FlashBot Installation and Deployment Manual v1.1_20231120

Release Date	Version	Changes	Modifier
2023/11/17	V1.0	first draft (of writing)	Zhang Jing
2023/11/20	V1.1	Update numerical related content	Zhang Jing

Summary

As a multi-functional robot, FlashBot can autonomously take elevators to complete tasks such as room delivery, greeting and escorting across floors.

The robot has the ability to sense the environment and operate autonomously, and then manually perform some installation and deployment to enter more environmental information and task intent, the robot can complete the task in the specified environment.

The robots are installed and deployed following the process framework below:

I Environmental surveys	II. Preparation for deployment	III. Environmental mapping	IV. Mandate	V. Testing and training
demand communication Environmental assessment Rehabilitation of the environment	unpacking and inspection charge (a battery) activate Tool checking	laser mapping Element Addition Path constraint settings Virtual Wall Setup Charge Pile On Positioning	Room Delivery Setup Password Setting scheduling setup	Functional Testing Cruise Run Test Peak testing cultivate

This document describes the installation and deployment process of the FlashBot with reference to this process link for technical support.

Part of the content involved in the operation will not be everything, I hope the reader more real machine operation, proficiency.

The implementation of the process of several major aspects may be repeated cross implementation, I hope that the reader understands the deployment of this product design, flexible application.

I. Environmental surveys

1.1 Communication of needs

To minimize the number of visits to your home, talk to your customers by phone or video in advance:

1. Obtain the initial requirements of the customer, the robot's route and stopping position, refer to the subsequent chapters to obtain the necessary information in advance

2. Obtain on-site environment and refer to subsequent chapters for deployment feasibility assessment of the environment

3. Evaluating the potential environment to be remodeled and designing an implementation plan based on customer needs and environmental information

1.2 Environmental assessment

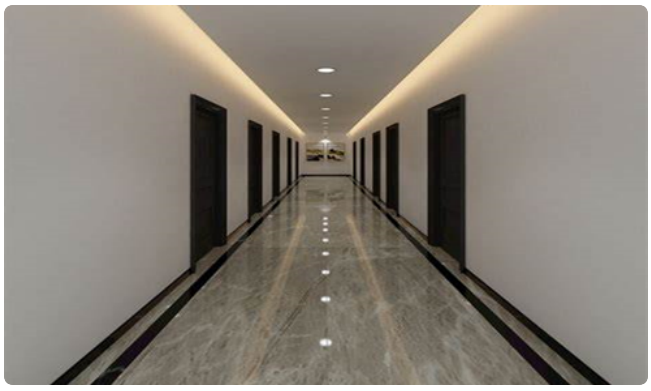
FlashBot can easily handle most indoor scenes.

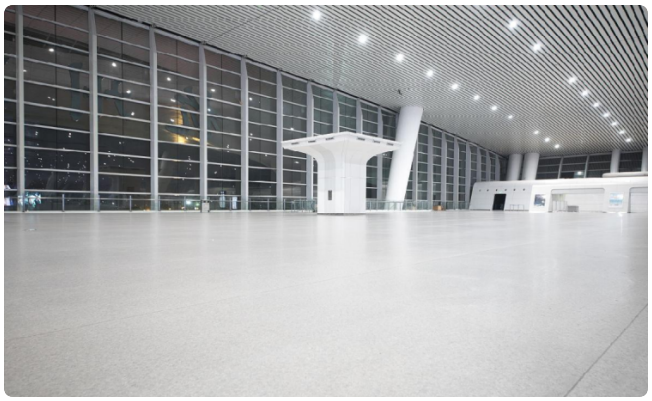
Since the robot's sensors have limited support for some environments, and indoor environments can have some specific differences in decorative design, an environmental assessment is required prior to actual deployment.

Environmental features that are commonly subject to assessment are addressed in this chapter.

1.2.1 Stereo space assessment

consultation	risk analysis

Narrow Passage:  	Risks: · Robots may be cut off. · Robots may fail to pass or be slow and inefficient Reason: · Too close a distance can cause some obstacles to enter the robot's blind spot · The effect of partial obstacle detection and the shape of the channel cause the perceived width to be less than 75cm(29.53 inch) from the robot's point of view. Solution: · Try to choose a road with a width of more than 75cm(29.53 inch), more than 1.2m(47.24 inch) optimal
Long corridors, high structural similarity scenarios: 	Risks: · Possibility of positioning errors in robots with laser positioning solutions Reason: · Scene similarity is so high that the environment scanned by LiDAR can be matched with multiple environments in the vicinity of the map, leading to matching errors Solution: · Fixed barriers could be added on both sides of the corridor · Or avoid the area.

Open up the big scene: 	Risks: · Possibility of positioning errors in robots with laser positioning solutions Reason: · FlashBot’s lidar scanning radius is recommended to be within 20m(65.62 foot). · The further the distance, the greater the error in laser ranging, the greater the error in the scanned environmental features, and the poorer the positioning effect Solution: · The robot runs along the edges of the environment to ensure that the LIDAR can steadily scan into the wall structure
Door curtains, overhanging obstacles: 	Risks: · The robot may stop under the door curtain and not be able to pass through · Robots may experience cuts to overhanging obstacles Reason: · Door curtains or overhanging obstacles may enter the robot's blind spot resulting in unstable detection of the Solution: · Modify the robot's route to avoid these areas · Modify these obstacles so that they are outside the robot's blind spot.

Glass walls: 	Risks: · The robot could crash into the glass. Reason: · The laser has a probability of passing through the glass, detecting objects behind the glass and missing the glass · RGBD also fails to detect glass. Solution: · Run routes away from this part of the area · Glass paste skirting, refer to section 1.3.1
Chair legs, minor obstacles: 	Risks: · Robots may collide with obstacles Reason: · Obstacles with a diameter of less than 2 cm(0.79 inch) cause the LIDAR to become unstable and the RGBD cannot detect them. · The legs of the chair extend beyond the cushion of the chair, resulting in the detection of the legs relying only on LIDAR detection. Solution: · Run routes away from this part of the area · Applying stickers makes the detected volume of small objects larger, refer to section 1.3.1

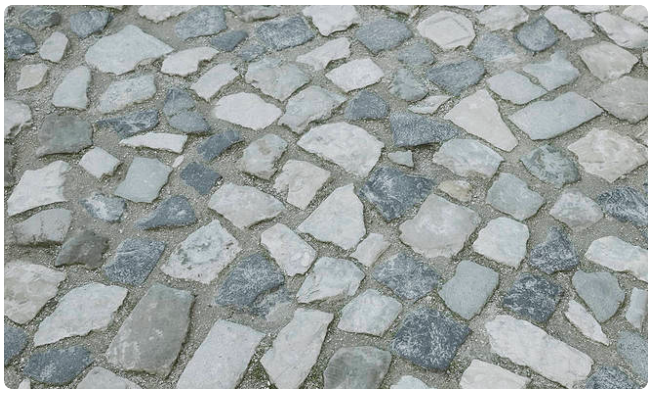
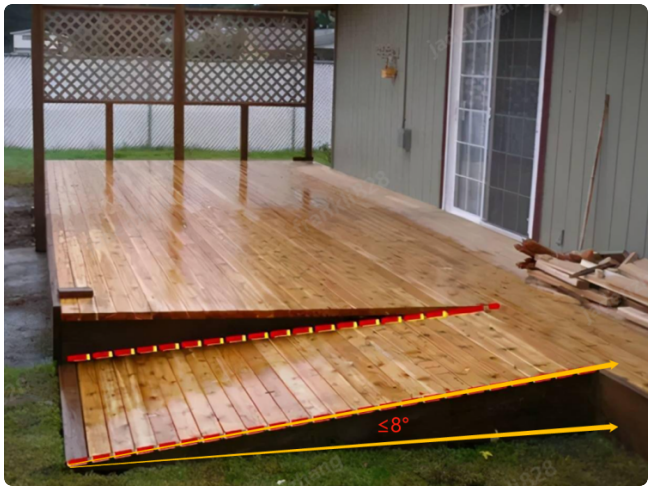
Dark color, leather material: 	Risks: · Robots may collide with obstacles Reason: · Objects made of dark-colored materials absorb more light, resulting in neither LIDAR nor RGBD returning a signal of sufficient strength, and missed detections may occur Solution: · Run routes away from this part of the area · Stickers make it possible to return to the laser normally

Metallic, mirrored, highly reflective surfaces: 	Risks: · Robots may experience unanticipated stops and swings to avoid obstacles · Robots may collide with obstacles Reason: · Multiple reflections from mirrors, causing false signals to interfere with the LIDAR · The fully emissive nature of the mirrors results in optical signals not being returned to the LIDAR and RGBD, resulting in missed detections Solution: · Run routes away from this part of the area · Stickers make it possible to return to the laser normally

Outdoor, open scenes: 	Risks: · Possible loss of localization in robots with laser localization solutions Reason: · Outdoor environments have fewer fixed objects and more moving objects, resulting in a low LIDAR scanning match rate Solution: · This part of the scenario is not in the context of the robot's designed application

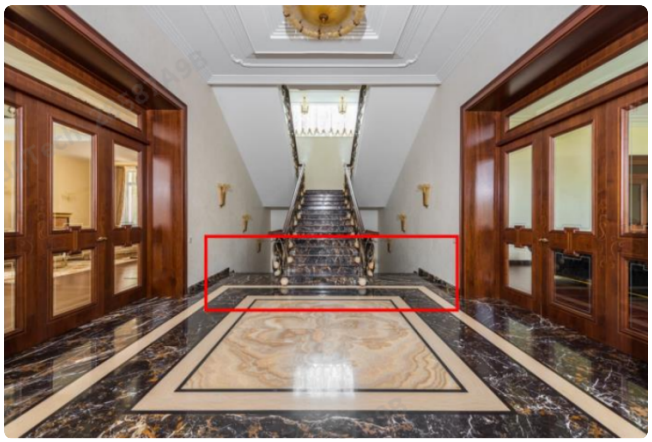
1.2.2 Ground assessment

consultation	risk analysis

Pavement leveling: 	Risks: · Robots are not smooth when making deliveries Reason: · Robot suspension design has a certain range of application, too hard will lead to poor damping ability, too soft will lead to insufficient support for the body has shaking Solution: · Communicate customer expectations in advance and assess whether their application needs are impacted by smoothness
Slope: 	Risks: · Robot fails to climb a hill Reason: · FlashBot supports slopes within 8° Solution: · slope modification · The route of operation does not pass through this part of the area

Thresholds, gutter seams:  	Risks: · The robot may not be able to pass through and motor blocking abnormality occurs Reason: · The maximum height of FlashBot is: 20 mm(0.79 inch) · The maximum seam width of FlashBot is: 35 mm(1.38 inch) Solution: · Thresholds and steps can be converted to gentle slopes · Caulking of trench joints or laying of covers · The route of operation does not pass through this part of the area
Smooth floor:  	Risks: · Robot may slip abnormally · Possible robot positioning error issue Reason: · Heavy grease, or back-of-the-house cleaning, etc. Solution: · Adjustment of area speed · The route of operation does not pass through this part of the area

Sewer covers: 	Risks: · Wear and tear of the robot's gimbals can increase. Reason: · In order to take into account the rattling of the robot during the walking process, only rubber material can be used for the universal wheel, which will increase the wear and tear of the universal wheel on the sharp contact surface. Solution: · The route of operation does not pass through this part of the area · Have some extra gimbals to replace

Stairs, escalators, and drop surfaces: 	Risks: · Robots may be a fall hazard Reason: · When an error in robot localization occurs due to environmental similarities or human factors, but the robot has not yet reached the threshold to trigger a stop alarm. The robot follows a set route, but in the real environment the robot may deviate to a stairway. · When speeds are high, or the sensitivity of the RGBD to detect fall risks is not high enough, the robot may not be able to decelerate and stop in time. Solution: · Environmental modifications and deployment with reference to fallout protection deployment scenarios

1.3 Environmental modifications

Since robots are new, many traditional environments are not designed with robots in mind, so there are some environments where applying robots is risky.

It is not that the environment has some risks that cannot be met by the use of robots; with some modifications, the risks can be circumvented.

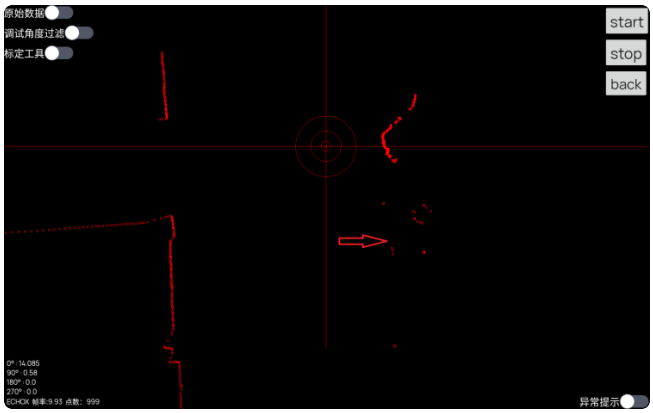
This chapter gives two examples of common environmental remodeling references.

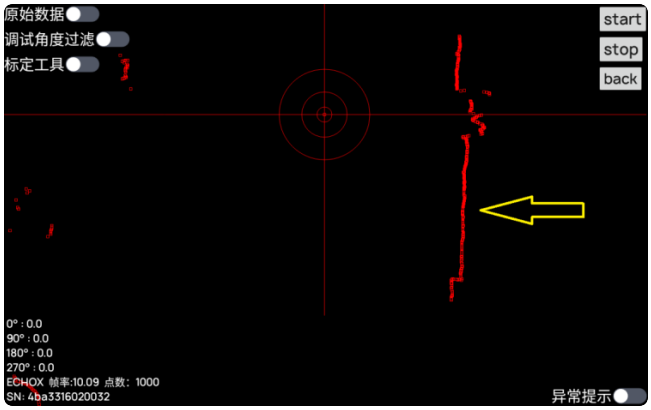
1.3.1 Lidar Sticker Retrofit Program

Be sure to double-check the environment with the page displayed by the LiDAR! Skeletonized, black, transparent, and tiny objects should all be considered for modification to avoid collision risk as far in advance as possible

Scene 1: Dark-colored objects, mirrored objects

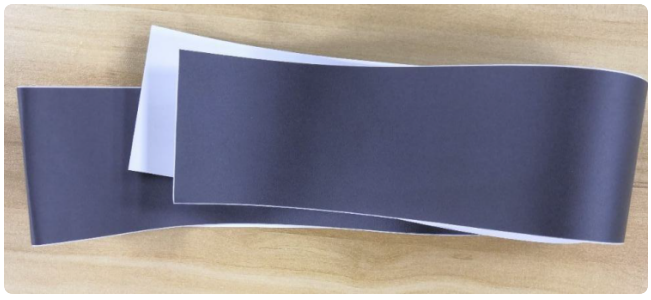
Judgment Program:

	
1. Position the center of the robot 0.3 m (11.81 inch)from the wall. 2. Orient the robot face to the direction shown in the figure	3. Open the LiDAR preview screen 4. Viewing the image after laser scanning, it can be seen that the glass wall is not scanned at all, and the sticker must be applied in this scenario.

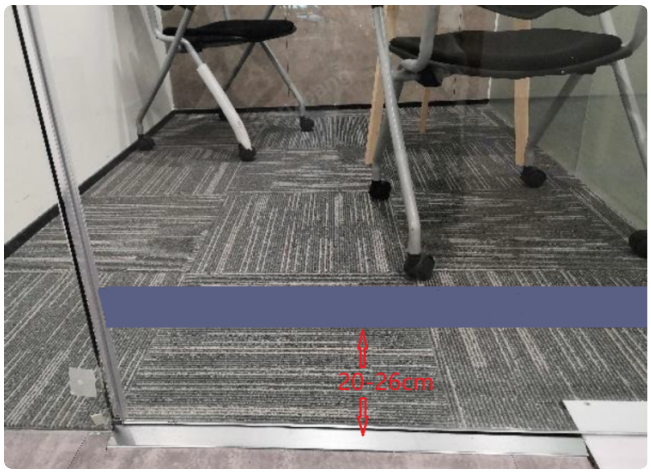


- In better cases, such as rough better diffuse reflective surfaces, the length of the red area that can be scanned by the laser is about 0.8m(31.5 inch), this does not have to do any processing.
- Worse case, such as black or glossy specular reflective surface, the length of the red area that the laser can scan is about 0.4m (15.75 inch), if the normal driving robot will be closer to this wall, then it is recommended to stick stickers to solve the possible collision problem.
- In the worst case, if the laser can scan a red area of less than 0.4m(15.75 inch), or even if the robot is oriented perpendicular to the wall and still scans a red area of less than 0.4m(15.75 inch), then the skirting must be applied.

Remodeling Guidance:



- Purdue's officially designed skirting decal has a frosted material and is of medium width

	· The sticker height needs to match the laser radar sent by Qiaolu, 20 ~ 26 cm(7.87 ~ 10.23 inch) above the ground.

Scenario 2: Tiny Obstacles

	· Tiny obstacles usually refer to obstacles with a diameter of less than 2cm(0.79 inch), such as thin chair legs, table legs, and so on. · Tiny obstacles may be missed while the LIDAR is scanning · Stickers can be attached to form flag stakes, 3~4 cm(1.18 ~ 1.57 inch) in width and 20 ~ 26 cm(7.87 ~ 10.23 inch) in height above the ground to improve the stability of chair legs detected by LIDAR.

1.3.2 Fall prevention retrofit program

As mentioned earlier in the environmental assessment

programmatic	Working Principle	Program limitations	Retrofitting requirements

RGBD Environmentally Sensitive Drop Protection	The ground plane is extracted through RGBD depth perception. When the floor is skeletonized, or has steps of different heights, the robot recognizes it as a risky area and decelerates or brakes	· Misdetection and omission may exist · Limited detection distance, risky at higher speeds · Only drop surfaces with a height difference of more than 10 cm can be recognized.	not involving

This only describes the environmental modification options for fallout protection. For more operational details, please refer to the Fall Protection Deployment Implementation Document V2.0_20230809.

1.3.3 Other special environmental modification programs

Much of the retrofitting experience relies on case experience, and different environments have local characteristics that are difficult to quantify and standardize into a uniform program.

You can refer to **"Installation Site Survey and Remodeling V1.0"** to familiarize yourself with more practical case experiences and flexibly handle them according to your own actual situation. Inside the case collection, we will continue to update more practical and detailed cases.

Not to be repeated here.

II. Preparation for deployment

To increase the efficiency of the subsequent steps and to minimize business interruptions at the customer's site. Some of the pre-deployment actions can be done in advance at the warehouse or at the customer's office.

2.1 Unpacking and inspection

Due to the long transportation route of the product, as well as the possible long storage time, it needs to be inspected after opening the box:

- Whether the packaging is intact, no obvious signs of extrusion damage
- Whether the power can be turned on normally, the light strip lights up normally
- Whether there are signs of damage to the display
- Whether the sensor self-test can be completed
- Is the charger working?

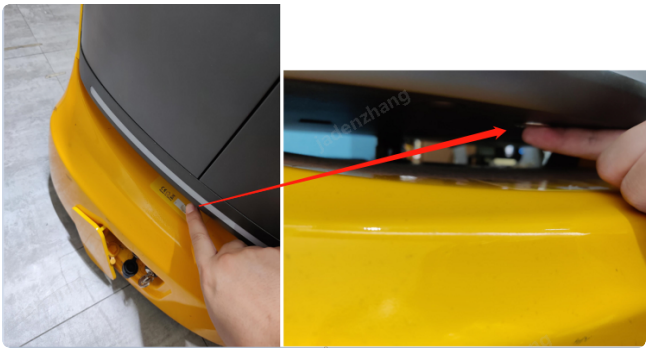
2.2 Recharge

If the robot is warehoused for an extended period of time, the batteries may go into storage mode or there may be some false charge.

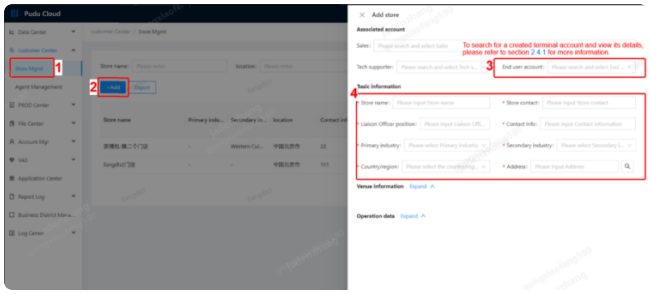
- Storage mode: the robot cannot be turned on and the battery is dormant. It can be activated after plugging in the charger.
- Virtual electricity: Due to the long-term storage characteristics of the battery, the actual power of the battery is different from the displayed power. There may be a sudden power outage or power jump during use. When recharging is required, FlashBot can be charged continuously for more than 3 hours to complete the battery calibration.

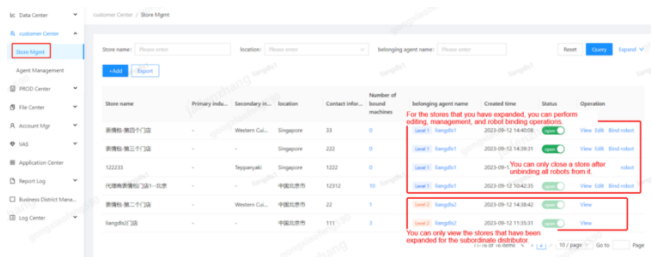
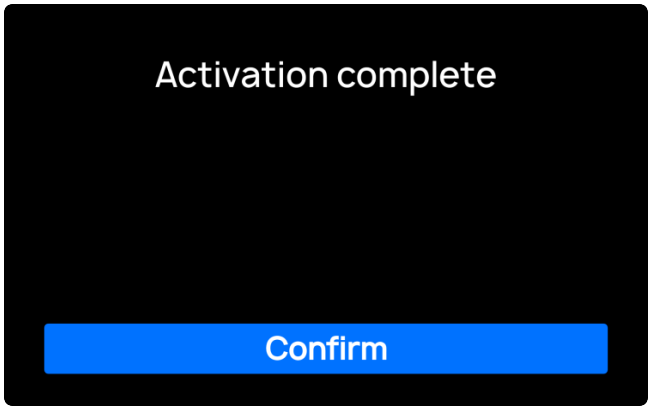
2.3 Activation

First time users will need to bind and activate the machine before it can be used properly.



- Turn on the key switch.
- Press and hold the power button for 3 seconds, the robot screen will light up and display the power on animation.

	Follow the interface guide: · Completing the language settings · Complete wifi setup · Record the MAC address of the robot
	· Registered as a Purdue agent, the system will be based on the agent's registration of the country filled in the region, send an e-mail containing the system login address and initialization of the account password information to the agent's administrator's mailbox, please use this mailbox in the login address shall prevail, the following address is for reference only: · Asia Pacific: https://css.pudutech.com/ · Europe and America: https://csg.pudutech.com/ · Domestic: https://cs-internal.pudutech.com/ · Open "Purdue Distributor Management Platform" in your computer browser and log in to create a store.

	· Click on "Bind Robot" in the corresponding store entry · In the pop-up screen, retrieve the product name and MAC address. · Click "Confirm Binding", the robot will appear in the list of the store after successful binding.
	· Click "Activate" on the robot side, the activation is successful.

· The information about the store and the robot needs to be confirmed accurately to avoid errors that may cause difficulties in subsequent online operations.

· For more information on the operation of the cloud platform, please refer to the "PUDU Distributor Cloud Platform Functional User Guide".

2.4 Tool checking

Software tools need to be checked to make sure they are all updated to the latest version to minimize the hassle of encountering historical problems:

· Robotic system mirroring

· Robot Ontology Software

Hardware tools, checking for good tools can reduce site contingencies, and you can construct your own item checklist based on experience:

· multimeter

· Screwdriver Set

· Lower computer firmware burning tool

- All-in-One Cables
- Stickers for environmental remodeling

III. Environmental mapping

The process of building a map of the environment is actually the key step:

1. The robot scans the environment for characteristic information and memorizes it;
2. Manual supplementary entry of information that is not well recognized automatically by the robot;
3. According to the needs of the scenario and business, enter some rule-based information to facilitate the subsequent task setup and automatic operation of the robot;
4. The robot passes through the same environment again and is able to determine its location based on matching the scanned information with a memorized map.

This chapter describes the laser mapping solutions available on top of the FlashBot.

3.1 Laser mapping

The FlashBot currently only supports laser maps

3.1.1 Introduction to start-up points

Start-up points are usually regarded as reference points for mapping. The robot starts mapping from the start-up points and builds the entire map based on this starting point. It is equivalent to the origin of the map coordinate system.

When starting up the map, you should select an area with obvious features that are not prone to major changes, so that the lidar can scan as many effective points as possible. Therefore, start-up points should be carefully selected and calibrated before mapping begins to ensure the accuracy of the map and the reliability of the robot.

Boot Region Selection Requirements:

1. Non-glass environments, non-long corridor environments, non-open environments, and non-completely cluttered environments should be selected;

2. The environment at this location is essentially unchanged from when the map was constructed (no more than 5% change);

3. It needs to be taken into account that the environment will not change during subsequent use of the location (not more than 5% change);

4. Instead of facing the wall directly, you can face the corner of the two walls;

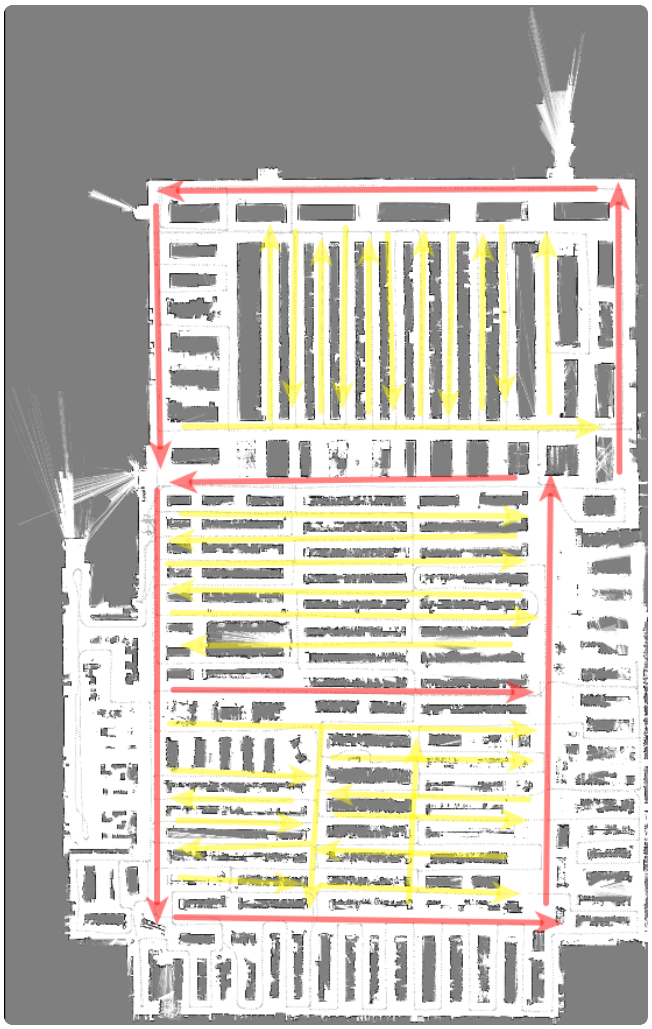
5. The recommended distance between start-up points and obstacles such as walls is about 1.5 meters(4.92foot), with a minimum distance of 1 meter(3.28foot).

	· Optional corner recess
	· Optionally facing a featured wall

	· Optionally, there are fixed and unchanging feature areas (graphic display stand)

3.1.2 Characteristics of common scenarios and the key points of their mapping

1. supermarket scene



Environmental Characteristics:

· Supermarket scenarios are generally characterized by the following: medium–sized scenarios (area of about 5,000 square feet), more complex scenarios, and frequent changes in the environment (frequent changes in shelf goods)

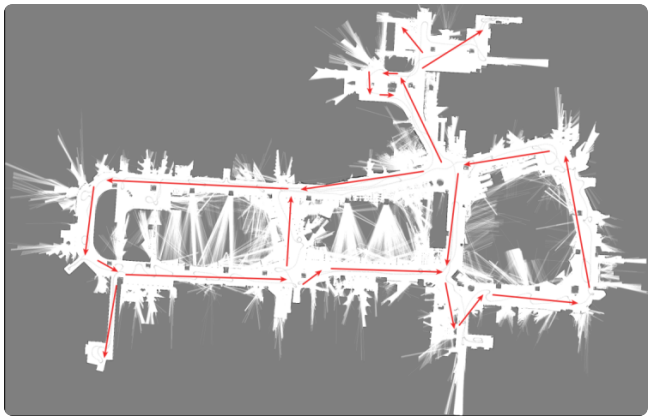
Push map essentials:

1. Push the main roads first, and the outer ring of main roads first to form a closed loop.

2. Then push the access to the feeder, prioritizing coverage of the closed loop with full access.

3. After implementation, go back to the initial point, click Finish building, wait for the map to be generated, watch the preview effect, and confirm the quality of the map.

2. Mall Scene

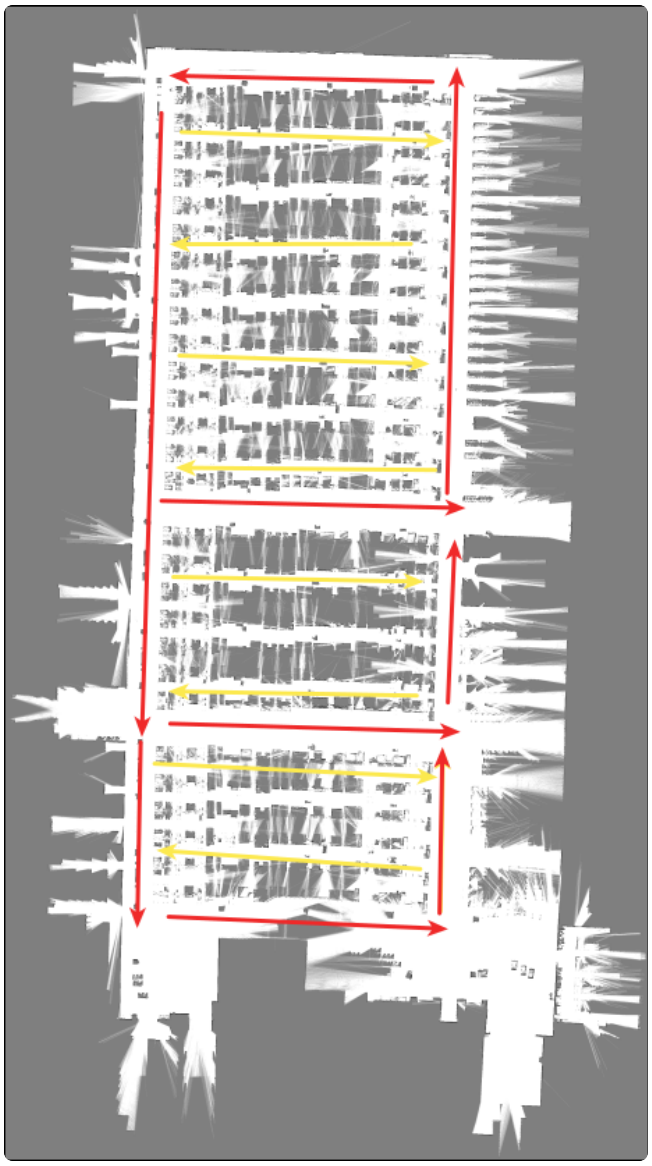


Environmental Characteristics:

· Shopping mall environment generally has the following characteristics: scene area from medium to large scenes are involved (area of 5,000 square feet to tens of thousands of square feet), the venue exists a large area of the glass scene, there are hazardous areas within the venue (escalators, staircases, elevators, etc.), the

	road is relatively wide, but there are a variety of decorations. Push map essentials: 1. Pushing small circles first, then large ones, must prioritize closed-loop paths. 2. Due to the mall in the road is relatively wide, but the actual existence of many obstacles to hinder the LiDAR scanning, so you need to implement the complete map in the machine operation area, otherwise the machine builds the map is incomplete, the later will appear in the positioning of the loss of frequent problems. 3. If the site area is too large to cause the push time is too long (more than 1h), at this time the machine's memory or storage space may not be able to support the continuation of the push, you can solve the problem by expanding the construction of the map, push the map to complete the first half of the scene of the construction of the map, in the follow-up to expand the construction of the map to make up for the way can be. 4. After implementation, go back to the initial point, click Finish Building, and wait for the preview of the final generated map to confirm the quality of the map.

3. Factory Scene



Environmental Characteristics:

· Factory scenarios are generally characterized by the following: general characteristics are as follows: oversized scenarios (more than 10,000 square feet in size), multiple adjacent and similar aisles

Push map essentials:

1. Push the small circle path first, then the larger circle path.

2. This type of scenario requires pushing the outer red routes first, then the yellow routes to ensure build quality.

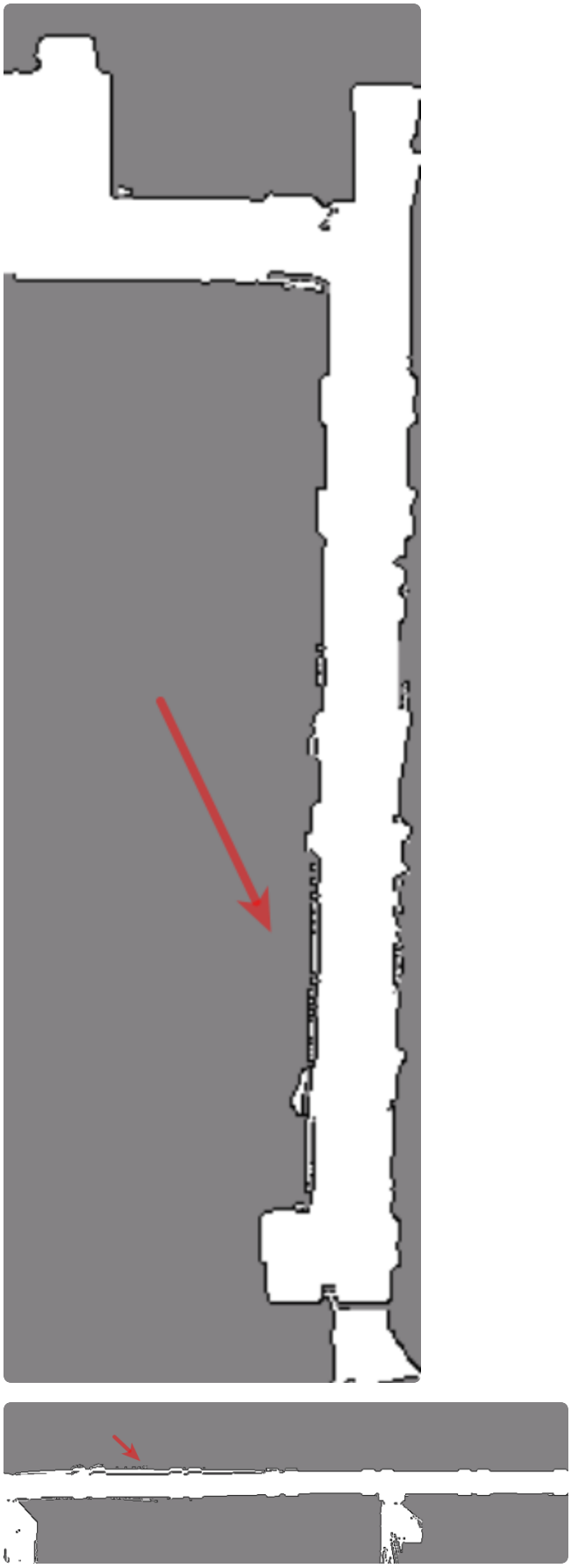
3. The machine is first implemented to build a map in accordance with the red map, and after ensuring that the machine completes a full circle back to the starting point, the machine is then implemented to repeat the route for more than 10 meters (32.8foot) to ensure that the loop is closed.

4. Then follow the yellow arrows to push the machine, when pushing, you need to pay attention to, can not continuously push adjacent channels, you can first take the odd-numbered channels, and then take the even-numbered channels.

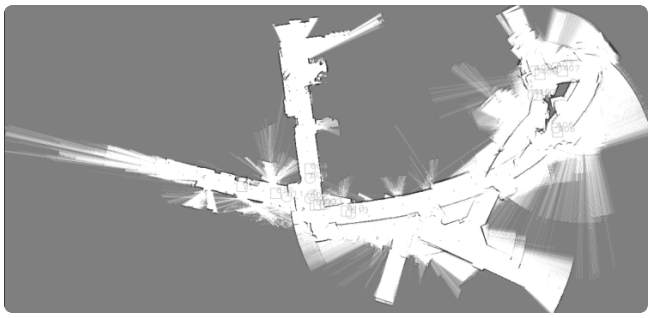
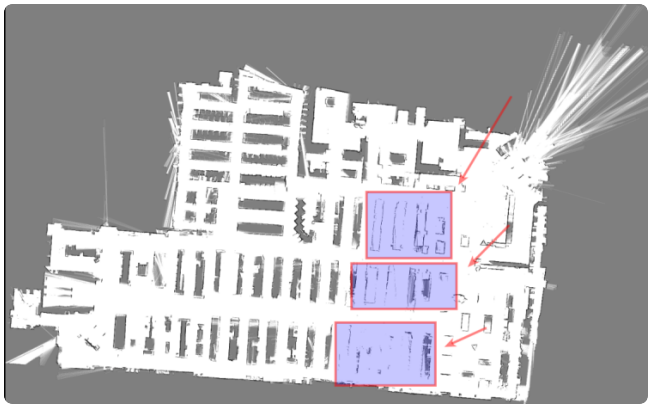
4. Frequently Asked Questions about Laser Maps and the Risks

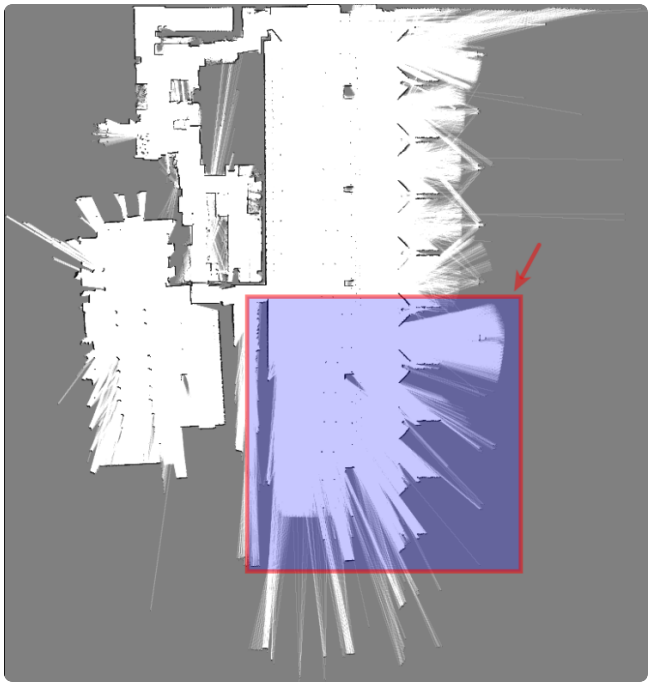
Problem description: There is ghosting of the wall at the location indicated by the	Risks:

red arrow



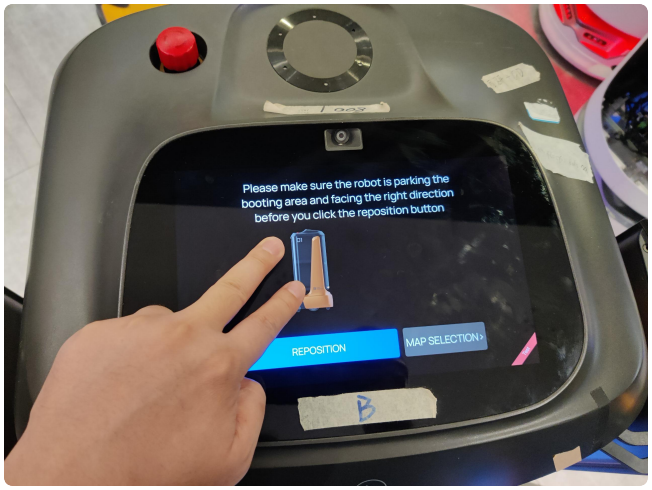
· Robots may have problems with positioning jumps

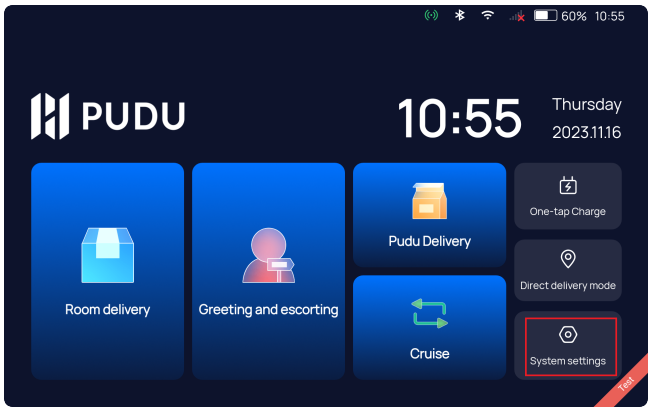
Problem description: The map preview does not match the actual environment, and the map is irregularly misaligned and distorted. 	Risks: · Maps are completely unavailable and location is easily lost Reason: · Lidar sweeps during map building
Problem description: There is a large obstacle in the actual scene in the area of the red rectangle, and the obstacle can be detected by LiDAR, but the large obstacle is missing from the map. 	Risks: · Positioning may be lost due to incomplete maps

Problem: The map is not complete. The location of the red rectangular box is included within the machine's path of travel, but the build is incomplete and in a semi-open area. 	Risks: · Positioning may be abnormal or lost due to incomplete maps

3.1.3 Guidelines for laser mapping and scanning

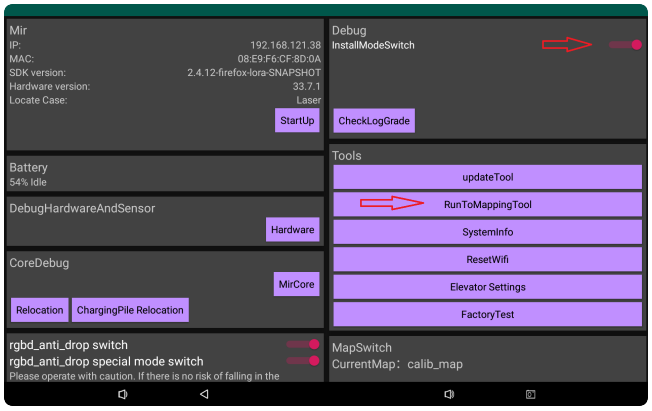
Please read sections 3.2.1 and 3.2.2 carefully before scanning a laser build, and use the build tool to start building after you have mastered the key points.

	· Two-finger long press to skip the lost screen

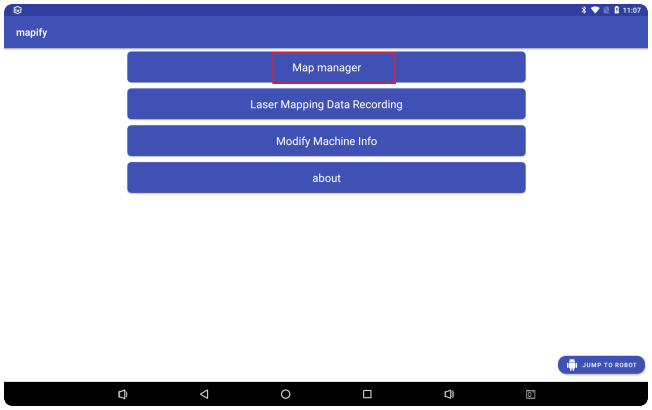


- Click on "System settings"

- Enter the password "0000"
- Select "Debug" in the setup menu.
- Type "pudupw".

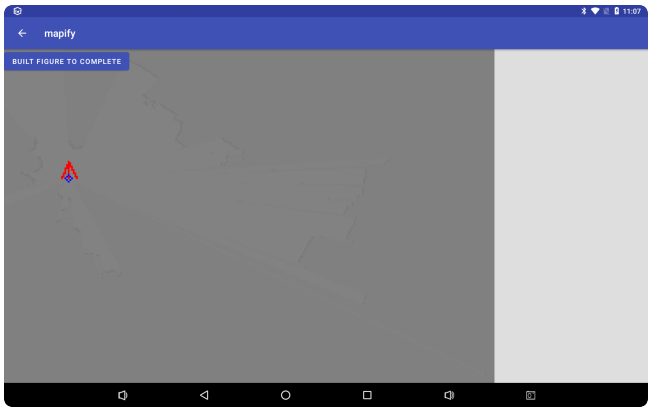


- After entering the debugging interface, turn on the "InstallModeSwitch".
- Click on "RunToMappingTool".



- Click on "Map manager"
- Click on "CREATE MAP"

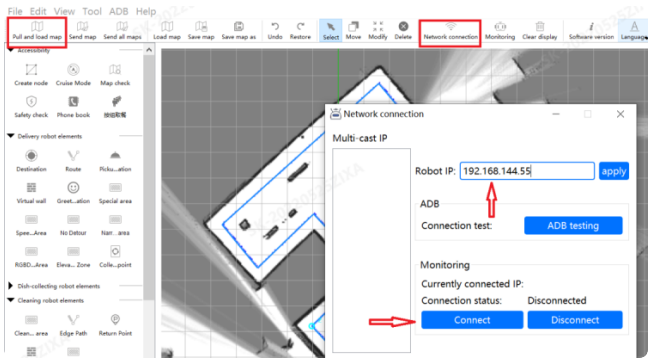
- NOTE: Before starting the build, the person must stand behind the side of the machine to prevent the radar from scanning their legs.

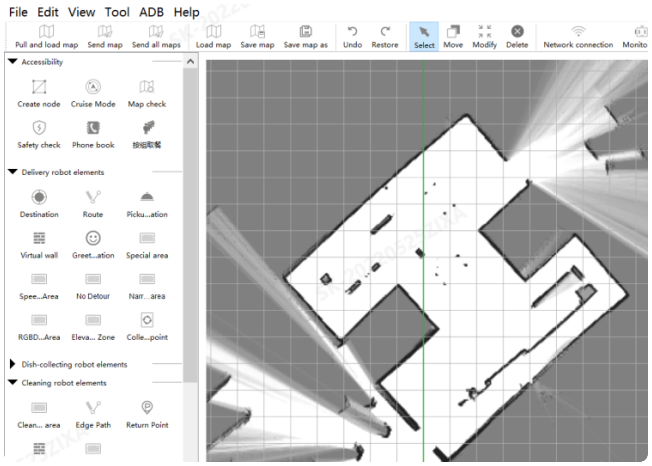


· Go to the gray build page and see the red symbol representing the robot.

· Push the robot to scan the path, all the routes are implemented at least twice, after completion, click on the "BUILT FIGURE TO COMPLETE" to enter the floor information and map name to complete the save

· Click "JUMP TO ROROT", you can only use the installation tool to connect via IP if you are in the main body and have turned on the debug switch.

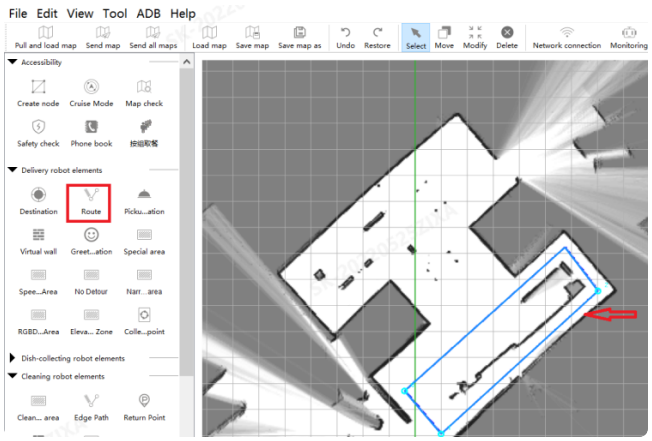




· Connecting the robot via the PC–based installation tool

· Pull the robot map, the robot and PC must be connected to the same wireless LAN when pulling the map.

· Conduct a comparison between the site environment and the static map. If in the comparison between the map and the site environment, there is a distortion and deformation, etc., it is necessary to rebuild the map; if the map situation matches well with the static map, it is possible to carry out the subsequent addition of elements;

	· Draw a simple closed-loop topological path on the map (see section 3.3 for how to add a path) · Click "Send map" to send the map to the corresponding robot.
	· Receiving the map, the robot will software reboot · When the robot passes the self-test, it indicates that the scanning is successful.

3.2 Element Addition

After completing the laser mapping, use the installation tool to pull out the map and add paths and target points on the installation tool as needed.

3.2.1 Topological Path Mapping

Principles of topological path mapping:

1. The topology path needs to fit the static map path as closely as possible;

2. When drawing, pay attention to the connection of cross-paths, the red circle of the adsorption symbol will automatically appear when the mouse is placed on the path;

3. When there are curved routes, the plotting principle can be drawn by connecting multiple paths;

4. The length of a single path (between two nodes) is ⩾1.2m(3.94foot), and the distance between two neighboring paths is >1.2m(3.94foot);

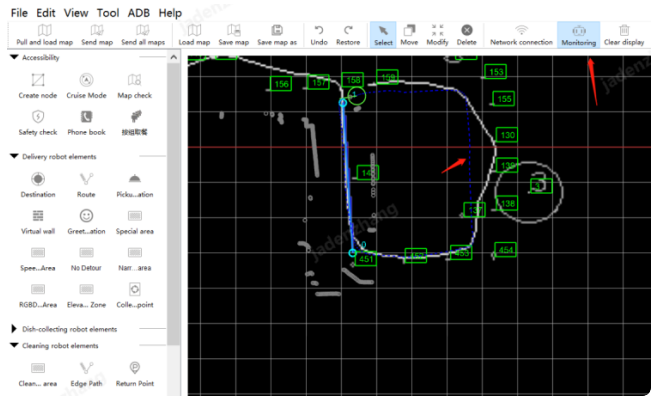
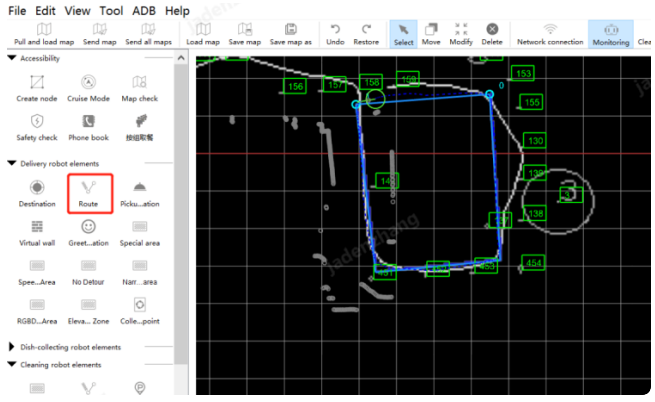
5. Angle between paths > 45°;

6. Dining table or stop <0.5m(1.64foot) from path; dining table or stop >0.2m(0.66foot) from node;

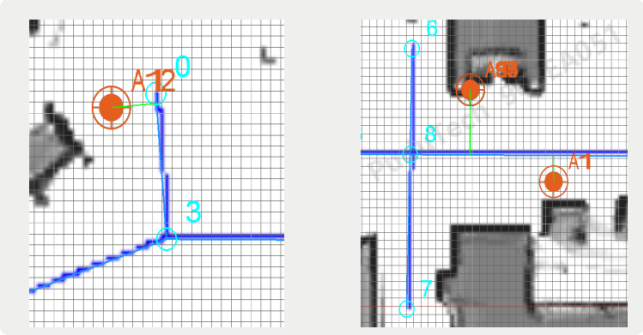
7. When pushing the robot to draw topological maps watch for jumps in robot localization and reassess the static maps for localization problems;

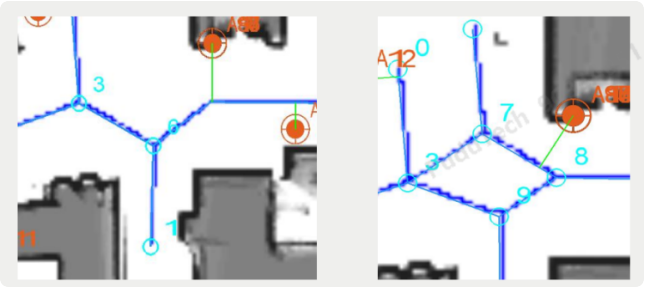
8. After drawing, you can click the **"Map Inspection"** button on the installation tool to view the topological map drawing effect.

Add a path step:

	· After connecting the robot, click on "Monitoring" to see a green circle representing the robot's location. · Push the machine by hand once to get the trajectory of the robot, as shown by the blue dotted line in the figure · Checking path correctness
	· Click on "Route" to add a path along the blue track · Click "Create Node" to automatically generate the node.

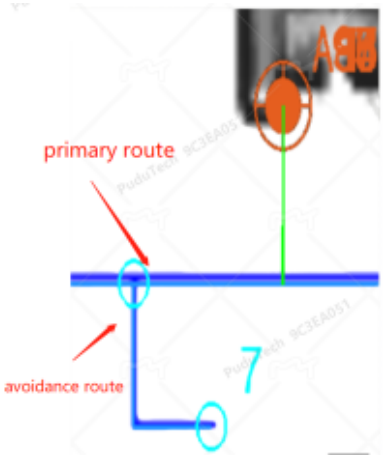
Topological mapping considerations (special cases):

	· The correct way to draw topological paths when faced with a T or intersection

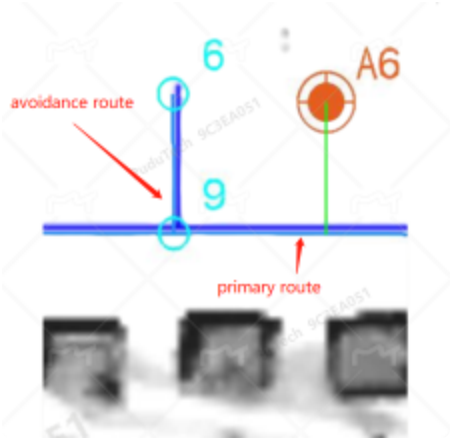


· Wrong way to draw topology paths when facing a T or intersection

L-shaped avoidance route



Right-angle avoidance route



· When the road width is long and there are no other paths nearby for robots to avoid each other, if the road width is wide and there is room for avoidance, avoidance paths can be drawn in addition to the main path to improve the efficiency of the robots in this path.

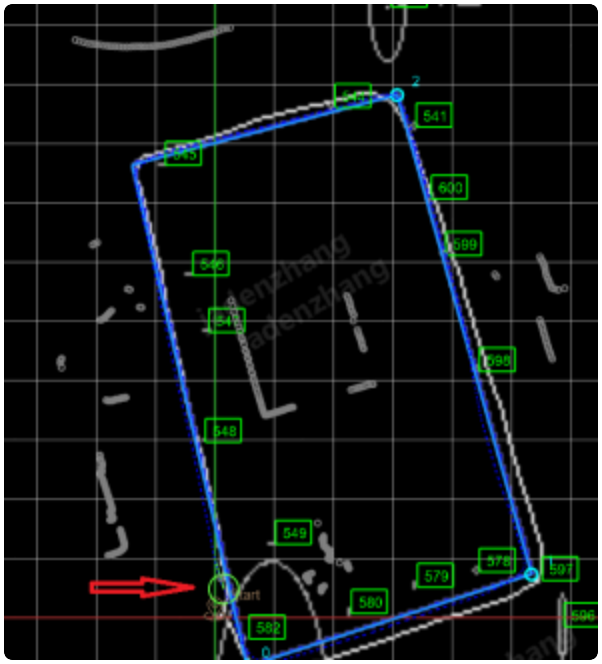
3.2.2 Arrival point mapping

Point of arrival introduction:

· The point of arrival is usually the location where the item needs to be delivered.

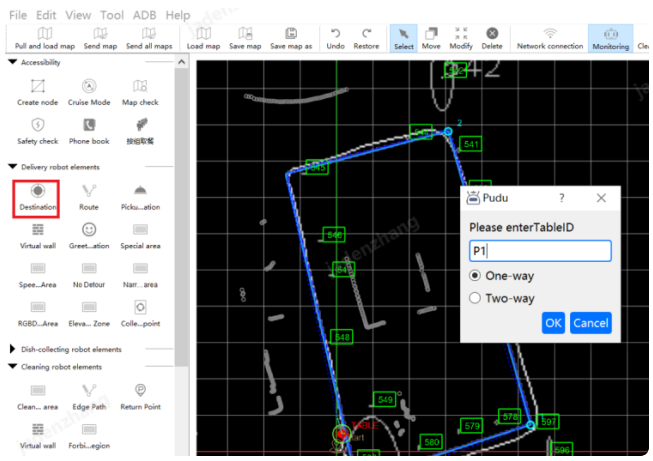
· Push the robot hand to the door of the guest room or any other point that needs to be delivered, and use the shortcut A to add a point, or click "Arrival Point" on the installation tool to add a point.

Add steps:



· After connecting the robot, click on "Monitor" to see a green circle representing the robot's location.

· The green line in the circle represents the direction of the machine.

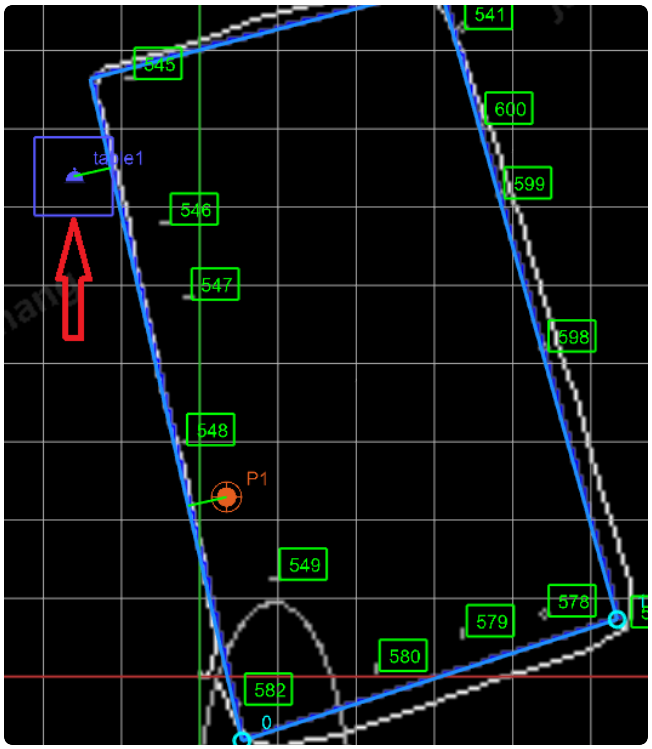


· Click on "Destination"

· Enter the table id in the popup window and click "OK".

3.2.3 Plotting of point of delivery

Docking Point Description:



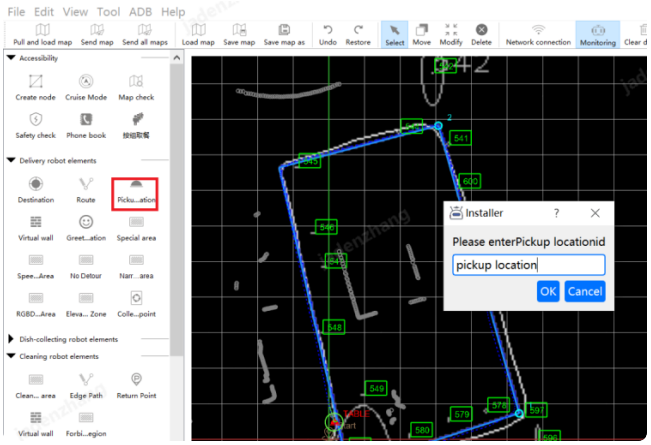
· The meal "Point of delivery" is generally set at a fixed location where the machine is parked, such as at the kitchen door.

· As with adding an arrival point, push the robot to the location where you want it to stop and click on "pickup Location" to add it.

Attention:

· When adding a pickup Location, the installation tool will automatically generate the corresponding docking area; when there is an obstacle in the docking area that prevents the robot from accurately returning to the docking point, the robot will dock to the side, i.e., entering the docking area indicates that the docking is complete; therefore, please do not modify or delete the docking area.

Add steps:



· Connect the robot and click on "Mornitoring" to push the machine to the point of delivery.

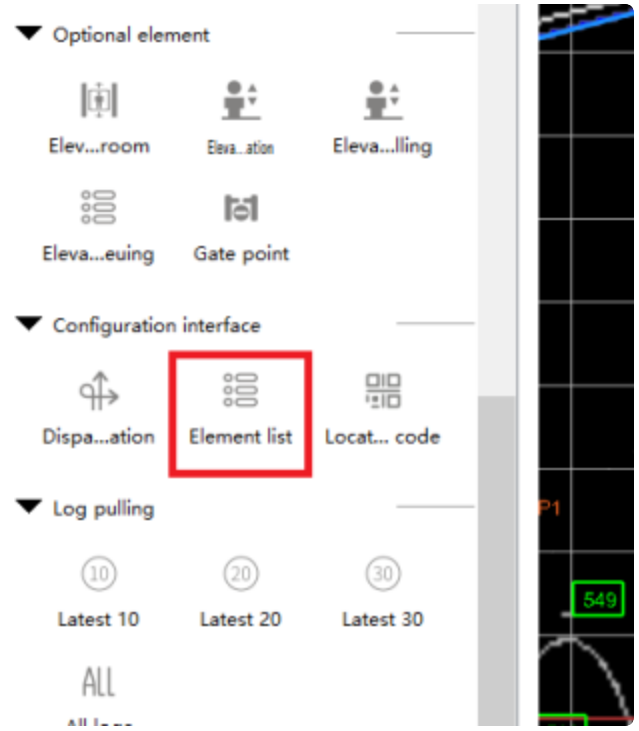
· Click on the "pickup Location"

· Enter the table id in the popup window and click "OK".

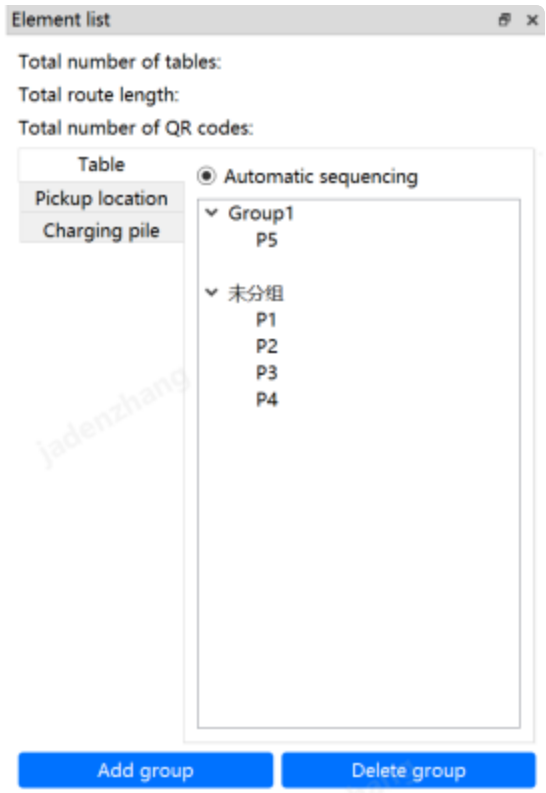
3.2.4 Grouping of Arrival and Point of delivery

Both arrival and departure points support grouping and have the same operation steps. This section takes departure points as an example to introduce the grouping operation.

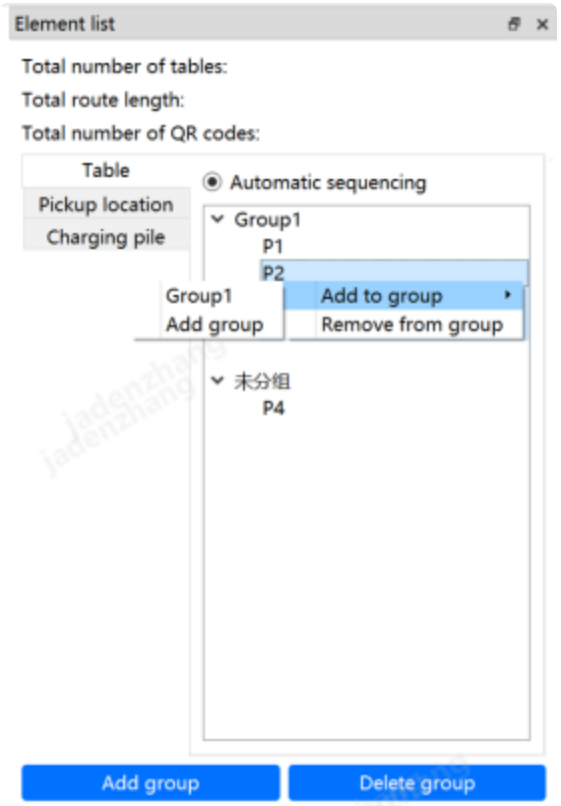
Operational Steps:



· Find the "Element List" according to the diagram.



· Click "Add Group" and set your own group name.

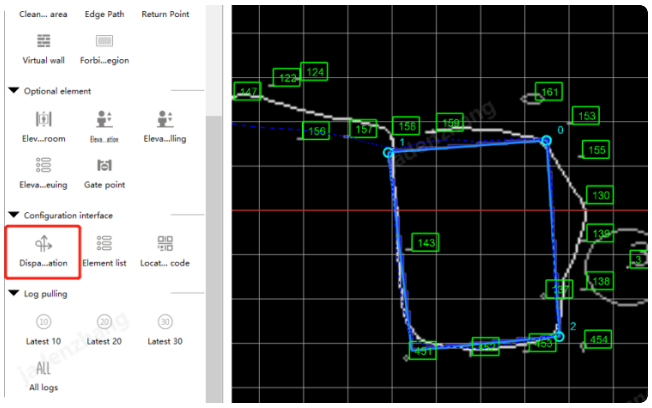
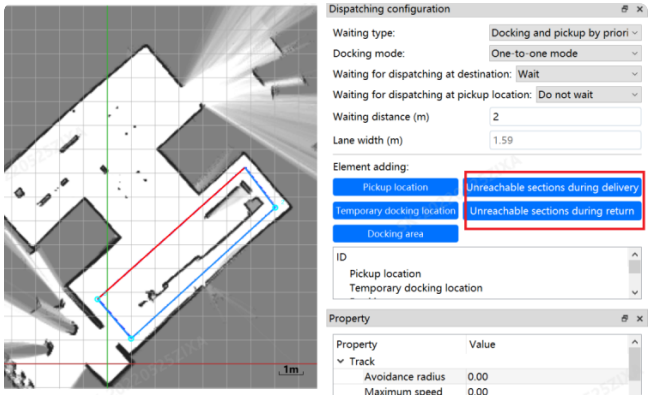


· Arrival point grouping supports multi-selection and can be added by dragging the mouse as well as clicking on the right-click menu.

· There is also the option of removing some table points or moving them to a different grouping

3.3 Route constraint settings

Steps for setting constraints on the outbound and return routes:

	· Click on "Dispatching configuration"
	· Select the route to be constrained, the route will be red when selected · On the Scheduling Configuration Options page, select "Unreachable sections during delivery" or "Unreachable sections during return". · Send the map to the robot after setting.

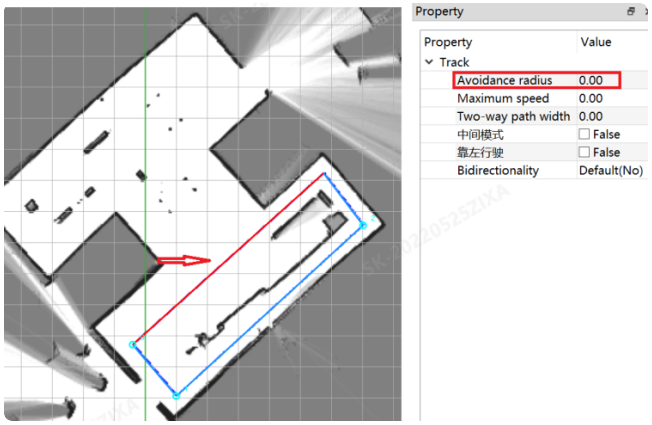
Route width adjustment:

When you expect the robot to walk as close as possible to the designed route during the traveling process, or you want to reduce the possibility of colliding with the obstacles on both sides with less obstacle avoidance action, you can adjust the "**Avoidance radius**" attribute to achieve the desired effect. The meaning of the **"Avoidance radius"** value is as follows:

numerical value	hidden meaning
Avoidance radius = 0	The robot will deviate from the design route by a maximum of 0.8m(2.62foot) when traveling on the roadway.
0< **Avoidance radius** < 0.5	The robot follows the designed route as far as possible, avoiding stops and obstacles.

Avoidance radius >= 0.5	The robot prioritizes attempts at obstacle avoidance with a maximum offset distance of " **Avoidance radius**" meters

Setup Steps:

	· Select the path you want to set, the "Property" dialog box will appear on the right, modify the avoidance radius.

Speed Adjustment:

If you want to pass through some complicated road sections, you can adjust the **"Maximum speed"** attribute to achieve the desired effect, and the meaning of the **"Maximum speed"** attribute is as follows:

numerical value	hidden meaning
Maximum speed = 0	Default value, planning the movement according to the set speed gears
0.2<= **Maximum speed** <= 1.2	Valid setting range, the maximum planning speed for the robot to pass through the section is "**Maximum speed**".
0 < **Maximum speed** < 0.2	Taking 0.2, the maximum planning speed is the "**Maximum speed**".
Maximum speed > 1.2	Taking 1.2, the maximum planning speed is the "**Maximum speed**".

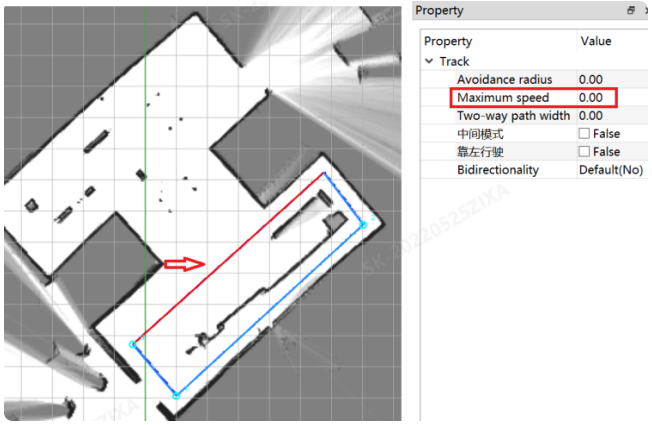
Caveats:

1. As far as possible to avoid adjacent sections of the "**Maximum speed**" difference is too large (**the difference is greater than 0.4m / s**), otherwise it is easy to appear in the

path of the machine switching at the smooth.

2. When **the path length is less than 3 meters**, the path and other paths connected to it need to have a speed limit of 0.6m/s (within 1.5 meters of the node).

Setup Steps:



· Select the path you want to set, the "Property" dialog box will appear on the right, change the maximum speed.

3.4 Virtual Wall Setup

Usually there are dangerous areas such as stairway exist in the actual scene, you can set up a virtual wall in the safe area in front of the stairway, so that the robot can keep a safe distance from the dangerous area to avoid falling down.

Example:

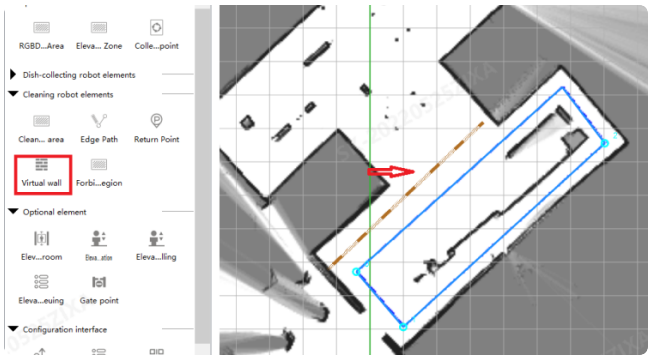
§ Slope on the side of the road (risk of falling)

§ Suspended water bottles (which may cause the robot to crash)

§ Tables (may cause robots to crash)

A virtual wall is a virtual obstacle or boundary that is used to limit the range of motion of a robot to ensure that it moves within a specific area, avoids entering a dangerous area, or performs a specific task.

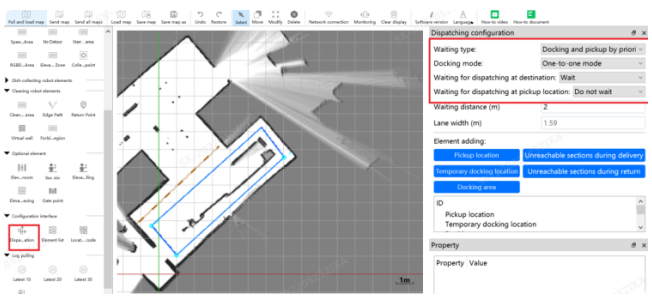
You can set up a "**virtual wall for obstacle avoidance**" to limit the width of the path to ensure that the robot does not collide and at the same time, improve the efficiency of the robot passage.

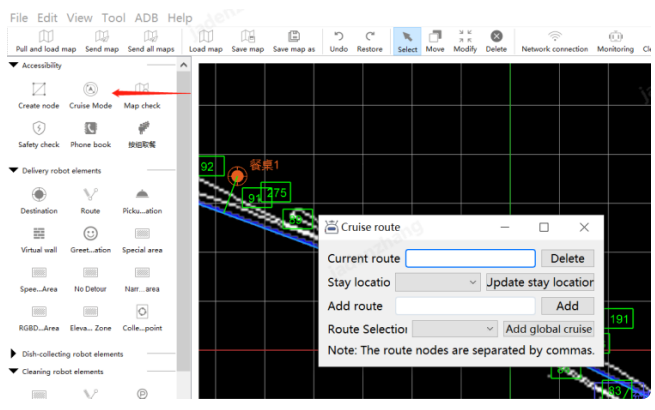
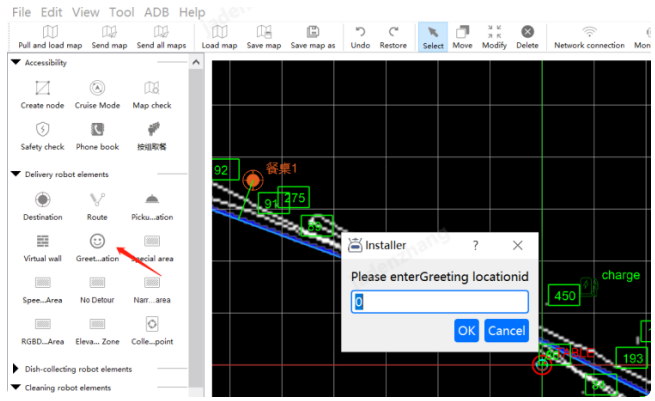
Notes on setting up a virtual wall for obstacle avoidance	· The location of the virtual wall needs to coincide with the location of the actual obstacle. · The virtual wall is a minimum of 45cm (17.72 inch) from the path.
	· Click **"Virtual Wall"** to set up a virtual wall.

3.5 Additional notes on tools

3.5.1 Installation tools

The main function of the installation tool is to edit the map, so that the map conforms to the use of the scene and the user's needs, 3.3 to 3.5 section is used in the installation tool, the following briefly introduces some of the functions that may be used, for more detailed instructions, please refer to the "Installation Tool Introduction Document".

	· You can set the mode of stopping and queuing here.

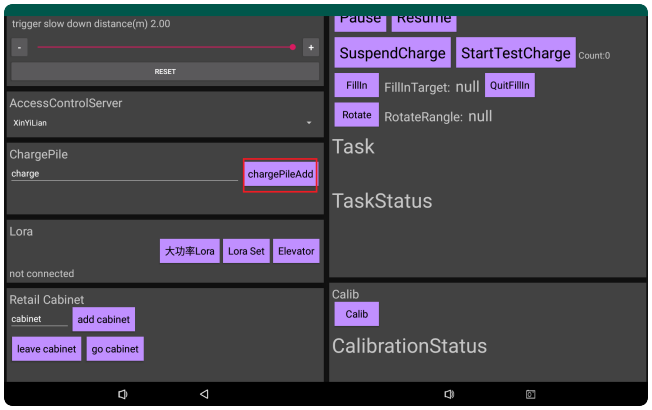
	· Addition of cruise routes
	· Add ladder control related points and gate points, ladder control related deployment view "FlashBot – Self-developed Ladder Control – Installation and Deployment Operation Guide v1.8", "FlashBot – Cloud Ladder Control – Deployment Operation Guide v1.0".

3.5.2 Unified mapping tools

Currently, the FlashBot does not support the Unified Diagramming Tool.

3.6 Charging pile start-up positioning

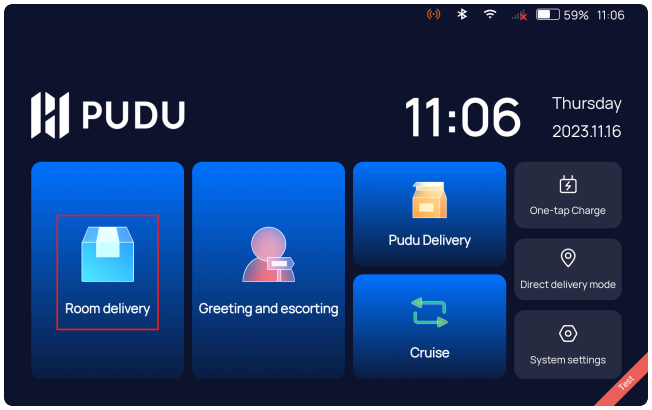
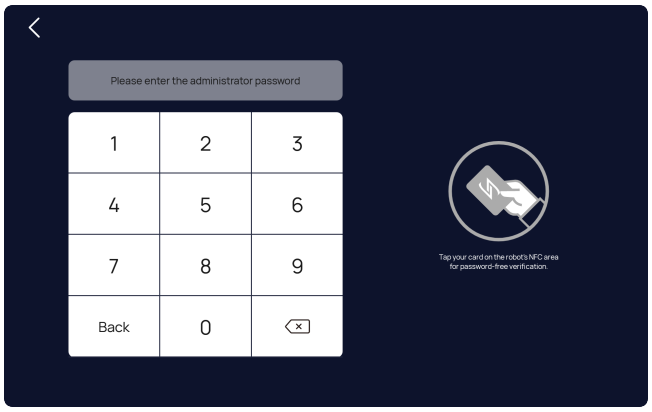
In addition to being powered on at start-up points, FlashBot can also be powered on and positioned on a charging pile.

<table>
<tr>
<td>  </td>
<td>· After completing the map, push the machine in front of the charging post, right in front of the charging post</td>
</tr>
<tr>
<td> 
</td>
<td>· After modifying the name of the charging post in the debug screen, click "chargePileAdd".
· reboot</td>
</tr>
<tr>
<td>  </td>
<td>· Positioning of the machine on the charging post can be done later.</td>
</tr>
</table>

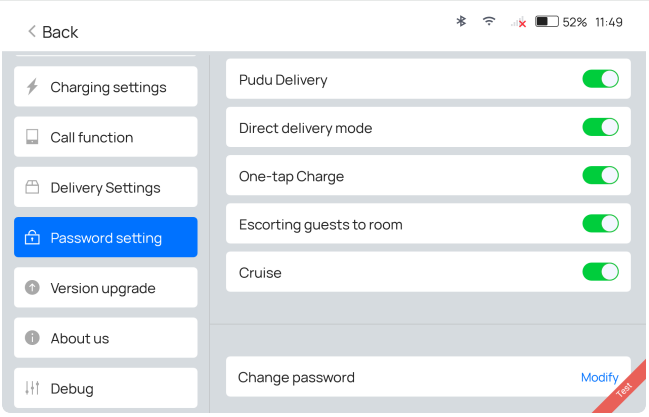
IV. Task settings

4.1 Room delivery setting

Use the installation tool to complete the points to add and push the map to the machine, you can use the machine to complete the task, the following is a brief introduction to the guest room delivery mode

	· Click on the upper left corner to bring up the function menu · Select "Room Delivery"
	· Enter the default password "0000".
	· Select the point and click on the "Start" machine to go to the target point.

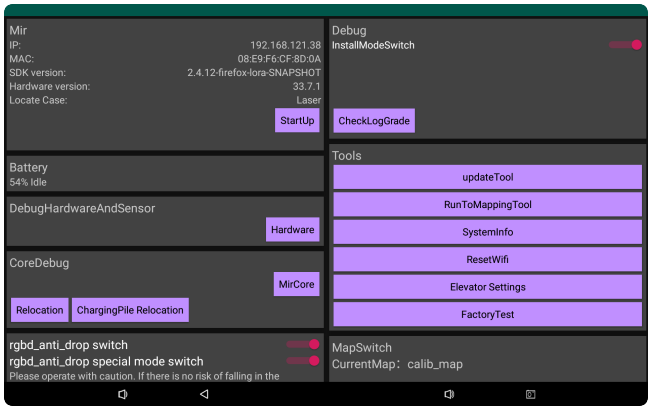
4.2 Password setting



- Access to each mode requires a password, if you don't want a password, you can turn it off here or change it here

4.3 Scheduling settings

When multiple machines are running at the same site, scheduling can be used to solve problems such as encounter avoidance during traveling, priority-based stops at multiple stops, fill-in stops at two distant stopping zones, and constraints on path planning for both outbound and return trips. When scheduling multiple machines, you need to make sure that the channel is consistent and the map is consistent. If you find that you can't schedule between machines, you can also enter this interface to troubleshoot.



For the configuration of scheduling, you need to refer to the following according to the actual business requirements:

- Enter the debugging interface and turn on the debug switch
- Click on "hardware"
- Click "open" in the scheduling test.
- Click "preview" to enter the monitoring interface.

(Explain the meaning of each by serial number on the right side of the figure)

1. Communication switch, when it shows open, it means that the communication module has completed initialization, and it is open by default, and generally there is no need to set this function.

2. The ChoiceChannel button displays all available communication channels when clicked, followed by the number 2 for the currently used channel.

3. Map identifier of the current machine

4. The current communication status of self-organizing network module and LAN module, displaying true means that the module is started successfully, "Data Normal" means that the scheduling data is received and the data is correct, and "No Data" is displayed when no data is received.

V. Testing and training

Based on past experience, after completing the delivery, often the need to come back to the door is because the testing and training was not done properly:

· Functionality validation was not performed, and customers found certain features not as expected during use

· The lack of good training, the customer in the long-term use of the process in accordance with the wrong use or maintenance in the operation caused by machine damage

So, the final testing and training actions of deployment delivery are also very important.

5.1 Functional Testing

When the deployment is complete, each table and feature needs to be entered for a test of the full functionality of the deployment. Here are some recommended tips:

- Reconfirm with the customer if any details need to be adjusted. Many customers may want to see the actual robot in operation before further adjusting their needs.
- Execute all arrival points in sequence
- After executing all the

5.2 Cruise test

When deployment is complete, a cruise test can identify some potential risks on some routes:

- Travel is not smooth. Possible jump in positioning or sensor interference.
- Cuts. It is possible that the sensor is not stabilizing enough to detect certain objects or has entered a blind spot.

5.3 Peak Testing

Some of the scenarios have peak foot traffic, at which point some efficiency degradation can be detected by testing at peak times.

It can be flexibly adapted to the needs and characteristics of the site:

- Adjustment of the robot's route to match the line of movement of the site personnel
- Customer site business fit adjustment
- Functional adjustments

5.4 Training

For all personnel:

- For training, Refer to the "Product User Manual" and "Simple Operating Instructions"
- Maintenance training, Refer to "Maintenance One Page"

For managers:

· Simple problem handling training, refer to "FAQ", mainly focus on charging and reboot can be solved, if not solve the problem, contact after-sales service