Marvelmind Boxie 2

Operating manual

v2024-09-03

www.marvelmind.com

www.boxie.fi

Contents

Version changes

V2024_09_03

- Minor polishing

V2024_02_15

- Changed to Boxie2 – new Marvelmind robot

V2022_09_06

- Chapter 5.8 Dashboard. Robot detailed settings updated
- Chapter 6.1 High-level robot control added

V2022_08_17

- Chapter 3 updated
- Minor improvements

V2022_08_12

- Section 1.1 What is the Robot Boxie used for added
- Section 3.6 Chassis. External interfaces added

V2022_08_10

- Minor improvements

V2022_06_23

- Chapter 2 updated
- Chapter 3 updated
- Section 4.3 moved to chapter 8
- Section 5.2 One-time flash for SW version from 7.000 added
- Section 5.3 Flashing via USB added
- Section 5.6 Robot detailed settings added
- Minor improvements

V2022_06_10

- Chapter 2 updated
- Chapter 5 updated
- Section 5.4 added

V2022_054_11

- Section 4.1.2 updated
- Section 4.3 added
- Section 4.4 added

V2022_04_19

- Section 1 updated
- Section 2.1 added
- Section 4 updated

V2021_08_05

- Multiple improvements

V2021_02_04

- Initial release

1. Executive summary

Marvelmind Boxie 2 is an autonomous mobile robot designed for smart warehousing, industrial applications, research, and education

- Fully autonomous move between way points covered by Marvelmind Indoor "GPS"
- Payload capacity up to 10kg
- Driving time up to 8h on a single charge (no payload)
- Automatic obstacle avoidance and detection
- Charging time is less than 2 hours with a high-current Marvelmind charger
- Default charging time – 6 hours (with supplied charger by default)
- Up to 125 robots per system (today, much higher number in future releases

Demo-videos:

- Autonomous delivery robot Boxie 2 and its inner beauty:-)
- Marvelmind Boxie 2 – autonomous driving
- Fully autonomous drive by 2 robots – Marvelmind Boxie 2

Key specs:

Parameter	Technical Specifications
Navigation	Marvelmind Indoor “GPS” + Camera + LIDARs + Odometer + IMU
Top speed	2km/h
Weight	4.5kg
Payload	Up to 10kg
Driving time	Up to 8h drive with internal batteries (with no payload)
Charging time	- ≤2h hours with optional charger (Hi-power Marvelmind charger) - <6h hours (with supplied charger by default)
Sensors	- Marvelmind Indoor "GPS" for positioning - Location + Direction based on Marvelmind precise indoor positioning system - LIDARs - Intera for optical recognition on the top - Odometer on each wheel - 12 x 1D LIDARs - Sonars - Current sensing

1.1 Legend

Legend chapter contains small icons and signs to highlight some key points of the text.

 Important

 For experienced users

 Demo or Help video

 Useful link

1.2 Robot Boxie. Typical use cases

Marvelmind Boxie 2 is an autonomous mobile robot designed for smart warehousing, industrial applications, research and education.

Learn more in this video:

Boxie 2 - autonomous robot - detailed (33'40'') review

1.2.1 Inspection

Autonomous (daily, nightly, hourly, etc.) inspection with optional cameras and additional measurement devices.

See an example in this video:

Autonomous driving - basic demo

1.2.2 Education and research

Good for universities. Robot Boxie 2 has a vast number of interfaces, power supplies and research capabilities.

It offers 12V&2A, 5V&2A power supplies and ground switch 2A. Raspberry Pi and Odometry interfaces. WiFi, Bluetooth, HDMI and USB ports. Boxie 2 is like a computer on wheels.

See an example in this video:

How autonomous robots keep driving so precise?!

1.2.3 Autonomous delivery

Autonomous delivery of goods or baskets with goods/tools/inventory in warehouses, assembly plants (expensive gauges and similar), chemical plants (samples, etc.).

Check the video:

- Autonomous robot Boxie 2 carries up to 10kg

2. What's in the box

There are 3 types of Boxie 2 configuration:

- Basic – Boxie 2 with charger and without charging station
- Standard – optimal Boxie 2 configuration – includes charging station
- Advanced – the most rich configuration: includes Marvelmind ultrasound positioning system, training course and extended warranty

	Basic	Standard	Advanced
Boxie 2 robot	Yes	Yes	Yes
Charger	Yes	Yes	Yes
Charging station	—	Yes	Yes
Zoom training course, hours	—	1	5
Super-Beacon + Modem HW v5.1 included, pcs	—	—	5+1
Extended warranty	—	—	Yes

2.1 Basic configuration

This configuration is for users who already have charging stations and want to acquire more robots without adding

additional stations.

- Robot Boxie 2 Basic
- Charger 5A

2.2 Standard configuration

This configuration is recommended for users, who already have ultrasound Marvelmind indoor positioning system

kit and want to play around with Boxie 2 robot.

- Robot Boxie 2 Standard
- Charger 5A
- Charging station

2.3 Advanced configuration

This configuration is suitable for users without previous experience. This kit includes basic ultrasound Marvelmind

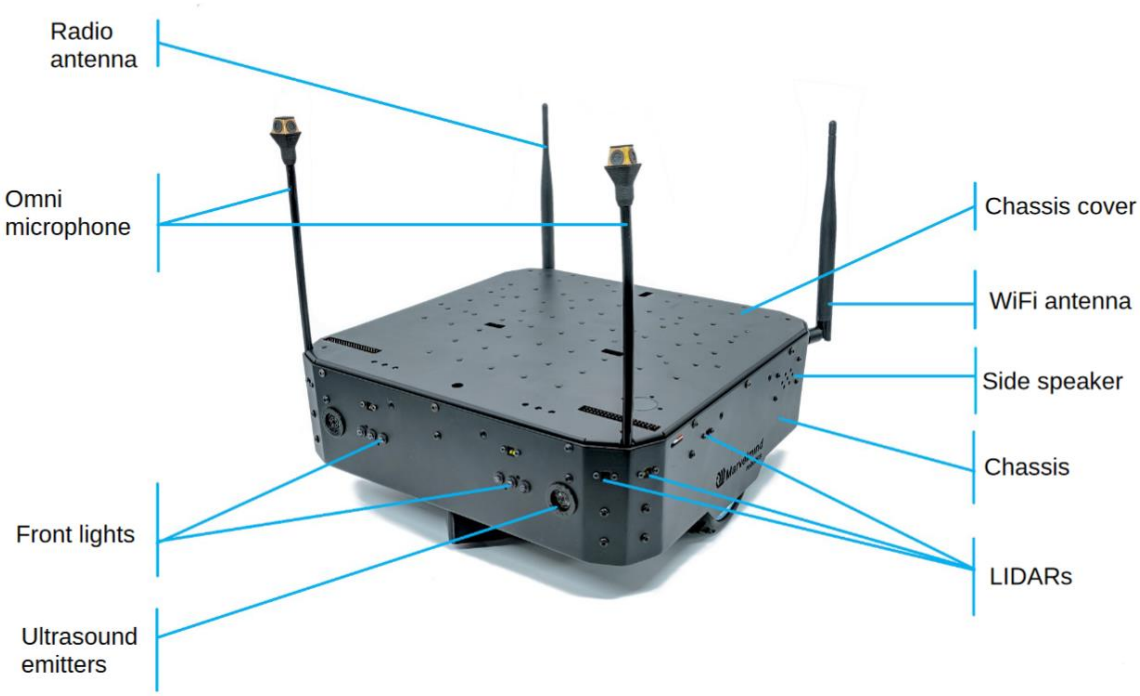
indoor positioning system, standard Boxie 2 kit, introductional course and a warranty.

- Robot Boxie 2
- Charger 5A
- Charging station
- Extended warranty
- 5 x Super-Beacon
- 1 x Modem HW v.5.1

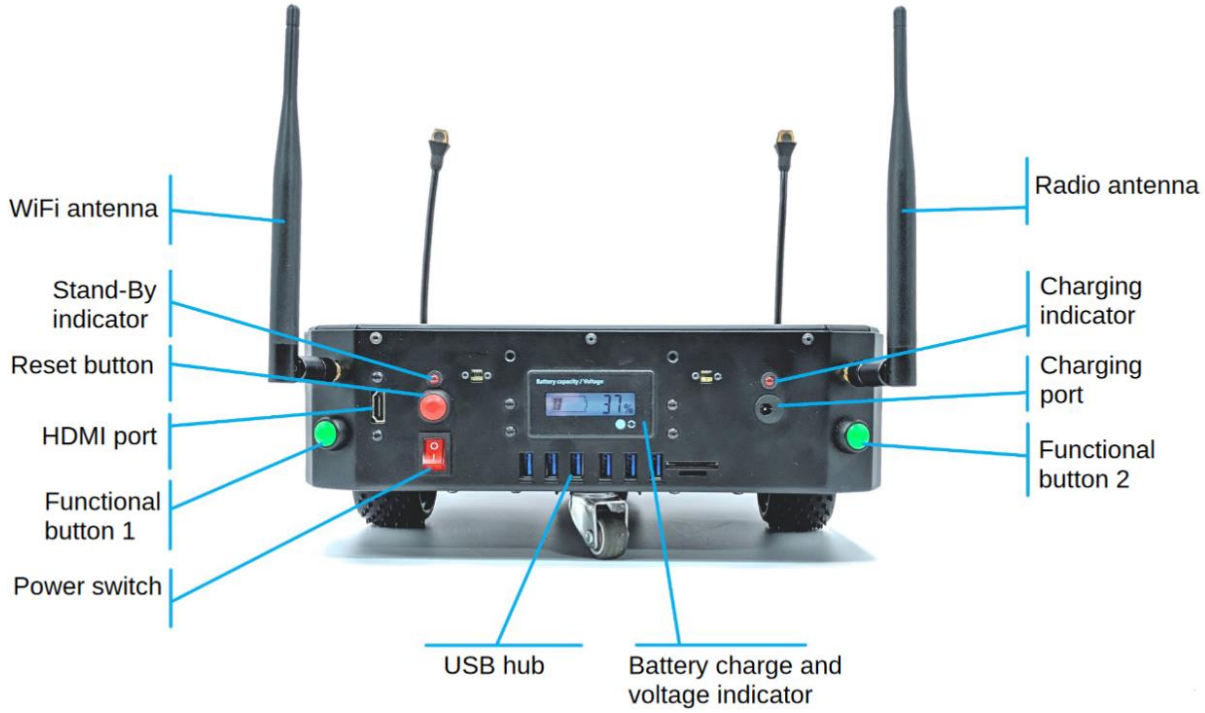
3. Hardware System elements

In this chapter are represented core elements of Marvelmind Boxie 2. What included in Marvelmind Boxie 2, how it looks like, how it works, how to use it.

In this chapter you will get acquainted with the hardware part of the robot.



Side view:



Rear view:

Check the video: [Boxie 2 - autonomous robot - detailed (33'40'') review]

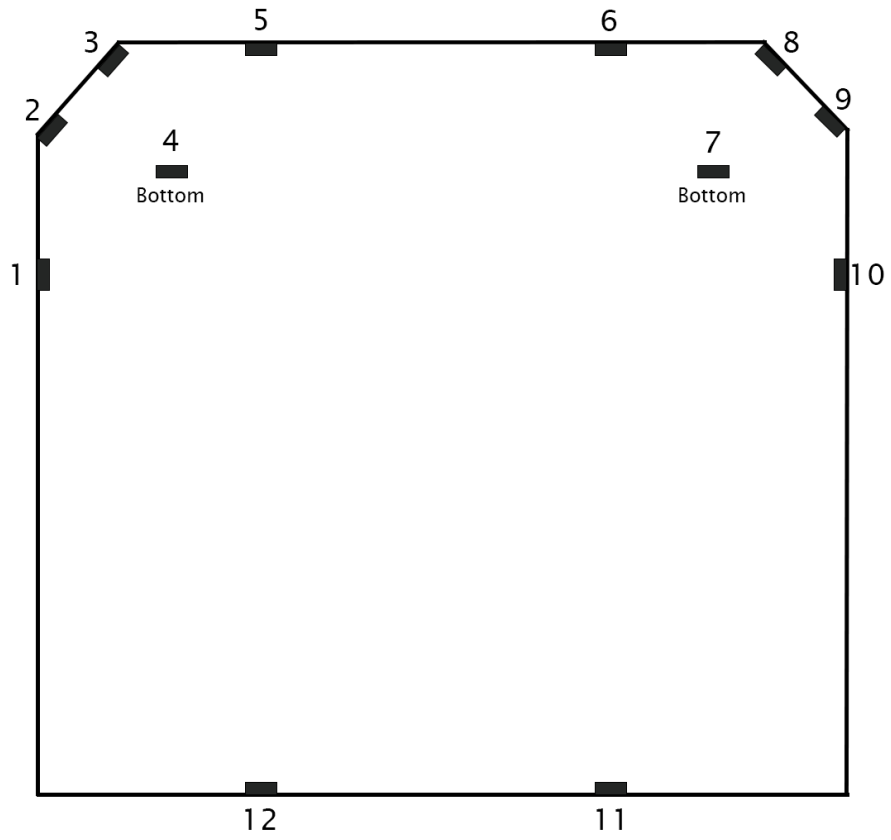
Bottom view:

Boxie 2 has guide cup and charging contacts, that was added for Charging station.

Boxie 2's wheels are easy replaceable.

3.1 Location of Lidars

This section describes connections and placement of LIDAR system. This system provides an obstacle-detection function.



3.1.1 Placement

LIDARs are located around the perimeter, each of them has viewing angle up to 27 degrees.

LIDARs only react on objects that reflect infrared light in a distance up to 4 meters. It can't be use to avoid clear glass. To avoid false alarms, this distance is limited to a meter, which allows the robot to stop and decide to avoid obstacle.

3.2 Marvelmind ultrasound indoor positioning system

Marvelmind Indoor Navigation System is an off-the-shelf indoor navigation system, designed to provide precise (±2cm) location data to autonomous robots, vehicles (AGV), and copters. It can also be used to 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 radio interface in a license-free band, one or more mobile beacons installed on objects to be tracked and modem providing gateway to the system from PC or other computers.

Mobile beacon's location is calculated based on a propagation delay of an ultrasonic pulses (Time-Of-Flight or TOF) between stationary and mobile beacons using trilateration algorithm.

The system can build the map of stationary beacons automatically. In simple cases, no additional manual data input or any manual distance measurements are required. This map formed once can be frozen and stored in

modem's memory and the system becomes fully active within 7 to 10 seconds after the modem is powered.

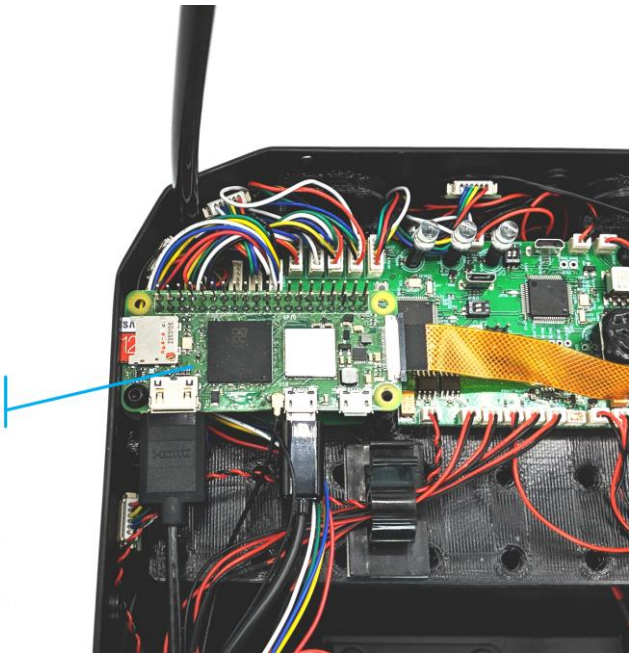
In the Robot Boxie 2 it instilled for ultrasound tracking.

3.3 Omni microphone

Omni-Microphone-IP67 is an advanced all-directions microphone for robots and forklifts when the highest performance and the largest submaps are required.

- Omni-Microphone is an external microphone that can be used along with Super-Beacons and Mini-RXs. On request, it can also be used along with Industrial-RX and Industrial Super-Beacons. The later support in HW and SW, but additional modification of housings is required
- It has a super-wide 360×360-degree beam, i.e. Omni-directional pattern
- It is possible to enable and receive signal from any of the microphones separately, thus, to disable a noise source from an unwanted direction, because the Omni-Microphone consists of 4 external microphones back to back
- The Omni-Microphone is great for Direction + Location, for example, for robot's
- It is highly recommended for larger submaps (25m+) or when a particularly guaranteed and robust tracking of a forklift or similar mobile object on the largest possible distance. See video below for more info about microphone diagrams
- The microphone is IP67 protected by special membranes and compound
- The microphone requires soldering. There are easy to use pins on the board and connectivity is described in the Operating Manual
- Only one Omni-Microphone can be connected to a Super-Beacon or to a Mini-RX, because, effectively, there are four microphones inside already
- The default cable length is 20-25cm. Optionally, it is possible to have the Omni-Microphone with up to 1m-cable
- By default, the microphone is shipped with a 2mm-flexible cable ready for soldering. On request, it can be supplied with a flexible mounting tube for easy installation on a forklift or a robot – "antenna-like configuration". Let us know about your preferences and the desired length when ordering. There are other mounting options as well

3.4 Main Computer



In Boxie 2 Raspberry Pi Zero 2 W is used.

Main computer supports:

- Bluetooth
- Wi-Fi
- SD card
- 40pins of Pi Zero 2W – standard interface
- Camera
- HDMI port

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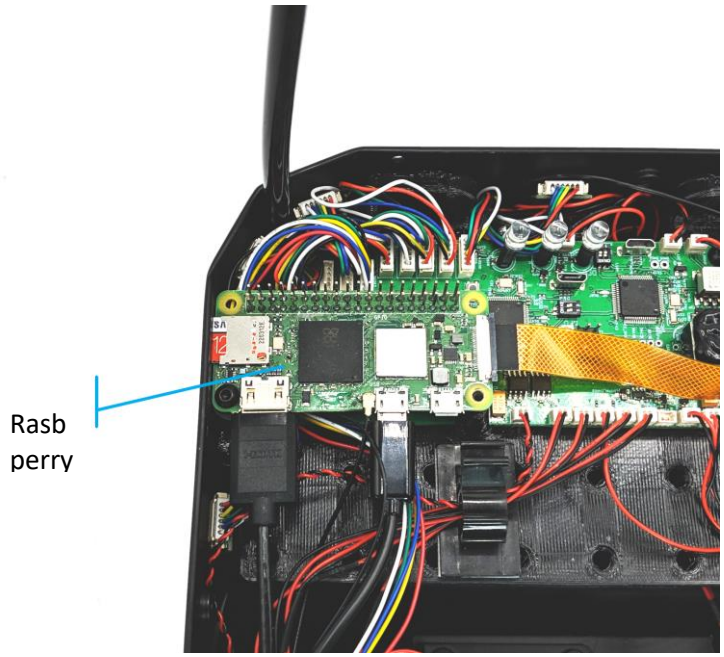
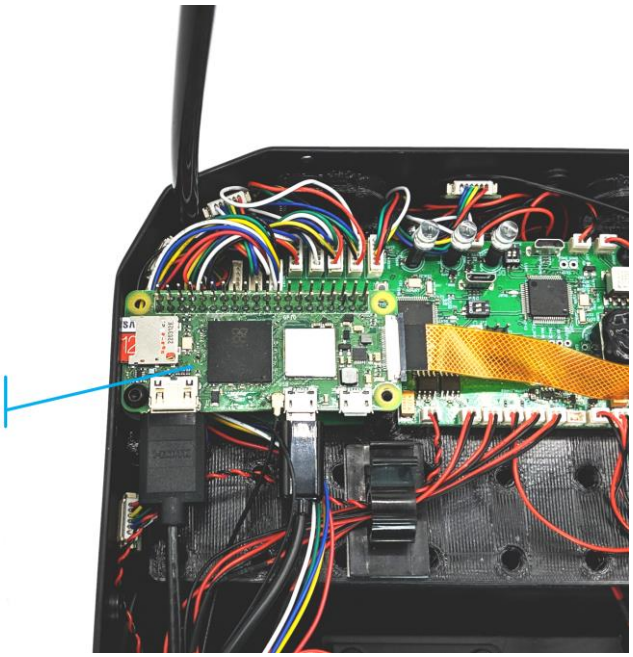


3.5 Bluetooth

Bluetooth allows communication with external devices. Supports by hardware.

Software related will be provide in future update.



3.6 Wi-Fi

Wi-Fi is used for fast data transfer, for debugging, for transfer of volume data, for example – visual data. For obstacle detection, image recognition and similar tasks.

Rasp

3.7 Mini HDMI port

HDMI Port

Raspberry PI Zero 2 W offers Mini HDMI port, which can be used to connect a display. It is propagated as HDMI port to the outside of a robot for convenience.

Used for debugging, research and development.

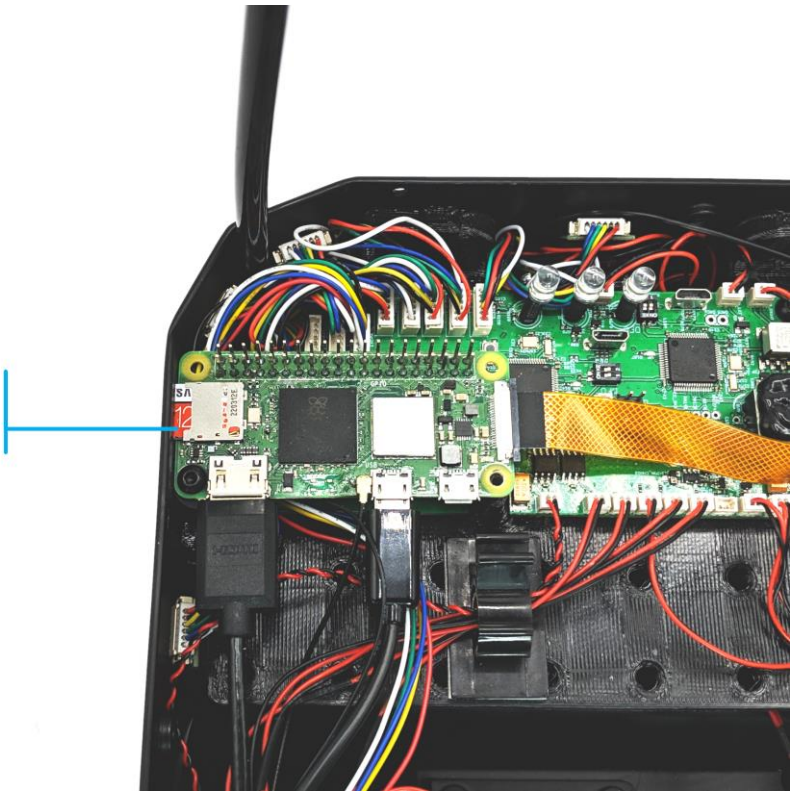
3.8 Up-facing Camera

Boxie 2 is equipped with the camera internally connected to Raspberry Pi.

Up-facing camera is used for optical robot positioning using ArUCO tags. May be used together with Top lights – bright LEDs, lighting tags in dark environments.

3.9 SD Card

Raspberry Pi, which is used in Boxie 2, uses SD card to store operating system image and data. Boxie 2 offers easy



access to this SD card.

SD Card comes preinstalled into Boxie 2 Main computer's SD card slot. It stores Raspberry Pi operating system and low-level Marvelmind software, needed for robot functioning. Also can be used to store user data.

3.10 Odometry board

Odo board stands for Odometry board. It takes low level operations that are too fast for a main computer.

Odo controls the motor controllers. A special processor helps to process data and motion algorithms and controls motors.

Also on it are the components responsible for lighting, for obstacle detection control and LIDAR board.

Contains keys for external devices control:

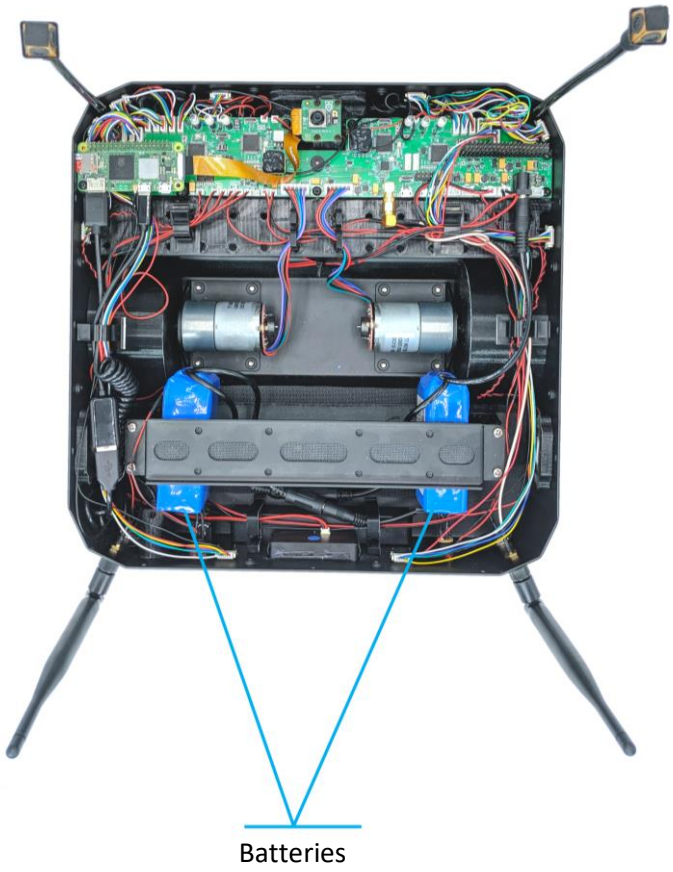
- To turn on
- Turn off and
- Power supply.

40 pins from our Odometer board:

- UART (allows you to connect directly to the board, bypassing the main computer)
- SPI
- I2C
- USB
- GND switch, +12V & 2A and +5V & 2A to power your external devices

3.11 Battery and Chargers

Boxie 2 is equipped with a Li-ion polymer battery.



- 12V-battery with different internal capacity from 40Wh to 100Wh
- 5A charger
- Optional external batteries
- Current and voltage sensing (also available via API)

3.12 Charging

One of the main Boxie 2 features is the Charging station.

Robot can automatically drive to a station and charge. Charging station is used with the default charger, supplied with the robot.

Boxie 2 is equipped with 12V & 5A charger

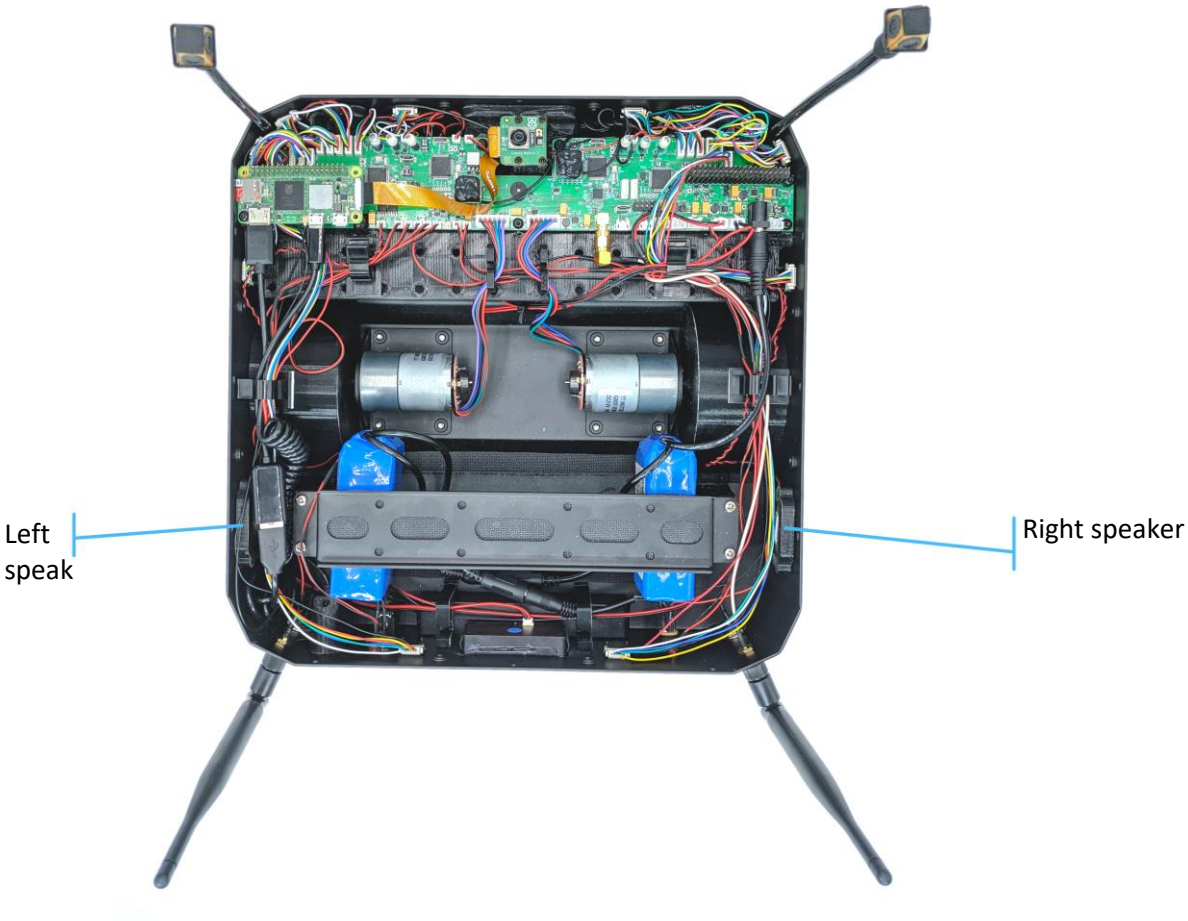
Charging time: approx. 2 hours

Operating time at full battery is up to 8 hours (No payload).

Use only Marvelmind supplied chargers

3.13 Speakers

Speakers used to inform a user about Boxie2 state. Boxie2 has two speakers in stereo mode.



User can turn off and on notifications – either particular types of notifications or all at once.

3.14 Lights

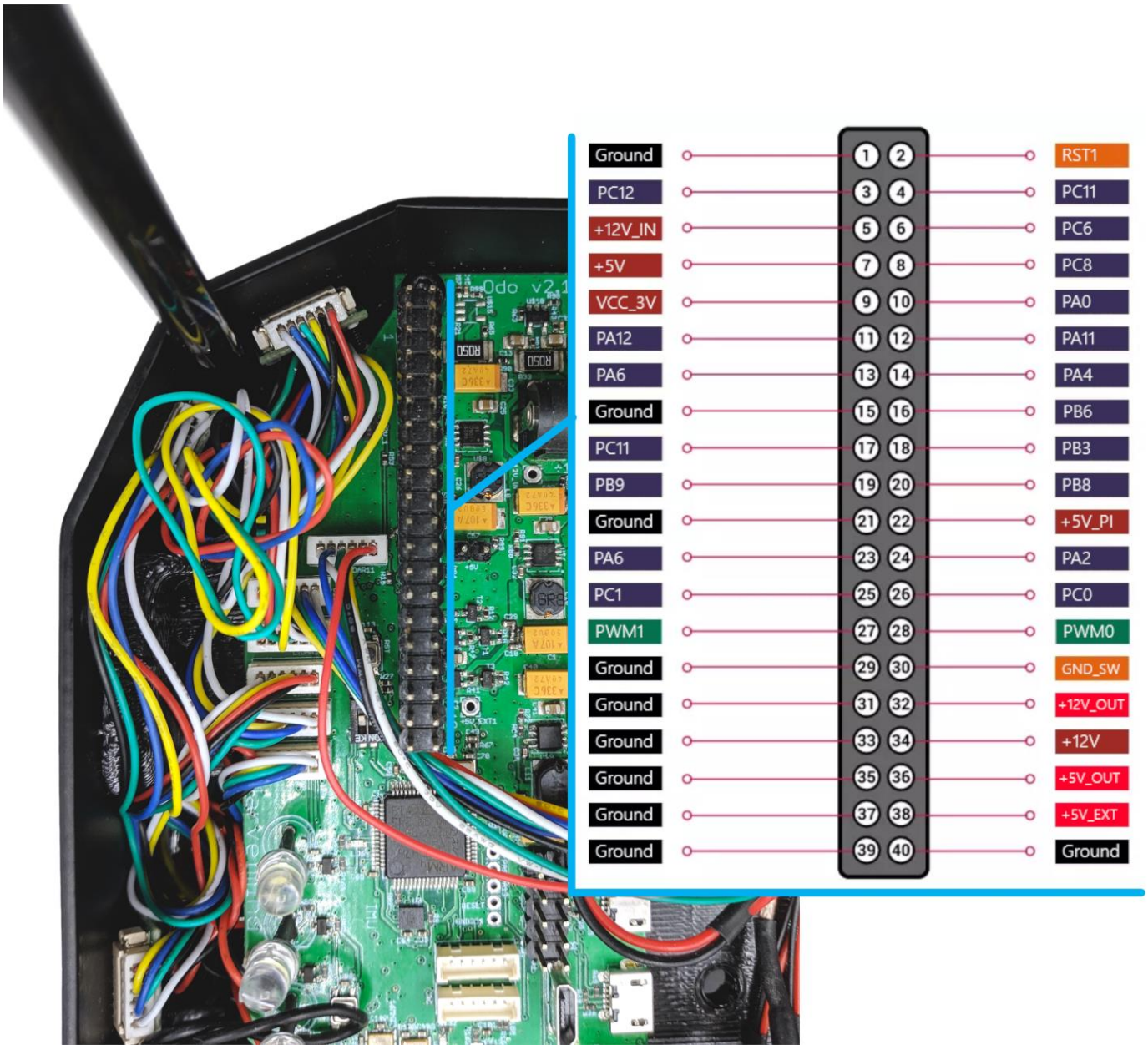
Boxie 2 has top and front lights.

Top lights are used to help up-facing camera detect positioning tags in dark environments. Front lights are used mainly for people. Both lights may be used for debugging and interfacing. Read more in Communication chapter.

3.15 External interfaces

Boxie- 2 has the following interfaces, which are all available to the User:

- Raspberry Pi Zero 2 W standard 40-pin interface
- Odometry 40-pin interface:
  - UART
  - SPI
  - I2C
  - USB
  - Power output: +12V 2A; +5V 2A
  - GND switch
  - HDMI (for Raspberry Pi)
  - Stereo sound
  - Buzzer
  - LEDs – on the top and front
  - 2x programmable Function buttons and Reset button



Boxie 2 odometry board offers a great interaction possibilities. Currently implemented pins are:

PWM0, PWM1 – pulse-width modulation

RST1 – reset

Ground – ground

+12V_IN – 12 volt input

+5V – 5 volt internal power supply

VCC_3V – 3 volt internal power supply

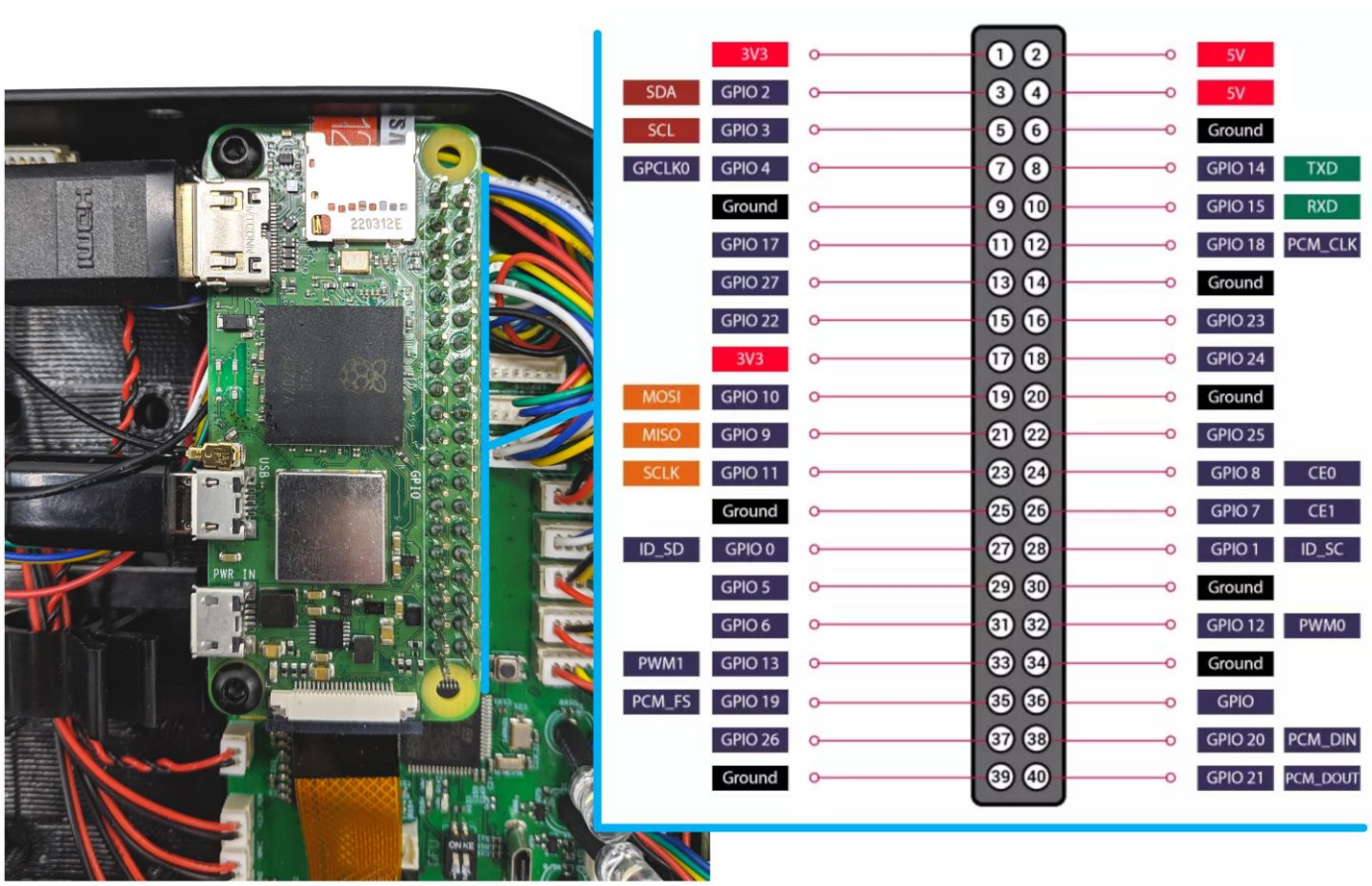
+5V_PI – Raspberry Pi power supply

GND_SW – ground switch

+12V_OUT – 12 volt output, up to 2A

+5V_OUT – 5 volt output, up to 2A

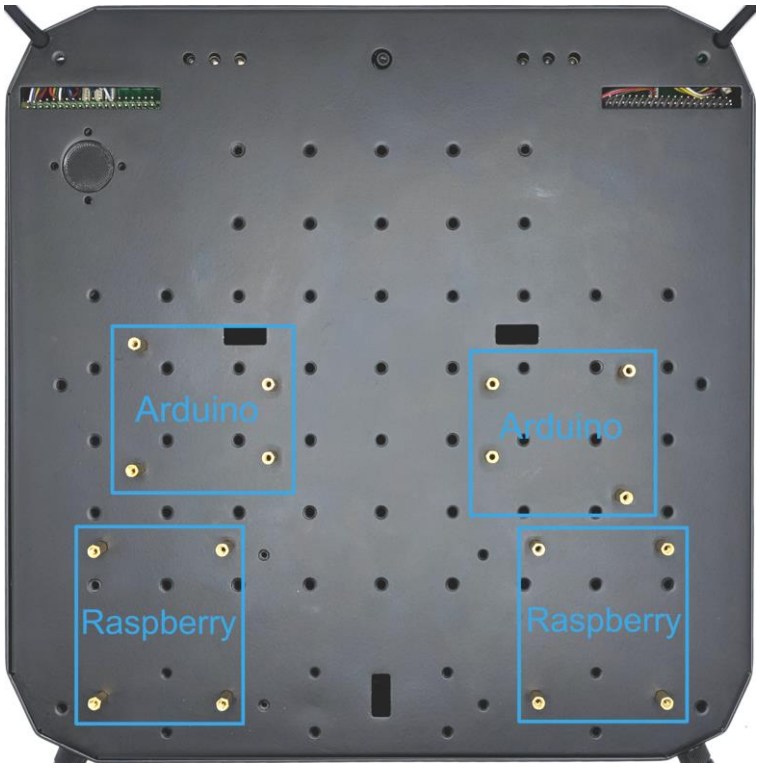
+12V – 12 volt internal power supply



Raspberry Pi pinout is standard.

3.16 Chassis. External interfaces.

Boxie 2's chassis is designed for ease installation of the most popular development boards such as Arduino and

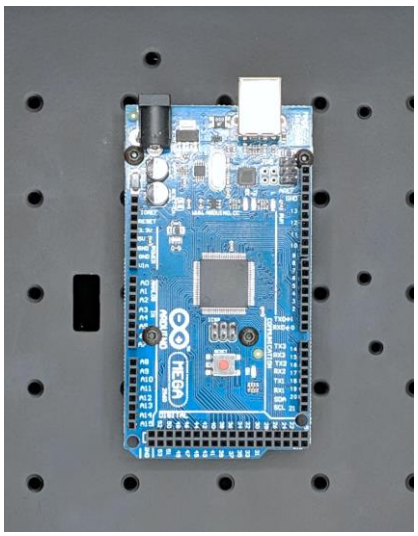


Raspberry.

There are mounting holes on a chassis' cup. The mounting process is simple: install M3 stands on it and place development board onto them.

- Raspberry

- Arduino Uno



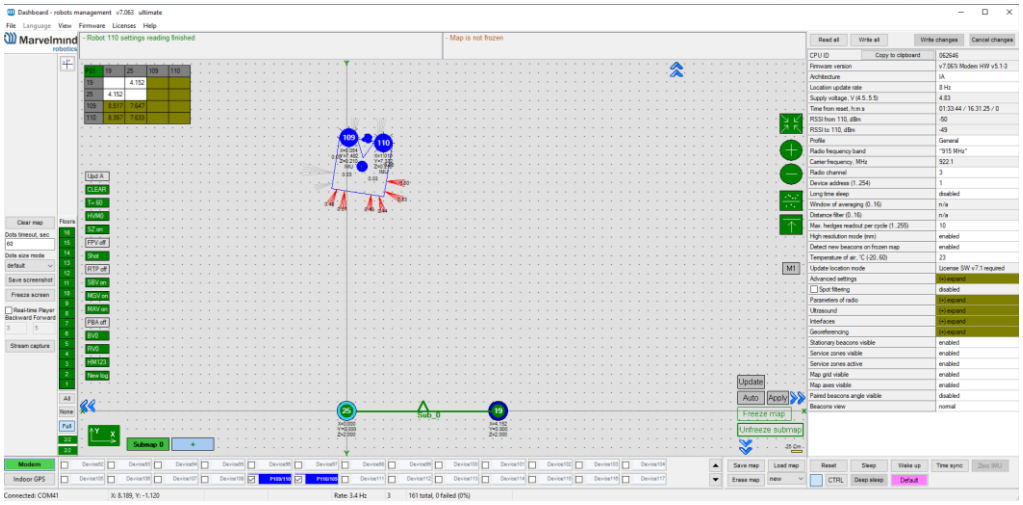
- Arduino Mega

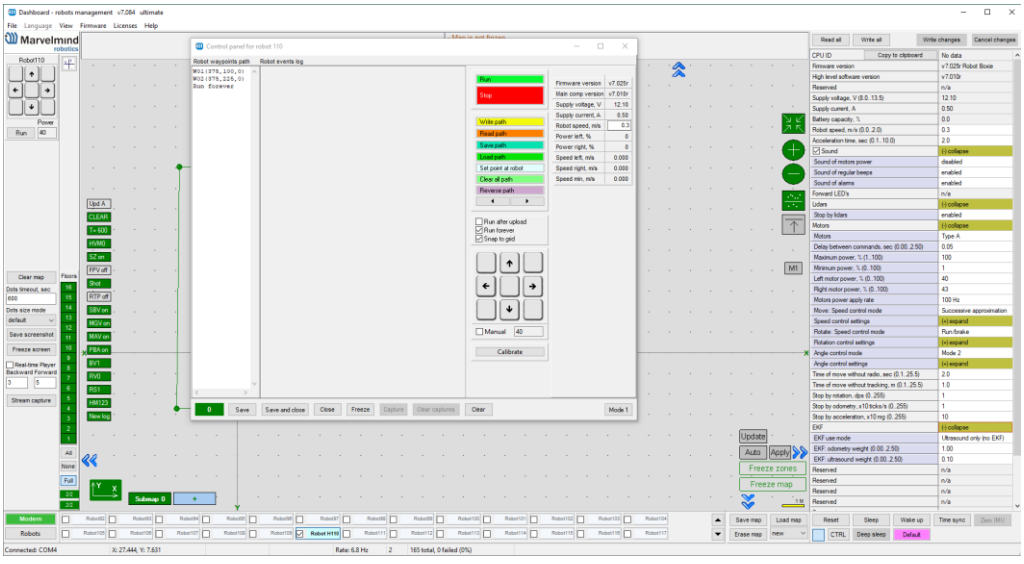
4. Software elements and functions

In this chapter described the main software system elements and functions of the Robot Boxie 2.

4.1 Control system

There are two ways to control Marvelmind Boxie 2 system.





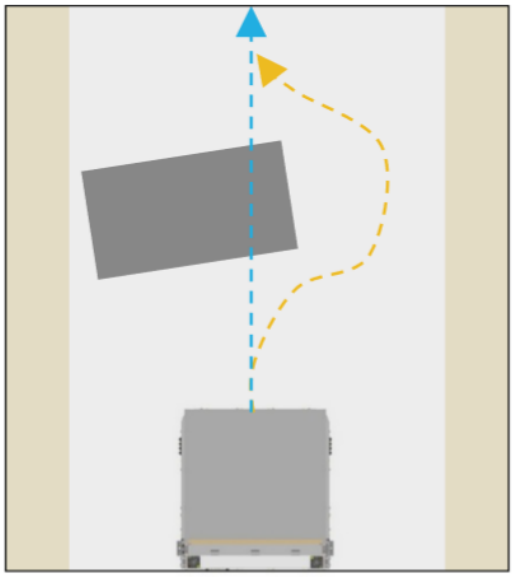
4.2 Via dashboard

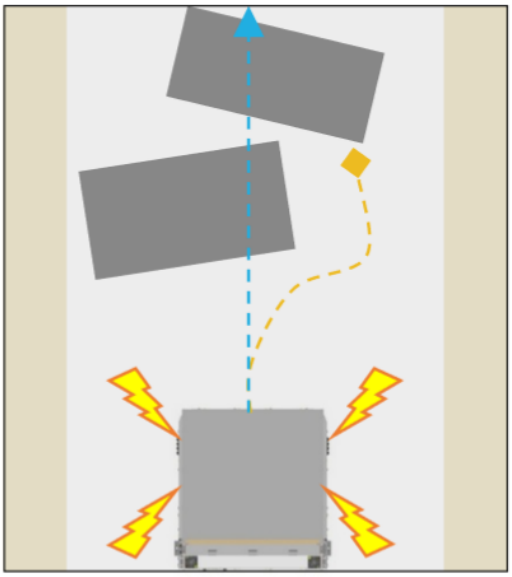
In this way Boxie 2 controls with Marvelmind Indoor “GPS”. When system fully set up, you can control a Boxie 2 via Dashboard. Read more about first setting up a Boxie 2.

Visual Dashboard view (Check the video: How autonomous robots keep driving so precise?!)

5. Obstacle detection and avoidance

Marvelmind team installed multiple 1D LIDAR's into the robot to provide obstacle detection and avoidance up to 4





meters away.

To avoid false alarms, this distance is limited to a meter, which allows the robot to stop and decide to avoid obstacle.

- Adjustable detection distance (0.3-4m)
- Emergency stop - https://youtu.be/efOc-ItVvgg?t=67
- Rebuilding paths and alarming if stuck
- In future SW versions this function will be used as addition to positioning, in difficult cases when positioning via ultrasound is impossible.

5.1 Communication

There are two ways how Boxie 2 can communicate with people:

6. Sound

This functions are supported by speakers.

- With the help of this sound, the robot warns people about the approach.
- With the voice it informs about the current processes of the Robot Boxie 2, as written path, flashing, start of a ride and similar actions.

7. Light

This function supported by lights.

- Helps to indicate Boxie 2.
- Flashing faster when Boxie 2 flashing via USB.
- Used to illuminate the space for camera

8. Setting up Boxie 2

This chapter describes interactions with basic robot controls and setting up the system with Marvelmind Boxie 2.

8.1 Software Pack

When you just received Robot Boxie 2, update SW on the latest version.

This chapter shows how to use SW Pack for Boxie 2

**Copy this folder to USB drive, connect it to Robot and press Reset button. After that Boxie 2 will flash by itself.*

***Use HEX.files to flash devices via Dashboard. It's possible to flash via USB and radio. Flash mobile beacons via radio (don't try to remove it from robot) and flash stationary beacons via USB or radio, as you prefer.*

8.2 One-time flash, for SW version from 7.000

Do this only once, for your Robot Boxie 2. After this disassembling is not needed, SW flashes via USB.

How to:

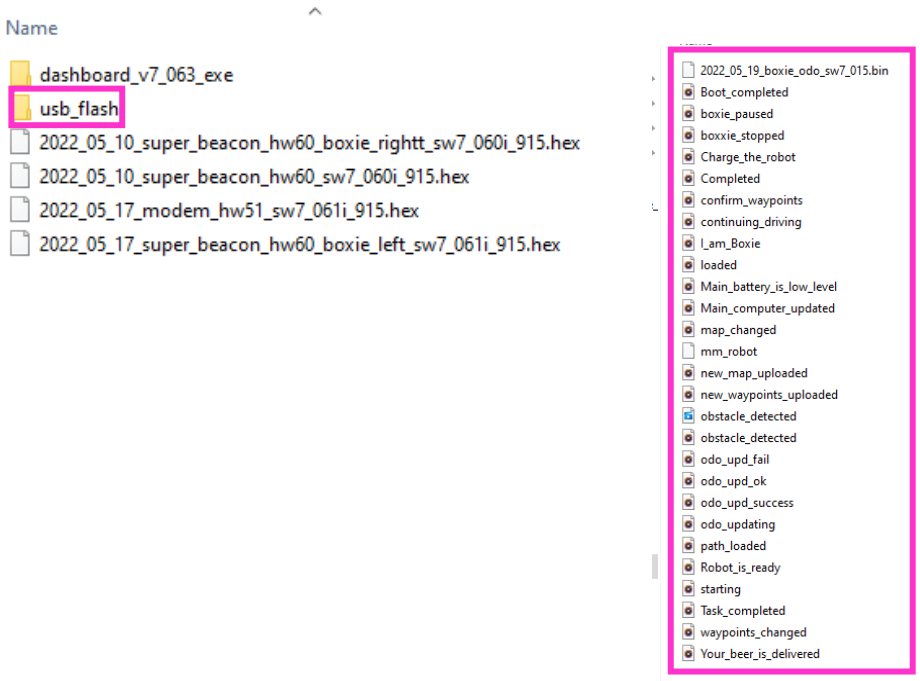
- Pull out the SD Card from SD Card slot

- Download the latest Boxie 2 image file and write it to a SD Card (for example using Raspberry Pi Imager)
- Put SD card back

8.3 Flashing via USB

After one-time flash, Robot Boxie 2 flashing via USB. Follow steps below to flash Robot Boxie 2 via USB

1) Download latest SW pack for Boxie 2 from Marvelmind website https://marvelmind.com/download/



2) Copy all files from usb_flash folder to USB drive

3) Insert USB drive to Robot Boxie 2 and press reset button
4) After reset, Boxie 2 will say “Main computer updated successfully” – Main computer updated.
5) After Raspberry board successfully updated, robot will inform that flashing of Ode. board been started. “Updating of odometry board”. When odometry board updating in progress, robot will beep and blink.
6) In the end of flashing Boxie 2 will inform “Odometry board firmware updated successfully” – it means, that flashing completed. Robot Boxie2 will be reseted by itself.
7) Remove USB drive from the Boxie 2
8) Flashing completed.

9. Setting up the autonomous robots

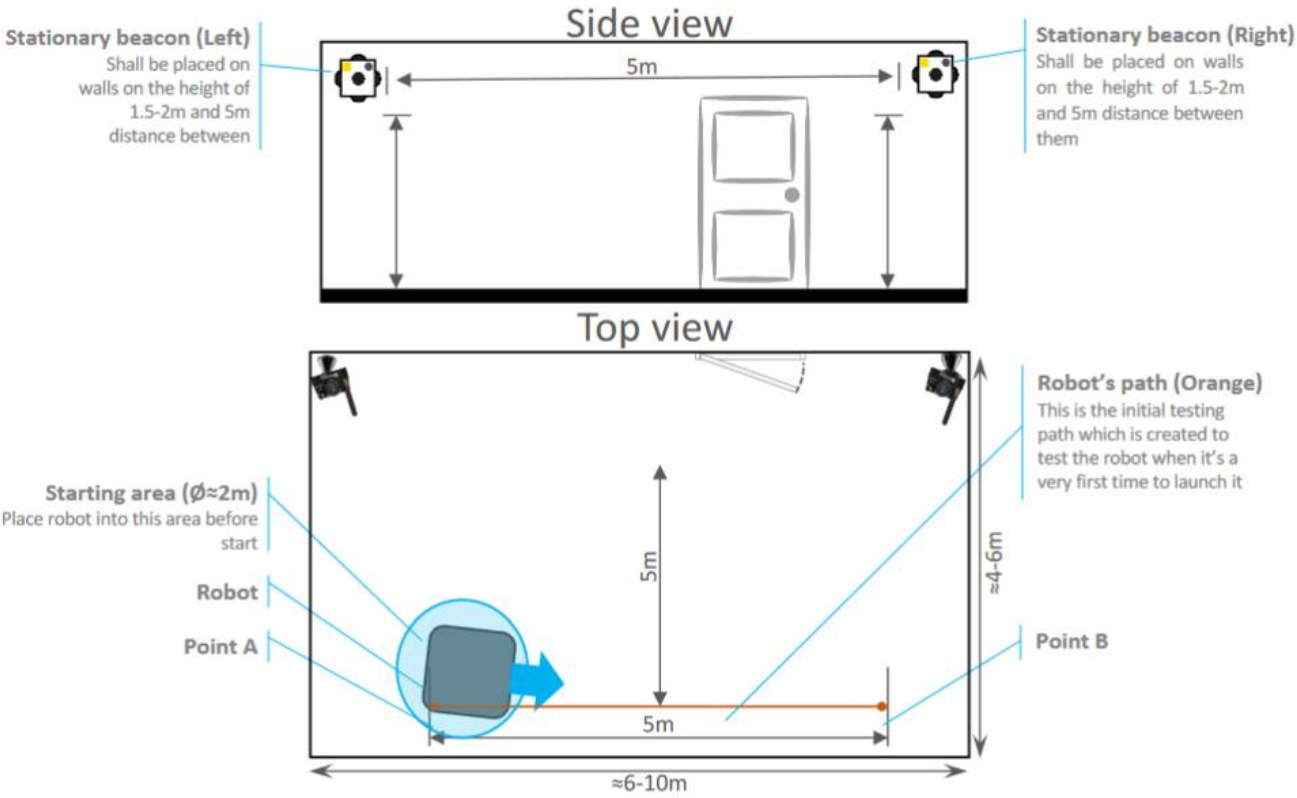
The steps below describe setting up the system with Marvelmind Boxie 2.

Robot Boxie 2 uses only Inverse Architecture.

9.1 Test launch

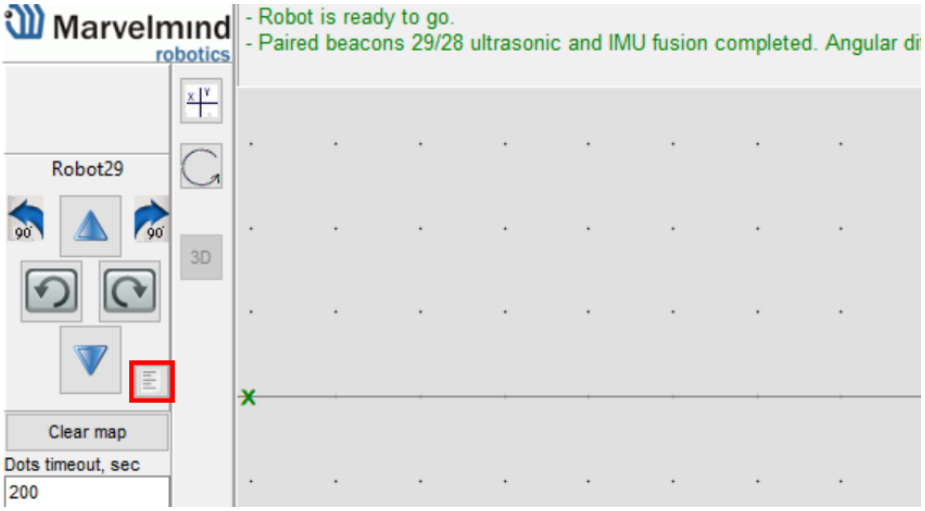
When you receive flashed the robot, you can start a testing launch process. Test launch is a process of testing for Marvelmind Small Robot. Test launch consists building a simple map and a simple path for robot. If you are experienced enough, you can skip this part and go forward to “Launching robots in custom maps” chapter.

How to:

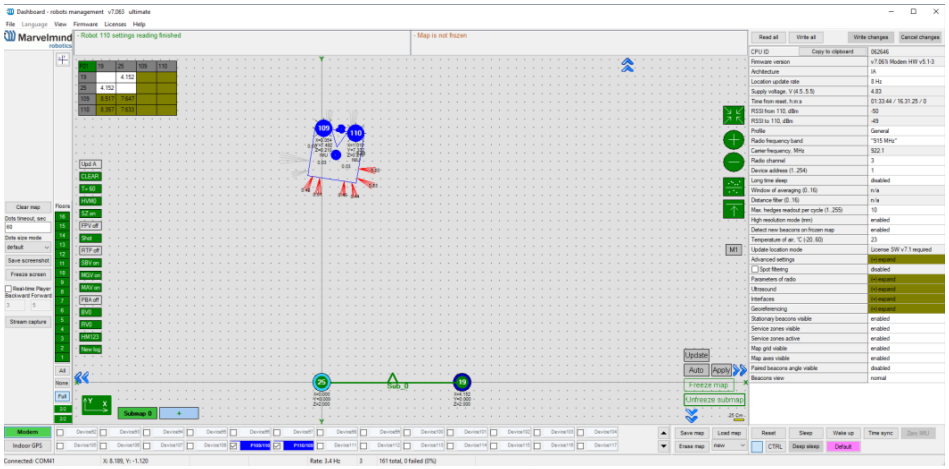


1. Place stationary beacons as described on the picture below
2. Install and launch Marvelmind Dashboard
3. Connect Modem to your PC via USB and update it with the corresponding SW
4. Turn on the robot and wait for 1 minute, until the robot is fully loaded.

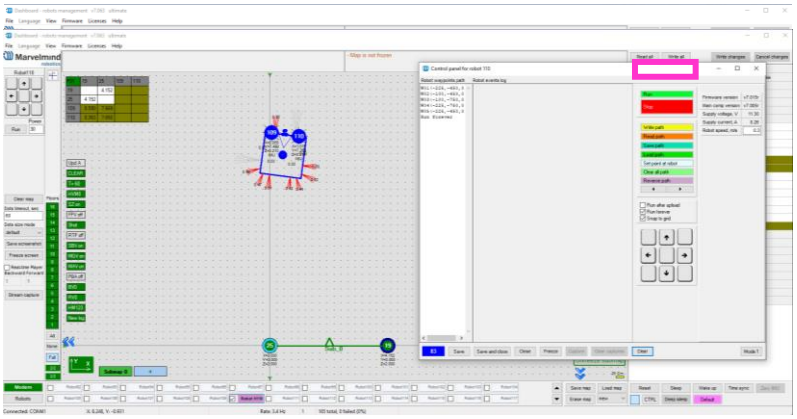
1. Check the Marvelmind Operating Manual (Chapter 5.0) and build up a simple 2D map and Freeze Submap:



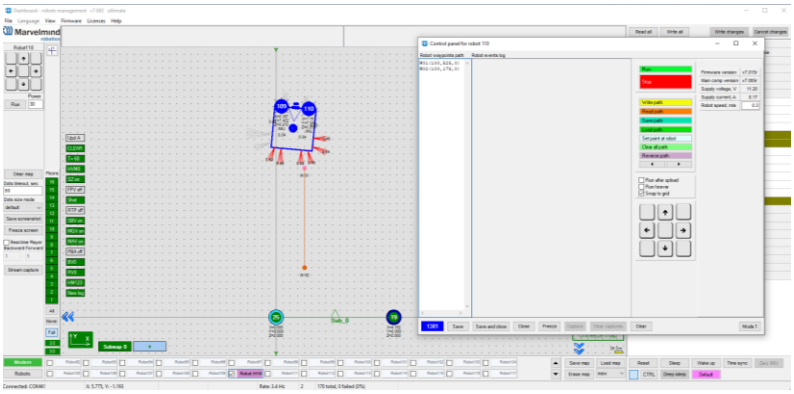
2. Wake up the beacons which are written on the bottom of the Boxie 2
3. Click on the leading beacon (By address) and click on the “Movement path” button (see the picture below)Robot will appear on the map. Wait till Robot setting reading will be finished:



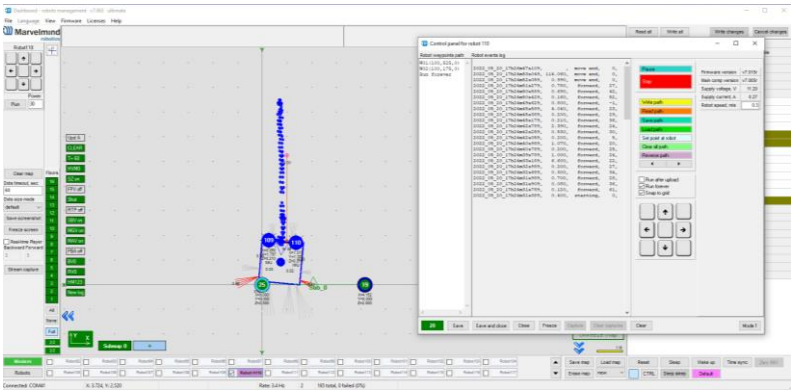
4. Make a simple path (Use **Shift+Left mouse button click** to create point, click on point – to removeLeft click to Indoor GPS button and choose Robots option. Find your robot in devices list and Left click on the robot number icon. (Robot named as higher hadge number):)



1) Press on “Write path”Control panel for robot will open:



2) Use **Shift + Left Click** to draw a point of path. And **Shift + Left Click on point** to remove already existed point. Draw the path, as shown in the picture below:



3) Press “Run”. Robot will start a ride:

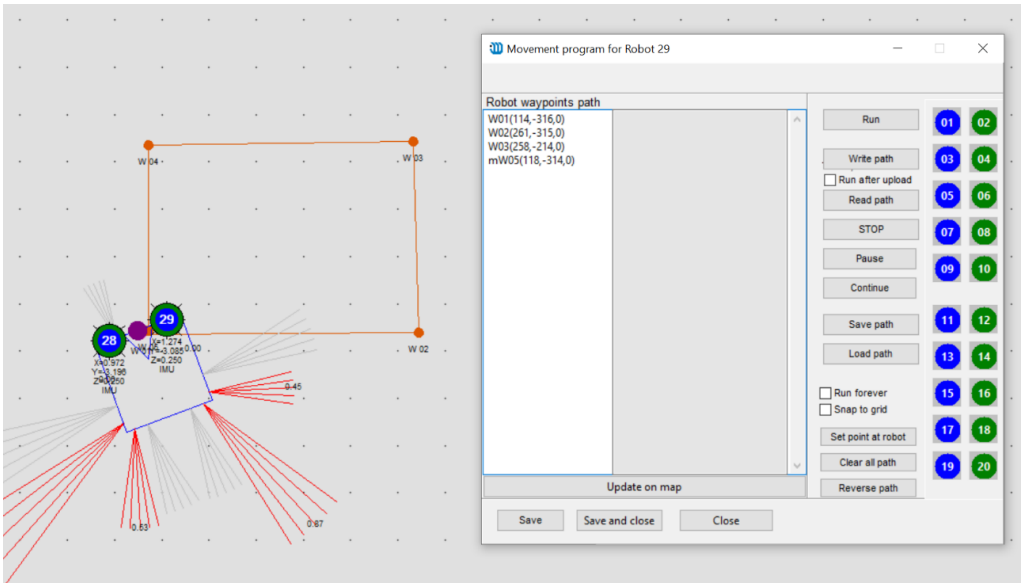
Make sure that you have enough space for the test launch.

9.2 Launching Boxie 2 in the custom map

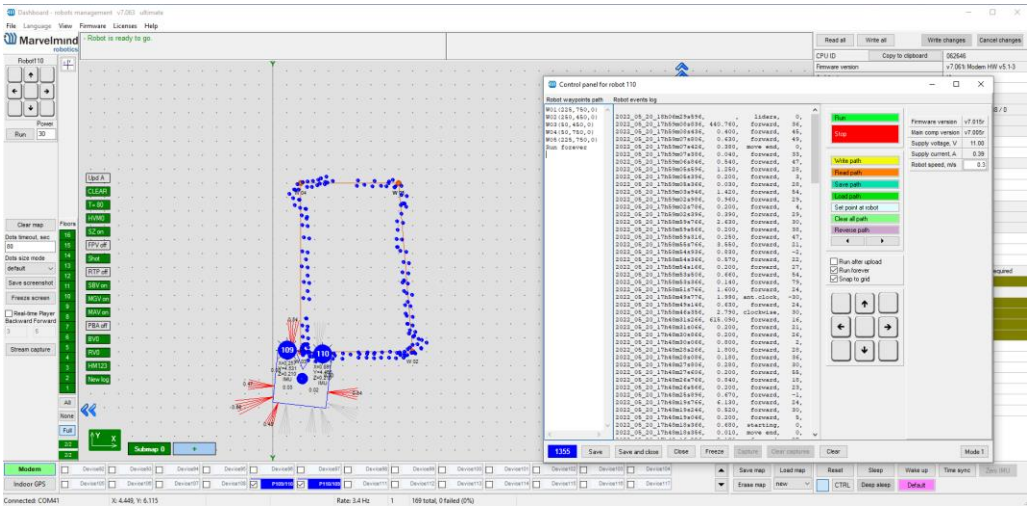
When you made a test launch of the robot and succeed, you can build more complex maps and launch the robot in it.

How to:

1) Set up the Marvelmind Indoor “GPS” system. It’s detailed described in the Operating Manual
2) Turn on Boxie 2 and wait for 1 minute
3) ConfigurateConfigure paths and start/end points (Use **Shift+Left mouse button click** to create point, click on point – to remove):



4) Press “Write path”

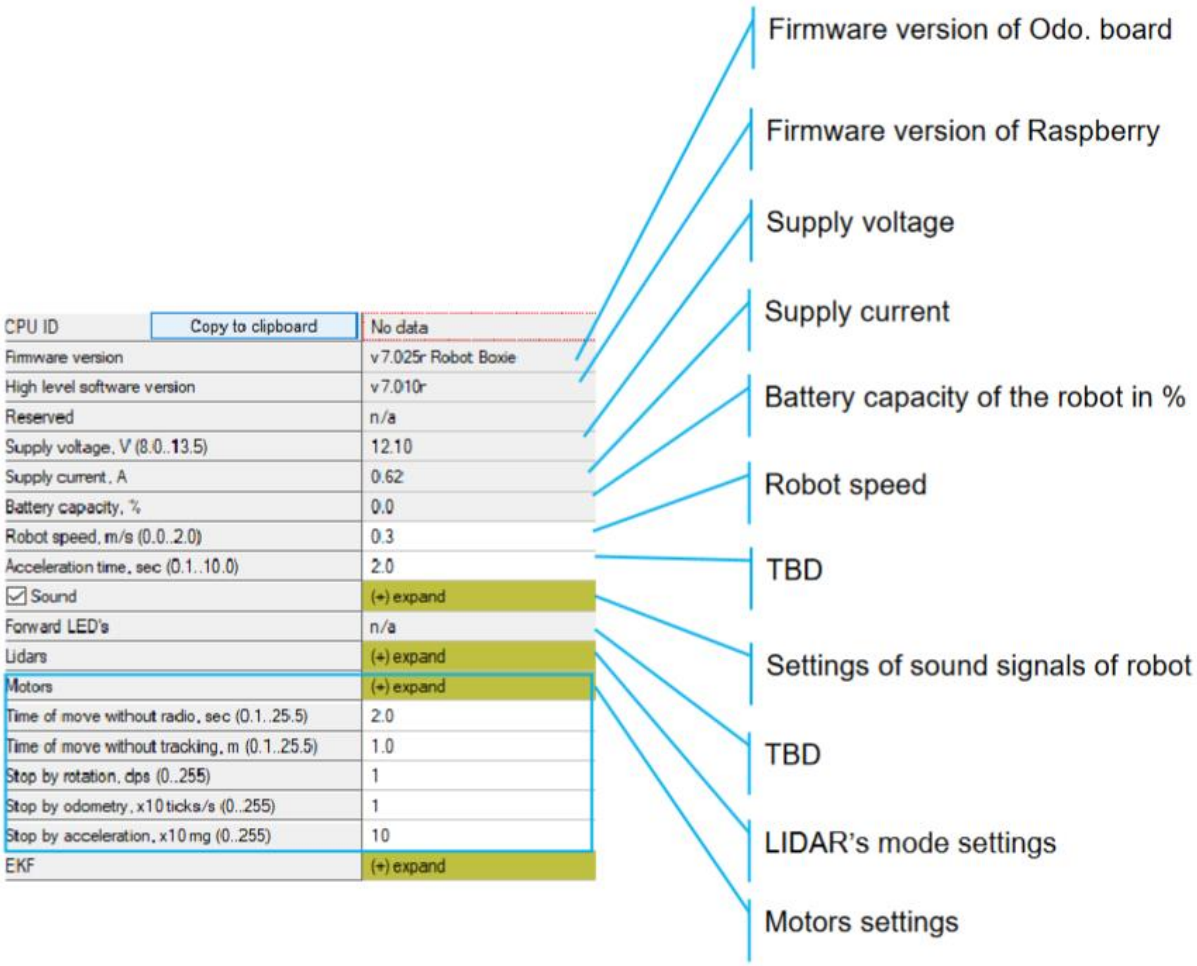


5) Press “Run”. Robot will follow the path that you draw:
6) If you put a tick on “Run forever”. Robot will move till you press stop button in control panel or before obstacle detected:

9.3 Dashboard. Robot detailed settings

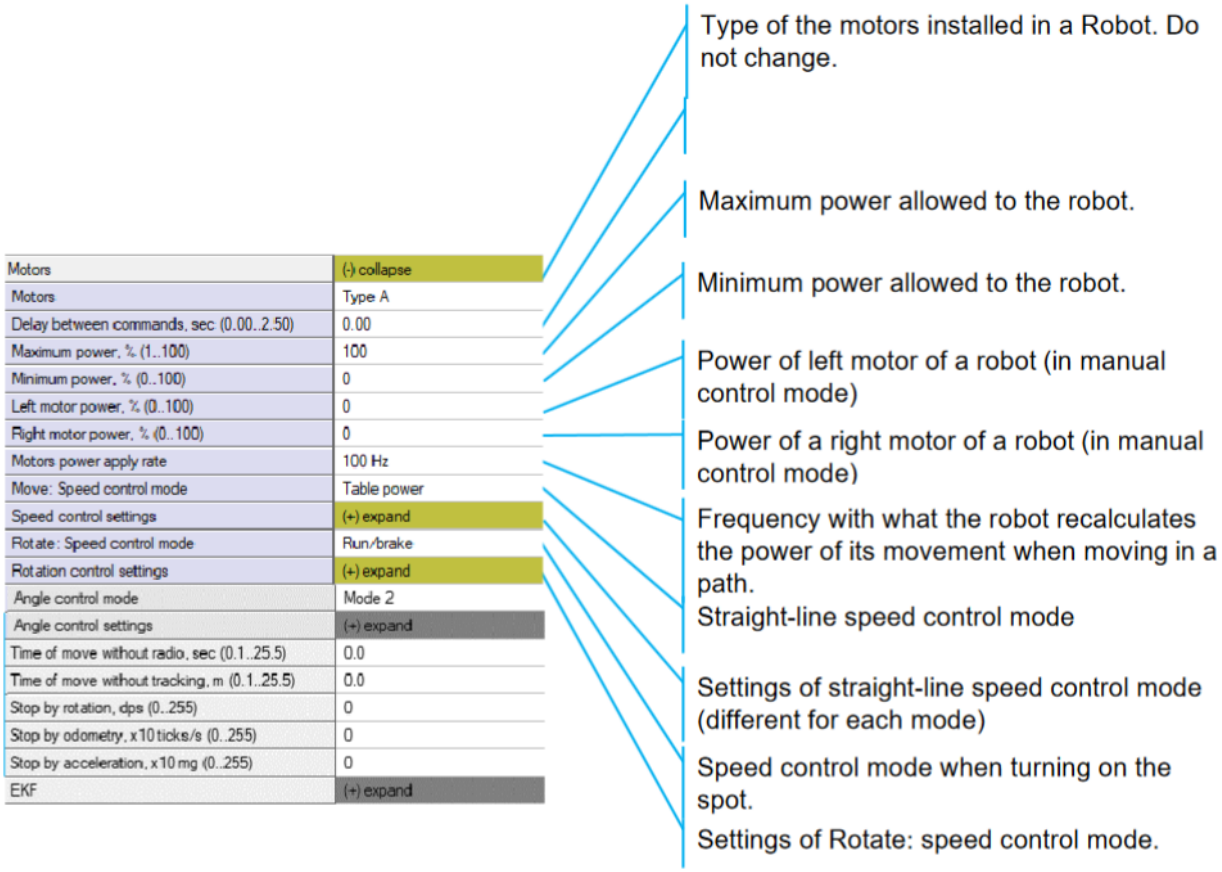
This bar allows user to adjust device precisely. It contains a lot of parameters for advanced usage.

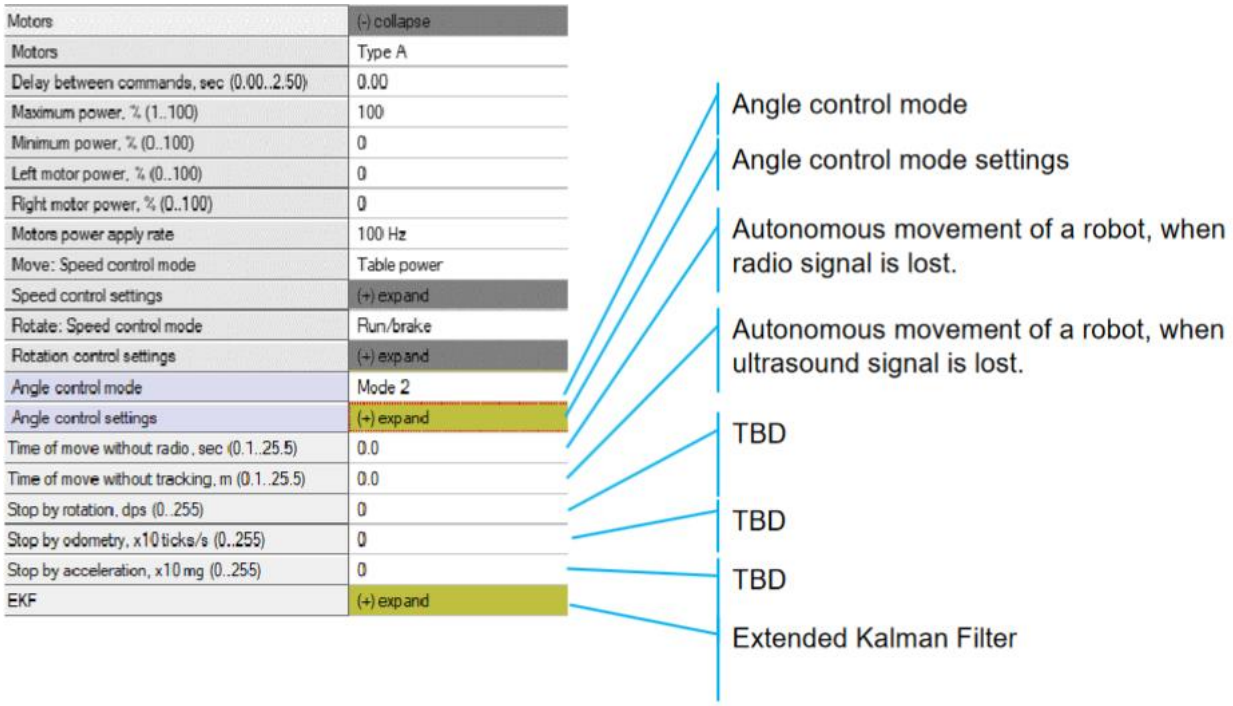
Choose Robot in robots list, to see Robot detailed settings:



10. Main settings and information

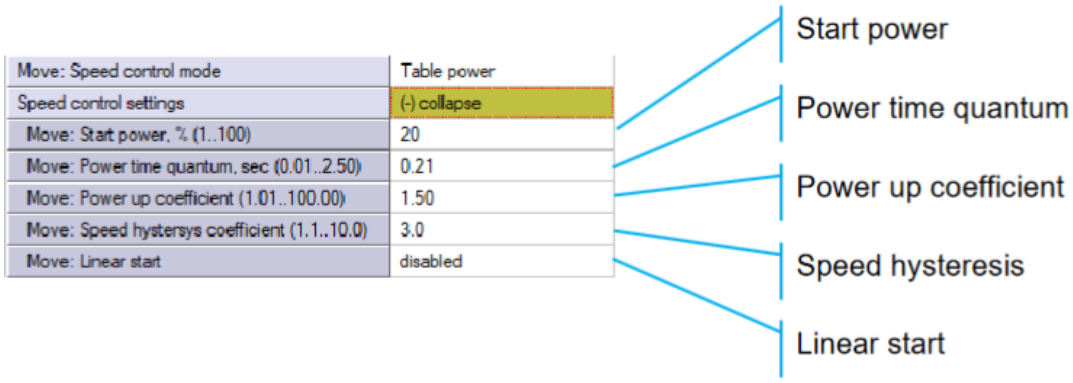
User can see robot's settings, parameters and firmware versions in settings window, which is located on the right side of Dashboard program. This window is shown when focus is on the robot. To change focus click on a robot either on a map or on its address.


Motors
(-) collapse
Motors
Type A
Delay between commands, sec (0.00..2.50)
0.00
Maximum power, % (1..100)
100
Minimum power, % (0..100)
0
Left motor power, % (0..100)
0
Right motor power, % (0..100)
0
Motors power apply rate
100 Hz
Move: Speed control mode
Table power
Speed control settings
(+) expand
Rotate: Speed control mode
Run/brake
Rotation control settings
(+) expand
Angle control mode
Mode 2
Angle control settings
(+) expand
Time of move without radio, sec (0.1..25.5)
0.0
Time of move without tracking, m (0.1..25.5)
0.0
Stop by rotation, dps (0..255)
0
Stop by odometry, x10 ticks/s (0..255)
0
Stop by acceleration, x10 mg (0..255)
0
EKF
(+) expand
Type of the motors installed in a Robot. Do not change.
Maximum power allowed to the robot.
Minimum power allowed to the robot.
Power of left motor of a robot (in manual control mode)
Power of a right motor of a robot (in manual control mode)
Frequency with what the robot recalculates the power of its movement when moving in a path.
Straight-line speed control mode
Settings of straight-line speed control mode (different for each mode)
Speed control mode when turning on the spot.
Settings of Rotate: speed control mode.

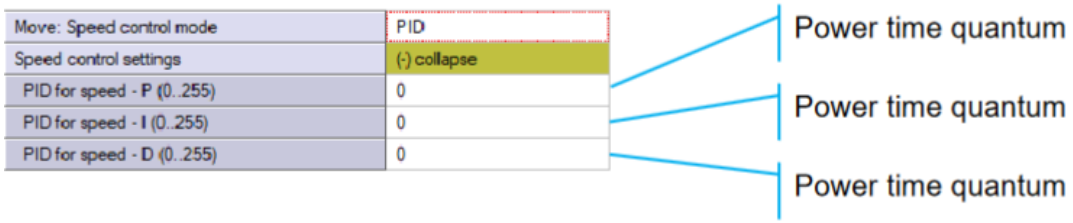

Motors
(-) collapse
Motors
Type A
Delay between commands, sec (0.00..2.50)
0.00
Maximum power, % (1..100)
100
Minimum power, % (0..100)
0
Left motor power, % (0..100)
0
Right motor power, % (0..100)
0
Motors power apply rate
100 Hz
Move: Speed control mode
Table power
Speed control settings
(+) expand
Rotate: Speed control mode
Run/brake
Rotation control settings
(+) expand
Angle control mode
Mode 2
Angle control settings
(+) expand
Time of move without radio, sec (0.1..25.5)
0.0
Time of move without tracking, m (0.1..25.5)
0.0
Stop by rotation, dps (0..255)
0
Stop by odometry, x10 ticks/s (0..255)
0
Stop by acceleration, x10 mg (0..255)
0
EKF
(+) expand
Angle control mode
Angle control mode settings
Autonomous movement of a robot, when radio signal is lost.
Autonomous movement of a robot, when ultrasound signal is lost.
TBD
TBD
TBD
Extended Kalman Filter

10.1.1 Motors

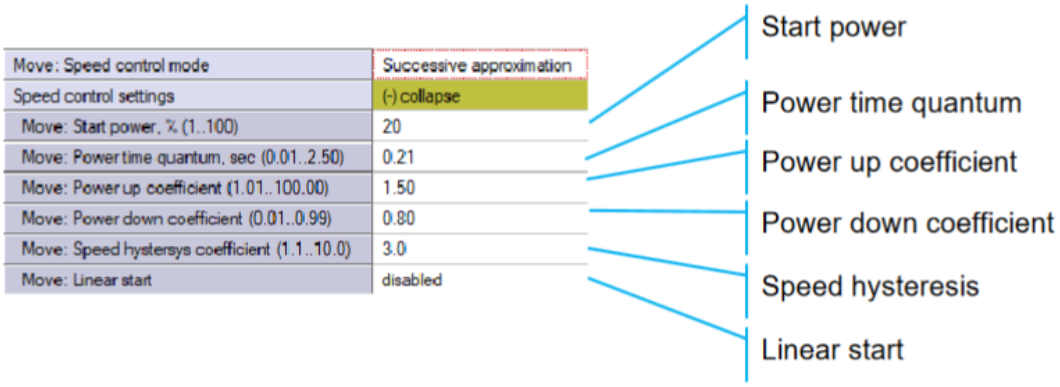
10.1.2 Speed control settings



- Table power mode



- PID



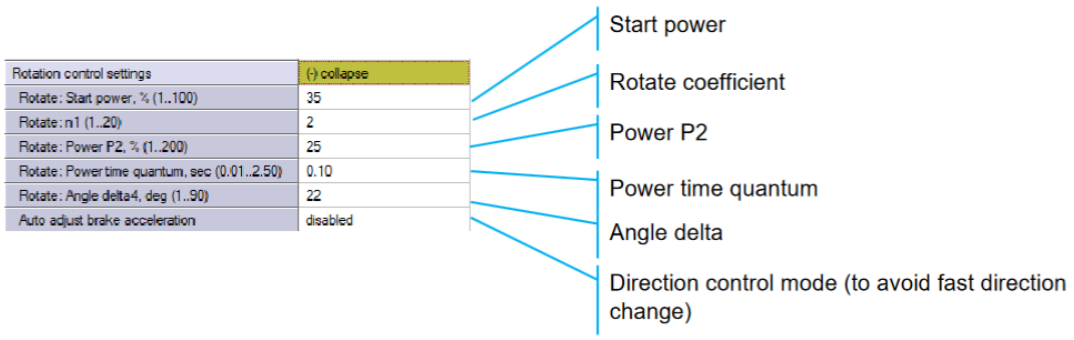
- Successive approximation

- Constant power

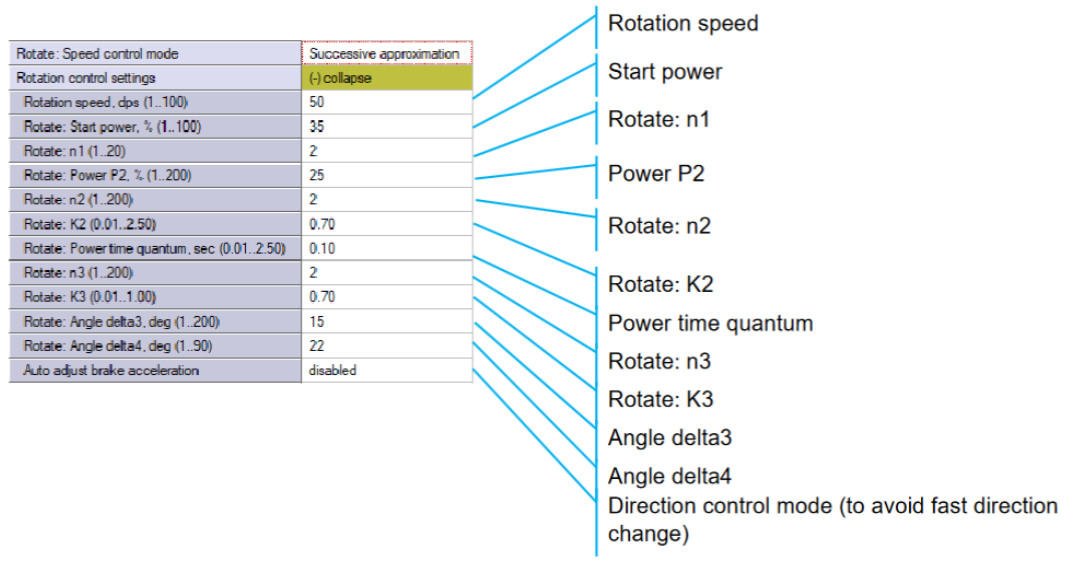
10.1.3 Rotate: Speed control mode

10.1.4

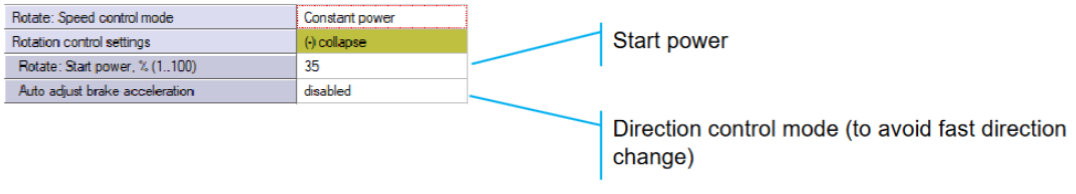
- Run/brake



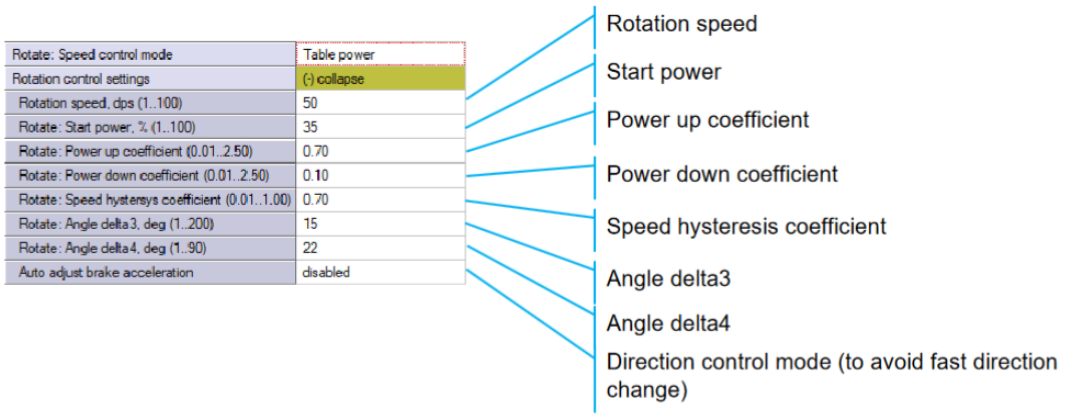
- Rule based mode 1



- Successive approximation
- Constant power

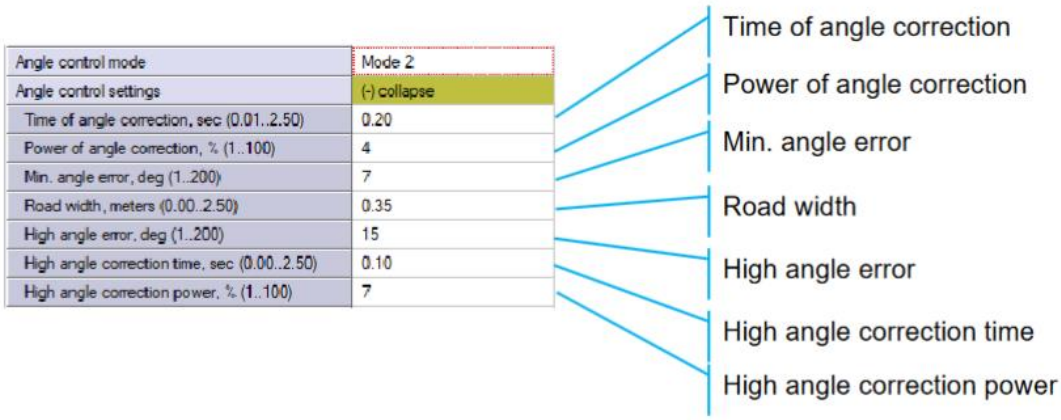


- Table power

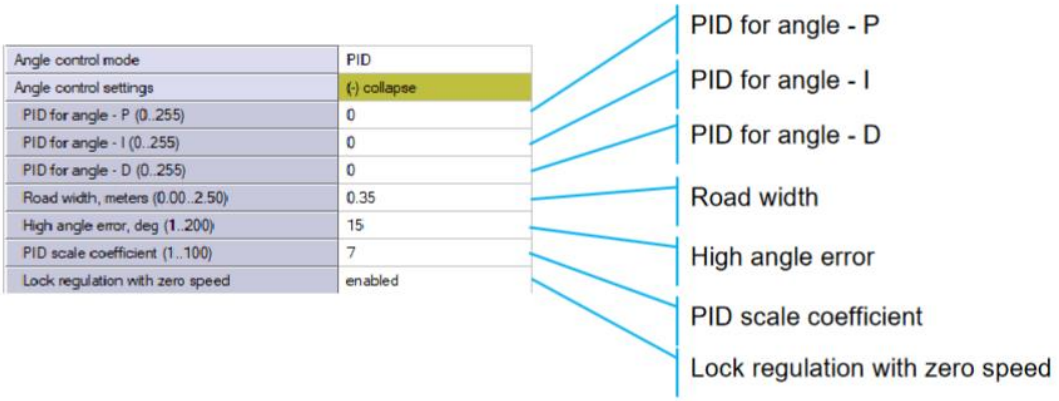

Rotate: Speed control mode
Table power
Rotation control settings
(-) collapse
Rotation speed, dps (1..100)
50
Rotate: Start power, % (1..100)
35
Rotate: Power up coefficient (0.01..2.50)
0.70
Rotate: Power down coefficient (0.01..2.50)
0.10
Rotate: Speed hystersys coefficient (0.01..1.00)
0.70
Rotate: Angle delta3, deg (1..200)
15
Rotate: Angle delta4, deg (1..90)
22
Auto adjust brake acceleration
disabled
Rotation speed
Start power
Power up coefficient
Power down coefficient
Speed hysteresis coefficient
Angle delta3
Angle delta4
Direction control mode (to avoid fast direction change)

10.1.5 Angle control mode

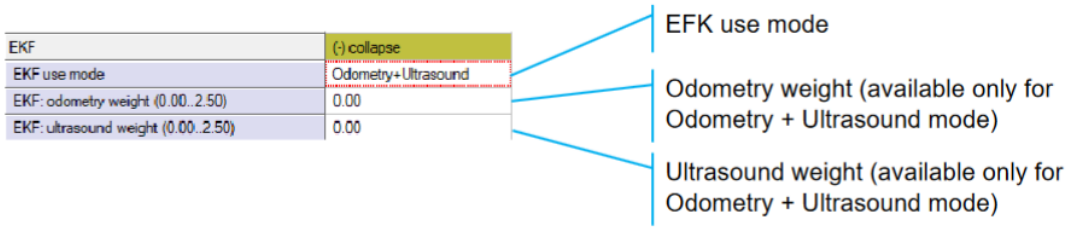
- Mode 2



- PID



10.1.6 EKF

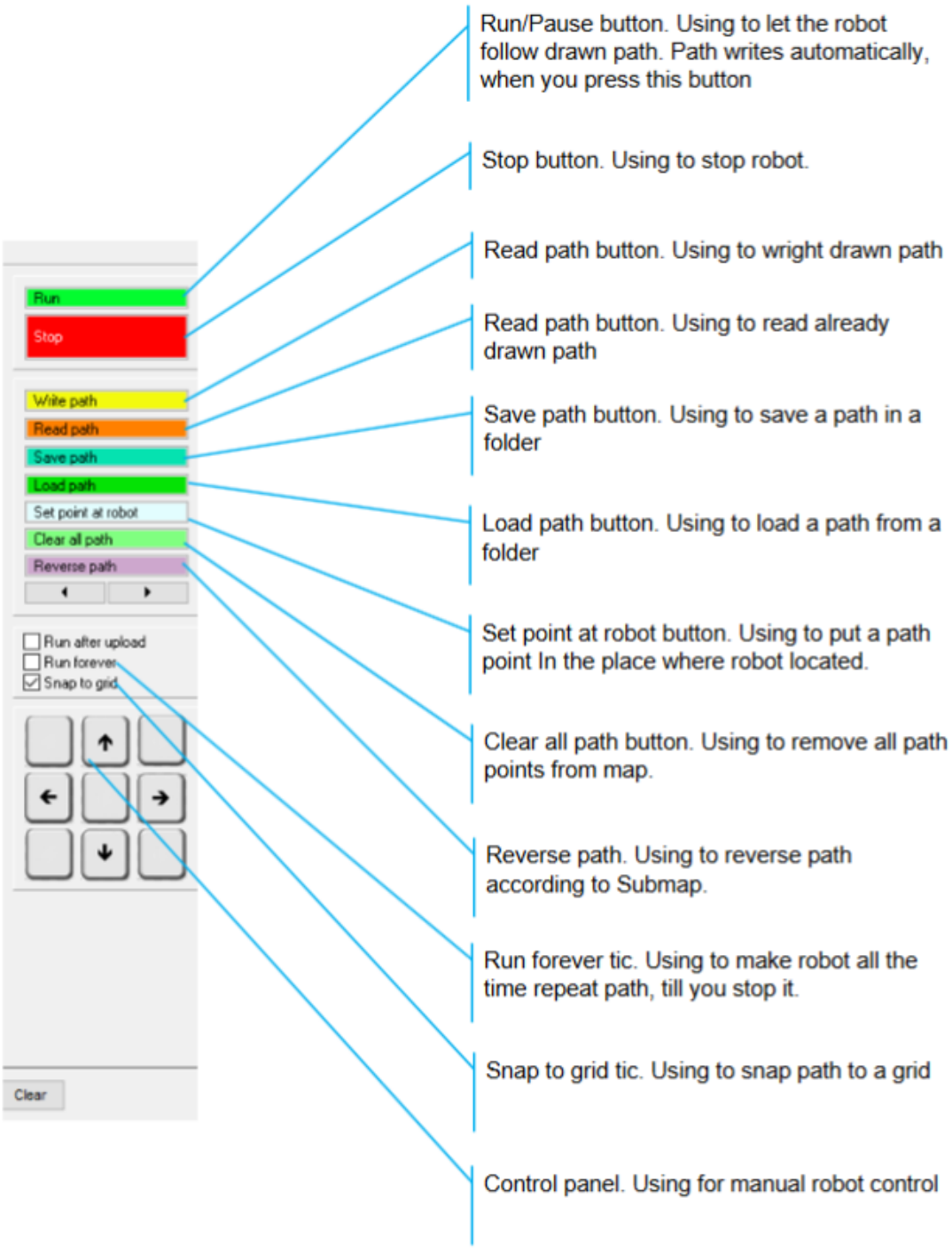


- Odometry + Ultrasound

- Odometry only (no EKF)
- Ultrasound only (no EKF)

10.2 Control Panel for robotRobot control panel

Robot control panel allows to control robot manually, check robot path waypoints, see its versions and parameters

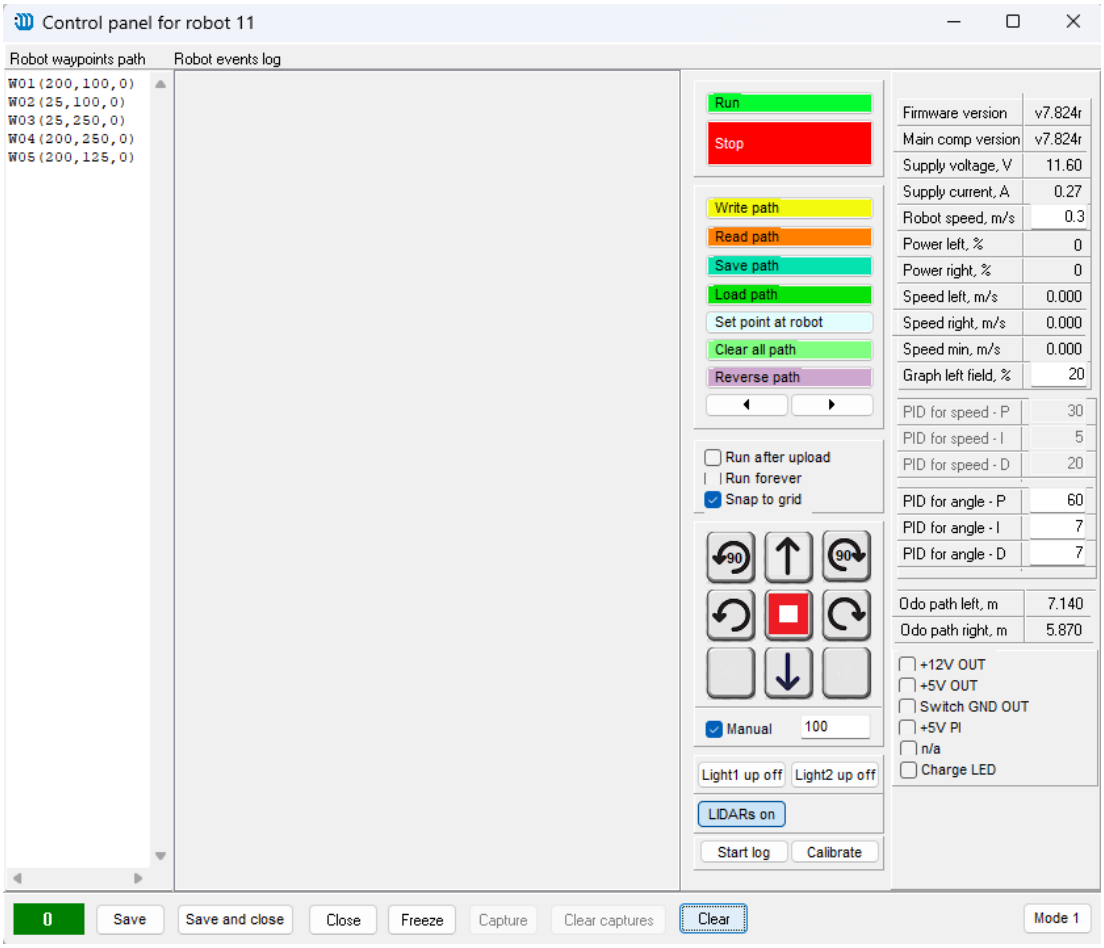


and so on.

To open Robot control panel, go to Tools → Robot control panel, or Left click on a robot (either on a map or on its address) → Robot control panel.

11. Advanced features

This chapter describes features that are intended for more experienced users.



11.1 High-level robot control

Below is a list of commands for manually compiling the path of the robot. From these, you can compose the robot's behavior such as the direction of movement and interaction with other devices. If you need more advanced commands to configure the robot, contact us at info@marvelmind.com and we will try to include these commands in the next release of SW Pack for Boxie 2.

The commands are executed one after the other from top to bottom.

After pressing the Run button, the commands are sent to the robot, after which it says 'Path loaded'. It then says 'Starting' and starts executing the first (upper) command

In the process, you can pause the execution with the Pause button (after that, you can continue from where you stopped with the Continue button),

The Stop button stops without the possibility of continuing, you can only start over

Commands:

Command name	General format	Command example	Comment
Movement to a given point (waypoint)	Wnn(X,Y,Z)	**W01(1000,2000, 0)** Here: 01 - point number 1000 - X coordinate of the point in cm, i.e. 10.00 m 2000 - Y coordinate of the point in cm, i.e. 20.00 m 0 - Z coordinate of the point in cm, i.e. 0.0 m	1. For the Boxie 2 robot, Z coordinate can be anything, for example 0. Reserved for robots that can move in 3D 2. It is not necessary to enter commands to move to a point manually - you can click shift + click on the desired point on the map
Rotate clockwise by a specified angle	Clockwise(A)	**Clockwise(90)** Here: 90 - the angle to turn, degrees	
Rotate counterclockwise by a specified angle	Counterclockwise(A)	**Counterclockwise(90)** Here: 90 - the angle to turn, degrees	
Moving forward a specified distance	Forward(D)	**Forward(100)** Here: 100 - movement distance in cm	The word 'Forward' can be shortened to 'F': F(100)
Moving backward a specified distance	Backward(D)	**Backward(100)** Here: 100 - movement distance in cm	The word 'Backward' can be shortened to 'B': B(100)
Pause in motion	P(T,B)	**P(10.5, 1)** Here: 10.5 - pause time, sec 1 - button number (behind Boxie 2) - 1 or 2	The pause ends either after the time has elapsed, or by pressing the specified button Instead of time, you can write 'inf', then there will be no time limit Instead of the button number, you can write 'any', then the pause will end when you press any button
Repeating a sequence of commands in an infinite loop	Run forever	**Run forever**	If this command is present at the end of a sequence of commands, the sequence is repeated in an endless loop You can insert/delete this command with the 'Run forever' checkbox in the control window.

13. Contacts

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