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ELITEMISSION ROBOTS

MN Series of user guides



MN500-CE User Manual

Mission Intelligent Robot (Suzhou) Co., Ltd.
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Version: Ver1.0.0

Read this manual carefully before use

The product version information corresponding to this version of the user manual can be found in the version information section of this manual. Please carefully check the actual product version information before use to ensure consistency.

The user manual will be regularly checked and revised, and the updated content will appear in the new version. The contents or information in this manual may be changed without further notice.

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Read this manual before installing and using the product.

Please keep this manual well so that you can read and refer to it at any time.

The pictures in this manual are for reference only. Please refer to the actual item received.

Table 1 version information

Name	Version
User Manual	Ver1.0.0

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Contents

1.Precautions before use 1
1.1.General Safety Statement 1
1.1.1. Safety Liability Statement 1
1.1.2. Personnel qualification requirements 1
1.1.3. Safety Labeling Instructions 2
1.1.4. Safety level definition 2
1.1.5. Safety Precautions 3
1.1.6. Safety precautions 6
1.2.Handling and unpacking 8
1.2.1. Precautions for handling 8
1.2.2. Packaging and transportation instructions 8
1.2.3. Handling 8
1.2.4. Packaging and unloading 9
1.2.5. Packing list 9
1.3.Operating environment requirements 10
1.3.1. Site ground requirements 10
1.3.2. Network environment requirements 11
1.3.3. Runtime field environment requirements 12
1.3.4. Transportation and storage of the robot 12
1.4.Safety requirements related to batteries and charging stations 13
1.4.1. Precautions for using lithium batteries 13
1.4.2. Safety requirements for using charging piles 14
1.4.3. How to deal with a damaged lithium battery 15
1.4.4. How to deal with discarded lithium batteries 15
1.5.Noise 15
2.Product Instructions 16
2.1.Product Introduction 16
2.1.1. Features 16
2.1.2. Application industry 17
2.2.Product structure 17
2.2.1.AMR dimension diagram 17
2.2.2. Parts description 18
2.2.3. Optional accessories 20

2.3.Basic features and descriptions of the product 20
2.3.1. Feature List 20
2.3.2. Technical Parameters 24
2.3.3. Navigate the laser detection range 26
2.3.4. Human-machine interaction status description 26
2.3.5. Load stability description 26
2.4.Product nameplate 27
3.Quick Instructions 28
3.1.Switches and Buttons 28
3.1.1. Power-on switch 28
3.1.2. Emergency stop switch 28
3.1.3. Release the brake switch 29
3.1.4. Reset switch 29
3.2.Mode selection 29
3.3.Charging 30
3.3.1. Quick battery swap 30
3.3.2. Automatic charging 30
4.Robot application software for use 32
4.1.Application software interface toolbar 32
4.1.1. Common Toolbars 32
4.1.2. Robot Toolbar 34
4.2.Connect robots 35
4.3.Map 38
4.3.1. Draw a mirrorless map 38
4.3.2. Draw an anti-map 40
4.3.3. Path point 42
4.3.4. Import Map 44
4.3.5. Edit the map, draw map paths and add obstacle avoidance areas 46
4.3.6. Map global speed modification 46
4.3.7. Map local path speed modification 47
4.4.Robot-controlled navigation walks 47
4.5.Obstacle avoidance 47
4.5.1. Testing and setting up robot obstacle avoidance schemes. 47
4.5.2. Configure the obstacle avoidance scheme 48
4.5.3. Apply the obstacle avoidance scheme 50
4.6.Positioning 52

4.6.1.Determine location 52
4.6.2.Accurate positioning 53
4.6.3.Repositioning 53
4.7.Configure wireless IP 55
5.Maintenance and servicing 57
5.1.Maintenance Precautions 57
5.2.Maintenance tools 58
5.3.Maintenance cycle instructions 59
5.3.1.Daily service and maintenance of the robot 59
5.3.2.Floor cleaning requirements 60
5.3.3.Robot cleaning requirements 60
5.3.4.Laser cleaning requirements 61
5.3.5.Regular cleaning program 61
5.3.6.Monthly service and maintenance (i.e. monthly inspection after the equipment is operational) : 62
5.3.7.Annual service and maintenance (i.e. annual inspection after the equipment is put into operation) : 63
5.4.Warranty Instructions 64
5.5.Simple Troubleshooting 65
5.6.List of vulnerable parts 66
5.7.Maintenance instructions 67
5.7.1.Maintenance of electrical components 67
5.7.2.Maintenance of casters 67
5.7.3.Maintenance and upkeep of drive components 68
5.7.4.Lithium battery maintenance 68
6.Appendix 69
6.1.Appendix A: Daily Maintenance Record Checklist 69
6.2.Appendix B: Monthly Maintenance Record Checklist 71
6.3.Appendix C: Annual Maintenance Record Checklist 73

1.Precautions before use

The operator is responsible for ensuring that the production environment of the robot complies with and conforms to national and local safety laws, regulations and rules. Robots are different from other equipment. Due to their characteristics such as high speed, wide range of motion and complex posture changes during operation, they are likely to cause personal injury or equipment accidents. Therefore, special attention must be paid to safety matters to avoid unnecessary losses.

Before carrying out installation, operation and maintenance work, be sure to have a thorough understanding of robot equipment knowledge, safety information and all precautions.

The robot, AMR, mobile robot, equipment, etc. that appear separately in the document are abbreviations for this vehicle body.

The robot may not be disassembled or assembled without authorization.

If the robot has any abnormal problems, please contact the manufacturer in time.

1.1.General Safety Statement

- Read and follow the safety precautions before installing, operating, and maintaining the product.
- For personal and equipment safety, please follow all safety precautions marked on the product and described in the manual when installing, operating and maintaining the product.
- The "precautions", "warnings" and "hazards" in the manual do not represent all safety instructions to be followed and are only supplementary to all safety precautions.
- This product should be used in an environment that meets the design specifications; otherwise, it may cause malfunctions. Functional abnormalities or component damage caused by non-compliance with relevant regulations are not covered by the product quality guarantee.
- Our company shall not be liable for any personal safety accidents, property damage, etc. caused by improper operation of the product.

1.1.1.Safety Liability Statement

Robots are committed to providing reliable safety information, but cannot guarantee the completeness of safety information. Even if operations are carried out in accordance with safety precautions, there is no guarantee that the robot will not cause personal or property damage in complex situations and uncertainties.

1.1.2.Personnel qualification requirements

Robots are only allowed to be installed, debugged, operated and maintained by qualified professionals.

In addition to the basic mechanical, electrical, commissioning operation, maintenance knowledge required for the work described herein, the transportation and handling of this product also require knowledge of the use of lifting devices and corresponding lifting gear. To ensure safe use, these tasks can only be carried out by professionals or by trainees under the guidance of professionals.

A professional is a person who, based on his professional education, knowledge and experience, and understanding of the relevant regulations, is capable of determining the work to be carried out, identifying potential hazards and taking appropriate safety measures. Professionals must adhere to relevant professional standards and possess the necessary professional knowledge.

- Mechanical installation and commissioning requirements

The personnel performing the mechanical installation and commissioning should have professional knowledge and experience in the relevant field and be fully experienced in assessing

whether the machine is in a safe operating condition after the use of protective equipment.

➢ Electrical installation and commissioning requirements

The person performing the electrical installation and commissioning should have professional knowledge and experience in the relevant field and be fully experienced to assess whether the machine is in a safe operating condition after the use of protective equipment.

➢ Operation and maintenance requirements

Personnel performing operations and maintenance should have professional knowledge and experience in the relevant field, be familiar with the application of protective equipment on the machine, and be guided by the machine user.

➢ Personal protective equipment requirements

When using this product, operators should wear appropriate personal protective equipment (such as safety shoes, do not let long hair loose, etc.).

As an equipment operator or operator, you are obligated to prepare appropriate protective equipment when using this product.

All components of personal protective equipment must be complete.

1.1.3.Safety Labeling Instructions

Table 11 Safety Label Instructions Table

	Safe electricity usage tips: Pay attention to electrical safety when using.
	Warning signs: All operations involving such signs and related product safety and user safety must be carried out strictly in accordance with the requirements, otherwise it will cause damage to the product or endanger the user's personal safety.
	Prohibition sign: All actions with this sign must be prohibited, otherwise it will damage the product or endanger the personal safety of the user.

1.1.4.Safety level definition

Table 12 Security Level Definitions Table

	"Dangerous" means that if not operated in accordance with the regulations, it would result in death or serious physical injury.

Danger	
 Warnings	"Warning" means that if not operated in accordance with the regulations, it may result in death or serious physical injury.
 Note	"Caution" means that if not operated as prescribed, it may result in minor physical injury or equipment damage.

1.1.5.Safety Precautions

Table 13 Safety Precautions Table

Unpacking inspection	
 Note	● Please check the outer packaging of the device before opening the box for any damage, moisture, dampness, deformation, etc. ● Please open the package in the order of layers and do not strike it hard! ● When opening the box, please check the surface of the equipment and accessories for any damage, rust, scratches, etc. ● After opening the box, please carefully check against the packing list to verify the quantity and completeness of the equipment and accessories.
 Warnings	● Do not install if damage, rust, signs of use or other issues are found with the equipment and accessories upon unpacking! ● Do not install if you find water inside the device, missing parts or damaged parts upon opening the box! ● Please check the packing list carefully. Do not install if the packing list does not match the device name!

Storage and Transport	
 Danger	● Handling operations such as rigging, crane lifting, or forklift driving should be carried out by qualified operators, otherwise serious injury or material damage may occur.
 Warnings	● Please handle with cranes and forklifts, etc. in their original packaging as much as possible. ● When using cranes, hoists and other handling equipment, the operator must wear personal protective equipment. No one is allowed to stand or stay around the handling route. ● When lifting equipment, hold it with your hands to ensure balance. Unstable lifting may cause the equipment to fall, resulting in serious injury or significant damage.
 Note	● Please store and transport the equipment in accordance with the storage and transport conditions. The storage temperature and humidity should meet the requirements. ● Avoid storing and transporting in places where water splashes, rain, direct sunlight, strong electric fields, strong magnetic fields, strong vibrations, etc. ● Avoid storing the equipment for more than 3 months. If it has been stored for an extended period, provide more rigorous protection and necessary inspections. ● Please pack the equipment strictly before vehicle transportation and use closed boxes for long-distance transportation. ● It is strictly prohibited to transport this equipment together with other equipment or items that may affect or damage it.
Use	
 Danger	● Use the system under specified environmental conditions, otherwise it may shorten the lifespan of the equipment and may also cause serious safety problems. ● Use the system within the specified range, otherwise it may shorten the lifespan of the equipment and may cause serious safety issues.

 Warnings	● Before proceeding, check that the system is properly installed, that cables and air sources are properly connected, and that peripheral devices are properly connected. ● Do not change factory Settings at will. ● If the system performs abnormal actions during operation, press the emergency stop switch immediately, otherwise serious safety issues may arise. ● It is strictly prohibited to carry non-standard items, such as flammable and explosive materials, personnel, etc. ● Make sure the load is properly installed during transportation. Overturning of equipment or dropping of load can cause personal injury; ● Fluid loads should be avoided as much as possible during transportation to prevent leakage; ● Using a charger other than the one provided by the manufacturer may damage the battery and may cause a fire; ● Do not use AMR devices to transport people; ● Ground slope grades (ramps, etc.) should not exceed 5%, as this could cause the robot to slip. ● Only travel on uniformly dry surfaces; wet and uneven surfaces may cause the robot to skid; ● The maximum payload for the top load of the robot is 500kg, and exceeding it may cause overturning, load drop and machine damage;
Maintenance and repair	
 Danger	● It is strictly prohibited for non-professionals to install, wire, maintain, inspect or replace parts of the equipment; ● Do not perform maintenance or upkeep on the equipment while it is powered on, otherwise there is a risk of electric shock; ● Do not disassemble parts not recorded in this manual or perform maintenance in a manner different from that recorded.
 Warnings	● When the equipment malfunctions or is damaged, have a professional troubleshoot and repair the equipment in accordance with the maintenance instructions, and keep a maintenance record. ● Replace parts in accordance with the replacement instructions in the manual. ● When maintaining, please do not allow foreign objects to enter the interior of the equipment or the connection terminals. ● Do not open the cover of the equipment except when performing maintenance and servicing operations. ● After replacing the equipment, be sure to recheck the wiring and set the parameters of the equipment.

 Note	● If the AMR is not in use for a long time or during holidays, it needs to be charged for maintenance if it is not used for more than 2 months. ● Do not modify program parameters when the AMR is running normally.

1.1.6.Safety Precautions

Table 14 Safety Precautions Table

	● This product has a high voltage, so non-professionals should not remove its casing to avoid electric shock; ● The grounding end of the power socket connected to this product should be reliably grounded, and all sockets, wires and other components should be certified as qualified products in accordance with relevant national regulations; ● The power circuit connected to this product shall be equipped with overload protection devices such as fuses of appropriate specifications; Do not oversqueeze, bend or twist the AC power line to avoid core breakage or short circuit; ● Turn off the power when not in use; ● There is no short circuit, charging or incorrect connection between the positive and negative electrodes; ● Do not expose to an environment beyond the specified range and do not burn the battery; ● Do not squeeze, puncture or remove the battery, which, if damaged, may cause the battery to heat up, explode or burn; ● The battery is recyclable. Do not burn, wet or discard at will, but dispose of other waste in accordance with local requirements; ● Only the original charger and battery manual are applicable.



- This mobile robot can only be used indoors and not outdoors;
- Small objects are not allowed on the floor within the area where the robot moves, as the robot cannot detect obstacles smaller than 185 millimeters;
- Components should be protected from overheating and the robot's working environment should not exceed 45 ° C;
- Do not expose the robot to extremely wet or extremely dry conditions and meet environmental requirements;
- This product should be used away from heat sources and direct sunlight to prevent plastic and rubber parts from accelerating aging and affecting its service life;
- No one is allowed to enter the operating area while the product is in operation;
- No water splashes on the equipment. If water accidentally gets into the product, ventilate and dry it before use;
- This product requires regular maintenance and cleaning as specified in this manual to avoid affecting its service life;
- If the floor, wall or other usage environment no longer meets the environmental requirements of this product, discontinue the use of this product and correct it;



- Untrained personnel are not allowed to operate and use this product;
- No one is allowed to enter the restricted area while the product is in operation, and the safe distance between the robot and the person must not be less than 500mm;
- No disassembly or modification of the product is allowed by professionals not designated by the company;
- Do not place open flame sources near the product;
- Do not use this product near flammable and explosive gases and liquids;
- Do not use organic solvents or corrosive liquids to wipe the exterior, plastic parts and rubber parts of this product;
- Liquid leakage should be avoided during transportation.
- Do not insert your hand into the gap between the housing and the robot housing;
- Do not insert your hands into the gap between the front and rear chassis;
- Do not touch the robot during operation.

1.2.Handling and unpacking

1.2.1.Precautions for handling

Table 15 Handling Precautions Table

 Notes	● The packaging weight of the robot is relatively large, so the prescribed labor protection equipment should be worn during handling, and reasonable handling methods should be adopted to avoid personal injury or damage to the robot; ● Robots should be kept dry during transportation or temporary storage to avoid inversion, rain and high-temperature environments. When hoisting the robot, pay attention to a firm installation and insertion depth to ensure stability and reliability, prevent collisions with objects and personnel, and prevent the robot from falling off.

1.2.2.Packaging and transport instructions

The robot should be packed in wooden cases according to the appropriate specifications. The packaging requirements are as follows:

➢ Wrap the robot in a wooden box or foam paper to prevent damage to the robot during transportation;

➢ Secure the robot to the wooden box chassis to ensure it does not move on the plane during transportation;

➢ Because the robot is heavy, it is recommended to use lifting equipment such as a gantry crane to assist the robot in packaging to avoid the danger to human body caused by manual handling;

➢ After placing the robot in a wooden box, it is necessary to secure the robot inside the box to ensure that it does not move; The box with the robot inside should be transported using dedicated equipment. During the transportation of the crates, the handling requirements of the robots should be strictly followed to prevent the crates from getting wet. Do not stack more than two boxes on top of each other, and keep the boxes flat.

1.2.3.Handling

Handling preparation: It is recommended to use a 1T forklift.

The packaging box is a steel-edge wooden box. Please prepare a 1T forklift in advance, lift the packaging box off the transport vehicle in the direction shown in Figure 1-1, and transport the packaging box to the equipment installation position.

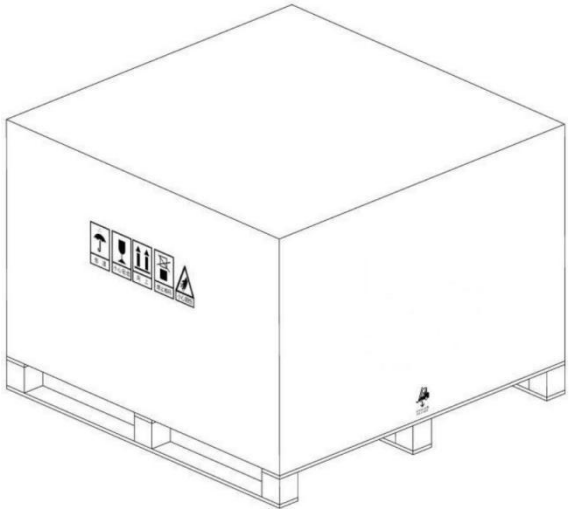


Figure 11 Handling of packaging boxes

1.2.4.Packaging and unloading

Robots are typically placed on planks, as shown in Figure 1-2, and then packed into boxes. However, due to the limitations of the actual loading and unloading environment, loading and unloading may not be convenient. Therefore, it is recommended to use a ramp.

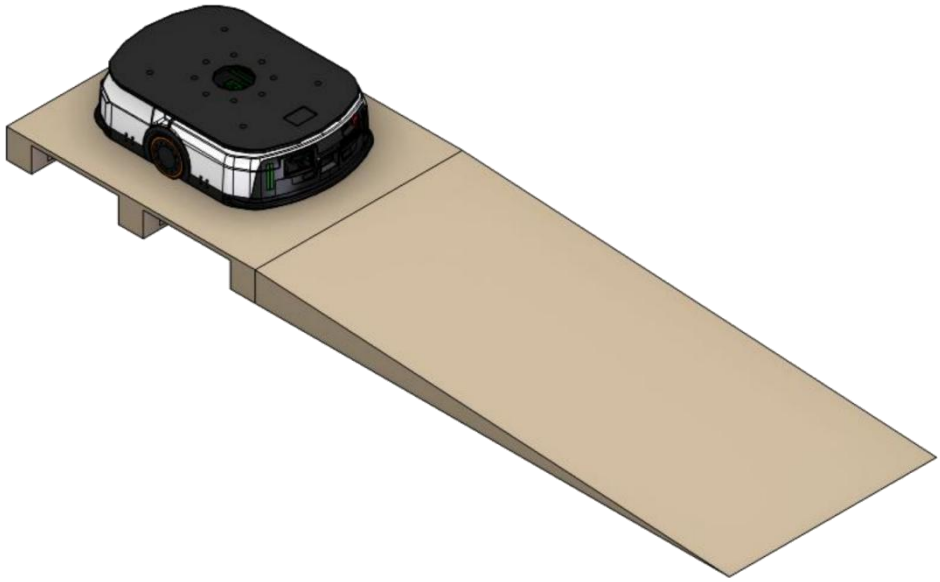


Figure 11 AMR packaging and unloading

1.2.5.Packing list

After opening the box, please confirm the product status and composition types according to the packing list.

Table 16 Packing List

Material names	Quantity (PCS)

Robot body	1

1.3.Operating environment requirements

1.3.1.Site ground requirements

Before the robot enters the site, the robot operation area should be inspected and evaluated by Mission staff in accordance with the technical requirements of the robot for the ground. The modification shall be carried out by the customer themselves. After the construction is completed, on-site inspection and acceptance shall be conducted after inspection. The basic requirements for the floor are as follows: Ground technical requirements (refer to national standard GB50209-2010 code for acceptance of Construction quality of Building ground engineering) :

- Degree of undulation: The maximum allowable value within 1 square meter should be less than 3mm (inclusive);

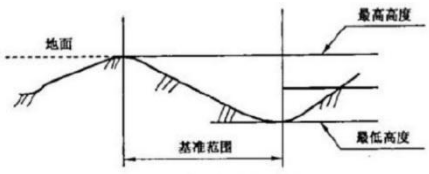


Figure 12 Diagram of the range of undulation

- Road slope: Road slope (H/L) is defined as the maximum ratio of the horizontal height difference of the road surface to the road surface length over a length range of 100mm for the robot. The maximum allowable value of the road slope must be less than 0.05 (including 0.05), and for parking points that require precise positioning, it must be less than 0.01 (including 0.01);

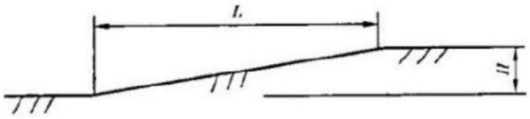


Figure 13 Diagram of the range of road slopes

- Step height: Step height is defined as the maximum of the road surface level height difference within a length range of more than 100mm. The maximum allowable value of the road surface step height should be less than 5mm (inclusive), and steps are not allowed at AMR parking positions;

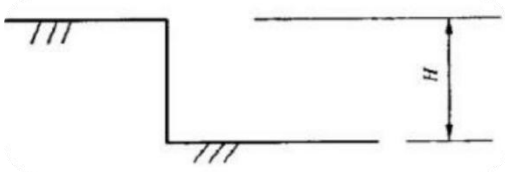


Figure 14 Diagram of the range of step heights

- Ditch width: The maximum allowable width of the pavement crack should be less than 10mm (inclusive);

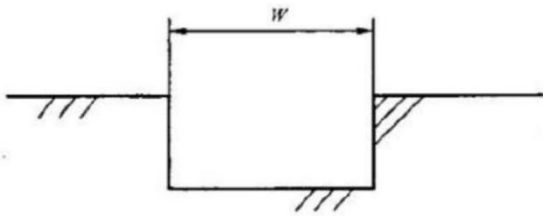


Figure 15 Diagram of the range of trench width

- Ground load: The average ground load of the MN500-CE mobile robot should reach 800kg/m ²;
- Floor hardness: The floor hardness should be above c30 (tested with a rebound hammer, and the value should be greater than 30MPa).
- Floor material:

1) Carborundum flooring or cement-hardened flooring is required to be wear-resistant, static-free and dust-free when rubbed;
2) The surface resistance or volume resistance of the floor material should not be higher than 1.0 × 10^9 Ω;
3) If an epoxy floor is used, anti-static treatment is required;
4) The floor for operation must be free of dust, water, ice, etc. Prevent the machine from slipping during emergency stops or braking;
5) No waxing is allowed on the floor, and the coefficient of static friction between the floor and polyurethane wheels should be no less than 0.55 (generally unwaxed floors can reach this value);

There should be no obvious potholes or unevenness on the ground, or any remaining items such as steel nails or expansion screws.

1.3.2.Network environment requirements

Wireless network environment should be set up in the robot operation area as required before the robot enters the site. If the network is built by the warehouse operator themselves, it should be inspected and accepted by Mission after the construction is completed. The wireless network environment of the robot shall meet the following requirements:

1) As an industrial production network, the AMR needs to have exclusive frequency bands and use 5G independently;
2) The requirement for the weakest signal at the edge of the covered network environment is greater than -65 DBM;
3) Minimum signal-to-noise ratio: 25 dBm;
4) Network overlap: 10% to 20%;
5) Channel overlap: no more than -82 DBM;
6) Single-terminal bandwidth no less than 2Mbps;
7) The number of terminals associated with a single AP should be no less than 30.
8) End-to-end latency from the robot to the server is no more than 100 ms;
9) Typical/maximum roaming time: For wireless client robots, it is necessary to set or negotiate a wireless roaming threshold that supports signals in the corresponding frequency band.

1.3.3.Runtime field environment requirements

When the robot is in operation, the site needs to meet the following requirements:

Table 17 Site Environment Requirements Table

Environment	Indoor environment
Ground conditions	For AMR driving surfaces, hard cement or conductive plastic surfaces are preferred
	The AMR running ground must not have iron filings, oil stains, corrosive liquids, etc
	Avoid seams on the running path, and the maximum seam should not exceed 30mm
	Ground slope no more than 3 ° and no more than 1 ° at stops where precise positioning is required
	Based on the requirements for braking safety distance and handling positioning accuracy, the coefficient of sliding friction on the ground should be no less than 0.5
Temperature	Working area temperature: Operating area temperature range -10 ° C to 45 ° C Charging area temperature: 0℃ to 45℃ Special customization is required in cold storage environments
Humidity	Relative humidity 10% to 90% no condensation
Signal	Wifi 2.4G/5G dual band Wireless signal coverage strength above -70dBm
Altitude	Electrical equipment supports normal operation in an environment at an altitude of 2,000 meters and below. For equipment used in high-altitude areas, the following factors must be considered for reduction: ● Dielectric strength; ● The switching capacity of the equipment; ● Air cooling effect. If the correction factor is not specified in the product data, it is recommended to consult the manufacturer about the applicable correction factor.

1.3.4.Transportation and storage of the robot

➢ Packaging and shipping instructions

Robots should be packed in wooden cases according to appropriate specifications. The packaging requirements are as follows:

1) Wrap the robot in a wooden box or foam paper to prevent damage to the robot during transportation;
2) Secure the robot to the wooden box chassis to ensure it does not move on the plane during transportation;
3) Because the robot is heavy, it is recommended to use lifting equipment such as a gantry crane to assist the robot in packaging to avoid the danger to human body caused by manual handling;

4) After placing the robot in a wooden box, it is necessary to secure the robot inside the box to ensure that it does not move;

5) The box with the robot inside should be transported using dedicated equipment. During the transportation of the crates, the handling requirements of the robots should be strictly followed to prevent the crates from getting wet. Do not stack more than two boxes on top of each other, and keep the boxes flat.

➢ Storage Instructions

When the robot is out of service for a long time, it should be stored under the following conditions:

1) Store indoors away from dust and flammable, explosive or corrosive gases and liquids;

2) Temperature: -10 to 50 ° C;

3) Humidity: No more than 80%, no condensation;

4) The battery should be charged to ≥100% rated capacity and charged regularly;

5) When stored at room temperature, the battery should be fully charged and discharged at least once every six months, otherwise it may be damaged.

1.4.Safety requirements related to batteries and charging stations



Battery usage precautions

- Lithium batteries are high-energy substances and must be used under certain technical conditions. If used beyond the limit, the buyer must notify the seller in writing, and the Seller must confirm before proceeding; otherwise, the consequences shall be borne by the party at fault.
- Please use the original charger. Do not mix chargers of other brands, otherwise it will cause irreversible damage to the battery.

1.5.

1.5.1.Precautions for using lithium batteries

➢ Batteries pose risks such as fire and explosion. Do not disassemble, crush, incinerate, heat or throw the battery pack into fire.

➢ Protect the battery from mechanical damage (impact, drop, vibration).

➢ Do not use dropped or damaged batteries.

➢ Do not use faulty or damaged batteries.

➢ Do not use batteries whose connection cables or contacts are damaged.

➢ Do not immerse the battery in water or wet it.

➢ Do not replace lithium batteries in a liquid environment.

➢ Do not bring the positive and negative terminals of the battery into contact with the metal casing simultaneously.

➢ Do not short-circuit, overcharge or overdischarge the battery.

➢ Do not use or store batteries near heat sources such as fire or heaters.

- Do not reverse the positive and negative terminals of the battery.
- Do not Pierce the battery case with nails or other sharp objects. Do not hammer or step on the battery.
- Do not disassemble or repair the battery in any way without authorization.
- Do not strike, throw or subject the battery to mechanical vibration or natural drop.
- Do not mix and use batteries of different types and brands.
- Do not use the battery if it gives off an odd smell, gets hot, is deformed, discolored or shows any other abnormality, and remove the battery from the environment of use.
- If the battery catches fire, extinguish it with dry powder, foam fire extinguishers, sand, etc., and remove the battery from the environment.
- When storing the battery, pay attention to the laws of the relevant country.

1.5.2.Safety requirements for using charging piles

If the operator has purchased our charging piles, the following matters should be noted

 Warnings	**Bridging the charging contacts of a charging station can pose a risk of injury!** Bridging charging contacts can lead to damage, electric sparks, overheating and fire hazards. ● No items, especially conductive or flammable ones, should be placed in the area in front of the charging contacts of the charging station.
 Note	**Mispositioned charging stations can pose a risk of injury!** There is a risk of people tripping when charging stations are placed along driving routes and in passageways. ● Do not place charging stations in driving routes and passageways. **Improper installation of charging stations can pose a risk of injury!** ● Anchor the charging station to the workshop floor to avoid functional failures and the risks that come with them. ● Lay the connection cables in accordance with the risk prevention regulations of the relevant countries. **Incorrect use can lead to injury hazards and may cause product damage!** There is a risk of falling and getting injured when boarding or stepping onto a charging station, as well as the risk of damaging the charging station's casing. ● Do not use the charging station as a stepping or climbing aid.

1.5.2.1.Usage Requirements

1) Altitude not exceeding 2000m;
2) Charging ambient temperature: 0 ° C to 45 ° C (AMR charging ambient temperature with heated battery: -20 ° C to 40 ° C);
3) The maximum relative humidity of the air does not exceed 90%, and good air circulation;

4) The operating site is free of conductive and explosive dust, gases or vapors that corrode metals and damage insulation, and strong electromagnetic interference;

5) The installation base is free from severe vibration and shock, with a vertical inclination of no more than 1 °;

6) Ground requirements: The same as AMR requirements;

1.5.2.2.Electrical requirements

1) The power of the power supply loop for a single charging station is no less than 3000W;

2) Use a 16A three-hole socket, and each charging station is separately equipped with an air switch or fuse of no less than 16A;

3) The three-hole socket is installed 30cm above the ground and in a straight line with the center of the charging station;

4) The red wire to the red stud and the black wire to the black stud of the charging station wiring. Avoid reversing the positive and negative terminals to cause a short circuit or damage to the equipment; Note: The on-site strong current layout shall be provided by Party A.

1.5.2.3.Installation requirements

1) Use M12 anchor bolts to secure to the ground, 4 sets;

2) There should be more than 30cm of space at the back door of the charging pile;

3) When installing, the charging head should be in a straight line with the center of the ground code.

1.5.3.How to deal with a damaged lithium battery

➢ Damaged batteries can only be touched and transported after wearing personal protective equipment such as alkali resistance and solubility resistance.

➢ Separate the battery from the casing if it shows signs of overheating, smoking, emitting an odor, making noise or deformation.

➢ Store the battery in a fire-resistant container or keep it at a safe distance from flammable materials.

➢ Do not inhale the smoke that may appear.

1.5.4.How to deal with discarded lithium batteries

➢ Please have your battery professionally disposed of.

➢ Remove the connection points for disposal.

➢ Store the damaged battery in a fire-resistant container.

➢ Be sure to comply with dangerous goods transport requirements related to batteries during transportation.

1.5.Noise

The noise generated by the robot during operation is no more than 75 dB.

2.Product Description

2.1.Product Introduction



Figure 21 Product image

The DN300-CE uses McNamm wheels as the traveling mechanism and has the ability to move in all directions. It can achieve complex movement trajectories such as forward, backward, lateral, oblique and in-place rotation, and has greater passability and flexibility in narrow Spaces and complex working conditions. The AMR chassis with laser SLAM navigation is equipped with a controller inside, providing core map-building and positioning navigation functions, and reserves rich interfaces such as I/O, CAN, RS485, etc., to help users quickly implement various applications of mobile robots. It can be integrated with various modules of the roller, six-axis robotic arm to expand the product's functionality and achieve efficient use in various environments.

This product is suitable for indoor environments such as warehouses, production lines, and logistics centers, and is designed to increase production efficiency and reduce labor costs.

When using this product, it is important to note that the extension of the upper structure should be safe and not exceed the size of the chassis.

2.1.1.Functional Features

- Positioning and navigation: Precise positioning with fusion navigation technologies such as laser Slam navigation;
- Motion control: With four McNamm wheel drives, it has the ability to move in all directions and supports various motion control modes such as forward, backward, lateral, oblique, and in-place rotation;
- Power management: Supports multiple levels of power threshold control, allows for the free setting of minimum charging power, and supports off-peak charging control;
- Safety protection: Equipped with dual front and rear Sik radars (dual obstacle avoidance in software area and built-in area), contact-type safety touch edge, omnidirectional four emergency stop buttons, safety PLC and other multiple safety protection measures;
- Human-machine interaction: Push-button switches, with standard audible and visual alerts indicating the current operating status of the equipment;
- Control mode: Supports automatic and manual control;
- Cargo handling: Supports handling operations with a maximum load of 500Kg and provides customized load attachments for multi-scenario applications;

➢ Network communication: Wifi network communication and seamless roaming with support for 5G network expansion;

2.1.2.Application Industry

For goods-to-person handling in e-commerce, 3C electronics, tobacco, pharmaceuticals and other fields, it supports customized load attachments as an expansion platform to meet the application requirements of multiple scenarios.

2.2.Product structure

2.2.1.AMR dimension diagram

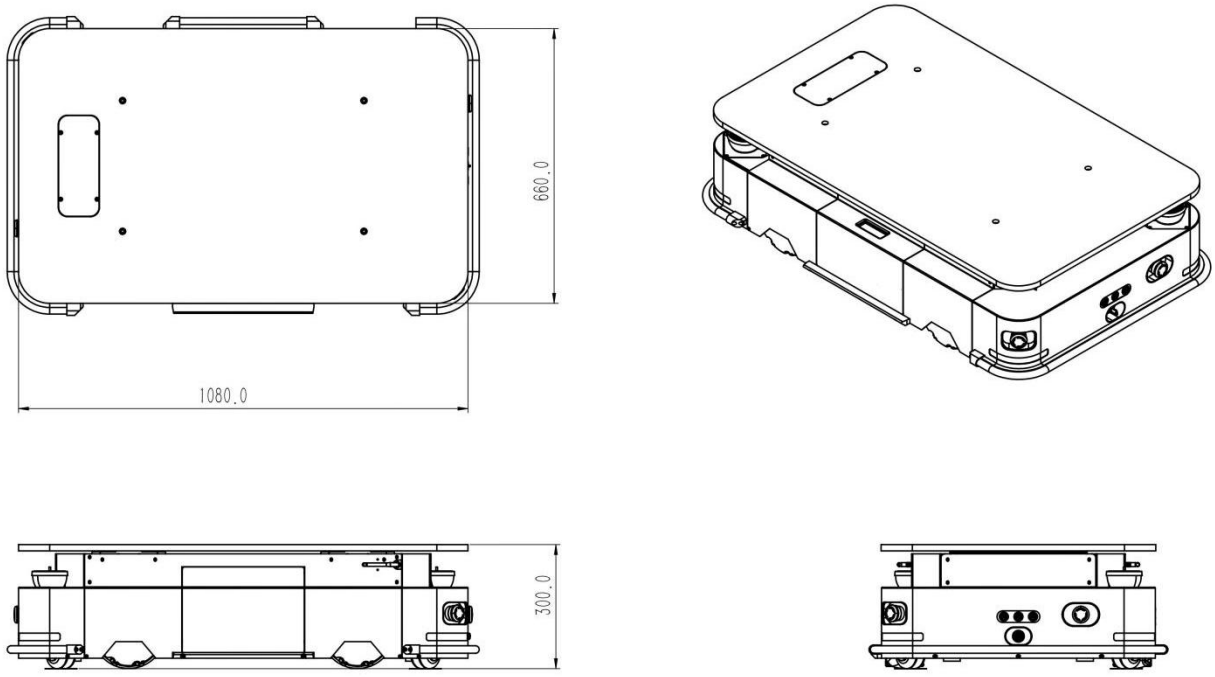


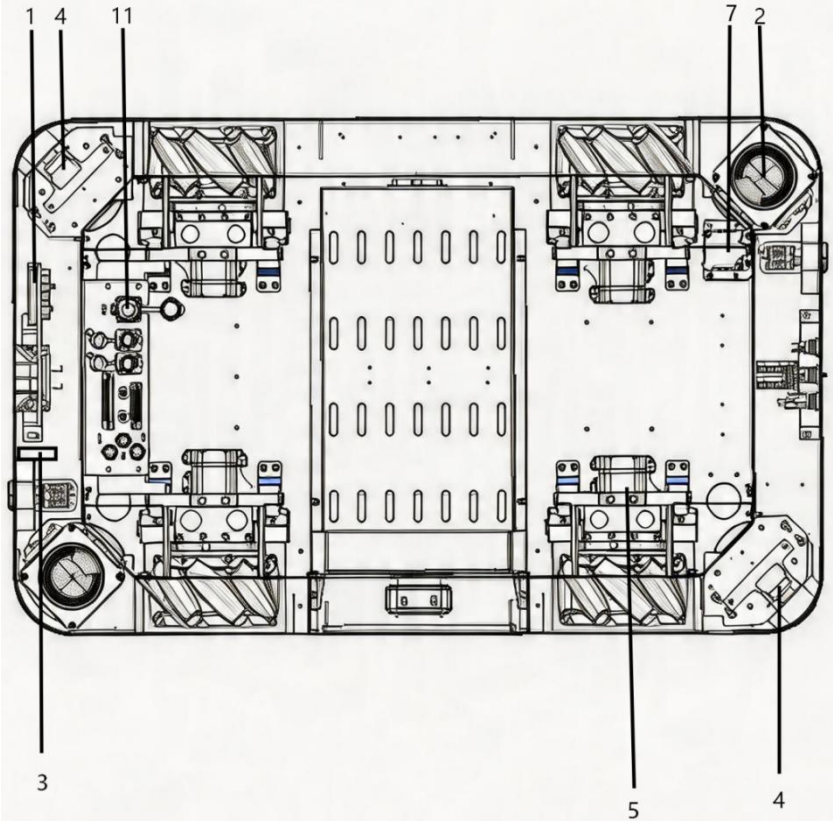
Figure 22 MN500-CE planar dimension diagram

Table 21AMR Dimension Table

Serial Numbers	Definition	Numerical value (unit: mm)
1	Length of the vehicle body (including anti-collision strips)	1100
2	Body length (without crash strips)	1050
3	Body width (including the anti-collision strips)	675
4	Body width (without bumpers)	650
5	Vehicle height	300
6	Navigation laser scanning area height	180
7	Drive wheel track	548

8	Drive wheel wheelbase	550
9	Drive wheel radius	88
10	Navigate the vertical distance from the laser to the differential axis	253.4

2.2.2.Parts Description



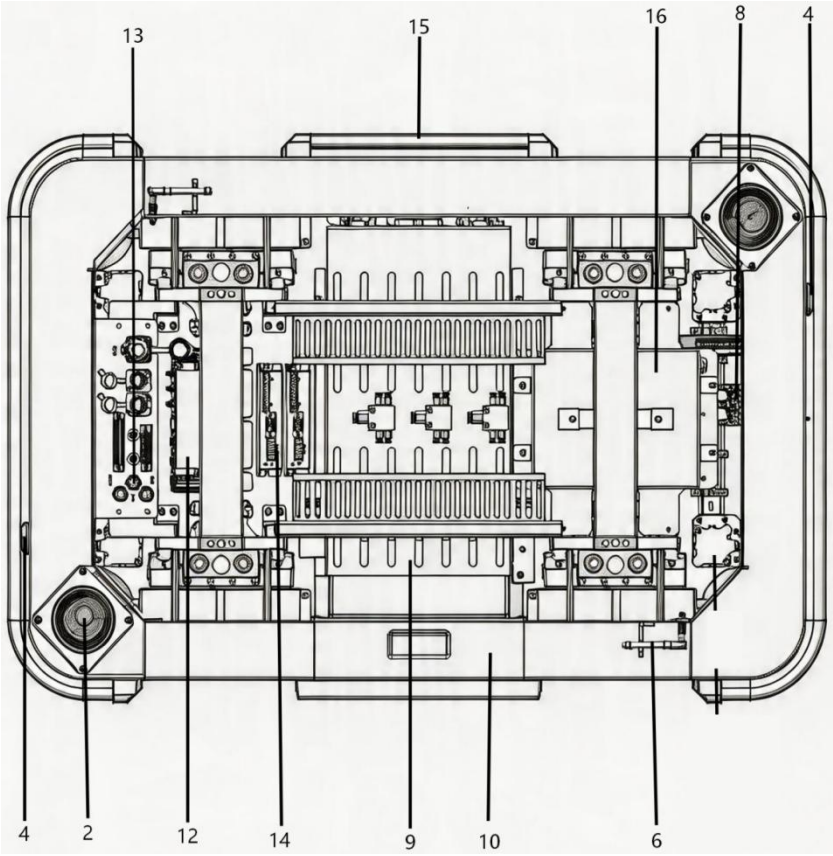


Figure 23 Schematic diagram of components

Table 22 Component Description Table

Serial Numbers	Name	Quantity
1	Horns	1
2	Radar (SICK nS3 pro)	2
3	Touchedge controller	1
4	Emergency stop	4
5	Servo	4
6	Antenna	2
7	Lifting cylinder	4
8	Key switch button	1
9	Large battery	1
10	Battery compartment	1
11	Debug the network port	1
12	SPC2000 Security PLC	1
13	Air port	1

14	Servo controller	4
15	Safe touch edge	3
16	Small batteries	1

2.2.3.Optional accessories

Table 23 Optional Accessories Table

Accessories	Model	Instructions
Charging station	Eh-4850-C1-130	
Battery charger	F1200-58.4 V20A	Output without load
Battery swap trolley	MXCDC-650	
Debugging Tools	Robot application software	

2.3.Basic features and descriptions of the product

2.3.1.Feature List

Table 24 Function List

Basic	Feature Names	Feature Description
Basic Features	Control mode	Automatic mode, manual mode, offline automatic mode executes motion commands, manual mode has point motion control function
	Navigation method	Laser SLMA navigation
	Driving mode	Four-wheel drive McNamm wheels
	Communication mode	WIFI 5G
	Braking methods	Electromagnetic braking/enabled braking
Motion control	Running	The robot can move to any position according to the trajectory planning and positioning navigation of the motion control system, rotate and adjust to any Angle, and support omnidirectional movement actions such as forward, backward, lateral translation, oblique movement, in-place rotation, and arc-shaped turns of any radius.

Basic	Feature Names	Feature Description
	Stop	The robot can stop normally according to the location specified by the dispatch system, and also activate soft stop when the robot has a regular malfunction, hard stop when there is a servo communication failure, fault stop when there is a servo hardware failure, obstacle avoidance stop when an obstacle is detected, and brake stop when an emergency stop operation occurs
	Reset	After the robot stops, it checks and repairs itself, resets, starts the task to run, and also resets and starts the task to run when there is human intervention for error clearing or restarting
Loading control	Motion interlock function	Vehicles should be designed to avoid material loading or unloading while in motion, and to prevent robots from moving during loading, unloading, or equipment docking operations
Navigation and positioning	Driving correction	Real-time deviation correction, follow the designated route
Power supply function	Self-charging	The robot should be able to automatically detect the battery level. When it is below the preset threshold, the robot should be able to automatically send a charging request and be able to automatically run to the charging station under platform scheduling to complete the charging. The online charging system supports shallow charging and discharging
	Manual charging	The robot can be charged using the manual charging interface
	Low battery self-protection	When the battery level drops below the preset value, the robot stops running, prompts charging and gives an alarm. Manual operation is required to resume
	Battery management system	Real-time monitoring of individual battery pack voltages, charge-discharge currents, sampling point temperatures, etc. Adjust charging strategies and perform charging equalization; Evaluate and calculate the state of charge, life and health status of the battery, and automatically output the battery maintenance strategy; When an abnormal state occurs (cell overvoltage, cell undervoltage, over-temperature, overcurrent), the management system immediately cuts off charging/discharging and uploids alarm information
Safety protection	RCS scheduling	Under the dispatch of the main control system, it ensures smooth operation and prevents traffic control incidents such as collisions

Basic	Feature Names	Feature Description
	Radar detection	Equipped with two Sikker nanoScan3 Pro safety radars (left front + right rear) with Type 3 PL d SIL2 functional safety certification. The radar is equipped with 16 pre-configured safety zone schemes, which are dynamically notified and switched by the safety PLC based on the AMR's driving status. Supports two sets of zone systems: ● When the software-configured zone is triggered, the controller performs deceleration stop + voice broadcast and automatic recovery; ● The built-in safety zone scheme has a higher priority. When the protection zone is triggered, the safety PLC directly cuts off the STO and requires manual reset. The OSSD safety output is directly connected to the safety PLC and operates independently of the main controller.
	Safety PLC	The SPC200 safety PLC complies with ISO 13849 Category 3 PL d standards and operates independently of the main controller. Core responsibilities: ● Dynamically notify Sick Radar to switch corresponding built-in safety schemes based on driving status such as AMR speed and direction (16 options in total); ● Receive radar OSSD signals and 4 emergency stop button dual-channel signals; ● Graded response - Warning zone detects deceleration compliance (non-compliant STO), protected/brake zone directly STO, STO and lock wheels when emergency stop is pressed; ● The motor power is cut off through the STO hardwire. After cutting off, the reset button must be pressed to restore it. Automatic recovery is not supported.
	Emergency stop button	It has four omnidirectional emergency stop buttons that are conspicuously positioned for emergency operation. When any button is pressed, the safety PLC immediately cuts off the STO and locks the wheels, and the robot immediately stops and remains stationary. After manual confirmation that the anomaly has been cleared, two reset steps are required to resume operation: ① Unscrew the pressed emergency stop button; ② Press the reset button. This mechanism prevents unexpected restarts and ensures safety.
	Automatically lock the reporting of fault points	If the robot is connected to the dispatching system, when it malfunctions, the location of the malfunction will be reported and the surrounding area will be locked to prevent other robots from approaching the dangerous area
Human-machine interaction	Switch buttons	It has the function of operating on/off and executing keys
	Indicator lights	Various robot statuses are indicated by lights of different colors

Basic	Feature Names	Feature Description
	Sound alerts	Define different sound alerts based on different conditions. It is recommended that the sound standard be 60dB, and it can be set to increase to 80dB, but the sound quality will vary.
	Operating platform	In standalone mode, the robot can be operated through the operating platform
Anomaly control and handling	Abnormal alerts	When in an abnormal state, the robot automatically reports warning messages to the RCS, and the body has different error messages Different audible and visual alarm modes
	Operational status monitoring	While the robot is in motion, various sensors inside the vehicle feed the data back to the DSP in real time. Through the upper computer software, data such as absolute coordinates, vehicle attitude angles, pallet height, obstacle distance, motion status, vehicle speed, battery level, etc. can be monitored
	Self-check upon startup	Before the robot starts working, it checks the operation of each module and displays different indicator light states based on the detection results. If there are some abnormalities, they can be cleared through self-recovery. If the clearing fails to solve the robot abnormality, it reports error information and alarms
	Fault diagnosis	It is capable of recording the robot's operational event log and status log in detail, and has the function of saving log data for professionals to interpret during repair or maintenance; Equipment faults can automatically alarm and be recorded, and the corresponding fault handling methods can be indicated through the system, supporting remote fault diagnosis
Maintenance operations	Remote data download	You can remotely connect to the robot to download local data such as logs and logs
	Remote upgrade	Robots upgrade their lower machines and components remotely over the network
	Remote restart	The robot can remotely restart the machine over the network, and the car performs initialization operations including sending parameters, ground Diagram deviation, attitude initialization, and other operations
	Remote on/off	The robot can be remotely turned on and off via the network

Basic	Feature Names	Feature Description
	One-click homing	An operation that can move the robot to a designated area for parking through background operations

2.3.2.Technical parameters

Table 25 Technical Parameters Table

Product model		MN500-CE
The body	Self-weight	200KG
	Size	1050*650*300mm
	Load	500KG
	Shell color	white
	Rotating diameter	The 1234.9 mm
	Laser scanning height	180mm
Actuator	Robotic arm	Support
	Drum	Support
	Parking stabilization system	Support
	Dock connection	Support
	Composite body	Support
Navigation	Navigation methods	Laser navigation
	Navigation position accuracy	±10mm for non-reflective and ±5mm for reflective
	Path planning	Automatically plan paths
	Navigation Angle accuracy	+ / - 0.5 °
Athletic performance	Running direction	Move in all directions
	Driving speed	1.5 m/s or less
	Maximum rotational speed	90°/s
	Vertical obstacle-crossing ability	< 5mm
	Ability to cross gullies	< 10mm
	Climbing ability	< 5%

	Drive mode	McKnum wheel
	Minimum peer width	720mm
Safety protection	Lidar	360° full surround
	Collision detection	Collision sensor
	Emergency stop button	All-directional four-stop emergency
	Status indicator	Four-color led light strip
Power supply	Battery capacity	48V/60Ah+41.6V/6Ah(lithium iron phosphate)
	Charging parameters	58.4 V / 20 a
	Battery life	8h
	Charging time	≤2h
	Battery life	Fully charge and discharge 2000 times
	Cell material	Lithium iron phosphate
	Charging methods	Fast battery swapping, automatic charging
Protocol/Interface	Wireless networks	Wifi/5G
	Ethernet port	have
	I/O	32/22
	Support Protocol	CANopen/Modbus_RTU/Modbus_TCP
Drive wheel	Material	Aluminium & Polyurethane
Configuration	Number of lidars	2 (SICK nS3 Pro)
	Number of emergency stop buttons	4
	Number of speakers	1
	Number of indicator lights	4
	Number of protective strips	2
Function configuration	Basic Features	Support
	Wifi roaming feature	Support
	Auto-charging feature	Support
	Laser reflector navigation function	Support

1) The robot is suitable for indoor environments with flat ground, not for outdoor environments.
2) Navigation accuracy refers to the repeat accuracy with which a robot navigates from a fixed direction to a target site.
3) Basic functions refer to map editing, positioning navigation, obstacle avoidance configuration, etc.
4) Charging options include charging stations, battery swap carts, etc.

2.3.3.Navigate the laser detection range

Table 26 Navigation Laser Detection Range Parameters Table

Serial numbers	Definition	Parameters
1	Detection distance (m)	30
2	Scanning Angle (°)	275
3	Detection height (mm)	180

2.3.4.Human-machine interaction status description

Table 27 Human-Computer Interaction Status Description Table

Indicator lights show	Status
Red always bright	Emergency stop alarm, collision alarm, servo alarm
Green light always on	For AMR fault-free status, green when going straight in auto mode and waiting
Yellow breathing	The AMR is in manual mode
Red flashing	The AMR is blocked. Low battery alert charging alarm
Purple light on	AMR charging status
The white light remains on	Fully charged battery

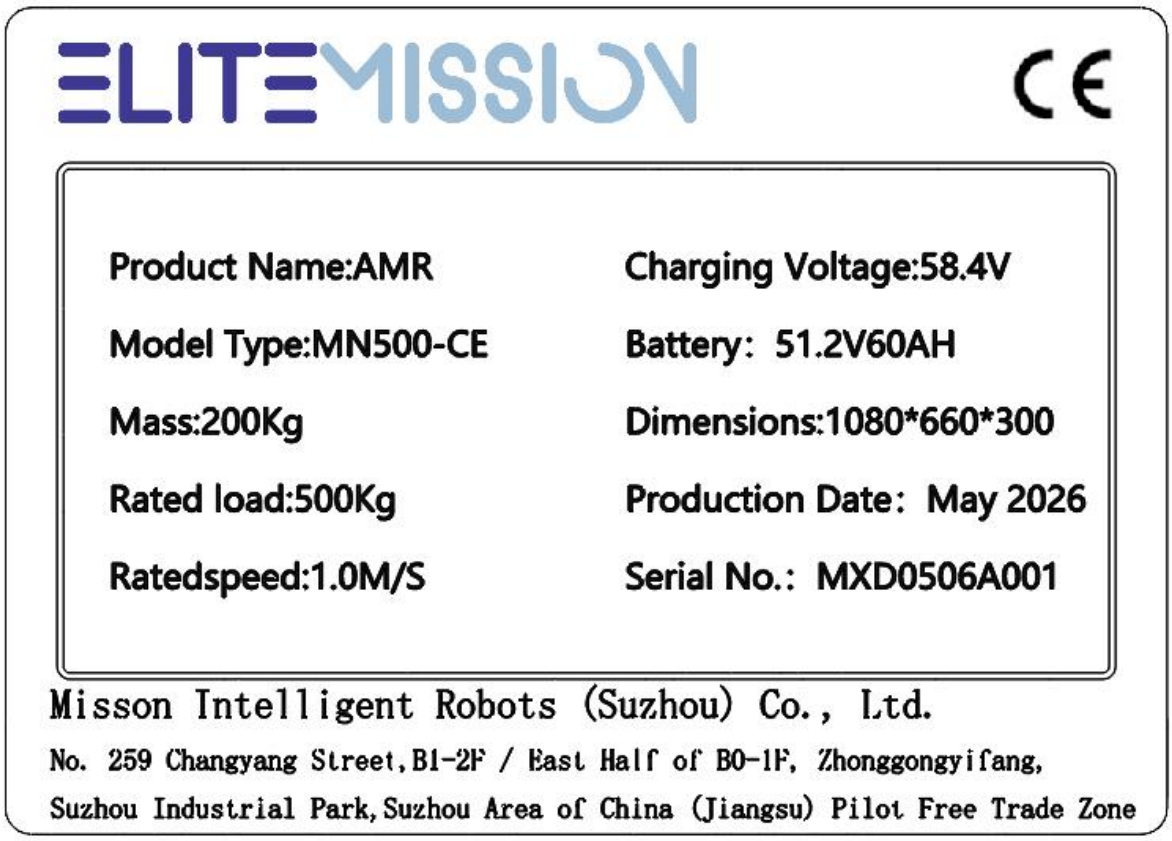
2.3.5.Load stability description

To ensure the safety of the load, it is recommended that items be distributed as evenly as possible and that heavier items be placed below lighter ones. And the items being placed need to be fixed and there should be no displacement between them. The load weight must not exceed the rated load, and try to keep the center of gravity at the center.

- The robot and its load must not exceed the allowable range of the road surface.
- The cargo being carried must be securely fastened.
- The cargo must be placed in the center of the load and have certain anti-slip measures.

➢ The weight of the goods carried by the upper mechanism must be evenly distributed and must not be skewed.

2.4.Product nameplate



3.Quick Instructions

3.1.Switches and Buttons

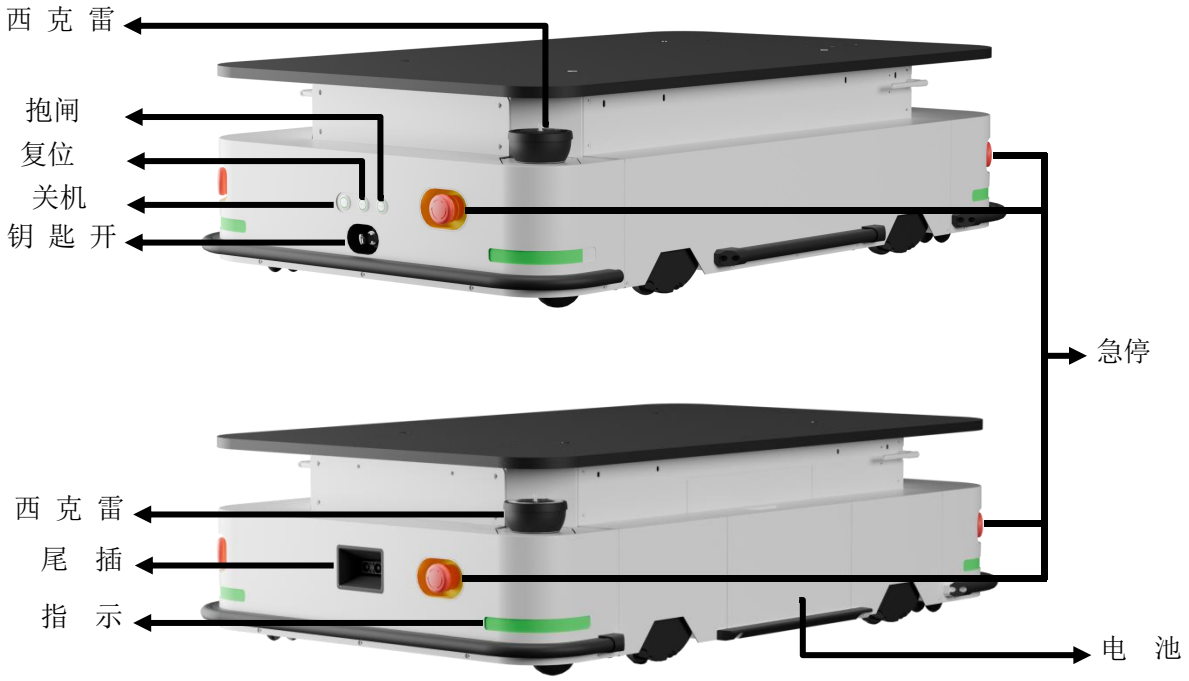


Figure 31 Operation panel

3.1.1.Power-on switch

Table 31 Power-on switches

Mode	Status
Power on	Rotate the key switch until the indicator light is on and the AMR starts
Power off	Press the power off button to turn off the indicator light

3.1.2.Emergency stop switch

Table 32 Emergency Stop switches

Mode	Status
Press the emergency stop button	Emergency braking;
Pull up the emergency stop button	System restored;

- ➢ The emergency stop button is for emergency use only and must not be used to stop the robot.
- ➢ When the emergency stop button is pressed, the robot stops all movement immediately.
- ➢ The emergency stop can only be pulled up if the cause of the fault has been determined and the fault has been eliminated.
- ➢ After pulling the emergency stop, press the reset button to clear the error and restore the STO.

3.1.3.Release the brake switch

Table 33 Release the brake switch

Mode	"Status"
Press the brake button	Unlock the brake

- ➢ The release brake button is used to push the vehicle body.
- ➢ This is a self-locking button that can be pushed when pressed, and the vehicle must be powered.
- ➢ This button can only be used when the vehicle is turned off.

3.1.4.Reset switch

Table 34 Reset Switches

Mode	Status
Reset	System Reset

- ➢ Press the button for more than 1 second after the error message has been resolved to clear the error message.
- ➢ If the relevant safety alarm is triggered while driving and the STO is cut off, after error confirmation, pressing the reset button will enable the STO and continue with the previous task.

3.2.Mode selection

Table 35 Mode Selection

"Mode"	Status
Automatic	Switch to Auto Run mode

Manual	Switch to manual control mode (Manual mode indicator yellow breathing)

➢ Automatic mode: Execute movement commands from the control system.

➢ Manual mode: Operated by a trained operator;

3.3.Charging

When the AMR battery level drops below 20%, voice "Low battery. Please charge it in time." There are two ways to charge: automatic charging and quick battery swap.

➢ Quick battery swap: Open the battery compartment and replace the battery.

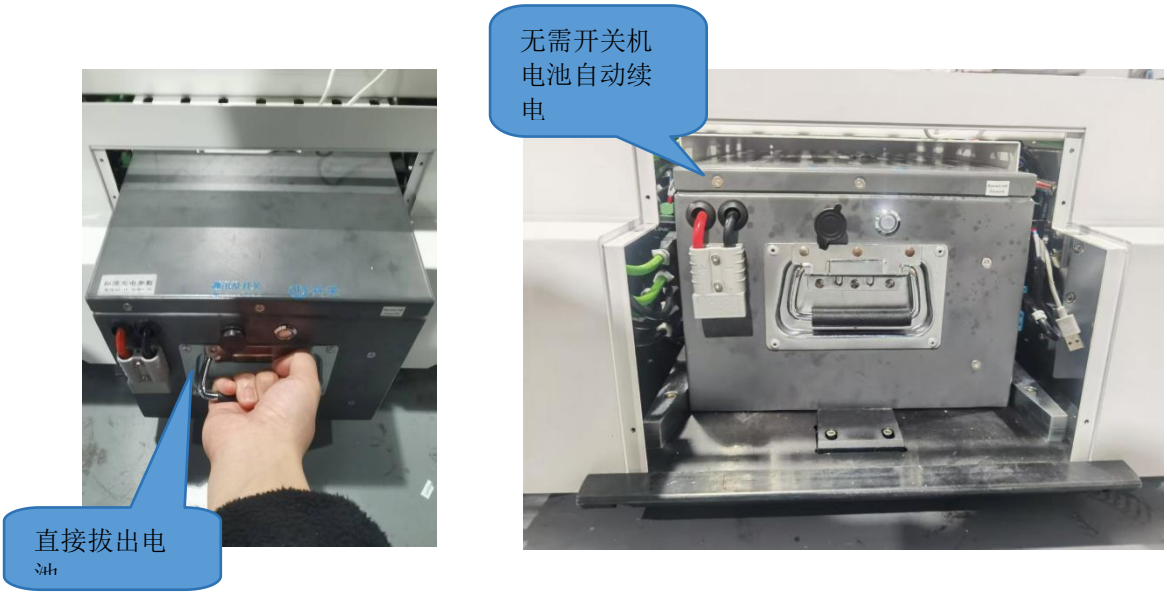
➢ Automatic charging: When using the charging tail plug, it needs to be paired with a charging station. After configuring the map station, automatic charging can be achieved.

3.3.1.Quick battery swapping

Achieve quick battery swapping by replacing the battery.

1) Open the battery compartment and pull out the battery directly. During this process, the small battery discharges to ensure the car is on standby normally;

2) Replace the new battery, which automatically discharges and charges the small battery;



3.3.2.Automatic charging

Use the AMR to dock the location of the charging station, set the station number of that location to 500, and when the charging station parameters are set, the automatic navigation to that station will automatically start charging.

Suggestion: Set a near charging point in front of the charging point as shown in Figure 12. Take the path 12->500 in reverse and 500->12 in forward at a slow speed. Set an appropriate obstacle avoidance scheme for the area connected to the charging station, such as the laser at the rear of the vehicle to draw the protection zone of this scheme to avoid triggering the obstacle due to the charging station.

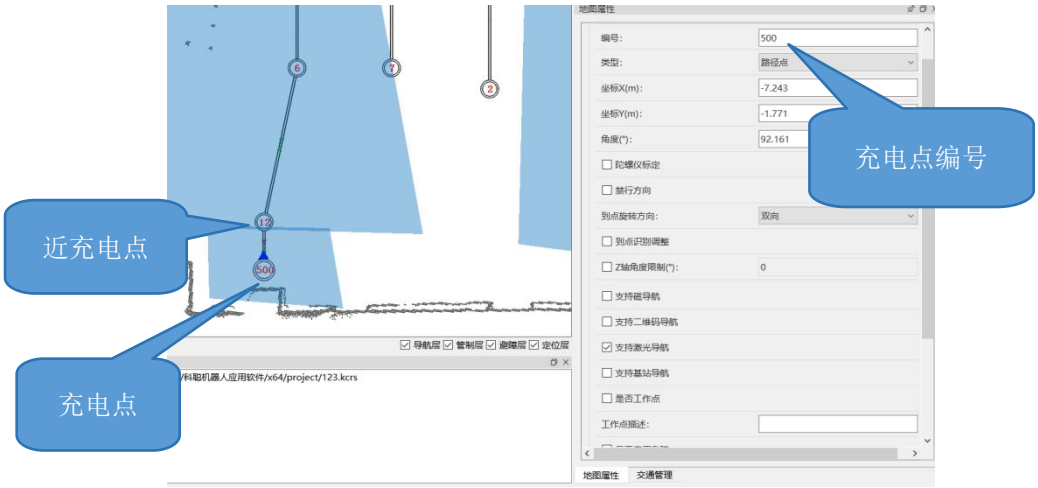


Figure 32 Automatic charging

4.Robot application software usage

4.1.Application software interface toolbar

4.1.1.Common Toolbars

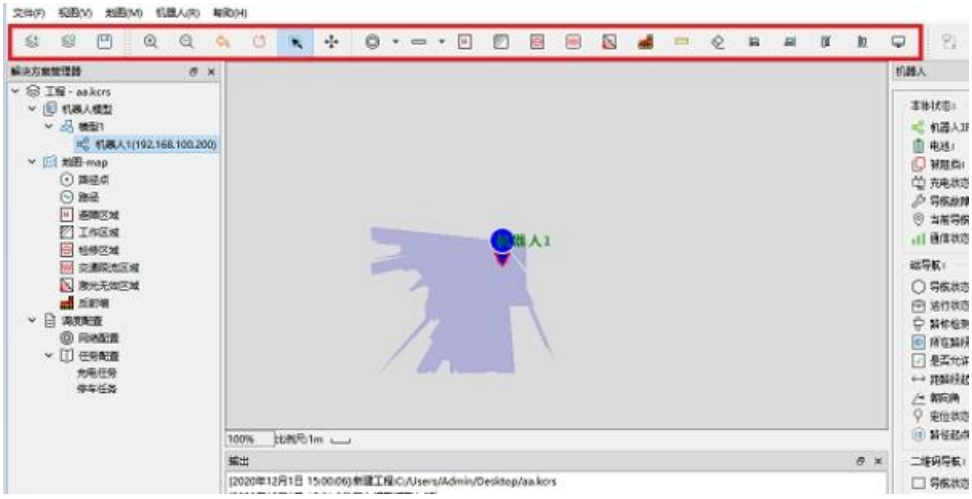


Figure 41 Common toolbars

Table 41 Common Toolbar Function Description Table

Function ICONS	Function Name	Function Description
	New Construction Project	New Project File
	Open the project	Open the local project file
	Save the project	Save the modified project files to a folder in the local directory
	Enlarge	Enlarge the map
	Shrink	Shrink the map. Minimize to 10%
	Undo	You can choose to undo to a specified map operation, supporting up to 16 operation records
	Redo	You can choose to redo a specified map operation, supporting up to 16 operation records
	Select	Setting the mouse to selection mode can select elements in the map
	Move	Setting the mouse to move mode can move elements in the map
	Select Map	Set the mouse to Select Map mode to move the location map and the navigation map

Function ICONS	Function Name	Function Description
	Path points	Mouse Set to Path Point Mode adds path points to the map (Laser Navigation points, magnetic navigation points, QR code navigation points, laser + magnetic navigation points, laser + QR code navigation points, QR code + magnetic navigation points,  Laser + QR code + magnetic navigation points, mixed navigation path points are uniformly represented by symbols) 
	Support model	Support Model 1/ Model 2/ Model 3/ Full Model (Multiple options available)
	Path	Setting the mouse to path mode can add paths to the map (laser navigation paths, magnetic navigation Paths, QR code navigation paths)
	Obstacle avoidance area	Set the mouse to Draw obstacle avoidance Area mode. Add obstacle avoidance areas to the map, and the areas will be displayed in gray. When used in conjunction with the navigation laser configuration scheme, call up the set obstacle avoidance area group number.
	Work area	Set the mouse to Draw Workspace mode. Add the work area to the map, and the area will be displayed as Green box with white background. When used in conjunction with the robot monitoring system, assign robots to work by area.
	Maintenance area	Set the mouse to draw maintenance Area mode. Add maintenance areas to the map, which are displayed in yellow It can be used to retain map resources, but navigation is not planned, the same as the annotation function.
	Traffic restriction area	Set the mouse to traffic restriction Zone mode. Add traffic restriction zones to the map, which are displayed in red. It can limit the number of AMRs running in that area and be used in conjunction with the robot monitoring system.
	Apply for the area	Set the mouse to Apply Area mode. Add the application area to the map, and the area will be displayed in pink Color is used for the application and release of third-party path resources.
	Laser-invalid area	Set the mouse to Laser Ineffective Area mode. Add laser-ineffective areas to the map, which are displayed in pink. Laser navigation positioning can mask the positioning references covered by the area and can be used In environments where the rate of change in some scenes is high.
	Laser-enhanced area	Set the mouse to Laser Enhanced Area mode. Add laser-enhanced areas to the map, which are displayed in brown. The default laser enhancement coefficient is 2 (with a coefficient range of 2 to 10), and the laser navigation and positioning program will raise it Increase the calculation weight of this area to address the issue of insufficient positioning references before and after narrow alleys.
	Reflector wall	Set the mouse to Draw Reflective Wall mode. Reflective walls can be added to the map Laser navigation positioning can shield positioning references blocked by reflective walls and can be used for AMRs to always run on one side of reflective walls or for multi-floor map splicing partitions.

Function ICONS	Function Name	Function Description
	Ranging	Set the mouse to distance mode to roughly get the actual distance. After selecting the distance function, click on the starting point you want to measure and then drag the mouse down to the end point. A straight line will appear on the map, on the ground The actual data is shown in the upper left corner of the graph
	Eraser	Set the mouse to erase mode to erase the content of the base map by area
	Left-aligned	Left-align multiple path points
	Right-aligned	Right-aligned multiple path points
	Top alignment	Top alignment of multiple path points
	Bottom alignment	Bottom alignment of multiple path points
	Legend	Show/Hide the legend

4.1.2.Robot toolbar

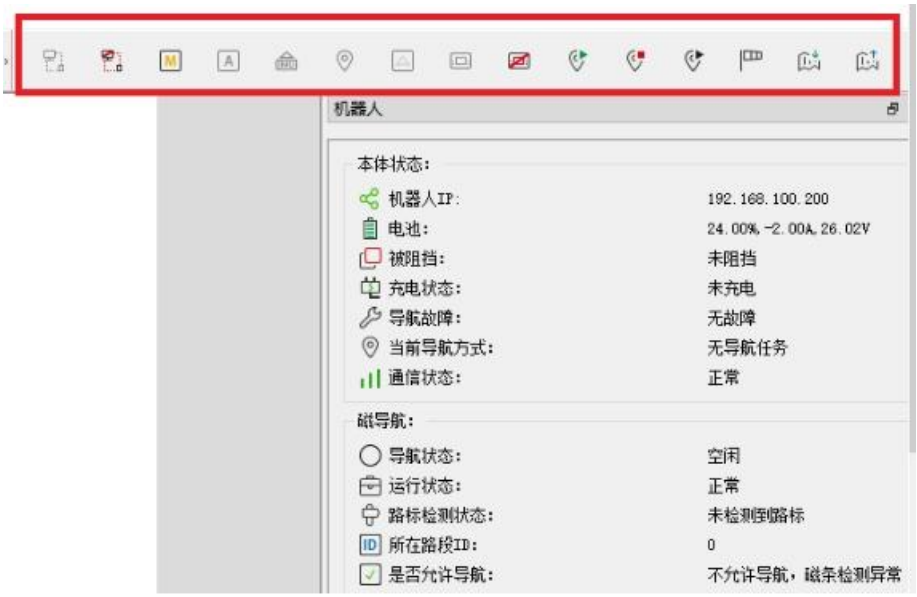


Figure 42 Robot toolbar

Table 42 Robot Toolbar Function Description Table

Function ICONS	Function Name	Feature Description
	Connect	After setting up the robot IP, click Connect
	Disconnect	Enable the robot connection and disconnect the robot connection
	Manual	Automatic Mode Switch to manual mode (Keyboard control fails in automatic mode, map download fails. Effective, relocation failed, navigation available)

Function ICONS	Function Name	Feature Description
	"Automatic	Switch manual mode to Auto mode
	Gyroscope calibration	When the robot's gyroscope has a "zero drift" phenomenon, which is manifested as the robot not moving, the blue icon displayed on the software can be used for calibration while rotating. (Note: When calibrating the gyroscope, keep the vehicle in a horizontal position and stationary state)
	Positioning	Manual robot map positioning, no anti-laser positioning point allowable error range: ±5.0m Plus or minus 15 °
	Confirm position	Confirm the current position of the robot on the map. No further actions can be taken without confirming the location
	Get control	Get Robot control
	Release control	Release Robot control
	Start Navigation	In Auto mode, after selecting a path point, click on Navigation and the robot will automatically navigate to that point
	Stop navigation	In Auto mode, abort the navigation behavior that is currently in progress
	Return to the navigation laser path Path points	After the robot exits the path, click Back path and the robot automatically returns to the path only The robot can be used when it is in automatic mode
	Set path points	Set the current position of the robot as the path point, which works when the robot is connected to the laser.
	Download the map	Upload maps from the robot to your local device, available only when the robot is connected. Download Maps are only valid for laser maps and navigation maps mixed with lasers.
	Upload Map	The map is downloaded to the robot and is available only if the robot is connected and in manual mode. Uploading maps is only effective for laser maps and navigation maps mixed with laser.

4.2.Connect the robot

First rotate the AMR key switch to turn the AMR on. Next, open Robot Applications, click New Project, save and open the new project after creating it. As shown in the following figure:

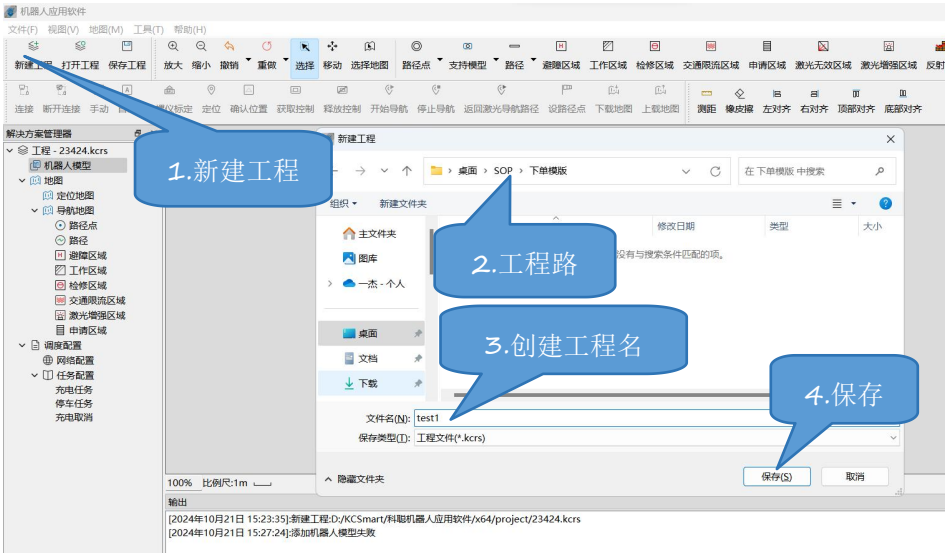


Figure 43 Create a new project

Right-click the robot model, click Add Robot Model, click Import Robot Model File and OK.

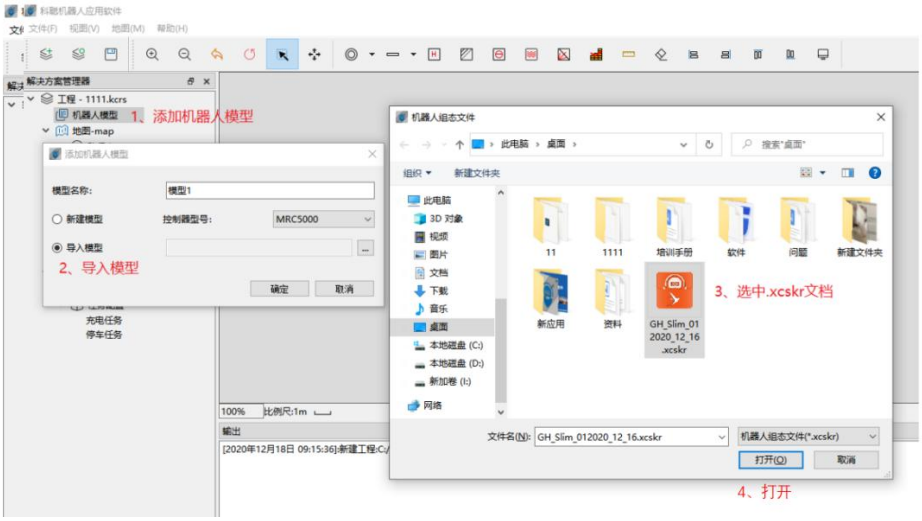


Figure 44 Add a Robot model

Set your computer's Ethernet IP to the 192.168.192.xxx segment, with a subnet mask of 255.255.255.0 and the gateway omitted. Use a network cable to connect your computer to the robot's debug network port.



Figure 45 Ethernet setup

Select the robot model, right-click Add Robot, fill in the robot IP and name (the name must not be a number, symbol, or empty name), IP 192.168.100.200. When using a wired connection, the robot will be this IP.

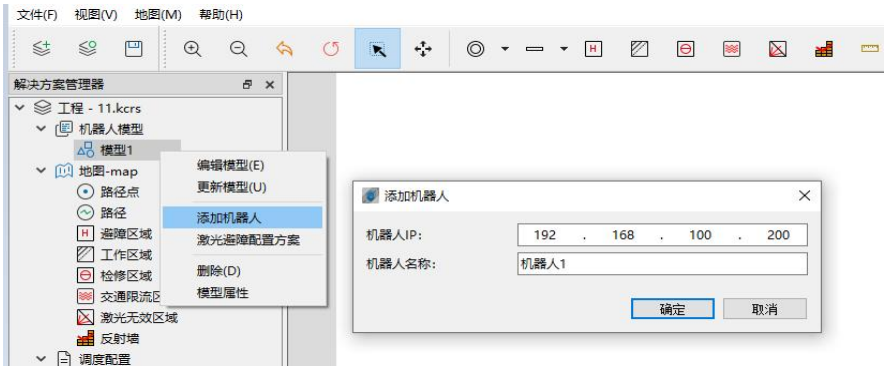


Figure 46 Add the robot

Click on the robot's IP, click on the link on the home page, and if you need control, click Get Control.

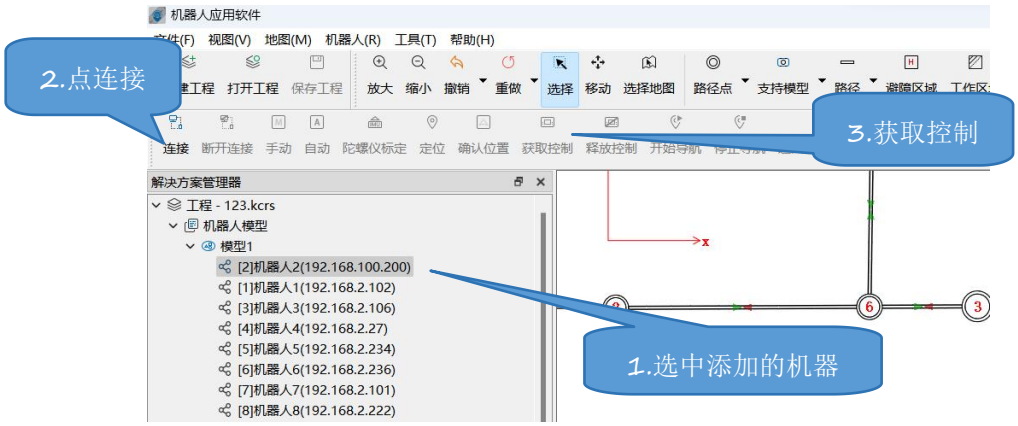


Figure 47 Gain Control

The left side of the robot IP is displayed in green, and the right side of the robot status shows the robot IP, battery level and other information, indicating a successful connection. After the connection, use "W (forward)", "A (left)", "S (backward)", "D (right)", "Q (left lateral)", "E (lateral)" to manually control the movement of the AMR.



Figure 48 State of the robot

4.3.Map

4.3.1.Draw a mirrorless map

Set the car to manual mode, remotely to the location where you need to draw the map, right-click the map, and click Make Laser Map in Options.



Figure 49 Make a laser map

Enter the name of the map and click OK.



Figure 410 Enter the map name

Then the software will automatically redirect to the map management software. In the following [Mapping Settings] pop-up window, pay attention to the IP address and file path. Other parameters are recommended to use the default parameters. Click Start Mapping to enter the mapping software.

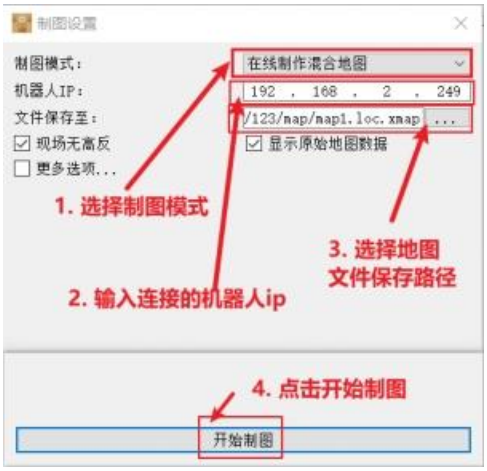


Figure 411 Mapping Settings

After entering the mapping interface, control the robot to make a loop around the mapping area, end to end, with the path closed.

The red circle is the path for the car to travel. Wait for the mapping software to complete the data upload on the map in the lower left corner. Finally finish mapping and exit.

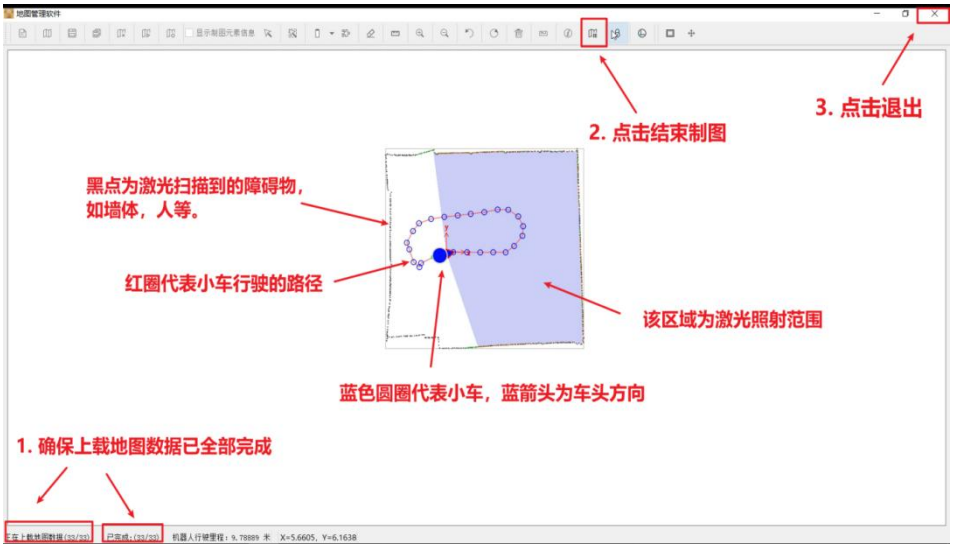


Figure 412 Mapping interface and steps

Note: Save the map to the directory you selected for mapping Settings, including two files with the suffixes.xmap and.brawmap respectively. .brawmap is the map sensor data file; .xmap is the map file that needs to be imported into the application software.

Follow the previous steps to go back to the application, follow the prompts to import the map, and click Yes.



Figure 413 Importing the map

Select the robot whose ip you need to download, and click on "Download Map" in the menu above



Figure 414 Download Map

Click Confirm to save and click Yes to download the map



Figure 415 Confirm

As shown in the figure, it can be seen that the imported map does not overlap with the actual laser irradiation situation because positioning is still required. For detailed positioning process, see 4.6 Positioning.

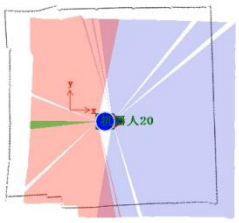


Figure 416 Comparison of the imported map with the actual laser irradiation map

4.3.2.The map is drawn with an anti-map

There are requirements for reflectors in reverse mapping:

- The point to be located must be able to detect four or more reflectors;
- Each reflector must be spaced at least 1 meter apart;
- The arrangement of reflectors must not be symmetrical. Try to avoid having the same number of reflectors on both sides of the path.
- Try to ensure that the spacing between the reflectors is unequal (the spacing between two adjacent reflectors is no less than 350mm);

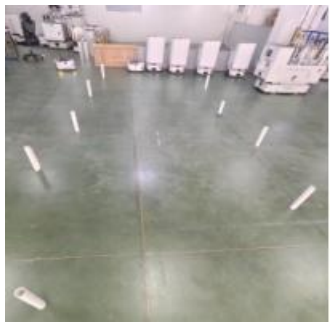


Figure 417 Schematic diagram of reflector arrangement

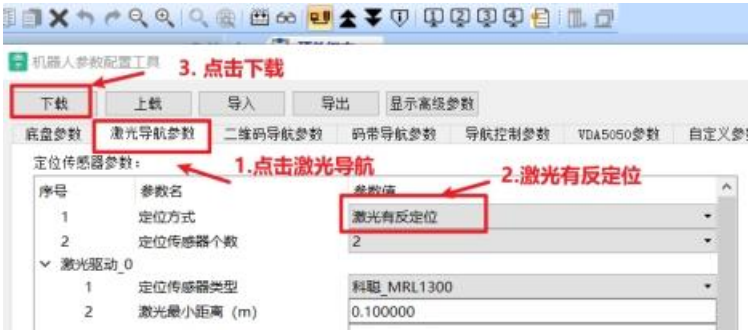


Figure 418 Parameter configuration

The pre-steps are the same as drawing a mirrorless map: set the vehicle to manual mode, remotely control to the location where you need to draw the map, start making the laser map, and open the map management software. In Mapping Settings, uncheck no height reflection, select the type such as reflector column, check More options, and enter the detailed data of the reflective object.



Figure 419 Enter detailed data of reflective objects graph

The parameters are referred to as shown in the following figure

参数名称	说明	参考值
控制线速度	制图时车辆行进线速度	0.5m/s
控制角速度	制图时车辆行进角速度	0.5rad/s
反光柱类型	反光柱直径/反光板宽度，建 值 0.6~0.8，单位 m	
反光柱直径	最近激光反射强度，pf_r2000 建议值 800（反光柱）/1100（反光板），sicknano 建议值 570（反光柱）/550（反光板）	0.075m
反射强度阈值	最远激光反射强度，pf_r2000/sicknano 建议值 500（需要与参数配置工具中配置的值一致）	500
反光物最小间距	参数范围 0.5-1.5，默认是 0.5	0.5

Figure 420 Parameter Reference figure

Click Start Mapping, enter the mapping interface, and control the robot to make a loop around the mapping area, end to end, path closed loop. The blue circle is the path for the car. Wait for the mapping software to complete the data upload on the map in the lower left corner. Finally finish

mapping and exit.

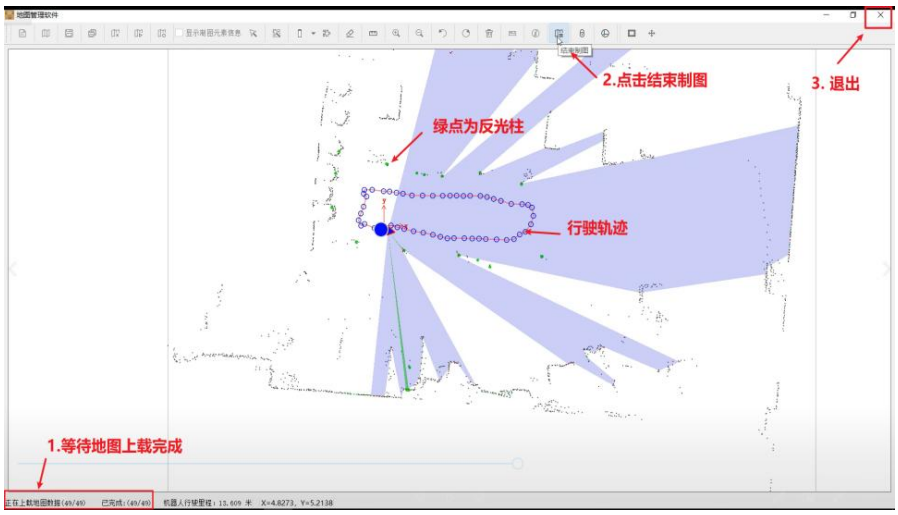


Figure 421 Mapping interface

Select the target car and click Download Map from the top menu



Figure 422 Download Map

Click Confirm to save and click Yes to download the map



Figure 423 Confirm to download the map

The import was successful. As shown in the figure, it can be seen that the imported map does not overlap with the actual laser irradiation situation because positioning is still required. See 4.6 Positioning for details of the process.

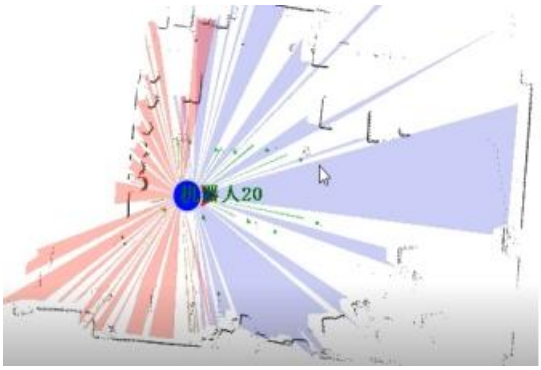


Figure 424 Comparison of imported map with actual laser irradiation

4.3.3.Path points

There are two ways to set up path points:

➢ Method 1:

Click the path point [The point will be built directly below the car on the map, and this method will directly copy the position and posture of the current car].



Figure 425 Click Set Path Point

Points can be seen in the Solution Manager on the left or on the map.

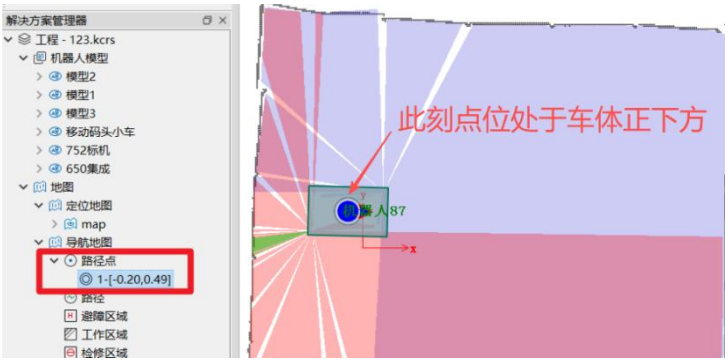


Figure 426 dot plot

➢ Method 2:

Click on path points



Figure 427 Click the path point

Move the mouse over the map and click anywhere on the map, and path points will be generated at the click. Points can be seen in the Solution Manager on the left or on the map.

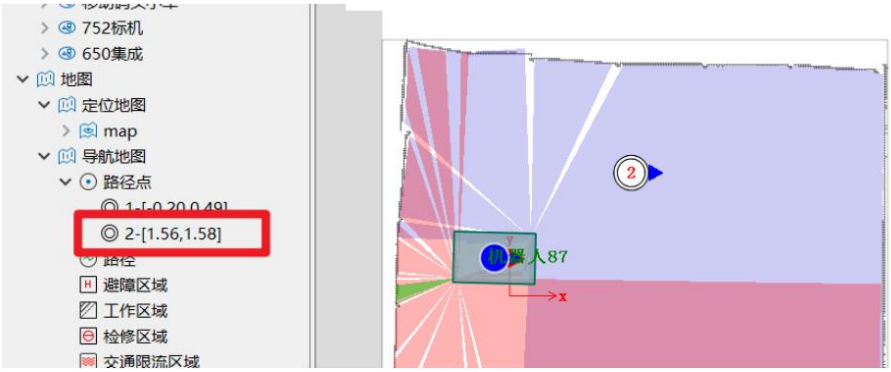


Figure 428 Click anywhere on the map to set a path point

Click the path point on the map, or click the point in the Scheme Manager on the left, to see the specific properties of that point in the map properties on the right side of the software.

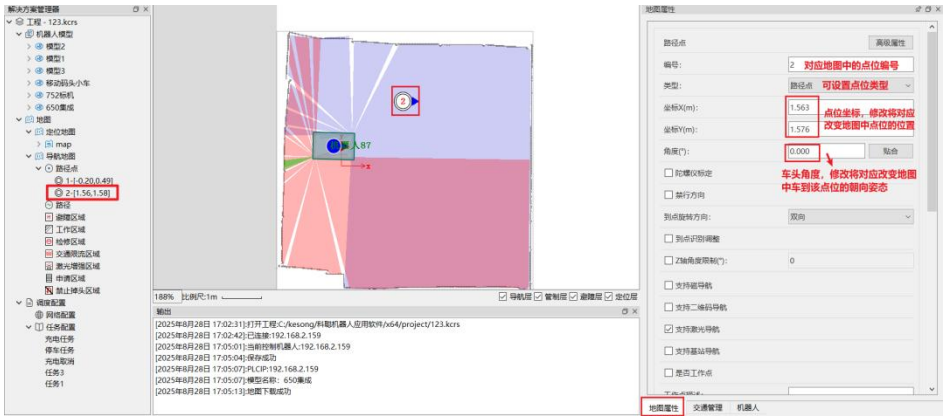


Figure 429 Specific properties of Point

Click on "Move" in the toolbar and then click on the point on the map to hold down the left mouse button and drag the position of the point

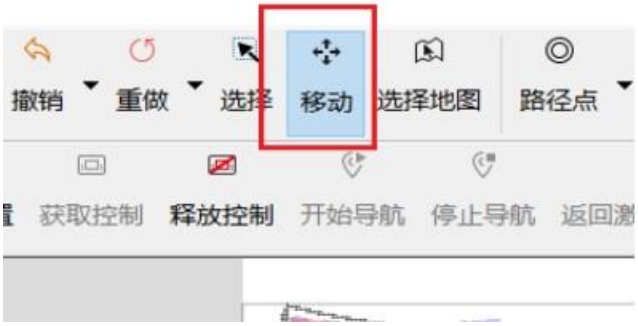


Figure 430 Point Position Move

Click on "Path" in the toolbar, at one point on the map, hold down the left mouse button and drag to another point to generate a path on the map. There can only be one path between two points. After creating the path, simply click on the path in the solution on the left; Or click on "Select" in the toolbar and then click on the path in the map to see the path details in the map properties on the right

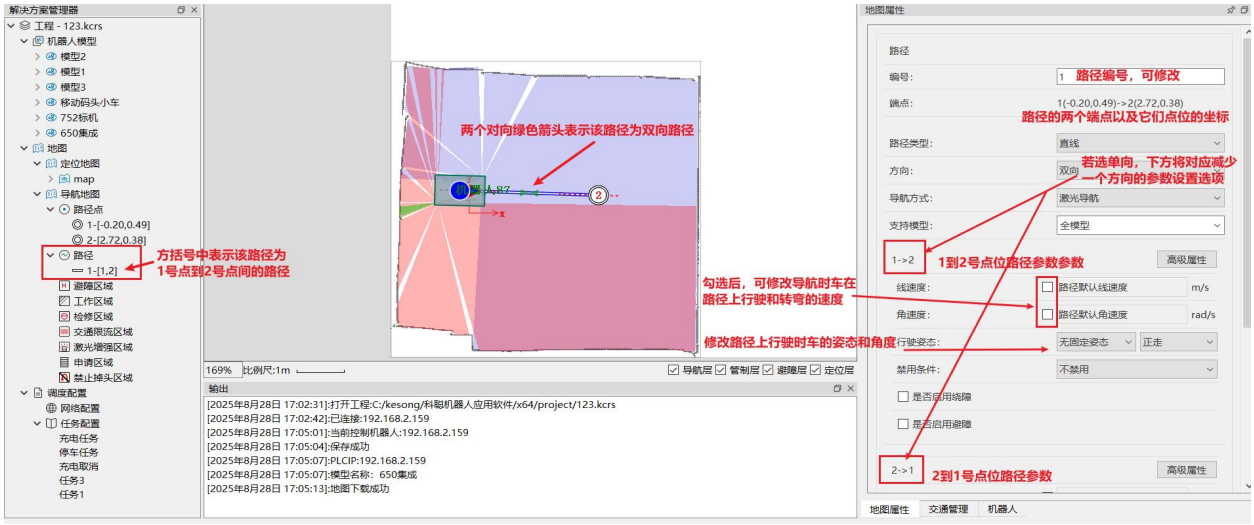


Figure 431 Path Details

4.3.4.Import Map

Right-click the map, or right-click the Location map, and select Import Map.



Figure 432 Import the map

The original map will be cleared. If necessary, export and save the original map.



Figure 433 Import Warning

Select the target map file and click OK.

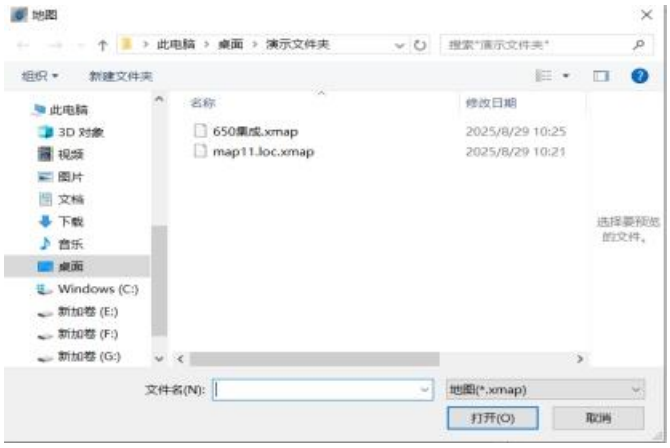


Figure 434 Import the target map file

The previous method 2 exports a compressed map file, where:

- xxx.loc.xmap is a pure contour map;
- nav.xmap is a pure path map;
- Model 1.xmap is path plus outline;
- If you need to import the retained paths and points, you need to import the "model name.xmap" file;

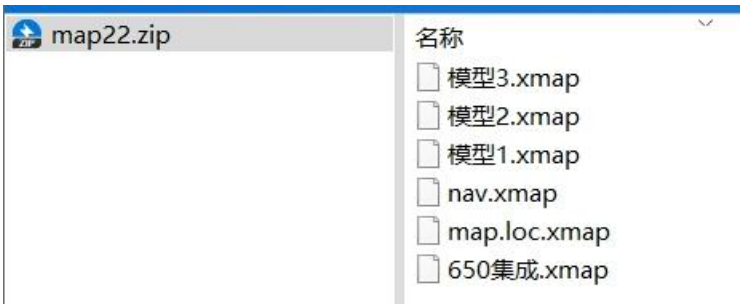


Figure 435 Instructions for importing file formats

4.3.5.Edit the map, draw map paths and add obstacle avoidance areas

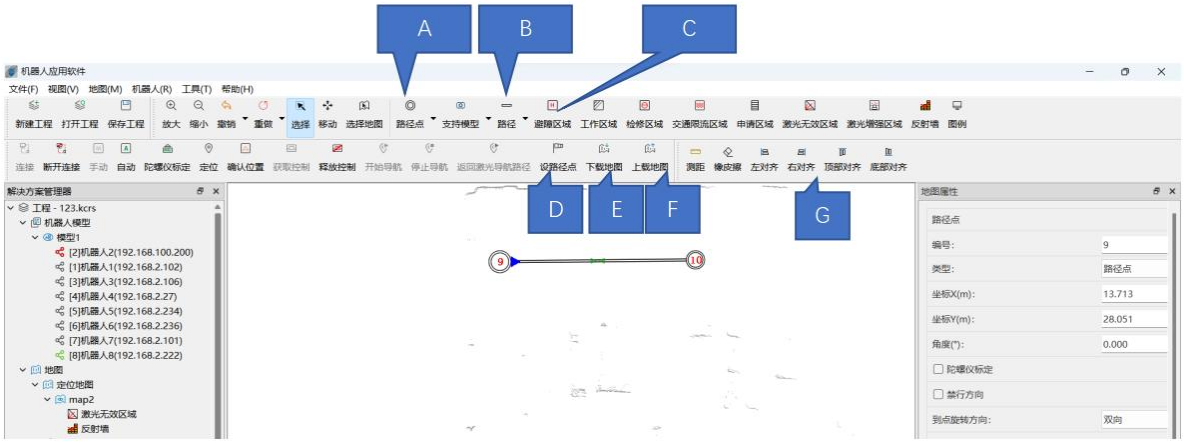


Figure 436 Introduction to the Main operational functional areas of Map Editing

A: Path points can be set, map properties can be adapted with numbers and coordinates

B: Path for connecting points, path properties can be set as forward or backward, curve, etc

C: Different obstacle avoidance schemes and switches for obstacle avoidance functions can be set according to actual needs in the obstacle avoidance area

D: Set the current position of the AMR as the path point

E: Each time you modify the map, you must click Download Map for it to take effect

F: Read the map in the AMR to the computer

G: You can hold down Ctrl or mouse to select a batch of points for alignment and other operations

4.3.6.Map global speed modification

The maximum linear velocity and maximum angular velocity of the AMR across the entire map can be set by following this method without modifying the velocity parameters for each path one by one. Once set, the global speed value will be used by default for all paths. If some areas need to run at a slower speed, you can modify the speed of the corresponding path segment separately.

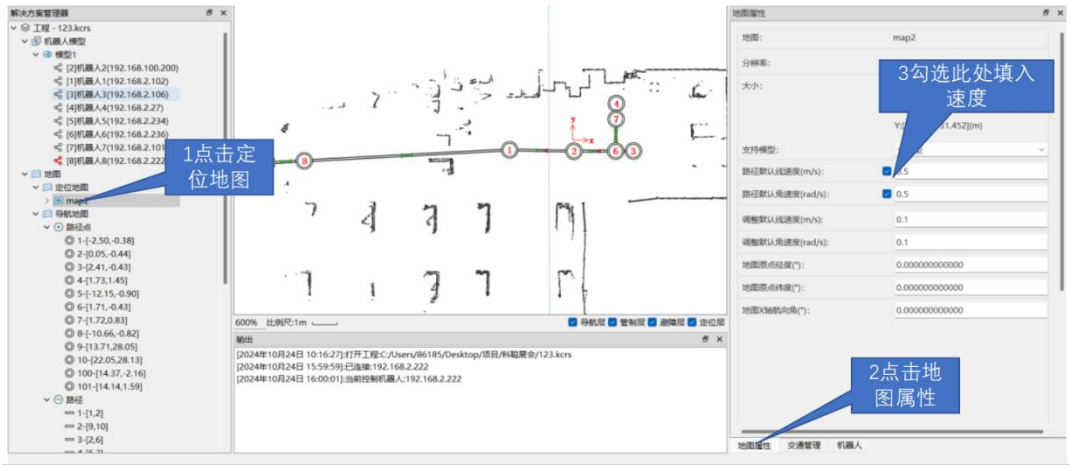


Figure 437 Map Global Speed modification

4.3.7.Local path speed modification on the map

If a local path requires a speed limit, select the path and modify the linear and angular velocities of the current path



Figure 438 Map Local Path speed modification

4.4.Robot-controlled navigation walking

➢ Hand-auto switch:

Navigation needs to switch from manual to automatic.

If you switch to manual during navigation, the vehicle stops.

➢ How to navigate**:**

In Auto Mode, click on the map path point and click Start Navigation.

➢ Stop navigation:

You can stop the navigation at any time during the navigation process, then the vehicle stops, or press the shortcut key space.

➢ Selection of navigation paths

If the path is not unique, choose the shortest route as the navigation path.

Note: If the vehicle stops outside the designed path, manually navigate the vehicle to find and drive to the nearest path before performing the subsequent navigation task.

4.5.Obstacle avoidance

4.5.1.Testing and setting up robot obstacle avoidance schemes.

When connected to the robot, clicking the test button while the robot is stationary can detect whether the robot detects an obstacle in the current obstacle avoidance zone based on the selected obstacle avoidance scheme. If there is an obstacle, it indicates an obstacle in the area.

No need to download the obstacle avoidance plan when testing the area. Just click the test button after changing the obstacle avoidance area.

Set the range of obstacle avoidance schemes as needed. Multiple obstacle avoidance schemes can be set, with deceleration distance, stop distance, and protection distance set for each area.



Figure 439 Configuration of laser obstacle avoidance schemes

Draw the obstacle avoidance area on the map path.

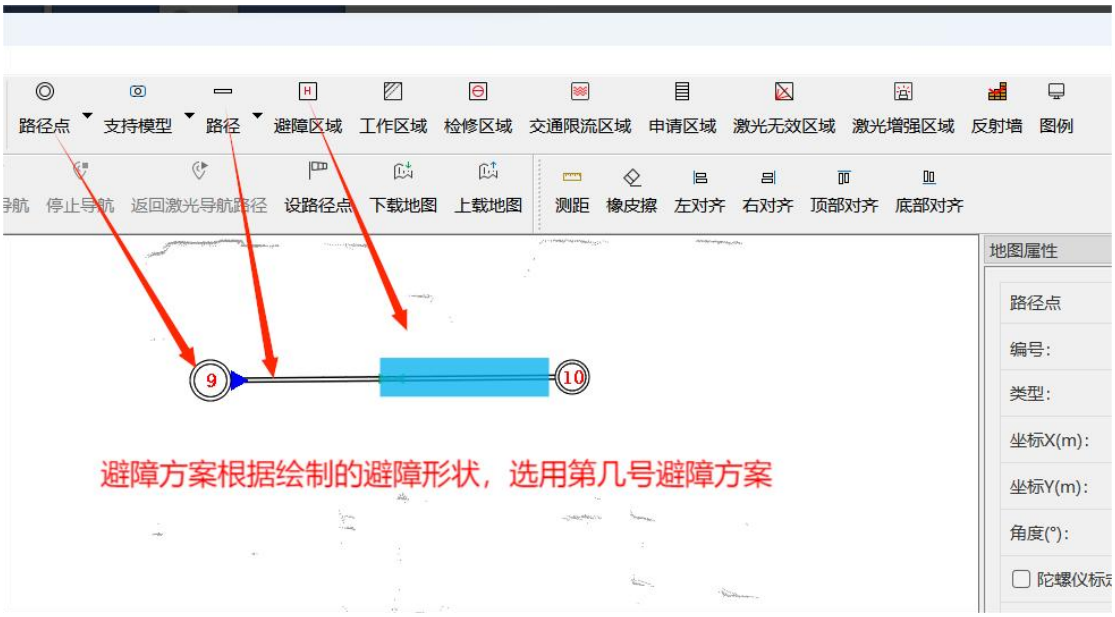


Figure 440 Draw the obstacle avoidance area

When the obstacle enters the warning zone, the AMR slows down to the preset speed. When entering the protected zone and the stop zone, the AMR stops in place and gives the voice prompt "Move the obstacle ahead."

4.5.2.4 Configure the obstacle avoidance scheme

In automatic mode, the AMR needs to be equipped with an obstacle avoidance plan during driving to ensure safety. When an obstacle enters the protected area, the AMR stops and alarms "Obstacle ahead, please move away." Apply different schemes for different road conditions, for example:

➢ Charging points:

The rear obstacle avoidance scheme at the docking position needs to be shortened.

➢ Spacious passageways for quick passage

The obstacle avoidance range in front, back, left and right should be kept at a distance, and the deceleration speed in the two-level warning area should be set reasonably to prevent situations such as tailgating due to sudden braking.

➢ Narrow road on one side:

The narrower side needs to shorten the obstacle avoidance area.

The obstacle avoidance zone is divided into four layers, with two outer warning zones. When an obstacle appears in the warning zone, the AMR slows down to the configured speed; The inner side is the braking zone and the protection zone. When an obstacle appears inside, the AMR stops and gives a voice alarm, with the indicator light flashing red.

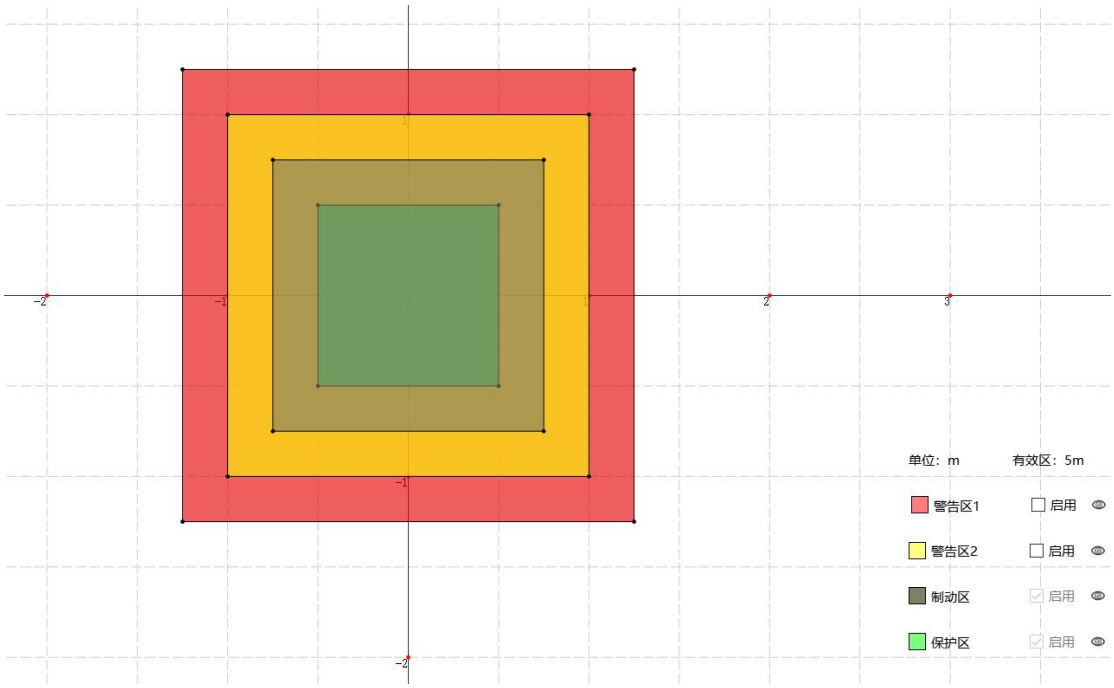


Figure 441 Obstacle avoidance area

4.5.2.1.Configuration steps

In the robot application software, right-click the robot model, select the Laser obstacle avoidance scheme, and select Laser-centered. Open it and switch to the old version of the scheme.

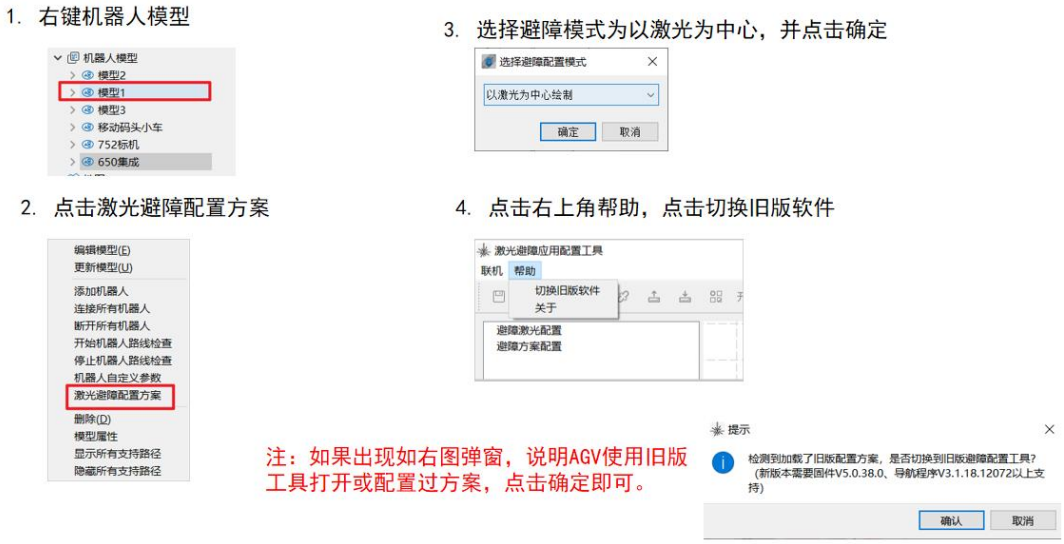


Figure 442 Select the robot model for which you want to configure the laser obstacle avoidance scheme

Right-click "Laser Obstacle Avoidance Scheme Configuration" to add lasers. By default, Laser No. 0 is the front laser and laser No. 1 is the rear laser. Right-click "Area Group" under Laser to add the scheme. The "area group number" of the added scheme corresponds to the obstacle avoidance number filled in when applied on the map.

In the map, the laser before and after the AMR will apply the scheme corresponding to the same number.

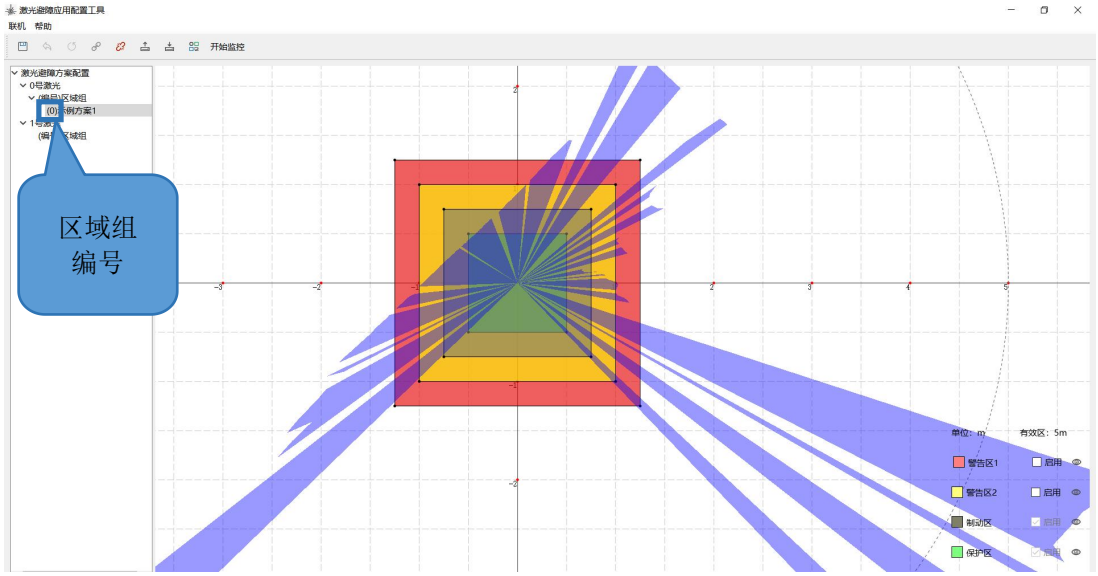


Figure 443 Add laser obstacle avoidance scheme

Double-click an edge of the area to create a point, drag the point to change its shape, and the purple part is the current real-time laser irradiation (in a stationary and normal state, the protected and braking zones must be inside the laser to avoid false blocking, the same applies to the warning zone).

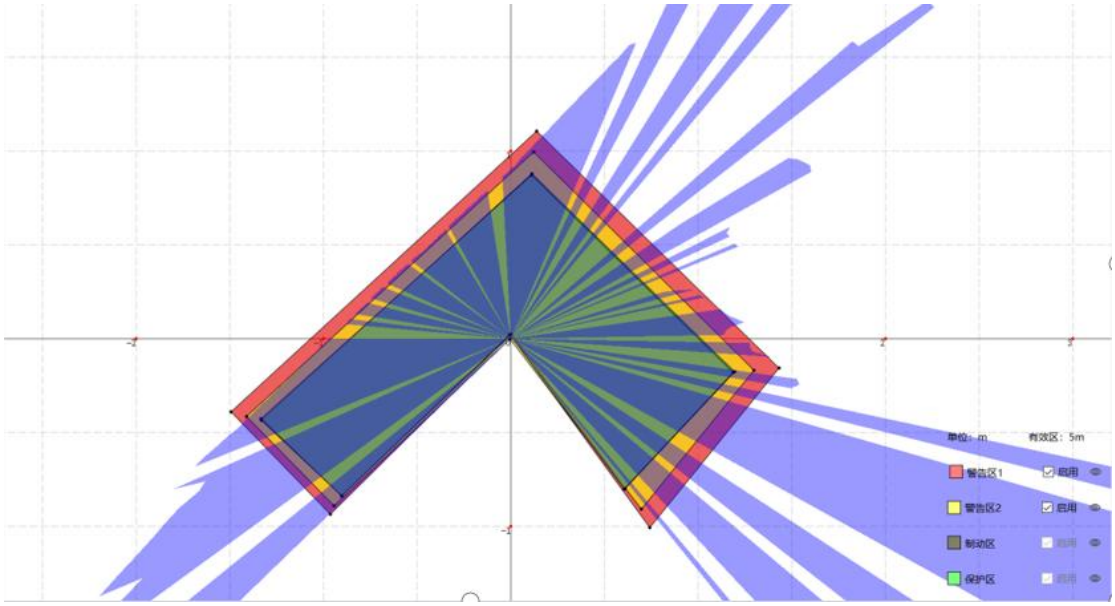


Figure 444 Real-time laser irradiation

4.5.3.Apply the obstacle avoidance scheme

There are two ways to apply obstacle avoidance schemes: the box obstacle avoidance area and the setting of site path attributes. When both exist, the latter has a higher priority.

4.5.3.1.Obstacle avoidance area

Click on the Obstacle Avoidance Area, box the target area in the map, click on the area and enter the application scheme number, then download the map.

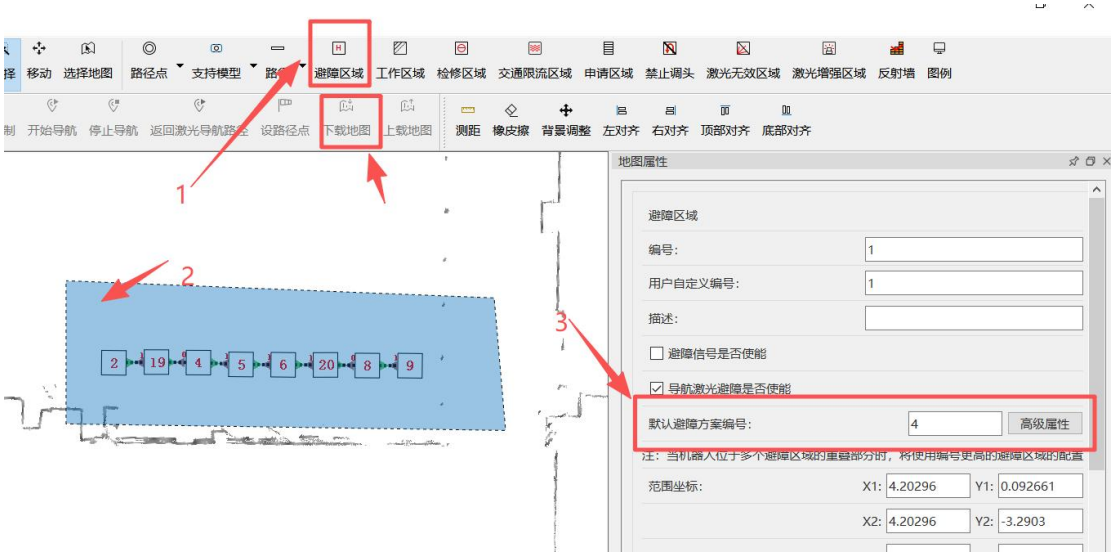


Figure 445 Select Obstacle Avoidance Area in the box

4.5.3.2.Path and point avoidance

Click on the target point, check "Enable Obstacle Avoidance" in Properties, enter the target scheme number, modify and download the map.



Point 446 in Figure enables obstacle avoidance

Click on the target path, check "Enable Obstacle Avoidance" in Properties, enter the target scheme number, modify and download the map. Note: When the path is bidirectional, both directions need to be configured, and different schemes can be configured for the return.

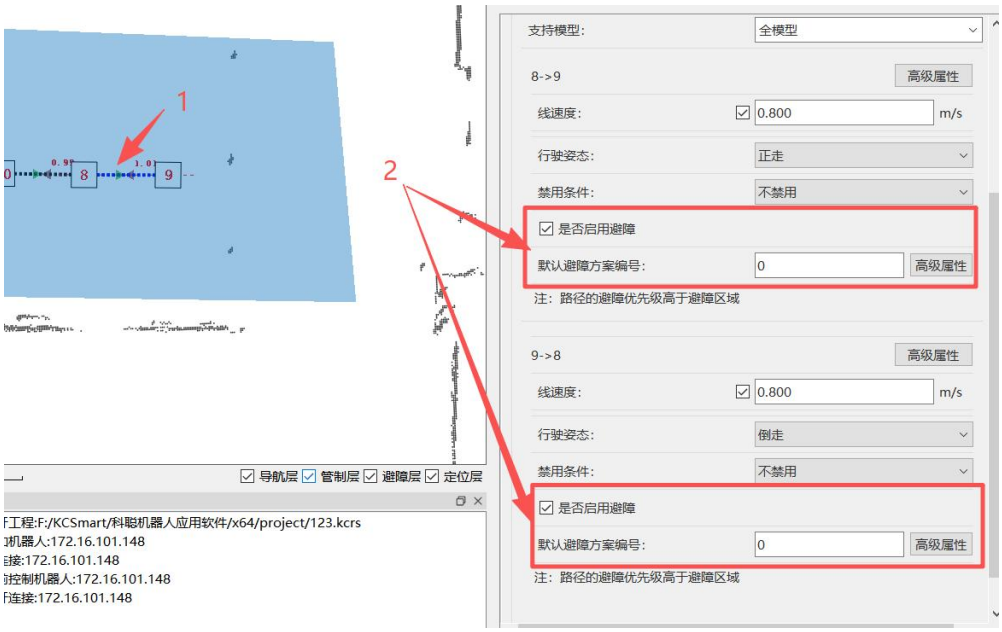


Figure 447 Path enables obstacle avoidance

4.6.Positioning

The first thing to do after each startup is to open the application software to confirm the location; When the current positioning status is a failure or the laser does not match the map or the confidence level is very low, you need to click this button to confirm that the positioning is correct.

If the AMR is positioned wrongly, it will cause the AMR to be unable to navigate, or even move wrongly and collide!

4.6.1.Determine the position

If the current position is correct, click "Confirm Location" to confirm the current robot's position on the map. No further actions can be taken without confirming the position.

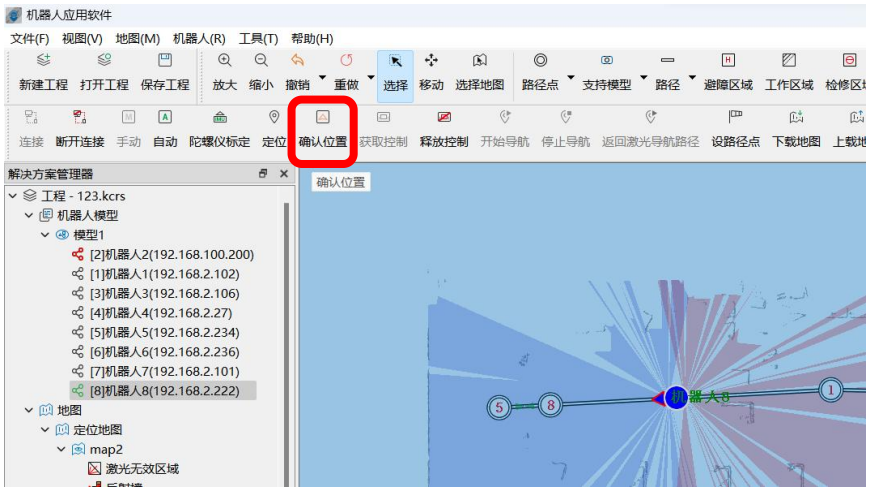


Figure 448 Confirm position

The positioning confidence level ranges from 0 to 1, which is of reference significance. The closer it is to 1, the higher the positioning confidence level. When it is low, it may indicate lost positioning or incorrect positioning. One should not only consider the confidence level but also the actual matching situation between the AMR and the map.



Figure 449 Positioning Confidence

4.6.2.Accurate positioning

Check if the purple and red laser dot clouds overlap with the black wall; If there is no coincidence in either the X or Y directions, it indicates a misalignment and needs to be repositioned until all directions are perfectly aligned to complete the positioning.

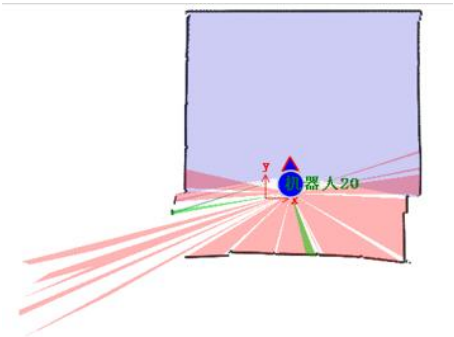


Figure 450 Accurate positioning

4.6.3.Repositioning

When the current position of the robot does not match a normal point on the map, you can click the "**Locate**" button to reposition the robot on the map.

Switch the AMR to manual and click Locate

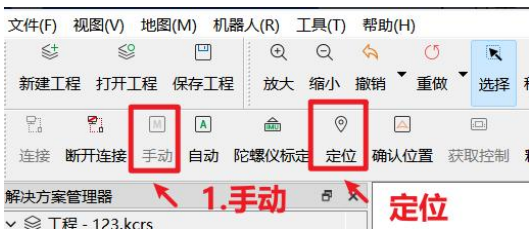


Figure 451 Switch manual positioning

Observe the outline of the map. In the map below, the actual position of the car should be at the lower part of the map and the front of the car should face the top of the map. The direction of the blue triangle arrow in the picture below is the front of the car.

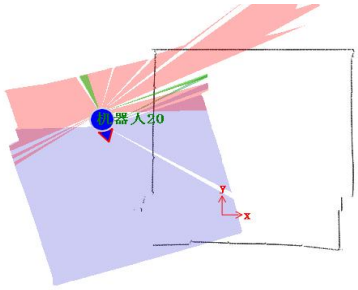


Figure 452 does not match the actual laser point cloud on the map

The operation is illustrated as follows: Click the actual position with the left mouse button and hold it, then swipe the mouse towards the front of the car (indicated by the black arrow in the following figure), release the mouse and observe the car automatically calibrating and positioning.

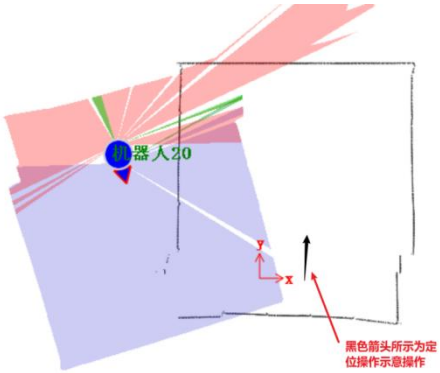


Figure 453 Automatic calibration and positioning

After the operation is completed, the AMR will automatically recognize and calibrate the position, and the calibration is successful as shown in the following figure.

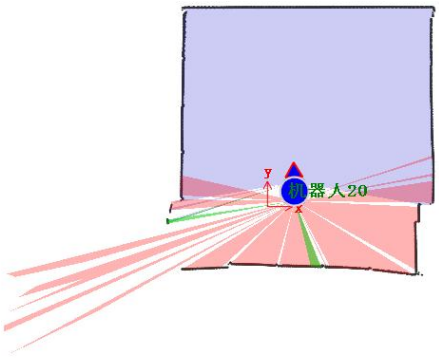


Figure 454 Calibration successful

Repositioning operation steps:

Click the "Location" button. Use the mouse to drag the black circle representing the vehicle body to the approximate position of the vehicle body (actual on site), click the left mouse button and drag the mouse arrow to point the black circle in the actual direction the vehicle body is pointing. After releasing the arrow, wait for the process to complete, during which the green square representing the vehicle body may jump and the green point cloud attempts to overlap with the gray wall or obstacle shown on the map

Note: If repeated repositioning fails, try the following method:

- Manually move the AMR to a position with more references on the map and try again.
- Try again after downloading the map.
- The objects on the map are so different from the actual scene that you need to redraw.

4.7.Configure wireless IP

Configuring the wireless IP requires configuring the AMR to connect to a local area network and assigning an IP address. Then, simply debug that the computer and the AMR are in the same local area network, and you can wirelessly connect and operate the AMR through that IP address.

Plug in the network cable to connect to the AMR and type 192.168.100.1 in your browser. Enter your account password and log in. Username: admin password: 12345678.

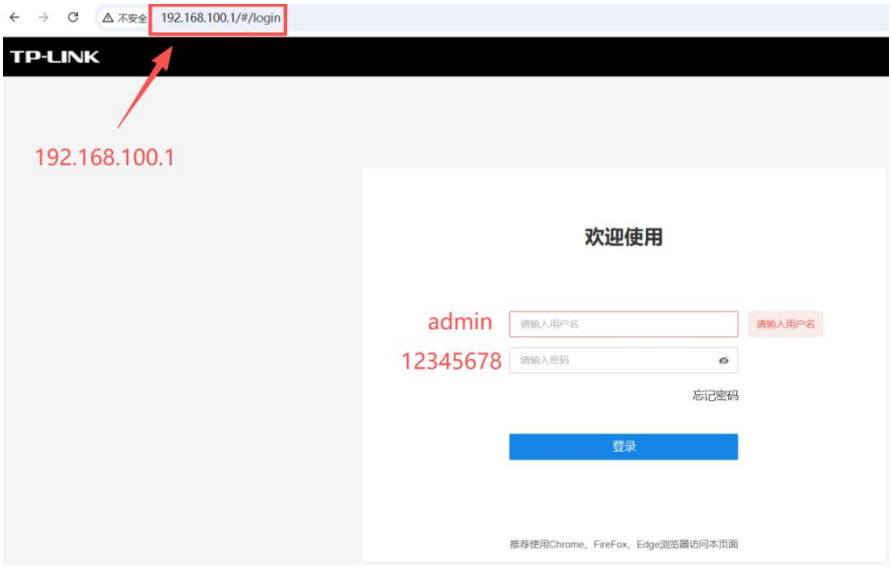


Figure 455 Login

In the wireless Settings, click Scan, connect to the target wireless network, and then click Save.

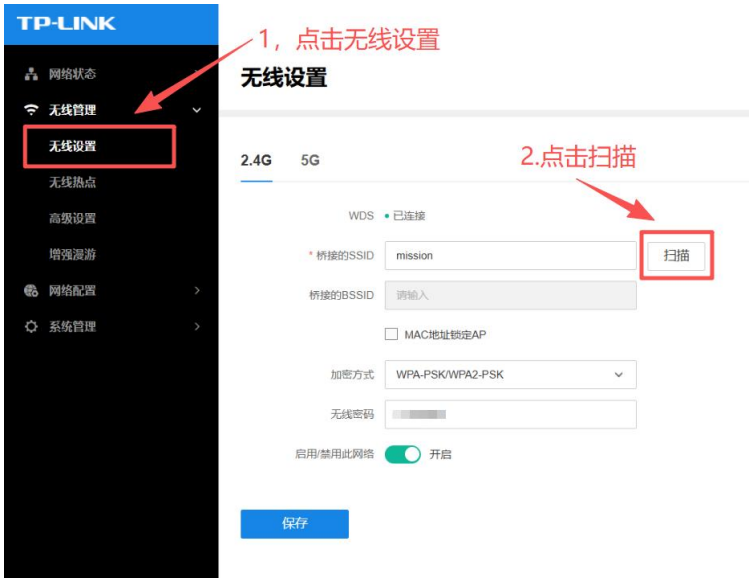


Figure 456 Connect to the target wireless network

In the network configuration, set a static IP that is not occupied within the same segment of the local area network currently connected. If you need to allow IT, you need to contact the factory IT to allow that IP.



Figure 457 Network setup

Go back to the robot application software and add the IP robot.



Figure 458 Add the robot

5.Maintenance and servicing

5.1.Maintenance Precautions

Maintenance work is the guarantee for the safe, normal and reliable operation of the equipment. In order to ensure the safe and stable operation of the equipment and extend its service life, inspection and maintenance work of the equipment is indispensable. Therefore, we should carry out regular maintenance of the unit, and the maintenance methods shall be in accordance with this manual. Please contact our after-sales service personnel for regular maintenance as required.

At the end of the repair, please ensure that the repairman manually fills out the repair record for this product. At the end of the repair, start the machine together with the repairman to verify that this product is functioning properly.

When the robot malfunctions, the maintenance personnel need to enter the operation site for repair and need to maintain communication with off-site personnel. Additionally, when the maintenance personnel enter the site, the system will be paused and an alarm will be triggered. The system will resume normal operation and stop the alarm only after the maintenance personnel have completed the operation and left the area. When it is necessary to repair or replace parts of the robot, parts approved by Mission must be used.

Read the "Maintenance Precautions" carefully before maintenance and carry out equipment maintenance on the basis of a full understanding of the safety maintenance method.

 Dangers	● No non-professionals are allowed to install, wire, maintain, inspect or replace parts of the equipment! ● Do not perform maintenance or upkeep on the equipment while it is powered on, or there is a risk of electric shock! ● Do not disassemble parts not recorded in this manual or perform maintenance in a manner different from that recorded. ● Before entering normal operation, make sure that the emergency stop switch is functioning properly; otherwise, in the event of an emergency, the system will not be able to perform its safety function, which may result in serious injury or significant damage.
 Warnings	● Please report your device for repair in accordance with the product warranty agreement. ● Please conduct daily and regular inspections and maintenance of the equipment in accordance with the equipment maintenance and care requirements, and keep records. ● In the event of a malfunction or damage to the equipment, a professional should troubleshoot and repair the equipment in accordance with the maintenance instructions and keep a record of the repairs. ● Replace parts in accordance with the replacement instructions in the manual. ● Do not allow foreign objects to enter the interior of the equipment and the connection terminals during maintenance. ● Please do not open the cover of the equipment except when performing maintenance and upkeep operations. ● After replacing the equipment, be sure to recheck the wiring and set the

	parameters of the equipment.

5.2.Maintenance tools

Before maintenance, be clear about the content of this maintenance, bring the corresponding maintenance form, prepare protective equipment and the tools and oil required for maintenance. Different types of maintenance do not necessarily use all the tools listed in the table below. You can choose according to the maintenance content.

Serial Number	Tool Name	Purpose/Specification	Notes
Tool list			
1	Small gantry cranes	For lifting AMRs and inspecting casters and drive wheels	
2	Battery charger	For manual charging of the battery	
3	2m sling	AMR hoisting	
4	M12 lifting ring screws	AMR hoisting	
5	Manual torque wrench 50Nm		
6	Hex socket wrench		
7	Small cross screwdriver		

8	Big cross screwdriver		
9	Ratchet tool assembly		
10	Digital multimeter		
Consumables			
1	Grease		
2	Thread fastening glue		
3	Cotton cloth		
Background tools			
1	Laptop		
2	1m Network cable	Connect the AMR locally	
3	Motor serial cable	Connect the motor driver locally	

5.3.Maintenance cycle instructions

The maintenance intervals specified in the maintenance and inspection checklist are only applicable to the 8-hour workweek and normal operating conditions. The maintenance intervals should be appropriately shortened if the intensity of the operating conditions is higher than the normal level, such as a lot of dust, large temperature fluctuations, acidic or alkaline environment, or other operating conditions such as the AMR operating cycle of 24 hours.

Equipment maintenance work is classified into three types based on the time intervals for regular maintenance: daily inspection, monthly maintenance, and annual maintenance.

5.3.1.Daily service and maintenance of robots

Keep the entire surface of the robot clean and free of dirt, and the upview lens free of obvious dust and foreign objects (dust and particles removed must not be shot into the device, and there are precise electronic components under the camera lens that are easily damaged by scattered dust and particles);

1) Routine maintenance requires regular visual inspection and noise checks;
2) Keep the surfaces of the entire vehicle clean and free of dirt;
3) The robot warning light is functioning properly, and the panel display and operation can be used

normally;

4) Check the integrity of the rubber coating on the casters and drive wheels for cracks and detachment;

5) The robot should be free of abnormal noise;

6) Check the top plate anti-slip mat for damage, warping, and detachment;

7) Check if the lidar sensor is functioning properly and the obstacle avoidance lidar should be working properly;

8) The robot housing should be free of defects; Check if the left and right drive wheels are stuck in the wheel frame and if the wheel frame screws are locked;

9) Check if the charging pin and CAN communication pin of the charging port are tilted and if the charging sensor is retracted;

10) Keep the charging port clean, free of foreign objects and dust.

11) The emergency stop button, key switch, reset button, shutdown button and release brake button should be functioning properly.

12) The robot housing should be free of defects; Check if the left and right drive wheels are stuck in the wheel frame and if the wheel frame screws are locked;

5.3.2.Floor cleaning requirements

➢ Check the floor every day and clean up dust, foreign objects and liquid contaminants in time to prevent the robot from slipping.

➢ Clean up the marks left by the casters on the ground in a timely manner to avoid heavy marks.

➢ Do not wax the ground along the robot's running path as it may cause the robot wheels to slip or get dirty.

5.3.3.Robot cleaning Requirements

Regular cleaning on a weekly basis is important to ensure the reliability of the robot's operation. Be careful to unplug the power sockets before cleaning to avoid short circuits that could damage the electrical system.

1) External cleaning

Remove attachments from the wheels every day to keep the wheels turning smoothly.

After cleaning, apply lubricating oil to the parts of the forklift that need lubrication as indicated in the lubrication table.

2) Clean electrical components

Use compressed air to blow off the motor dust. Do not wipe the dust in the circuits with a damp cloth.

Electrical components should not be rinsed with a high-pressure flushing device.

Do not damage the electrical components on the circuit board. Keep the electrical components in place to avoid short circuits.

3) Before assembling the vehicle body, use an air gun to clean the dust and debris inside the vehicle body. After cleaning, check the vehicle body to ensure there is no residue, dirt, etc.

4) No residues are allowed inside the vehicle body: After the vehicle body is assembled (without the outer shell), check whether there are any fallen screws, cut copper wires, wire sheaths or other residues inside the vehicle body. If any are found, they must be cleaned up thoroughly.

5) Check if the wiring inside the vehicle is neat and there is no dust or dirt on the wires. If any are found, wipe them clean with alcohol.

6) The outer shell should be wiped clean with a dry cloth after installation.

7) If there is still dirt after cleaning with a dry cloth, dip a little alcohol to clean the surface until it is completely clean.

5.3.4.Laser cleaning requirements

 Note	**Laser cleaning precautions** Not cleaning or cleaning the laser improperly may result in the following problems: ● The robot is unable to detect the sign/pallet rack. ● The robot enters an emergency stop without a clear reason.

5.3.5.

Please clean the laser according to the following instructions, otherwise it may cause damage to the laser lens or failure of function:

➢ Keep the glass surface of the laser clean and remove dust regularly.

➢ Please use a dedicated cleaning cloth.

➢ Do not dry wipe the laser glass surface. Use a damp soft cloth to clean and add a little detergent if necessary.

➢ Do not use corrosive solvent-based cleaners such as acetone.

➢ Do not use alcohol to clean the laser.

5.3.5.Regular cleaning project

Project	Content	Notes	Intervals/Cycles
AMR body	Use a damp cloth to clean the outer surface of the device	 NOTICE! Be careful not to use compressed air Be careful not to use corrosive cleaners Be careful not to use abrasive cleaners	As needed
Wheels	Remove dirt and make sure there is no entanglement on the surface of the wheel and on the pivot		2-3 weeks
Laser scanner	Clean the optical element cover of the laser scanner for optimal performance.	 NOTICE! Avoid using corrosive or	Weekly/as needed

3D camera	Clean the surface of the 3D camera to give it the best performance	abrasive cleaning agents; Static charges cause dust particles to be attracted to the optical device cover, and you can use an anti-static plastic cleaner to reduce this effect.	Weekly/as needed

5.3.6.

5.3.6. Monthly service and maintenance (i.e. monthly inspection after the equipment is operational) :

When the installation and commissioning of the equipment are completed, it is necessary to adhere to daily maintenance work and establish a system of daily inspection, monthly inspection and annual overhaul.

Project	Check Contents	Maintenance intervals	Maintenance methods/basis	Specifications/Parameters
Casters	Check the bearings and bolts	1 month/as needed	Tool inspection - If the wear exceeds 10mm, replacement is required.	Outer diameter 65mm
	Check for wear on the wheels			
Indicator light	Check if the indicator light is intact and if the light shows properly	3 to 4 months	Visual	
Emergency Stop button	Check if the emergency stop button works	3 to 4 months	Press the red button and check if the reset button lights up	Emergency Stop button
Bolts/fasteners	Check for loose bolts at all connections of the equipment	1 month	Tool inspection - Tighten according to the required torque and apply thread glue if necessary, see Appendix 1 for details	
Laser scanner	Check for defects in functionality	As needed	NOTICE! The wheels must be recalibrated after replacement	

Project	Check Contents	Maintenance intervals	Maintenance methods/basis	Specifications/Parameters
Drive wheels	Check for wheel wear	As needed	Replace worn wheels; Remove foreign objects from the wheel surface; NOTICE! The wheels must be recalibrated after replacement.	Drive wheel: Outer diameter 176mm
	Check the wheels for any foreign objects			
Lithium battery	Check the battery's endurance or if it discharges too quickly	As needed		Lifespan: Full charge discharge 2000 times
Line/Sensor	Check for secure installation of photoelectric switches, proximity switches, junction boxes, and cable laying	1 month	Handle as a fault judgment	
	Check if the connectors are securely plugged in			
Vehicle body cover	Check for dents and deformations on the body cover	As needed	Reshape or replace	

5.3.7.Annual service and maintenance (i.e. annual inspection after the equipment is put into operation) :

Annual maintenance requires a comprehensive inspection of the entire vehicle, which is independent of the total time of the equipment and is carried out even when the equipment is not in operation;

Project	**Check Contents**	**Maintenance intervals**	**Maintenance methods/basis**	**Specifications/Parameters**

Project	Check Contents	Maintenance intervals	Maintenance methods/basis	Specifications/Parameters
Screw fastening	Check the fixing bolts of the drive wheel, reducer and motor	Annual	Disassemble the vehicle to check if the fastening bolts of the drive wheels, reducers and motors are securely fastened;	
Drive wheels	Check for wheel wear	Annual	Replace worn wheels; Remove foreign objects from the wheel surface; NOTICE! The wheels must be recalibrated after replacement.	Drive wheel: Outer diameter 176mm
	Check the wheels for any foreign objects			
Casters	Casters replacement	Annual/as needed	Replace casters that have been in operation for more than one year in advance to avoid deviation caused by problems with the casters, depending on the on-site conditions	
Lithium battery	Check the battery soc and cycle count	Annual	Check the battery cycle times (soc). If it exceeds 2,000 times, the battery needs to be replaced	Life: Full charge discharge 2000 times
Line/Sensor	Wire harness inspection	Annual	Check the wiring harness for aging or peeling; Check if the terminal connections are secure;	
	Connector inspection			

5.4.Warranty Instructions

The warranty for the entire product does not cover the following situations:

1) Damage resulting from improper transportation, installation, operation or management by the user;
2) Damage caused by the user's unauthorized disassembly of the product;
3) Damage resulting from external causes such as abnormal voltage or fire;
4) Damage caused by non-compliance with the requirements of the manual, the indicative marks on the main body of the product, and other matters that need attention;

5.5.Simple Troubleshooting

Before entrusting the product for repair, please check and confirm according to the following checklist. If it is indeed a fault, please contact our after-sales service personnel and do not repair it on your own. Before checking, make sure the product is powered off.

When the robot malfunctions, the corresponding protection mechanism will be triggered and the corresponding error code will be displayed in the upper computer monitoring interface bar.

A list of common fault types and troubleshooting methods is as follows:

Serial Numbers	Fault manifestations	Cause of Failure	Solutions
1	Robot abnormal obstacle avoidance	Radar malfunction or incorrect parameter configuration.	● First check the parameter Settings to see if the radar data varies correctly with the range of the obstacle. If the radar data does not change, replace the radar. ● Clean the surface dust of the lidar or replace it with a new lidar;
2	Motor failure	An emergency stop or edge contact trigger causes the motor power supply to be cut off.	Check if the emergency stop button is pressed and if the contact switch is triggered;
3	Congestion caused by occupied routes	Traffic control, deadlocks.	If the deadlock persists for a long time, you can release the deadlock by switching one of the robots to manual mode and moving it to another place to come back online.
4	Path error	The path between the initial point of the task and the target point is discontinuous	Check if the task is correct or if the map has been changed.
5	Congestion caused by occupied routes leads to the robot being shut down due to low battery power	Robots that are not on the map have not been removed from the system.	Check the number of robots parked in front of the robot, select the blocked robot, and after pushing the robot to the charging station position for charging, drag the faulty robot away from the site through the upper-level system.
6	Report an error while performing the robot lifting operation	Rack tilt	Adjust the rack.

Serial Numbers	Fault manifestations	Cause of Failure	Solutions
7	Charging error	Misalignment or mispositioning of the charging station leads to poor plugging of the charging interface	● Reset the position of the charging pile to the initial fixed position;
8	The robot drives with a load slide	Slippery	Check if the slippery floor is flat, check if the robot's drive wheels are stuck, and check if the limit block screws that fix the wheel frame are loose.
9	The robot reports an error under no-load conditions	Slipping	The recovery process is the same as the above recovery process
10	The robot network is disconnected	Robot disconnected from server for more than 30 seconds, wifi module failure or poor contact at the wifi module's network port.	● Plug and unplug the wifi module network cable; ● Check if the venue wifi network is communicating properly; Check if the server network connection is functioning properly;

5.6.List of vulnerable parts

Serial numbers	Name	Quantity
1	Batteries	1
2	McNamm 7-inch wheels	4
3	Swivel wheels	4
4	Front and rear bumpers	2
5	Side bumpers	2
6	Front housing of VM650CE-M01-006-X1	1
7	VM650CE-M01-007-X1 rear fill housing	1
8	Left housing of VM650D1-M01-005-X1	1
9	VM650D1-M01-004-X1 right housing	1

5.7.

5.7.Maintenance Instructions

 Warnings	Power must be cut off during all part removal operations!

5.8.

5.8.1.Maintenance of electrical components

Before repairing the product, please check and confirm according to the following list. If it is indeed a fault, please contact our after-sales service personnel and make sure the product is powered off before the inspection. For details on component allocation, see Parts description 2.2.2.

1) Check if the power switch is loose and if the button pops up properly when pressed.
2) Check whether the piezoelectric contact signal is normal and inspect its electrical wiring.
3) Check the cables of the drive motor to see if they are securely connected.
4) Check if the communication line connectors between the drive modules are securely connected.
5) Check if the connection and communication lines of the buzzer are functioning properly.
6) Check whether the 12V, 24V, 48V aviation plugs on the power management module are securely connected, whether the signal connectors are securely connected, and whether the debug ports are securely connected.
7) Check if the laser sensor signal is normal by connecting to the background and placing obstacles to detect.
8) Check if the charging connector of the charging bell is loose.

5.8.2.Casters maintenance

Casters	Maintenance methods
Screw fastening inspection and maintenance	Fasten the casters fixing bolts with the sleeve assembly.
Check and maintain the condition of casters	Turn the AMR over, check if the rotating casters run smoothly and if there is any abnormal noise, check if there is any entanglement at the casters bearing, and visually check if the casters are damaged or de-glued.
Replace the faulty casters	Replace casters that have been in operation for more than one year. Remove the fixing nuts of the casters for replacement. When restoring, apply thread glue to all removed bolts and tighten them to ensure they are securely fastened and marked.

5.8.3.

5.8.3.Maintenance and upkeep of drive components

Drive components	Maintenance methods
Maintenance of drive motor fixing bolts	Retighten the bolts of the walking drive wheel with a manual torque Allen wrench to ensure they are securely fastened and marked.
Drive motor condition inspection and maintenance	● Check for entanglement on the inner side of the drive wheel and clean it up; ● Check if the drive wheel motor is securely plugged in with the wiring harness connector; ● Tighten the screws that secure the drive wheels.

5.8.4.

5.8.4.Lithium battery maintenance

5.8.4.1.Lithium battery screw fixation maintenance

Lithium battery	Maintenance methods
Lithium battery screw fixation maintenance	Use a manual torque Allen wrench to retighten the screws that hold the lithium battery, and make sure the screws are marked after they are fastened.
Lithium battery cable connection maintenance	Check the connectors of the charging/discharging and communication cables led out from the lithium battery to ensure a firm connection.
Charge maintenance	● Perform a full charge maintenance operation on the lithium battery using a manual charger. ● Check the lithium battery lead-out charge/discharge and communication cable connectors to ensure they are securely connected.

5.8.4.2.

6.Appendix

6.1.Appendix A: Daily Maintenance Record Checklist

Daily maintenance record checklist					
Maintenance level	Equipment model			Inspectors	
	Device Number			Date	
	Check items		Methods	Check Results	Notes
Daily maintenance and care items	Visual inspection (Check the casing for damage, screws for looseness or detachment)		Visual inspection	□ Normal □ Abnormal	
	Abnormal noise check (Check for abnormal noises during walking)		Auricular inspection	□ Normal □ Abnormal	
	Check for any damage to the upper code reader		Check	□ Normal □ Abnormal	
	Check if the emergency stop switch, power button switch, and lidar are functioning properly		Check	□ Normal □ Abnormal	
	Check if the anti-collision touch edge is intact and functioning properly		Check	□ Normal □ Abnormal	
	Check whether the anti-slip pad on the top plate is intact and whether there is any damage or delamination		Check	□ Normal □ Abnormal	
	Check for any damage to the charging port		Check	□ Normal □ Abnormal	
	Check if the status indicator light is functioning properly		Check	□ Normal □ Abnormal	
	The AMR surface is clean and hygienic		Cleaning	□ Clean □ Not cleaned	
Anomaly Record sheet					
Device Number	Abnormal situation	Handling measures	Handler	Processing Date	Notes

Notes:
1. The inspectors should make a record in the record box after completing the maintenance. Mark "√" in the corresponding place of the table if the condition is normal, "NG" if it is not normal, and "/" if it does not need to be checked.
2. If there are any abnormal situations, please fill in the abnormal situation information in the abnormal situation record form and feed it back to the equipment department. If it cannot be solved, please contact the after-sales personnel of Mission intelligent robot in time.
3. Daily maintenance is carried out by the operator before work each day (except for the equipment marked "idle"). Monthly and quarterly maintenance is carried out by the equipment maintenance personnel at reasonable times based on usage and production conditions. Annual maintenance is carried out by professionals or institutions.

6.2.

6.2.Appendix B: Monthly Maintenance Record Checklist

Daily maintenance record checklist					
Maintenance level	Equipment model			Inspectors	
	Device Number			Date	
	Check items		Methods	Inspection result	Notes
Monthly maintenance items	Control the operation by configuring the software and observe whether the process is smooth; Whether the sensor can be triggered effectively;		Check	□ Normal □ Abnormal	
	Check for damage to the upviewcode reader and for normal images		Check	□ Normal □ Abnormal	
	Check for wear on the drive wheels and for any foreign objects entangled		Measurement/visual inspection	□ Normal □ Abnormal	Normal wheel diameter 176mm
	Check the casters for smooth rotation, wear and for any foreign objects entangled		Measurement/visual inspection	□ Normal □ Abnormal	Normal wheel diameter 65mm
	Check if the controller terminal connections are secure and loose		Check/visually	□ Normal □ Abnormal	
	Check if the power management module terminals are securely connected and loose		Check/visually	□ Normal □ Abnormal	
	Check if the electrical components such as emergency stop, switch, and emergency stop are functioning properly		Check	□ Normal □ Abnormal	
	Check if the lidar is functioning properly and perform surface cleaning		Check/Wipe	□ Normal □ Abnormal	
	Check for damage to the charging bell, for broken or blackened pins;		Check/visually	□ Normal □ Abnormal	
	The AMR surface is clean and hygienic		Cleaning	□ Clean □ Not cleaned	
Anomaly Record sheet					
Device Number	Abnormal situation	Handling measures	Handler	Processing Date	Notes

Notes:
1. The inspectors should make a record in the record box after completing the maintenance. Mark "√" in the corresponding place of the table if the condition is normal, "NG" if it is not normal, and "/" if it does not need to be checked.
2. If there are any abnormal situations, please fill in the abnormal situation information in the abnormal situation record form and feed it back to the equipment department. If it cannot be solved, please contact the after-sales personnel of Mission intelligent robot in time.
3. Daily maintenance is carried out by the operator before work each day (except for the equipment marked "idle"). Monthly and annual maintenance is carried out by the equipment maintenance personnel at reasonable times based on usage and production conditions. Annual maintenance is carried out by professionals or institutions.

6.3.

6.3.Appendix C: Annual Maintenance Record Checklist

Daily maintenance and upkeep record checklist				
Maintenance level	Equipment model		Inspectors	
	Device Number		Date	
	Check items	Methods	Check Results	Notes
Annual maintenance items	Control the operation by configuring the software and observe whether the process is smooth; Whether the sensor can be triggered effectively;	Check	□ Normal □ Abnormal	
	Check for damage to the upview code reader and for normal images. Replace any damage in time	"Check	□ Normal □ Abnormal	
	Check for wear on the drive wheels and for any foreign objects entangled	Measurement/visual inspection	□ Normal □ Abnormal	Normal wheel diameter 176mm
	Check the casters for smooth rotation, wear and for any foreign objects entangled Replace casters that have been in operation for more than one year as needed	Measurement/Replacement	□ Normal □ Abnormal	Normal wheel diameter 65mm
	Check that all vehicle connectors are securely fastened and tighten them	Check/Tighten	□ Normal □ Abnormal	
	Check for aging of the battery connection wires and any damage	Check	□ Normal □ Abnormal	
	Battery check (check battery soc and cycle count) Replace beyond 1500 cycles	Check/Replace	□ Normal □ Abnormal	
	Check if the lidar is functioning properly and perform surface cleaning	Check/Wipe	□ Normal □ Abnormal	
	Check for damage to the charging bell, for broken or blackened pins;	Check/visually	□ Normal □ Abnormal	
	The AMR surface is clean and hygienic	Cleaning	□ Clean □ Not cleaned	
Anomaly Record sheet				

Device Number	Abnormal situation	Handling measures	Handler	Processing Date	Notes

Notes:
1. The inspectors should make a record in the record box after completing the maintenance. Mark "√" in the corresponding place of the table if the condition is normal, "NG" if it is not normal, and "/" if it does not need to be checked.
2. If there are any abnormal situations, please fill in the abnormal situation information in the abnormal situation record form and feed it back to the equipment department. If it cannot be solved, please contact the after-sales personnel of Mission intelligent robot in time.
3. Daily maintenance is carried out by the operator before work each day (except for the equipment marked "idle"). Monthly and quarterly maintenance is carried out by the equipment maintenance personnel at reasonable times based on usage and production conditions. Annual maintenance is carried out by professionals or institutions.

6.4.

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