

SLAMTEC

Athena 2.0

General Purpose Robot Platform

Model: N5M42-R3

User Manual

- Small- to medium-sized robot development
- Highly adaptable and scalable
- Powerful optional functions

[Learn more >](#)



Shanghai Slamtec Co., Ltd.

2024/06/27.rev.1.8 Read through this user manual carefully before

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1. Product Overview

1.1 Introduction

Developed by Slamtec, Athena 2.0 is a scalable and low-cost robot platform capable of meeting the needs of small-sized robot application development in areas such as smart patrol robots, container transportation robots, food delivery robots, and more.

The built-in SLAMCUBE 2 autonomous localization and navigation system enables path-finding and localization and navigation features, making Athena 2.0 capable of performing a variety of tasks across different commercial environments.

Cross-floor Moving, Light Deployment

Athena 2.0 is equipped with the latest version of Slamtec Smart Elevator Control 4.0, which allows it to adapt to different brands of elevators.

Through the latest version of Slamtec RoboStudio 2.0, Athena 2.0 supports integration of maps of multiple floors in one click. This improves the mapping efficiency and streamlines the deployment, thus enabling light deployment and fast use.

Multi-Sensor Data Fusion

Athena 2.0 uses multi-sensor data fusion technology. Fitted with equipment such as lidar, magnetic sensors, depth cameras, and bumper sensors, Athena 2.0 can implement autonomous mapping, localization, and navigation by flexibly responding to complex and ever-changing operational environments.

1.2 Basic Functions

1.2.1 Compact and Flexible

Athena 2.0 can move flexibly in a small size, thus meeting the needs of flexible moving and deployment-free scenarios. Thanks to its high obstacle passing stability, Athena 2.0 can easily pass narrow aisles and ramps.

1.2.2 Cross-floor Delivery and Light Deployment

Athena 2.0 is equipped with the latest version of Slamtec Smart Elevator Control 4.0, which allows it to adapt to different brands of elevators. When combined with RoboStudio 2.0, it can effectively enable light deployment and fast use.

Smart Elevator Control 4.0 addresses the challenges of bad weather, as well as unstable air pressure and communication in high-rise buildings. It provides accurate detection of elevator statuses along with call-control functionality. For hotel/restaurant delivery robots, it provides efficient and reliable solutions that help them autonomously navigate elevators in cross-floor scenarios.

1.2.3 Autonomous Mapping, Localization and Navigation

Athena 2.0 is built with the latest version of Slamtec SLAMCUBE 2 autonomous localization and navigation system which is more stable and can accommodate more interfaces. The

structural design integrated three boxes into one, saving more space for base layout. With the path-finding, autonomous mapping and localization and navigation features, it helps robots figure out where they are, where they should go, and the best way to get there. It enables the robots to automatically find paths, locate, and move as needed without human assistance. In addition, Athena 2.0 supports multi-route patrol mode.

1.2.4 Rich Port Options and High Scalability

Athena 2.0 owns a completely open hardware and software platform and supports extended hardware. The rich port options eliminate the restrictions in development platform and programming language, which makes Athena 2.0 universal for all types of host computer and support development of business logic applications through SLAMWARE SDK.

1.2.5 360° Protection and Smart Obstacle Avoidance

Athena 2.0 is fitted with equipment such as lidar, magnetic sensors, depth cameras, and bumper sensors, and adopts the multi-sensor fusion technology. It provides rapid and accurate identification of surrounding active environments, enabling smart obstacle avoidance and greatly reducing the chances of safety incidents. It also has fall-resistant and collision-resistant protection and emergency stop features, making the food delivery process fully protected, secure, and reliable.

1.2.6 Autonomous Recharging

The autonomous recharging feature ensures that Athena 2.0 will have enough power to complete the assigned tasks. Athena 2.0 will return automatically to its charging station when its remaining power falls below the set limits.

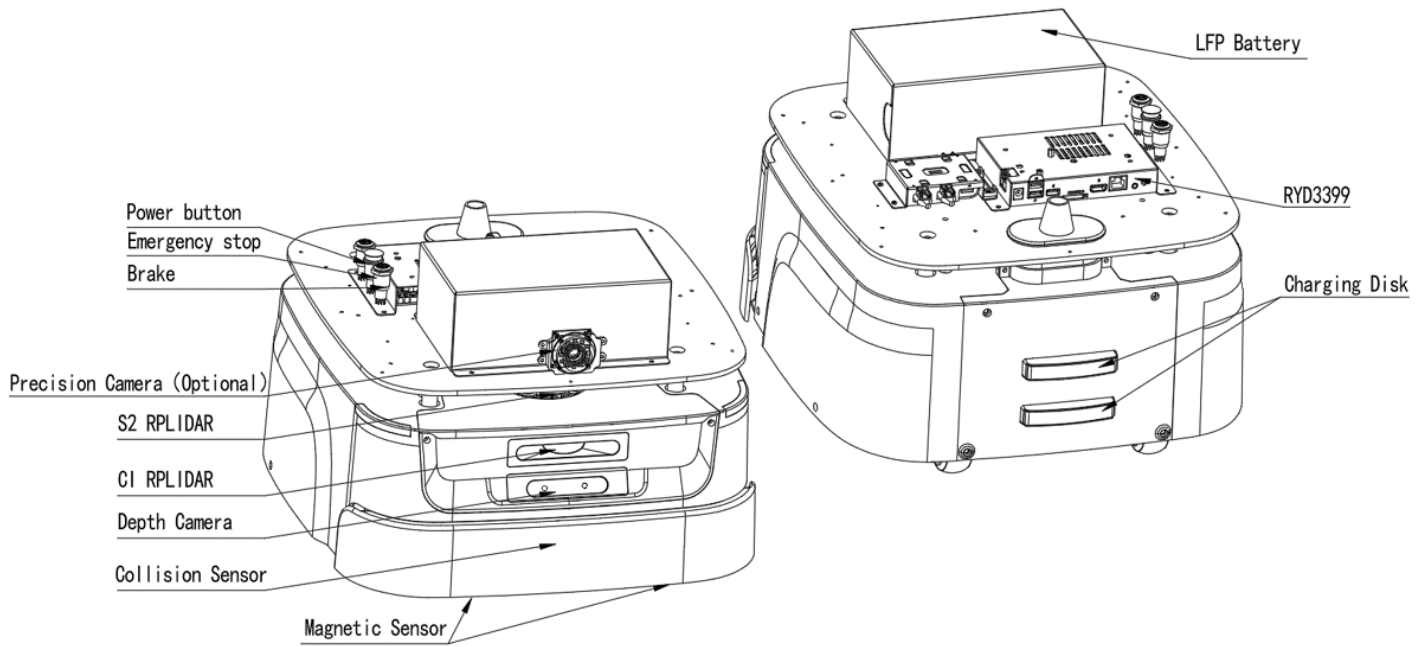
Special note: the automatic recharge function cannot be triggered only under the condition of that combined with upper machine with delivery and disinfection plug-in or customized models.

1.2.7 Multi-robot Scheduling & Collaboration

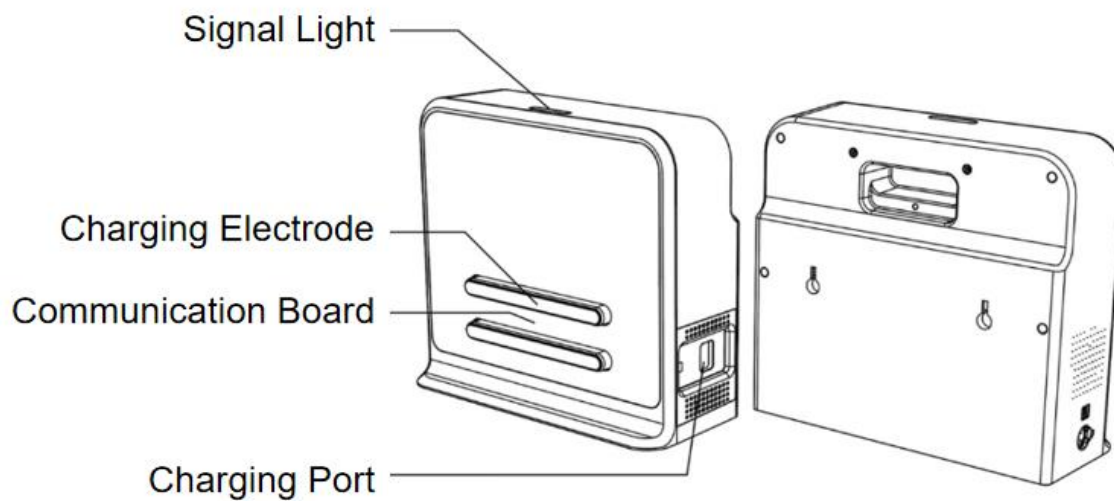
In scenarios such as large hotels, office buildings, and malls, multiple robots will avoid each other according to the task priority when they meet. The collaboration of multiple robots can further improve the delivery and guide efficiency.

Athena 2.0 supports local area network (LAN) and cloud platform collaborative operations, along with the dynamic adjustment of both speed and delivery routes in accordance with the environment to realize efficient, safe, and reliable multi-point delivery.

1.3 Exterior



1.4 Charging Station



Charging station diagram

1.5 Product List

| Name | Quantity | Notes |
|------------------|----------|---|
| Athena 2.0 body | 1 | Athena 2.0 base body |
| Charging station | 1 | Select environment for deployment before use. |

2.Product Parameters

| Model | | Athena2.0 Robot Base | |
|----------------------|---------------------------------------|--|---|
| Core Feature | | SLAMWARE™ Localization and Navigation | |
| Dimension and Weight | | Length × Width | 429*460mm |
| | | Height | 237mm (excludes controller, battery) |
| | | Net Weight | 22kg |
| | | Rated Load | 40kg |
| | | Max Load (Flat Concrete Surface) | 60kg |
| Sensor Performance | LIDAR | Scanning Radius (90% reflectivity) | 30m (Tof S2 LIDAR) |
| | Depth Camera | Quantity | Standard 1 unit |
| | | Detection Range | 0.3m – 3.5m (Varies with lighting conditions) |
| | | Field of View (FOV) | H:75±3°; V:51±3° |
| | Low Obstacle & Cliff Detection Sensor | Quantity | 1 |
| | | Minimum Detection Height for Low Obstacles | >3cm |
| | | Quantity | 2 |

| | | | |
|----------------------------|---|--------------------------------------|---|
| | Magnetic Sensor (Default Disabled, Enabled when Needed) | Max detection range | 35mm |
| | Bumper | Quantity | 2 |
| | | Trigger Mode | Physical Collisions |
| | | Detectable Minimum Force | 8N |
| Mapping performance | | Map Resolution | 50mm |
| | | Max Mapping Area | 300m x300m |
| Motion Performance | | Maximum Moving speed | 1.2m/s |
| | | Default Moving Speed | 0.7m/s |
| | | Maximum Moving Speed in Mapping Mode | 0.6m/s |
| | | Max Cross Slope | 10° Slope: Max slope angle of base: 10°; Slope = 18% × Ramp; The height of the full-machine mass center is within 18 cm, and the safety ramp within 10°. (A 100% slope means a 45° ramp, whose height difference for 100 m is 100 m.) |
| | | Vertical crossing height | 20mm |

| | | | |
|-----------------------------|--|-----------------------------|---|
| | | Horizontal crossing width | 40mm |
| | | Min Path Width (robot base) | 550mm |
| Wheelset | | Wheelset Parameters | 6.5 Inch In-Wheel-Motor*2 2.5 Inch Industrial Universal Wheel*4 |
| User Interface | Hardware Interface | Power Connector | DC 24V 10A |
| | | | DC 12V 2A |
| | | HDMI | 1*HDMI |
| | | Audio | 1 × 3.5mm headset socket; |
| | 1 × LINE_MIC audio jack (co-lay with headset socket) | | |
| | 1 × Dual-channel 5w/8Ω amplifier jack | | |
| | Network Interface | Ethernet | 1*RJ45 Gigabit Ethernet port |
| | | Wi-Fi | 2.4GHz/5GHz |
| | Software Interface | SLAMWARE™ | HTTP APIs support different programming languages and platforms, such as Windows, iOS, Android, and Linux |
| Ethernet | | Wi-Fi | Network environment without authentication |
| | | 4G | Supports 4G SIM cards from domestic and international carriers (customized according to needs) |
| Battery and Capacity | | Capacity Specification | 20Ah (Lithium Iron Phosphate Battery) (Add-on) |






| | | |
|------------------------------|--|---|
| | Stationary State | >19H (No-load, Ambient Temperature Environment) |
| | No-load Operating Time | >15H (No-load, Ambient Temperature Environment) |
| | Full-load Operating Time | 8H(40KG, Ambient Temperature Environment) |
| | Charging Time | 3~4 h (Standard Charging stationer) |
| | Battery Life | Capacity decreases to 60% of the initial capacity after 2000 full charge and discharge cycles |
| Power Consumption | Standby Power Consumption | 17W(No-load) |
| | Full-load Rated Power Consumption (40kg) | 40W (Moving) |
| | Max Power Consumption with External Load | 240W |
| | Rated Output | 25.2V 2A |
| Noise | Operating Noise Level | ≤60db |
| Operating Environment | Operating Temperature | 0°C ~ 40°C |
| | Transport and Storage Temperature | -25-+55°C |
| | Operating Humidity | 20 ~ 90%rh (No condensation) |

| | | |
|--|--------------------|--------|
| | Operating Altitude | ≤2000m |
|--|--------------------|--------|

| Charging station | |
|------------------|------------------------------|
| Size | 360 mm*150 mm*320 mm (W*D*H) |
| Color | White |
| Rated input | 100-240V 50/60 Hz 3A Max |
| Rated output | DC 25.5V 6A |

3. Instructions Of Hardware

3.1 Wire Instructions

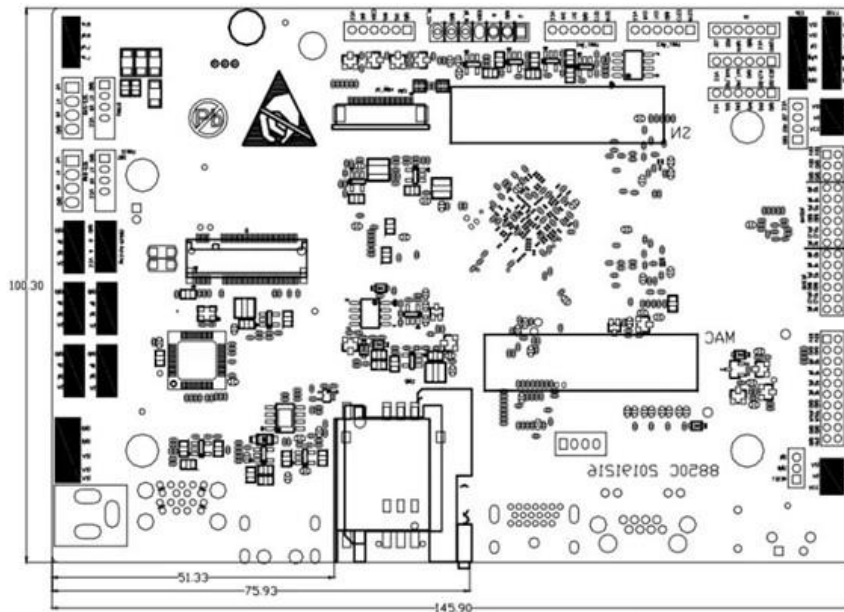
| Interfaces | Picture | Index | Function | Note |
|-------------------------------|---|--|--|---|
| Power ON/OFF |  | -- | Power switch of the entire system. Short press until the indicator light turns on power-on, long press until the indicator light turns off power-off. | -- |
| Shut Down |  | -- | Effectively control Athena2.0 in an emergency. After pressing, Athena2.0 will immediately shut down. | It is a switch that must be designed according to rigid regulations. If the switch is not designed, Athena2.0 will refuse to run. |
| Brake |  | -- | When robot is energized, press this switch to release the brake and you can push the robot freely; press it once again to brake, and the robot will not be able to push it freely. | Invalid if the robot is not turned on |
| 24V Power |  | Rated Voltage 24V Maximum current 10A | Maximum output power is 240W, can be used to supply power to external devices | No overload |
| 12V RYD3399 Power Supply Wire |  | Rated Voltage 12V Maximum Current 20A | Cube2R supplies power to the RYD3399 development board. | |

| | | | | |
|-------------------------------|---|---|--|--|
| <p>Depth Camera Interface</p> |  | <p>USB3.0</p> | <p>Connected to the RYD3399 development via USB3.0 to obtain information.</p> | <p>Need to pay attention to the left and right sequence.</p> |
| <p>Stationing Camera</p> |  | <p>USB2.0</p> | <p>Connected to the RYD3399 development via USB3.0 to obtain information of code scanning camera.</p> | <p>Assist precise stationing.</p> |
| <p>12V -DISP</p> |  | <p>Rated Voltage 12V (See the figure below for the design drawings)</p> | <p>12V working power of Cube2R to provide the external display screen of human-computer interaction.</p> | <p>Maximum current 2A</p> |
| <p>USB-BASE</p> |  | <p>USB2.0</p> | <p>Used for communication between 3399 and Cube2R.</p> | <p>Connect to Hub3.0</p> |

Design drawing of 12V -DISP terminal

| | | |
|---|--|--|
| Processor | CPU | Rockchip RK3399 ARM Dual-core Cortex-A72 and Quad-core Cortex-A53, up to 1.8 GHz |
| Memory | DDR | 4GB LPDDR3, 2G/4G(optional) |
| | Flash | 16GB eMMC Flash(Default), 8GB/16GB/32GB/64GB/128GB(optional) |
| | SD | 1xTF card storage expansion socket |
| Multimedia | H/W Video Codec | Decoder: 4K 60fps H.265/H.264/VP8; Encoder: 1080P30fps H.265/H.264 |
| Network | Ethernet | 1x10/100/1000Mbps |
| | WiFi+BT | Configurable, IEEE 802.11 b/g/n 2.4G, Supports BT4.2, BLE |
| | 4G | Mini-PCIe 4G module interface |
| Graphics | eDp | 1, max 1080p |
| | LVDS | 1x Dual Channel LVDS, max 1920x1200 |
| | MIPI | 2, max 1080p (reserved) |
| | HDMI | 1x HDMI Type A, max 3840 x 2160@60Hz |
| The display interface can meet diversified combinations, and can support dual-screen different display output | | |
| Video input | MIPI | 1x MIPI CSI (reserved) |
| Other | Support RTC function and timing boot, can be connected to CR2032 button battery; support system Watchdog | |
| I/O | USB | 6 x USB 2.0, 2 x USB3.0 (Contains OTG) |
| | Audio | 1 x audio output (3.5mm audio port), support left and right channel output, 2*5W8R |
| | Serial Port | 2 x RS232, 1 x RS485 (Optional for TTL serial port), 2 x ttlSerial Port, 1 x ttlDebug serial port |
| | SPI | 1, Multiplexed with ttl serial port. |
| | GPIO/ADC | 7 x GPIO (3.0V TTL level), 1 x ADC |
| | I2C | 1 x I2C (2.0mm-6pin), Can be connected to I2C touch screen; 1 x I2C (2.0mm-4pin) |
| | Button and pilot lamp | 1 x upgrade button (interface side), 1 x reset button (inside the board), 1 x power button interface, 1 x working status indicator interface |
| Power | Power Supply Voltage | 12V/24V DC-IN, 5.5*2.1mm, The board can be connected to 4pin-2.5mm power socket |
| | Power Type | DC-IN or power socket (optional) |
| Environment | Operating emperature | 0 ~ 60°C (-20 ~ 85 °C optional) |
| | Operating Humidity | 5% ~ 95% relative humidity, non-condensing |
| Mechanical | Radiating | Standard 28mm*28mm*6mm |
| | Dimensions (W x D) | 146 mm x 100 mm |
| Operation System | Android/Debian/Ubuntu | |

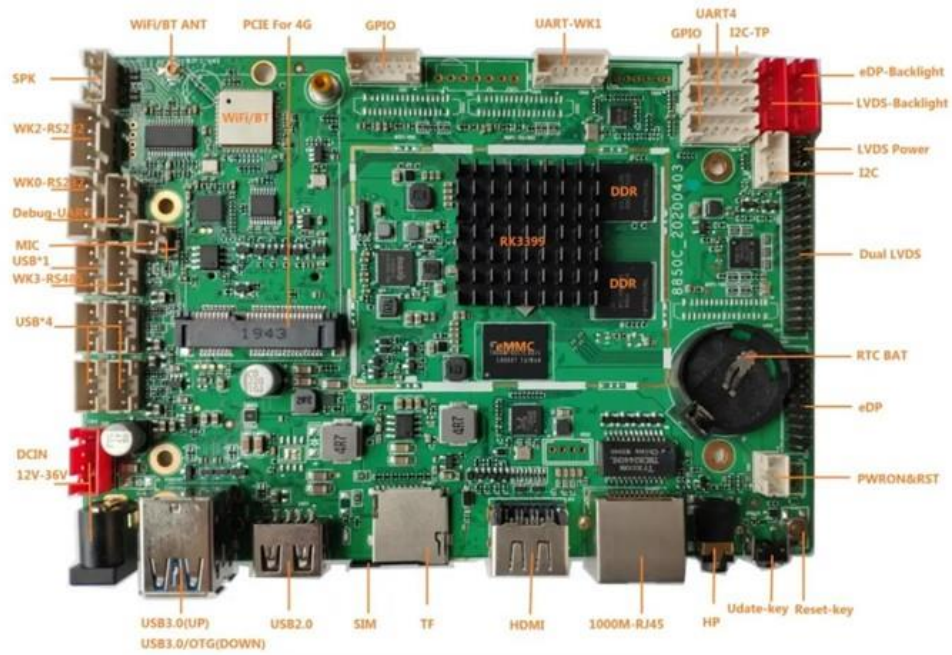
(2) Size of main board



Unit: mm

3.3.3 Introduction of Interfaces

(1) Front view of main board

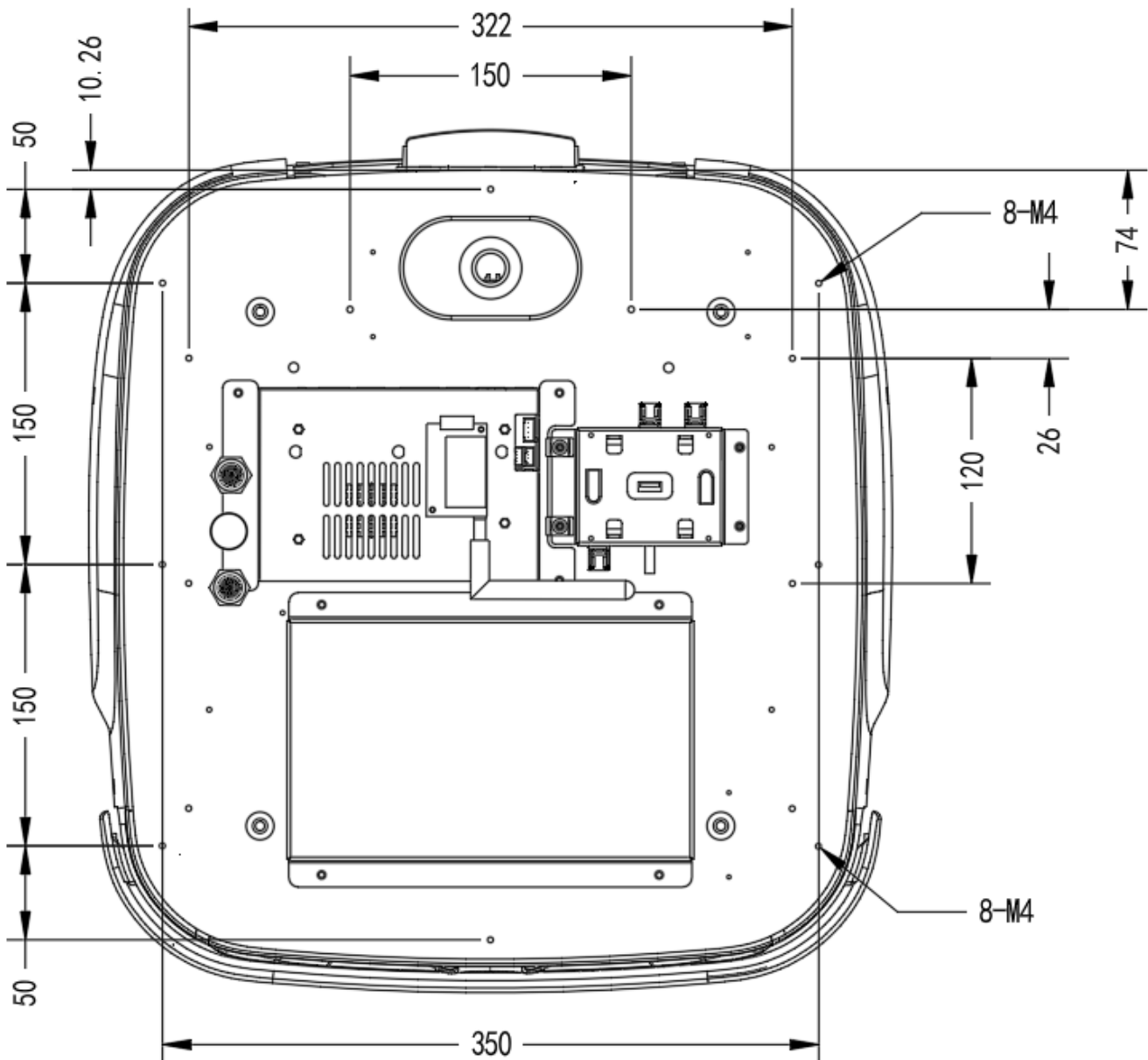


(2) Front IO diagram of the main board



4. Reference of Structure Design

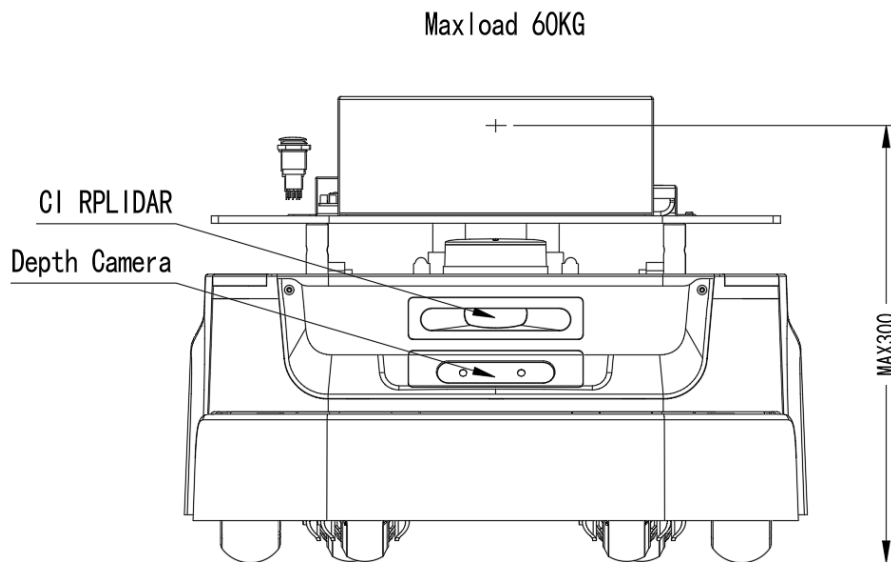
4.1 Installing Interface of Host Computer



As shown in the figure above, there are a total of 8 M4 threaded holes for the installation and fixation of the host computer.

It is recommended to use M4 screws with spring washer and blue anti-loosening glue.

4.2 Instruction of Load Limit

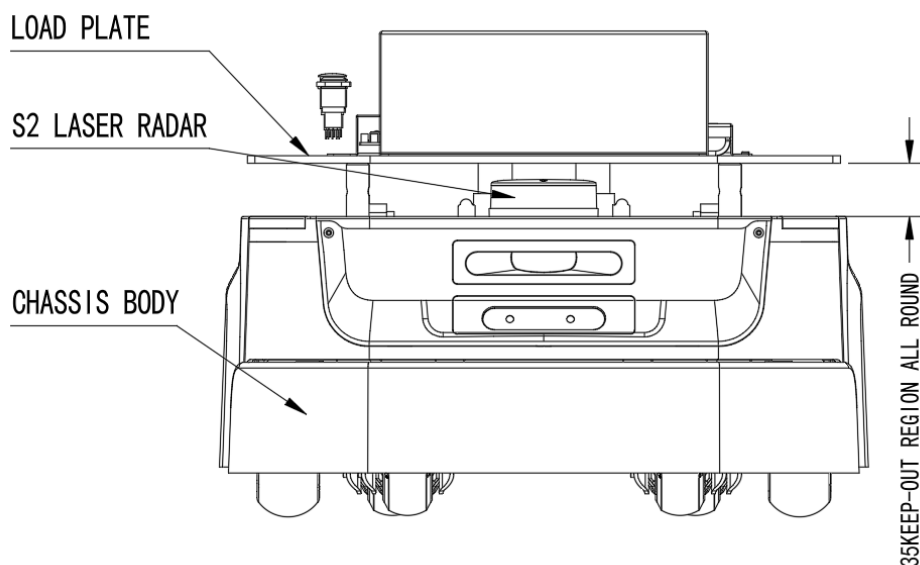


(1) Max load of host computer is 60 kg, Rated load is about 40kg..

(2) * It is recommended that the center of gravity of the whole machine is not higher than 300mm from the ground during installation.

- i. *The center of gravity of base is the one which Slamtec provides, the height is 82 mm;
- ii. The center of gravity of the whole machine is the overall center of gravity of the base plus the robot;
- iii. If the center of gravity of the whole machine exceeds 300mm, the slope-climbing and obstacle-crossing performance may be reduced.

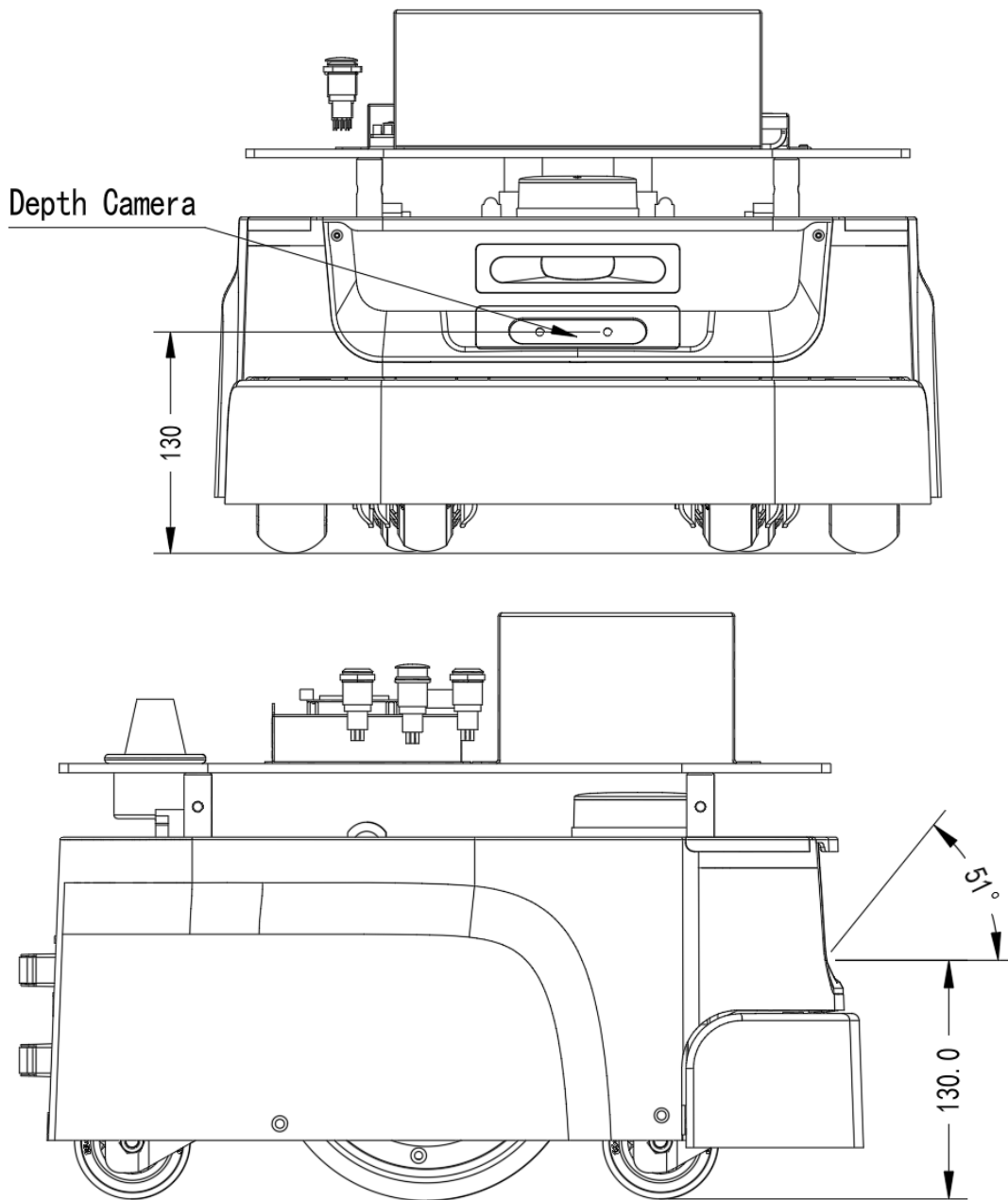
4.3 Lidar Clearance Area



There is a lidar between the base body and the host computer, which requires a certain clearance area to avoid being shielded or interfered;

The boundary of the host computer cannot exceed the lower boundary line of the host computer as shown in the figure.

4.4 Deep Camera Clearance Area



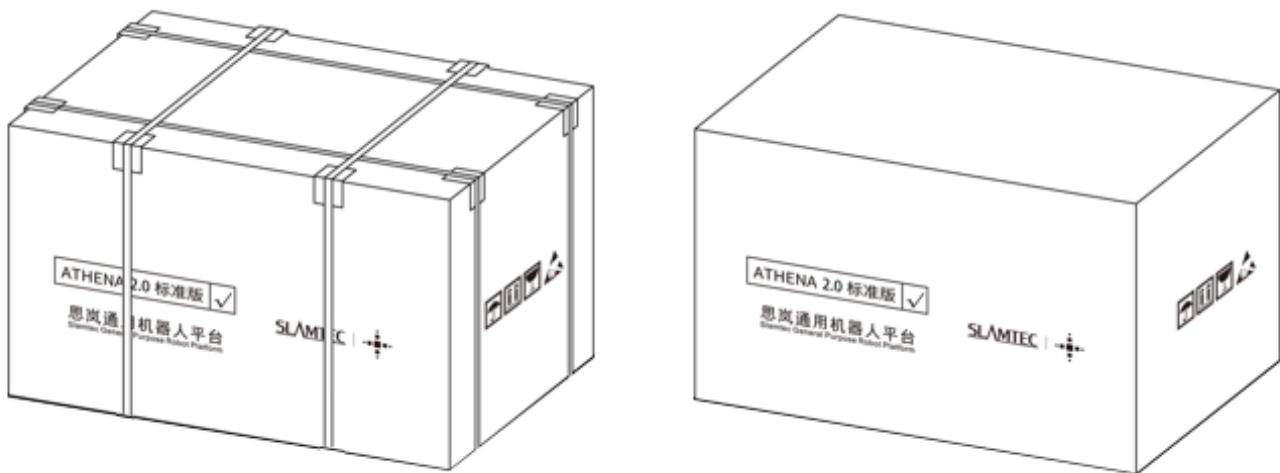
There is a deep camera on the base, which requires a certain clearance area to avoid being shielded or interfered;

The host computer cannot exceed the clearance area as shown in the figure. Due to the angled layout of the dual cameras, the superimposed clearance area is larger than a single FOV.

5. Setup Instructions

5.1 Opening

1. After receiving the Athena2.0 machine, please check whether the packing box is intact as shown in the left picture, and whether the box on the right side of the Athena2.0 sample of the outer box is checked. After confirming that the packing is complete and the box contains Athena2.0, use packing pliers to cut the packing tape, remove all packing straps and paper corners, it should be shown as on the right picture.



5-1 Athena2.0 unpacking

5.2 Placing Charging Base

Athena2.0 can be charged by returning to the charging base automatically, so the position of the charging base will affect the automatic return charging function of Athena2.0. When Athena2.0 returns to the charging station, it will generate propelling force. Therefore, it is best to place the charging stand with its back against the wall. The wall must meet the following conditions:

- a. The charging base must be attached to the wall, without no obstacle in the middle, try to avoid the wall with skirting, etc.
- b. The wall material cannot be high-permeability materials, such as mirror or glass
- c. The wall width needs to be at least three times wider than the width of the charging stand
- d. The wall must be a straight wall, not a curved wall

The charging base needs to be connected to a 220V power supply. The length of the external power cord of the charging base is 1.5m. Therefore, it is necessary to ensure that there is a 220 V interface within 1.5m of the wall against which the charging base rests. The ground wiring harness is messy causing unnecessary trouble).

The ground in front of the charging base must meet the following conditions:

- a. Open, with no obstacles within a radius of 2m in front of the charging stand as the center of the circle

b. Plane, no slope

c. The ground cannot be covered with soft carpet that causes Athena2.0 to sink more than 2cm

To ensure that Athena2.0 automatically returns to the charging function, it is necessary to ensure that Athena2.0 always starts from the charging base.

Note: If you want to change the position of the charging stand, you need to set the corresponding setting according to the position you need when loading the map. For detailed operations, please see the SDK corresponding interface operation document.

5.3 Power ON/OFF

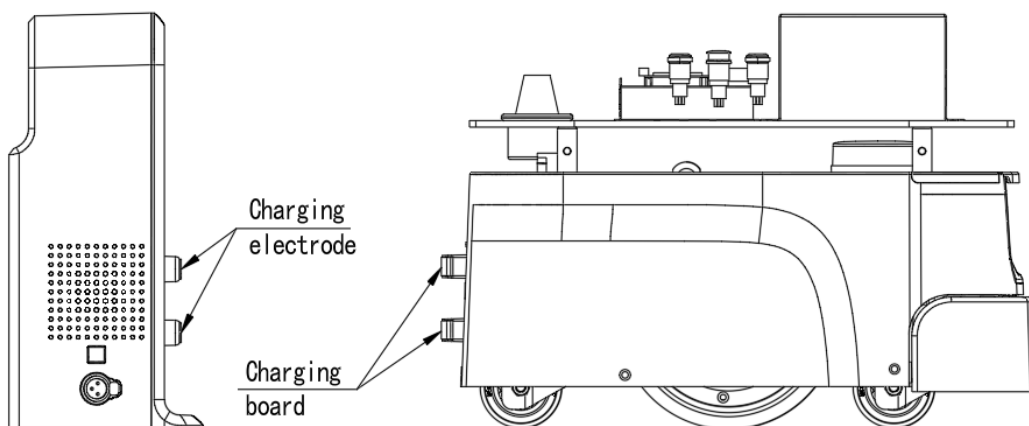
Power on: if the machine is not in the position of charging pile, long press the power switch until the power switch indicator lights up and release it. The machine system enters the startup process, the front light strip lights up, and the wheel hub is in the brake state, indicating that the startup is completed.

If the machine is in the position of charging pile, short press the power switch until the power switch indicator lights up and then release it. The machine system enters the startup process, the front light strip lights up, and the wheel hub is in the brake state, indicating that the startup is completed.

Power off: long press the power switch until indicator light goes out, then release it, the machine enters the shutdown process, the light strip on the front of the machine goes out, and the machine can be pushed arbitrarily, indicating that the shutdown is completed.

5.4 Charging

As shown in the figure below, align the charging piece of the machine with the charging electrode of the charging pile. After waiting for 10 seconds, the front light strip of the robot lights up, the wheel hub enters the braking state, and the breathing light of the charging pile flashes, indicating that charging has started.



5-2 Athena2.0 charging

5.5 Emergency stop & brake and reset

(1) Emergency stop button

Press the emergency stop button, the Athena2.0 machine will stop immediately, stop and no longer respond to any motion control commands, and the manual push is blocked.

Release the "emergency stop button " and the machine can return to normal working conditions.

(2) Brake button

Press the "brake button", the Athena2.0 machine will stop immediately, stop and no longer respond to any motion control commands. The machine can be pushed manually, such as pushing it to the charging pile.

Release the "brake button", the machine can return to normal working condition, and the manual push is blocked.

5.6. Connection to Computer

【Step 1】 The hotspot of the computer connected to the base

Athena 2.0's hotspot is auto-started by default, the hotspot format is: SLAMWARE-XXXXXX

Hot spot identification method: query the last six digits of the SSID in the base label.



5-3 Base label SSID

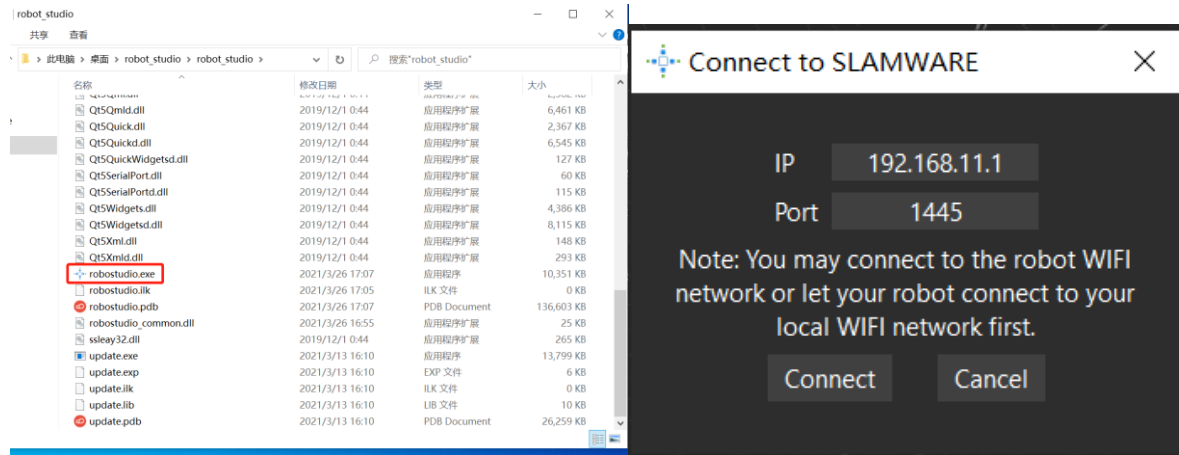
For example, if the label SSID: Robot-D70CED, the hot spot of this Base is SLAMWARE-D70CED

【Step 2】 Download and install Slamtec RoboStudio from the official website of Silan



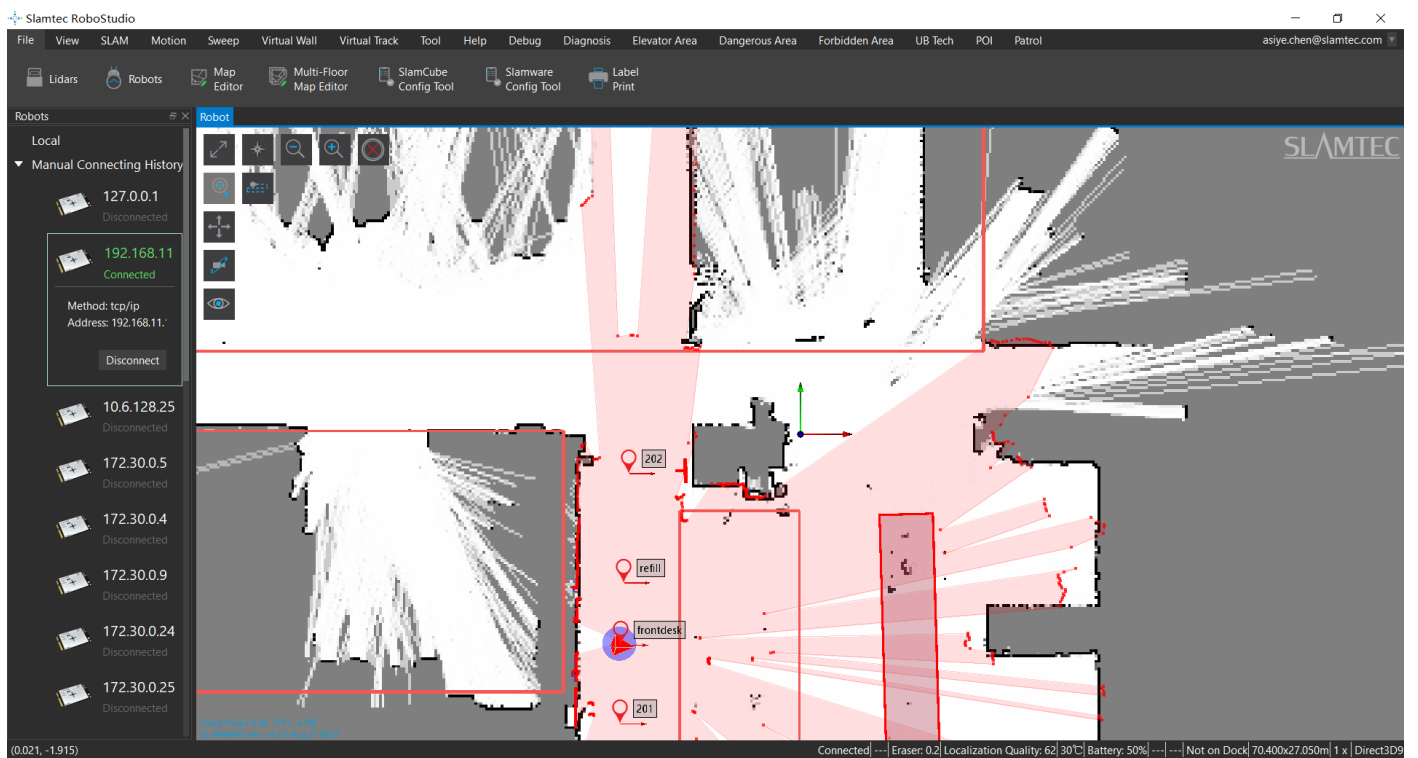
5-4 Official Slamtec RoboStudio

If you downloaded slamtec robostudio, After logging in to RS, click the "Robot" option and manually connect the robot with the right mouse button.



5-5 Robo studio login screen

[step 3] if you downloaded slamtec robostudio, run "robostudio.exe", enter the interface of slamtec robostudio, enter the IP address and port, click "connect", and RS login succeeds.



5-6 Robo studio interface

Note : The method of IP address query is to press the shortcut key, Windows+R, and enter the code ipconfig. Copy the IP of the default gateway and paste it into the IP address box of Slamtec RoboStudio. Click Connect to enter Slamtec RoboStudio.




```

C:\WINDOWS\system32\cmd.exe
C:\Users\ena.liu>ipconfig

Windows IP 配置

无线局域网适配器 本地连接* 1:

    媒体状态 . . . . . : 媒体已断开连接
    连接特定的 DNS 后缀 . . . . . :

无线局域网适配器 本地连接* 2:

    媒体状态 . . . . . : 媒体已断开连接
    连接特定的 DNS 后缀 . . . . . :

无线局域网适配器 WLAN:

    连接特定的 DNS 后缀 . . . . . :
    本地链接 IPv6 地址. . . . . : fe80::78a1:69ee:385e:c308%7
    IPv4 地址 . . . . . : 192.168.11.243
    子网掩码 . . . . . : 255.255.255.0
    默认网关. . . . . : 192.168.11.1

以太网适配器 蓝牙网络连接:

    媒体状态 . . . . . : 媒体已断开连接
    连接特定的 DNS 后缀 . . . . . :

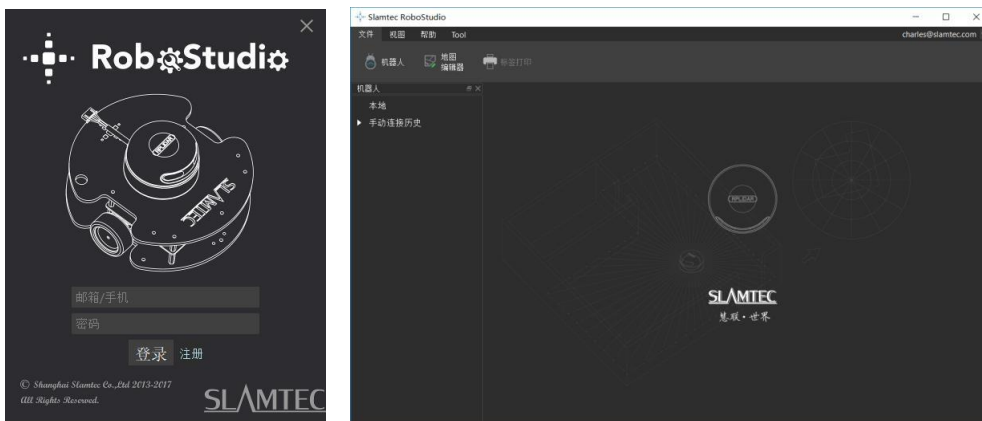
C:\Users\ena.liu>

```

5-7 Method of obtaining an IP address

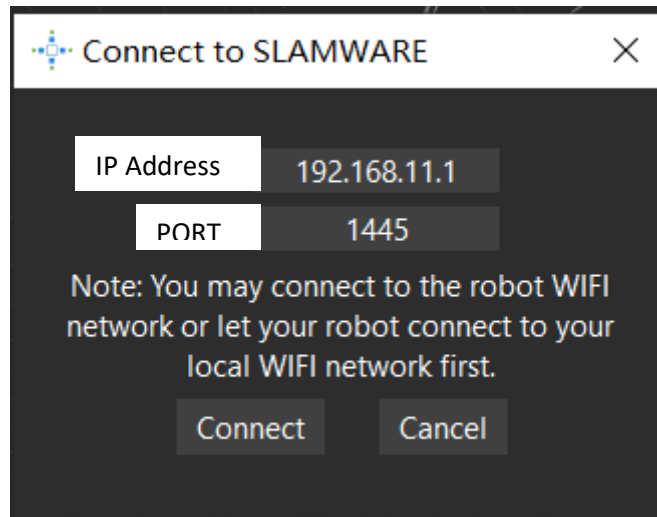
5.7 Map Building and Upload

Download and install the robot graphical control management tool Robot Studio from our official website <http://www.slamtec.com/cn/RoboStudio> to adjust and use Athena2.0, sign up account and log in. In the menu-toolbar area, click "File-Robot" in turn, and a stationing page named Robot will appear on the left side of the workspace, as shown in the figure below. The user connects/disconnects the robot through this page.



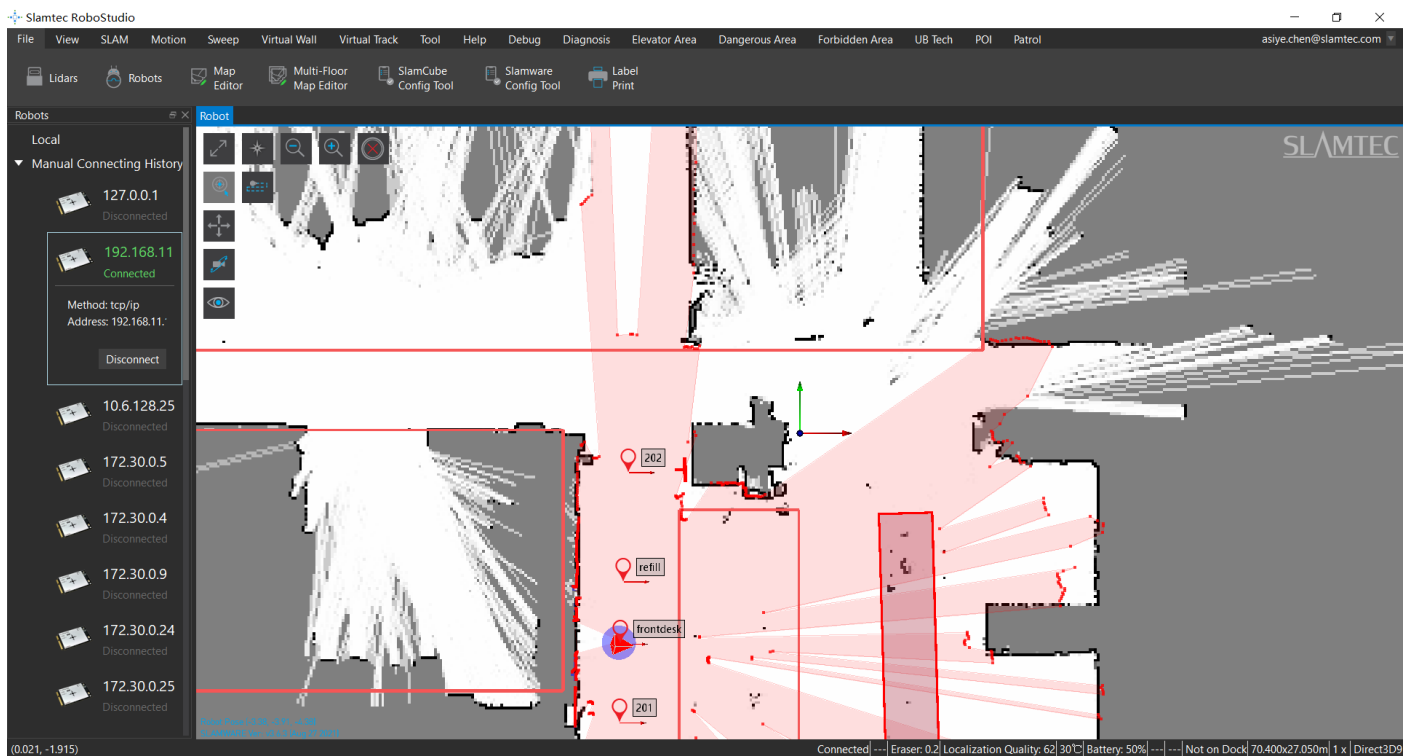
5-8 Rob Studio Robot page

Right-click the blank space of the robot list, click "Manually connect robots" in the pop-up menu, and the connect robot dialog box will pop up (as shown below). Enter the IP address and port number of the Athena2.0 robot above and click the connect button to connect (This connection method is suitable for machines that have been assigned an IP address through the Web portal management backstage). When the computer has been connected to the SSID of the aforementioned Athena2.0 robot through a network adapter (SSID can be viewed on the label of the machine), enter the IP address 192.168.11.1 by default (note that your wireless network adapter IP address should be set to automatically obtain it using DHCP).



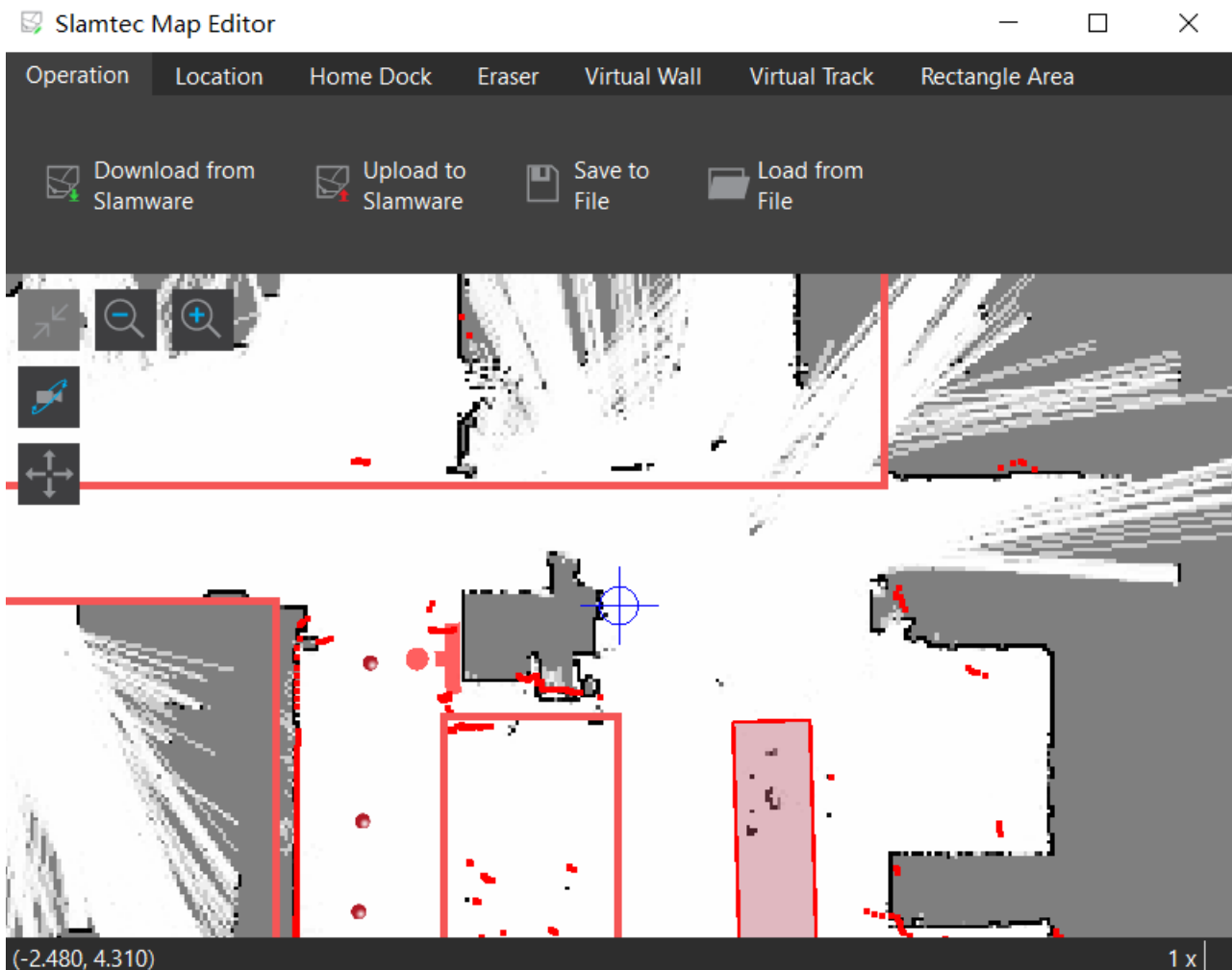
5-9 Rob Studio Robot connecting page

When finishing connecting, the work area will display the robot, map information, and status information. In the robot page, you will find that the name of the connected device turns green, and the status is "Connected", as shown in the figure below.



5-10 Rob Studio Robot connecting page

Left click the spot inside the map-building area, let Athena2.0 build the map. When finishing, please use the virtual wall function to isolate the places that need to be isolated. Then click "File-Map Editor" in turn, choose to save the file or upload to the firmware to save the map.



5-11 RoboStudio Robot Map Editor Window

There is a difference between the functions of restricted areas and virtual walls.

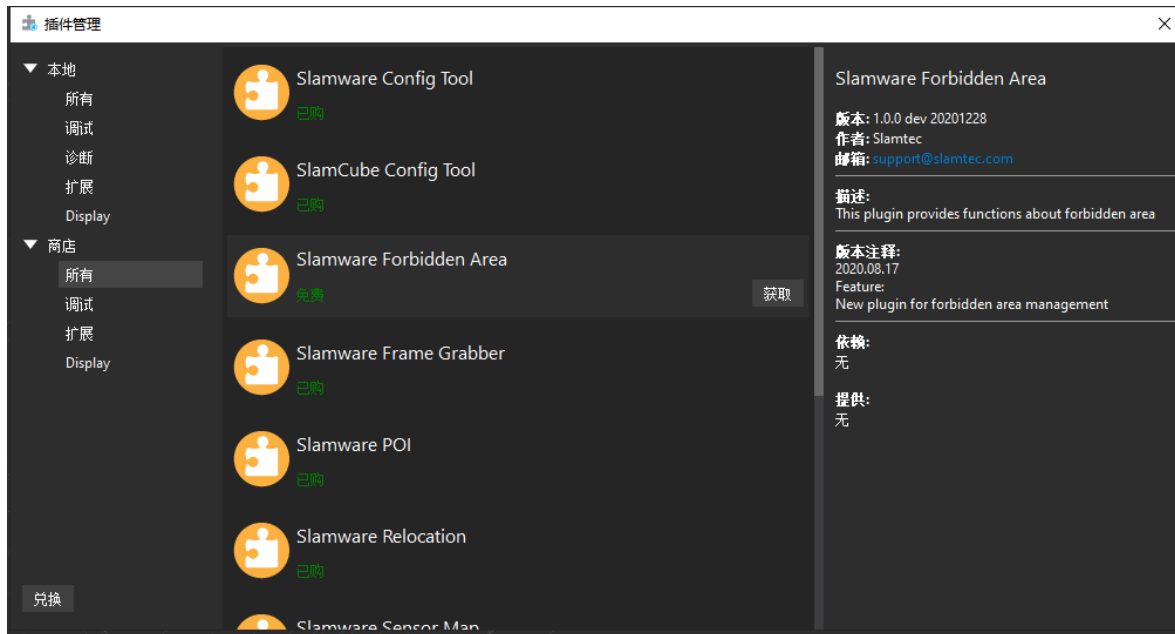
Restricted Area: When the Athena 2.0 is accidentally pushed into the restricted area, the Athena 2.0 machine can be automatically freed from the restricted area by giving a random point in RoboStudio.

Virtual Wall: When a human accidentally pushes Athena 2.0 into the virtual wall, the Athena 2.0 machine cannot automatically get out of the virtual wall and needs to be pushed out by a human at a random point in RoboStudio.

The Forbidden Area management function relies on the Slamware Forbidden Area plug-in. Slamware Forbidden Area is a public plug-in, the computer is connected to the Internet, after logging in RoboStudio, click Tools -> Plug-ins -> Shop -> All -> Slamware Forbidden Area -> Get -> Download -> Restart RoboStudio.

Public plug-in links:

<https://wiki.slamtec.com/pages/viewpage.action?pageId=56164379>)



5-12 RoboStudio Public plug-in

After the plug-in runs normally, connect to the machine, you can see the "Ban zone" toolbar in the menu bar.



5-13 RoboStudio No-go areas

5.8 Host Computer Completes Startup and Loading The Map

Below is a reference example of how to use the SDK to complete the startup and loading of a specific map on the host computer.

```

1.  /*
2.  * upload map file
to Athena2.0 3.  */
4.  #include <iostream>
5.  #include <rpos\robot_platforms\slamware_core_platform.h>
6.  #include <rpos\robot_platforms\objects\composite_map_reader.h>
7.  #include <rpos\core\pose.h>
8.
9.  using namespace std;
10.
11. int main()
12. {
13.     try
14.     {
15.         string map_path = ".\\map.stcm"; //the path of map
16.         string Athena2.0_ip = "192.168.11.1"; //the ip of Athena2.0
17.         int Athena2.0_port = 1445; //the port of Athena2.0 ,default is 1445
18.
19.         rpos::robot_platforms::SlamwareCorePlatform Athena2.0 =
20.             rpos::robot_platforms::SlamwareCorePlatform::connect(Athena2.0_ip, Athena2.0_port);
21.         //connect to the Athena2.0

```

```
22.     rpos::robot_platforms::objects::CompositeMapReader cmapreader;
23.     //map reader
24.     rpos::core::Pose Athena2.0_pose = rpos::core::Pose(rpos::core::Location(0, 0, 0));
25.     //the Athena2.0 pose in map(Athena2.0_pose should be the Athena2.0's real pose in new map)
26.     //using Athena2.0.getpose() to get the old Athena2.0 pose
27.     auto map = cmapreader.loadFile(map_path);
28.     //load map
29.     Athena2.0.setCompositeMap(*map, Athena2.0_pose);
30.     //set compositemap
31.     rpos::core::Pose home_pose = rpos::core::Pose(rpos::core::Location(0, 0, 0));
32.     //the home pose in map(home_pose should be the home's real pose in new map)
33.     //using Athena2.0.gethomepose() to get the old home pose
34.     Athena2.0.setHomePose(home_pose);
35.     //set home pose
36. }
37. catch (rpos::robot_platforms::ConnectionFailException &e)
38. {
39.     cout << "connect failed on " << e.what() << endl;
40. }
41. catch (rpos::system::detail::ExceptionBase &e)
42. {
43.     cout << "failed on " << e.what() << endl;
44. }
45.
46. return 0;
47. }
```

Further motion deployment details, please see the SDK instruction document

6. Adjusting Tools

6.1 RoboStudio

RoboStudio graphical tools are used to adjust and use Athena2.0, please download and install it from our official website: <http://www.slamtec.com/cn/RoboStudio>, and coming with manual to introduce those features.

6.2 Web Management Backstage

In the process of developing, adjusting and using SLAMWARE equipment, various operations can be performed on the equipment through the web management backstage, such as viewing basic information, updating the version, configuring WiFi, etc. (Default username: admin, default password: admin111)

Currently, web management backstage supports following functions:

1. Check basic information of the device
2. Restart the module
3. Update the firmware

Slamtec will regularly provide Athena2.0 firmware updates and upgrades. You can easily upgrade the firmware for Athena2.0 through the management backstage. Please obtain the latest firmware from sales or technical support personnel. The update process will last 5-10 minutes. The buzzer of Athena2.0 will continue to sound during the update, and Athena2.0 will automatically restart after the update. Before that, please make sure that Athena2.0 has sufficient power.

4. Configuring WIFI
5. Start the SLAMWARE Core diagnostic mode
6. Modify the administrator password

More details on usages please refer to:

<https://wiki.slamtec.com/display/SD/SQ001+SLAMWARE+Web+Portal+Function+Overview>

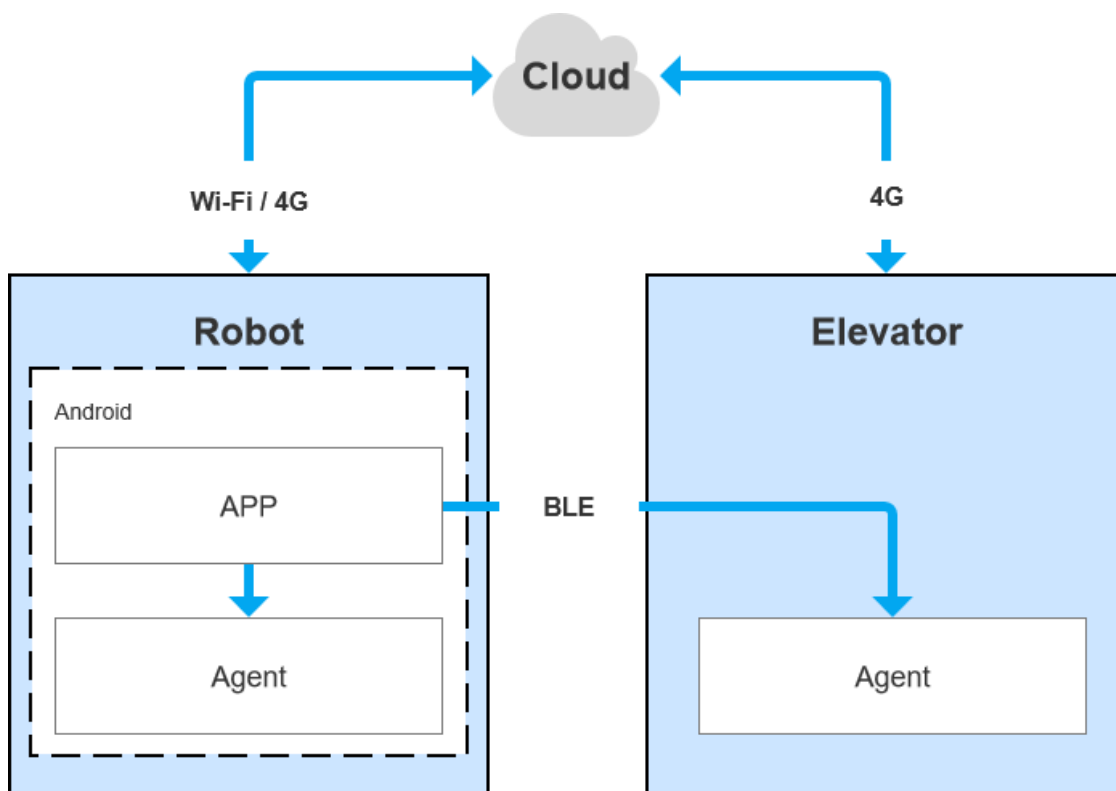
7. Developer Tools

7.1 Start Using

The Agent SDK of the Athena2.0 base is developed based on the C++ language to reduce user access costs and improve the robustness of the SDK. At the same time, it has strong compatibility and supports multiple languages such as Java, C++, C, and Kotlin. The following is a detailed introduction to the relevant examples and usage guidelines of the Agent SDK call based on the Athena2.0 base.

7.2 Inter-system Adjusting Framework

Robot App controls the robot's positioning, movement, and return to piles through communication; at the same time, Robot App sends instructions to the robot according to various business scenarios, and Robot Agent will provide data interfaces, task operation interfaces, and business services to Robot App.



7-1 COMMUNICATION BETWEEN EACH SYSTEM OF ATHENA2.0

7.3 Instructions of Each System

7.3.1 Robot Agent

Robot Agent is a service program running on the Athena2.0 base, through which the cloud and the elevator control terminal communicate with the elevator control equipment. Inside the Robot system, the Robot Agent communicates with the Robot App, receives instructions from the Robot App to control the Robot, and sends the Robot status at the same time.

The core function of Robot Agent is:

- ✓ Communicate with the Robot Cloud, Robot APP, send the Robot status and receive instructions

7.3.2 Elevator Agent

Elevator Agent is a service program running on the Linux system of the elevator control main control box. The cloud and the robot end communicate with the elevator control equipment through it. Inside the elevator control system, the Elevator Agent communicates with the Elevator Controller through UDP, sending elevator control instructions and obtaining elevator status.

The core function of Elevator Agent is:

- ✓ Communicate with the Robot Cloud, Robot APP, send the elevator status and receive instructions of elevator control
- ✓ Communicate with the Elevator Controller, receive the elevator status and send instructions of elevator control

7.3.3 Robot Cloud

Robot Cloud is a set of services provided to realize remote management, scheduling, and control of robots. It runs in the cloud and communicates with the robot at one end and the elevator control equipment at the other end. Therefore, elevator control is part of the function. Robot Cloud communicates with the Elevator Agent running on the main control box of the elevator control through the MQTT protocol.

Its core functions include:

- ✓ Send instructions, control the elevator to the designated floor
- ✓ Send instructions, control the elevator to open the door
- ✓ Send instructions, control the elevator to close the door
- ✓ Receive the up/down status of elevator
- ✓ Receive the current floor of the elevator

7.3.4 Robot App

Open-Source application – Restaurant Delivery App

The restaurant delivery app is a service program running on the robot. The application scene is a restaurant. It draws a map and loads it to the robot's local area through RoboStudio graphical tools. It is a universal application for human-computer interaction to achieve multi-point task delivery.

7.4 Demonstrations of Code

1. The following is an example of the Robot APP calling the Robot Agent interface to check the battery status

```
GET http://127.0.0.1:1448/api/core/system/v1/power/status
```

The format of the returned data is application/json


```

interface AgentApi {
    /**
     * get方式调用 value: 接口地址
     * PowerStatus: 接口返回json格式对应的bean格式的data class的值
     */
    @GET("/core/system/v1/power/status")
    fun queryPowerStatus(): Call<PowerStatus>
}

/**
 * batteryPercentage : 90电池电量百分比, 0 ~ 100
 * dockingStatus : 对桩状态
 * isCharging : 是否正在充电...
 */
data class PowerStatus(
    val batteryPercentage: Int, val dockingStatus: String, val isCharging: Boolean,
    val isDCConnected: Boolean, val powerStage: String, val sleepMode: String
)

/**
 * retrofit接口代理类
 */
object AgentServiceCreator {
    fun <T> create(serviceClass: Class<T>, timeout: Long): T =
        Retrofit.Builder().baseUrl("http://127.0.0.1:1448/api/")
            .addConverterFactory(GsonConverterFactory.create()).client(
                OkHttpClient.Builder().retryOnConnectionFailure(true)
                    .connectTimeout(timeout, TimeUnit.SECONDS)
                    .addInterceptor { chain ->
                        val originalRequest = chain.request()
                        val requestBuilder =
                            originalRequest.newBuilder().addHeader("Connection", "close")
                        chain.proceed(requestBuilder.build())
                    }.build()
            ).build().create(serviceClass)
}

// 查询电量, 返回值为powerstatus
val powerStatus = AgentServiceCreator.create(AgentApi::class.java, 1L).queryPowerStatus().await()
    Result.success(powerStatus)

```

2. The following is the Robot App calling the Robot Agent interface to make the robot move across floors

POST <http://127.0.0.1:1448/api/core/motion/v1/actions>

The request message format is application/json

```

{
  "action_name": "slamtec.agent.actions.MultiFloorMoveAction",
  "options": {
    "target": {
      "poi_name": "201" //表示前往名称为 201的poi
    }
  }
}
} // JavaScript Document

```

7.5 Details Of Robot API

FUNCTION OF MODULES

API LIST

| | |
|---|--------------------------------------|
| Locate, map building-related functions | Get the Robot location |
| | Set the Robot location |
| | Get quality of location |
| | Whether support locating |
| | Start/Close locating |
| | Whether start map building |
| | Start/ pause map building |
| | Get location of power station |
| | Set location of power station |
| | Get current map |
| | Delete current map |
| Mark map elements manually | Get all virtual line segment |
| | Add virtual line segment |
| | Adjust virtual line segment |
| | Delete virtual line segment |
| | Delete virtual line segment |
| | Get all POI in current map |
| | Add POI |
| | Empty POI |
| | Find POI according to ID |
| | Modify POI |
| | Delete POI |
| Motion control of the Robot | Get all supported actions |
| | Get current action |
| | Stop current action |
| | Create new action |
| | Check action status |
| Firmware Upgrade | Get firmware upgrade process |
| Android application management | Get all custom installed apps |
| | Install APP |
| | Uninstall an APP |
| Multi-floor map and POI management, taking elevator, etc. | Move across floors |
| | Go back across floors |
| | Get all floor info |
| | Get floor info of floor of the robot |
| | Setup info of floor of the robot |
| | Get POI info |
| | Upload map to the robot |
| | Long-lasting save the map |
| | Reload the map |
| Delivery service-related interfaces | Get password of the action |
| | Set password of the action |

| | |
|-----------------------------------|--|
| | Get configuration info of the device |
| | Get setup info related to the delivery |
| | Check task info |
| | Create task |
| | Cancel all task |
| | Cancel some task |
| | Get current mission status |
| | Stop/ continue current mission |
| | Start picking up items |
| | End picking up items |
| | Get info of objects |
| | NOTE: delivery business please inform marketing department |
| | Restaurant delivery service-related interfaces |
| Get the health info of the device | |
| Get POI info | |
| Get password of the action | |
| Make up new actions | |
| Get current action | |
| Terminate current action | |
| Shut down or restart the robot | |

MORE DETAILS OF API: <https://github.com/slamtec/Athena2.0SampleApp>

8. Introduction And Use Of Elevator Control

8.1 Introduction

Intelligent elevator control, independently developed by Shanghai SLAMTEC CO., Ltd, can provide accurate detection of elevator status, program control call elevators, control elevators, combined with Mercury II hotel robots, helping the robots to take and exit the elevators autonomously. Providing reliable solutions to multi-floor operation scenarios. In addition to working with hotel robots, the product can be used as an independent set of solutions. Through the API interface we provide, this product can also interact with other smart devices or products to meet the different customization needs of customers. At the same time, the product can also be seamlessly connected to the Athena2.0 base, to provide technical service support for more specific needs in other scenarios.

8.2 Features

8.2.1 Intelligence Elevator Control

The core function of this product is to help robots and other intelligent devices to control the elevator, such as calling the elevator, going to the designated floor, and controlling the elevator to open and close the door. This function greatly improves the business scenario of robots and breaks the previous limitation that robots can only work on the same floor.

8.2.2 Intelligence Status Detection

Through the built-in sensor and adaptive algorithm, this product can accurately detect the current floor, up and down status of the elevator, real-time to the millisecond level, with an accuracy of more than 96%, providing a very critical foundation so that the robot can enter and exit the elevator correctly and complete the work.

8.2.3 Elevator Diversity Adaption

The main control box has developed a variety of optimized filtering algorithms, so that this product is suitable for many different types of elevators, such as single-door elevators, double-door elevators, front and rear door elevators, etc. As it covers as many scenes as possible, this product can be used in most elevators at present. Users only need to simply calibrate and adjust through the APP provided after installing the equipment.

8.2.4 Multi-Level Network Adaption

Considering the limitations of the elevator network, how to ensure data interconnection and program interoperability is a very critical factor, and relatively it is also a difficult point. After continuous optimization iterations, we finally found a way to solve this problem. This product provides 4G, WIFI, BLE and other multi-level network communication methods to interact with robots and other smart devices to ensure the reliability of the communication link.

8.2.5 OTA Remote Upgrade

Support OTA remote upgrade of software and firmware, and batch deployment. At the same time, it provides support for VPN, which can remotely log in to the Linux system of this product for upgrades and other operations. Through the OTA function, real-time updates, upgrades and optimization can be done.

8.2.6 Interface Support

The intelligent elevator control provides a consistent API interface to the outside world, supports Bluetooth, MQTT, and HTTP communication protocols. Customers can control and interact with the elevator by writing their own program code. At the same time, it supports secondary development to meet the different customization needs of customers.

8.2.7 Swipe To Bypass

For some elevators that require a swipe card to ride, this product can also be easily supported. Just install the equipment we specify when installing the device, and then turn on the swipe card to bypass it in the APP. In this way, even if there is a card reader, it can be easily bypassed and freely enter and exit the elevator.

8.2.8 Unified Management

The cloud platform provided by SLAMTEC can perform real-time monitoring of the status of all deployed products, batch upgrades, and further data mining through online management, information statistics, equipment monitoring, etc., to provide exclusive accurate data models for hotels or commercial buildings, to guide them to improve their overall operational capabilities and service quality.

To know more about the detailed solution of elevator control, obtain it from the marketing department.

[Elevator control user manual->>](#)

Note: This intelligent elevator control can only be used in China. For foreign customers, it needs R & D evaluation and customization.

9. Special Note

9.1 Charge point deployment

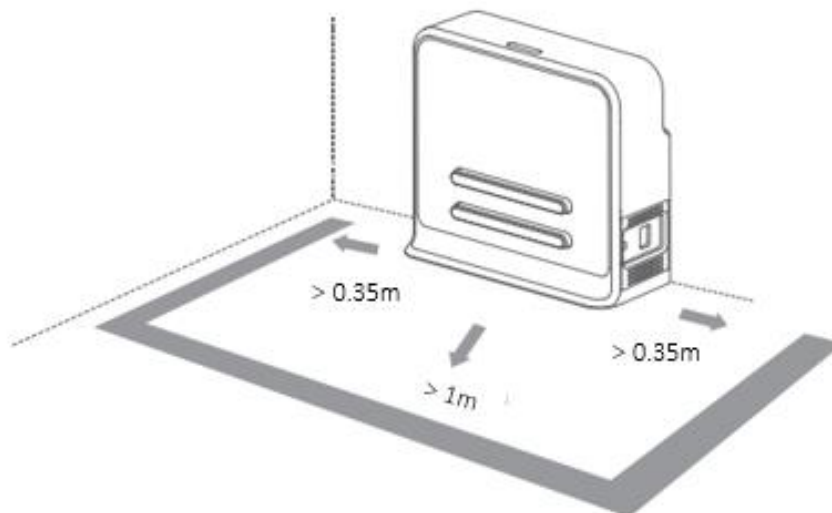
Precautions for the selection of charging pile location:

(1) The charging pile should be placed on the wall with a space of more than 0.35 meters on both sides and more than 1 meter in front;

(2) The charging pile shall be close to the wall, and shall not be placed in the mirror wall, back hollowed out and other areas, etc;

(3) The position of the charging pile must not be placed on soft ground such as carpet, otherwise it will cause height difference and cannot be charged;

(4) The position of the charging pile in the scene needs to be marked to prevent incorrect recovery after moving.



9.2 Restricted usage scenarios

Please avoid using Athena2.0 base in the following scenarios to avoid base failure or damage.

(1) Overrun/heavy transportation

Do not put in items that exceed the maximum weighing parameter value to avoid affecting the normal use of Athena2.0. Please refer to the information in the product parameter table for the maximum load-bearing parameter value.

(2) Sill height

Please ensure that there are no obstacles more than 20mm in front of Athena2.0, and the maximum height of Athena2.0 over the sill is 20mm. During Athena2.0 driving, please try to avoid passing through uneven ground or other environments with large height.

(3) Man-made impact

Do not forcefully push or hit the Athena2.0 body when Athena2.0 is in normal use.

(4) Temperature / humidity

Do not place Athena2.0 in places with high temperature, high humidity or water stains.

(5) Ground obstacles

Please ensure that the ground is clean and free of wireless obstacles and sundries.

(6) Outdoor

Do not use the machine outdoors.

(7) It is limited to safe use below 2000m above sea level.

9.3 Faults that cannot be handled temporarily

When the machine encounters a fault that cannot be handled temporarily, you can try the following operations:

(1) Please press the brake button;

(2) Push the machine back to the charging pile;

(3) The machine can be forced to switch on and off in any state after power-on.

*Use only in emergency situations.

9.4 Notes

Notes for storage:

(1) Since the machine contains battery, it should be stored in a cool and dry environment;

(2) For long-term storage (more than 3 months), it is recommended to put it in a dry environment with room temperature of 10-25 °C and no corrosive gas;

(3) Athena2.0 shall be charged every 6 months during long-term storage to ensure that the voltage of each battery unit is in the range of 3.6v-3.9v.

Packing notes:

(1) The packaging material must have a certain degree of strength and toughness, and can withstand slight vibration, extrusion, friction and collision during transportation;

(2) There should be padding around the package, which can play a good cushioning role;

Notes for transportation, loading and unloading:

(1) Please handle with care to prevent falling, collision, dragging and inversion;

(2) Stacking needs to be built firmly, compactly, stably and neatly;

Other notes:

(1) Do not treat Athena2.0 violently (such as kicking, pushing, pulling);

(2) Do not spill liquid on the machine;

- (3) Do not use the automatic recharge function on the soft carpet with a subsidence of more than 2cm;
- (4) It is recommended to start the equipment on the charging base;
- (5) Do not change the inside of the machine without authorization;
- (6) In environments with many high-transmittance materials, please use auxiliary protection functions, such as virtual walls.

10. Maintenance

1. General maintenance

(1) Lidar cleaning: When the machine is shut down and not working, check the surroundings of the lidar to ensure that there are no obstructions.

(2) Universal wheel cleaning: When the machine is shut down and not working, gently lift the base, wipe the universal wheel with a soft dry cloth, and remove the surrounding foreign matters.

(3) Depth camera lens cleaning: Please wipe the lenses of the depth cameras with a soft dry cloth when the machine is powered off.

(4) Cleaning the charging pile: Please wipe the charging pile and charging electrode with a soft dry cloth when the power is off.

(5) Collision bar cleaning: Please wipe the collision bar with a soft dry cloth when the power is off, and ensure that there are no wires, paper scraps and other foreign objects stuck on the anti-collision bar.

2. Maintenance cycle

For the maintenance of the main engine, it mainly includes depth camera lens inspection, collision bar inspection, clearance inspection around the lidar, foreign matter inspection around the driving wheel and universal wheel, charging pile inspection, etc. The time interval of the maintenance cycle can be appropriately adjusted according to the environment, frequency, intensity and temperature of the machine.

| Athena2.0 maintenance schedule | | | Time interval | | |
|--------------------------------|-------------------|-------------------|---------------|--------|--------|
| NO | Name | Maintenance level | Year | Month | Week |
| 1 | Depth camera lens | Clean | -- | -- | 1 time |
| 2 | Collision bar | Clean | -- | -- | 1 time |
| 3 | Around the lidar | clearance | -- | 1 time | -- |
| 4 | Universal wheel | Clean | -- | -- | 1 time |
| 5 | Driving wheel | Clean | -- | -- | 1 time |
| 6 | Charging pile | Clean | -- | 1 time | -- |
| 7 | Machine body | Overhaul | 1 time | -- | -- |

10-1 Athena2.0 maintenance schedule

11. Common faults and troubleshooting

When an abnormality occurs during Athena2.0 operation, please refer to the following table or page tips to solve the problem:

| NO | Fault prompt | Solutions |
|----|---|---|
| 1 | Collision bar abnormal | Please check whether the collision bar is jammed, and tap the anti-collision bar several times to return the anti-collision bar to its position. |
| 2 | Athena2.0 battery low | Please press the brake release button and push the machine back to the charging point to charge. |
| 3 | The charging point cannot be charged | Please check whether the power cord plug of the charging point is inserted into the socket and whether the indicator light of the charging point is on normally. |
| 4 | Unable to power on | Please check whether the charging point is connected to the power supply. After the charging point and Athena2.0 are connected normally, if it cannot be solved, please contact the after-sales service department. |
| 5 | Athena2.0 cannot be charged on the pile | Please try again on the charging pile. If you cannot solve it, please contact after-sales service. |
| 6 | Unable to go back to the charging point | <ol style="list-style-type: none"> 1. Please confirm whether the position of the charging point has been moved. If the position has been moved, please contact the after-sales department. 2. Please confirm whether there is a slope at the position of the charging point. If there is a slope, please contact the after-sales department. 3. Please push Athena2.0 back to the charging point and try to restart Athena2.0. |
| 7 | Unable to get in / out of the elevator | <ol style="list-style-type: none"> 1. Please confirm whether there are obstacles in the elevator. 2. Please confirm the internet signal near the elevator. 3. Please push Athena2.0 back to the charging point and try to restart Athena2.0. |
| 8 | Universal wheels rotate intermittently | Please check whether there are any foreign objects such as threads, cards, etc. around the universal wheels and the driving wheels. If there are foreign objects, please clean them. |
| 9 | Machine can't walk | Please check whether the drive cable is connected normally. If it cannot be solved, please contact the after-sales service. |
| 10 | The light strip does not light up | Please check whether the connecting wire of the light strip is connected normally. If it cannot be solved, please contact the after-sales service. |

12. Certificate

Company name: Shanghai Slamtec Co., Ltd

Company Address: Unit 01, 2nd Floor, Building E, Shengyin Building, No.666 Shengxia Road, China (Shanghai) Pilot Free Trade Zone.

Contact information: (+86) 021 68581569

