KettyBot Installation and Deployment ManualV1.1_20231031

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Summary

KettyBot is a multi-functional robot that can perform a variety of functions such as delivery and advertising in a variety of scenarios.

Robots have the ability to sense the environment and operate autonomously, and after some manual installation and deployment to enter more information about the environment and the intent of the task, the robots 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. Task settings	V. Testing and training
demand communication Environmental assessment Rehabilitation of the environment	unpacking and inspection charge (a battery) activation Tool checking	marker build laser mapping Element Addition Path constraint settings Virtual Wall Setup	Customer attraction Settings Advertisement Settings scheduling setup	Functional Testing Cruise Run Test Peak testing cultivate

This document will refer to this process link to introduce the installation and deployment process of KettyBot 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. Obtaining the initial requirements of the customer, the robot's route and stopping position, referring 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

The KettyBot is designed to be an indoor robot and can handle most indoor scenarios with ease.

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 Ceiling assessment

consultation	risk analysis

Mirrored ceiling: 	Risks: • The marker localization scheme may be incorrectly positioned, resulting in abnormal robot routes. Reason: • Specular reflective materials such as mirrors map the marker into more than one, causing the robot to recognize it incorrectly Solution: • The route does not pass through this area • When this area is not large, no code is posted and the robot's odometer is relied upon to position itself through the small area • Adoption of laser positioning solutions

Outdoor Ceiling: 	Risks: • Possible mislocalization, causing the robot to run the route abnormally or report errors • Sensor interference, resulting in abnormal robot routing Reason: • Bright outdoor light causes overexposure of the top view camera, which fails to recognize the marker • Fewer outdoor fixed references, no characteristic references for laser positioning solutions • Outdoor bright light causes noise in sensor recognition Solution: • The route does not pass through this area
Glass ceiling: 	Risks: • The marker localization scheme may be incorrectly positioned, resulting in abnormal robot routes. Reason: • Bright outdoor light causes overexposure of the top view camera, which fails to recognize the marker Solution: • The route does not pass through this area • When this area is not large, no code is posted and the robot's odometer is relied upon to position itself through the small area • Adoption of laser positioning solutions

Strong lights, spotlights: 	Risks: • The marker localization scheme may be incorrectly positioned, resulting in abnormal robot routes. Reason: • When bright light such as spotlights hits the camera, it can cause the top-view camera to overexpose itself and fail to recognize the marker Solution: • The route does not pass through this area • Adoption of laser positioning solutions

1.2.2 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
- Some obstacles are detected and the shape of the channel is affected, resulting in a perceived width of less than 55cm from the robot's point of view.

Solution:

- Try to choose a road with a width of more than 55cm

Long corridors, high structural similarity scenarios:

Risks:

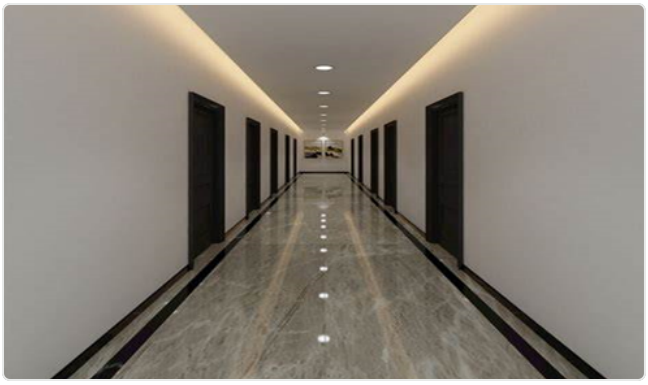
- Possibility of positioning errors in robots with laser positioning solutions

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:

- Adoption of the marker positioning scheme

Open up the big scene: 	Risks: • Possibility of positioning errors in robots with laser positioning solutions Reason: • The recommended LIDAR scanning radius for hoists is 20m. • 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 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 • Using a combination of marker positioning solutions and virtual walls • window film
Chair legs, minor obstacles: 	Risks: • Robots may collide with obstacles Reason: • Obstacles with a diameter of less than 2 cm will cause the LIDAR detection to be unstable and the RGBD will not be able to 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 • Stickers make the detected volume of small objects larger.

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

Billboards, screens, moving objects:  	Risks: • Possible loss of localization in robots with laser positioning solutions Reason: • If an object blocks a large view of the LiDAR, when the object moves, it can cause the LiDAR's scan of the environment to change significantly, resulting in an incorrect match or a mismatch to the original environment map. Solution: • Adoption of the marker positioning scheme
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

1.2.3 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: • This part of the scenario is not in the context of the robot's designed application • Communicate customer expectations in advance and assess whether their application needs are affected by smoothness
Slope: 	Risks: • Robot fails to climb a hill • High probability of spilling food when delivering dishes Reason: • The hoist only supports slopes up to 5°. 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 over-threshold height of the hoist is: 5 mm
- The maximum over-seam width of the hoist is: 35 mm

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

Soft pile carpet:

Risks:

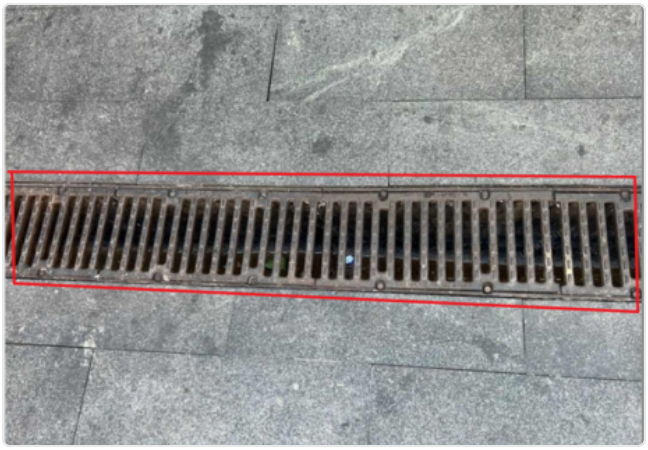
- The robot may not be able to pass through, motor blocking, or slipping abnormally occurs.

Reason:

- KettyBot only supports short-pile hard carpets with a thickness less than 10 mm, which needs to be subject to actual testing.

Solution:

- 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: • keep away from • 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 can 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

Scene 1: Dark Objects, Mirrors

Judgment Program:

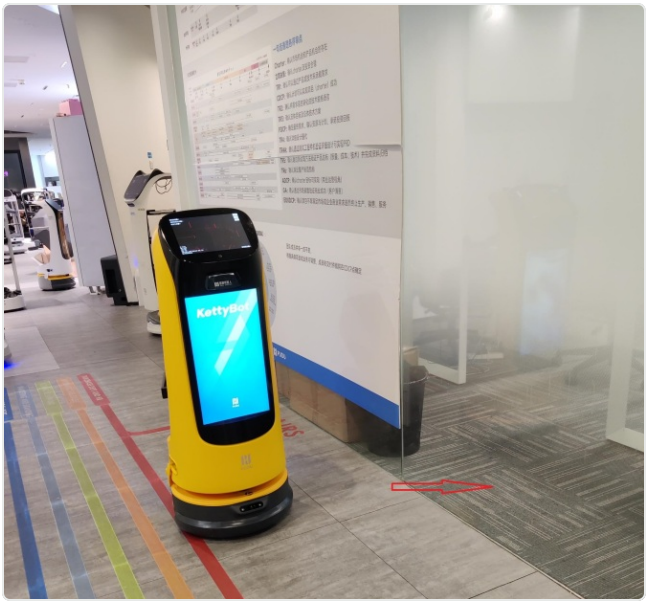
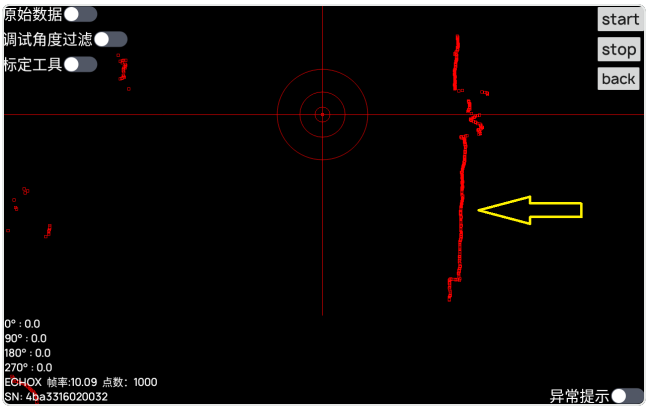


Figure 1–3–1

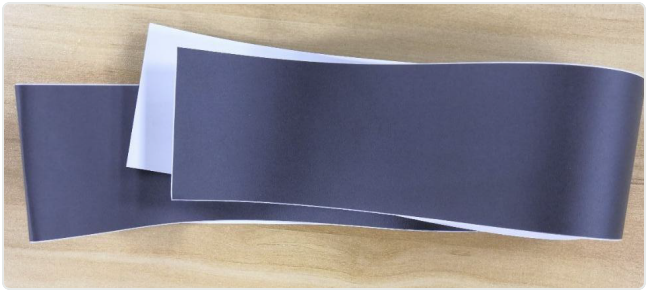
Figure 1–3–2

1. Position the robot center 0.3 m from the wall.
2. Orient the robot in the direction shown in Figure 1–3–1.
3. Open the LiDAR preview screen
4. View the laser scanned image, Figure 1–3–2 can be seen in the complete absence of scanning the glass wall, you must paste the skirting stickers



- Under better circumstances, such as a rough diffuse reflective surface, the length of the red area that the laser can scan is about 0.8m. This does not require any processing.
- In poor situations, such as black or bright mirror reflective surfaces, the length of the red area that the laser can scan is about 0.4m. If the robot is driving normally and will be relatively close to the wall, it is recommended to put stickers on it to resolve possible collisions. question.
- In the worst case, the red area that the laser can scan is less than 0.4m, and even if the robot is oriented perpendicular to the wall, the red area still scanned is less than 0.4m, so the skirting line must be attached.

Remodeling Guidance:



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

	• The sticker height should match the LIDAR scanning pipe of the hoist, 16 ~ 18 cm above the floor.

Scene 2: Tiny Obstacles

	• Tiny obstacles usually refer to obstacles with a diameter of less than 2cm, 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 in width and 16 ~ 18 cm in height above the floor 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 floor 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
marker Positioning correction	Improved localization stability with multiple markers to reduce the risk of the robot running into risky areas	• Need to post code	Multiple marker markers need to be applied to the smallpox where the risk area must be passed through
reflective sheeting	Recognition of special reflective signal shape and intensity characteristics by LiDAR, slowing down or braking after the robot recognizes it as a risk area	• Reflectors need to be affixed • Only certain radar models are supported • Reflectors fail when blocked.	Reflectors need to be affixed to walls near risk areas

Magnetic Stripe for Drop Protection	The magnetic stripe is sensed by a geomagnetic sensor and exceeds a set threshold, the robot recognizes it as a risk area and decelerates or brakes.	• Magnetic stripe required • Magnetic stripes wear out and need to be replaced • Supports only machines with magnetic sensors installed	Magnetic strips need to be placed on the floor where the risk area must be passed through.

A single fall prevention deployment program has its limitations, the real deployment scenarios inside as many sets of programs as possible combined deployment.

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**.

The Fall Arrest Deployment Implementation Document V2.0_20230809 is a more specific introduction to the operational process of fall arrest deployment, and will continue to quantify and standardize related actions.

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 will be continuously updated with 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.
- False charge: The characteristic of battery storage for a long time, the actual battery charge is different from the display charge, there may be a sudden power failure or power jumping phenomenon during use. A recharge operation is required, and the hoist can take more than 4.5 hours of continuous charging to allow the battery to complete its calibration.

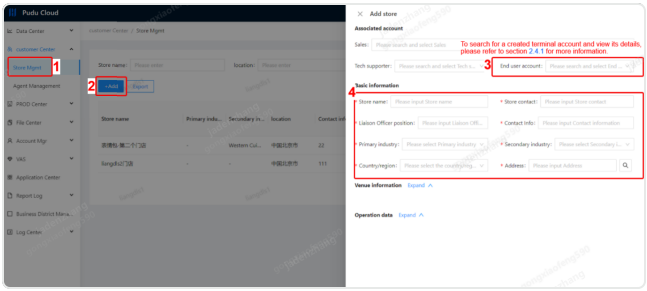
2.3 Activation

The first time you use the machine, you need to activate and bind it before you can use it properly.

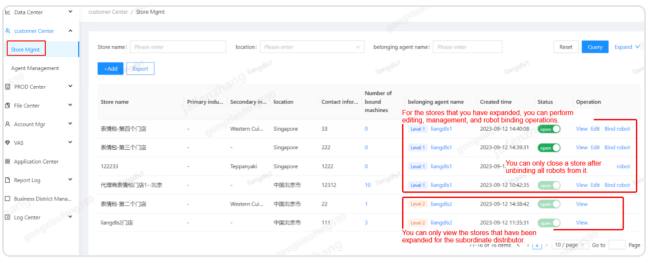
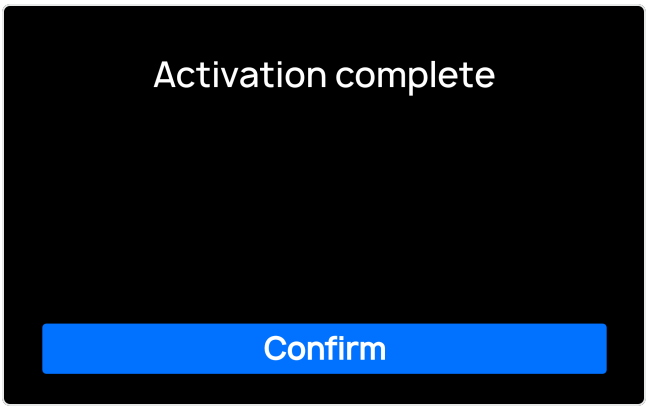
- Turn on the key switch.
- Press and hold the power button for 3 seconds and release when you see the strip light up.
- The robot's screen will light up and display a boot-up animation

Follow the interface guide:

- Completing the language settings
- Complete wifi setup
- Record the MAC address of the robot



- Register as a Pudu agent, the system will be based on the agent's registration of the country and region, the system will send an e-mail containing the system login address and initialization of the account password information to the agent administrator's e-mail address, please use this e-mail address in the login address shall prevail, the following address is for reference only:
- Asia-Pacific region: https://css.pudutech.com/
- Europe and the United States: https://csg.pudutech.com/
- Domestic: https://cs-internal.pudutech.com/
- Open the "Pudu Distributor Management Platform" in your computer browser and log in to create a store.

	• Click "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 "Confirm" on the robot side and the activation is successful.

- Stores and robots need to confirm the relevant information accurately to avoid errors that may cause difficulties in subsequent online operations.
- For more information about 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
- pudulink software

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

- marker code, whether there is any heavy code
- Paste the code on the board、Ties、glass glue
- multimeter

- Screwdriver Set
- Lower computer firmware burning tool
- All-in-one cable
- 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.

In this chapter, we will introduce the marker mapping and laser mapping solutions that KettyBot has above, where the laser mapping solution can be based on adding a small amount of marker stickers to realize fusion mapping to improve the positioning effect.

3.1 marker mapping

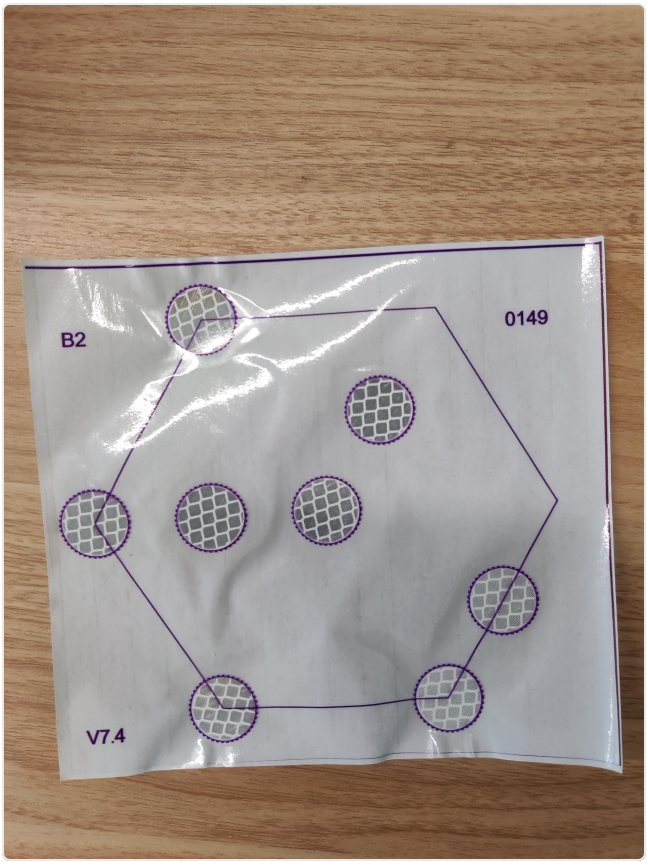
Based on the environmental assessment in Chapter 1.2, determine which mapping method is more suitable for the site,Since marker mapping requires pasting the marker code on the ceiling in advance, it is necessary to communicate with the customer in advance whether it can be pasted. It is recommended to use the marker mapping method, which has a more stable positioning effect.If the marker code cannot be pasted on the ceiling, you can choose the laser mapping solution. Please refer to Chapter 3.2 for laser mapping.

3.1.1 Introduction to Marker

The ability of a robot to operate stably inside a restaurant usually requires the deployment of markers on the ceiling.

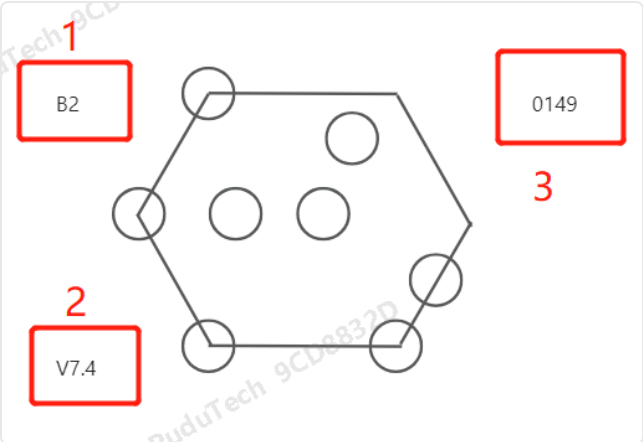
People need to perceive where they are when they drive, so they make use of road signs and environmental features to carry out their orientation.

For the robot, the Marker acts as a signpost, and the robot recognizes and locates the Marker with a camera on its head to determine where it is.



The real thing is shown in the picture, with some of the designs:

- Purdue's Marker Code consists of different arrangements of reflective discs.
- The markers are categorized into regular codes (2 to 5 meters high) and high level codes (5 to 8 meters high) to accommodate different floor heights.
- Alphabetical numbering, along with color variations, makes it easy to quickly sort with extra yards to use in different venues
- Numeric numbering for easy identification of uniqueness and avoidance of recoding during deployment
- There are version numbers, in order to consider the scalability and compatibility, some versions in history can be compatible by selecting the version when building the map.

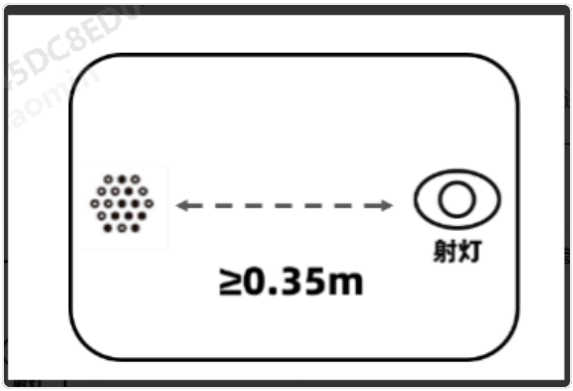
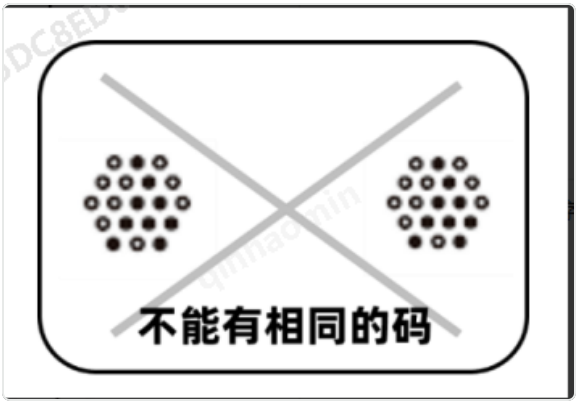
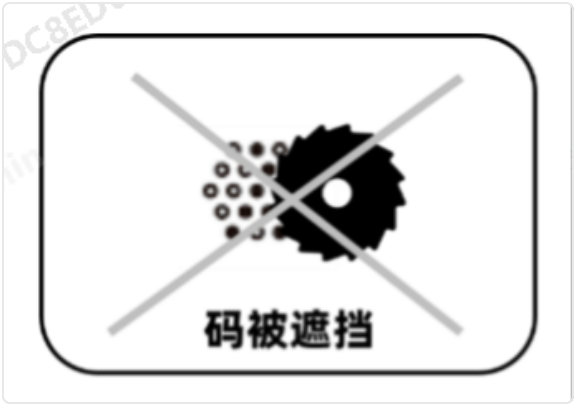


1. The letter number A, in the upper left corner, is the letter number. There are 100 different code numbers in each letter number:
    - Regular code: A~H, J, K ten code segments (code number: 1~1000)
    - High-level code: L, M, N, P, Q five code segments (code number: 1001~1500)
2. The number V05.3 in the lower left corner is the marker version number.
3. The number 0001 in the upper right corner is the code number. There is a correspondence with the letter number
    - A : 0001 ~ 0100
    - B : 0101 ~ 0200
    - C : 0201 ~ 0300
    - Other code segments : in descending order

3.1.2 Pasting Marker Guidelines

Requirements for code posting, in addition to the previous section on environmental surveys inside the selection of ceilings should also include the following specifications:

- Number of Markers required for pre-sales assessment of sites
- Try to place the code directly above the robot's path of travel.
- Pay attention to the beauty of the code, the same route on the code as far as possible alignment

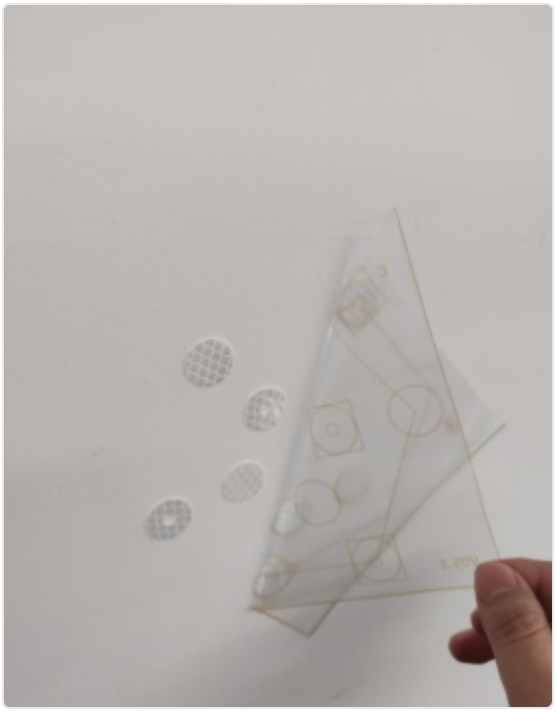
	• The marker should be pasted away from strong light sources to avoid interference.
	• You can't have the same number of markers on the same map.
	• The place where the marker is pasted should not be obscured by other items
	• The maximum angle between the marker and the horizontal plane must not exceed 5°.

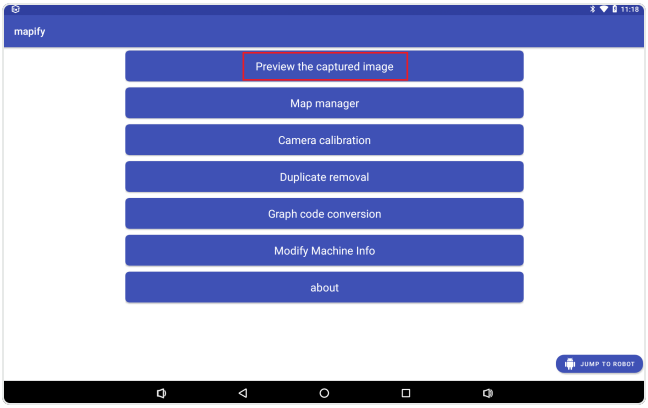
	• It is not allowed to be attached to movable surfaces, and the position and angle of the code cannot be changed. • When assisting with the coding tool, you should not use adhesive that may peel off or deform such as foam or 3M adhesive, and it is recommended to use tapes, screws, and so on.
	• Risk areas (e.g. up and down slopes, stairways, and other areas) require more coding, refer to the Fall Protection Deployment Requirements specification

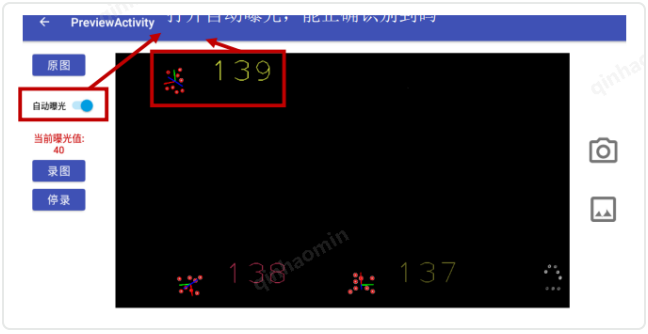
The recommended spacing for the marker:

Horizontal Pitch	Floor height (m)	Patch spacing (m)	Corner spacing (m)
Unicode	2~2.5	0.8	0.5
	2.5~4	1.2	0.7
	4~5	1.5	1.2
high level code	5~6.5	2	1.0
	6.5~8	2.5	1.5

A step-by-step guide to posting codes is below:

	• Communicate requirements and determine the robot's route of travel • Peel off the marker backing and spread it out flat to attach to the ceiling above the robot's path of travel.
	• Remove the protective film • Paste multiple markers with reference to the recommended spacing requirements for markers

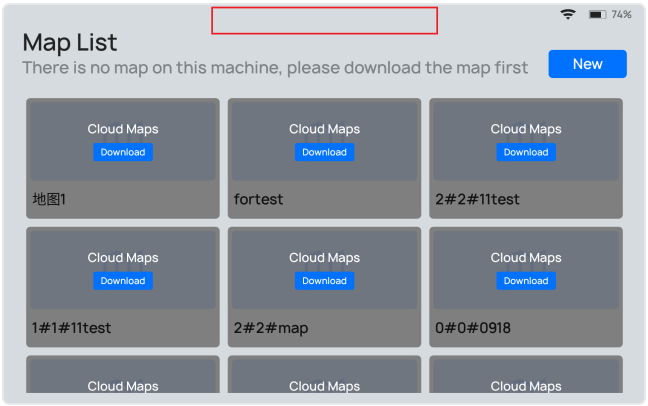




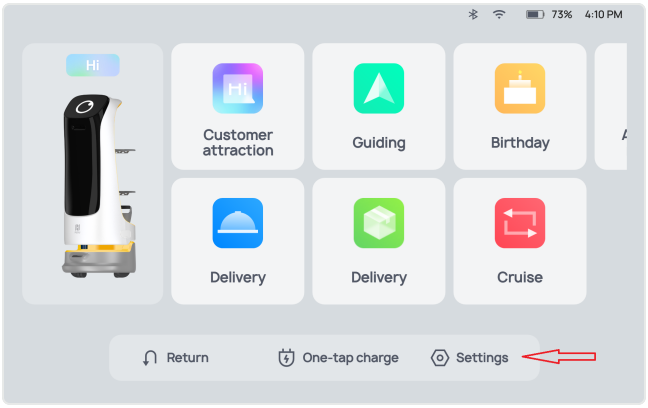
- Open the "Preview the captured image" in the build tool, push the robot to view the Marker on the path, push to check the
- The codes on the path should all be correctly recognized as code numbers
- Most of the path, the preview view has 2~3 correctly recognized markers within the field of view of the preview view
- If you can't recognize the code correctly, the same code, no code, etc., you need to re-add or replace the new code.

3.1.3 Marker Mapping Scanning Guide

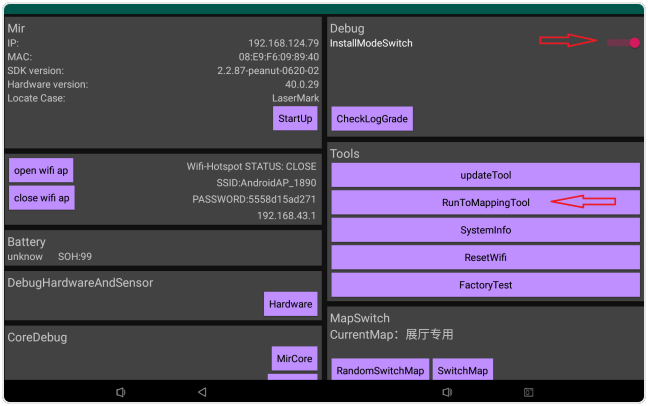
After completing the marker pasting as mentioned above, the next step is to start marker mapping. This chapter introduces the marker mapping operation guide of the mapping tool mapify.



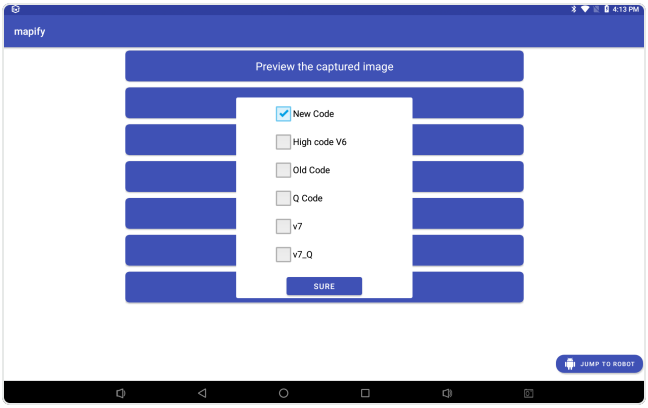
- When there is no map in the machine, entering the main body will automatically enter the easy installation interface. Quickly click on the top blank space for more than 20 times, and enter the password "pudupw" in the pop-up box to enter the debugging interface.



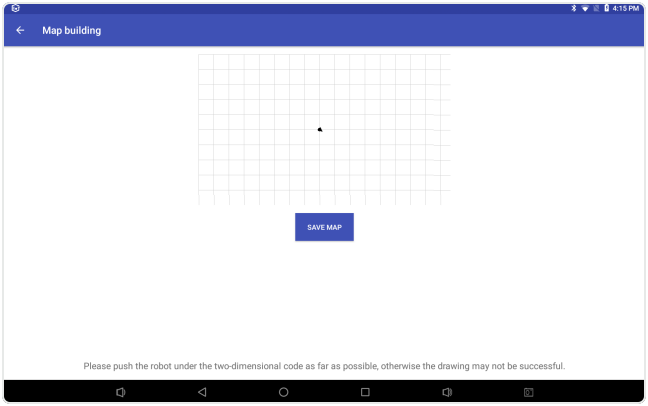
- If the Robot has a map and you can access the homepage, click "Settings".
- Select "Debug" in the setup menu.
- Enter the password "pudupw" to enter the debugging interface.



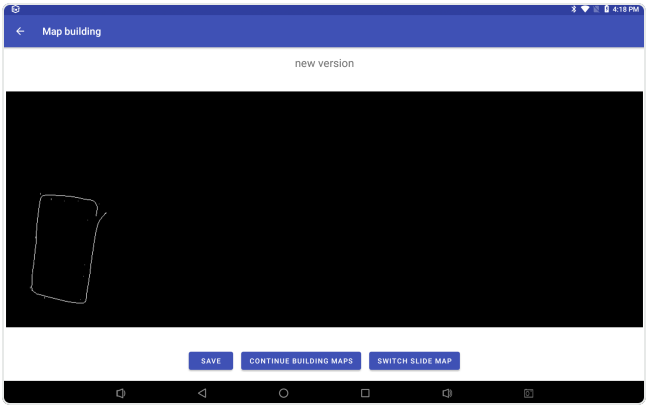
- After entering the debugging interface, turn on the "InstallModeSwitch".
- Click "RunToMappingTool".



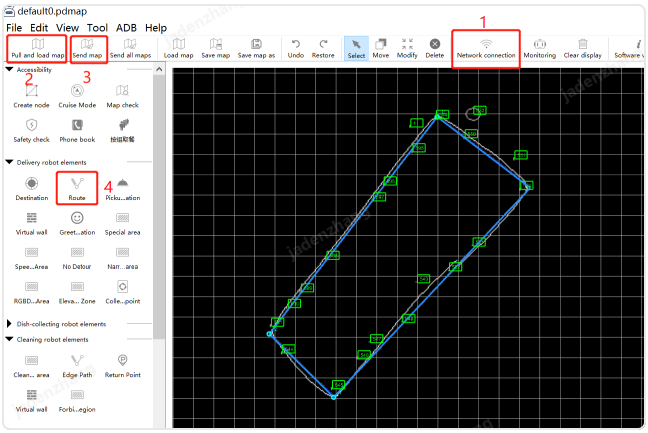
- Click "MARK MAP".
- Select the corresponding marker version and click "SURE".
- Click "Map manager".
- Click "CREATE MAP".
- Follow the prompts, click "START MAPPING" –> "NEXT STEP".



- Robot triangle appears
- Follow the UI prompts until you see the grid, then you can start to push the robot to scan the path, and click "SAVE MAP" when you are done.
- Note: All routes are to be implemented at least twice



- Once you see the complete still image
- Click "SAVE".
- Click "JUMP TO ROBOT", only when you enter the main body and turn on the debug switch, you can use the installation tool to connect via IP.



- Click "Network Connection" to connect via the robot's IP.
- After successful connection, click "Pull and Load Map".
- Click "Route" and draw a simple closed-loop topology path on the map.
- Click "Send Map" to send the map to the corresponding robot, and the robot will restart the software after receiving the map.
- After the robot passes the self-test, it means the map scanning is successful, please refer to section 3.3 for adding map elements.

3.2 Laser mapping

If it is impossible to paste marker codes on the ceiling, or the environment is not suitable for using marker mapping, you can choose to use laser mapping or fusion mapping solutions. This chapter will introduce the laser mapping and fusion mapping operation guidelines.

3.2.1 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:

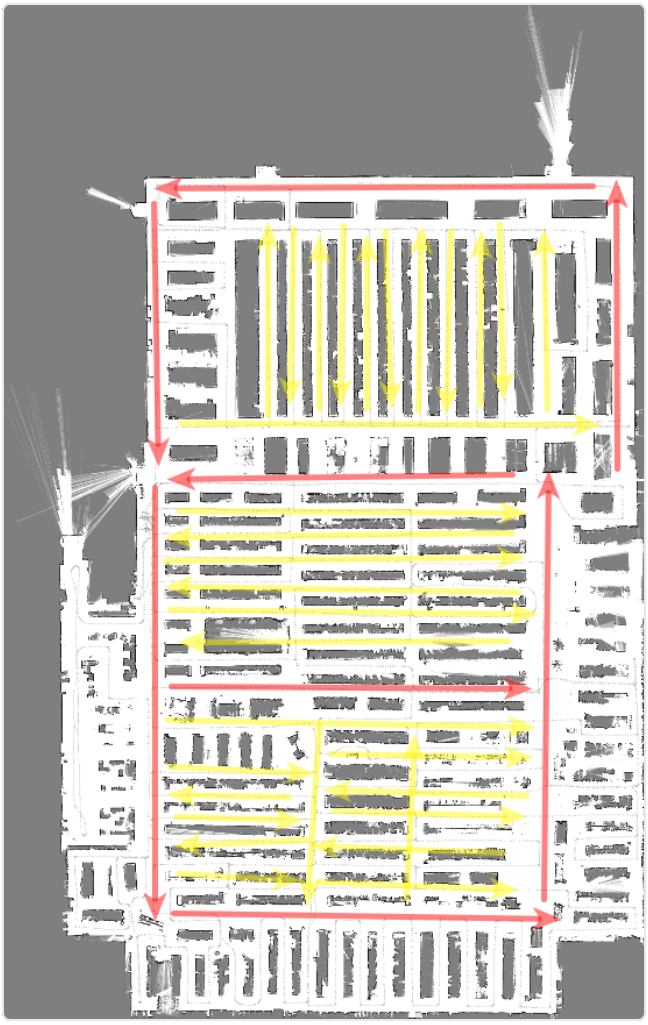
1. Non-glass environments, non-long corridor environments, non-open environments, and non-completely cluttered environments should be selected;
2. The environment at this location is essentially unchanged from when the map was constructed (no more than 5% change);
3. It needs to be taken into account 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, with a minimum distance of 1 meter.

- Optional corner recess

	• Optionally facing a featured wall
	• Optionally, there are fixed and unchanging feature areas (graphic display stand)

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

1. Supermarket Scene



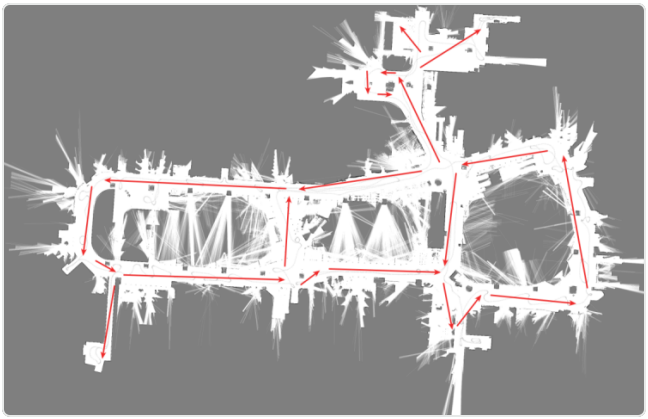
Environment characteristics:

- Supermarket scenarios are generally characterized by medium-sized scenarios (around 5,000 sq. ft.), complex scenarios, and frequent changes in the environment (frequent changes in shelf goods)

essentials for mapping:

- The supermarket scene is a medium scene, but due to the large number of aisles, each aisle needs to be pushed once, so the overall time consuming to push the map is longer.
- Prioritize the implementation of the outer ring of the main road and the formation of a closed loop
- Push after the branch channel, and prioritize the closed loop and full channel coverage.
- After pushing, go back to the initial point, click Finish building, wait for the preview of the final map to confirm the map quality.

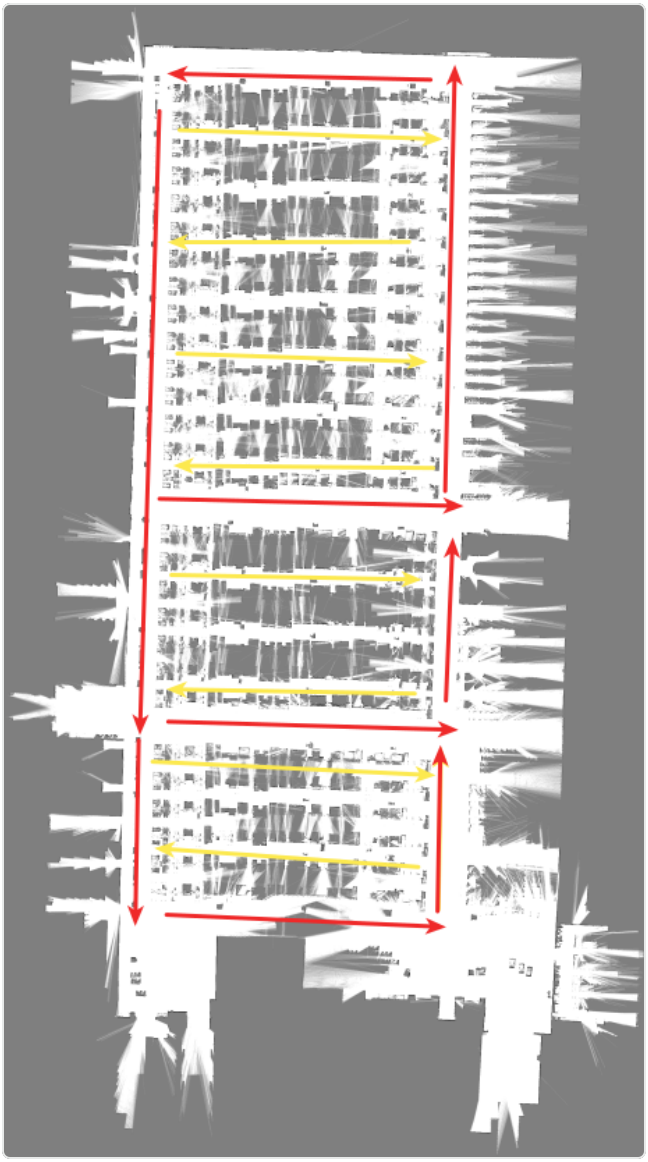
2. Mall scene

	Environment characteristics: • Mall environments are generally characterized by the following features: scene sizes ranging from medium to large (5,000 sq. ft. to tens of thousands of sq. ft. in size), the presence of large glass scenes in the venue, the presence of hazardous areas in the venue (escalators, staircases, elevators, etc.), and roads that are relatively wide but with a wide variety of decorations.

essentials for mapping:

- Push the map should pay attention to, first push the small circle, and then push the large circle route, must be a closed loop.
- Due to the mall in the road is relatively wide, but the actual and many obstacles to hinder the LiDAR scanning, so you need to push the machine running area of the map is complete, otherwise the machine builds the map is incomplete, the later will appear in the positioning of the loss of frequent problems.
- If the site area is too large, resulting in a long time to push the map (more than 1h), the machine's memory or storage space may not be able to support the continuation of the implementation, you can solve the problem by expanding the way to build the map, push the map to complete half of the scene of the map first, and then follow up by expanding the way to build the map to make up for it.
- After pushing, go back to the initial point, click Finish building, wait for the preview of the final map to confirm the map quality.

3. Factory scenes



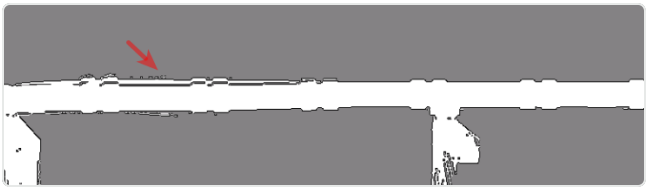
Environment characteristics:

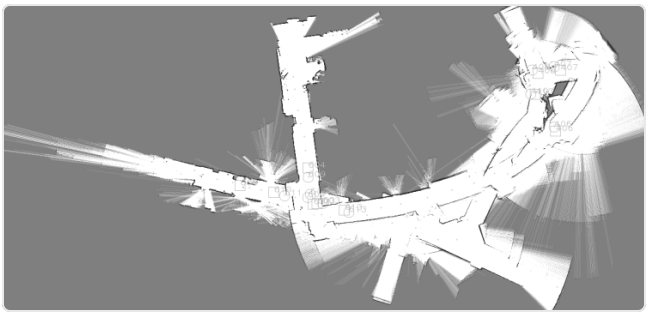
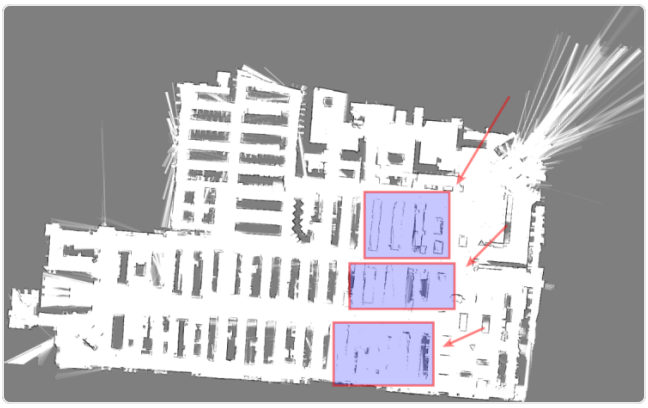
- Factory scenarios are generally characterized by the following: general characteristics are as follows: oversized scenarios (more than 10,000 square feet in size), multiple adjacent and similar aisles.

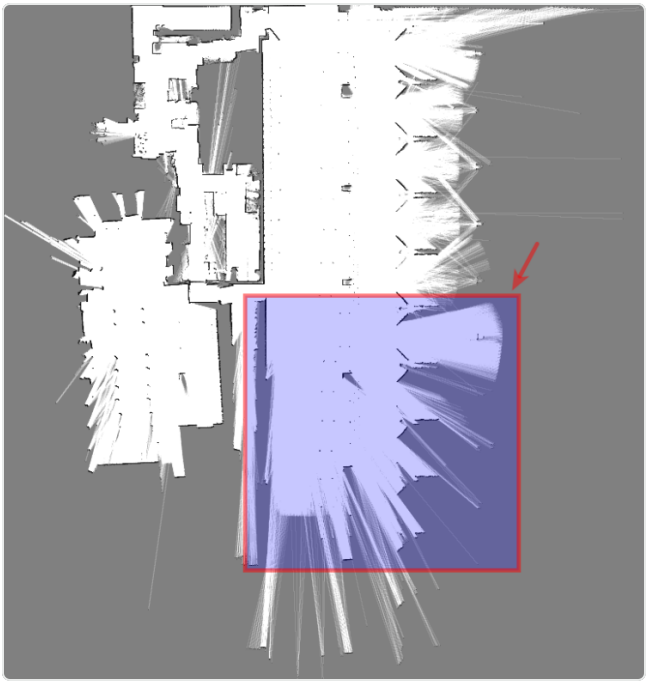
essentials for mapping:

- This type of scenario requires pushing the peripheral red route first, then the yellow route to ensure the quality of the build.
- First according to the red map to push the machine to build the map, and ensure that the machine walks a full circle back to the starting point, and then push the machine to repeat the route more than 10m to ensure that the loop is closed.
- Then push the machine according to the yellow arrow, when pushing, need to pay attention to, can not continuously push the neighboring channels, you can first take the odd number of channels, and then take the even number of channels.

4. Frequently Asked Questions about Laser Maps and the Risks

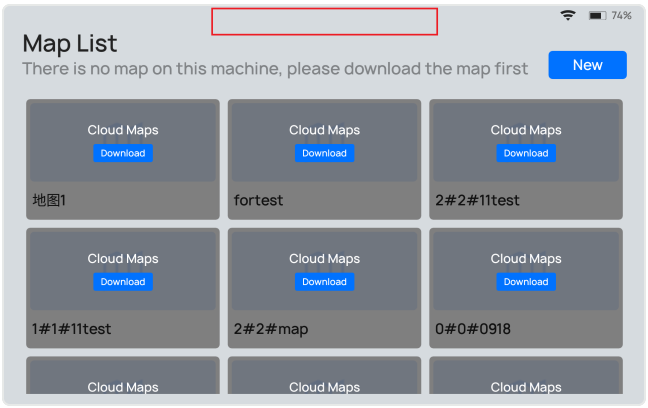
Problem description:	Risk:
• There is ghosting of the wall at the location indicated by the red arrow  	• Robots may experience positioning jumps

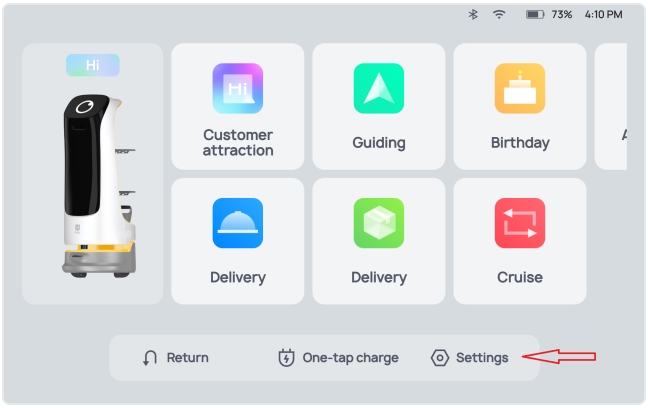
Problem description: • The map preview does not match the actual environment at all, the map is irregularly misaligned and distorted. 	Risk: • The map is completely unavailable and the positioning is easily lost Cause: • Lidar sweeping during map building
Problem description: • There is a large obstacle 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. 	Risk: • Positioning may be lost due to incomplete maps

Problem description:	Risk:
• The map is not complete enough. The location of the red rectangular box is included within the machine's path of travel, but the build map is incomplete and in a semi-open area. 	• Incomplete map may result in anomalous or lost positioning

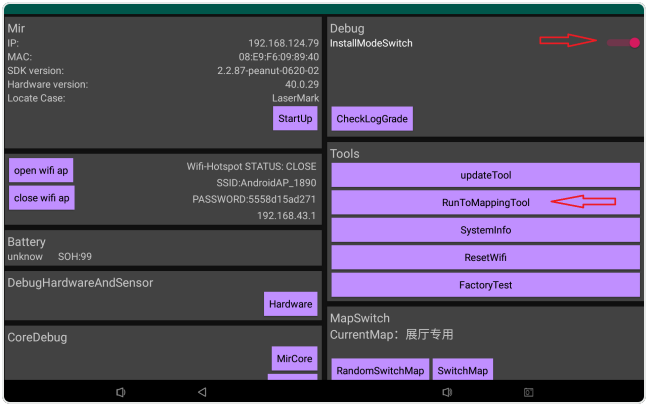
3.2.3 Guidelines for laser mapping and scanning

Please read Chapter 3.2.1 and Chapter 3.2.2 carefully before laser mapping scanning. After mastering the essentials, you can use mapping tools to start mapping.

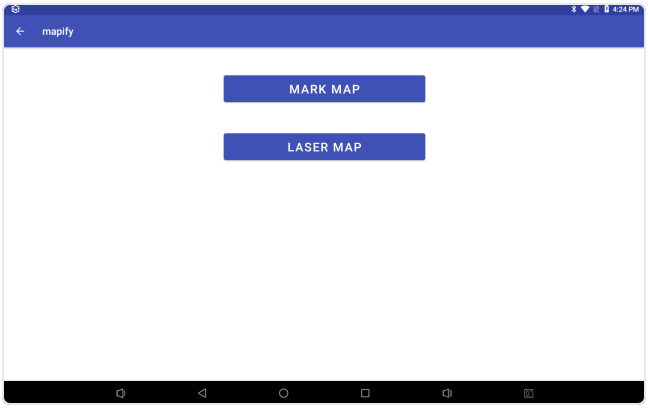
	• When there is no map in the machine, entering the main body will automatically enter the easy installation interface. Quickly click on the top blank space for more than 20 times, and enter the password "pudupw" in the pop-up box to enter the debugging interface.



- If the Robot has a map and you can access the homepage, click "Settings".
- Select "Debug" in the setup menu.
- Enter the password "pudupw" to enter the debugging interface.

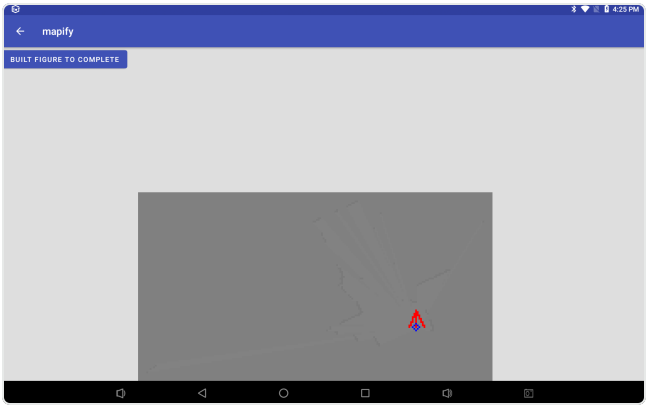


- After entering the debugging interface, turn on the "InstallModeSwitch".
- Click on "RunToMappingTool".

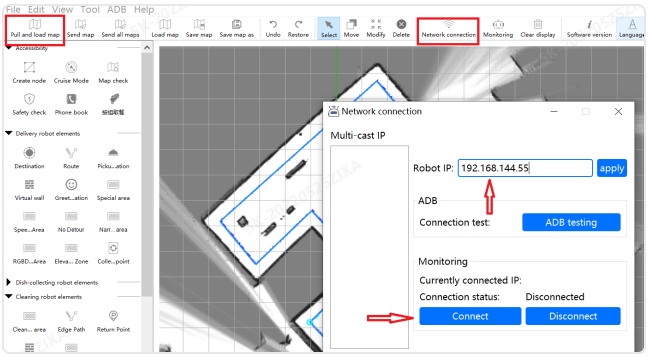


- Push the machine to the start-up points,select "LASER MAP"
- Click "Map manager"
- Click "CREATE MAP"

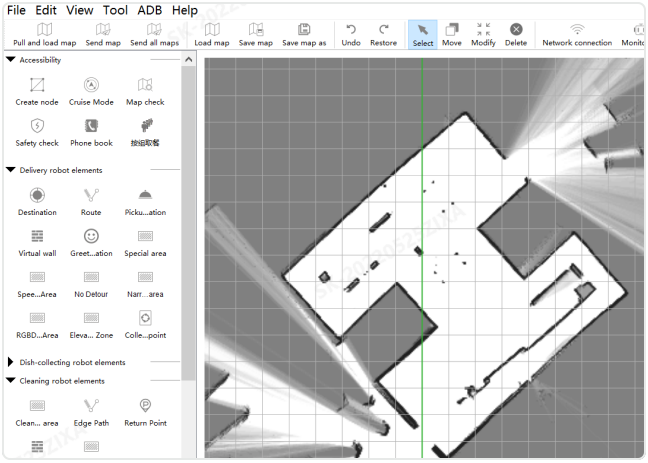
Note: Before starting to build a map, people must stand behind the machine to prevent the radar from scanning their legs.



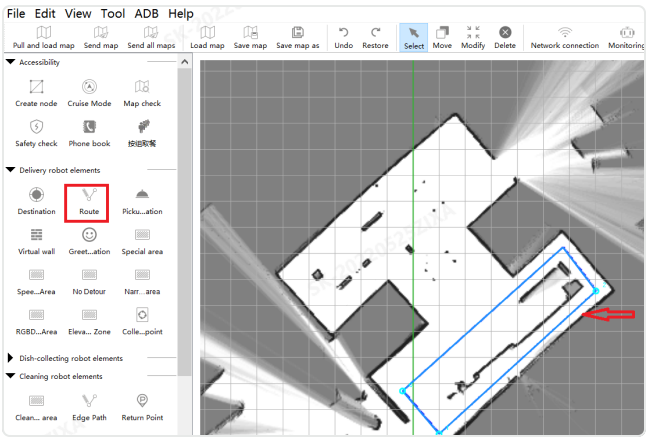
- Go to the gray map building page and see the red symbol representing the robot.
- Push the robot to scan the path, and click "BUILT FIGURE TO COMPLETE" when finished.
- Click "Jump to Robot", only when you enter the body and turn on the debug switch, you can use the installation tool to connect to the robot via IP.
- Note: All routes should be traveled at least twice.



- Connecting the robot via the PC-based installation tool
- Pulling Robot Maps
- Perform site environment to static map comparisons



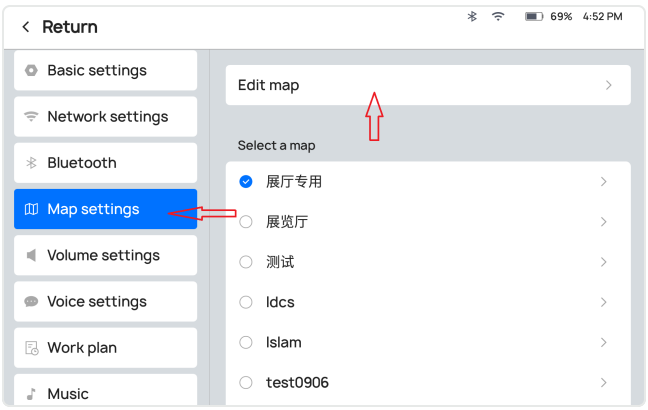
- If there are distortions and deformations in the comparison between the map and the on-site environment, it is necessary to rebuild the map; if the map situation matches well with the static map, it is possible to carry out the subsequent addition of elements

	• Drawing a simple closed-loop topological path on a map(How to add a path can be found in Chapter 3.3) • 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.

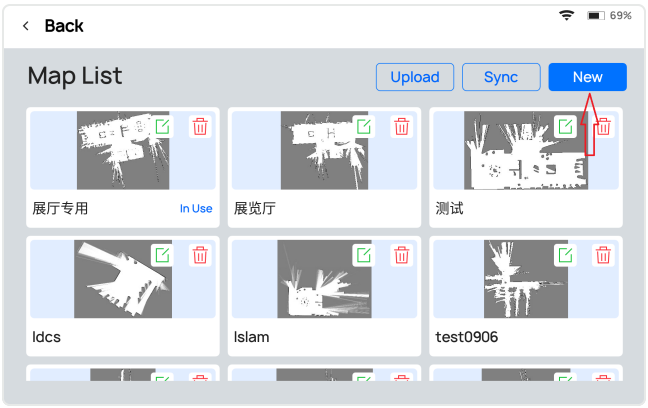
3.3.4 Guide to Fusion Mapping

Since laser mapping has certain limitations, if the environment changes greatly, it is easy for the machine to get lost. In order to improve the positioning accuracy of laser maps, a fusion mapping solution was born. This method does not need to paste marker codes in all places, but only needs to be placed where it is easy to get lost or In scenarios where there is a risk of falling, just paste the marker code. The marker code can calibrate the positioning of the machine. The fusion mapping introduced in this chapter is achieved through an easy-to-install tool. This tool can perform fusion mapping in two ways: "Positioning on the Ceiling" and "Positioning on the Wall" , the following introduces how to use the easy installation tool

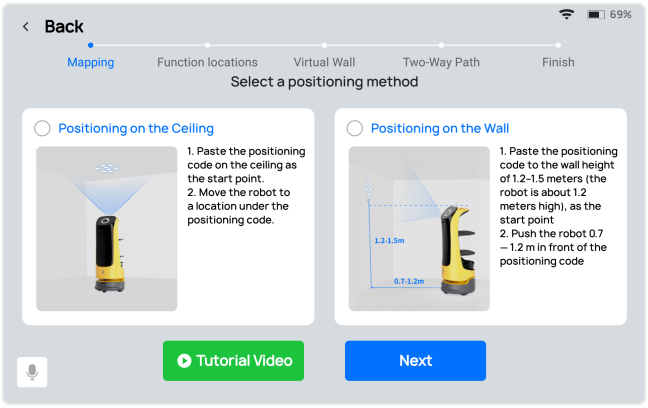
	Please fulfill the following two points before installation and deployment: • the robot power is more than 35% • With a connectable wireless network



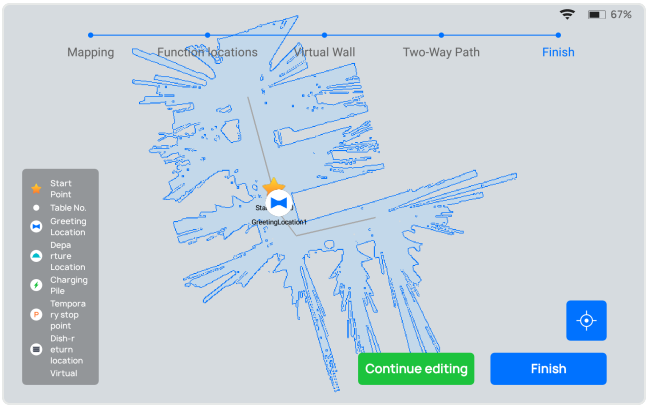
- Click "Map Settings" –> "Edit Map".
- Enter the authorization code to enter the Easy Installer tool.The authorization code can be obtained from the store details in the "Pudu Agent Management Platform" mentioned in Chapter 2.3.



- Click "New"



- Select the positioning method and click "Next".
- If you choose "Positioning on the Wall", you need to paste the wall code according to the interface prompts.
- If you choose "Positioning on the Ceiling", you need to have at least one ceiling marker code at the startup point.
- Follow the guidelines for subsequent operations, refer to section 3.2.2 for map pushing requirements.
- Note: All routes should be implemented at least twice.



- Finish building the map after completing all the steps

3.3 Element Addition

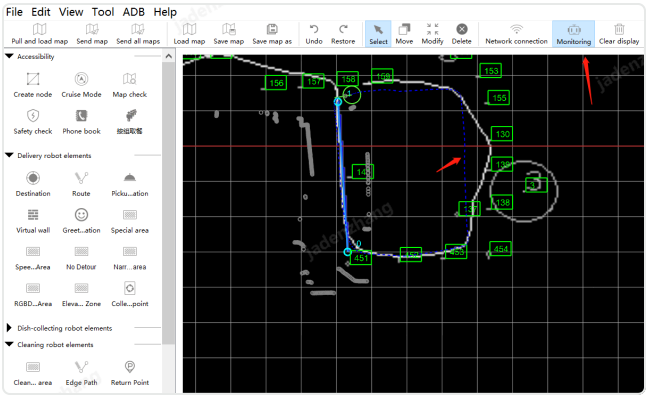
After completing marker mapping or laser mapping, use the installation tool to pull out the map, and add paths and target points on the installation tool as needed.

3.3.1 Topological path drawing

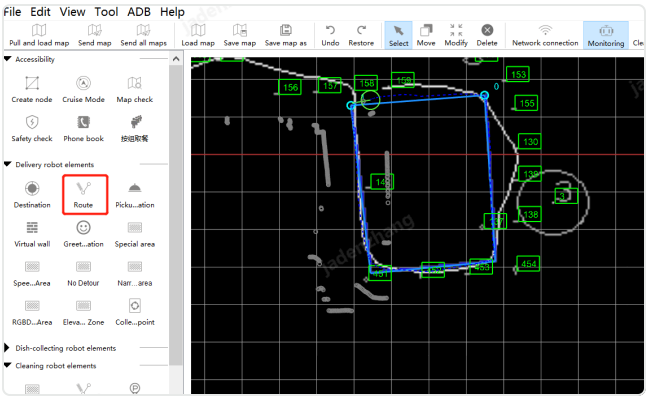
Topological path drawing principles：

1. The topological path needs to fit the static map route 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, and the distance between two neighboring paths is >1.2m;
5. Angle between paths > 45°;
6. Dining table or stop <0.5m from path; dining table or stop >0.2m 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 route step:

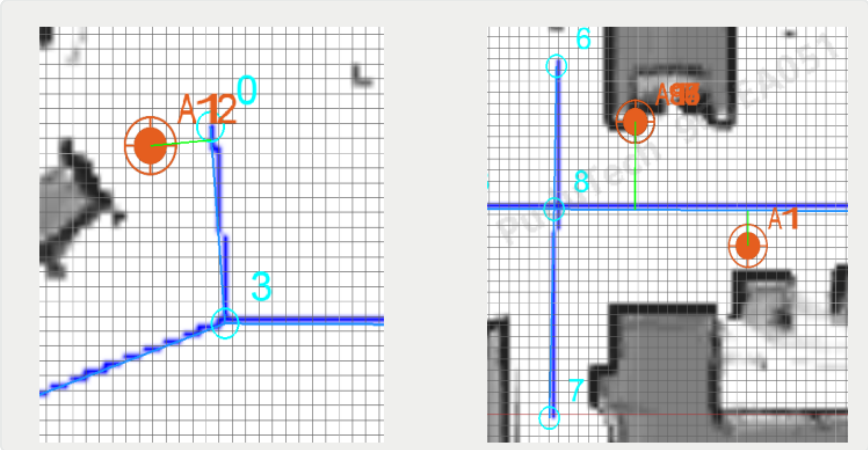


- After connecting the robot, click on "Monitoring" to see a green circle representing the robot's location.
- Push the machine by hand once to get the trajectory of the robot, as shown by the blue dotted line in the figure
- Checking path correctness

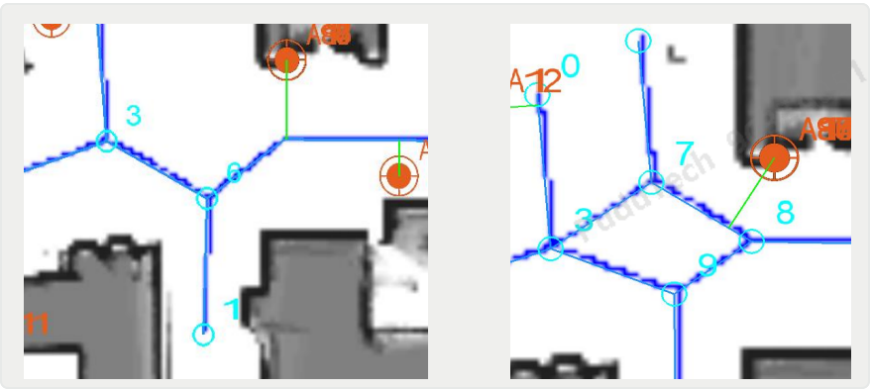


- Click on "Route" to add a path along the blue track
- Click "Create Node" to automatically generate the node.

Topological path drawing considerations (special cases):

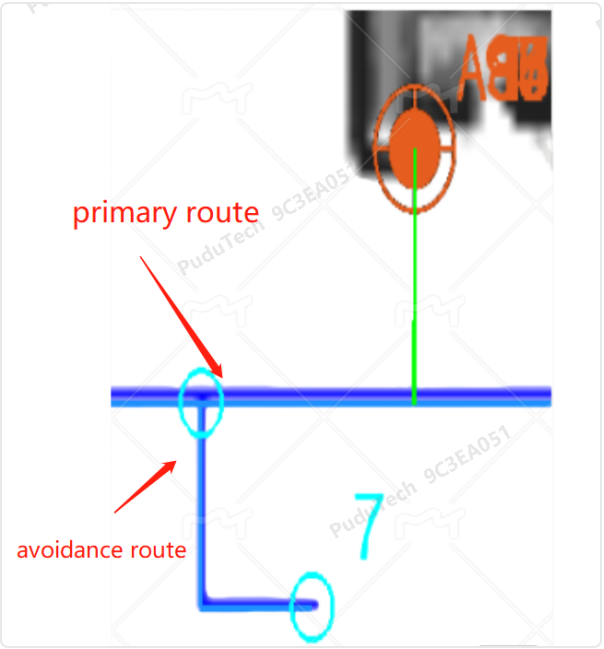


- The correct way to draw topological paths when faced with a T or intersection



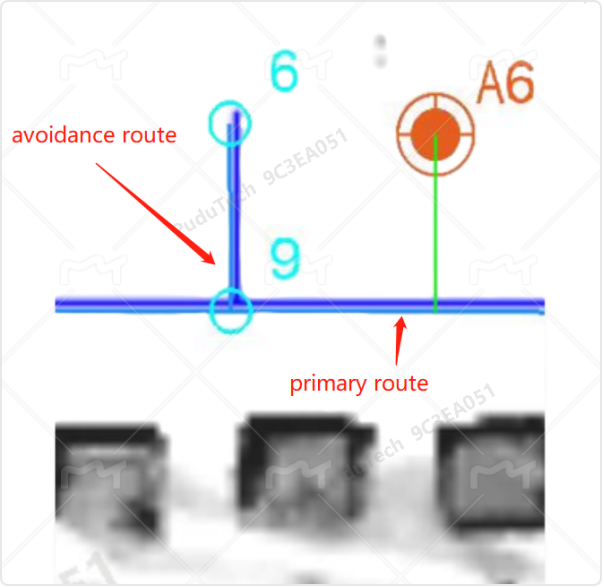
- Wrong way to draw topological paths when facing a T or intersection

L-shaped 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 routes can be drawn in addition to the main path to improve the efficiency of the robots in this path.

Right-angle avoidance route

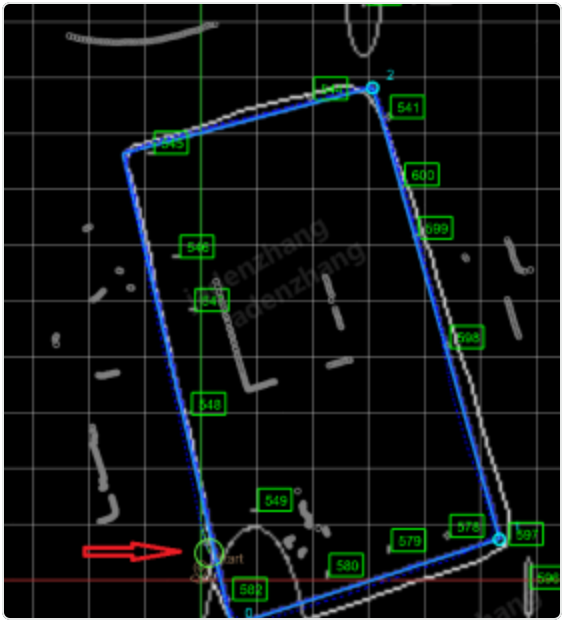


3.3.2 Arrival point Drawing

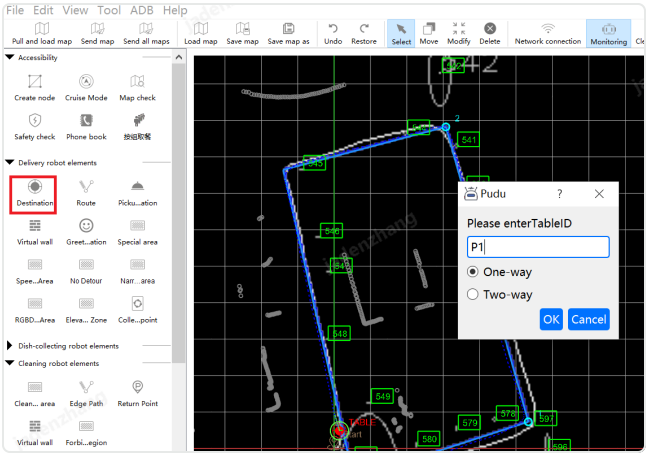
Arrival point Introduction:

- The point of arrival is usually the location where the food needs to be delivered,like at the dining table
- Push the robot hand to the table point and use shortcut A to add a point, or click on "Destination" on the setup tool to add a point.

steps:



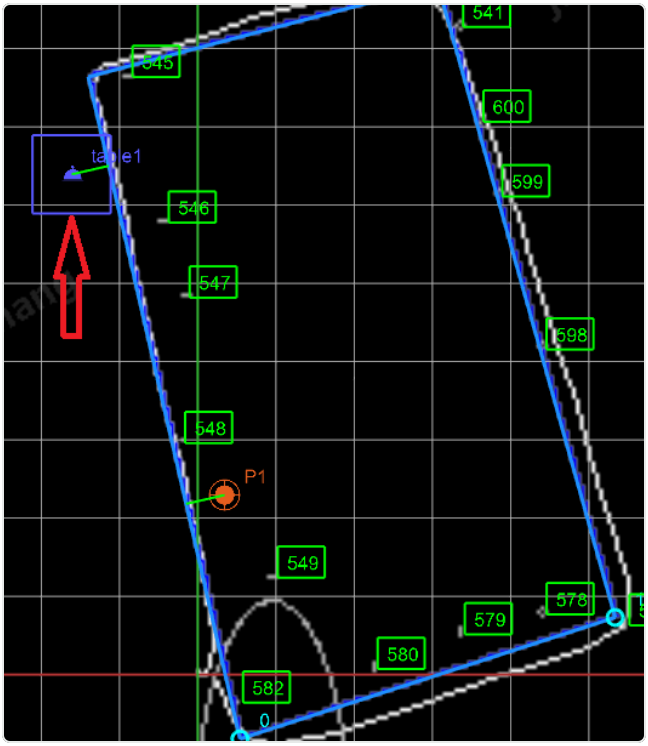
- After connecting the robot, click on "Monitoring" to see a green circle representing the robot's location.



- Click on "Destination"
- Enter the table id in the popup window and click "OK".

3.3.3 Plotting of point of delivery

Point of delivery Description:



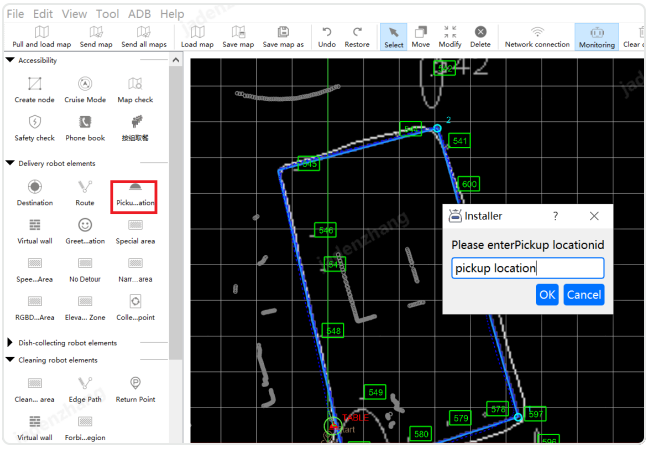
- The meal "Point of delivery" is generally set at a fixed location where the machine is parked, such as at the kitchen door.

- 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:

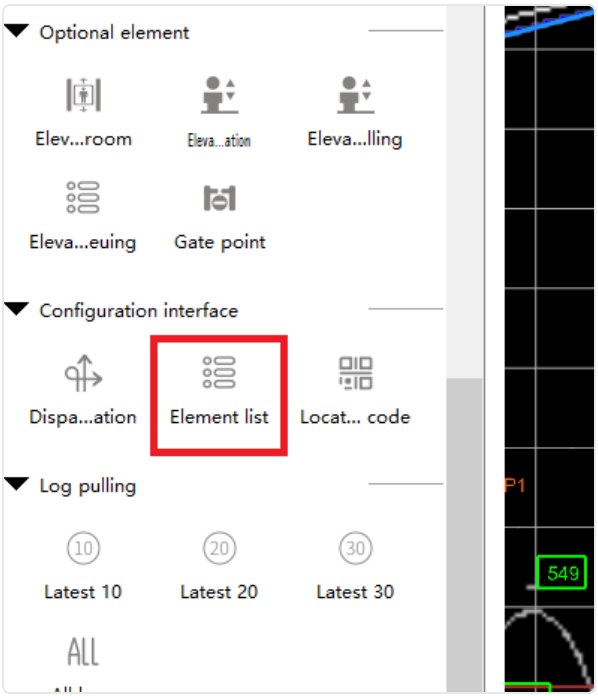


- Connect the robot and click on "Mornitoring" to push the machine to the point of delivery.
- Click on the "pickup Location"
- Enter the table id in the popup window and click "OK".

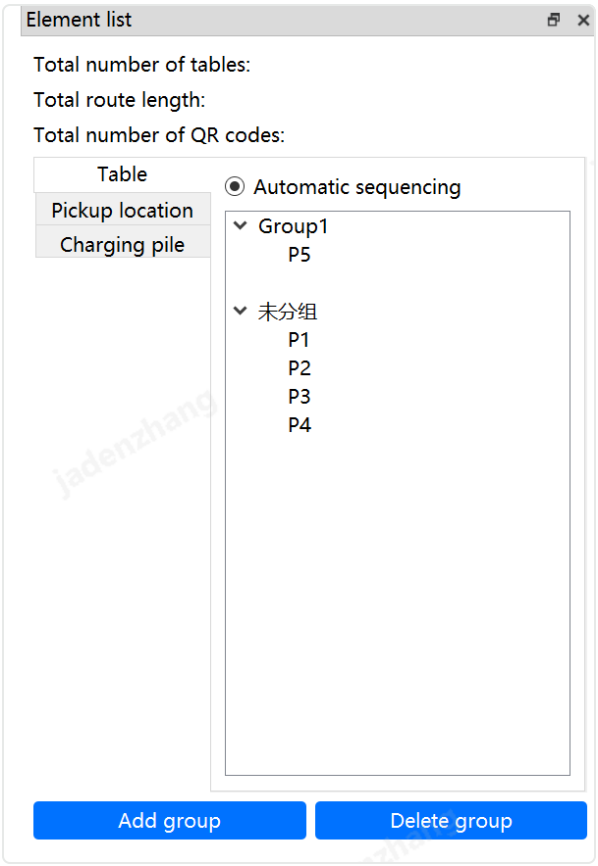
3.3.4 Grouping of Arrival point and Point of delivery

Both the arrival point and the point of delivery support grouping, and the operation steps are the same. This chapter takes the point of delivery as an example to introduce the grouping operation.

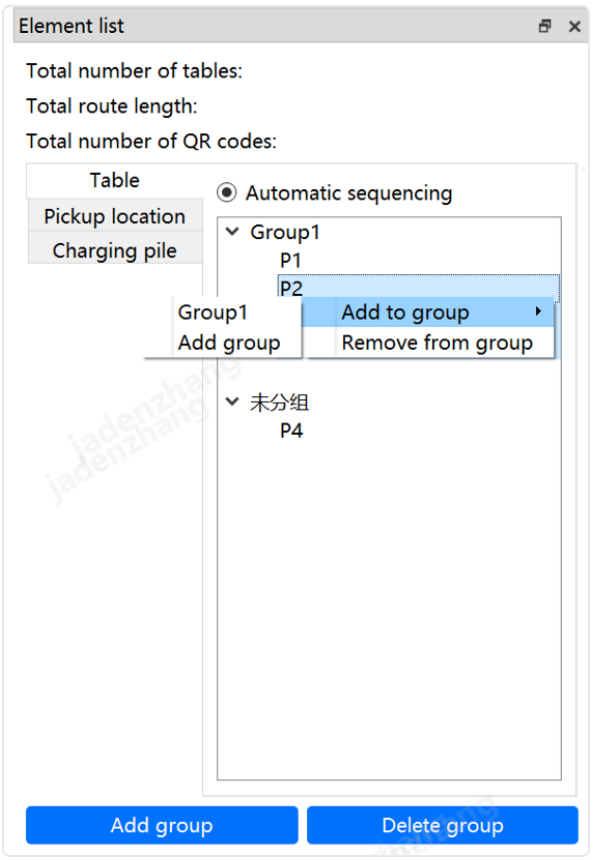
Operational Steps:



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



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

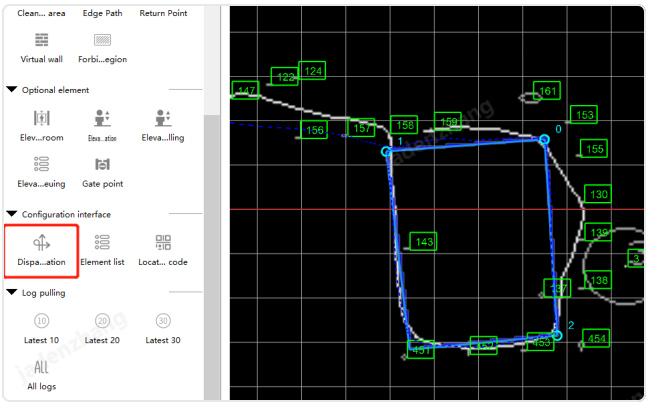


- These groups supports multi-selection and can be added by dragging the mouse as well as clicking on the right-click menu.

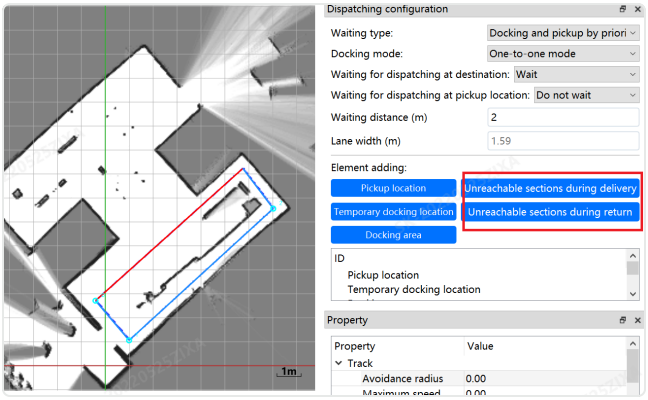
- There is also the option of removing some table points or moving them to a different grouping

3.4 Route constraint settings

Steps for setting constraints on the outbound and return routes:



- Click on "Dispatching configuration"



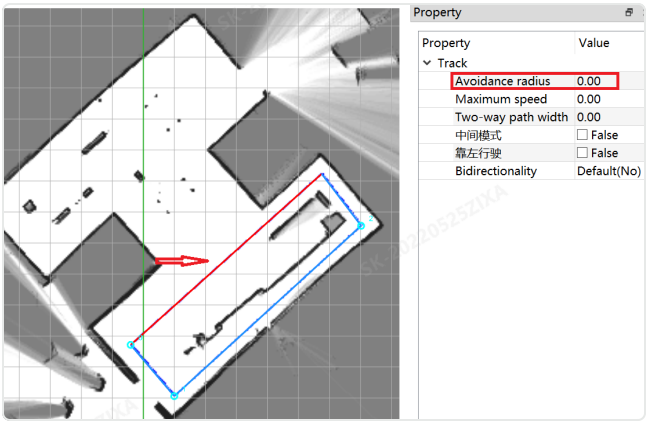
- Select the route to be constrained, the route will be red when selected
- On the "Dispatching configuration" options page, select "**Unreachable sections during delivery**" or "**Unreachable sections during return**"
- Send the map to the robot after setting.

Route width adjustment:

When the robot is expected to walk as close as possible to the designed route during the traveling process, or when it is expected to have less obstacle avoidance action to reduce the possibility of colliding with the obstacles on both sides, the desired effect can be achieved by adjusting the "**Avoidance radius**" attribute. The value of **"Avoidance radius"** has the following meaning:

numerical value	hidden meaning
Avoidance radius = 0	The robot will deviate from the design route by a maximum of 0.8m when traveling on the roadway.
0< **Avoidance radius** < 0.3	The robot follows the designed route as far as possible, avoiding stops and obstacles.
Avoidance radius >= 0.3	The robot prioritizes attempts at obstacle avoidance with a maximum offset of “**Avoidance radius**” meters.

Setup Steps:



- Select the path that needs to be set, and the "Property" dialog box will appear on the right to modify the avoidance radius.

Speed Adjustment:

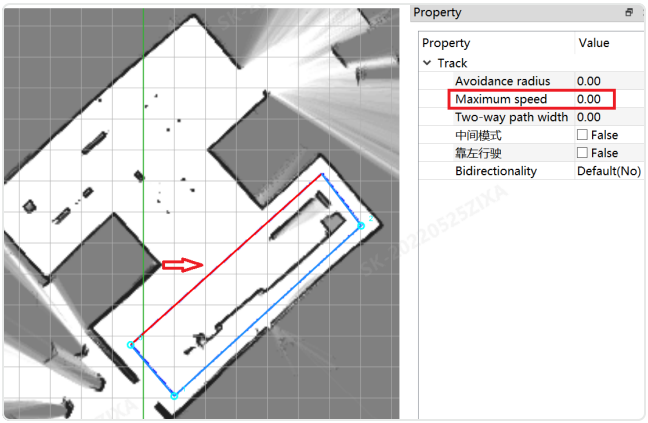
When encountering some complex road sections in the real environment, and you want to pass through this road section at a slower speed, you can adjust the **"Maximum speed"** attribute to achieve the desired effect, and the meaning of the value of the **"Maximum speed"** attribute is as follows:

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 **Maximum speed**
Maximum speed > 1.2	Taking 1.2, the maximum planning speed is **Maximum speed**

Caveats:

1. As much as possible, avoid the **Maximum speed** difference between neighboring sections is too large (**the difference is more than 0.4m/s**), otherwise it is easy to have the machine not smooth at the path switching.
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 that needs to be set, and the "Property" dialog box will appear on the right to modify the maximum speed.

3.5 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.

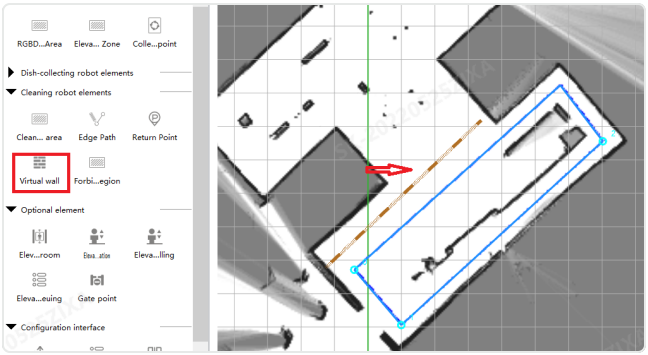
Example:

- 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 route 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** from the route.

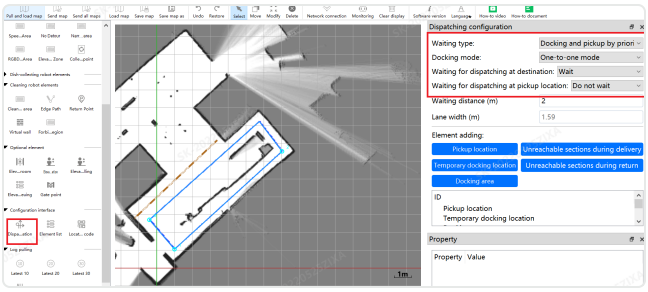


- Click **"Virtual Wall"** to set up a virtual wall.

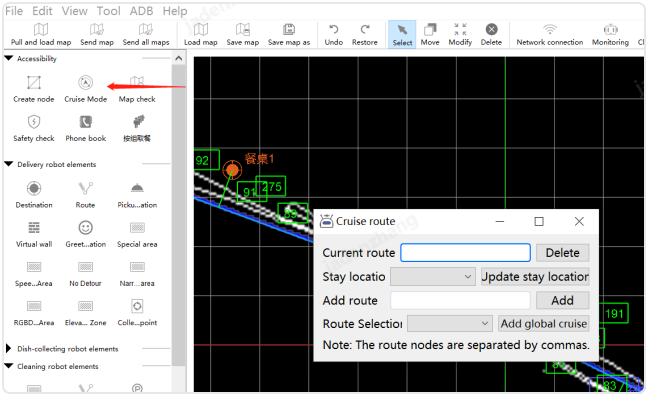
3.6 Additional notes on tools

3.6.1 Installation tool

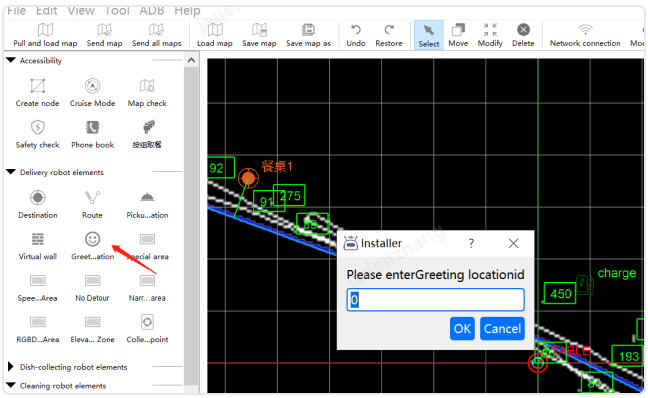
The main function of the installation tool is to edit the map, so that the map conforms to the use of the scene and the user's needs, 3.3 to 3.5 chapters of the use of the installation tool, the following briefly describes some of the functions that may be used, please refer to the "Installation Tool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



- Set the Wating type and Docking mode here.



- Addition of cruise route

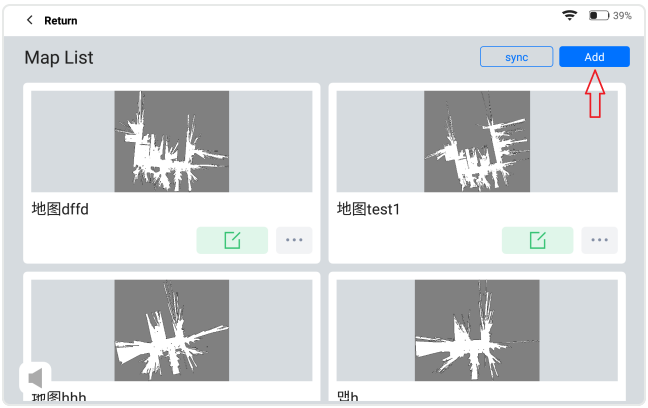


- Add "Greeting location"

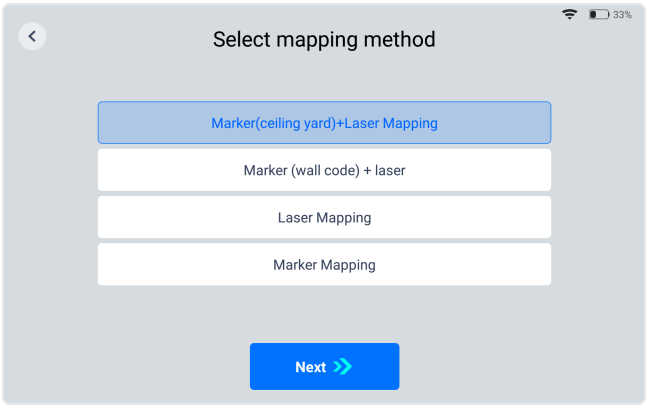
3.6.2 Unified Mapping tool

The unified mapping tool integrates the functions of the installation tool. The concepts of mapping methods and element addition are the same as those of the original PC-side installation tool. It can now be applied in relatively simple scenarios. You can try this tool for mapping, and you will switch to this mapping tool later.

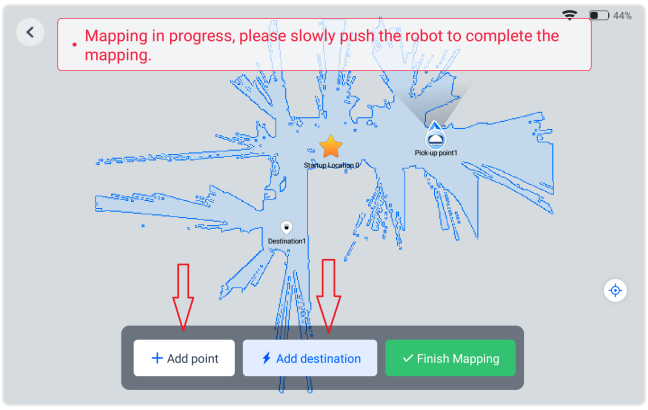
- The way to enter the unified mapping tool is the same as section 3.1.3, click on "RunToMappingTool", if the mapify mapping tool is installed in the machine, it will start mapify; if the Harmonization of mapping tools is installed in the machine, it will start the unified mapping tool.



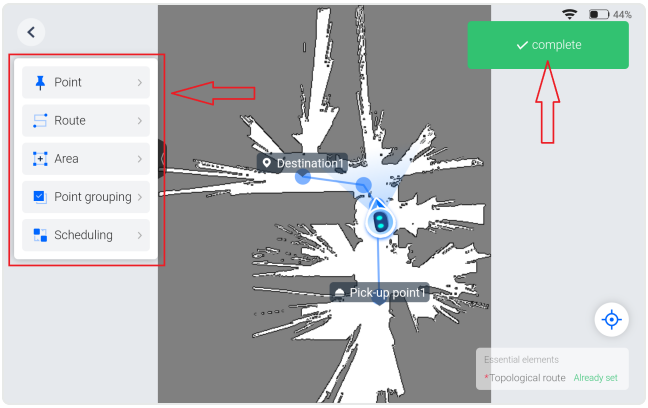
- Click "Add" to start building the map.
- Note: The battery level of the KettyBot should be more than 35% to use the unified map building tool to build a map, and the precautions and key points of the laser push map are the same as those in section 3.2.2.



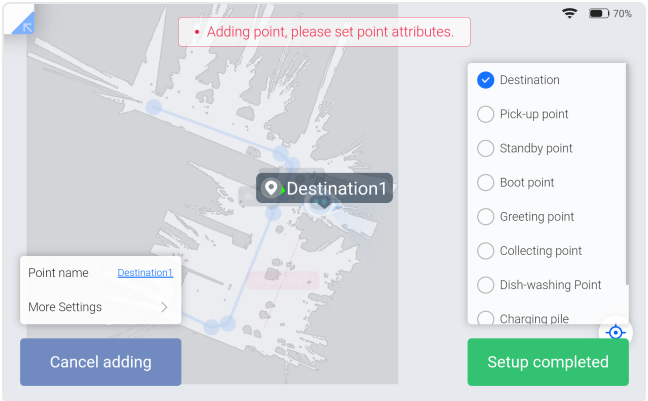
- Click "Next" after selecting the map building method.
- Follow the instructions.



- During the push map process, you can push the machine to the place where you need to add points to add points, such as destination, pickup Location, door welcome points, etc.

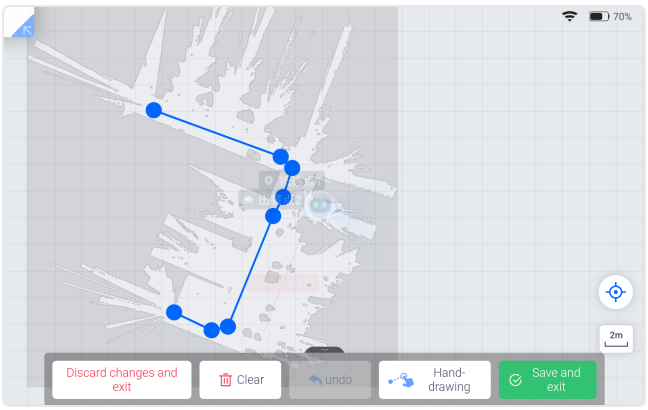


- You can also modify the points and paths after the map is completed.
- Finally click "complete".



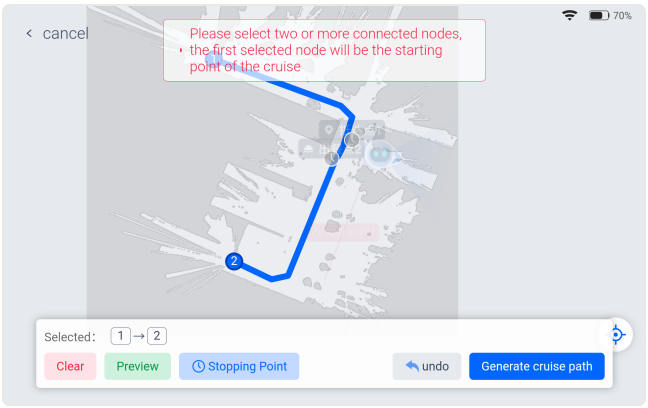
1. Add Destination

- Click "Point".
- Push the machine to the position where you need to add Destination, facing the correct direction, click "Add point", select the type of points you need to add to add.
- You can modify the name of the point, and finally click "Setup completed".



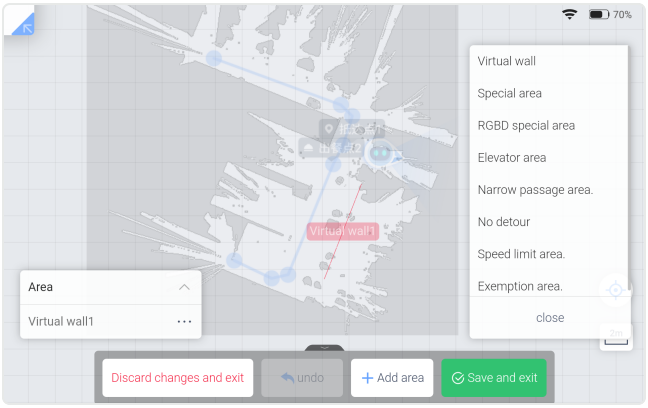
2, add and modify the topological path

- Click "Route"–>"Topological route", you can click on the original nodes and paths to adjust, you can also click on the "Hand–drawing" to draw new paths.



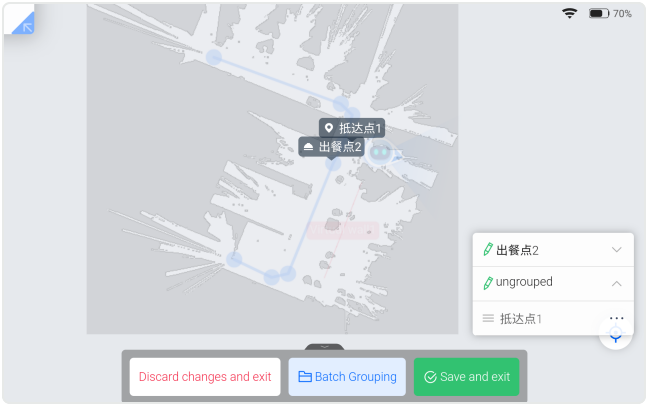
3. New cruise path

- Click "Route"–>"Add cruise route".
- Click "Add cruise route", click the nodes in order to set the cruise route.
- Click "Generate cruise path" to preview the cruise route.
- Click "Confirm Addition" to finish adding the cruise route.



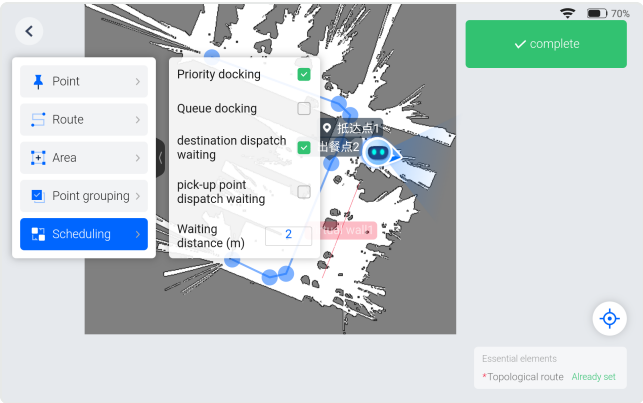
4. Add Special Area

- Click "Area" –> "Add area", you can add virtual wall, special area, RGBD special area, etc.



5. Point grouping

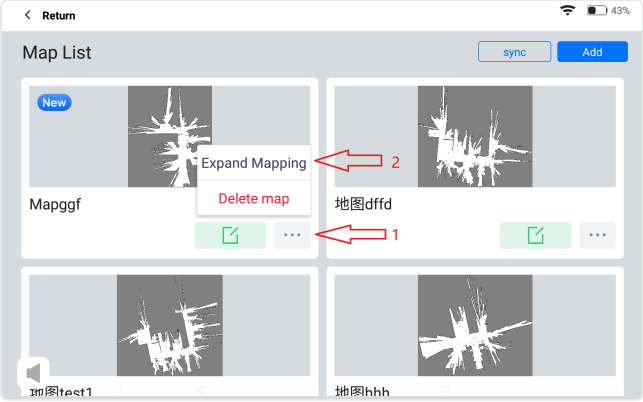
- Click on "Point grouping" to adjust the grouping of points.



6. Scheduling Settings

- Click "Scheduling" to set the scheduling strategy for the map.

- edit the map after you finish building it

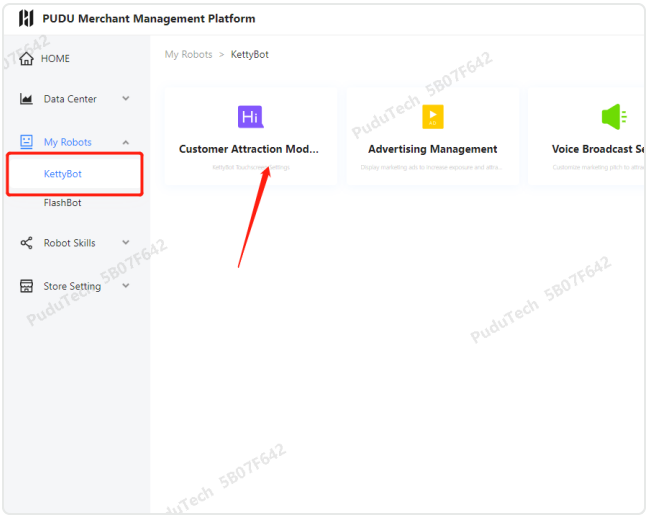


- Expansion of maps and deletion of maps

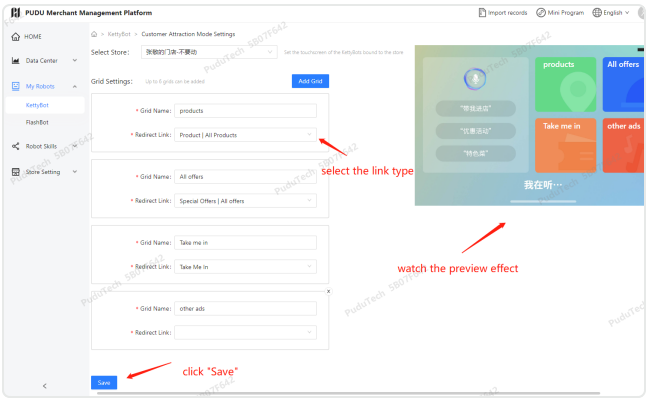
IV. Task settings

4.1 Customer attraction Settings

Kettybot can be set to the customer-attracting mode. When it is detected that a pedestrian moves towards the hoist and reaches 1.2 meters in front of the robot, the interface jumps from the expression to the customer-attracting interactive interface. This chapter introduces how to set up the customer solicitation mode on the merchant management platform.



- Enter PUDU Merchant Management Platform., click "My Robot".
- Go to the "KettyBot" screen and click "Customer Attraction Mode".

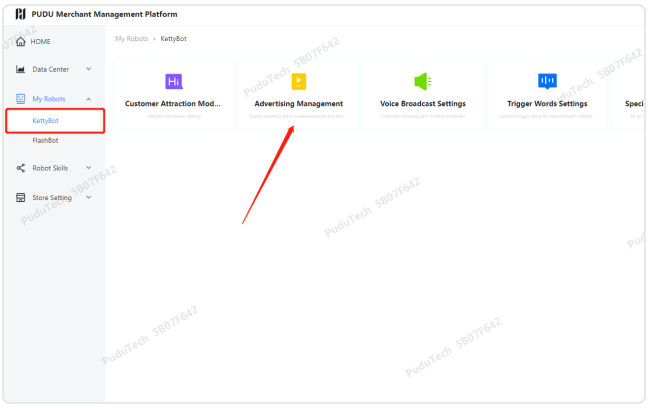


- Select robot and store
- Configure the display grid
- Set the link to jump to after clicking in the grid.
- Save the settings

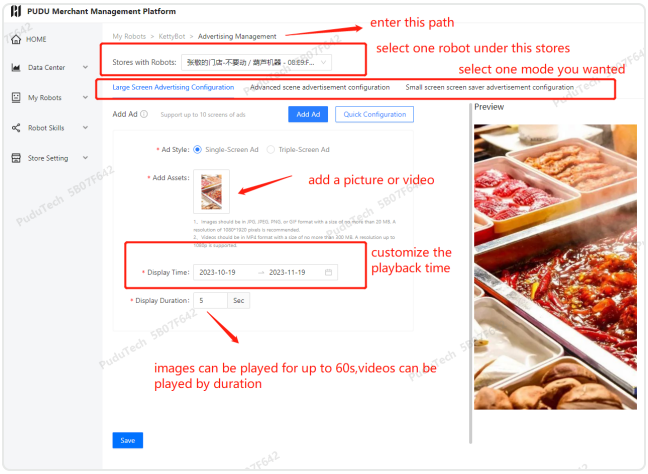
4.2 Advertisement Setup

This chapter only briefly introduces the setting of advertisements. For more functions and applications of advertisement screens, please refer to "KettyBot Merchant Management Platform & Advertisement Screen Linkage Use V1.0" and "20211125 Purdue Merchant Management Platform_V2.0.2_Operation and Use Manual".

Setup Steps:



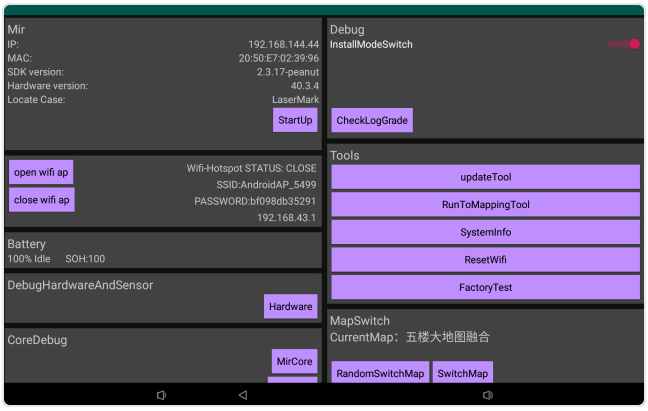
- Go to Purdue Merchant Management and click on "My robots".
- Go to the KettyBot Settings and click "Advertising Management".



- Selecting Robots and Stores
- Selection of the configuration mode (selectable on demand via effect preview)
- Add an advertisement (picture or video)
- Save Settings

4.3 Scheduling settings

When multiple machines are operating at the same site, scheduling can be used to solve problems such as encounter avoidance while traveling, priority–based stopping points for multiple stops, make–up stops for two stopping zones that are far away from each other, and path planning constraints for both the going and the returning trips.When scheduling multiple machines, you need to ensure that the channels and maps are consistent. If you find that the machines cannot be scheduled, you can also enter this interface to troubleshoot.



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

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

(The right side of the figure explains the meaning of each by serial number.)

1. Communication switch. When it shows that it is turned on, it means that the communication module has completed initialization.
2. ChoiceChannel button clicked to show all the available communication channels, the number 2 is the current channel.
3. The map identification code of the current machine. When scheduling multiple machines, the map identification code needs to be consistent.
4. The current communication status between the self-organizing network module and the LAN module, displaying true means that the module has been successfully started, "Data Normal" means that the scheduling data has been received and the data is correct, and "No Data" is displayed when no data has been 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 were 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 destination in sequence
- Execute the route

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 **the FAQ manual,** mainly focus on charging and rebooting can be resolved, if not resolved, contact the after-sales service