Génération ROBOTS

Convergence in ecology,

Agile development

N avis

Industry-Level robot navigation solution

2022.05 Version 1.0   Shenzhen Links Enterprise

Navis Navigation

Industry-Level robot navigation solution

NAVIS is an industry-level mobile robot navigation product aimed at semi-enclosed and fully enclosed scenes. It uses multi-line LiDAR, depth camera and IMU as the main sensors to achieve environmental perception and scene construction. Combined with NAVIS Brain (navigation brain), NAVIS Bridge (data bridge) and multi-platform intelligent interaction NAVIS Board system, it has realized data visualization, scenario map building and management, task system management, system management and many other functions.

NAVIS Navigation can be adapted to the all chassis of Agilex Robotics series that adopts full splicing sensing scheme. The embedded sensing hardware devices on mobile platforms enable fully autonomous open top space; Camera+LiDAR integrated positioning and safety protection realize autonomous and safe operation of equipment; and multi-sensor fusion and true 3D perception help achieve better and more reliable positioning capabilities. Uncessary for the users to have the basic knowledge of mobile robot, it enjoys ready-to-use functionality, continuous iteration and free upgradation, which is also cost-efficient and supports rapid mass production.

Product Features

☐ Environmental perception and scenario construction

☐ repeat positioning accuracy: ±5cm; moving positioning accuracy: ±10cm

☐ Supporting assisted re-positioning of locating points

☐ Supporting path point and path navigation

☐ Support autonomous obstacle stopping/avoidance, obstacle avoidance in blind areas

☐ Data visualization

☐ Automatic charging
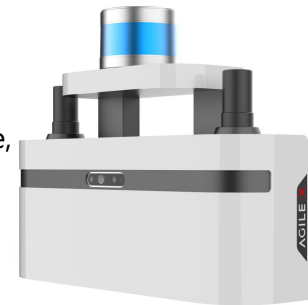
*The sensor support scheme is for reference only, not the only specified delivery mode. Users can customize and design special sensor brackets according to the adopted vehicle models, and Agilex Robotics provides customization services for sensor brackets.

Navis Navigation

Génération ROBOTS

Industry-Level robot navigation solution

行业级移动机器人导航方案

360 Version

Multi-line LiDAR   1PCS

Nine-axis Attitude Sensor   1PCS

x86 Industrial Personal Computer   1PCS

Optional hardwares:

Blind spot Compensation Camer   1PCS Camera / Depth camera (optional according to the project)

RTK GPS   1PCS

4G Router   1PCS

Gigabit Switch   1PCS   Two LAN ports are required

Qianxun Network Service   1 Year

移动承载未来 · Smart Mobile The World

Scenarios	Description	Notes
Suitable	Indoor/Outdoor	Other than rainy, snowy, and foggy weather
Positioning	3D LiDAR location	Supporting RTK-GPS assisted positioning
Maximum drawing area	200W ㎡	Closed loop scenario
Across floors	Not supporting	
Repeated positioning accuracy	±8cm	
maximum navigation moving speed	2.5 m/s Depends on different robot base	
Motion model	Supporting Ackermann, differential, and four-wheel-four-turn models	
Obstacle avoidance mode	Autonomous obstacle stopping/detour	
Obstacle avoidance sensor	LiDAR, inocular depth camera	Not supporting ultrasonic sensors currently
Navigation mode	Autonomous navigation/path tracking	
Map import	Supporting the import and migration of maps between different Navis devices	
Map export	Supporting	
Map incremental expansion	Not supporting	
3D point cloud map editing	Not supporting	
2D point cloud map editing	Supporting	
Communication method	Network interface communication/WIFI communication	WIFI communication requires the configuration of a WIFI router
Secondary development interface	Websocket/Http	Computing power is unable to use

Industry-Level robot navigation solution

Type	Detailed parameters
Multi-line LiDAR	laser wavelength: 905nm
	Ranging capacity:150m(90m@10% NIST)
	Blind area: ≤0.2m
	Accuracy (typical value): ±2cm(1m to 100m)
	Horizontal field of view : 360°
	Vertical field of view : 30° (-15°~ +15°)
	Horizontal angular resolution: 0.1°/0.2°/0.4°
	Vertical angular resolution: evenly 2°
	Output points: ~288,000pts/s(single echo)
	~576,000pts/s(double echo)
	Product power (typical value): 11W
	Operating temperature: -40°C ~ +60°C
	Storage temperature: -40°C ~ +85°C
	Protection level: IP67
Industrial Personal Computer	CPU configuration: Intel i7 9th
	Memory: 16G DDR4 by default (expandable to 32G)
	Hard disk storage: 512 G SSD by default (industrial level)
	Operating temperature: - 20~60°C (SSD)
	Storage temperature: - 40~80°C
	Relative humidity: 10%~90%@40°C
	Vibration: SSD: 3Grms@5~500Hz, random, 1 hr/axis
	Impact: 10G, interval of 11 seconds, half sine wave

Type	Detailed parameters
IMU	Operating voltage: 5~24V
	Supporting data output of three-axis acceleration, three-cycle gyroscope, three-cycle attitude angle
	Operating temperature: -20°C~85°C
Blind-area compensation camera (optional)	Distance: 0.2m - 2.5m
	Colorful FOV
	■ 16:9: H86° V55° D93.5°±3°
	■ 4:3: H64° V55°
	Relative accuracy
	■ 1.0%(81% of the center) @1000mm
	■ 1.1%(81% of the center) @2000mm
RTK-GPS (optional)	Starting time
	■ Cold starting time of GNSS < 25s
	■ Initialization time of GNSS RTK <5s
	■ Integrated navigation alignment time <60s
	Supporting Beidou, GPS, Galileo, Glonass satellite system
	Accuracy of heading
	■ Dual antenna: 0.1°
	■ Single antenna: 0.2°
	Accuracy of Horizontal positioning: 1CM ± 1PPM

Hardware parameter description

Industry-Level robot navigation solution

Considerations on hardware configuration

➤ The selection of routers will be adjusted based on customer needs and scenarios. For example, in a robot operating scenario where an AP hotspot is required, a vehicle-side router can be selected. The vehicle can connect to the designated AP hotspot using its own WiFi, and will be assigned an IP address. Customers can communicate with the vehicle by accessing this IP address. If customers have specific requirements for routers in their scenarios, they can choose their own routers and configure them with the corresponding IP and network segments.

➤ The blind spot optimization camera uses a depth camera, which may generate noise and affect its normal operation under strong outdoor sunlight. Since different vehicle models have different dimensions and positions, the blind spots will vary after installing the LiDAR. Therefore, it depends on the specific vehicle model.

➤ If automatic charging is required, the current scheme for automatic charging requires a LiDAR to locate.

➤ At present, integrated navigation is mainly used in the relatively open outdoor area, which is used to assist in the relocation of LiDAR.

➤ If integrated navigation is used, it is necessary to evaluate whether the region in use can use the Qianxun network service.

Navis Navigation   **Hardware parameter description**

Industry-Level robot navigation solution

Additional Exlanation on technical parameters

➢ The area of drawing construction is mainly affected by whether the scenario is closed loop or not, and the environment data package is affected by the storage space of the industrial personal computer. In the case of large space, autonomous path planning is affected by computing power. The larger the space size and the farther the distance between path points, the higher the computing power required.

➢ Cross-floor mapping refers to directly constructing floors with other vertical heights in a vertical plane without re-recording the map after completing the mapping within a plane; however, a second map can be reconstructed for map building.

➢ The environment of re-positioning accuracy test has obvious structural features, and the scenario change rate shall be lower than 10%. If the scenario change rate is too high, the re-positioning accuracy may be low.

➢ Map incremental expansion refers to expanding the map of unknown areas directly on top of the local map if it has already been built, without the need to rescan the previously map;

➢ Ladder control and IoT: Currently there is no direct adaptation of ladder control module and IoT module support in the navigation map description, and we are evaluating possible selection options and appropriate logic;

➢ At present, the computing power in the navigation host does not support the deployment of client applications. If customers need to develop their own corresponding applications, additional computing units need to be configured.

Navis Navigation **Software interaction platform**

Industry-Level robot navigation solution

The Navis Board software interaction platform is a web-based full-platform robot management system software that can be customized for different industries, of which main basic functions include:

■ Data visualization, including but not limited to:

- ☐ Mileage data
- ☐ Vehicle status data
- ☐ Battery data
- ☐ LiDAR data
- ☐ Storage space data

■ Map management: map creation, map editing

■ Task management: task planning, management and execution

■ System management and third-party ecological application access

Navis Navigation 软件交互平台
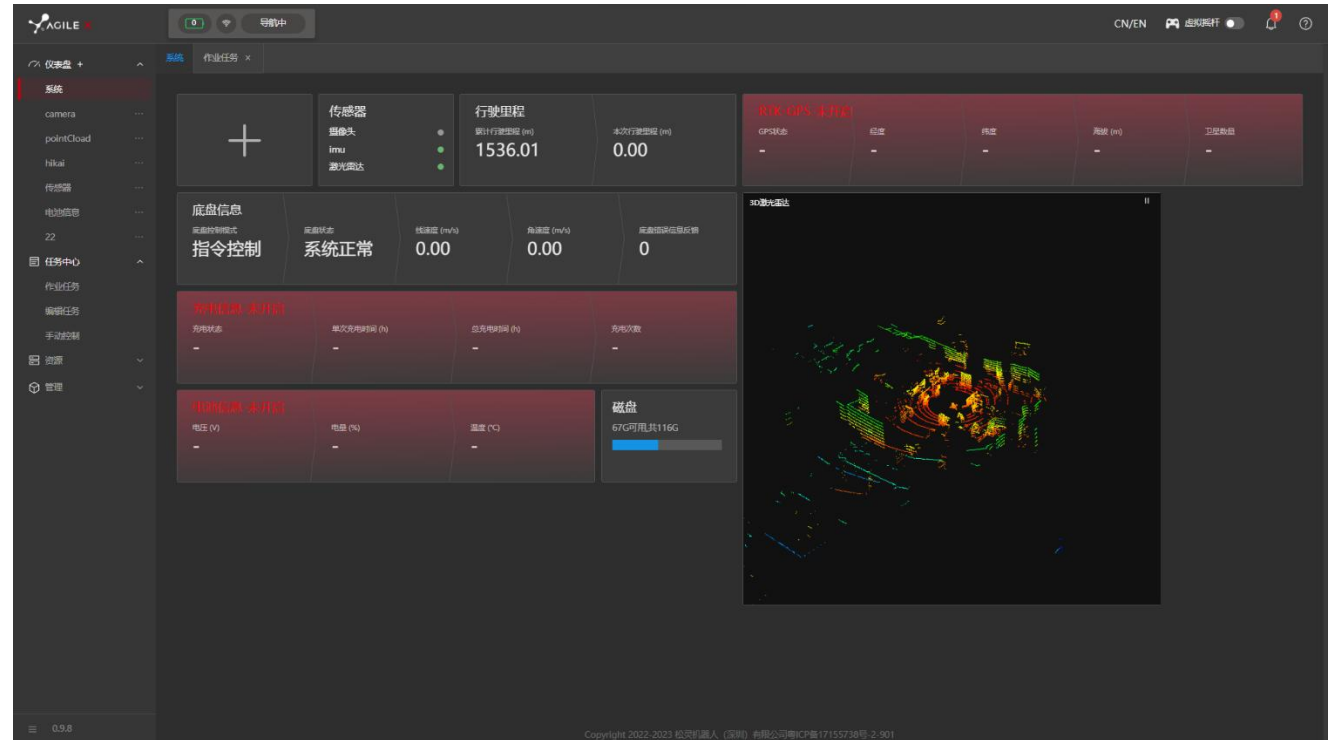
Industry-Level robot navigation solution

行业级移动机器人导航方案

数据看板为数据可视化的具体呈现模块，用户可在看板上自由添加所需数据类型，用户只需一键拖拽所需的数据板块至看板，即可在看板订阅对应的实时数据类型。
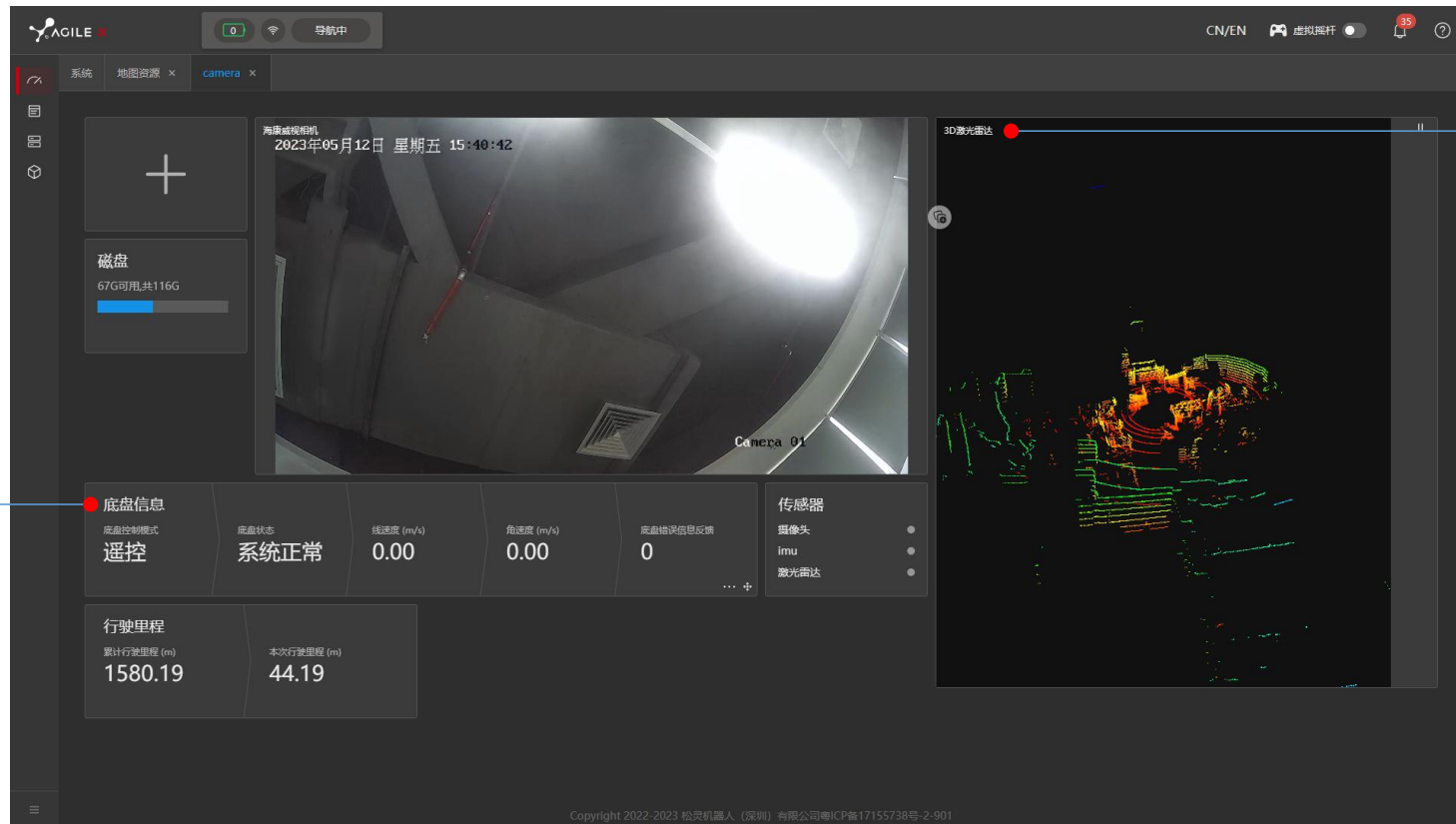
用户可基于自身业务需要，增加数据看板类型，也可以定制用户企业自身的数据看板呈现（含LOGO专属定制），该部分由Agilex Robotics定制化服务团队提供技术支持。

Navis Navigation

Industry-Level robot navigation solution

Dash board is the concrete presentation module of data visualization. Users can freely add the required data types on the dash board, and can subscribe to the corresponding real-time data types by dragging the required data blocks to the dash board with one click.
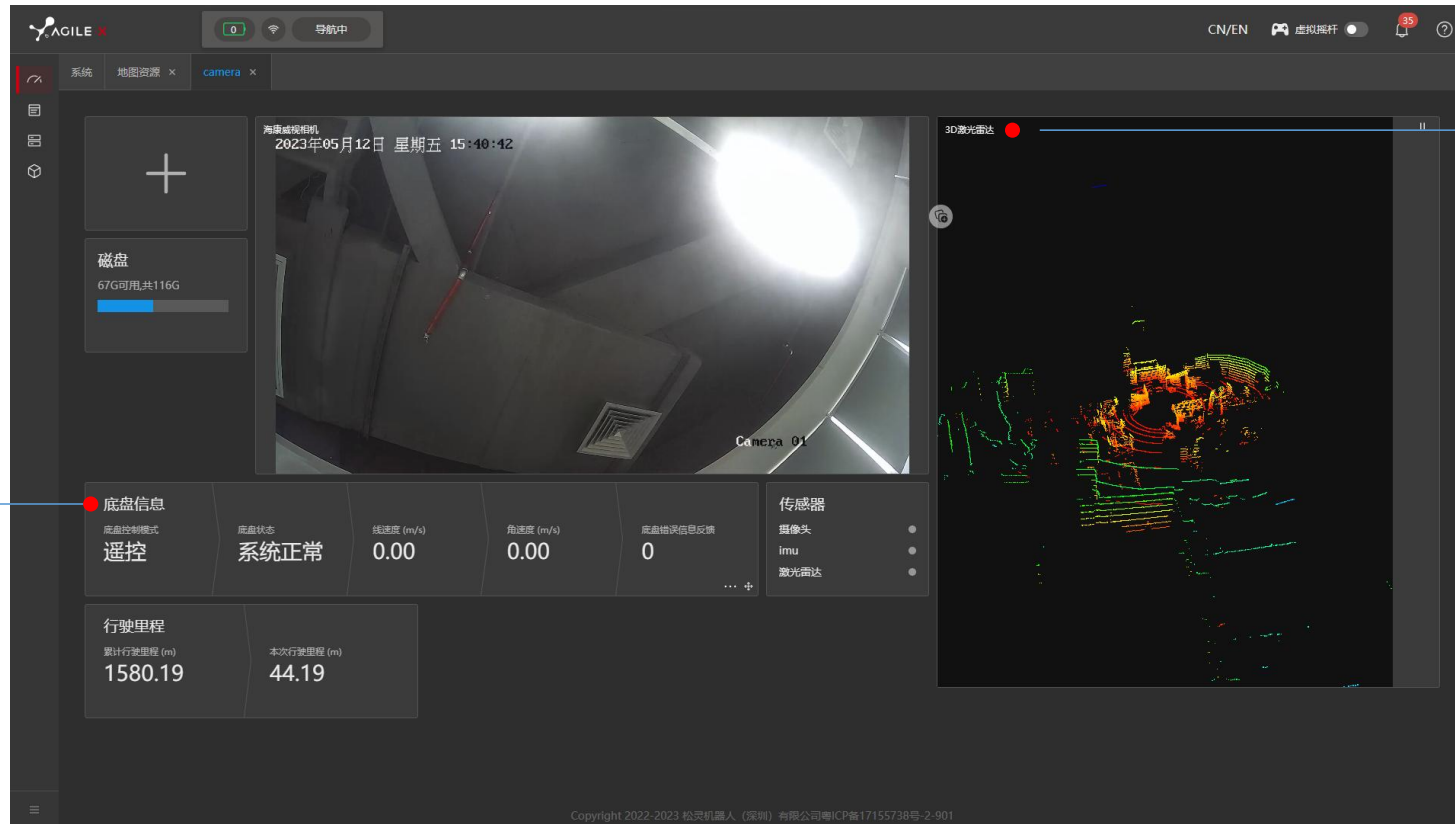
Users can add types of dash board based on their own business needs, or customize their presentation of dash board (including exclusive customization of LOGO). This part is provided by the customization service team of Agilex Robotics.

Navis Navigation   **Software interaction platform**

Industry-Level robot navigation solution
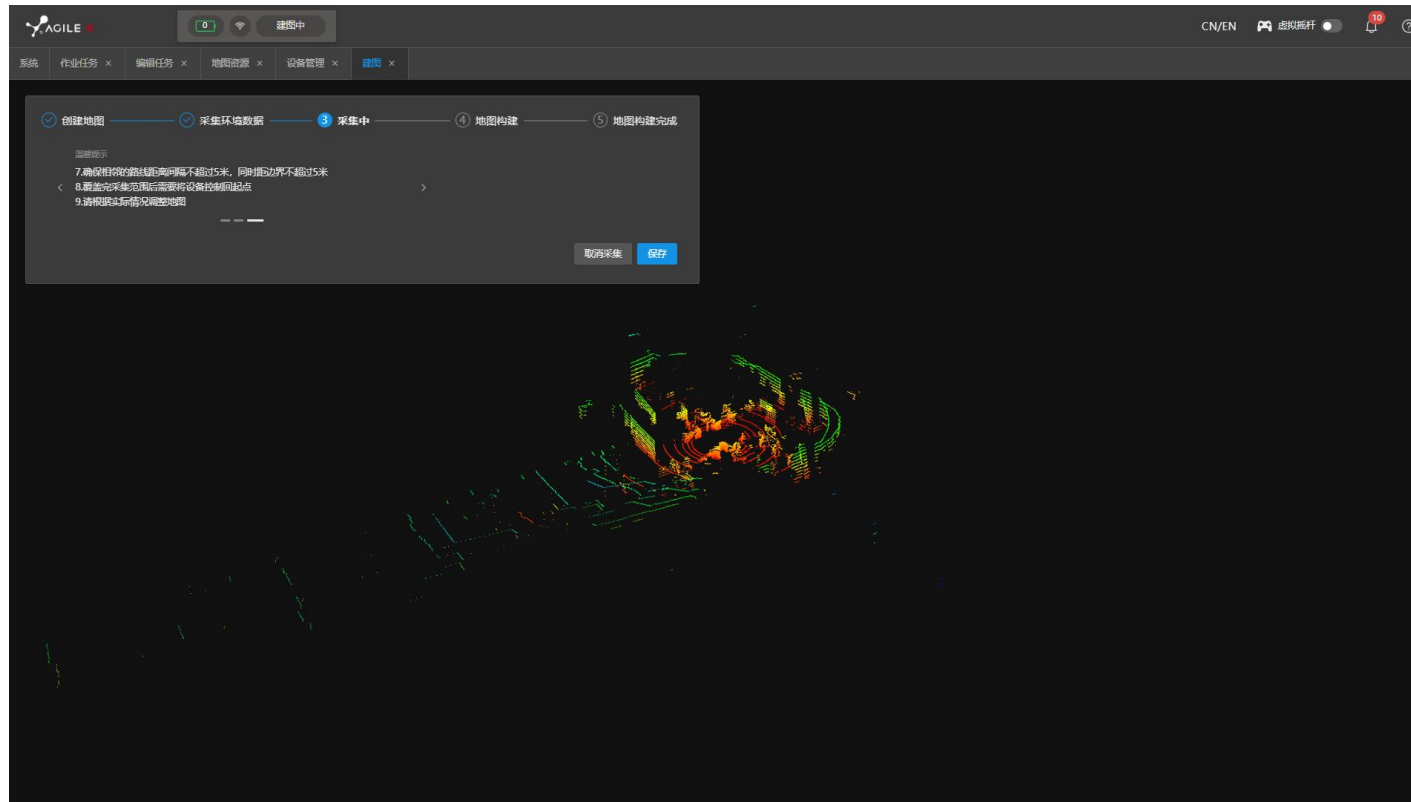
The Navis Board provides comprehensive guidelines for navigation map building. When entering a navigation map building task, users only need to follow the task guidance to quickly complete the navigation map building operation, and it is automatically saved in map resources, making it easy to modify and invoke at any time.
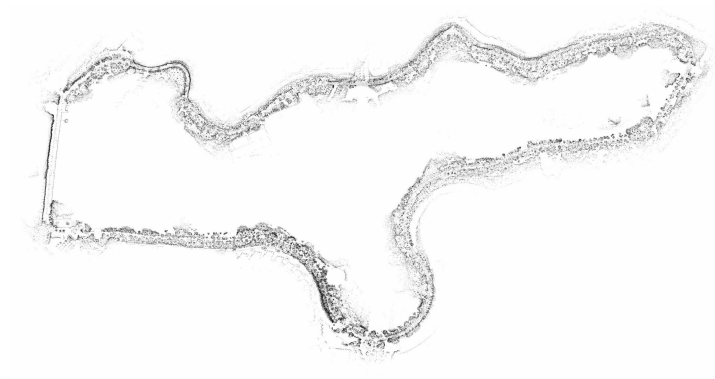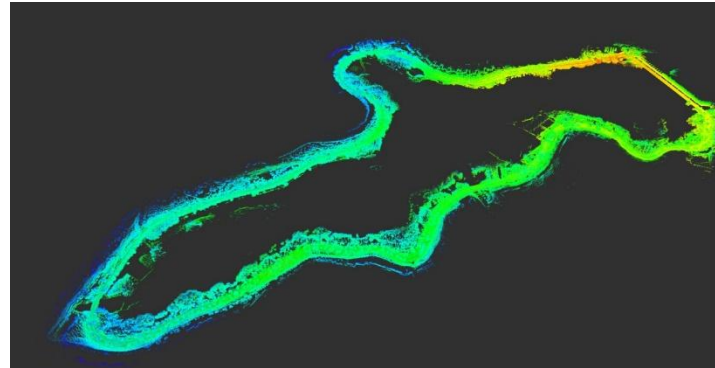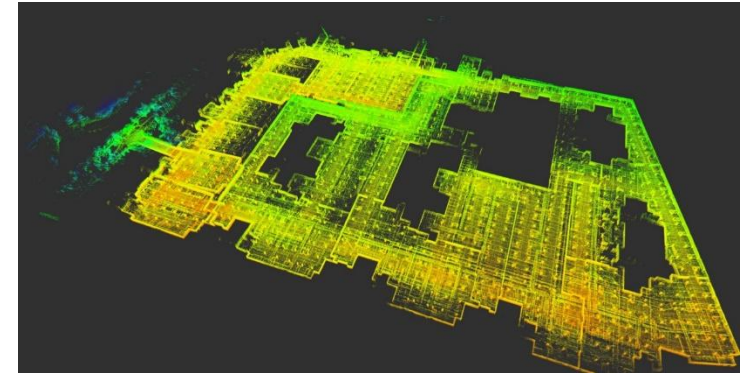
Industry-Level robot navigation solution

行业级移动机器人导航方案
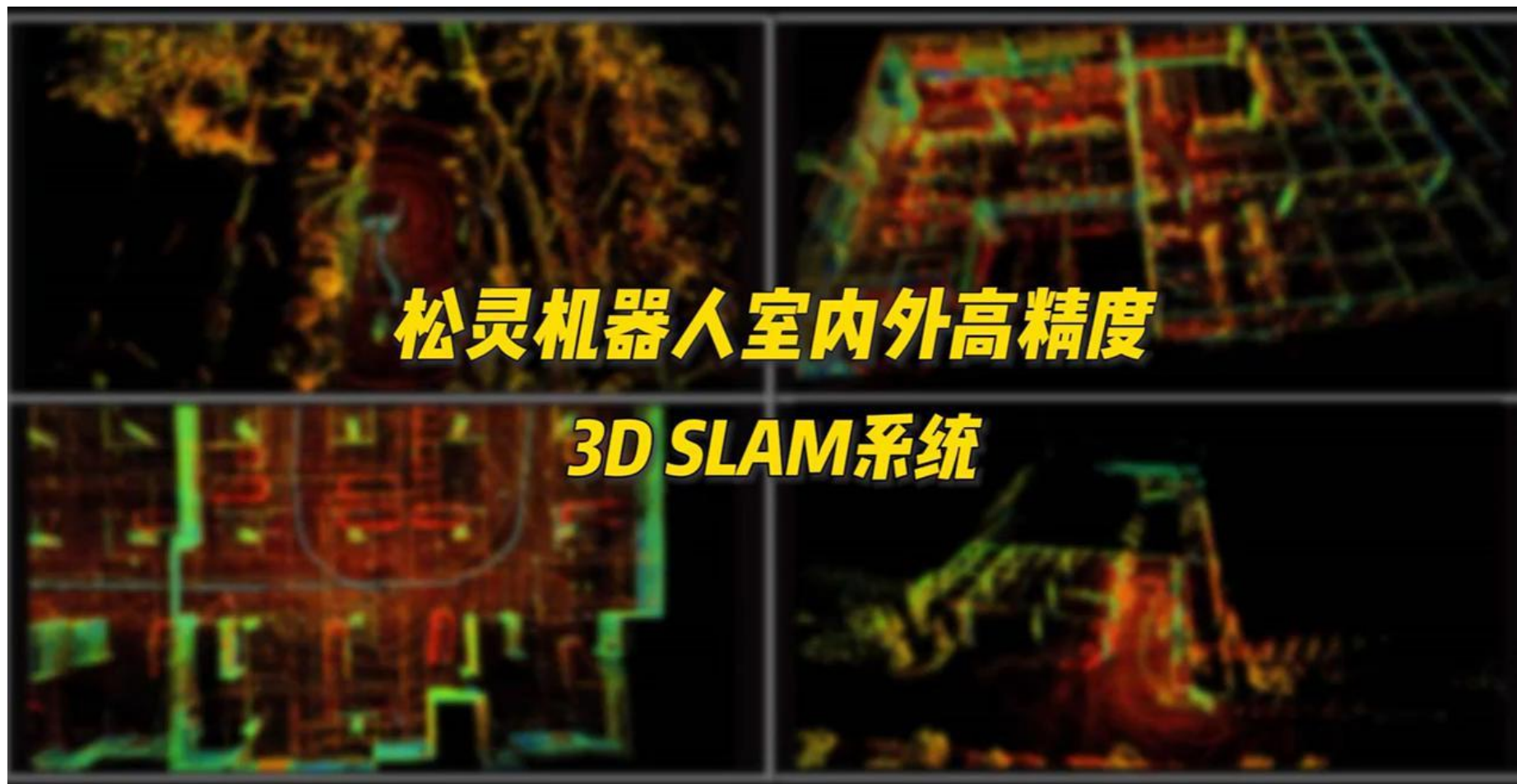
Industry-Level robot navigation solution
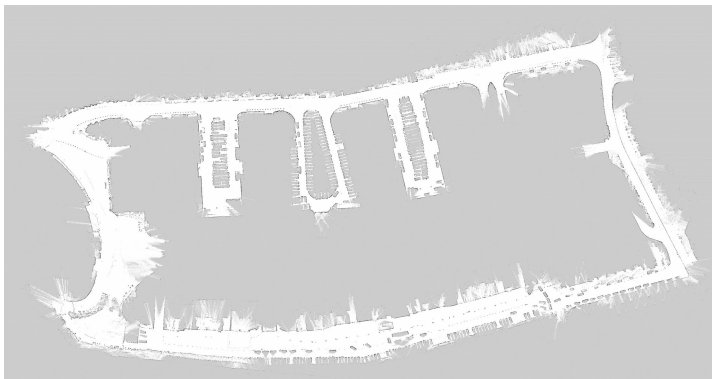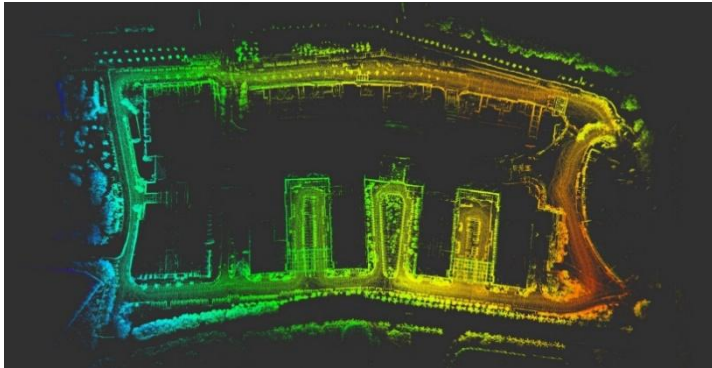
Half-closed area 30W㎡ mapping effect

Outdoor park 115W㎡ mapping effect

Underground parking lot 16W ㎡ mapping effect

Navis Navigation   **Software interaction platform**

Industry-Level robot navigation solution

The resource module of Navis Board contains all navigation map data created by users. Users can conveniently name, preview, edit, export, and delete maps, and switch point cloud maps in different operating scenarios at any time.
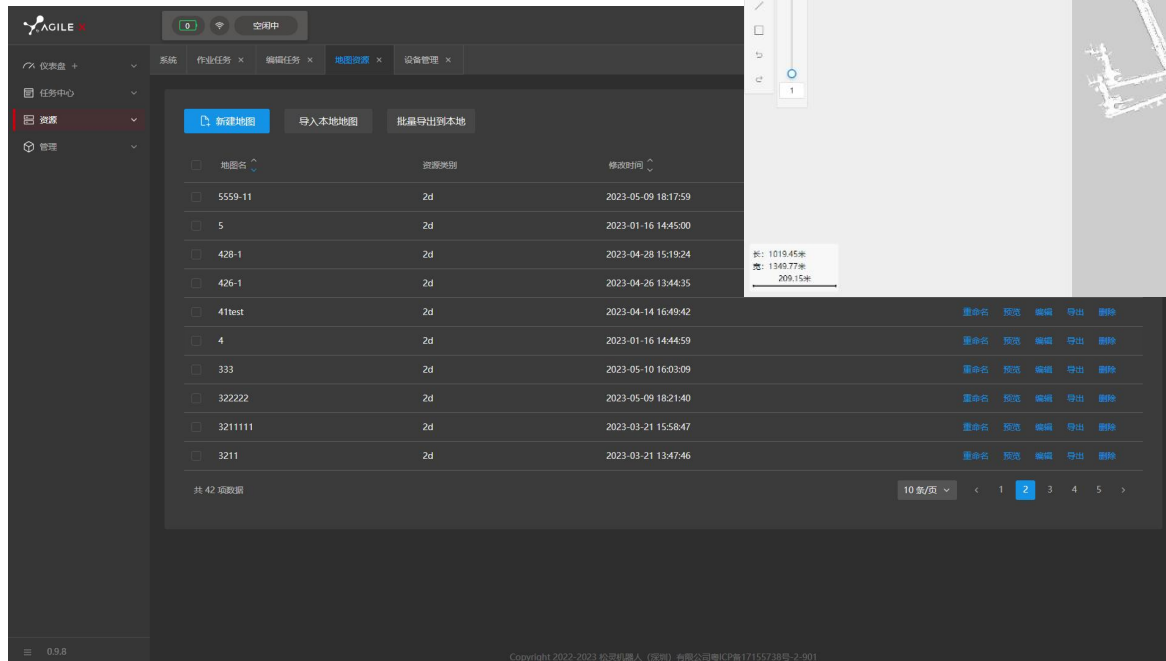
In the map editing module, users can edit on the basis of completed map resources, erase the obstacle areas on the map, and set up virtual walls (delineating the robot operation area) to make the map boundaries clearer and facilitate the robot to operate in the environment more smoothly.

Navis Navigation **Software interaction platform**

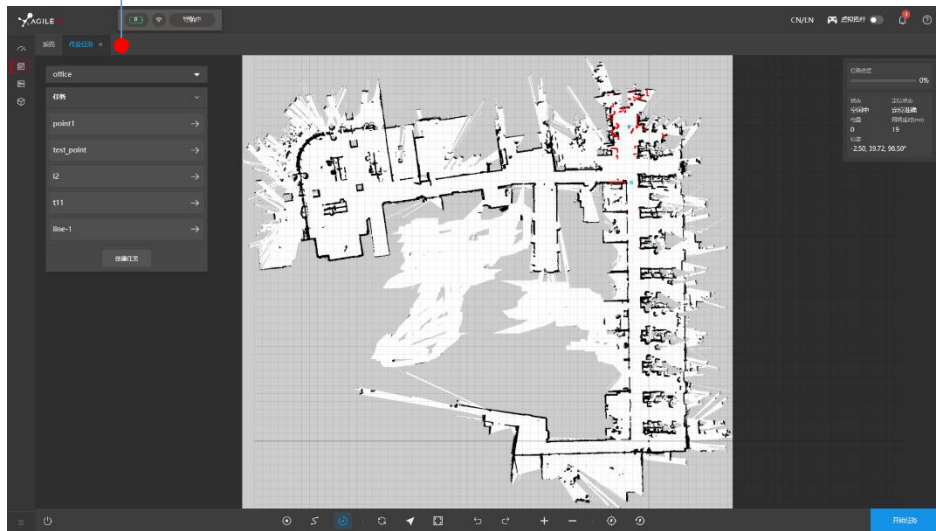Industry-Level robot navigation solution

In the task management module, users can choose the point navigation mode, which supports users to select robot navigation points from the constructed point cloud map and set specific task actions, such as orientation, when the robot reaches the navigation point.
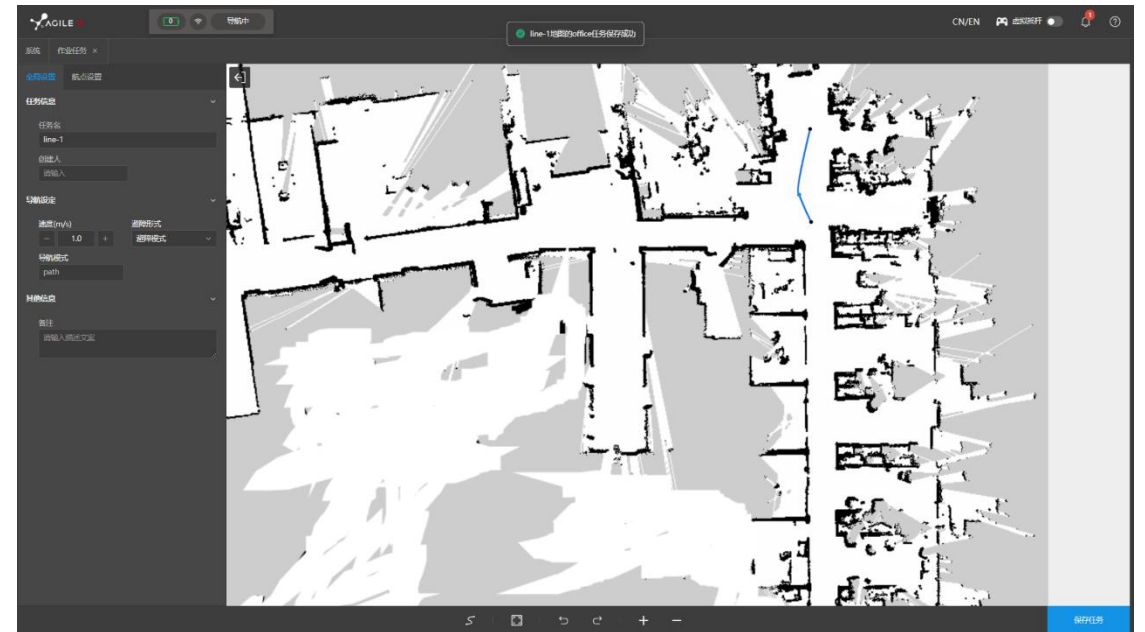
Users can also choose the path navigation mode, which supports users to set the complete robot walking force, as well as the robot's walking speed and obstacle avoidance mode. At the same time, it also supports setting the specific task actions that the robot will perform when reaching the end of the path, such as orientation.

# Navis Navigation   **Software interaction platform**

Industry-Level robot navigation solution

After establishing the corresponding navigation task in the task management module, users can select the corresponding navigation task for autonomous robot navigation operations. After selecting the task, they can start the task with a single click in the lower right corner. During the task process, they can pause or start the task at any time.


During the execution of navigation tasks, users can view real-time feedback including task progress, status, positioning status, battery level, network latency, and pose information at any time through the dash board.

Navis Navigation **Software interaction platform**

Industry-Level robot navigation solution
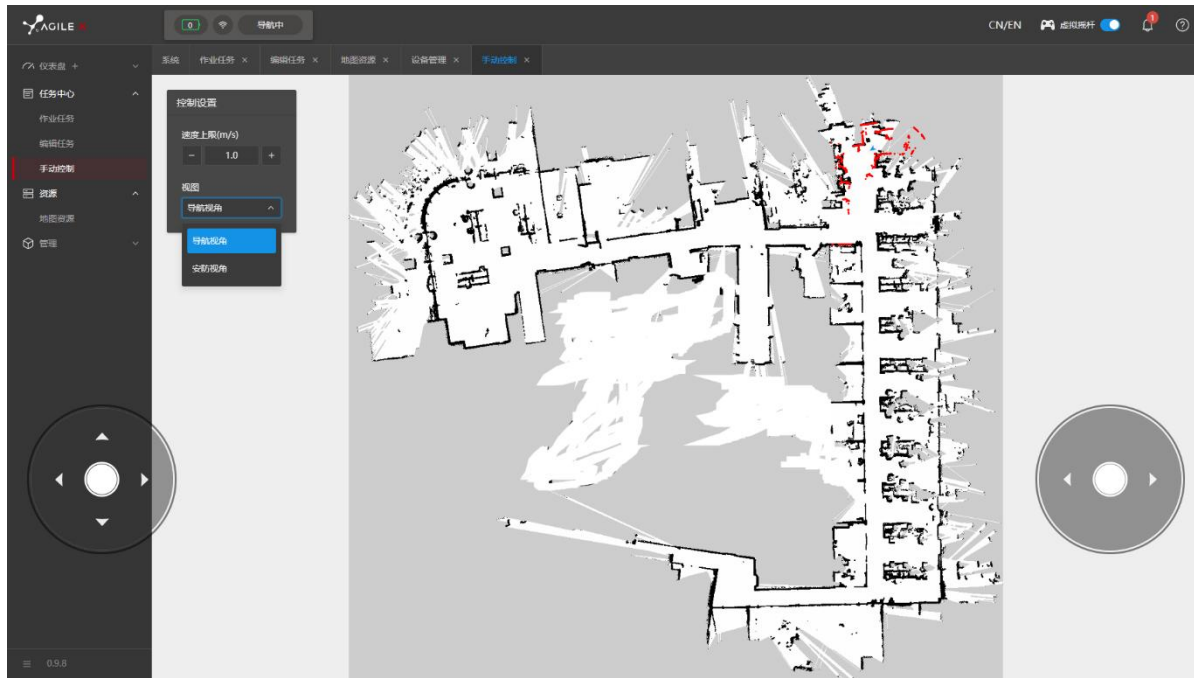
Users can choose to manually control the robot's movement (which requires local area network or 4/5G network conditions). In this mode, the software backend will have a virtual joystick, and users can choose a security or navigation perspective to remotely control the robot's movement and operation.
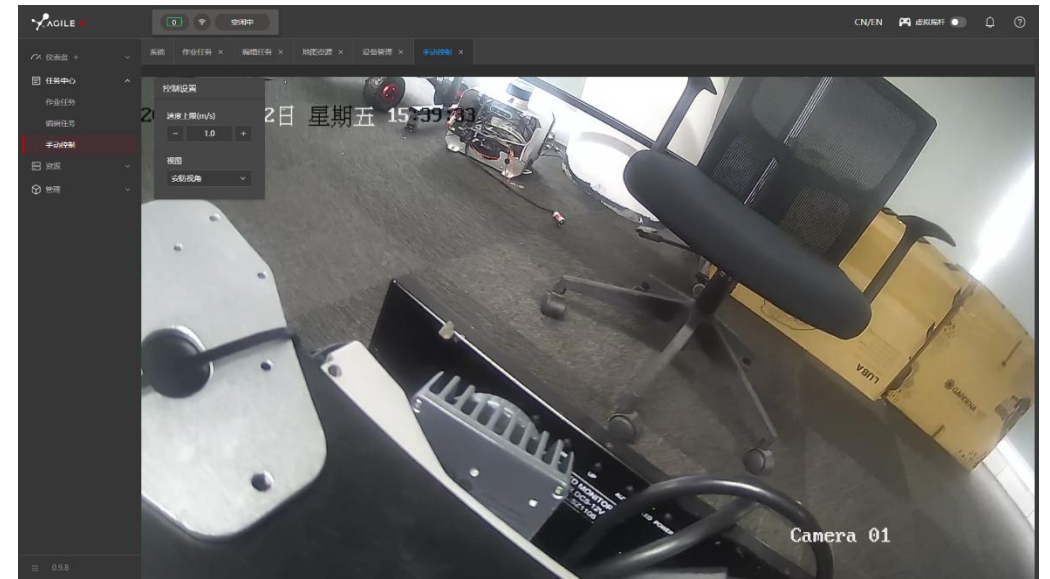
From the perspective of security, high-definition remote image transmission is used, which presents real-time images in the scenario through transparent transmission of the server. Users can control the movement of mobile robots based on image transmission.
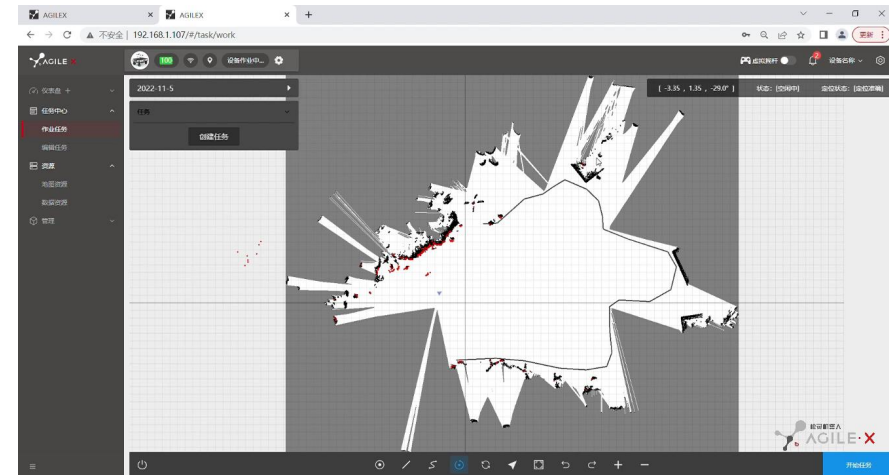
Navis Navigation   **Software interaction platform**
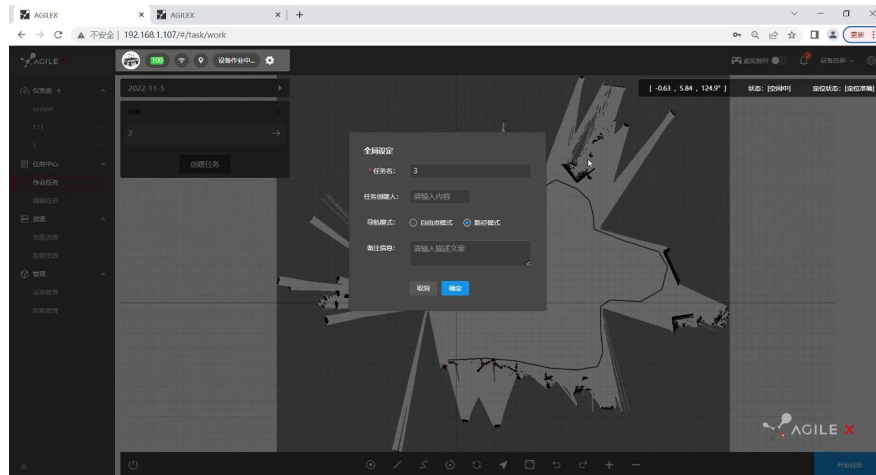
Industry-Level robot navigation solution
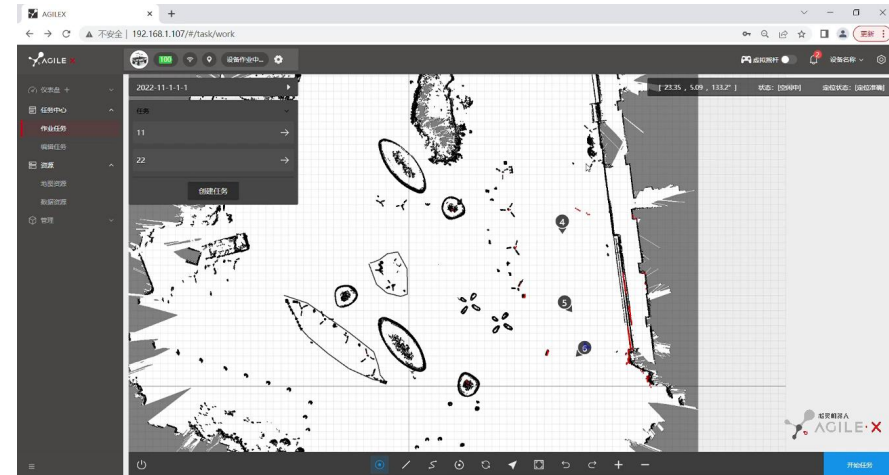
行业级移动机器人导航方案
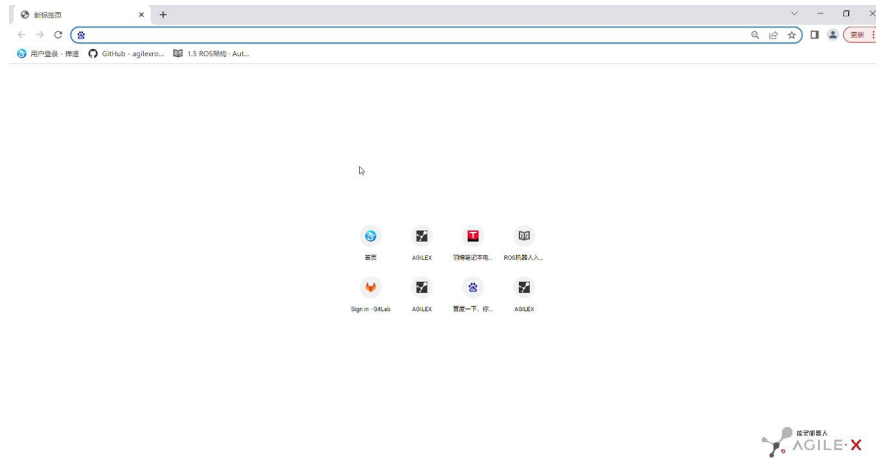
Map building and map editing

Task points and execution

Industry-Level robot navigation solution

Line segment task and execution

Navigation task and execution

Navis Navigation **Software interaction platform**
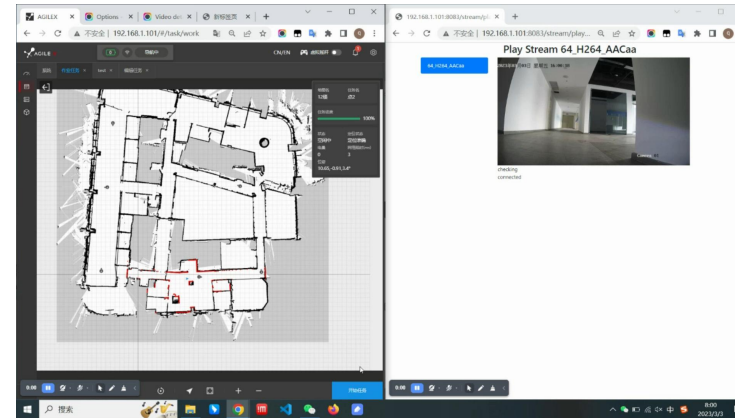
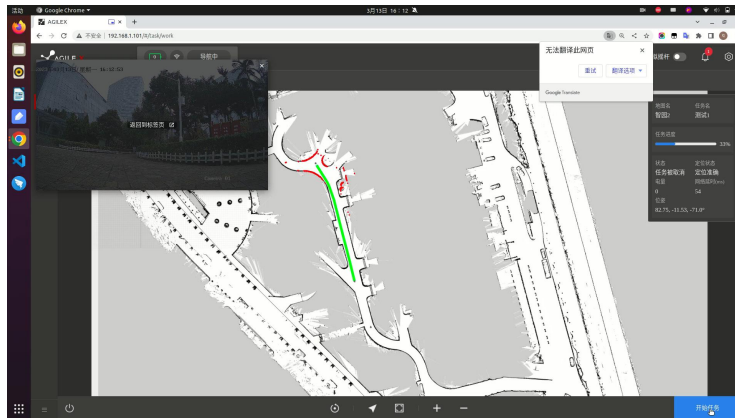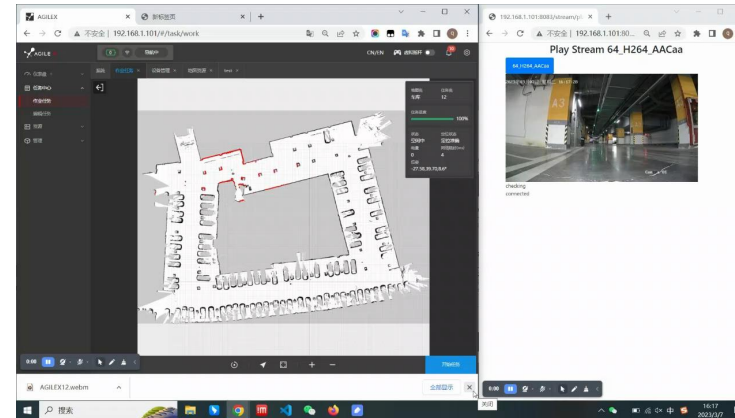Industry-Level robot navigation solution

Large enclosed factory

Inside of commercial buildings

High-tech park

Underground parking lot

Industry-Level robot navigation solution

NLP | Scenario simulation

Edge computing platform/cloud server

Operation backend | APP

Point cloud/image data

2D/3D map building

Path planning

Autonomous navigation

Autonomous obstacle avoidance

Industrial design

LiDAR | Binocular camera

IMU | RTK GPS

......

SDK | API

Python | C/C++

Ubuntu System

4/5G | Router

WIN | Other

ARM | NVIDIA

PTZ Camera | Robot arm

Mapper | Gas detection sensor

Acousto-optic device | Distribution box

Multispectral spectrum | ......

Industry-Level robot navigation solution

CAN Communication

All-terrain structural design | Motion control algorithm | Motor control | Modular expansion access

Power module

Automatic charging

Navis Board software platform makes the development of mobile robots more agile and efficient. No matter what kind of industrial applications, rapid access can be conducted based on Navis Board, such as security inspection, and users need to add a PTZ dual-optical camera. The hardware can be quickly deployed based on Agilex Robotics mobile chassis, and the software only needs to add corresponding interfaces to quickly complete the deployment of PTZ dual-optical camera, supporting the rapid access of many third-party applications.

Navis Navigation **Software interaction platform**

Industry-Level robot navigation solution
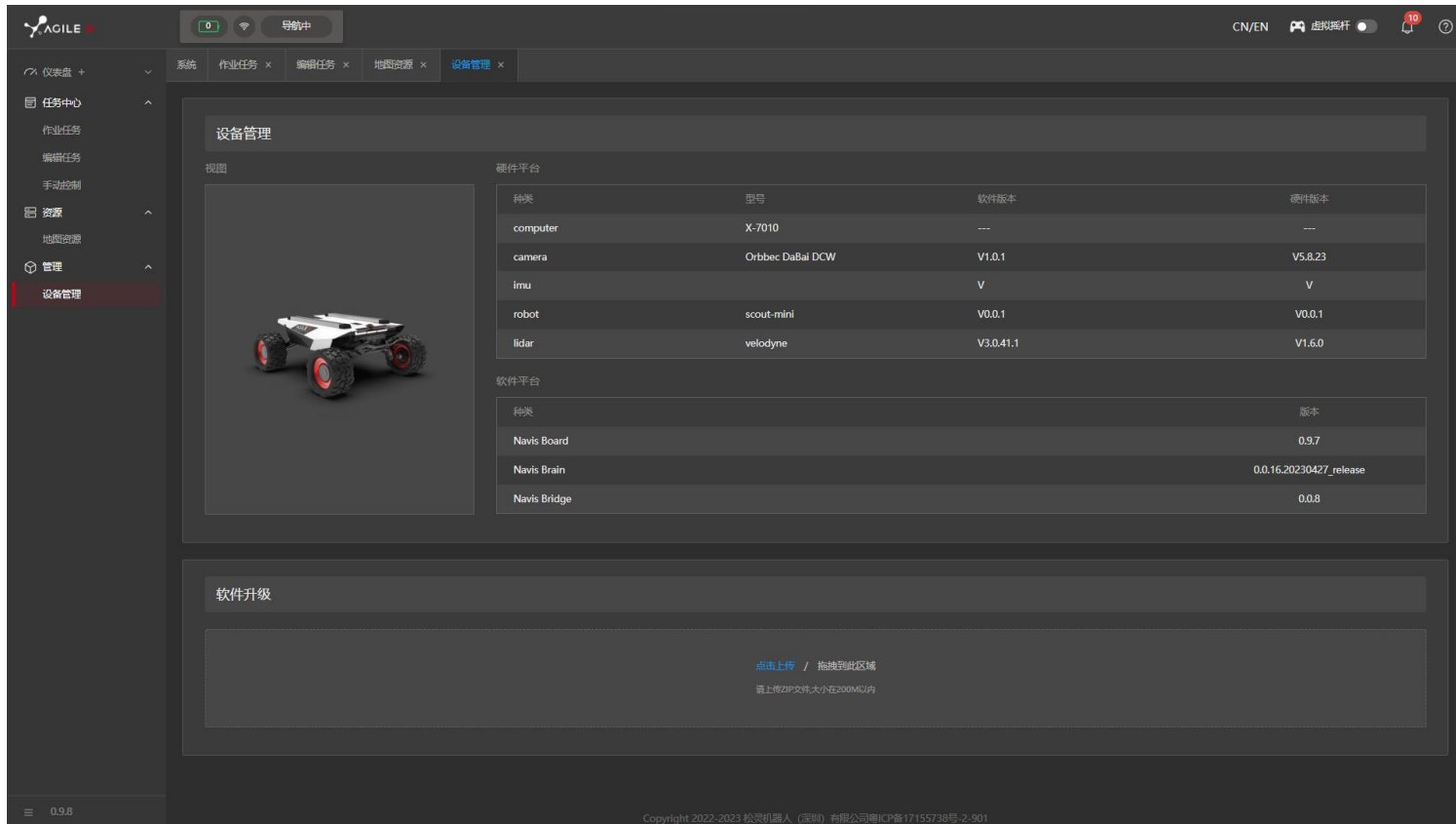
The management module of Navis Board software platform is a third-party application management module that supports customized development, making it easy to quickly manage connected devices such as PTZ cameras, robotic arms, omnidirectional instruments, etc. Users can commission Agilex Robotics to customize products, quickly forming mobile robot industry application solutions.

Navis Board provides a unified and fast access mode for applications, in which users do not need to worry about the underlying implementation, what they see is what they get, and is unnecessary to worry about software adaptation. They only need to connect as plugins or choose from the plugin store to easily integrate corresponding devices into the unified system platform.

Navis Navigation   **Software interaction platform**

Industry-Level robot navigation solution

Comprehensive technical support

✓ Comprehensive API technical documentation and sample engineering code will speed up your deployment;

✓ The engineers' after-sales technical communication group will directly solve your technical difficulties in the technical development process;

✓ For subsequent engineering optimization, we will provide software upgrade packages to upgrade your product;

✓ For customized needs, we will also conduct appropriate and reasonable assessments to provide satisfactory services.

If the navigation system is equipped with a wireless router (optional), the Navis Bridge allows users to conduct secondary development through WebSocket and Http on the premise of directly contacting the system through LAN or network cable. The interface includes sensor raw data, map building, map editing, task editing, task management, system status, etc. Agilex Robotics also provides rich example codes to guide users on how to use and develop the products.

Navis Navigation

Industry-Level robot navigation solution


Project requirement

The customer wants to realize the comprehensive test of outdoor cluster scheduling control algorithm based on multiple devices, and needs to find such a mobile robot that owns the ability of positioning, navigation and video transmission in relatively open outdoor areas, as well as the ability of positioning and navigation, autonomous obstacle avoidance, along with a portable and mobile chassis. The multi-state vehicle is required to own the ability of Ad-hoc networking, facilitating unified scheduling and control of multiple devices. In addition, the customer also requires the ability to obtain some raw data from sensors through interfaces.

Scheme description

The SCOUT MINI small four-wheel differential mobile chassis is fitted with NAVIS 360 version, as well as a Hikvision security camera. And a small wireless router with mesh Ad-hoc networking is adopted for communication, realizing convenient testing. Through http and websocket interfaces, the scheduling algorithm development and verification experiment of several devices have been quickly completed, which accelerates the progress of R&D and experiment.

Scheme configuration

SCOUT MINI (cross version) + Hikvision Security Camera + H3C Mesh Router + NAVIS

360 Version + Customization Service of Brackets
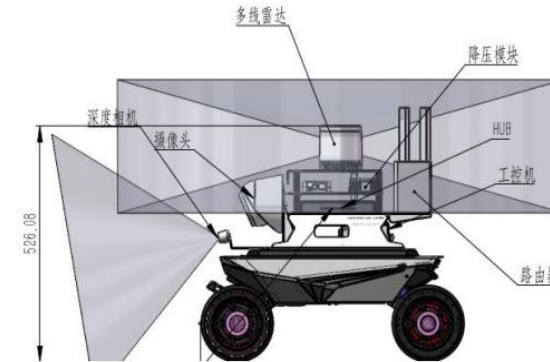
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