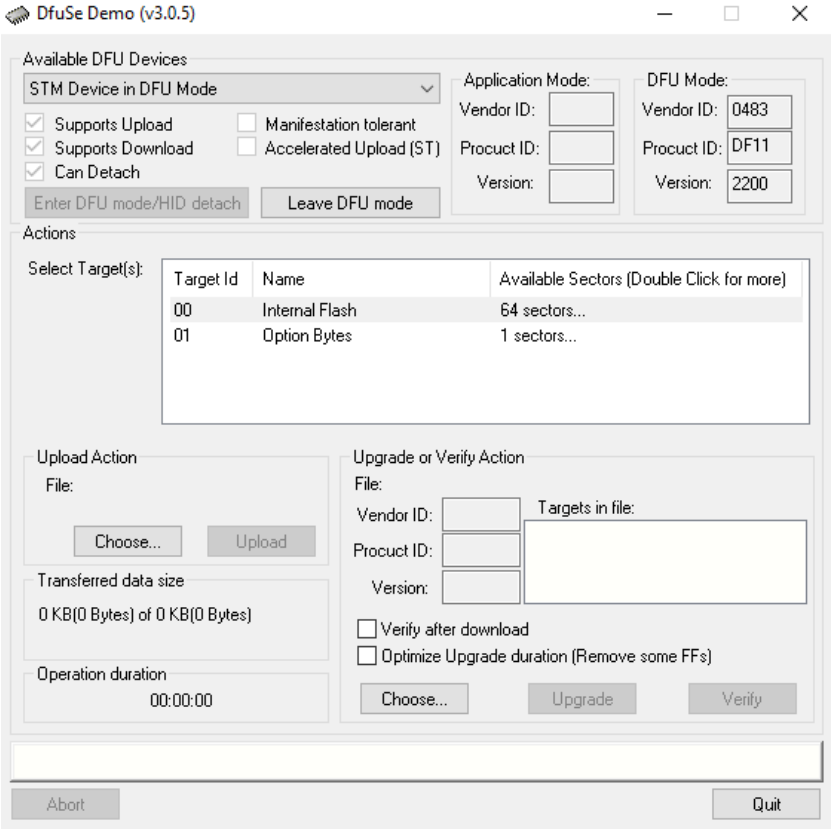


DFU Programming process:

1. Enter the device into DFU Mode:
   - For the Encoder board – switch DIP switches into positions shown on the picture (both up) and press the Reset button – the device will go into DFU mode

2. Connect the device via USB to your PC
3. Run DfuSe (Choose whichever works best for your Windows: DfuSe v3.0.4 or DfuSe v.3.0.5.
4. In the upper left corner of the DfuSe program, you will see a device connected in the DFU mode (If not – reenter the device into DFU mode).

5. Choose the DFU driver (file) for the Encoder board. (*SW folder/Encoder central board SW* - stm32l4_robot_encoder_cmu_api.dfu as name example)



6. Click the **UPGRADE** button.

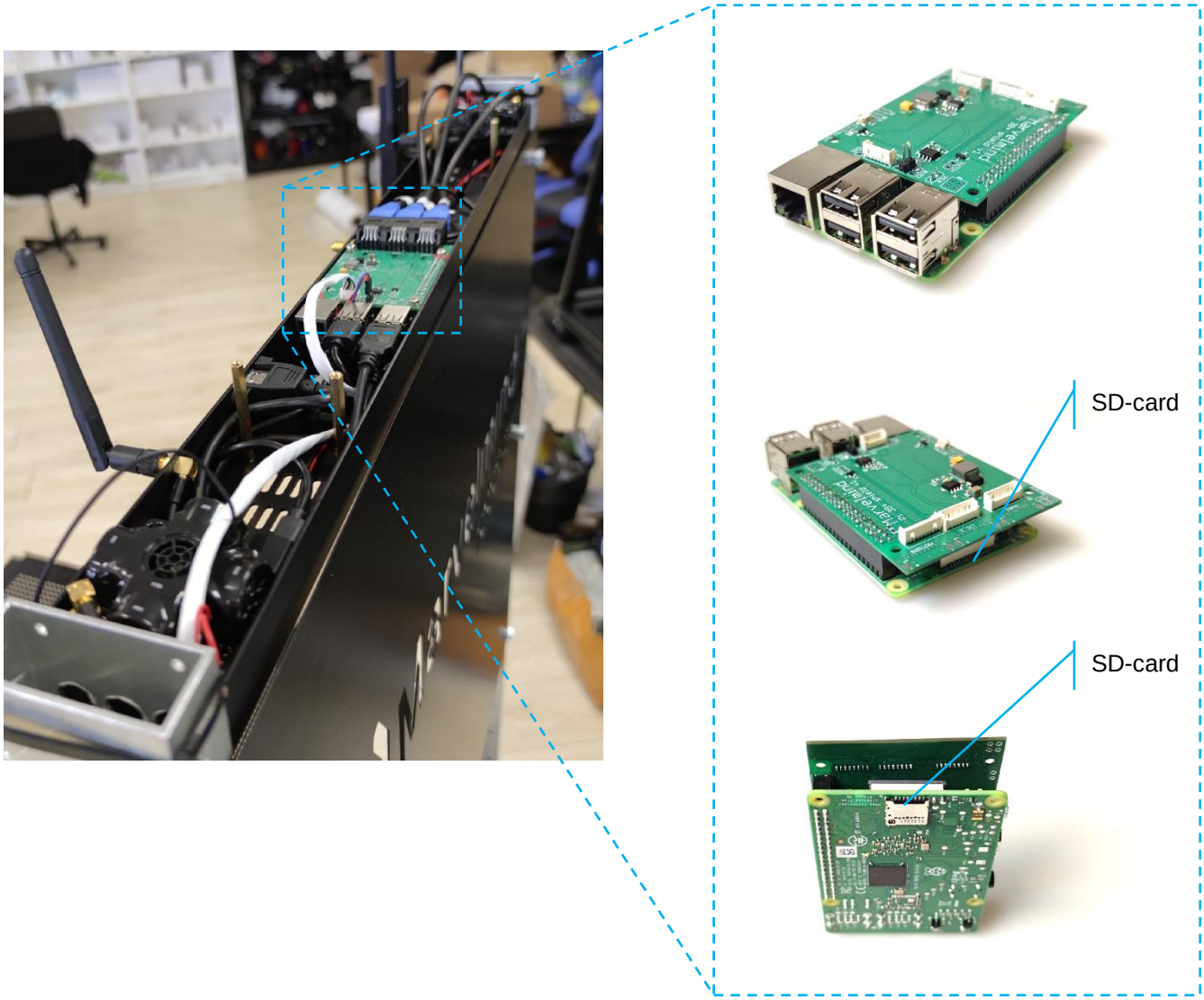
7. After a couple of seconds, the DFU will be uploaded to the beacon. Make sure it takes 1–3 seconds and does not happen instantly. If the DFU appears to upload immediately, check the "Choose" button you used or change the version of DfuSe SW you selected. Otherwise, the SW has not been uploaded correctly.

8. Exit from the DFU mode:
   - For the Encoder board – switch DIP switches into positions shown on the picture (Left – down, right – up) and press the Reset button – the device will exit from DFU mode

9. DFU programming is complete.

5.4.2 Robot's Raspberry board SW update

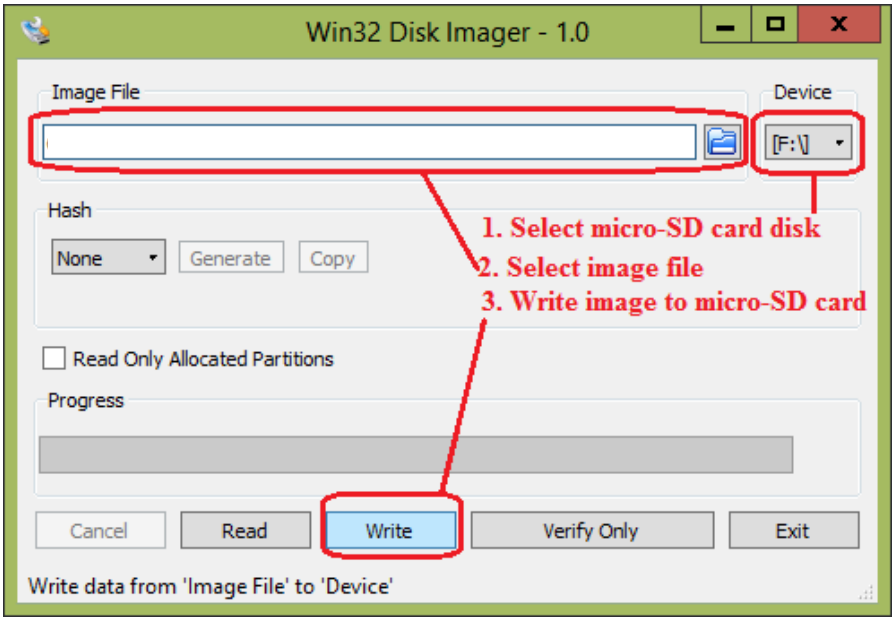
Robot's Raspberry board is situated in the top beam. To reach it – take off the cover.
SD card located on the board, from the downside.



How to update:

1. Follow the steps below to update Raspberry's SW.
2. Eject the micro-SD card (Robot should not be powered at this time)
3. Insert a micro-SD card into any MS Windows computer via a card reader
4. Download and unpack the archive with an image of updated software (included in the *SW folder/Robot's Raspberry SW or Download it separately*)
5. Install and run the Win32 disk imager program (supplied in the archive with the image)

6. Open the image file and write to the micro-SD card (see screenshot below)



7. Eject the micro-SD card from the computer and insert it back into Robot's Raspberry

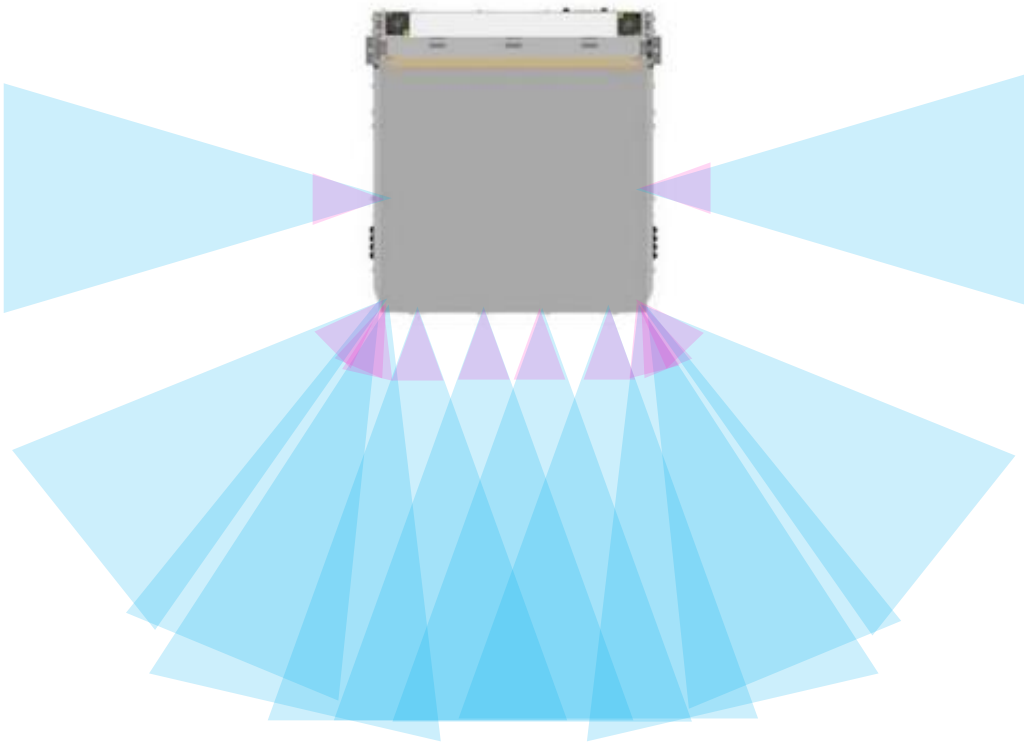
8. Robot's Raspberry board update is complete.

6. Robot’s functionality

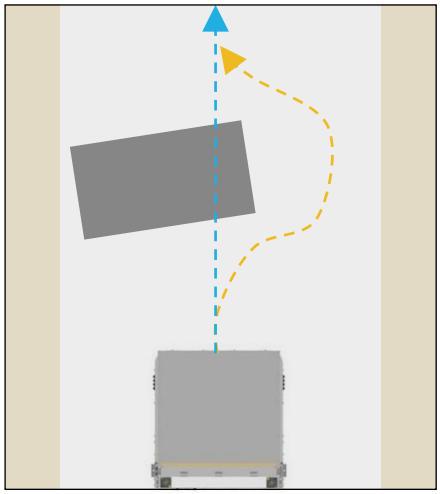
This chapter describes some key features of Marvelmind Autonomous Delivery Robot

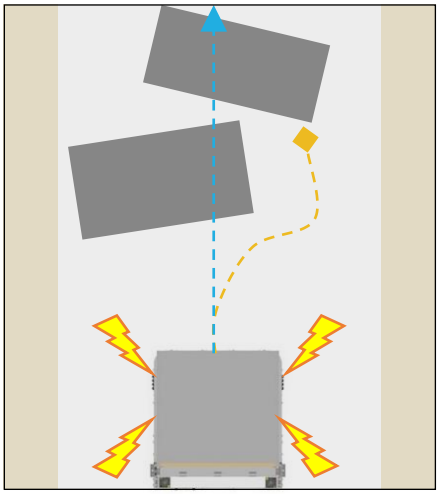
6.1 Obstacle avoidance and detection

Marvelmind team installed multiple low-cost lidars into the robot to make it safe and guarantee solid coverage in different cases.



- Adjustable detection distance (0.3-4m)
- Emergency stop - https://youtu.be/efOc-ItVvgg?t=67
- Rebuilding paths and alarming if stuck





7. Robot's optional features

This chapter describes some additional parts and components which can be installed in the robot depending on your case. If you need something more, you can request some features you want to see in the robot (contact info@marvelmind.com for details)

7.1 QR-scanner

QR scanner placed in a special convenient holder. It was added and smartly linked with the robot's ECU. It can be added to decrease wrong deliveries and wrong goods placement.

Working order with Marvelmind QR-scanner algorithm:

- Robot gets a task. (To take goods with code 0021, for example)
- Robot reaches row and shelf with this good
- Worker takes goods with code 0021 and scans them. If it matches – the robot will start and go to its finish point
- If the worker mixed goods and scanned goods with code 0022, the robot won't drive and will notify the worker about the mistake. It also will write that mistake into a CSV file for future analysis
- Delivery complete

You can also use the scanner as a regular scanner without a solid bond to the Marvelmind Autonomous Delivery System.

7.2 Touchscreen control

The touch screen gives advanced experience and control level of Marvelmind Autonomous Robots. It replaces and complements hardware buttons on the robot's housing.

What new abilities it gives:

- Displays information about the current task
- Highlights goods code and delivery stage
- Displays statistics in real time
- Edit tasks and order
- Edit paths
- Displays the whole map with robots and paths
- Other functions you may need (contact info@marvelmind.com for details)

8. Contacts

For additional support, please send your questions to info@marvelmind.com.