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Version changes

V2020_04_02
  - Initial release
1. Executive summary

Marvelmind Autonomous Delivery Robot is a fully autonomous, economically viable and safe robot for delivery of small-size goods for warehouse, retail and industry.

**Key robot’s features:**
- Fully autonomous delivery from point A to point B indoors with a single button click
- Up to 60 kg payload with easily reconfigurable multi-shelves, for example:
  - 160x65x65 cm – 1 shelf or
  - 50x65x65 cm – up to 3 shelves or
  - 15x65x65 cm – up to 8 shelves
- Automatic obstacle detection and avoidance for safety and productivity
- Long battery lifetime - ≥ 16h drive with maximum load on a single charge
- Fast charging - ≤ 4h (Fast charger is included)
- High-capacity Autonomous Delivery System supports up to 250 robots per system

There are multiple options, including, but not limited to QR-scanner to eliminate errors loading & unloading and task fulfillment, touch-screen display for advanced control and many more.
Key specs:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Technical Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Navigation</td>
<td>Marvelmind Indoor “GPS”</td>
</tr>
<tr>
<td>Control</td>
<td>Single button control to send from point A to point B</td>
</tr>
<tr>
<td>Top speed</td>
<td>( \leq 7 \text{ km/h} )</td>
</tr>
<tr>
<td>Payload</td>
<td>( \leq 60 \text{ kg} )</td>
</tr>
<tr>
<td>Driving time</td>
<td>( \geq 16 \text{h} ) on a single charge with 60+kg payload</td>
</tr>
<tr>
<td>Charging time</td>
<td>( \leq 4 \text{h} ) with quick charger</td>
</tr>
<tr>
<td>Safety</td>
<td>- LIDARs for obstacle detection and avoidance</td>
</tr>
<tr>
<td></td>
<td>- Emergency buttons</td>
</tr>
<tr>
<td></td>
<td>- External control by dispatcher</td>
</tr>
<tr>
<td>Weight</td>
<td>40 kg</td>
</tr>
<tr>
<td>Battery</td>
<td>LiPol, 36 V &amp; 840Wh</td>
</tr>
</tbody>
</table>

![Image of the robot](image-url)
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
2. System description

Marvelmind Autonomous Delivery System consists of three major elements:

1. Marvelmind Autonomous Delivery Robots
2. Marvelmind Indoor “GPS”
3. Marvelmind Control System

2.1 Marvelmind Autonomous Delivery Robots

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

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

2.1.1 Powertrain

Bringing together large batteries, powerful motors and smart controllers in one device, the Autonomous Delivery Robots are very productive and budget friendly at the same time. Together the systems create a perfect balance between battery life and performance.

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

Marvelmind Delivery Robots have customizable multi-shelves, which means you can configure according to your needs since 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 ending with the top ones for correct weight distribution and avoiding rollover.
2.1.3 Obstacle avoidance and detection

Marvelmind Autonomous Delivery Robots are equipped with multiple low-cost LIDARs for increased safety and in order to provide solid coverage in different cases.

Side view:

Top view:
Basic functions using lidars:
- Emergency stop
- Obstacle detection and avoidance
- Rebuilding paths and alarming if stuck

Emergency stop

Emergency stop function is a basic safety function, which makes it possible to stop at a safe distance from an obstacle (human, box, etc.).

When robot detects an obstacle, it immediately stops and turns on the sound alarm.

You can see an example here - [https://youtu.be/efOc-lTvvgg?t=67](https://youtu.be/efOc-lTvvgg?t=67)

Obstacle detection and avoidance

Obstacle detection and avoidance is a feature which helps to increase working time of the robot. Instead of stopping and waiting, it finds new paths to reach its target location.
Alarming if finally stuck

If robot detected an obstacle, tried to build a new path through it and then got stuck, it activates an alarm. Not only with sound and lights but additionally sending an alarm to the control system. Personnel in charge of the control system will be notified and be able to send a technical crew for help.
2.1.4 QR-scanner

QR-scanner placed in dedicated and convenient holder. It was added and linked with robot's ECU. It can be added to decrease wrong deliveries and placement of wrong goods.

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 take goods with code 0021 and scan it. If it's match – robot will start and go to its finish point
- If worker mixed goods and scanned good with code 0022, robot won't drive and will notify worker about the mistake. It also will write that mistake into CSV-file for future analysis
- Delivery complete

You can also use the scanner as a regular scanner, without strong bond to the Marvelmind Autonomous Delivery System.
2.1.5 Touch screen control (optional)

Touch screen gives advanced experience and control level over Marvelmind Autonomous Robots. It replaces some and complements other hardware controls and buttons on the housing of the robot.

Additional features that touch screen gives compared to buttons:

- Supports sending the robot to any allowed point on the map simply clicking on the map
- Displays detailed information about current task
- Highlights goods code and delivery stage
- Displays statistics in real time
- Allows edit tasks and order
- Edit paths
- Displays whole map with robots and paths
2.2 Marvelmind Indoor “GPS” 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.

For more details of the system – [Operation Manual](#).

More details of correct placement – [Placement Manual](#).

![Marvelmind Indoor “GPS” system is not supplied together with Marvelmind Autonomous Delivery Robot](image)
2.3 Control System

The Control System allows you to configure the system, receive various telemetry from the robots, collect statistics, prepare analytics and form reports.

The center of the control system is the Marvelmind Dashboard. It communicates with the Super-Modem via USB or UDP, receives telemetry from the Marvelmind Indoor “GPS” and from the robots, and sends data in various formats to external systems, for example, warehouse management system (WMS) and enterprise control system (ECS) for control and analytics.

Control System allows remote monitoring and remote control of the robots:
- Reading of all telemetry from all elements of the Indoor “GPS” navigation system, all robots and all other mobile beacons installed on forklifts, drones, people
3. What’s in the box

The base robot configuration consists of the following elements:

1. Robot’s chassis which includes robot’s base and multi-shelves
2. Fast charger

3.1 Autonomous delivery robot

Marvelmind Autonomous Delivery Robot comes in the box with safety plastic caps.

⚠️ Remove safety caps and clips before using

Depending on the country, the Marvelmind Autonomous Delivery Robot will be supplied in two versions:

- Two boxes version:

![Two boxes version](image1)

- One larger box version:

![One larger box version](image2)
3.2 Marvelmind power charger

Marvelmind charger comes in the box.

⚠️ Use only Marvelmind supplied chargers
4. Robot’s controls and basic operations description

This chapter describes interactions with the robot and the basic robot controls.

4.1 Controls

The robot has several control options:

- Manual control panel (Top control panel) for sending from point A to point B for different routes

4.1.1 Top control panel

Top control panel contains buttons which control robot and its paths. It also contains emergency stop button.

- Button: Continue along the route after stopping
- Button: Emergency stop/Hand brake
  Hold for 3 seconds to turn off hand break to allow rolling the robot by hand
- Go to warehouse
- Go to assembly floor
4.1.2 Bottom control panel

Bottom control panel contains main control buttons and charging port. It also contains the main power switch.
4.1.3 Break lever

Break lever added for safety during charging and long-term parking. It blocks the wheel and keeps the Marvelmind Autonomous Delivery Robot safe from unintentional moving.

Break lever (on each wheel)
Lower for long parking, storage, and charging. Lift before starting work.
4.2 Charging

The Autonomous Delivery Robot is supplied with a powerful fast charging 42V & 10A.

Use regular precautions when working with high-current electronics equipment.

Before charging the robot lower the break levers to prevent the robot and connect cable into charging port. Time until full battery is 5 hours. Operating time at 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 Delivery Robots support Inverse Architecture

How to launch:
5.1. Set up the Marvelmind Indoor “GPS” system. It’s detailed described in the Operating Manual
5.2. Configure paths and start/end points.
5.3. Reset the modem and connect it to the network.
5.4. Wait for 30 seconds after connecting (keep the modem and antenna vertically).
5.5. Position the robot on the driving zone/path.
5.6. Press the blue button (go to point 2 - end point).
5.7. After arrival at end point press the black button (go to point 1 - start point)
6. Contacts

For additional support or request for additional features and functionalities contact us via info@marvelmind.com.