ELITEMISSION

ELITEMISSION Robots

MC Series User Guide

MC500-12-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 show 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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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.

Robots, HMR, compound robots, equipment, etc. that appear separately in the documentation are all abbreviations for this vehicle body.

Without authorization, the robot shall not be disassembled or assembled at will.

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

Note For more detailed safety precautions for the collaborative robotic arm, please refer to the General section on robots in Elite Robots CS_User Manual _CS612.

1.1 General Safety Statement

- Read and follow the safety precautions before installing, operating, and maintaining t he product.
- For personal and equipment safety, please follow all safety precautions marked on th e product and described in the manual when installing, operating and maintaining th e 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 specification r equirements; otherwise, it may cause malfunction. Functional abnormalities or compon ent damage resulting from non-compliance with the relevant regulations are not cove red 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

Personnel engaged in mechanical installation and commissioning should master professional knowledge and experience in the relevant field, possess sufficient experience, and be capable of assessing whether the machine is in a safe operating state 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-

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

1.1.5 Safety Precautions

Table Safety Precautions Table1- 3

Unpacking inspection	
 Caution	● 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! ● When opening the box, if you find that the equipment has water inside, missing parts or damaged parts, do not install it! ● 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 handling equipment such as cranes and hoists, the operator must wear personal protective equipment and 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.

 Caution	• 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. • Do not carry non-standard items such as flammable and explosive items, 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 HMR 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 tro ubleshoot and repair the equipment in accordance with the maintenance i nstructions, and keep a maintenance record. ● Replace parts in accordance with the replacement instructions in the man ual. ● Do not allow foreign objects to enter the interior of the equipment and t he connection terminals during maintenance. ● Do not open the cover of the equipment except when performing mainte nance and servicing operations. ● After replacing the equipment, be sure to recheck the wiring and set the parameters of the equipment.
 Note	● If the HMR is not in use for a long time or during holidays, it needs to b e charged for maintenance if it is not used for more than 2 months. ● Do not modify program parameters when the HMR is running normally. ● The joint module of the collaborative robotic arm CS612 is equipped with brakes. When power is cut off, keep the robot body in position. Do not manually frequently cut off the power supply system. It is recommended t hat the time interval between each power-on and power-off be more tha n 10 seconds. ● The collaborative robotic arm CS612 has a collision detection function. Wh en the external force on the robot body exceeds the normal force range set by the user for safety, the robot body automatically stops to prevent injury from collision to the robot or the operator. This feature is specific ally designed by CS612 for the safety of human-machine collaboration, bu t it requires the robot system to be within normal operating range and t o be compatible with the collaborative robotic arm. If other controllers ar e used, the robot will not have the above features, and the user will be r esponsible for the dangerous consequences. ● Make sure that the robot s arm and tools are properly and safely install ed in place. ● Make sure the robot s arm has enough space to move freely. ● Pay attention to the movement of the collaborative robotic arm when usi ng the teaching device. ● connecting different machines may increase the danger or trigger new da ngers. If the robot and its accessories require different levels of safety an d emergency shutdown performance, a relatively higher performance level

	should be chosen.

1.1.6 Safety precautions

Table Safety Precautions Table1- 4

	• 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 over squeeze, 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 applies;



- This robot can only be used indoors and not outdoors;
- Small objects are not allowed on the floor within the area where the robo t moves, as the robot cannot detect obstacles smaller than 185 millimeter s;
- Components should be protected from overheating and the robot s work ing environment should not exceed 45 ° C;
- Do not expose the robot to extremely wet or extremely dry conditions an d meet environmental requirements;
- This product should be used in a place away from heat sources and direc t sunlight to prevent the plastic and rubber components from accelerating aging and affecting their service life.
- No one is allowed to enter the operating area while the product is in ope ration;
- No water splashes on the equipment. If water accidentally gets into the p roduct, ventilate and dry it before use;
- This product requires regular maintenance and cleaning as specified in thi s manual to avoid affecting its service life;
- If the floor, wall or other usage environment no longer meets the environ mental requirements of this product, discontinue the use of this product a nd 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 Handling Precautions table1- 5

 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; • The robot should be kept dry during transportation or temporary storage to avoid upside-down, 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 du ring transportation;
- Secure the robot to the wooden box chassis to ensure it does not move on the plan e during transportation;
- Because the robot is heavy, it is recommended to use lifting equipment such as a ga ntry crane to assist the robot in packaging to avoid the danger to human body caus ed by manual handling;
- After placing the robot in a wooden box, it is necessary to secure the robot inside t he box to ensure that it does not move; The box with the robot inside should be tr ansported using dedicated equipment. During the transportation of the crates, the ha ndling requirements of the robots should be strictly followed to prevent the crates fr om 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 advan ce, 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.

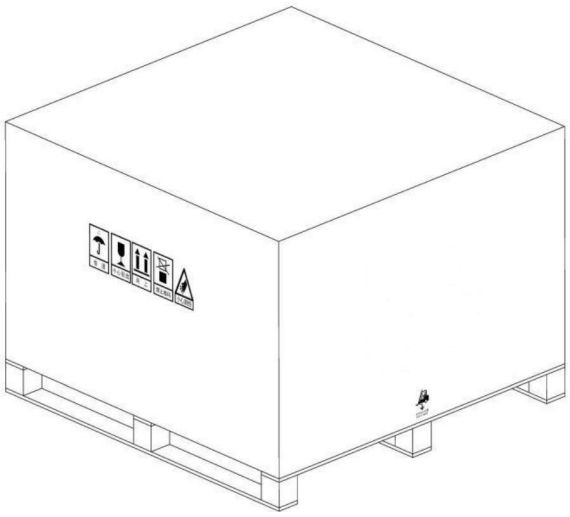


Figure Handling of the packaging box1- 1

1.2.4 Packaging and unloading

Robots are usually placed on wooden boards, as shown in Figure 1-2, and then pack ed into boxes. However, due to the limitations of the actual loading and unloading enviro

nment, loading and unloading may not be convenient. Therefore, it is recommended to us e a ramp.

1.2.5 Packing list

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

List the packing list1- 6

Material name	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 e valuated by Mission staff in accordance with the technical requirements of the robot for t he ground. The modification shall be carried out by the customer themselves. After the c onstruction is completed, on-site inspection and acceptance shall be conducted after insp ection. The basic requirements for the floor are as follows Ground technical requirement s (refer to national standard GB50209-2010 code for acceptance of construction quality o f Building ground engineering)

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

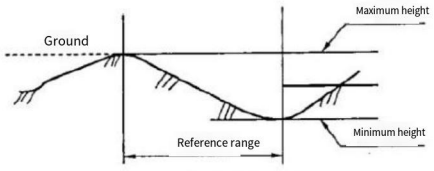


Figure 11 Schematic diagram of the range of undulation-

- Road slope Road slope (H/L) is defined as the maximum ratio of the horizontal hei ght 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);

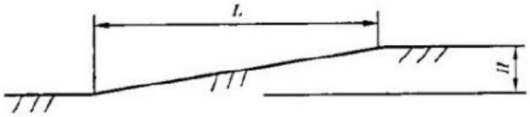


Figure 12 Diagram of the range of road slopes-

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

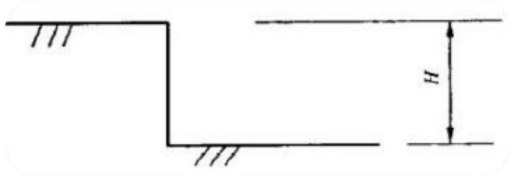


Figure 13 Diagram of the range of step heights-

- Ditch width The maximum allowable value of pavement crack width should be less than 10mm (including 10mm).

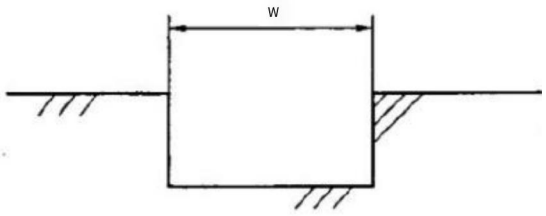


Figure 14 Diagram of the range of trench width-

- Ground load The average ground load of the MC500-12-Ce composite robot should reach 1000kg/m ²;
- Ground hardness The floor hardness should be above c30 (tested with a rebound h ammer, 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, HMR requires dedicated frequency bands and independent use of 5G;
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) At least 30 terminals are associated with a single AP;
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 Field environment Requirements Table1- 7

environment	indoor environment
Ground conditions	Hard cement or conductive plastic is the best material for the driving surface of HMR

	The HMR 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 of braking safety distance and handling positioning accuracy, the coefficient of ground sliding friction should be no less than 0.5
Temperature	Working area temperature Operating area temperature range -10 ° C to 45 ° C Charging zone temperature 0 ° C to 45 ° C 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

The robot should be packed in wooden cases according to the 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 ga ntry crane to assist the robot in packaging to avoid the danger to human body caus ed by manual handling;

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

5) The box with the robot inside should be transported using dedicated equipment. Duri ng the transportation of the crates, the handling requirements of the robots should b e strictly followed to prevent the crates from getting wet. Do not stack more than t wo 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 discharge d at least once every six months, otherwise it may be damaged.

1.4 Safety requirements related to batteries and charging piles



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.

1.4.1 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. It is strictly forbidden to 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 batteries of different types or 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.

1.4.2 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 piles along driving routes or in 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 connecting cables in accordance with the risk prevention regulations of the relevant country. **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.

1.4.2.1 Usage Requirements

1) Altitude not exceeding 2000m;
2) Charging ambient temperature 0 ° C to 45 ° C (HMR charging environment with he ated battery -20 ° C to 40 ° C);
3) The maximum relative humidity of the air does not exceed 90%, and the air circulatio n is good;
4) The operating site is free of conductive and explosive dust, gases or vapors that corr ode metals and damage insulation, and strong electromagnetic interference;
5) The installation base is free from severe vibration and shock, with a vertical inclinatio n of no more than 1 °;
6) Ground requirements The same as HMR requirements;

1.4.2.2 electrical requirements

1) The power of the power supply loop for a single charging station is no less than 30 00W;
2) Use 16A three-hole sockets, and each charging pile is separately equipped with an ai r 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 st ation wiring. Avoid reversing the positive and negative terminals to cause a short circ uit or damage to the equipment; Note The on-site strong current layout shall be p rovided by Party A.

1.4.2.3 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.

1.4.3 How to deal with a damaged lithium battery

- Damaged batteries can only be touched and transported after wearing personal pro tective equipment such as alkali resistance and solubility resistance.
- Separate the battery from the casing if it shows signs of overheating, smoking, emi tting an odor, making noise or deformation.
- Store the battery in a fire-resistant container or keep it at a safe distance from fla mmable materials.
- Do not inhale the smoke that may appear.

1.4.4 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.
- When transporting, it is essential to strictly abide by the requirements for the transportation of dangerous goods related to batteries.

1.5 Forced movement of robotic arms in emergency situations

in rare cases, it may be necessary to move one or more robotic arm joints in an emergency where the power supply to the collaborative robotic arm fails or the power supply is not intended to be used. This can be forced to move the robotic arm joints by the following methods

Forced reverse drive Push or pull the body of the robotic arm forcefully (at least 500N) to force the joints to move.

Reverse drive function definition The reverse drive function can be used to release the robotic arm from a stuck state. When entering the reverse drive mode, the robotic arm can be directly dragged by hand. When the force reaches a certain level, the servo will automatically

release the brake and be pushed.

Trigger condition When the robotic arm is in standby mode, pressing the drag button will enter the reverse drive mode.

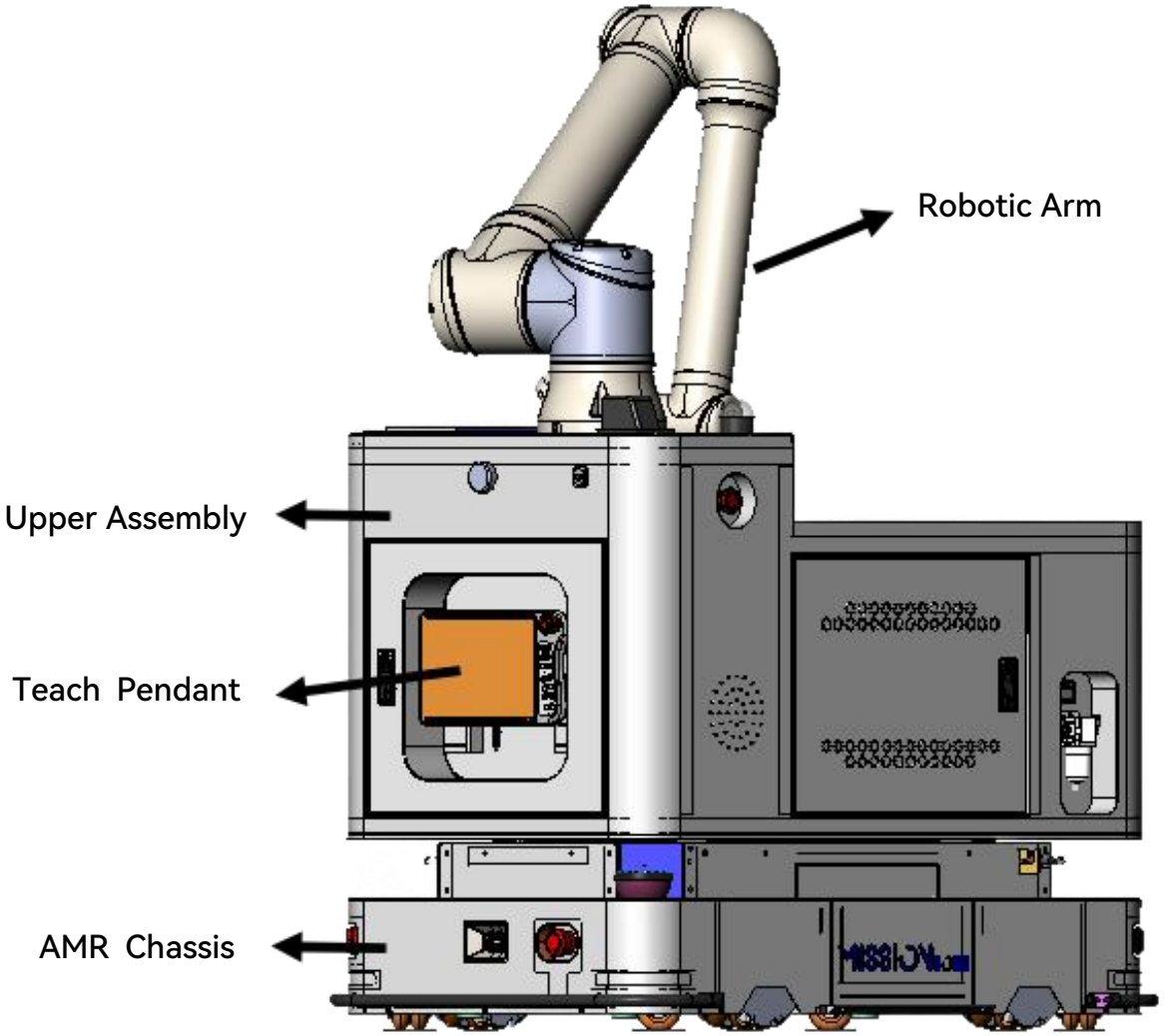
Note Forced manual movement of the robotic arm body is only in emergency situations and may damage the joints.

1.6 Noise

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

2 product instructions

2.1 product introduction



product Image2- 1

The MC500-12-Ce compound robot is mainly composed of a mobile chassis (AMR), a n upper assembly and a six-axis robotic arm, among which the chassis and the robotic ar m are driven by separate controllers respectively. The chassis uses McNamur wheels as th e traveling mechanism and has the ability to move in all directions. It can achieve comple x movement trajectories such as forward, backward, lateral, ob¡ que and in-place rotation, and has excellent passability and flexibility in narrow Spaces and complex working condi tions. Based on laser SLAM navigation technology, the chassis integrates a high-performa nce controller inside, providing core map-building and positioning navigation functions, an d reserves a rich array of I/O, CAN, RS485 and other expansion interfaces for users to q uickly implement various mobile robot applications. Meanwhile, the six-axis robotic arm in tegrated into the product is programmed and operated by a dedicated teaching device o

r an independent control system. in terms of coordinated operation of the entire machine, although the chassis and the robotic arm have different controllers, the emergency stop signals are linked pressing either the emergency stop button on the chassis or the upp er assembly simultaneously cuts off the power supply for the chassis drive and the roboti c arm servo, ensuring that the entire machine stops all movements immediately in an abn ormal situation.

2.1.1 Functional Features

- Positioning and navigation Precise positioning with fusion navigation technologies such as laser Slam navigation;
- Motion control With four McNamur wheel drives, it has the ability to move in all di rections and supports various motion control modes such as forward, backward, later al, ob¡que, 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 avoid ance in software area and built-in area), contact-type safety touch edge, all-direction al six emergency stop buttons for the entire device, safety PLC and other multiple sa fety protection measures;
- Human-machine interaction Push-button switches, display screens, and standard aud ible and visual alerts indicating the current operating status of the equipment;
- control mode Supports automatic and manual control;
- Network communication Wifi network communication and seamless roaming, support ing 5G network expansion;
- Robotic arm operation integrated six-axis collaborative robotic arm for grasping, as sembling, palletizing, etc. It can be programmed independently through the teaching device and has emergency stop linkage and safety coordination with the chassis;

2.1.2 Application industry

For goods-to-person handling in e-commerce, 3C electronics, tobacco, pharmaceuticals, et c., support as an extended platform for customized load attachments to meet multi-scena rio applications.

2.1.3 Optional configuration

Table 21 Optional configuration Table-

Accessories	Model	instructions
Charging station	eh-4850-C1-130	Recommended optional
Battery charger	F1200-58.4 V20A	Output without load
Swap battery	51.2 V / 60 ah	-
Battery swap trolley	MXCDC-650	-
2.5D vision	Standard/professional	-
3D Vision	-	Optional on demand
Calibration plate	100/50	Calibration boards come in two types 100 and 50. The 100 is for hand-eye calibration, and the 50 is for target guidance (related to the number of workstations), and is generally used in conjunction with 2.5D vision.
Packaging	Standard packaging pallet + ramp	Suitable for domestic short-distance road and rail transportation with a relatively controllable environment
	enhanced packaging pallets + ramps + fully enclosed boards	Suitable for long-haul sea transportation, export transportation, or scenarios with higher requirements for moisture and shock resistance

2.2 product structure

2.2.1 Size of the mobile chassis (including the upper assembly)

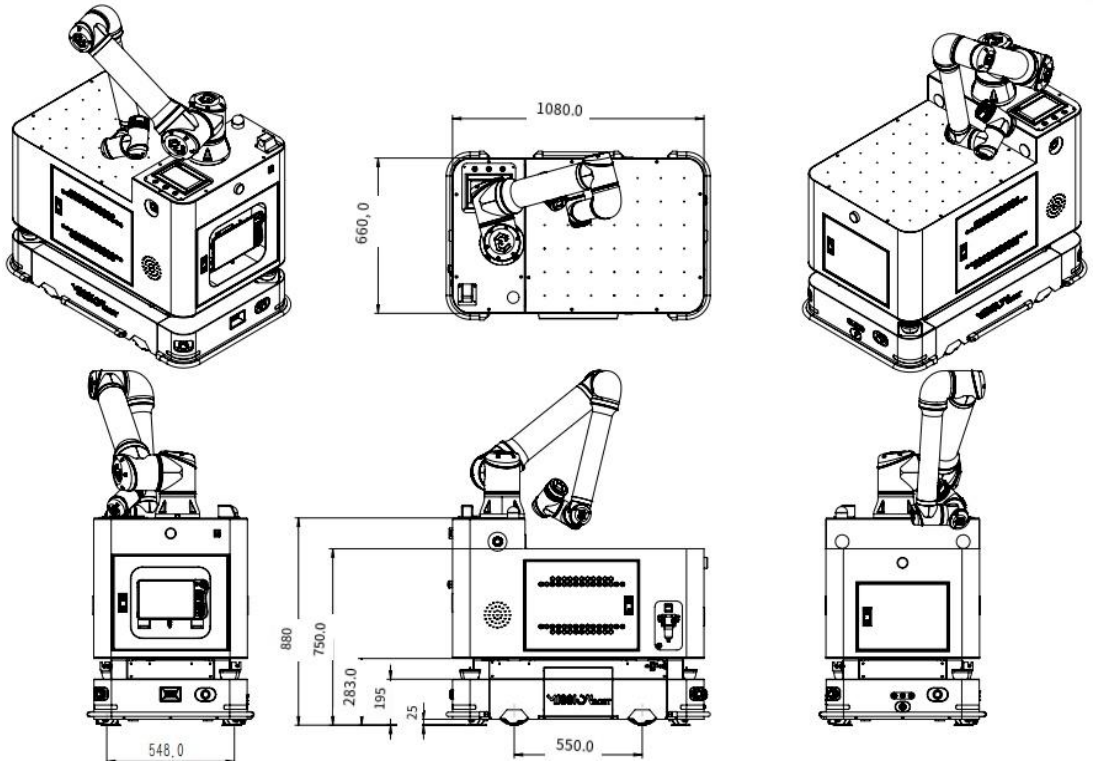
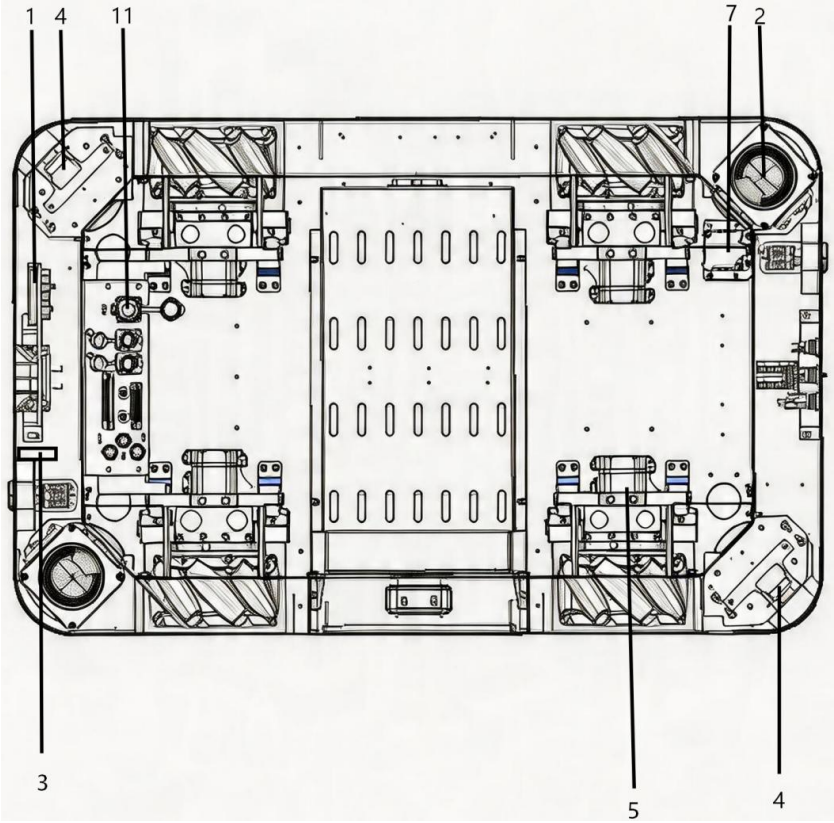


Diagram of the dimensions of the mobile chassis (including the upper assembly)2- 2

Table 22 Dimensions Table of mobile chassis (including the upper structure)-

Serial numbers	Definition	Numerical value (mm)
2	Length of the vehicle body (excluding anti-collision strips)	1080
4	Body width (excluding the anti-collision strips)	660
5	Vehicle height	880
6	Navigation laser scanning area height	195
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 Chassis parts description



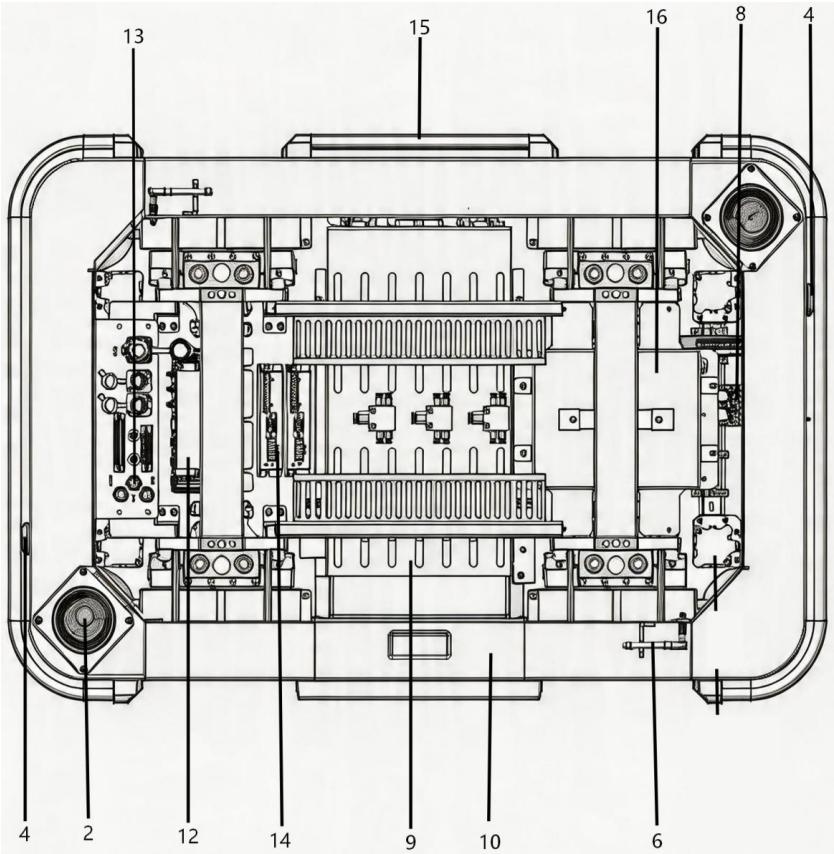


Illustration of chassis components2- 3

Table 23 Description of Chassis Components-

Serial number	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	Big 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 Collaborative robotic arm size

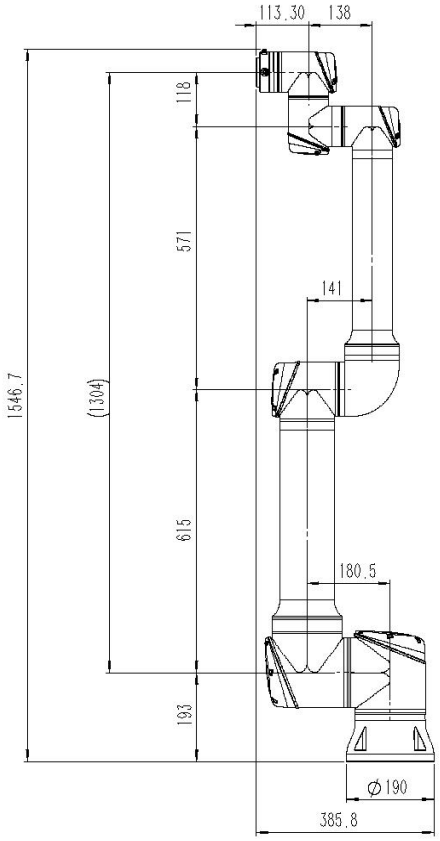


Figure 24 Diagram of collaborative robotic arm dimensions(mm)-

2.2.4 Collaborative robotic arm workspace

The workspace of the CS612 collaborative robotic arm is shown in the figure. When the robotic arm moves, the tool center can move within the maximum working range, and try to make the tool center move within the recommended working range.

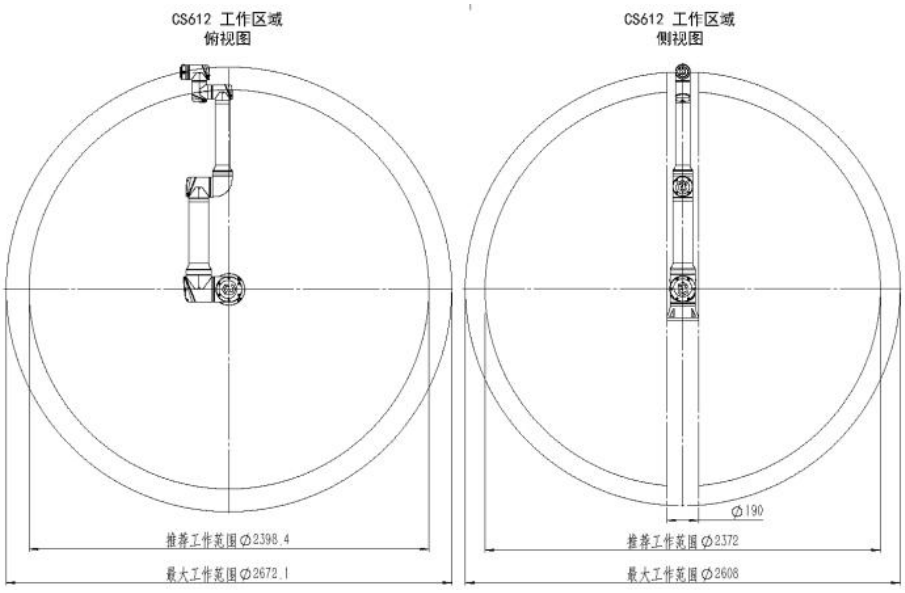


Figure 25 Collaborative robotic arm workspace, in mm- 4

2.3 Basic functions and descriptions of the product

2.3.1 Feature List

Table Function List2- 4

Basic	Feature Names	Feature Description
Basic Features	control mode	The motion instructions are executed in automatic mode, manual mode and offline automatic mode. The manual mode has the function of point control
	Navigation mode	Laser SLMA navigation
	Driving mode	Four-wheel drive McNamur 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, obl¡que movement, in-place rotation, and arc-shaped turns of any radius.
	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
Migration 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

Basic	Feature Names	Feature Description
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 master control system, ensure smooth operation without traffic control incidents such as crashes
	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 HMR 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.

Basic	Feature Names	Feature Description
	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 conditions such as HMR speed and direction (16 in total); ● Receive radar OSSD signals and dual-channel signals from 4 emergency stop buttons; ● 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	There are six emergency stop buttons with four all-directional emergency stop buttons on the chassis and two emergency stop buttons on the upper structure. They are located conspicuously and can be used for emergency stop of the entire machine, facilitating 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. The teaching device is equipped with a dedicated emergency stop button for the robotic arm, which is only effective for the robotic arm and not for the entire machine.
	Automatically lock and report the fault point	If the robot is connected to the dispatch system, when the robot malfunctions, it will report the location of the malfunction and lock the surrounding area 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
	Operation 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
	Power-on self-check	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

2.3.2.1 Whole machine technical parameters

Table Complete Machine Technical Parameters Table2- 5

product Model		MC500-12-Ce
Body	Net weight	400KG
	Size	1080*660*850mm
	Payload	300KG
	Shell color	white
	Laser scanning height	195mm
Robotic arm	Working radius	1304mm
	Load	12KG
	Degrees of freedom	6
	Repeat positioning accuracy	+ / - 0.03 mm
Navigation	Navigation methods	Laser navigation
	Navigation position accuracy	±10mm without reflection, ±5mm with reflection
	Path planning	Automatic path planning
	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	5mm

	ability	
	Ability to cross gullies	10mm
	Climbing ability	5%
	Driving mode	McKnum wheel
	Minimum peer width	720mm
Safety protection	Lidar	360° full surround
	Collision detection	Collision sensor
	emergency stop button	Chassis all-directional four emergency stop, upper body left and right double emergency stop, teaching device mechanical arm emergency stop
	Status indicator light	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	Overall 6 emergency stops, 1 robotic arm emergency stop
	Number of speakers	1
	Number of indicator lights	4
	Number of	2

	protective strips	
Feature configuration	Basic functions	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.

2.3.2.2 Collaborative robotic arm technical parameters

Table 26 Technical Parameters of Collaborative Robotic arm-

product Model		CS612
Basic Parameters	Degree of freedom	6
	Payload	6KG
	Working radius	914mm
	Repeat positioning accuracy	+ / - 0.02 mm
	Typical power consumption	250W
	installation method	Any Angle
	Self-weight	20KG
	Base diameter	150mm
Maximum joint speed	Base	150°/s
	Shoulder	150°/s
	elbow	180°/s
	Wrist 1	230°/s

	Wrist 2	230°/s
	Wrist 3	230°/s
Tool Parameters	Tool I/O	4×DO/4×DI(configurable), 1×AI, 1×AO
	Tool I/O power supply	12V/24V, 3A(three-pin mode), 1A(single-pin mode)
	Tool Communications	RS485
	Tool maximum speed	2.8 m/s
Others	IP protection level	IP68
	Operating ambient temperature	- 10 ℃ to 50 ℃
	Working environment humidity	90% relative humidity (non-condensing)
	Material	Aluminium alloy, steel, plastic, rubber
	Standard cable length	5.5 m
	product Certification	ISO 10218-1, ISO 13849, ISO/TS 15066, RoHS, Ce, UL, SeMI, Cleanliness ISO CLASS 5

2.3.2.3 DH parameters of the collaborative robotic arm

The Denavit-Hartenberg parameter, or DH parameter, is the traditional way to represent the forward kinematics of a robot. They are used to represent the position of the tool center point or TCP in the base coordinate system given the joint Angle of the cooperative robotic arm, as shown in the figure

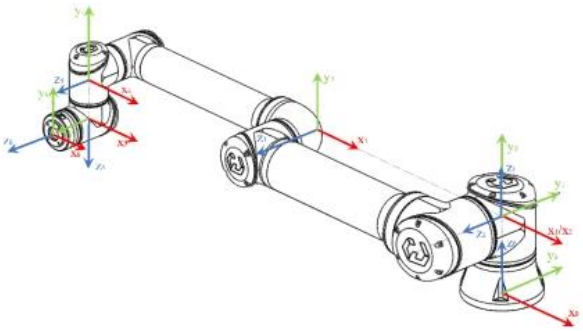


Figure shows a schematic diagram of the collaborative robotic arm DH2- 5

The DH parameters of the CS612 cooperative robotic arm are shown in the table.

Table CS612 Collaborative Robotic Arm DH Parameter Table2- 7

Joint	theta[rad]	a[m]	d[m]	alpha[rad]
Joint 1	0	0	0.193	0
Joint 2	0	0	0	π/2
Joint 3	0	-0.615	0	0
Joint 4	0	-0.571	0.1775	0
Joint 5	0	0	0.118	π/2
Joint 6	0	0	0.1103	-π/2

2.3.3 Navigate the laser detection range

Table 28 Navigation Laser Detection Range Parameter Table-

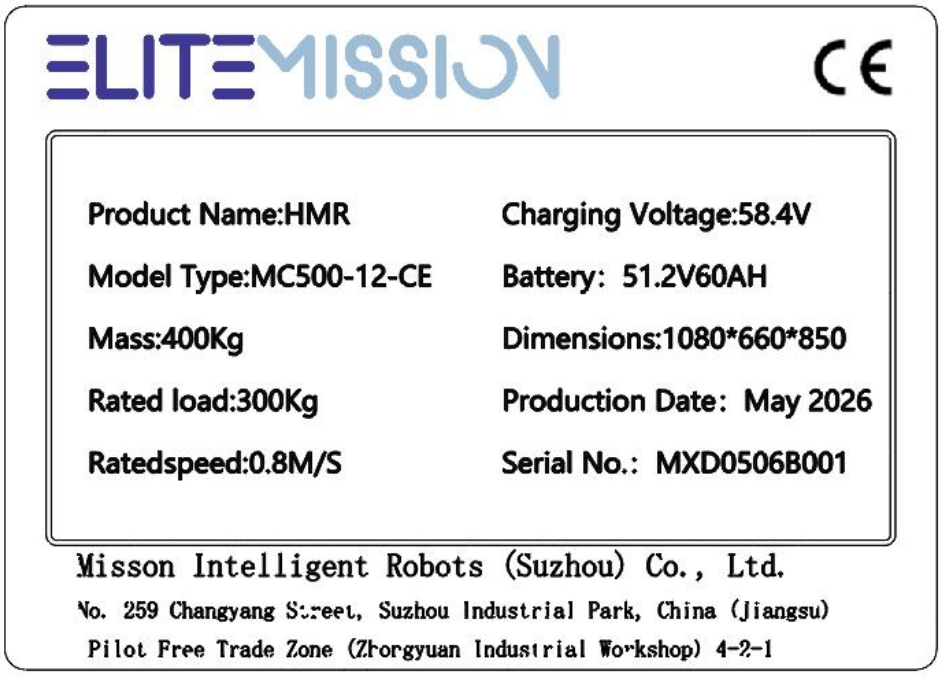
Serial Numbers	Definition	Parameters
1	Detection distance (m)	30
2	Scanning Angle (°)	275
3	Detection height (mm)	195

2.3.4 Human-machine interaction status description

Table Human-computer interaction status description table2- 9

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

2.4 product nameplate



Picture product nameplate2- 6

3 Quick instructions for Operation

3.1 Operation Panel

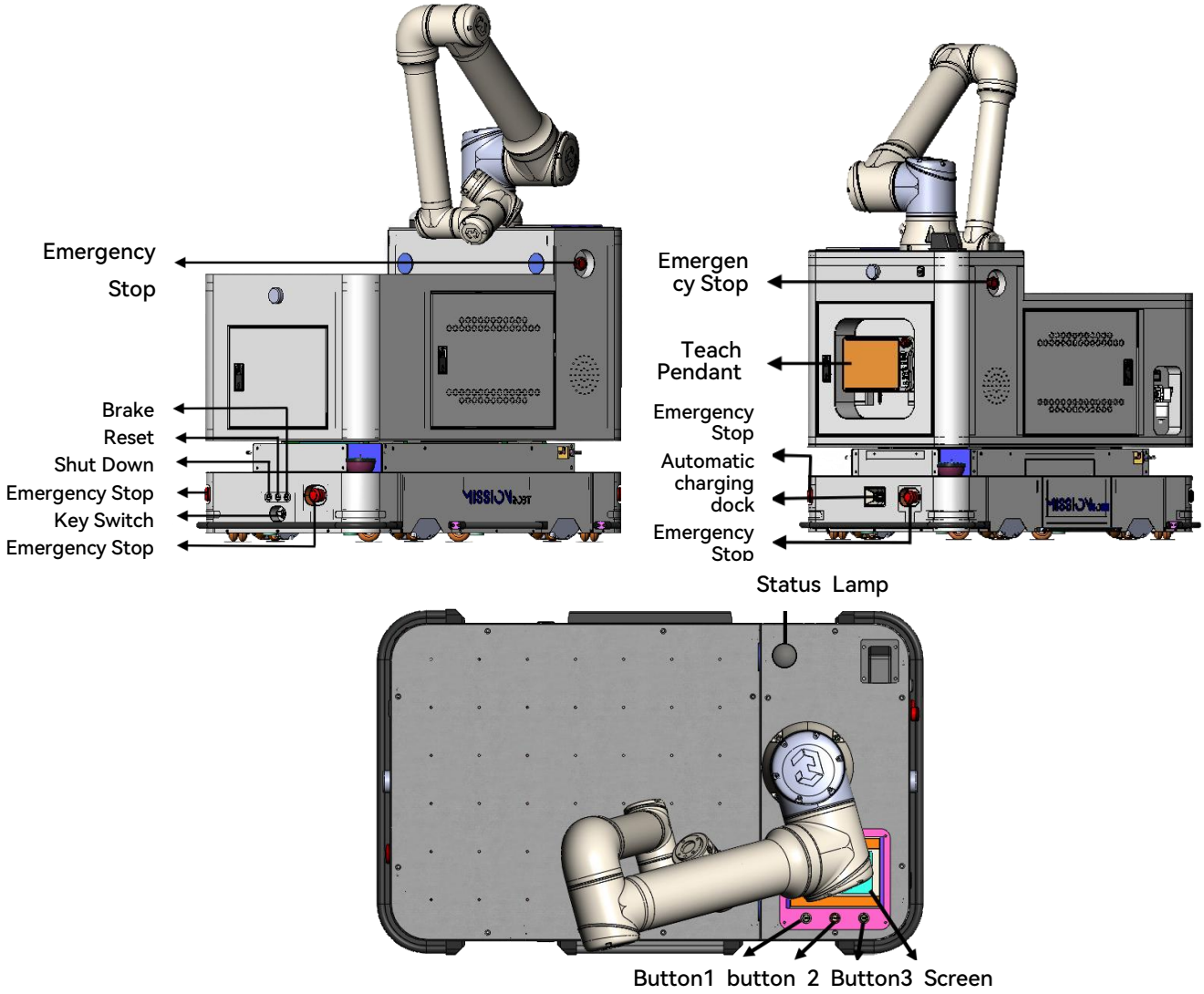


Figure 31 Operation Panel-

3.1.1 Key switch

Table key switch3- 1

Mode	Status
Power on	Rotate the key switch until the indicator light is on and the HMR starts

3.1.2 Shut down button

Table 32 Power Off buttons-

Mode	Status
OFF	Tap the power off button to turn off the indicator light

3.1.3 emergency Stop button

Table 33 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 only for emergency use and must not be used to stop the robot s operation.
- 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.
- The six emergency stop buttons on the chassis and the upper assembly are applicable to the emergency situation of the entire machine. The emergency stop button on the teaching device is only applicable to the emergency stop of the robotic arm and cannot be used for the entire machine.

3.1.4 Release brake button

Table 34 Release brake buttons-

Mode	Status
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.

3.1.5 Reset button

Table Reset button3- 5

"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.

3.1.6 Display screen

The human-machine interaction screen of the display screen allows the operator to monitor the status of the compound robot through the display screen. There are five interfaces displayed on the display screen, namely the main interface, manual control, robot IO, IP address, and AGV function Settings. The interface display details are shown in the following pictures

- The main interface mainly displays basic parameters of the robot such as current navigation mode, positioning confidence, task status, cumulative walking distance, cumulative running time, battery parameters, and fault information.



Figure 32 Main interface-

- The manual control interface is mainly the manual operation robot interface, which includes operation options such as linear velocity, lateral velocity, angular velocity, manual charging, manual enabling, etc.



Figure 33 manual control-

➢ The robot IO interface mainly shows the robot IO point function configuration.



Figure 34 Robot IO-

➢ The IP address interface mainly shows the IP address and version number of each component of the robot.

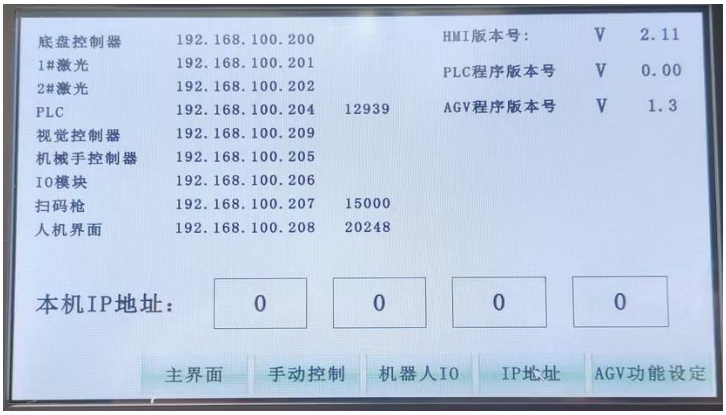


Figure 35 IP address-

➢ The AGV function setting interface mainly displays the Settings of chassis function parameters such as the maximum cumulative walking mileage in kilometers /k, the maximum number of battery charge and discharge cycles, sensor shielding, edge contact shielding, abnormal shielding, and voice volume control.

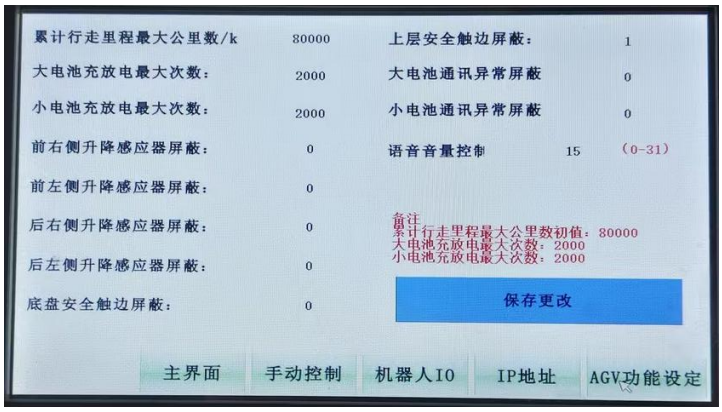


Figure 36 AGV Function Settings-

3.1.7 The countertop reserves buttons and status lights

This product has one status light and three function buttons on the countertop, which are currently reserved interfaces and have no preset functions. Users can read the status of the buttons and control the status lights through the control system to achieve custom operation and indication.

Warning The user is responsible for the safety and reliability of secondary development.

Name	Status
Button 1	Reserved
Button 2	Reserved
Button 3	Reserved
Status lights	Reserved

3.2 Teaching device

The teaching device is the operation and display part of the robot system, used to control the robot body and perform programming. The teaching device consists of the following components an LCD touchscreen, a power switch, an emergency stop button, a three-position switch, multiple motion control keys, and a teaching device connection cable socket. The LCD touchscreen clearly shows the details of the robot s movement, such as position, posture, parameters, etc. The user can perform all operations directly through the touchscreen for easy setup and adjustment.

The teaching device s housing is aesthetically and ergonomically designed, with a nylon rope strap and two hanging rings on the back for easy grip or hanging from the control cabinet.

➢ For details on the use of the teaching device, see elite CS_ Three-Position Switch Teaching

Device User Manual.

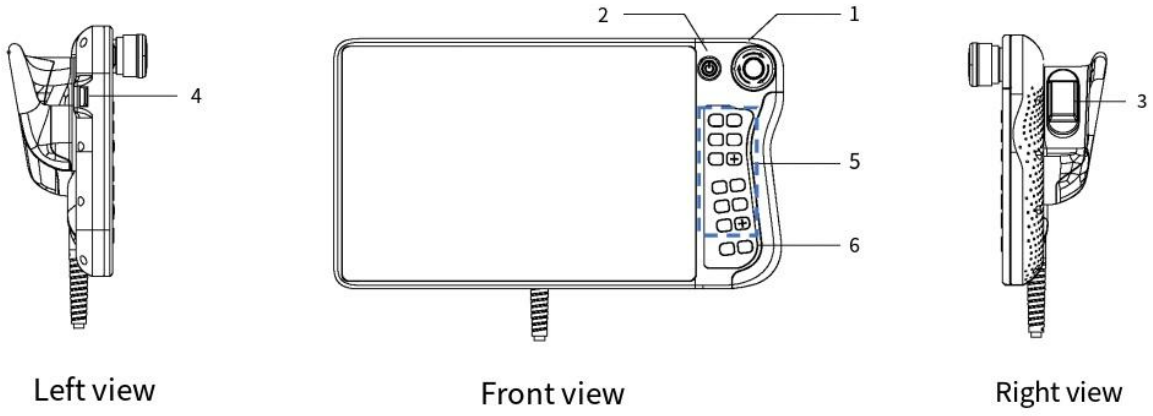


Figure 37 Appearance of the teaching device-

Table 36 interface and Button Description-

Serial numbers	Description	Features
1	emergency stop button	Trigger the emergency stop function (the light remains on when the emergency stop is not triggered and turns off when the emergency stop is triggered), only for the robotic arm emergency stop, not for the entire machine emergency stop.
2	Power switch	Turn on/off the teaching device
3	Three-position switch	Release protection stop
4	USB interface	connect USB storage devices
5	Axis motion control key	control the movement of each axis of the robot body
6	Speed control buttons	increase or decrease the speed percentage to adjust the current running speed

3.3 Mode selection

Table Mode selection3- 7

Mode	Status
Automatic	Switch to Auto Run mode
Manual	Switch to manual control mode (Manual mode indicator yellow breathing)

- Automatic mode mobile instruction execution control system.
- Manual mode Operated by a trained operator;

3.4 Charging

When the HMR level drops below 20%, voice "Low battery, please charge in time." Charging ways have automatic charging and fast in two ways.

- Quick battery swapping 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.

3.4.1 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;

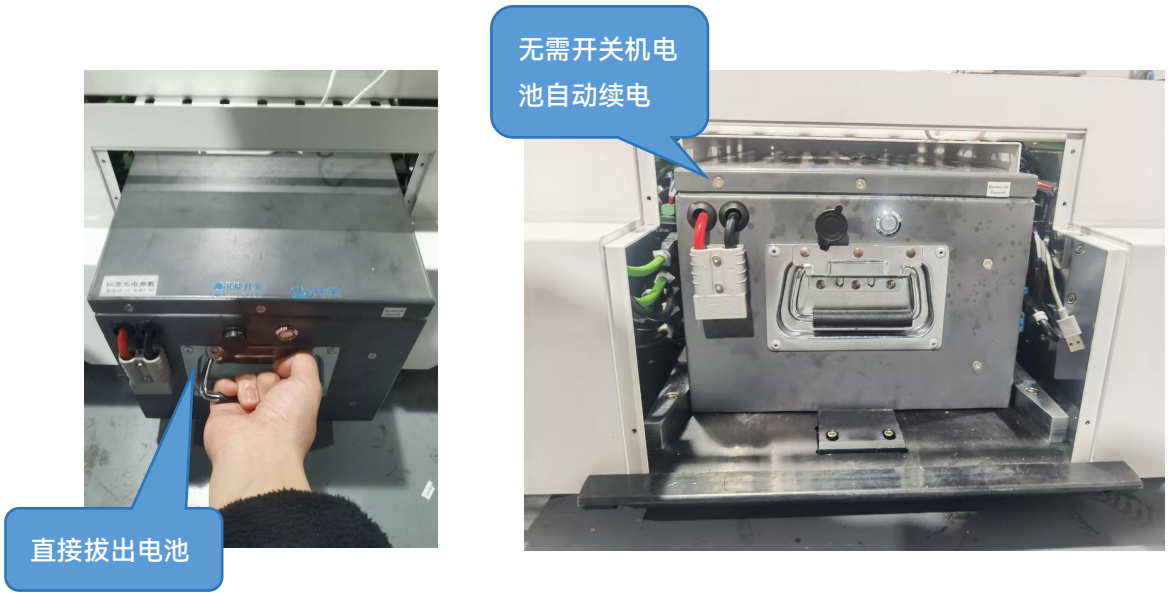


Figure 38 - Quick battery swap

3.4.2 Automatic charging

Use the HMR to connect to the charging station location, set the station number at 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.

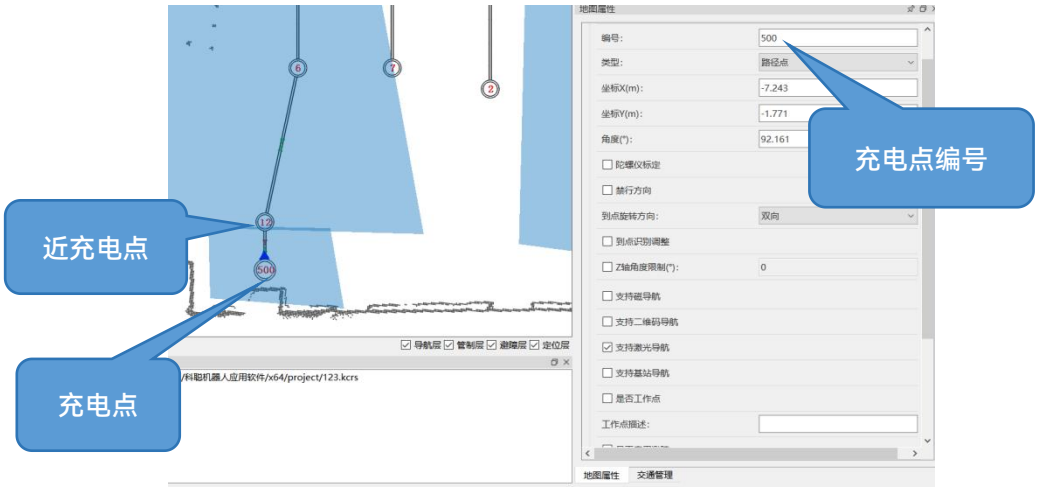


Image 3- 9Auto-charging

4 Use of robot application software

This section of the robot application software is the chassis application software. in this product, the functions of the mobile chassis (such as map building, path planning, task scheduling, status monitoring, etc.) are uniformly managed by the robot application software described in this manual. The motion programming, teaching, parameter setting and manual operation of the collaborative robotic arm installed on the chassis surface are carried out by separate teaching devices, which belong to different control systems.

The chassis application software is not involved in the motion control and programming of the robotic arm.

For detailed operation of the robotic arm and software usage, please refer to the robot software operation section in the CS_User Manual _CS612 of elite Robotics.

4.1 Application software interface toolbar

4.1.1 Common Toolbars

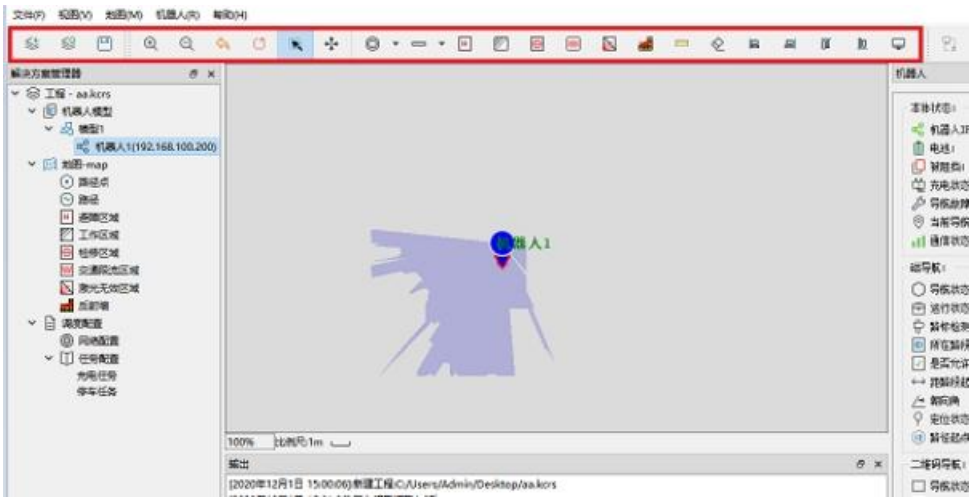


Figure 41 Common toolbars-

Table 41 Common Toolbar Function Description Table-

Function IconS	Function Name	Feature 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

Function IconS	Function Name	Feature Description
	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	The mouse is set to select mode to select elements on 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
	Path points	Setting the mouse to path point mode can add 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 model 1/2/3 / full model (can choose more)
	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.
	Working 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.

Function IconS	Function Name	Feature Description
	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 flow 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 HMRS running in that area and be used in conjunction with the robot monitoring system.
	Application 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 laser enhancement coefficient defaults to 2 (coefficient range 2-10), and the laser navigation and positioning program will lift increase the calculation weight of this area to address the situation where there is insufficient reference for positioning in the front and back of narrow lanes.
	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 HMR always running on one side of the reflective wall or for multi-floor map splicing partitions.
	Ranging	Setting the mouse to the distance measurement mode can roughly obtain the actual distance. After selecting the distance measurement function, click on the starting point to be measured, then long press the mouse and drag it down to the end point. A straight line will be displayed 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

Function IconS	Function Name	Feature Description
		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

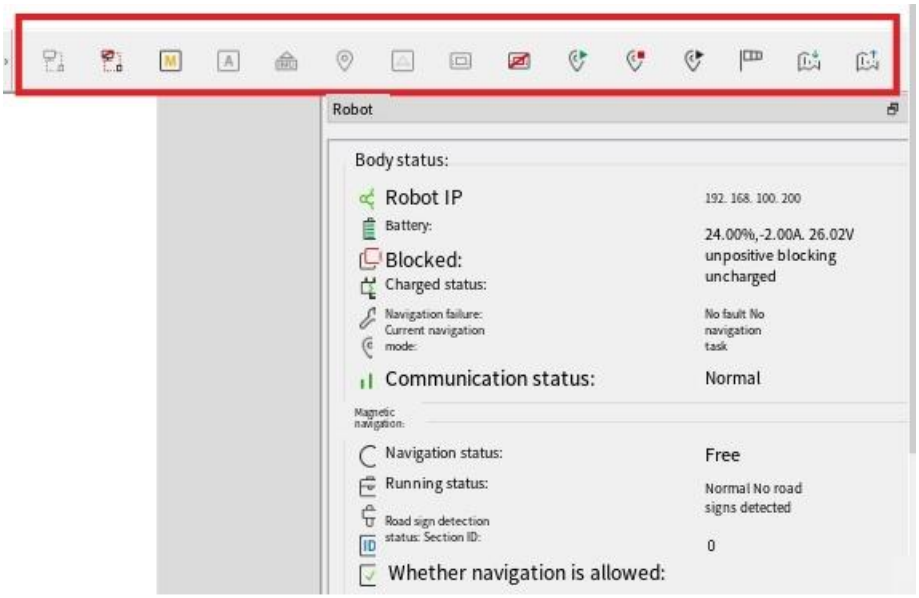


Figure 42 Robot toolbar-

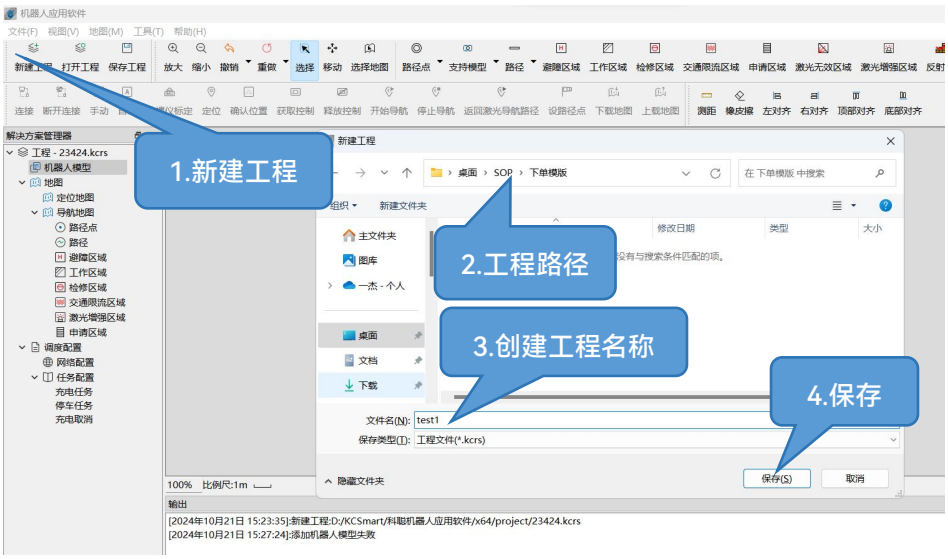
Table 42 Function Description Table of the Robot Toolbar-

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
	Auto	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 navigating	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 an automatic state
	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 HMR key switch to turn the HMR on. Next, open Robot Applications, click New project, save and open the new project after creating it. As shown in the following figure



The diagram creates a new project4- 3

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

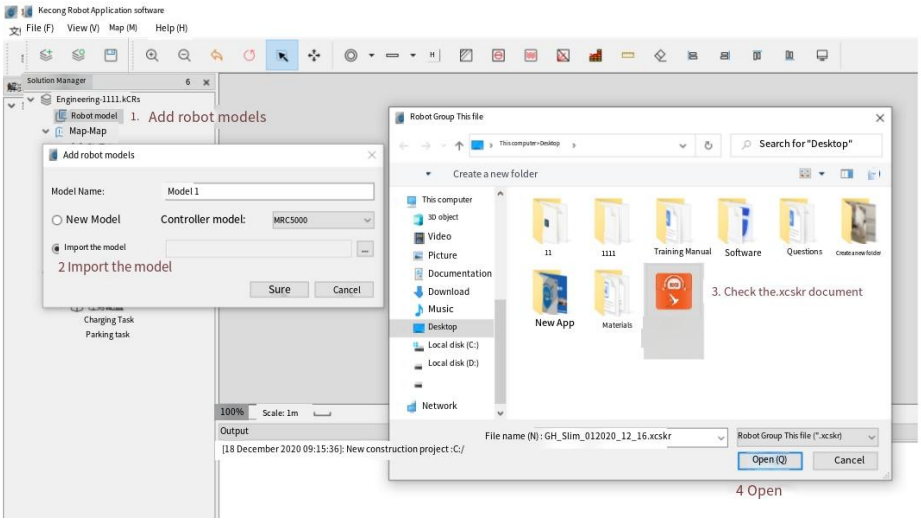


Figure add Robot model4- 4

Set your computer s ethernet IP to a segment of 192.168.192.xxx, 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.

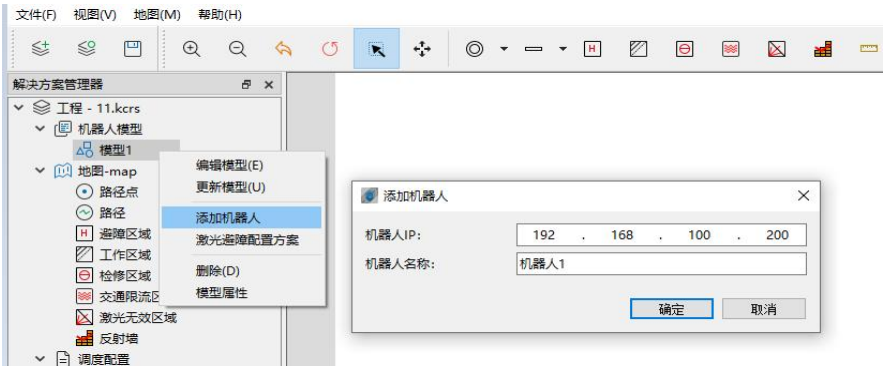


Figure 46 add the robot-

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

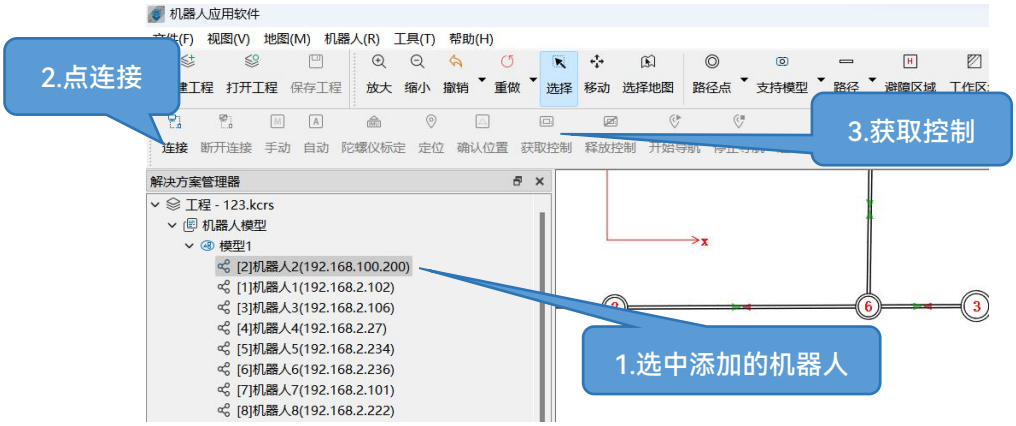


Figure 47 Gain control-

The robot IP on the left shows green, the robot status on the right shows the robot IP, and information such as battery level indicates a successful connection. After connection, use "W (forward)", "A (left)", "S (backward)", "D (right)", "Q (left lateral)", "e (lateral)" to manually control the movement of the HMR.

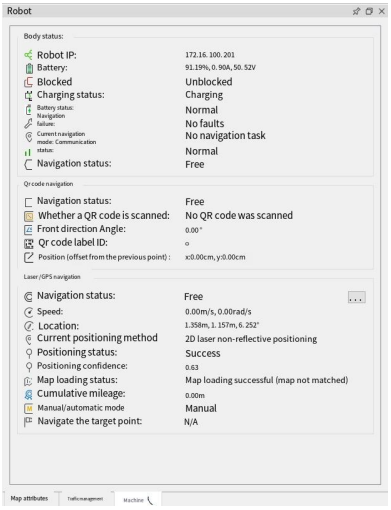


Figure 48 State of the robot-

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 Creating 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.

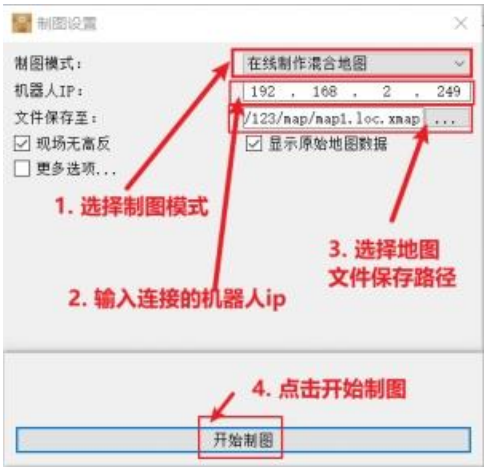


Figure 411 Mapping Settings-

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.

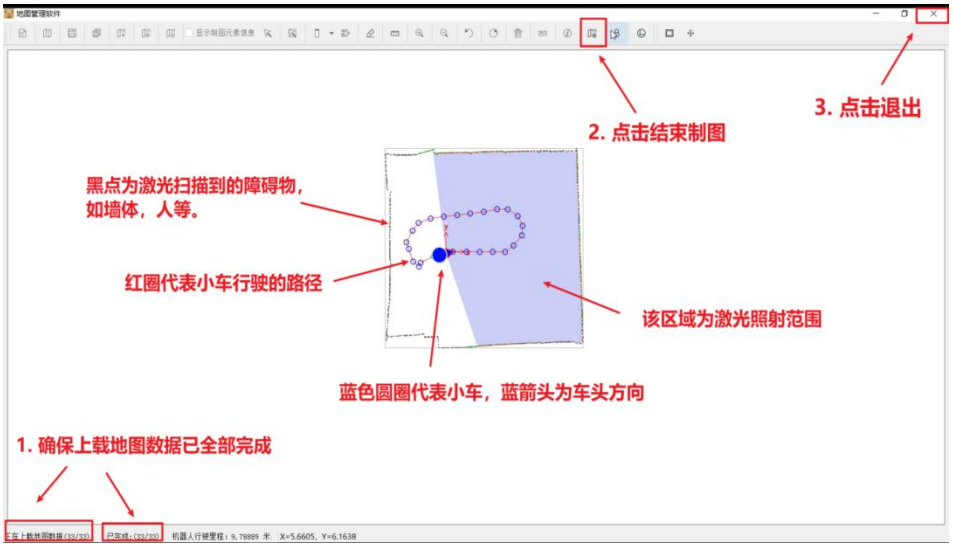


Figure 412 Mapping interface and steps-

Note The map is saved to the directory selected during the "Mapping Settings" process, including two files with 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 Download Map in the top menu

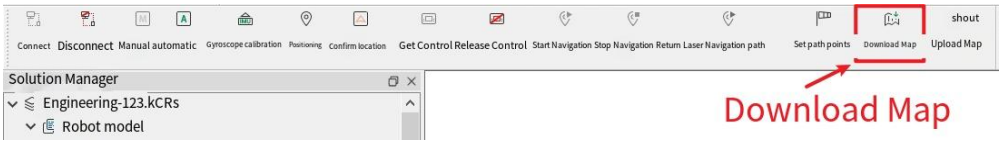


Figure 414 Download Map-

Click confirm to save and click Yes to download the map

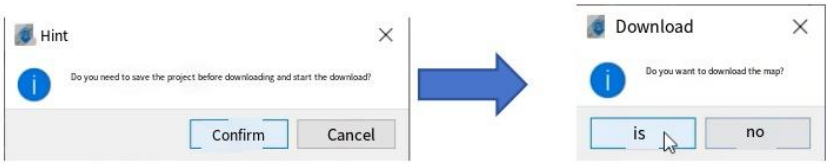


Figure 415 confirm-

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.

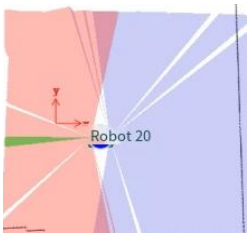


Figure 416 Comparison of the imported map with the actual laser irradiation map-

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);

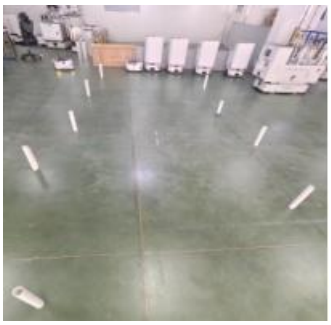


Figure 417 Schematic diagram of reflector arrangement-

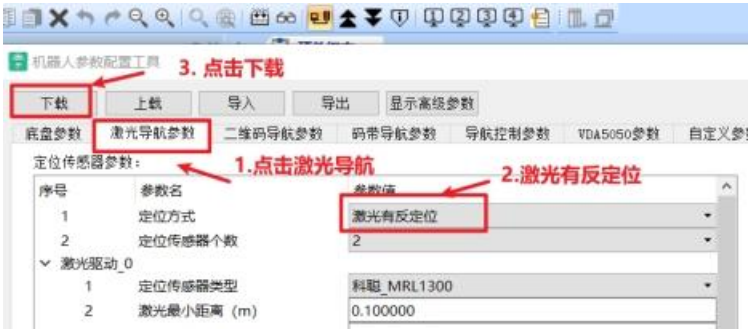


Figure 418 Parameter configuration-

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-

Parameters refer to 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[illegible]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.

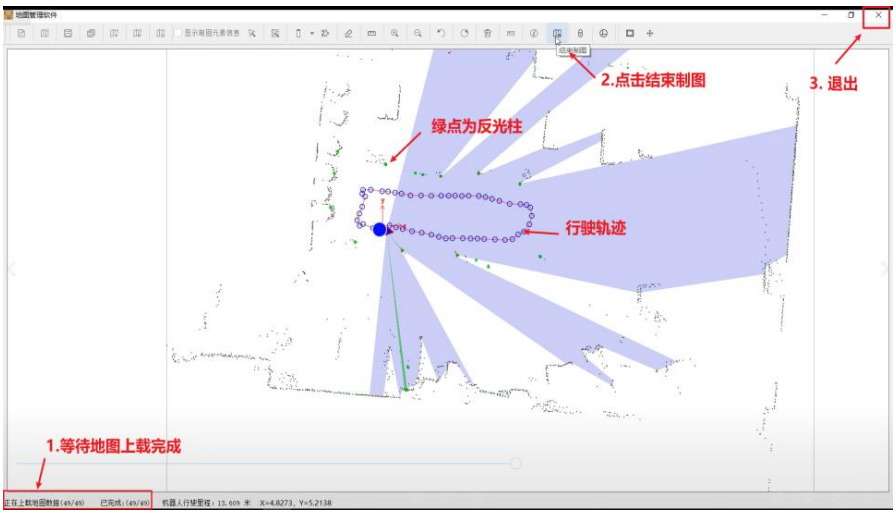


Figure 421 Mapping interface-

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.

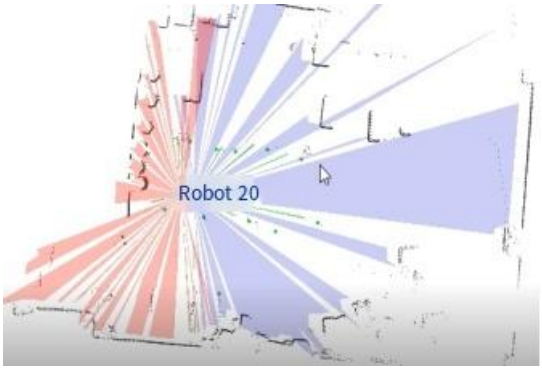


Figure 424 Comparison of imported map with actual laser irradiation-

4.3.3 Path points

There are two ways to set up path points

- Method 1

Click to set the path point. [The point will be directly established below the vehicle in the map. This method will directly copy the current position and posture of the vehicle.]



Figure 425 Click Set Path Point-

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

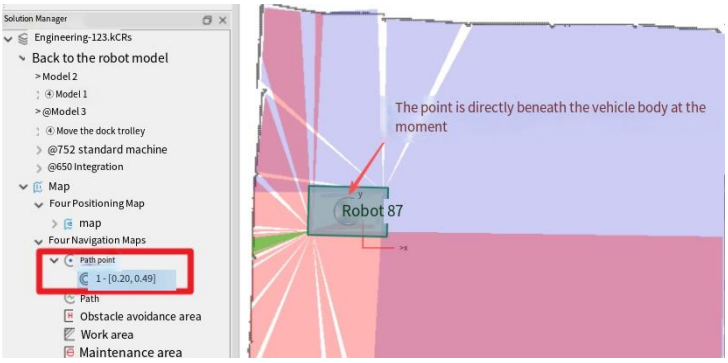


Figure 426 Point map-

- Method 2

Click on path points

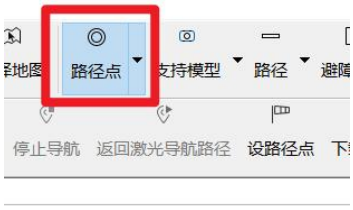


Figure 427 Click the path point-

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.

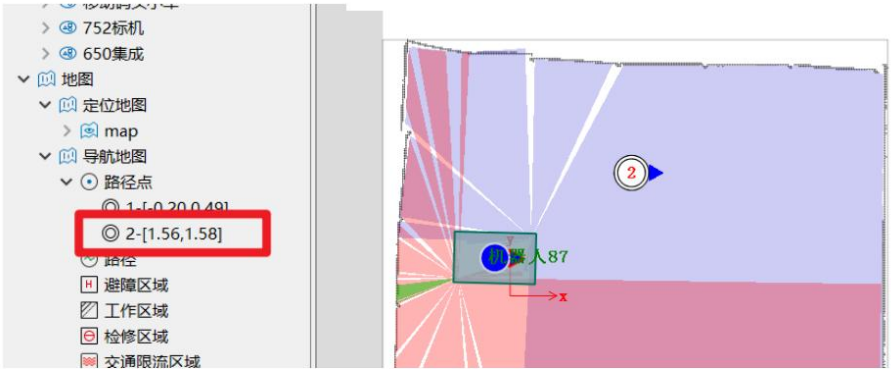


Figure 428 Click anywhere on the map to set a path point-

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.

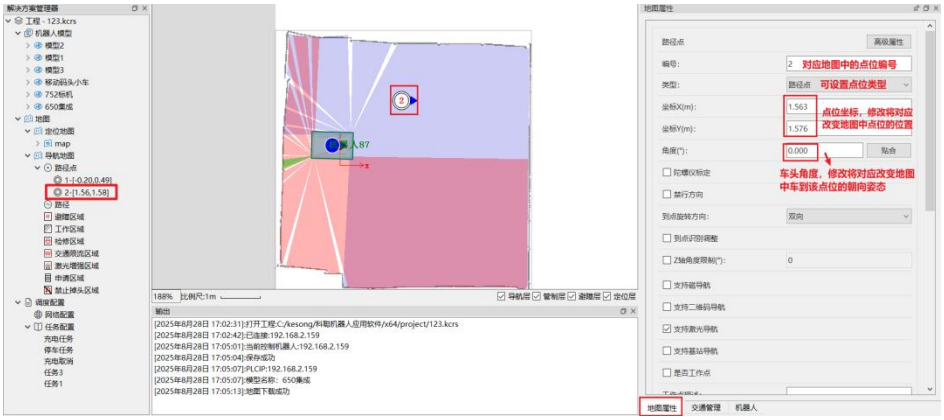


Figure 429 Specific properties of Point-

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

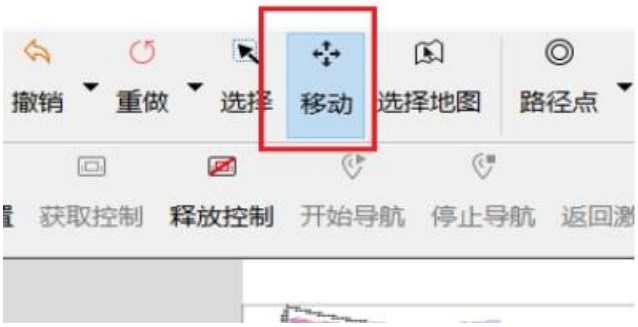


Figure 430 Point Position Move-

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

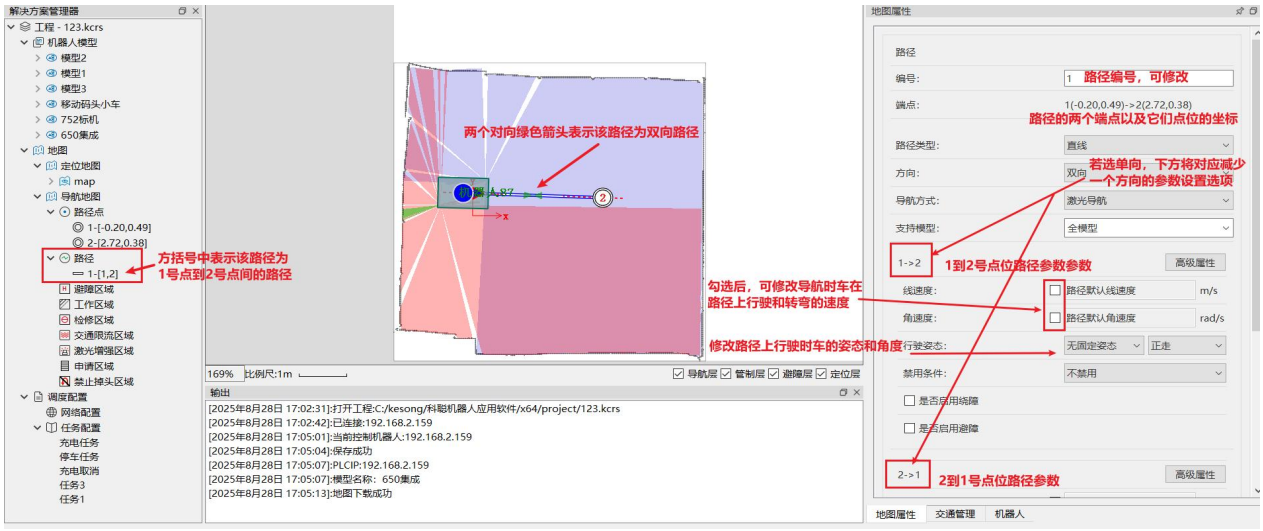


Figure 431 Path Details-

4.3.4 Import Map

Right-click on the map or right-click on 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.

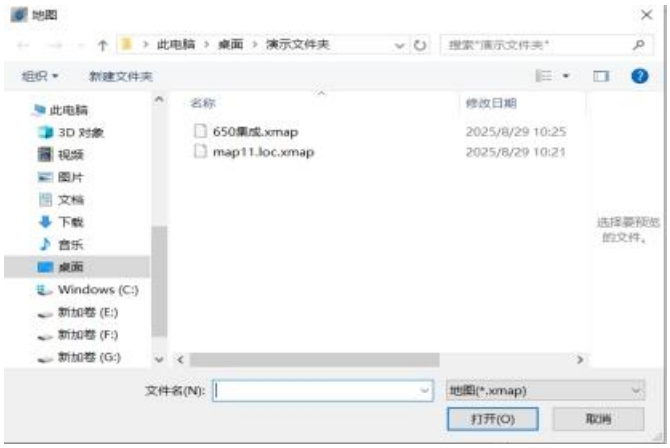


Figure 434 Import the target map file-

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;

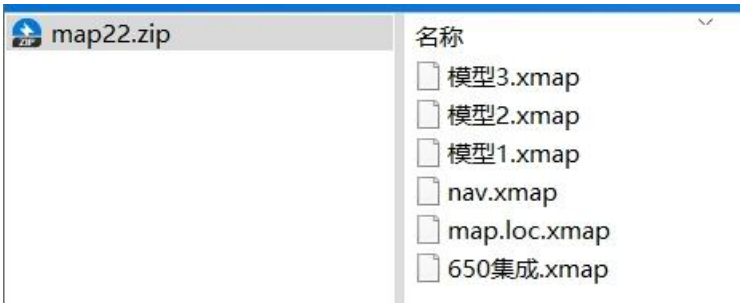


Figure 435 instructions for importing file formats-

4.3.5 edit the map, draw map paths and add obstacle avoidance areas

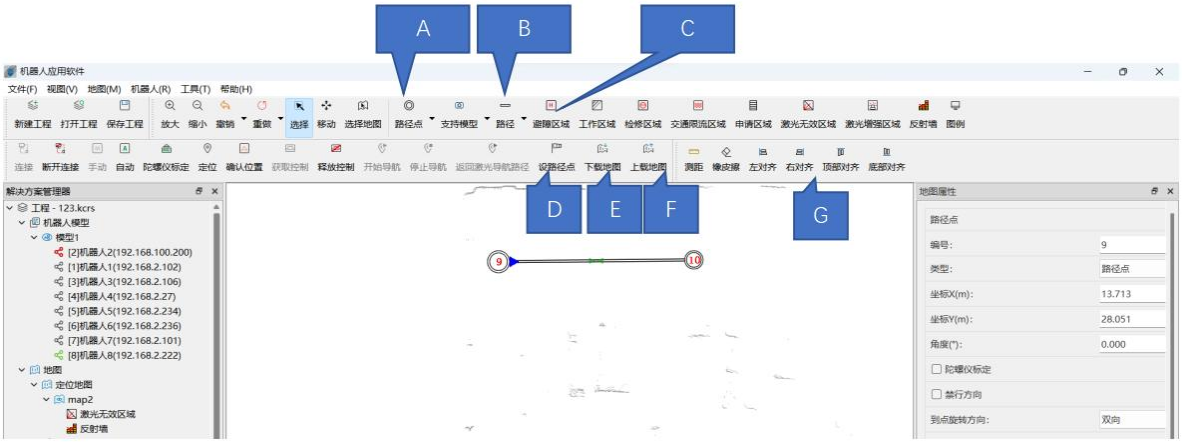


Figure 436 introduction to the Main operational functional areas of Map editing-

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 The obstacle avoidance area can be equipped with different obstacle avoidance schemes and switches for obstacle avoidance functions according to actual needs

D Set the current position of the HMR 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 HMR to your 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 HMR across the entire map can be set by following this method without modifying the velocity parameters for each path one by one. Once set, all paths will default to using the global speed value. If some areas need to run at a slower speed, you can modify the speed of the corresponding path segment separately.

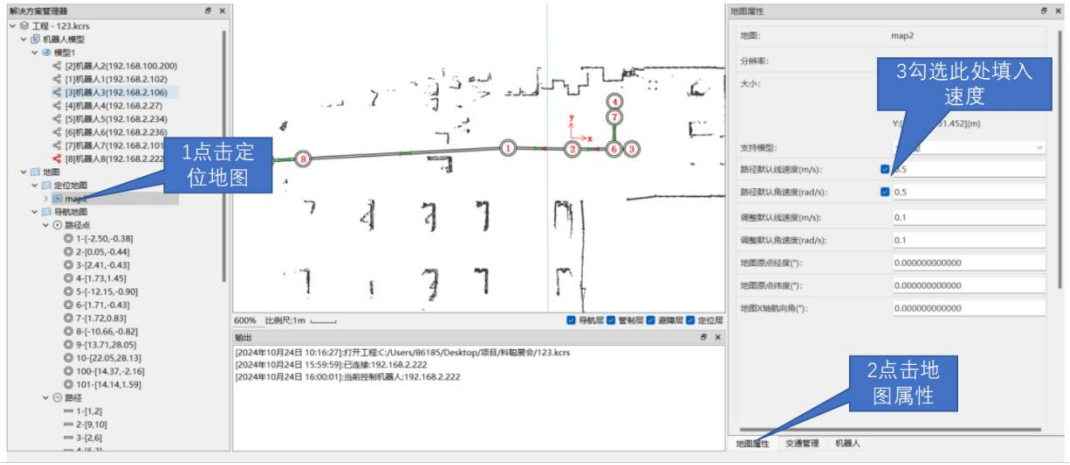


Figure 437 Map Global Speed modification-

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 automatic mode, click on the map path point and then 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 uni que, 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.

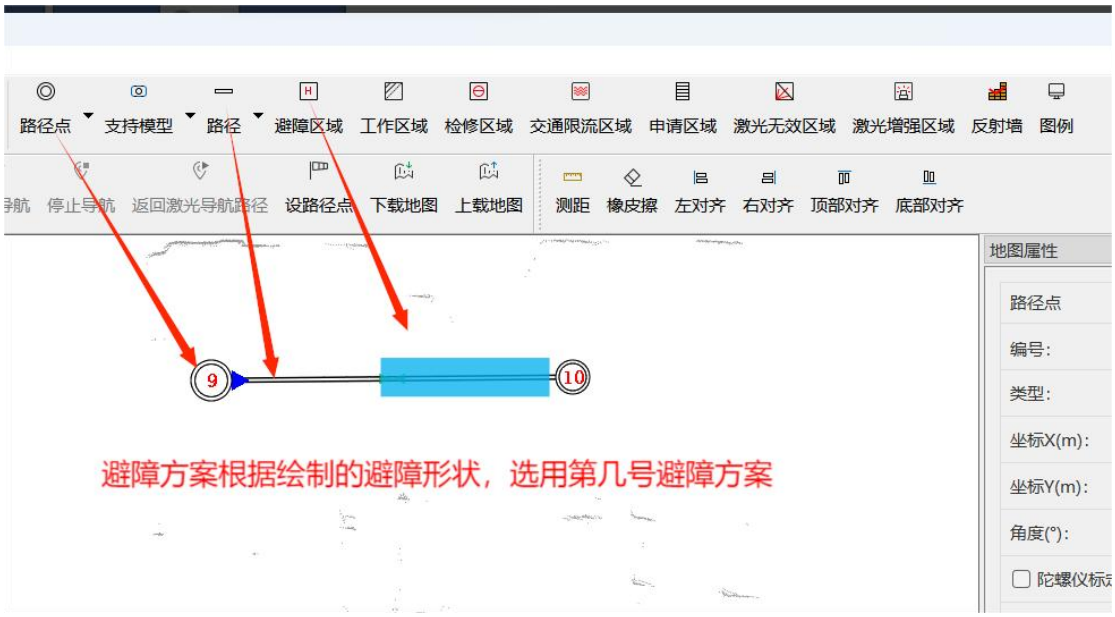


Figure 440 Draw the obstacle avoidance area-

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

4.5.2 4 configure the obstacle avoidance scheme

in automatic mode, the HMR needs to be equipped with an obstacle avoidance plan during driving to ensure safety. When an obstacle enters the protected area, the HMR stops and alarms, "Please move the obstacle ahead." Apply different schemes for different road conditions, for example

- Charging points

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

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

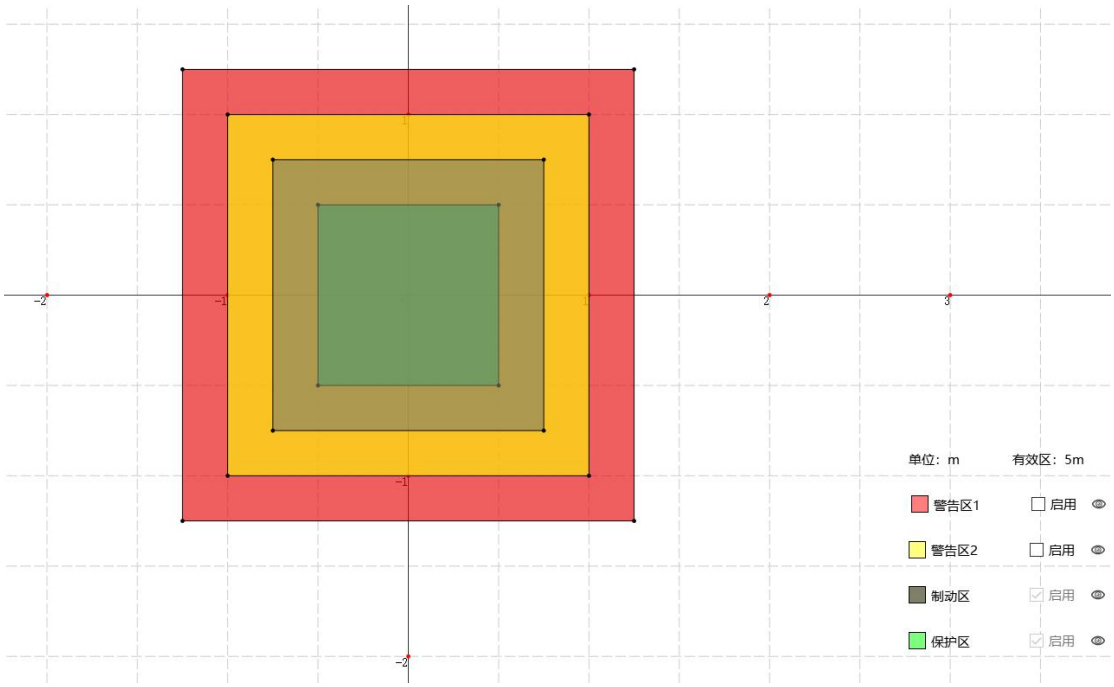


Figure 441 obstacle avoidance area-

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.

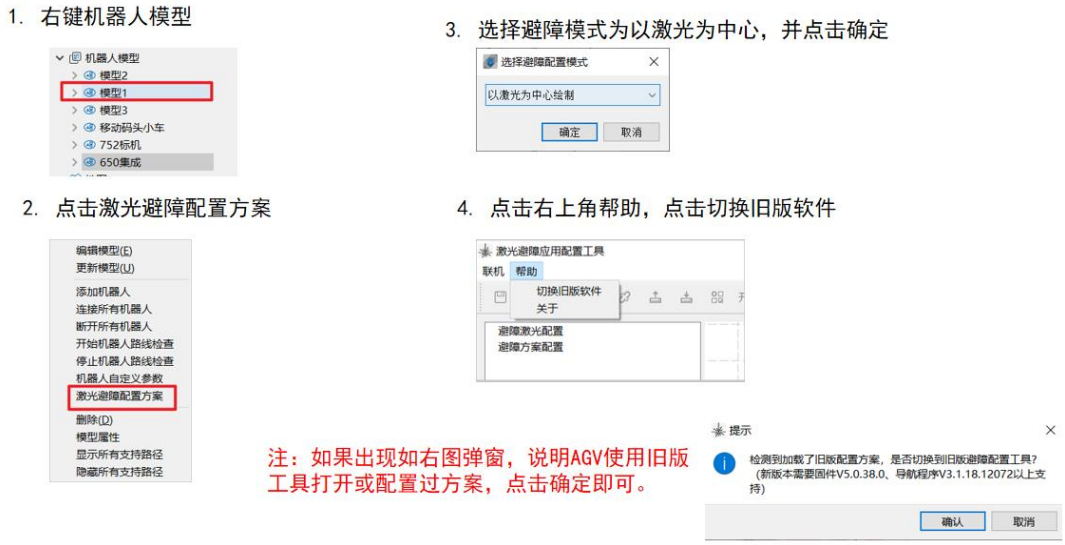


Figure 442 Select the robot model for which you want to configure the laser obstacle avoidance scheme-

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 HMR will apply the scheme corresponding to the same number.

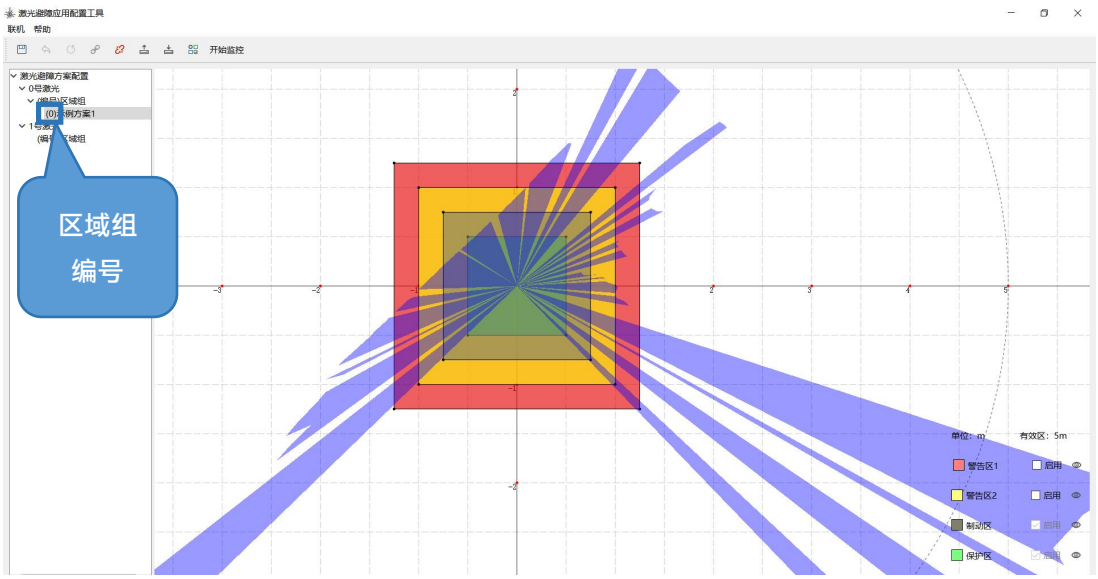


Figure 443 add laser obstacle avoidance scheme-

Double-clicking on one edge of the area creates a point, and dragging the point changes its shape. The purple part represents the current real-time laser irradiation situation (in a static and normal state, the protected area and the braking area must be within the laser to avoid false alarms of obstruction, and the same applies to the warning area).

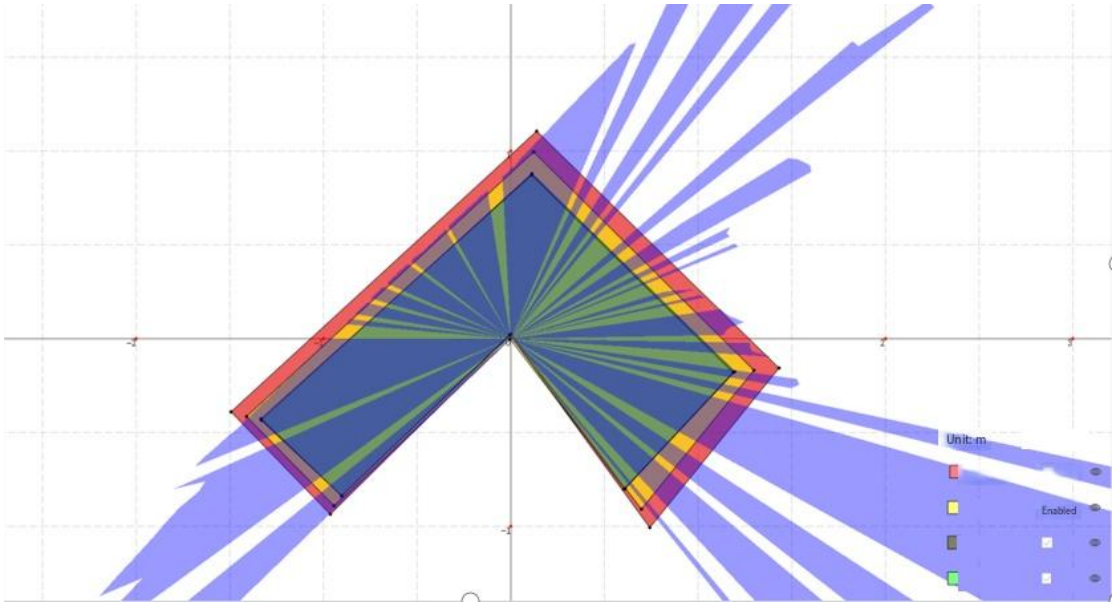


Figure 444 Real-time laser irradiation-

4.5.3 Apply the obstacle avoidance scheme

There are two ways to apply the obstacle avoidance scheme　box obstacle avoidance area, site path attribute setting, and the latter has higher priority when both exist.

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.

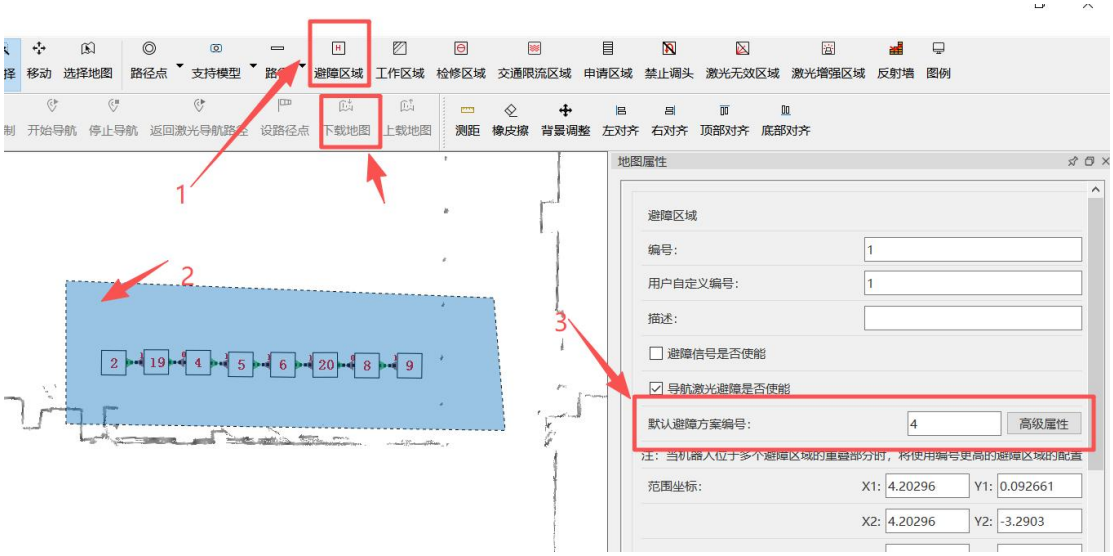
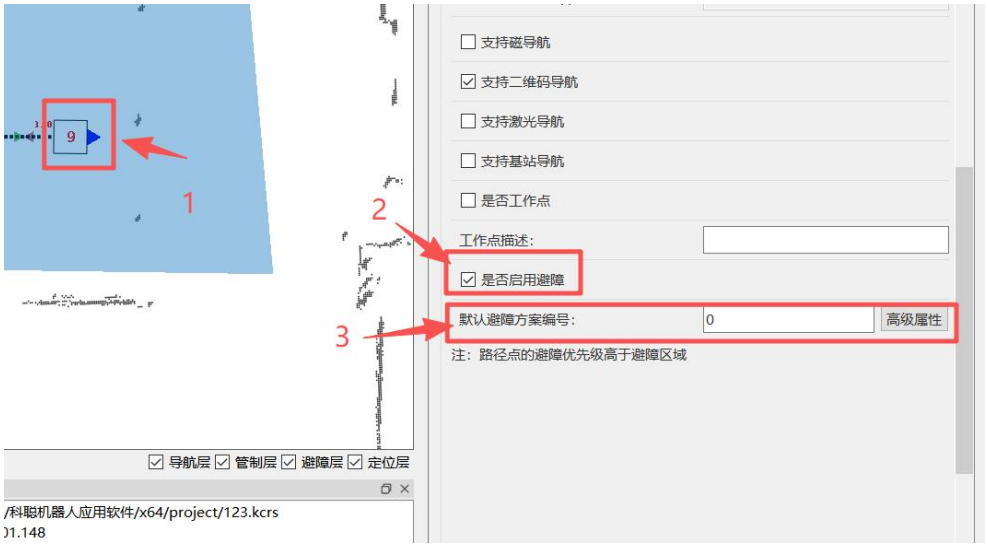


Figure 445 Select obstacle Avoidance Area in the box-

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.

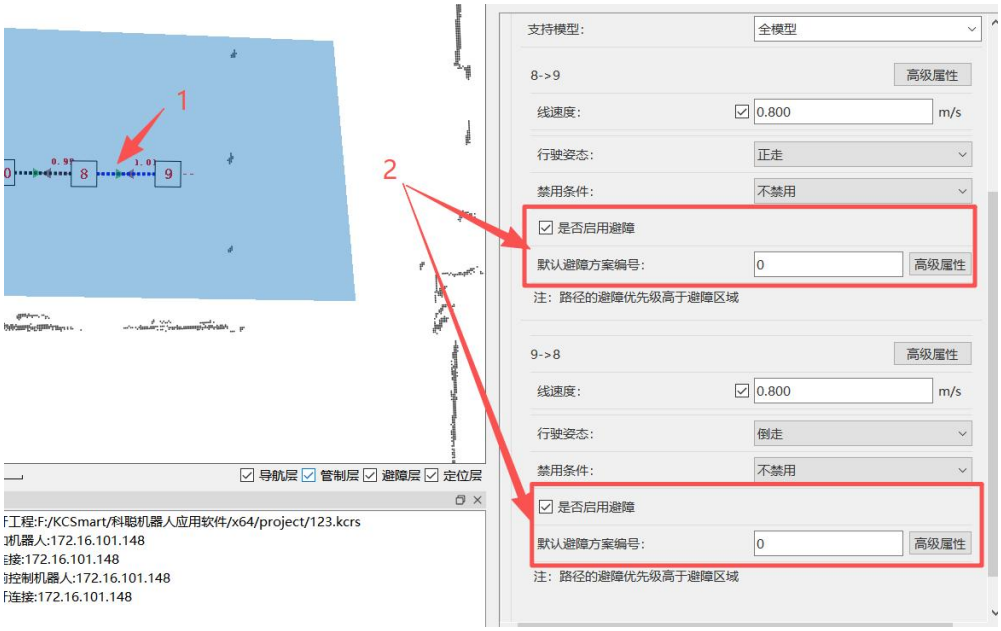


Figure 447 Path enables obstacle avoidance-

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 HMR is positioned incorrectly, it will cause the HMR to fail to navigate, or even move incorrectly and collide!

4.6.1 Determine the location

If there is no error in the current position, click "confirm Position" to confirm the current position of the robot on the map. No further actions can be taken without confirming the position.

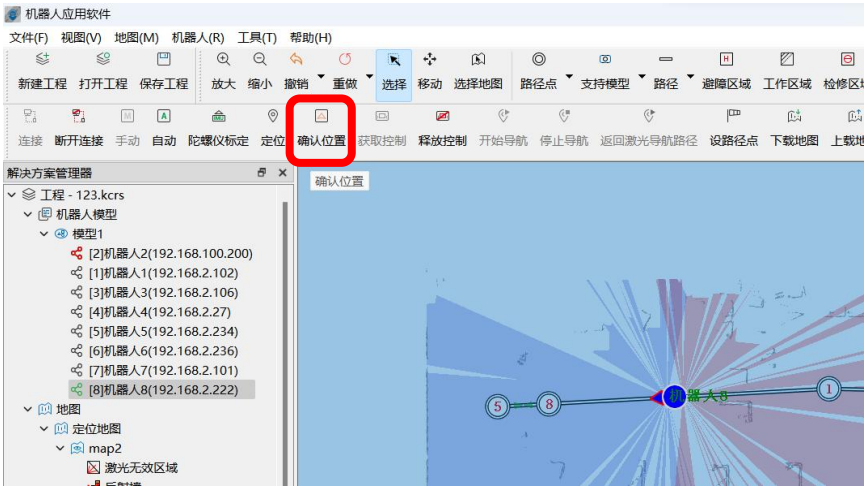


Figure 448 confirm position-

The positioning confidence is 0 to 1, which is of reference value. The closer to 1, the higher the positioning confidence. A lower level may indicate lost positioning or incorrect positioning. Do not only look at the confidence but also the actual matching of HMR with the map.

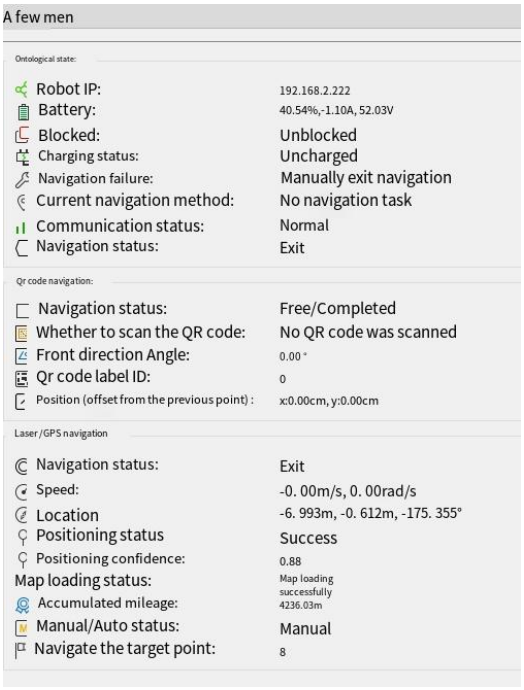


Figure 449 Positioning confidence-

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.

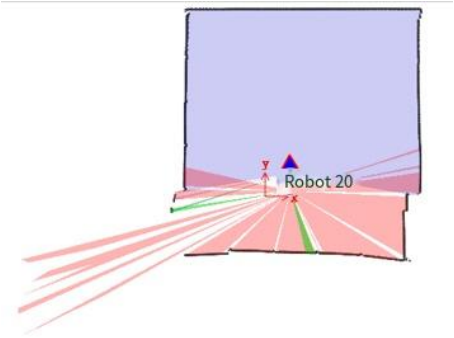


Figure 450 Accurate positioning-

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 HMR to manual and click Locate

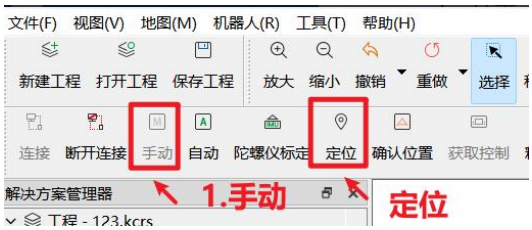


Figure 451 Switch manual positioning-

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.

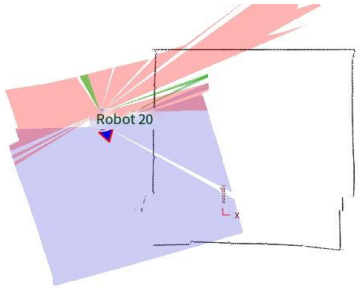


Figure 452 does not match the actual laser point cloud on the map-

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.

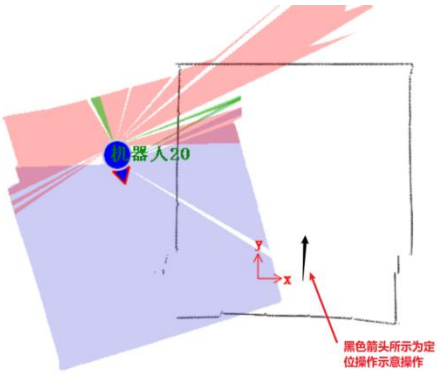


Figure 453 Automatic calibration and positioning-

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

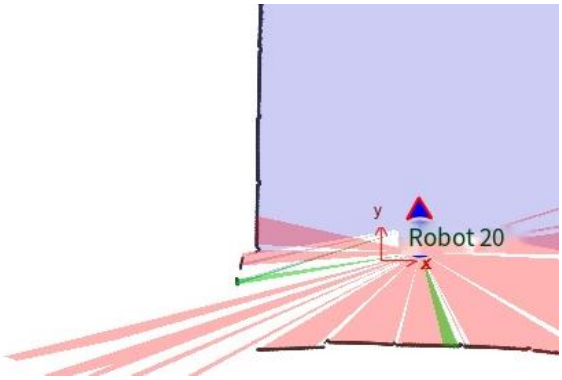


Figure 454 Calibration successful-

Repositioning operation steps

Click the [Locate] 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 HMR 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

To configure a wireless IP, you need to configure a connection to a local area network (LAN) for the HMR and assign an IP address. After that, you can wirelessly connect and operate the HMR through this IP address when you only need to debug that the computer and the HMR are in the same LAN.

Plug in the network cable to connect to the HMR and type 192.168.100.1 in your browser. enter your account password and log in. Username admin password 12345678.

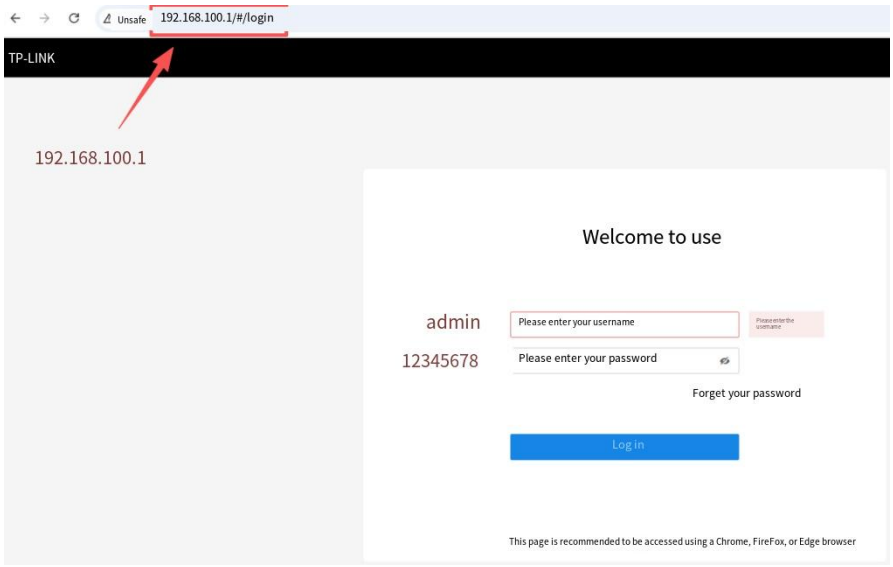


Figure 455 Login-

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

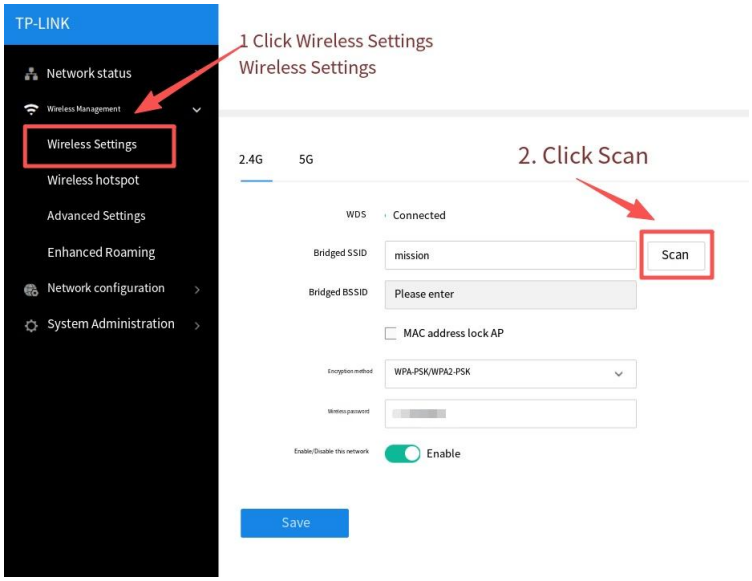


Figure 456 connect to the target wireless network-

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.

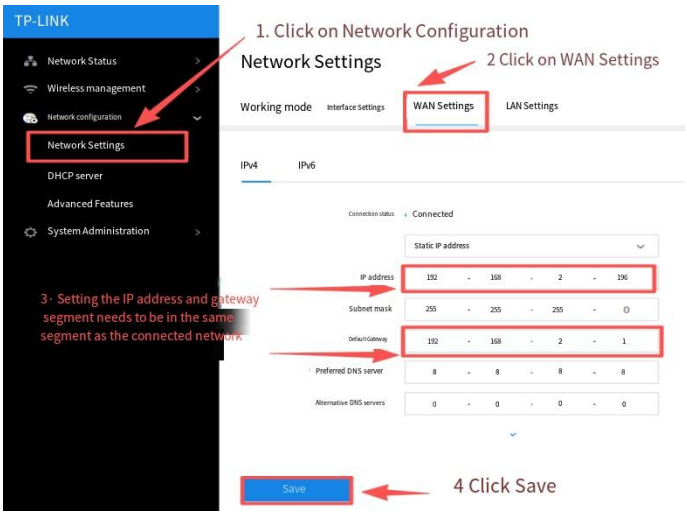


Figure 457 Network setup-

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



Figure 458 add a robot-

5 Maintenance and servicing

5.1 Maintenance Tips

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.

Note For detailed maintenance and care of the collaborative robot, please refer to the Maintenance and quality section of Elite Robots CS_User Manual _CS612.

 Danger	● 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. ● When equipment malfunctions or is damaged, professionals should troubleshoot and repair the equipment in accordance with the maintenance instructions, and keep good maintenance records. ● 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.

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 HMR and inspecting casters and drive wheels	
2	Battery charger	For manual charging of the battery	
3	2m sling	HMR hoisting	
4	M12 lifting ring screws	HMR hoisting	
5	Manual torque wrench 50Nm		

6	Hex socket wrench		
7	Small cross screw driver		
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 HMR locally	
3	Motor serial port 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 general level, such as a lot of dust, large temperature fluctuations, acidic or alkaline environment, or other operating conditions such as a 24-hour cycle for HMR operation.

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 t he device, and there are precise electronic components under the camera lens that are e asily 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 sho uld 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 b utton 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 ¡¡ quid 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. After cleaning, check the vehicle body to ensure there are no residues, dirt or other phenomena.

4) No residue is allowed inside the vehicle body After the vehicle body is assembled (without the outer shell), check if there are any fallen screws, cut copper wires, wire sheaths, etc. inside the vehicle body. If any are found, they must be cleaned up.

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.

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 items

project	content	Notes	intervals/Cycles
HMR subjects	Use a wet 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 component cover of the laser scanner to achieve its best performance.	NOTICE! Avoid using corrosive or abrasive cleaners; 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
3D camera	Clean the surface of the 3D camera to give it the best performance		Weekly/as needed

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	One month/as needed	Tool inspection - Wear beyond 10mm requires replacement;	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. If necessary, apply thread glue. For specific details, please refer to Appendix 1	
Laser scanner	Check for defects in functionality	As needed	NOTICE! The wheels must be recalibrated after replacement	
Drive wheels	Check for wheel wear	As needed	Replace worn wheels; Remove foreign objects from	Drive wheel Outer diameter 176mm

project	Check contents	Maintenance intervals	Maintenance methods/basis	Specifications/Parameters
	Check the wheels for any foreign objects		the wheel surface;  The wheels must be recalibrated after replacement.	
Lithium battery	Check the battery s endurance or if it discharges too quickly	As needed		Lifespan 2000 cycles of full charge and discharge
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 the casters that have been in operation for more than one year to avoid deviation caused by caster problems in advance. The specific situation can be determined based on the on-site working 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 caused by external factors such as abnormal voltage and fire;

4) Damage resulting from non-compliance with instructions, indicative marks on the main body of the product, and other matters requiring 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 whether the emergency stop button is pressed and whether 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.

Serial Numbers	Fault manifestations	Cause of Failure	Solutions
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.
7	Charging error	Misalignment or mispositioning of the charging station leads to poor plugging of the charging interface	● Reset the charging station to its initial fixed position;
8	The robot strikes 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	Battery	1
2	McNamur 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 Maintenance instructions

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

5.7.1 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 the chassis parts description in 2.2.2.

1) Check if the power switch is loose and if the button pops up properly when pressed.
2) Check if the piezoelectric contact signal is functioning properly and check 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.

5.7.2 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 HMR over to check if the rotating casters run smoothly with abnormal noises, check if there are any entanglements at the casters bearings, 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.

5.7.3 Drive assembly maintenance and servicing

Drive component	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.

5.7.4 Lithium battery maintenance

5.7.4.1 Lithium battery screw fixation maintenance

Lithium battery	Maintenance methods
Lithium battery screw fixation maintenance	Use a manual t or que 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 lithium battery lead-out charge/discharge and communication cable connectors to ensure they are securely connected.
Charging 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.

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 items	Visual inspection (Check if the casing is damaged and if the screws are loose or fallen off)		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 if the top plate anti-slip mat is intact and if 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	
	HMR surfaces are 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. in case of any abnormal situation, please fill in the abnormal situation information in the abnormal situation record column and feed it back to the equipment Department. If it cannot be solved, please contact the after-sales personnel of Maixing 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 Appendix B: Monthly Maintenance Record Checklist

Daily maintenance record checklist					
Maintenance level	equipment model			inspectors	
	Device Number			Date	
	Check items		Methods	Check Results	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 upview code 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 whether the terminal connections of the power management module are firm and whether they are 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		
	HMR surfaces are clean and hygienic	Cleaning	□ Clean □ Not cleaned		
Anomaly Record sheet					
equipment 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 Appendix C: Annual Maintenance Record Checklist

Daily maintenance 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	The normal wheel diameter is 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	
	HMR surfaces are clean and hygienic	Cleaning	□ Clean □ Not cleaned	

Anomaly Record sheet

Device Number	Abnormal situation	Handling measures	Handler	processing Date	Notes

Note

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.

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