FMS-Forklift Management System

Instructions

V1.0.0 2023.10

http://www.lslidar.com/

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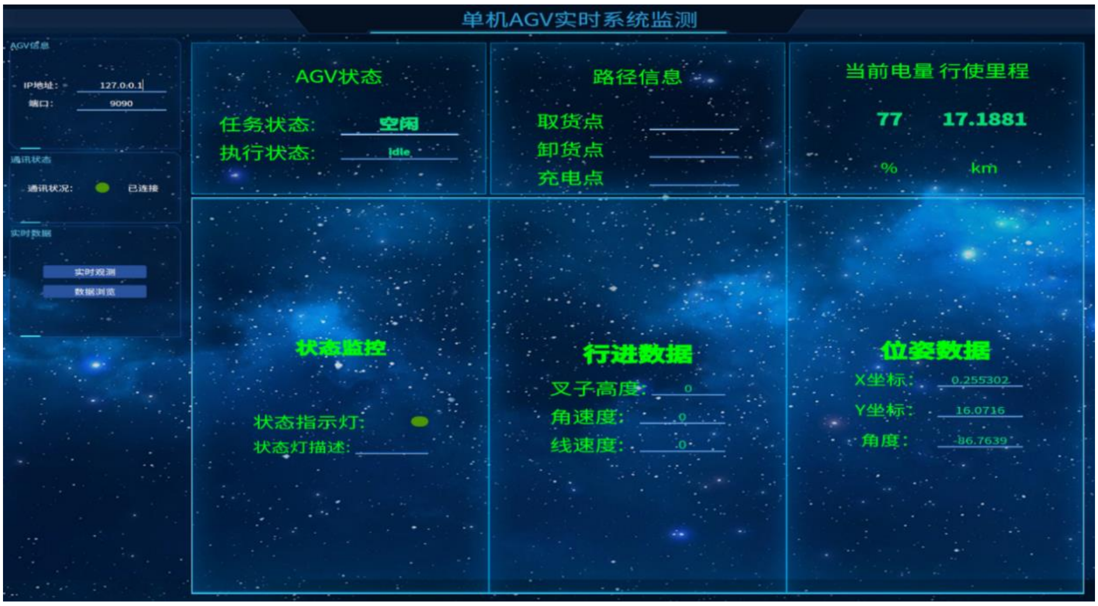
1. Software Introduction

1.1. Monitoring Interface

The monitoring interface displays the AGV's equipment information, operating status, sensor status and other information in real time which is convenient for the operators.

- **Real-time View**



- **Data Browsing**

1.2. Software Interface

1.2.1. Real-Time Preview

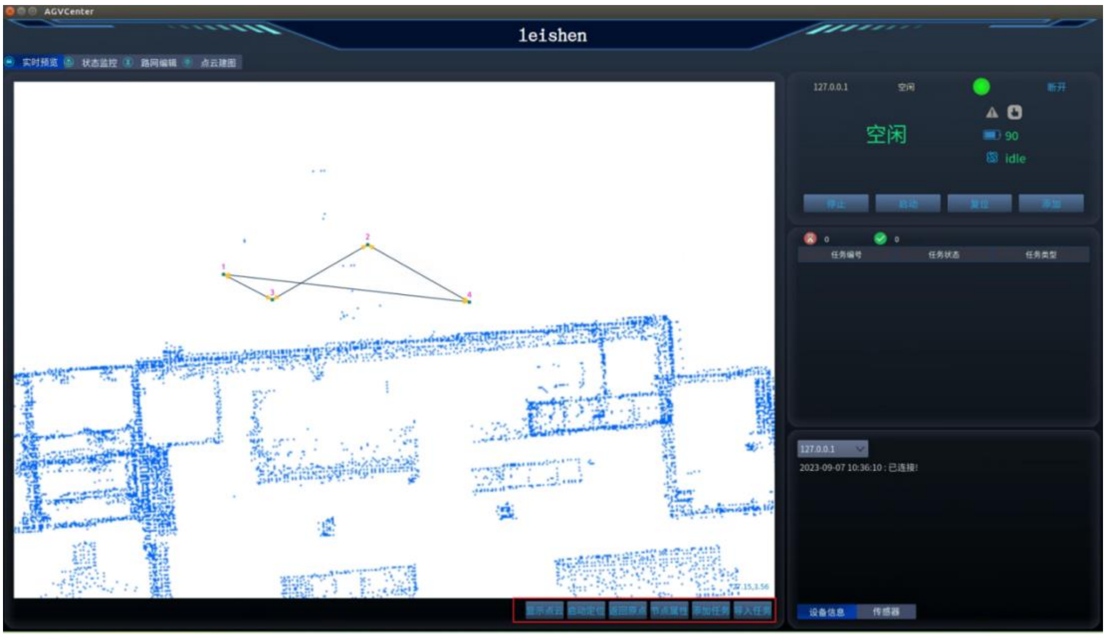
Real-time display of AGV route and location.

➤ **Device Information Operations**

serial number	describe	Remark
1	Forklift number	AGV's IP information, right-click this area to perform more operations
2	Task status	Idle, carry goods, charge and more
3	Connection Status	Green light (connection successful) Red light (connection failed) Yellow light (connecting)
4	Operation	Devices connected or disconnected
5	Abnormal equipment information	Highlight (Abnormal)
6	Manual/automatic mode	Highlight (manual)
7	Power	Actual power display
8	Vehicle body performs actions	-
9	Start up	Start AGV
10	Stop	Stop AGV
11	Reset	Reset AGV
12	Add	Add AGV equipment

➢ Right Click Operation

➢ Tool Action Bar



No.	Description	Note
1	Hide point cloud	Hide/show point cloud
2	Start positioning	Start positioning process
3	Return to origin point	Correction map
4	Node properties	View coordinate point attributes
5	Add task	Add an AGV task
6	Import tasks	Import the edited task file and generate the task

➢ Log Information Bar

Device information: information records of function operations

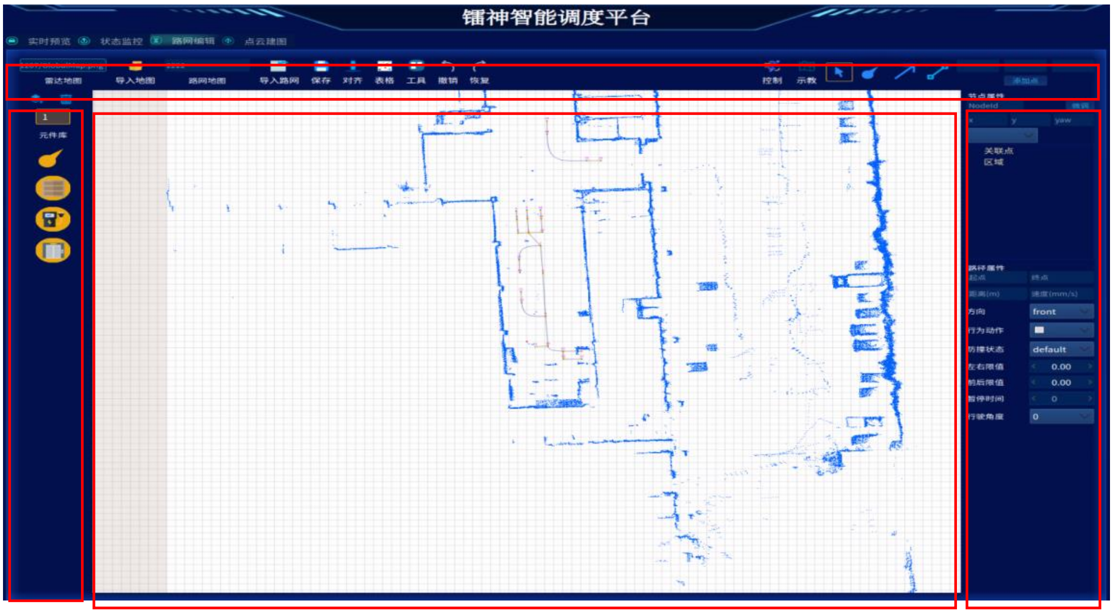
Sensor: Status of each sensor of AGV.

1.2.2. Status Monitoring

No.	Description	Note
1	Battery power	Actual power display
2	dork height	The height of the current vehicle body fork (unit: mm)
3	Current forklift linear velocity	Current AGV linear velocity (unit: m/s)
4	Current forklift angular velocity	Current AGV's angular velocity (unit: m/s)
5	Horizontal distance deviation on the travel route	The horizontal distance of AGV from the current straight line (unit: mm)
6	Angular deviation on the travel route	The current angular deviation of AGV from the straight line
7	Horizontal distance deviation from the current point	The horizontal distance of the AGV from the current point (unit: mm)
8	Angular deviation from the point	The angular deviation of the AGV's forward direction from the current point
9	Vertical distance deviation from the current point	The vertical distance of AGV from the current point (unit: mm)
10	Fork height deviation	The current deviation between the actual height of the fork and the set height (unit: mm)
11	Distance to target point	The current distance of AGV to the target point
12	Current issued linear velocity	The current linear speed issued by the navigation module
13	Current issued angular velocity	The current angular velocity issued by the navigation module
14	Operation state	The current task status of the vehicle body
15	Real-time motion status	AGV real-time motion status, including stationary, turning, unloading, moving, etc.
16	Lidar receiving data	Abnormal C16 lidar data receiving status, red light is lit
17	Location receiving	Navigation receiving positioning data status, red light is

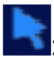
	data	abnormal
18	Bottom layer receiving data	The bottom layer of the vehicle body is receiving data, and the red light is lit.
19	Positioning status	The current AGV's positioning status is abnormal, the red light is lit.
20	Deceleration for collision avoidance	The anti-collision lidar is decelerating and the red light is lit.
21	Stop for collision avoidance	The anti-collision lidar stopped and the red light is lit.
22	Bumper triggered	AGV’s bumper status, red light is lit.
23	Switch triggered	Photoelectric sensor status of forks, red light indicates obstacles detected.
24	Predicted forklifts collision	Predict the travelling status of AGV and other AGVs, The red light indicates that the AGV may collide with other AGVs.
25	Off-route state	The AGV deviates from the straight line, and the red light indicates the deviation from the straight line exceeds the threshold.
26	Off-angle state	The AGV deviates from the route, and the red light indicates the angle deviation from the route exceeds the threshold.
27	Pallet presence or not	The status of the pallet at the pick-up point, the red light indicates that the AGV does not detected the pallet.
28	Pallet position state	Pick-up point pallet status, the red light indicates that the AGV detects that the pallet deflection exceeds the threshold.

1.2.3. Road Network Editing



- **Action Toolbar**

- Import map: Import the lidar map to be used from the local computer;
- Import road network: import the road network that needs to be used;

- Save: Save the modified parameters;
- Alignment: Based on a certain route, adjust the selected point to the route;
- Table: coordinate point information and function settings;
- Tools: map display, point and route attributes, coordinate conversion, data conversion settings;
- Undo: return to the previous step;
- Revert: revert to the previous step before undoing;
- Control: control AGV action;
- Demonstration: display AGV icon;
- : Control mode;
- : Add point mode;
- : Route setting mode;
- : Add point on the edge mode;
- Add point: Enter the values of X, Y, and Yaw to generate a coordinate point at the corresponding location on the map.

➢ **Component Library**

- : Coordinate attribute point, drag it to the map to generate a new coordinate point;
- : Shelf attribute point;
- : Charging attribute points;
- : Elevator attribute point.

➢ **Demonstration Window**

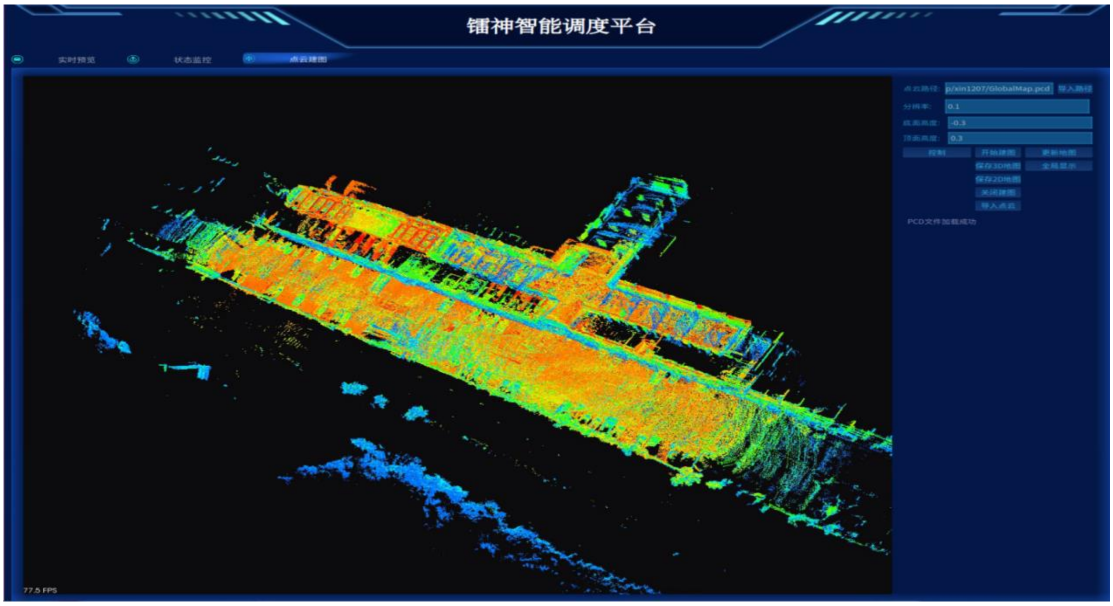
- Point and path editing display window.

➢ **Attributes Bar**

- Node attributes: Set the functional attributes and position movement of coordinate points;
- Route attributes: Set the functional attributes of the route;
- Starting point: the starting point of the route;
- End point: the end of the route;
- Route length: the distance between the current point and the associated point (unit: m);
- Travel speed: AGV’s travel speed on the route (unit: mm/s);
- steerAngle: angle of travel of the forklift AGV, normally 0°, or 90° if translation is required;
- The front direction of the vehicle: he direction of travel of the forklift AGV on this route. front: the front of the AGV faces forward; back: the rear of the AGV faces forward;
- Behavioral actions: other functional actions of the forklift on this route, unchecked if not specifically requested;;
- Anti-collision status: the corresponding anti-collision lidar configuration when the forklift AGV is driving on this route. Default: the maximum area of anti-collision lidar setting; reduce: primary deceleration area of the anti-collision lidar; reduce_2: secondary deceleration area of the anti-collision lidar; close: turn off the anti-collision lidar;
- Front and rear limits: parameter of the multi-machine collision avoidance configuration, front and rear safety distance (unit: m) between the forklift AGV and other forklifts;
- Left and right limits: multi-machine anti-collision configuration parameters, left and right safety distances between AGV and other AGVs, unit m ;
- Pause time: parameter of the multi-machine collision avoidance

configuration, the waiting time of the forklift at the start of the route (unit: seconds).

1.2.4. Point Cloud Mapping



- Point cloud route: after the mapping is completed, save the route of the 2D and 3D maps.
- Import route: import the route to save 2D and 3D maps.
- Resolution: compress 3D point clouds into 2D maps in such resolution, default value.
- Bottom height: the height of the bottom point cloud when compressed into a 2D map, default value.
- Top height: the height of the top point cloud when compressed into a 2D map, default value.
- Control: control AGV actions when building a map.
- Start mapping: start the mapping program, and the lidar begins to scan the surrounding environment and build a map.
- Save 3D map: save the constructed 3D map.

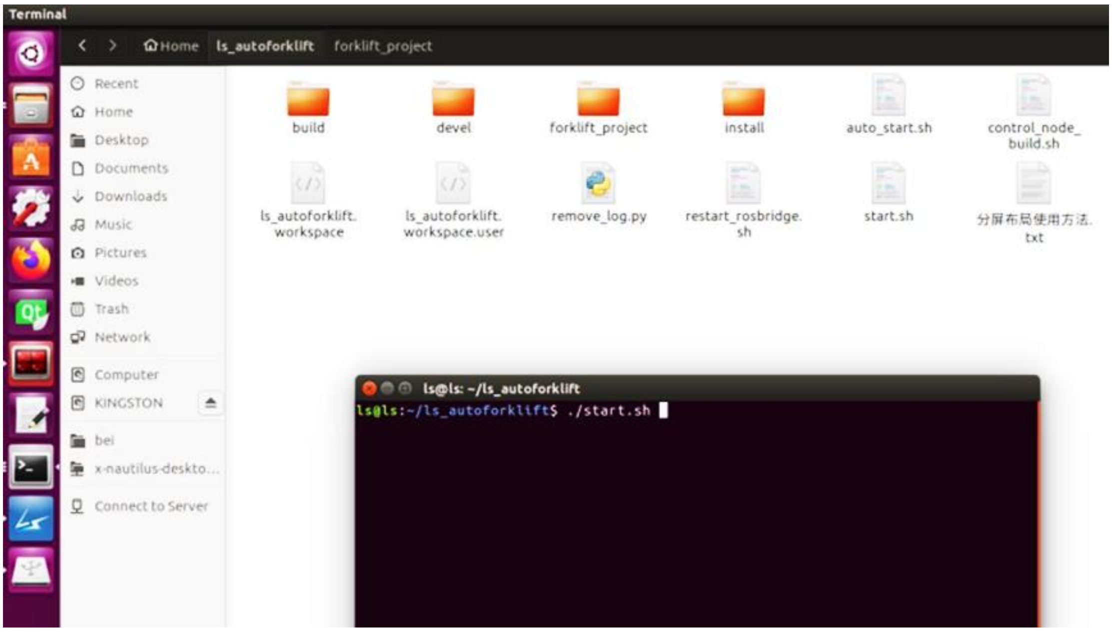
- Save 2D map: save the constructed 2D map.
- Close mapping: close the mapping program.
- Import point cloud: import the saved 3D point cloud image.
- Update map: update map information.
- Global display: display the mapping interface in full screen.

2. Function Operation

2.1. Software Startup

The industrial computer starts up automatically or clicks the home directory after starting up, finds the ls_autoforklift folder and enters it, right-clicks the mouse and selects “Open in Terminal” to open the terminal.

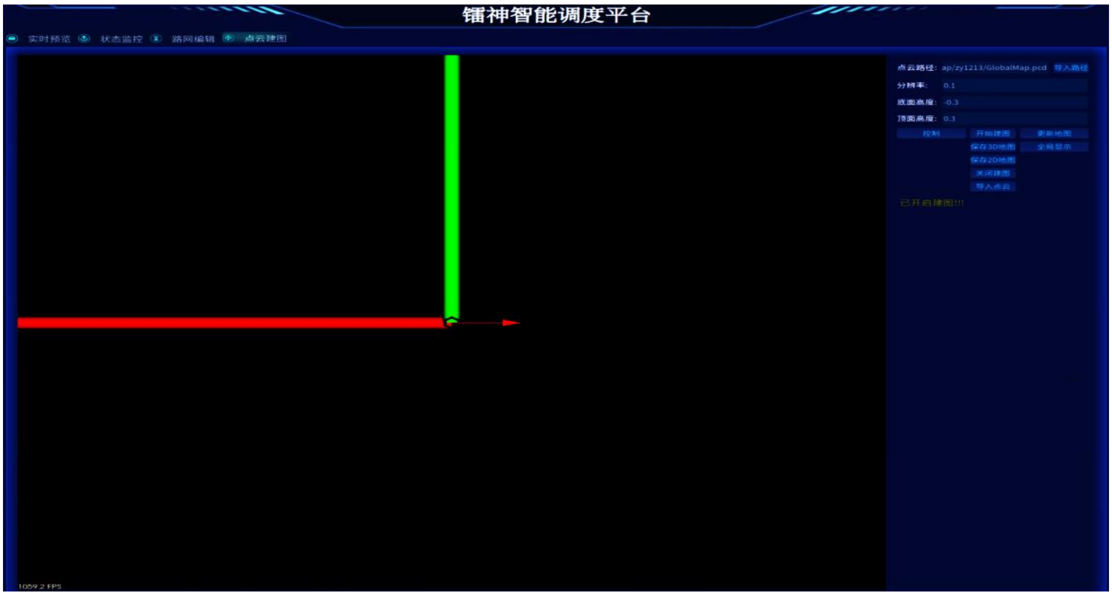
- Enter "./start.sh" on the terminal as shown below, and press the Enter key to open the scheduling software:



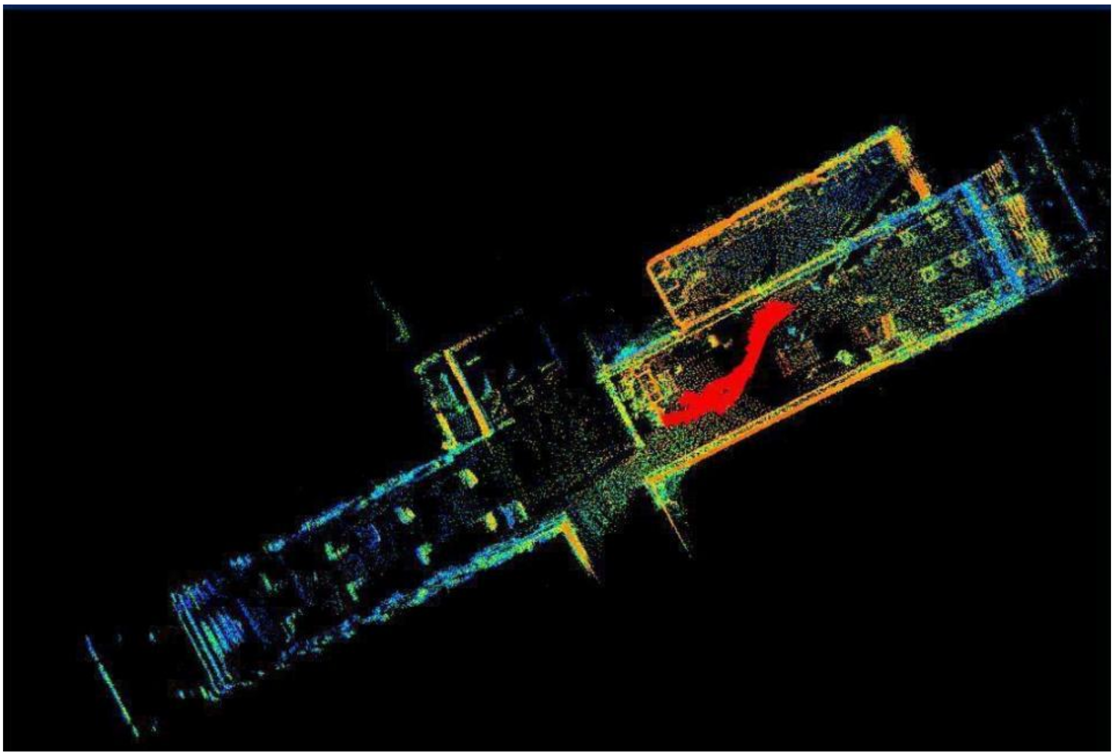
Click “Add” in the forklift list bar on the upper right side of the scheduling software, enter IP 127.0.0.1, and click Connect after confirmation:

2.2. Map Building

After connecting to the forklift, create a folder in the computer/home/ls_robot/map directory as a path, and then click on "Build Map" to enter the map building interface. In the point cloud path field, manually enter the path where the 3D and 2D maps will be saved and the map name, the map name is fixed to GlobalMap.pcd.



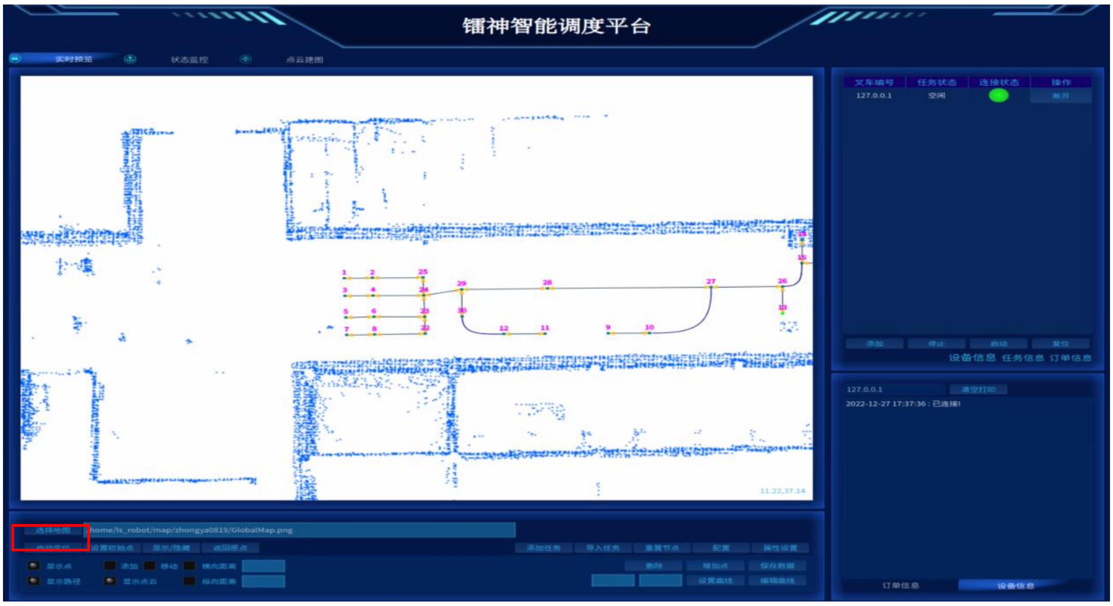
Click on "Start building". If it says "Mapping started!!!", you can click on "Control" to operate the forklift to travel around the work site. While the forklift AGV is in motion, the software interface will display a 3D point cloud outline of the site, as follows:



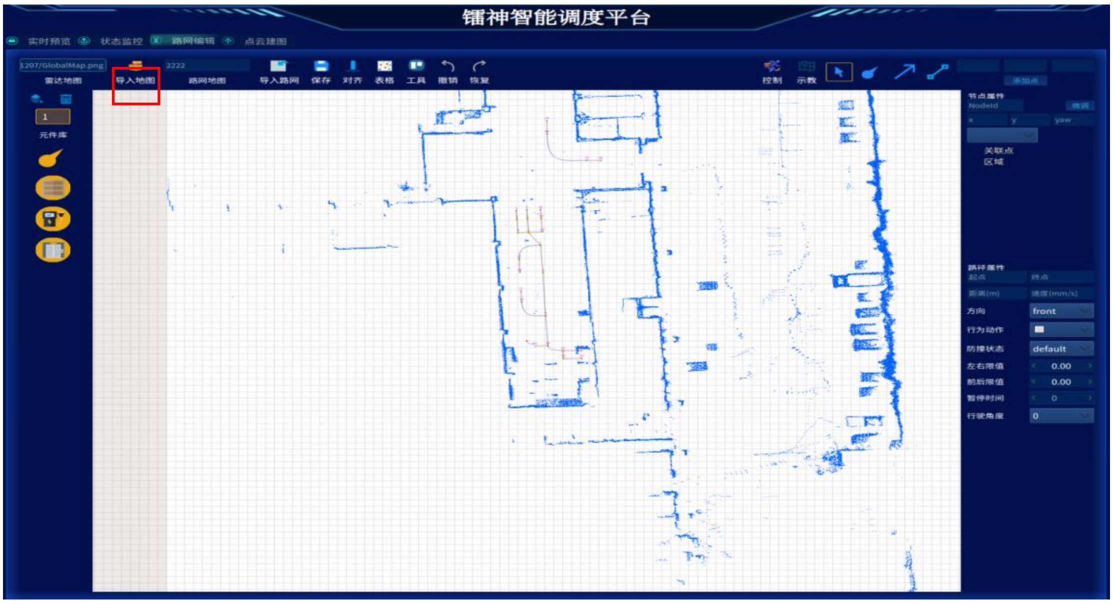
Click on "Save 3D map" and after the 3D map has been saved to the specified path, the software will prompt "Success save 3D map", as follows:

Click on "Save 2D map" and after the 2D map has been saved to the specified path, the software will prompt "Success save 2D map", as follows:

After the map construction is completed, in the real-time preview interface, click "Select Map" on the toolbar below to import the built map:



Click “Import Map” again to import the created map.

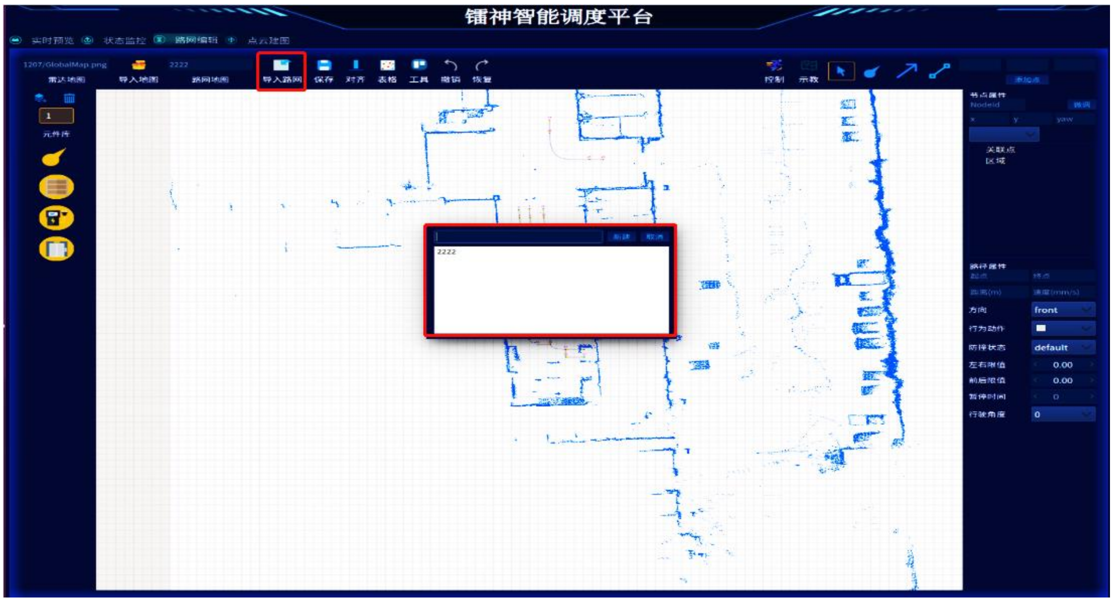


*Note: The mapping function requires manual startup of the software.

2.3. Coordinate Point and Route Settings

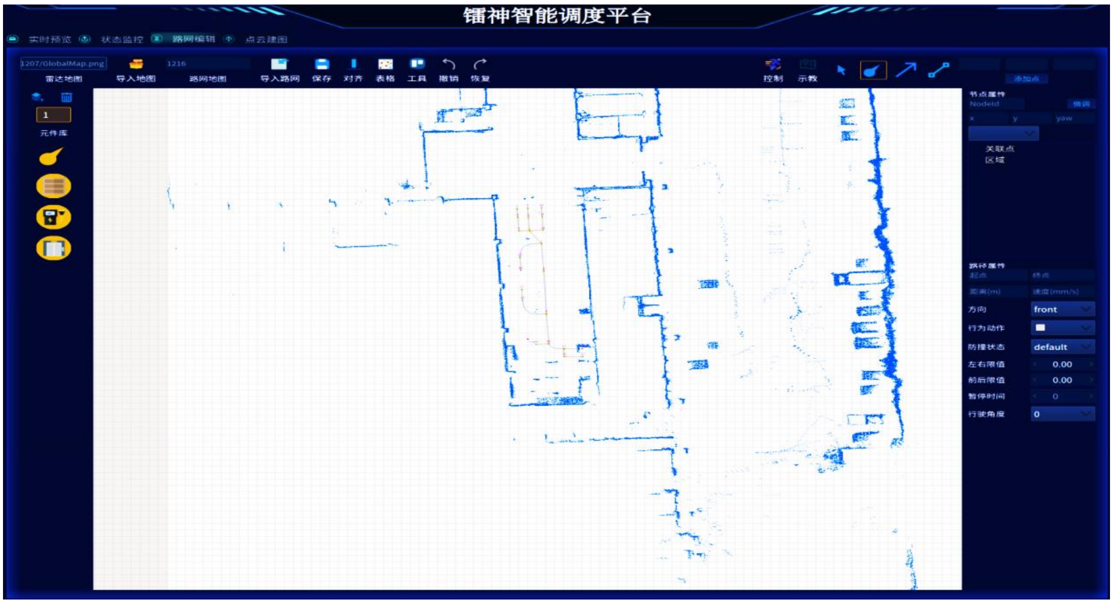
2.3.1. Adding and Deleting Coordinate Points

First, click “Import Road Network” to create a new road network and fill in the name of the road network.

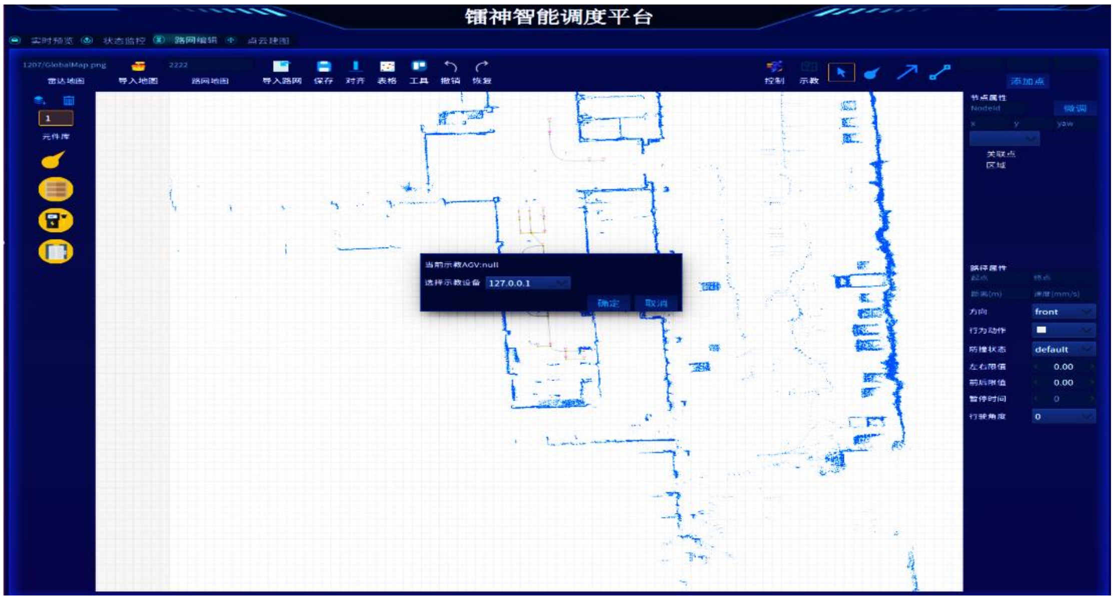


➢ **Add Point**

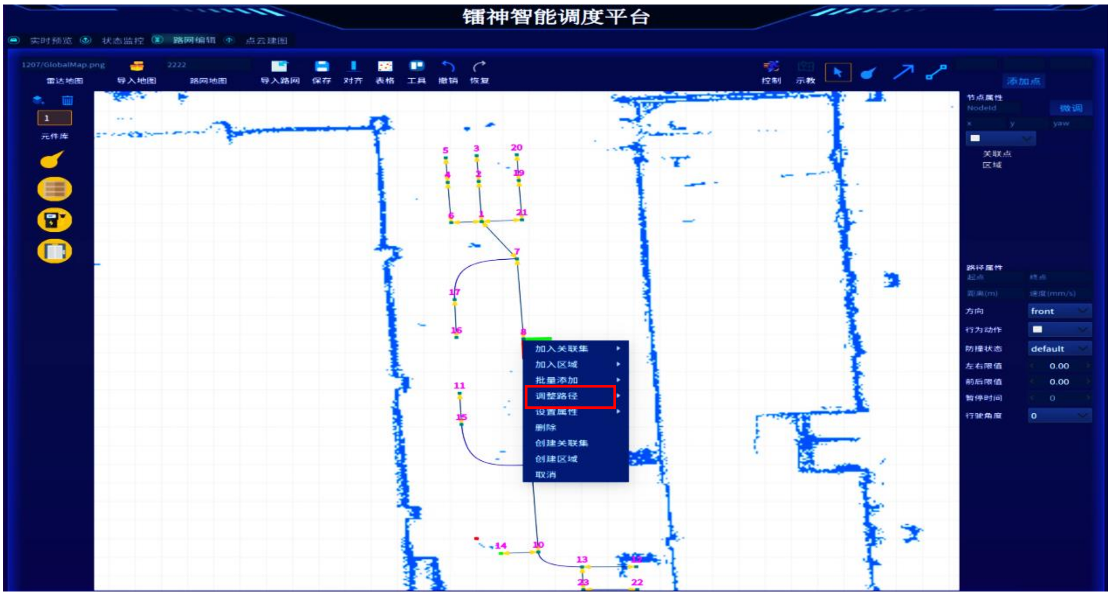
Once the point mode is selected, left click on the map to add a new coordinate point.



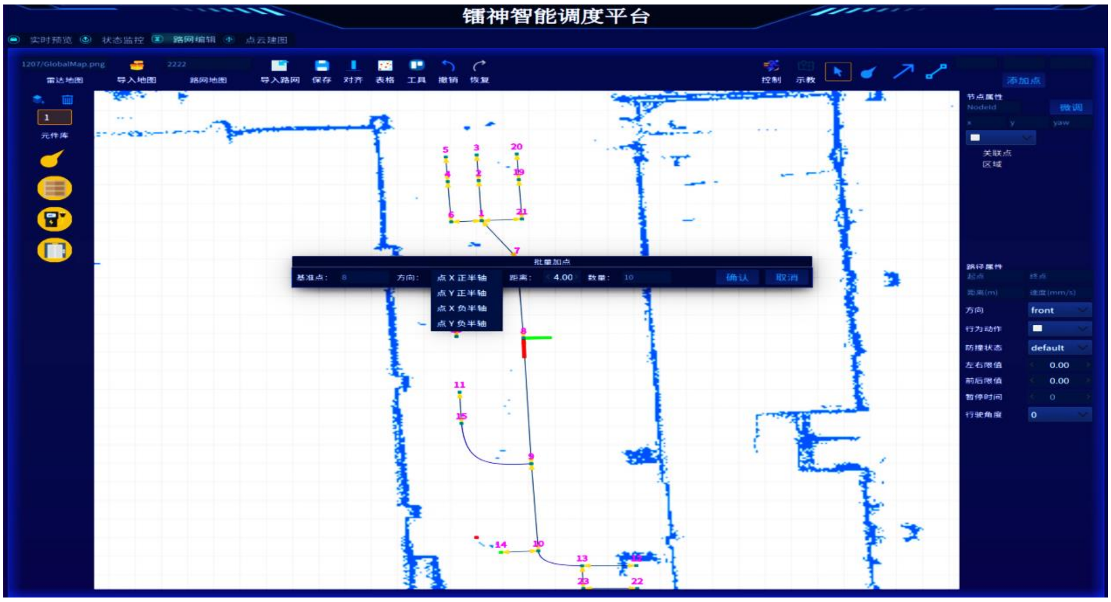
Or click on "Demonstration" and press "A" at the map location where the AGV is located to add a new coordinate point.



Or use a point as a reference and add a new point at a certain distance from the X/Y axis where the point is located. Right click on a point and select "Batch Add".

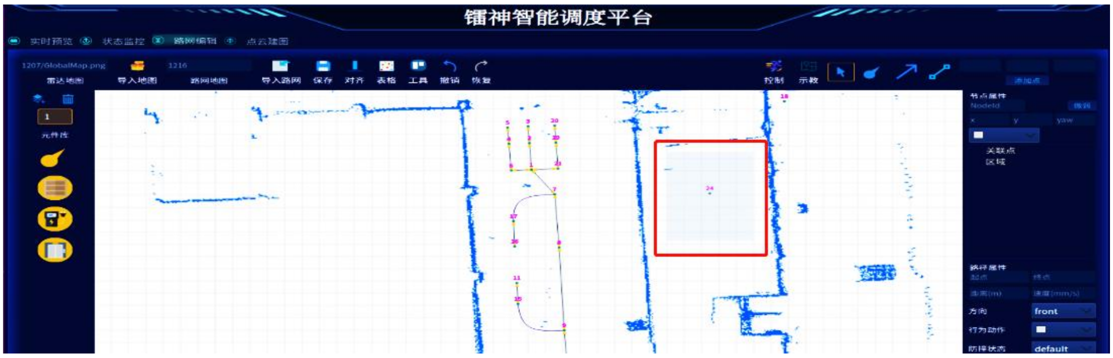


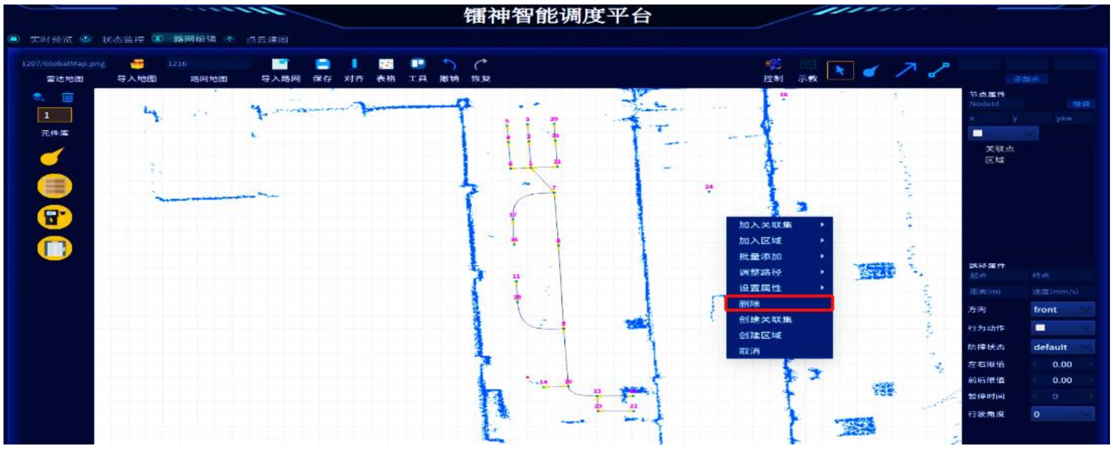
The reference point is the selected point. The green coordinate line points to the positive half-axis of the Y-axis at that point, and vice versa. The red coordinate line points to the positive half-axis of the X-axis, and vice versa.



➢ Delete Point

Left click to select the point to be deleted and then right click to delete it.





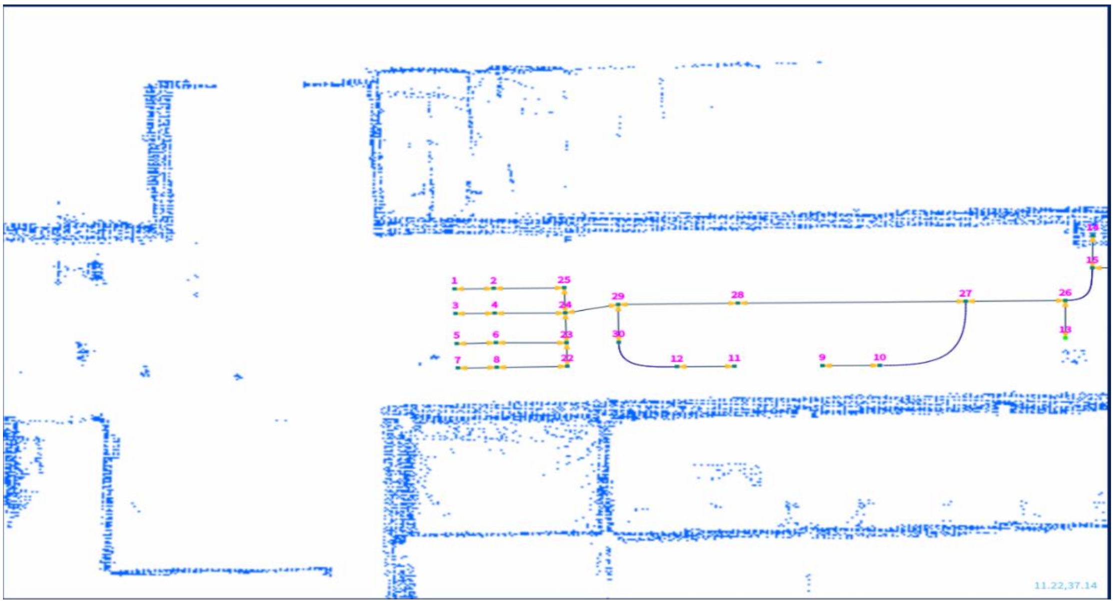
2.3.2. Route Settings

A route is a connection of two coordinate points. Double-click on a point to select it, and in the route management window, click on the "+" in the bottom left corner to add a new route.

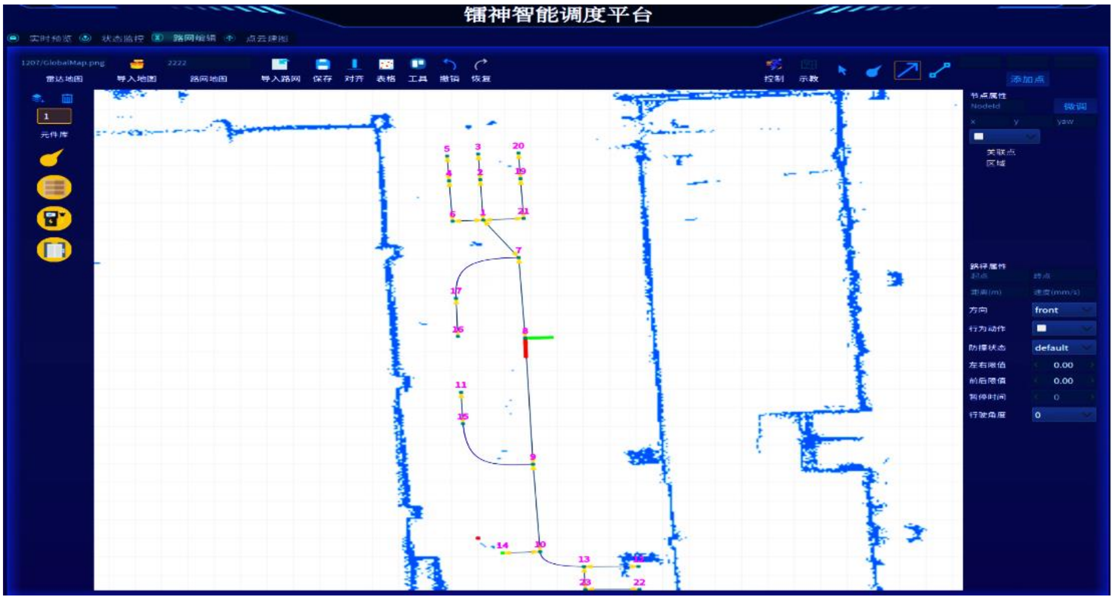
- Current point: the serial number of the currently selected coordinate point;
- Associated point: the position of the coordinate point connected to the current point in a route line;
- Route length: the distance between the current point and the associated point (unit: m);

- Travel speed: the travel speed of the forklift AGV on the route (unit: mm/s);
- SteerAngle: angle of travel of the forklift AGV, normally 0°, or 90° if translation is required;
- The front direction of the vehicle: Front facing: the direction of travel of the forklift AGV on this route. front: the front of the AGV faces forward; back: the rear of the AGV faces forward;
- Behavioral actions: other functional actions of the forklift on this route, unchecked if not specifically requested;
- Anti-collision status: the corresponding anti-collision lidar configuration when the forklift AGV is driving on this route. Default: the maximum area of anti-collision lidar setting; reduce: primary deceleration area of the anti-collision lidar; reduce_2: secondary deceleration area of the anti-collision lidar; close: turn off the anti-collision lidar;
- Front and rear limits: parameter of the multi-machine collision avoidance configuration, front and rear safety distance (in m) between the forklift AGV and other forklifts;
- Left-right limit: parameter of the multi-machine collision avoidance configuration, the safe distance between the forklift truck and other forklifts to the left and right (in m);
- Pause time: parameter of the multi-machine collision avoidance configuration, the waiting time of the forklift at the start of the route (in seconds).

After filling in the route parameters, click "OK" to generate a route between two points and so on to set up a complete route network.

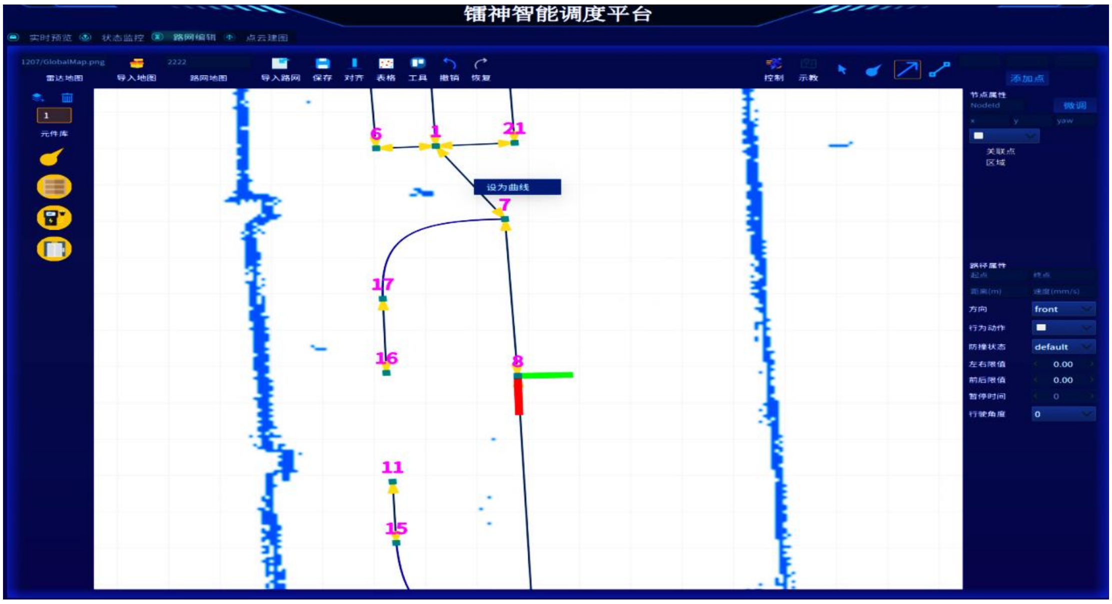


Or select 'Line mode', click and hold the left mouse button on a point and pull it towards another point to create a path between the two points. Double click on the starting point to modify the path information and save.

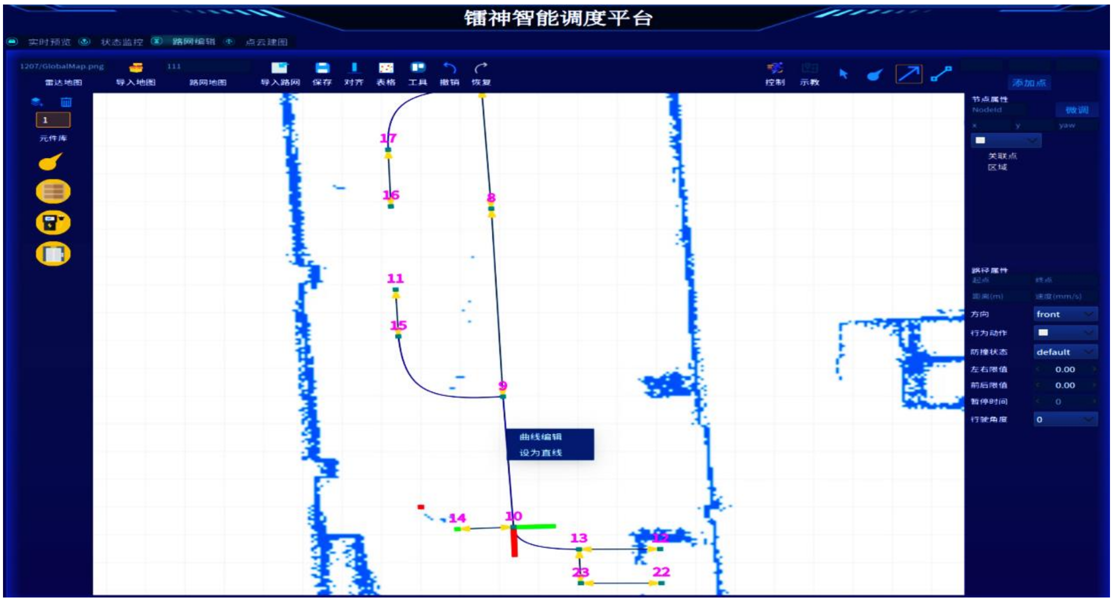


2.3.3. Curve Settings

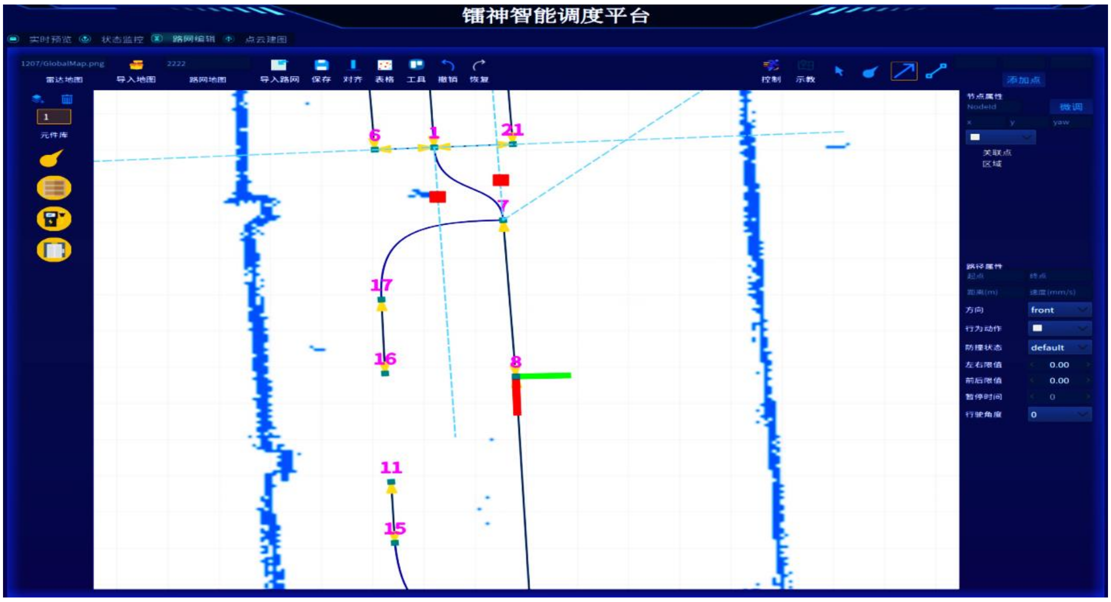
Select "Line mode", right click next to the path and select "Set as curve".



Right click on the curve, select "Curve edit" and drag the center point of the curve to modify it to the right size.

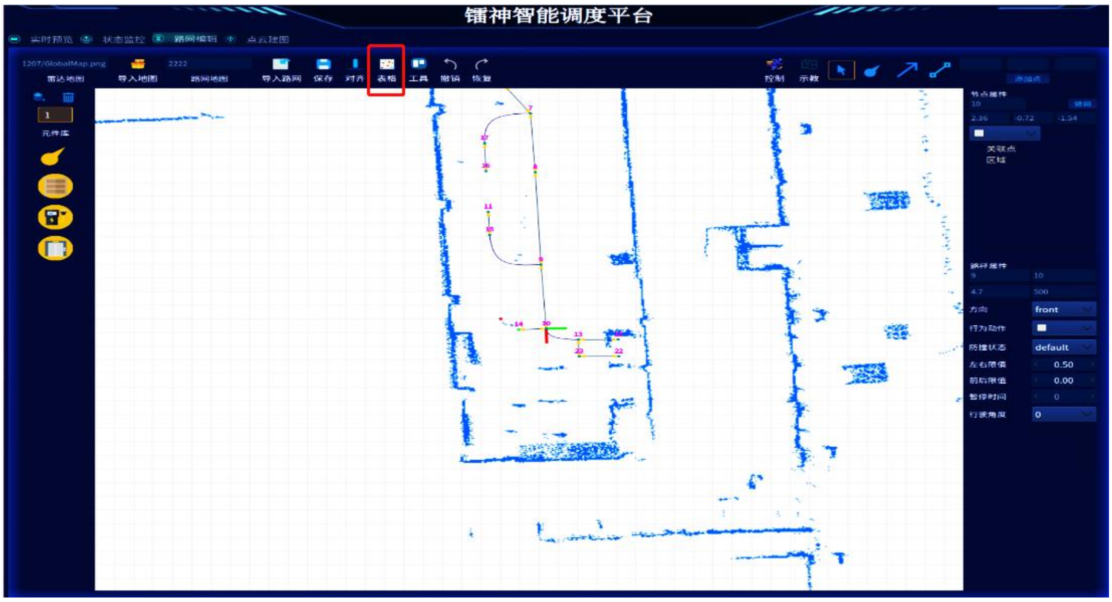


Drag the center point of the curve to modify the curve to a suitable size:

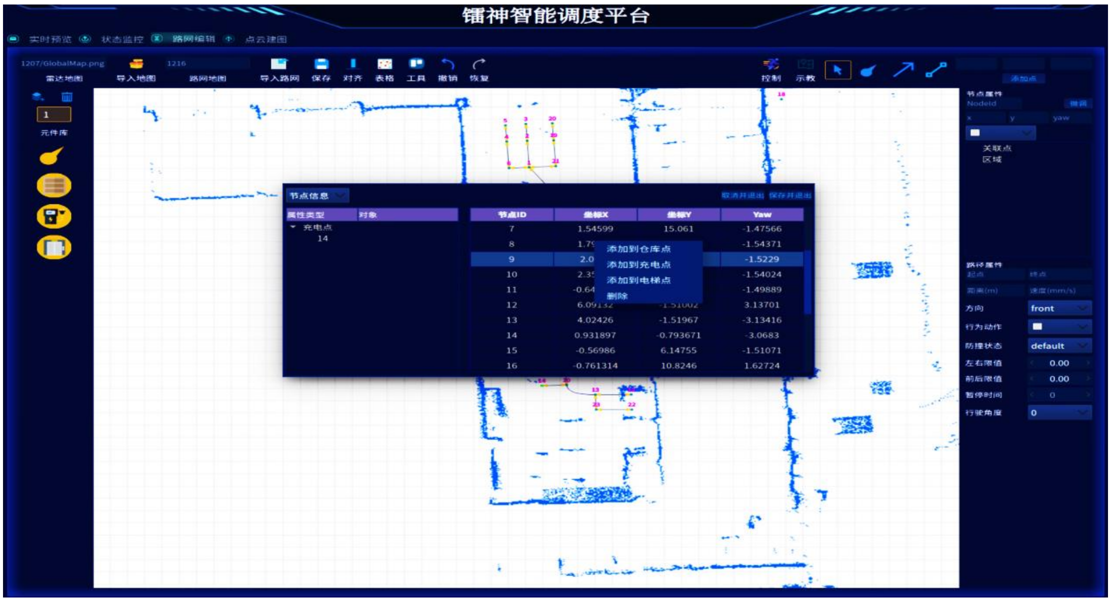


2.4. Charging Point Attribute Settings

Click on "Table" and select the node information.

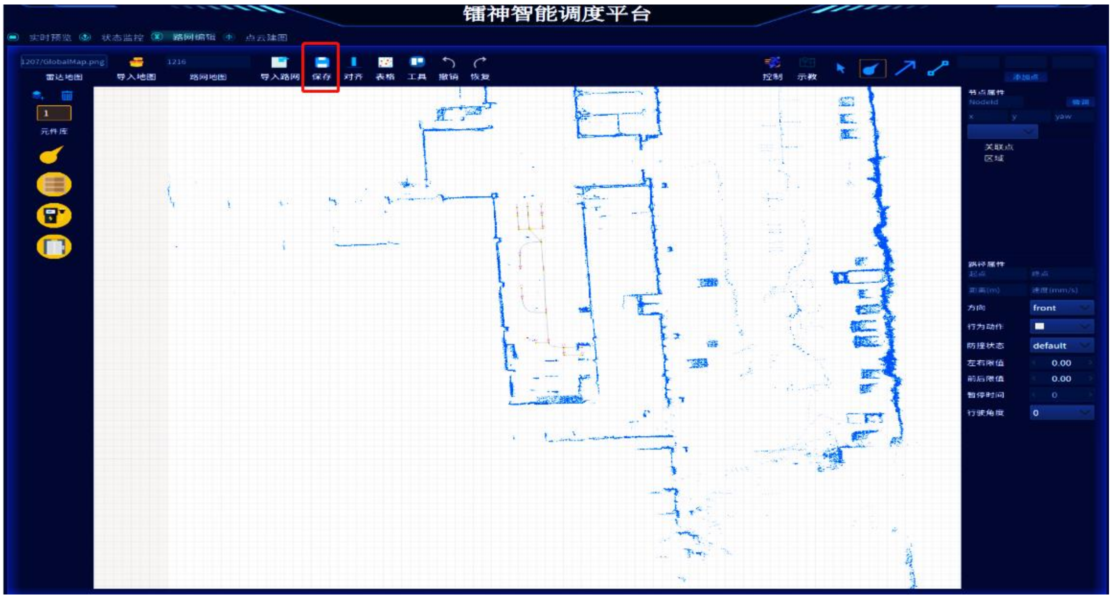


Right click on the serial number of the point you want to set as a charging point, select "Add to charging point", save and exit. If you want to delete a charging point, select "Delete".



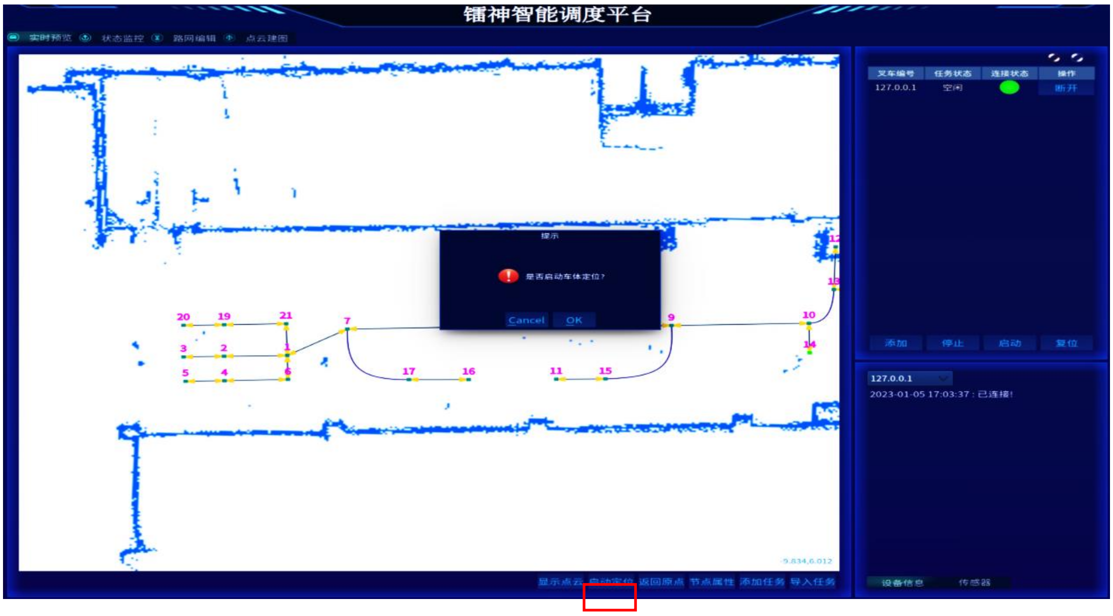
Deleting charging points is the same step as above, "Property Settings" → "delete" → close the pop-up window

*Note: Every time there are changes in the road network editing interface, you need to click Save, otherwise it will not take effect.

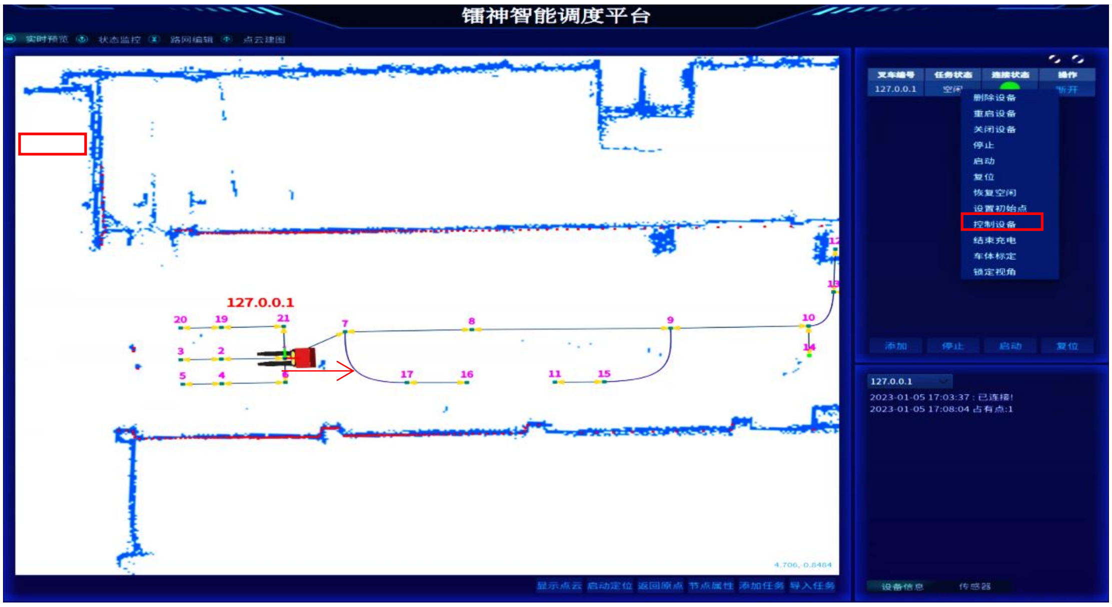


2.5. Start Positioning and Set Initial Point

After selecting the correct map, click "Start Positioning" and wait a few seconds for the terminal window to start:



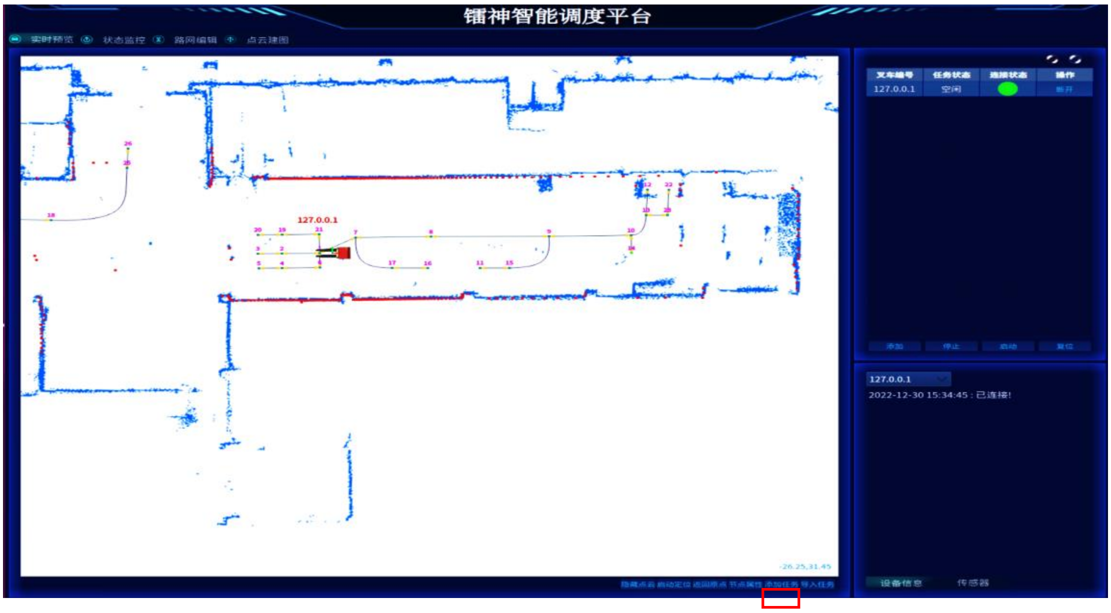
Then select the device in the upper right corner, click "Set Initial Point", observe the position of the AGV in the actual scene, find the corresponding position on the map, and pull it in the positive direction of the X-axis of the lidar (the opposite direction of the lidar wiring), you can try a few more times to adjust it. When the position is matched correctly, a red real-time point cloud will appear, indicating that the position is initialized successfully:



2.6. Task Publishing

2.6.1. Adding a Task

When the stand-alone software needs to publish tasks, click "Add Task" on the preview interface:

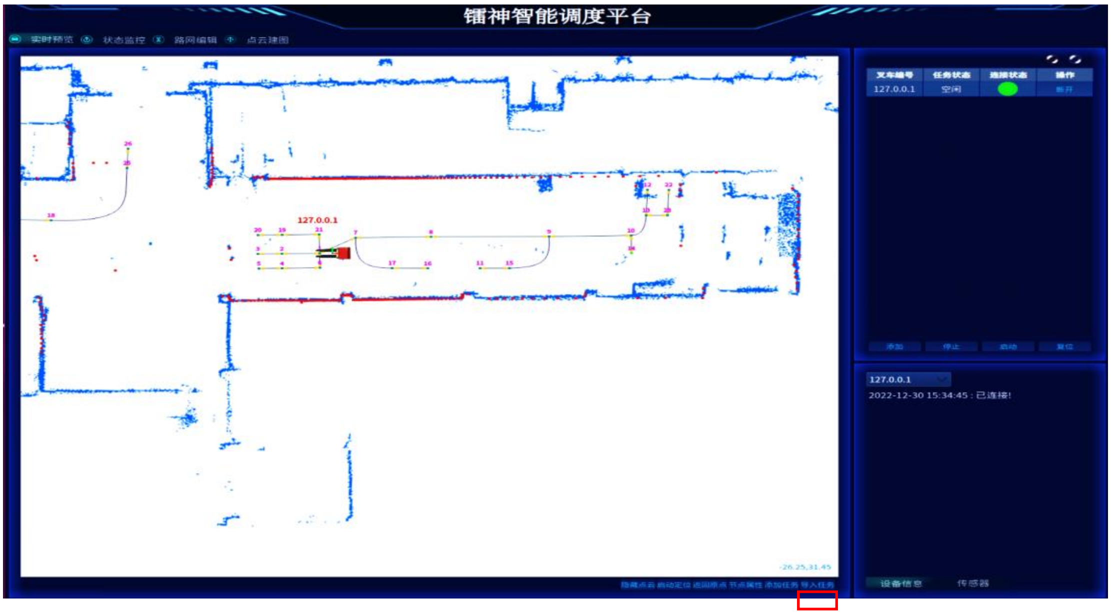


The task settings window pops up and you can set specific information about the task.

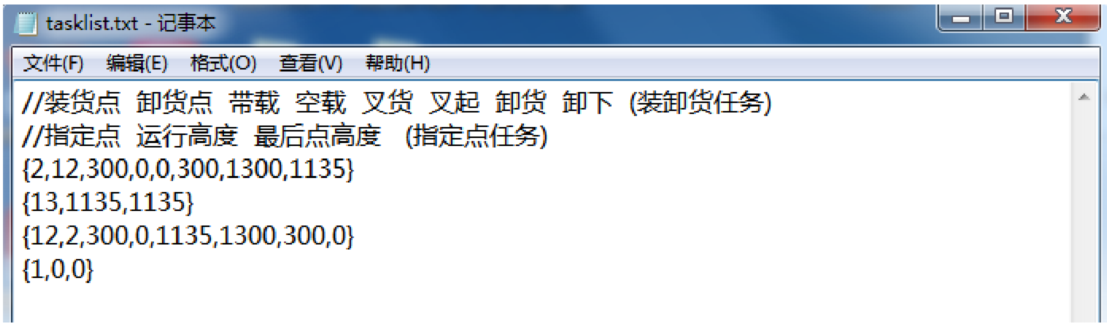
- Task name: the default value is 1, in the order in which the tasks are added, in increasing order from 1.
- Task type: divided into loading and unloading, transporting, charging and designated points. Loading and unloading: the forklift AGV will go to the pick-up point to pick the goods, then send them to the unloading point and finally return to the standby point; Charging tasks: the forklift AGV goes back to the charging point to charge; Designated point: the forklift AGV will go to the designated points.

- Pick-up point: the pick-up point of a forklift when performing loading and unloading tasks.
- Drop-off point: the point at which the forklift is unloaded when performing loading and unloading tasks.
- Designated point: the target point for performing charging and designated point tasks.
- Designated forklift: the default is the current forklift.
- Height with cargo: while performing loading and unloading tasks, the height of the forks when the forklift is travelling with the load on it.
- Height without cargo: the height of the forks when the forklift is not forked with goods when performing loading and unloading tasks.
- Height with cargo lift up: the height of the forks when the forklift is forking the load during loading and unloading tasks.
- Height with fork up: the height at which the forks are raised after the forklift has forked up the load when performing loading and unloading tasks.
- Height of unloading: the height of the forks when the forklift reaches the unloading point during loading and unloading tasks.
- Height with cargo unloaded: the height of the forks after the forklift has reached the unloading point for loading and unloading tasks.
- Start loop: when entered the value of times, the forklift will repeat the posted task, only valid for loading and unloading tasks.

2.6.2. Import Tasks



Create a new text document such as Tasklist.txt and enter the parameters of Pick-up Point, Unload Point, Height with load, No-load height, Fork Height, Fork-up Height, Unloading Height and Unloaded Height (fill in the number of tasks as required), as follows:



//装货点 卸货点 带载 空载 叉货 叉起 卸货 卸下 (装卸货任务)
//指定点 运行高度 最后点高度 (指定点任务)
{2,12,300,0,0,300,1300,1135}
{13,1135,1135}
{12,2,300,0,1135,1300,300,0}
{1,0,0}

The first two lines of figures in the task document above mean:

The forklift picks up the load from point 2 and delivers it to point 12 with a height of 300 mm with load, a height of 0 with no load, a fork height of 0, a fork up height of 300 mm, an unloading height of 1300 mm and an unloaded height of 1135 mm. It then returns to point 13 with a fork height of 1135 mm on the way to point 13 and a fork height of 1135 mm on arrival at point 13.

3. Troubleshooting

3.1. Notes on Use

- When creating a new map, you need to start the software manually. You do not need to manually click "Start Positioning". When you start building a map, the positioning program will start;
- When points, paths or other configurations are changed, you need to click "Save Data" to take effect;
- When using the keyboard for manual control, the linear velocity and angular velocity should not be too fast;
- Repeated startup of the software is prohibited.

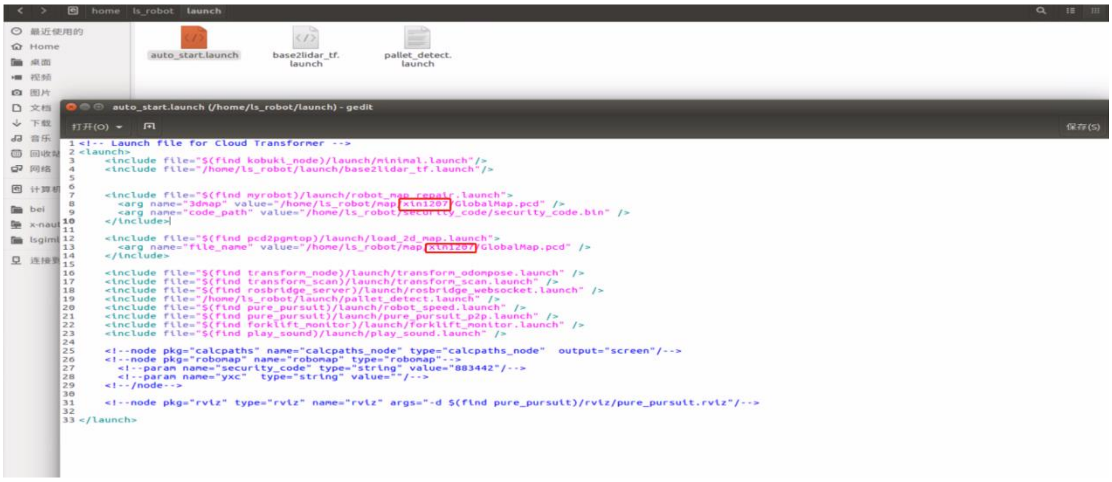
3.2. Exception Handling

3.2.1. Forklift not Performing Task

- Check if the forklift is in automatic mode.
- Check if the device status is "task received".
- Check if the forklift is on point.
- Check if the task path is set correctly.
- Check if there are alarms on the forklift sensors.
- Check if the forklift is paused, right click on the device and click on "Start" or on the shortcut "S".

3.2.2. Forklift Does not Start Positioning Properly After Being Powered on

- Check if the autorun map set in the autorun file is correct.



- Check if the autorun positioning method is correct (power off point autorun / fixed point autorun).

3.2.3. Unable to Control AGV Movement

- Check if the forklift is operating in the correct mode (manual/automatic).
- Check if the emergency stop button is pressed.
- Check if the forklift is on task.

Copyright Notice

The version of the software introduced in this description is only the current version (October 2023). The company reserves the right to upgrade and improve this system, so there is no guarantee that the content described in this description is completely consistent with the system you purchased. However, we will review and revise this description regularly, and any revisions to this description will be made without prior notice.

Revision History

Rev.	Release Date	Revised Content	Issued/Revised By
V1.0.0	2023-10-10	Initial Version	LS1300

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