

# APOLLO

General Purpose Robot Platform Standard Version

User manual

Model: A4M31



<b>CONTENTS</b> .....	<b>2</b>
<b>OVERVIEW</b> .....	<b>3</b>
INTRODUCTION.....	3
BASIC FUNCTION.....	3
INTERIOR MODULE BLOCK DIAGRAM .....	3
SENSORS.....	4
INTERFACES.....	4
CHARGING STATION.....	5
PRODUCT PACKING LIST.....	6
<b>EXTENDED PLATFORM</b> .....	<b>7</b>
INTRODUCTION.....	7
PORT DEFINITION.....	7
APOLLO REFERENCE DESIGN .....	10
<b>DEPLOYMENT AND USAGE</b> .....	<b>11</b>
APOLLO DEPLOYMENT .....	11
CONNECT TO COMPUTER.....	16
DEBUG TOOLS .....	16
CHARGING AND BATTERY.....	17
<b>ATTENTION</b> .....	<b>20</b>
<b>MECHANICAL DIMENSIONS</b> .....	<b>21</b>
<b>APPENDIX</b> .....	<b>22</b>
IMAGE AND TABLE INDEX.....	22

## Introduction

Apollo is a medium-sized general purpose robot development platform developed by SLAMTEC to meet the requirement of medium-size robot application like reception robot, shop guiding robot and etc. Its build-in SLAMWARE Cube autonomous localization and navigation module is designed to realize path finding and navigation. And different applications can be integrated with Apollo to make it work in varies business places. Apollo is equipped with RPlidar, ultrasonic sensors, cliff sensors, bumpers, magnetic sensors, depth cameras and etc., which helps Apollo walk freely and respond well in complicated business environments.

## Basic Function

### Autonomous Mapping for Localization and Navigation

The function of Apollo platform is to realize autonomous map building, localization and navigation. There is no need for human assistance during its working process. It can find the proper path to a specified place by itself and move there freely. And it also supports multi-line patrol mode like a security guard.

### Autonomous Recharging

We provide open source interface for users and developers to use it for their own upper application on Apollo, which can realize the recharging feature of Apollo, namely, the ability to go back to the charge station to charge itself when it has a very low battery.

### Third Party Application Development

The Apollo has a totally free platform both in software and hardware and we offer technical support for external extended hardware. Our users can focus on the developing of business logic application via SLAMWARE SDK.

## Interior Module Block Diagram

The following figure describes the communication between Apollo and external system, the connection of power supply and emergency stop.

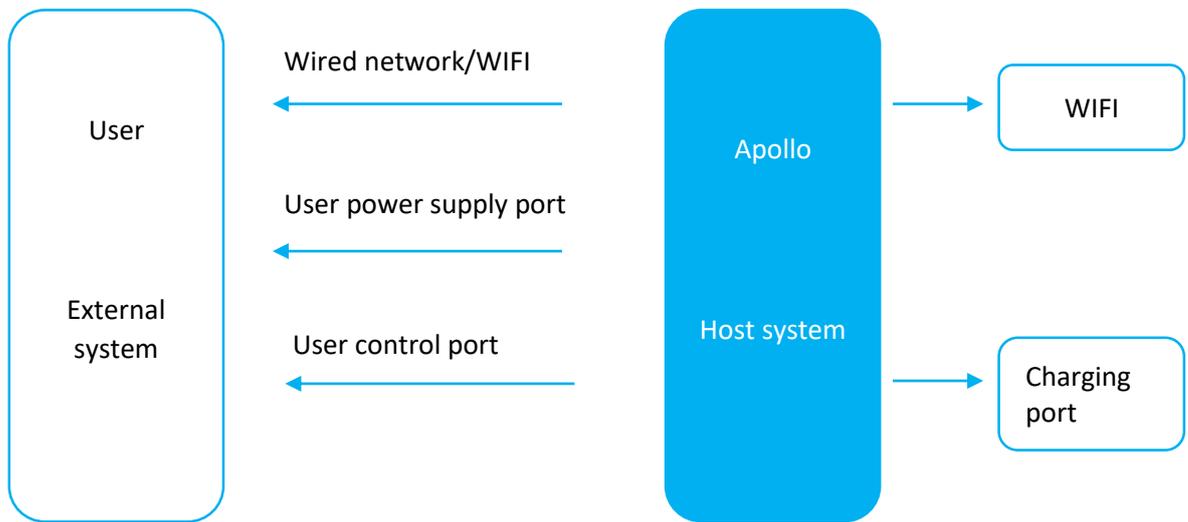


Figure 1-1 Connection between Apollo and External System

## Sensors

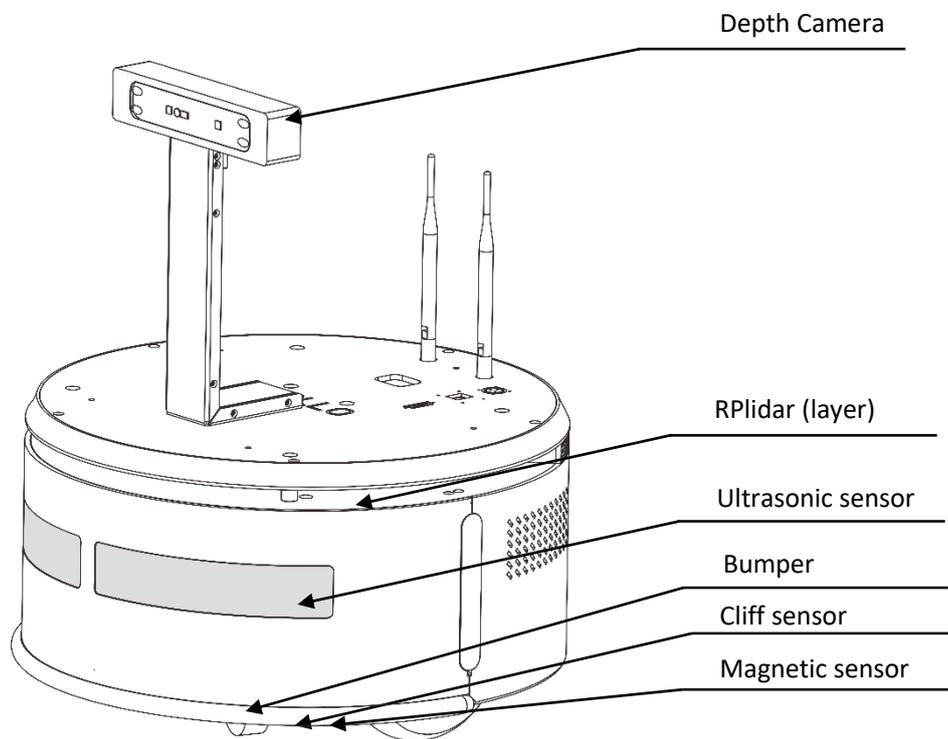


Figure 2-1 Apollo Sensor Configuration

## Interfaces

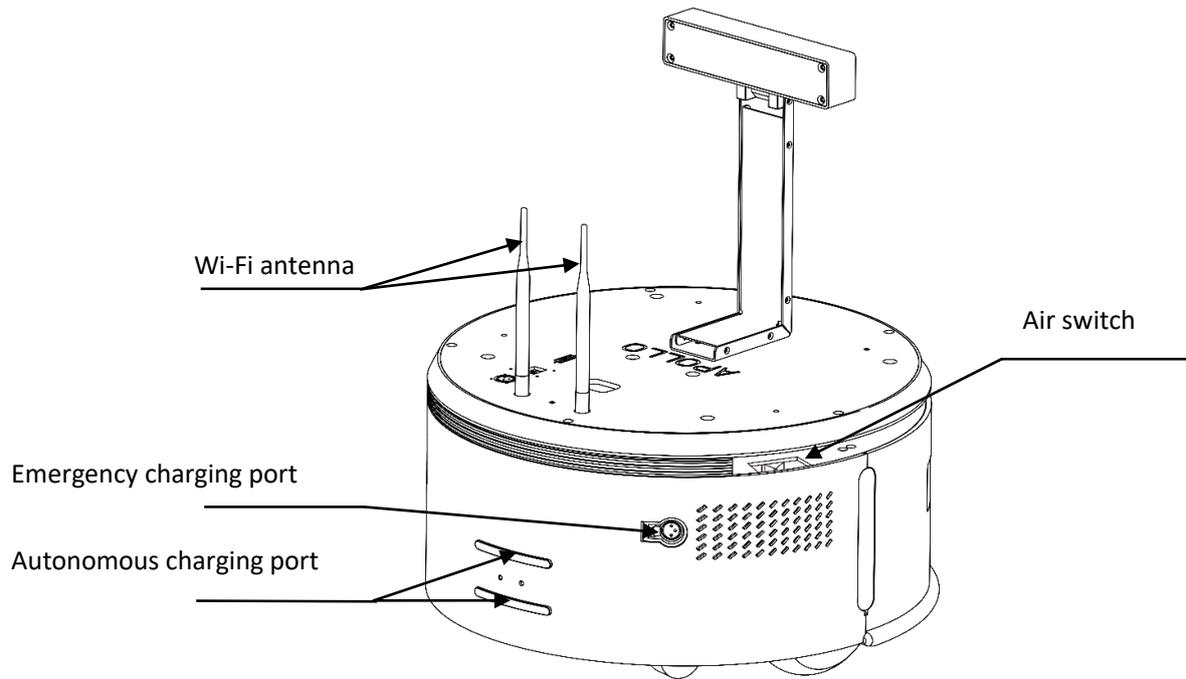


Figure 2-2 Apollo Interfaces Configuration

## Charging Station

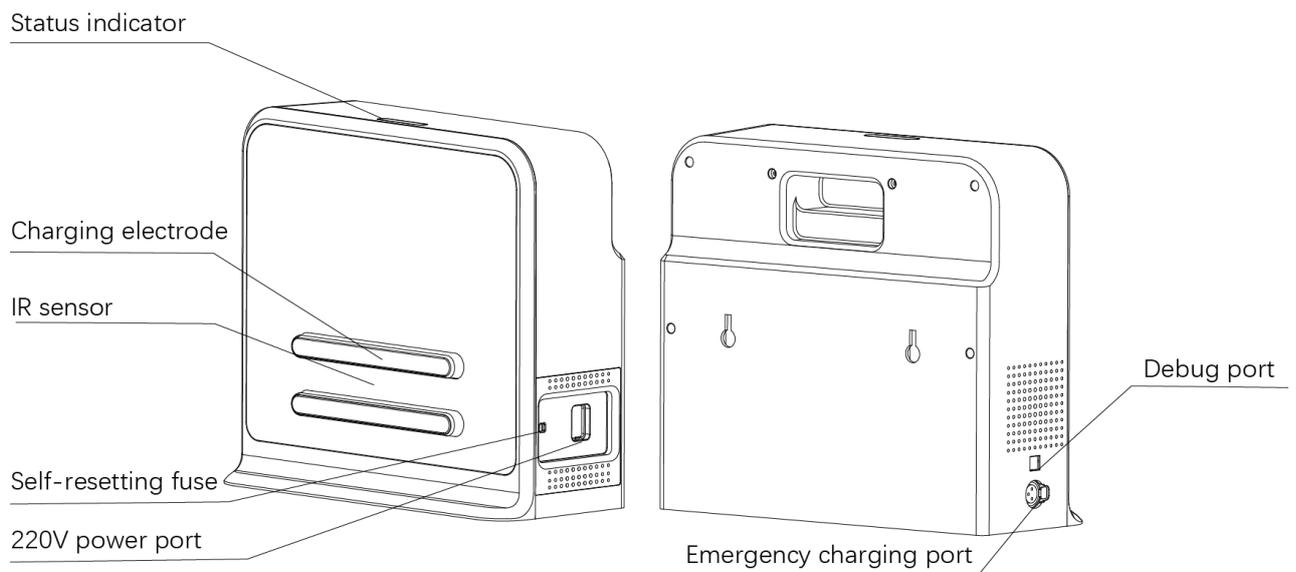


Figure 2-3 Apollo Charger

## Product Packing List

Item Name	Quantity	Remark
Apollo	1	Apollo platform
Wi-Fi antenna	2	Come with Apollo as accessories and need to be installed on Apollo.
Depth camera and its mounting structure	1	Come with Apollo as accessories and need to be installed on Apollo.
Charging station	1	Come with Apollo and need to choose a proper place before using it.
Power cable of charging station	1	Come with charging station as accessories. Please connect the charging station and 220V power with the power cable.
Emergencing charging cable of charging station	1	Come with charging station as accessories. Please connect the charging station and Apollo with the charging cable.

## Introduction

As shown in the following figure, the extended platform of Apollo is a rounded table with 220mm in radius. The whole top surface is all-steel and is processed by black phosphating solution. There are five M6 threaded holes regularly distributed on the table, which can meet various requirements of fixing the upper module on the Apollo. Please refer to the following figure for the specific position of threaded holes and the port dimensions.

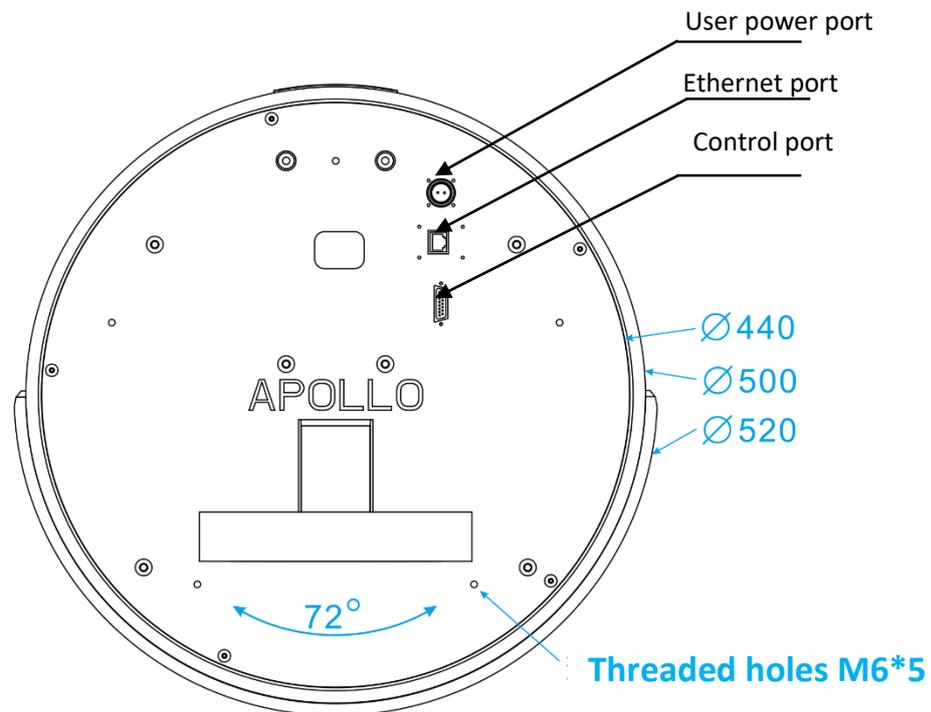
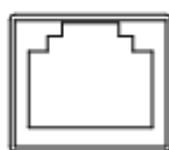
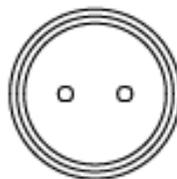


Figure 3-1 Apollo Extended Platform

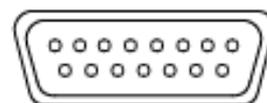
## Port Definition



**Ethernet port model:**  
Standard RJ45



**Power port model:**  
WS16K2Z WEIPU 2Pin Aerial  
Socket



**Control port model:**  
D-SUB 15P Female  
Connector

Figure 3-2 Interface Definition of Apollo Extended Platform

Name	Parameter	Description	Note
Ethernet port	1000/100/10Mbps	Used for communication between users and Apollo.	IP Address 192.168.11.1 ~ 192.168.11.100 are reserved for the bases of Apollo. Therefore, when using this Ethernet port, please ensure that the IP address of the device connected to Apollo not uses the above IP address. Or IP conflict may occur. Please refer to the SLAMWARE SDK for detailed communication protocols.
Power port	DC 18-25.2V 5A Max	Used for providing power supply for the device of users.	The end marked as 1 is positive while 2 is negative.
Control port	DB-15	Self-defined 15 pin port. User can design this port according to their own needs.	Please refer to the following figure for control port definition and pin definition, and the supported switch type for the reference design of the control port.
Emergency charging port	25.2V 10A	Used for charging Apollo under unexpected situations such as the charger electrode not working.	

### Pin Definition of Control Port

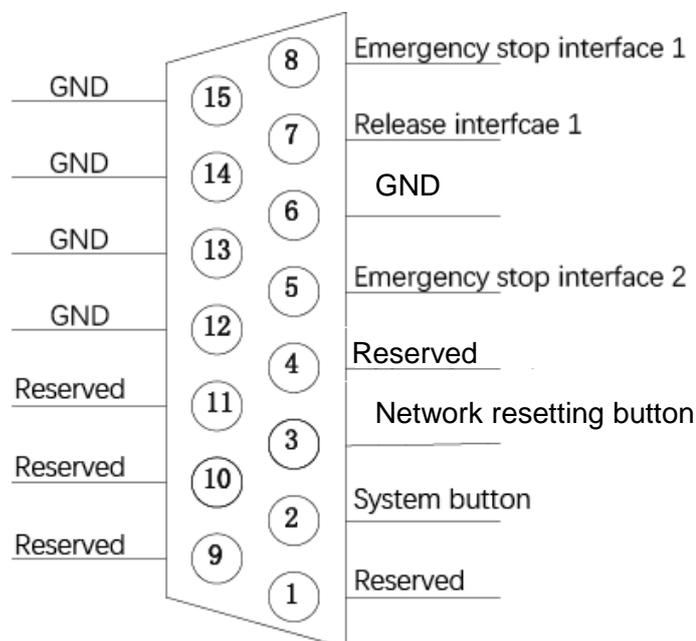


Figure 3-3 Pin Definition of Apollo Extended Platform Control Port

## Supported Switch Type and Description of Control Port

Switch Name	Description	Note
Emergency stop switch (Pin5 & Pin8)	Used for controlling Apollo in emergencies. Apollo will stop moving immediately after pressing this switch.	This switch is a must to design, or Apollo will refuse to work.
Release switch (Pin6 & Pin7)	Corresponded with the emergency stop switch, after pressing down the emergency stop switch, user needs to press the release switch to recover Apollo to normal status and continue other operations	
System switch (Pin2 & Pin12)	This switch is the power switch for the whole system. Short press for power-on and long press for power-off.	Checking method Internal pull-up to check the time width of the low level. Open time: 50ms~3000ms(Typical value is 300ms, and it is invalid to repeat this operation if it has already been in open status.) Close time: 3000ms~15000ms( Typical value is 4000ms, and it is invalid to repeat this operation if it has already been in open status.)
Network resetting switch(Pin3 & Pin14)	This switch is used to reset the wireless network.	When the network is abnormal, please long press the network resetting button for 3 seconds to reset Wi-Fi.

Figure 3-4 Supported Switch Type of Apollo Extended Platform Control Port

# Apollo Reference Design

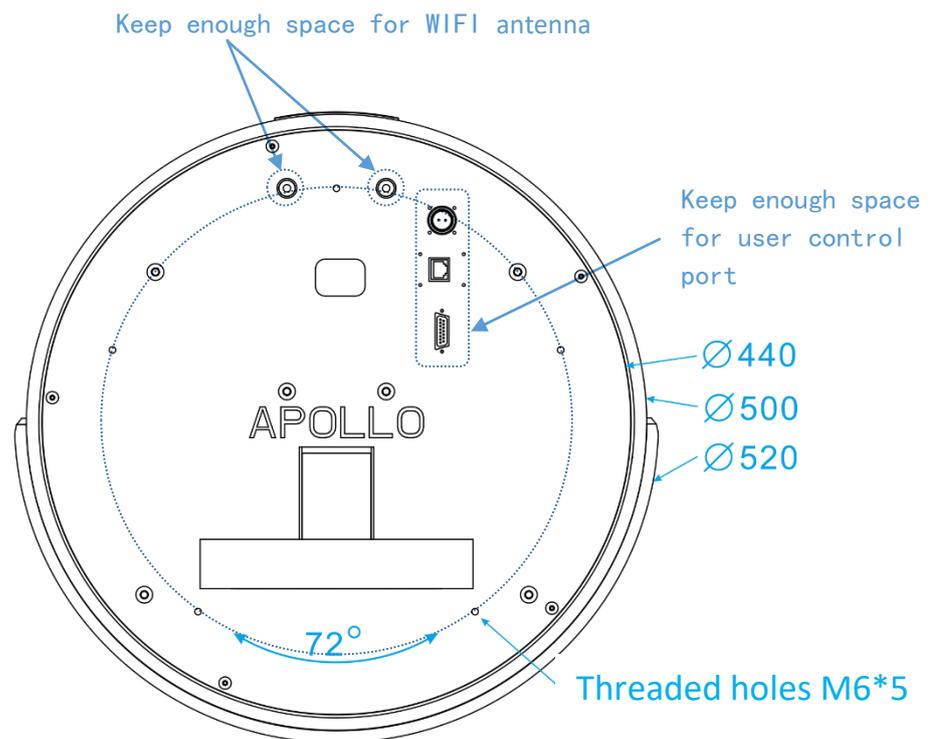
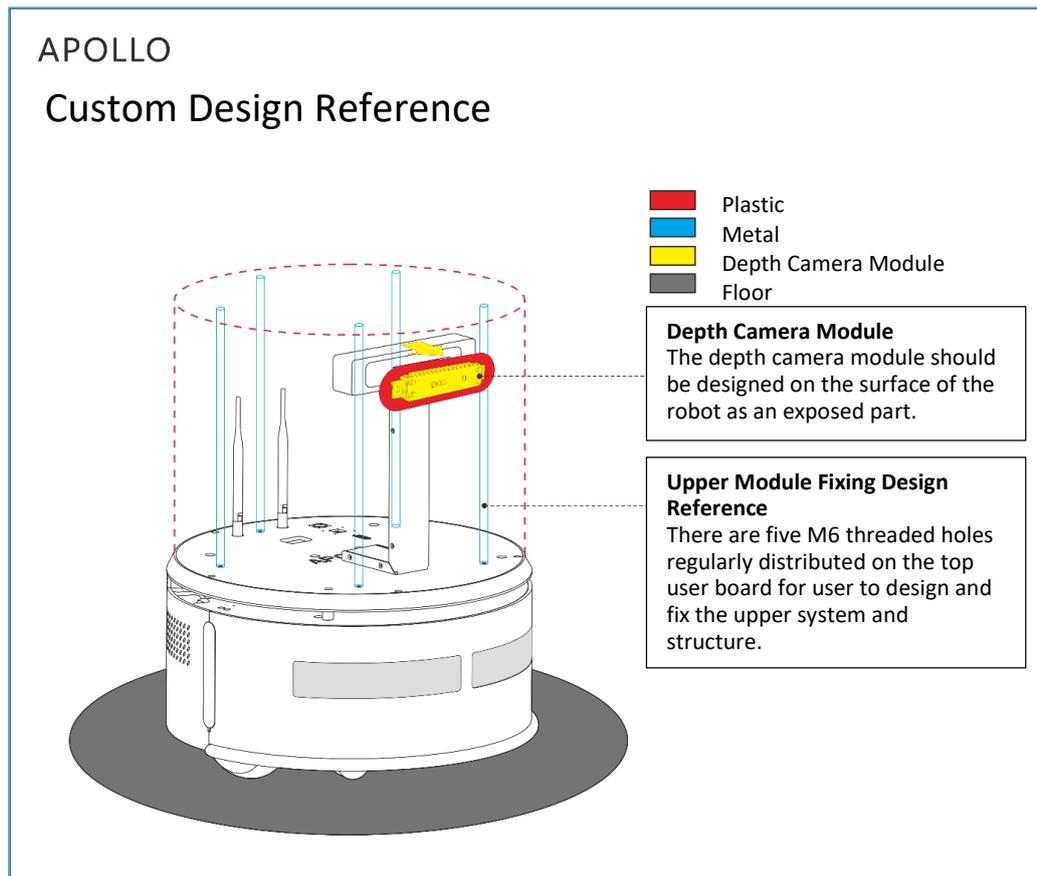


Figure 3-5 Apollo Reference Design

## Apollo Deployment

### 1. Place Charger

With the charger, Apollo can recharge itself automatically. Therefore, the charger requires to be put properly to ensure its performance. When Apollo goes back to the charger, it will have a driving force, so it's better to put the charger back against a wall. And the wall should meet the following requirements.

- a. The charger should fit the wall closely and there is no obstacles between them. The wall with skirting line is not recommended.
- b. The wall should not be made of transparent material like mirror or glass.
- c. The wall should be at least three times the width of the charger.
- d. The wall should be a straight wall instead of a curved one.

The charger requires a 220V power supply and its external power supply wire is 1.5m in length. So it's better that there is a power port on the wall for the charger(the power board is not recommended since it may cause danger due to messy wires).

The ground in front of the charger should meet the following requirements:

- a. Open. There is no obstacles in front of the charger ( with the charger as the center and within a radius of 2 meters from the center).
- b. Level. There is no slope on the ground.
- c. There is no soft carpet on the ground which leads Apollo sinking into it more than 2cm.

Please always launch Apollo from the charger to ensure that it can recharge itself properly.

Note: if the charger is moved to a different place when using Apollo, user should reset the charger position accordingly when loading the map. Please refer to the detailed interfaces description in our SDK document.

### 2. Launch Apollo

As shown in the following figure, find the air switch and turn it on, then press the system switch on the demo module to start the system. Once succeeded, the system indicator turns red and the buzzer beeps several times. It takes one minute to start the system.

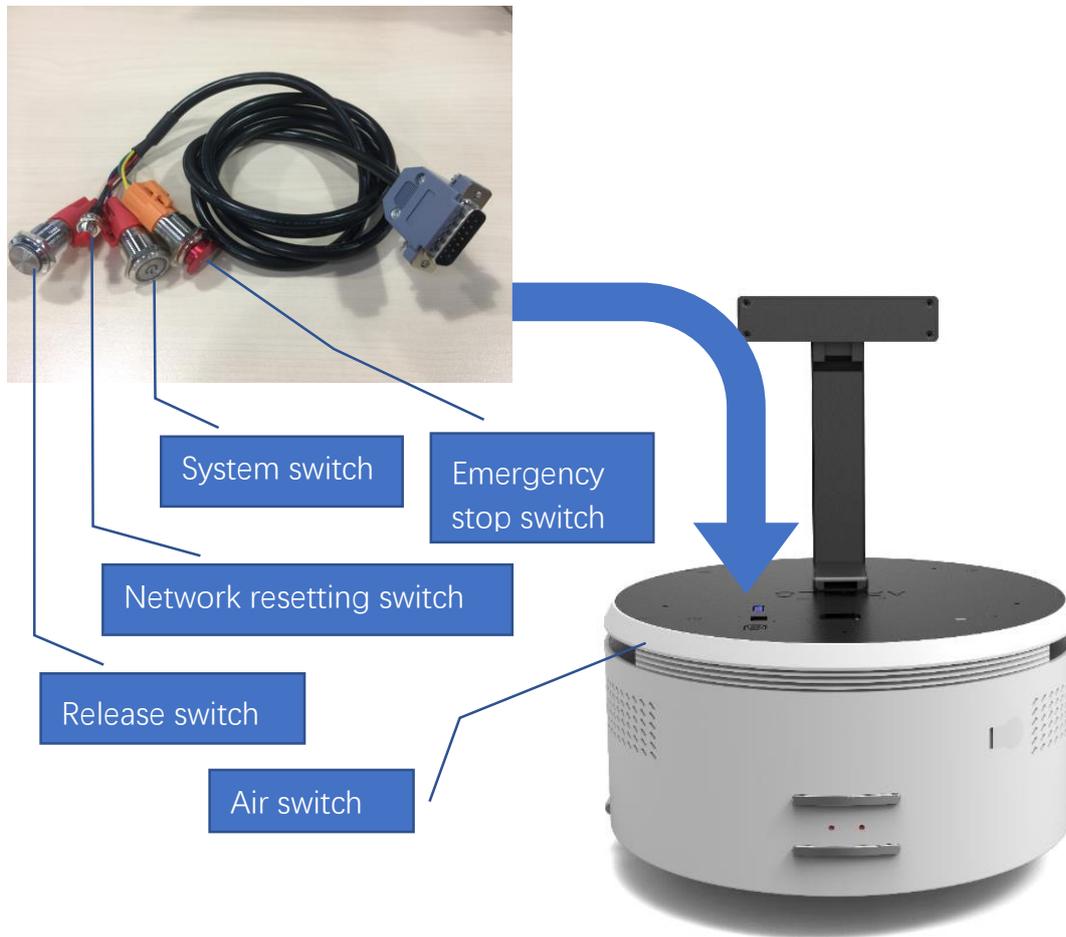


Figure 4-1 Apollo Air Switch and System Switch

### 3. Build and Save Map

Download and install the robot graphical tool RoboStudio from our official website <http://www.slamtec.com/cn/RoboStudio>. Register and login to the tool. By clicking **File->Robots** in the menu, user can find a docked window opened in the left side of the pane as in Figure 4-2. In this window, user can connect to or disconnect from robots.

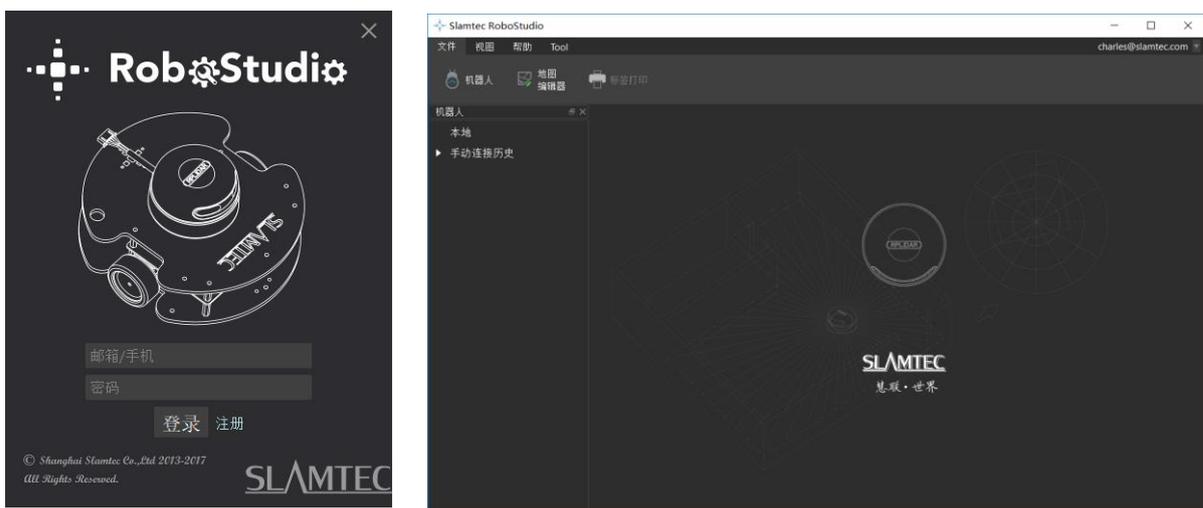


Figure 4-2 RoboStudio Robot Interface

Right click the whitespace of the robot list -> choose **manual connect robot** in the prompt dialog box, -> enter the IP address and port number in the new dialog box -> click **Connect** to connect to the robot as shown in the following screenshot. If you have already connected to the SSID obtained in step 3 via network adapter on computer, please enter the default IP address 192.168.11.1 in the above dialog box. (The IP address of your wireless adapter network should be DHCP mode)



Figure 4-3 RoboStudio Robot Connection Dialog Box

Once connected successfully, the major work area will show the robot, map information and its status. The robot name will turn to green and the robot status will turn to **Connected** as below.

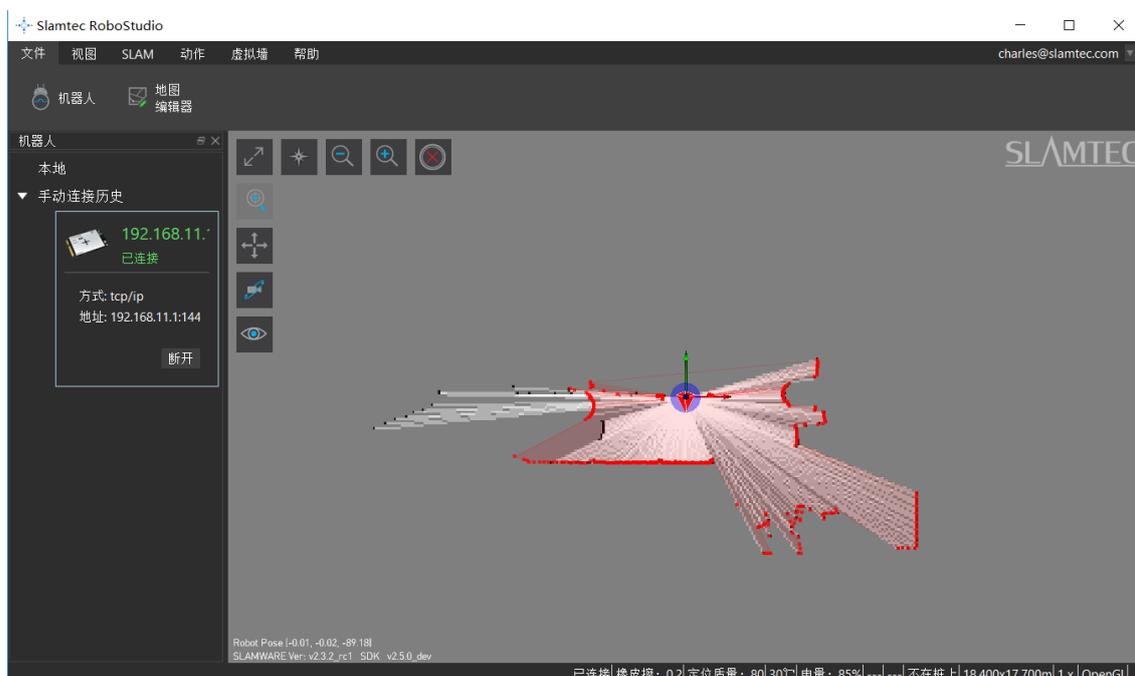


Figure 4-4 RoboStudio Robot Connection

Right click a point in the place where you want to build a map, and Apollo will follow the point to build map. After mapping, add virtual walls to the places where

you want to isolate them from robot. Click **File->MapEditor** and choose saving the map file to local or uploading it to the firmware.

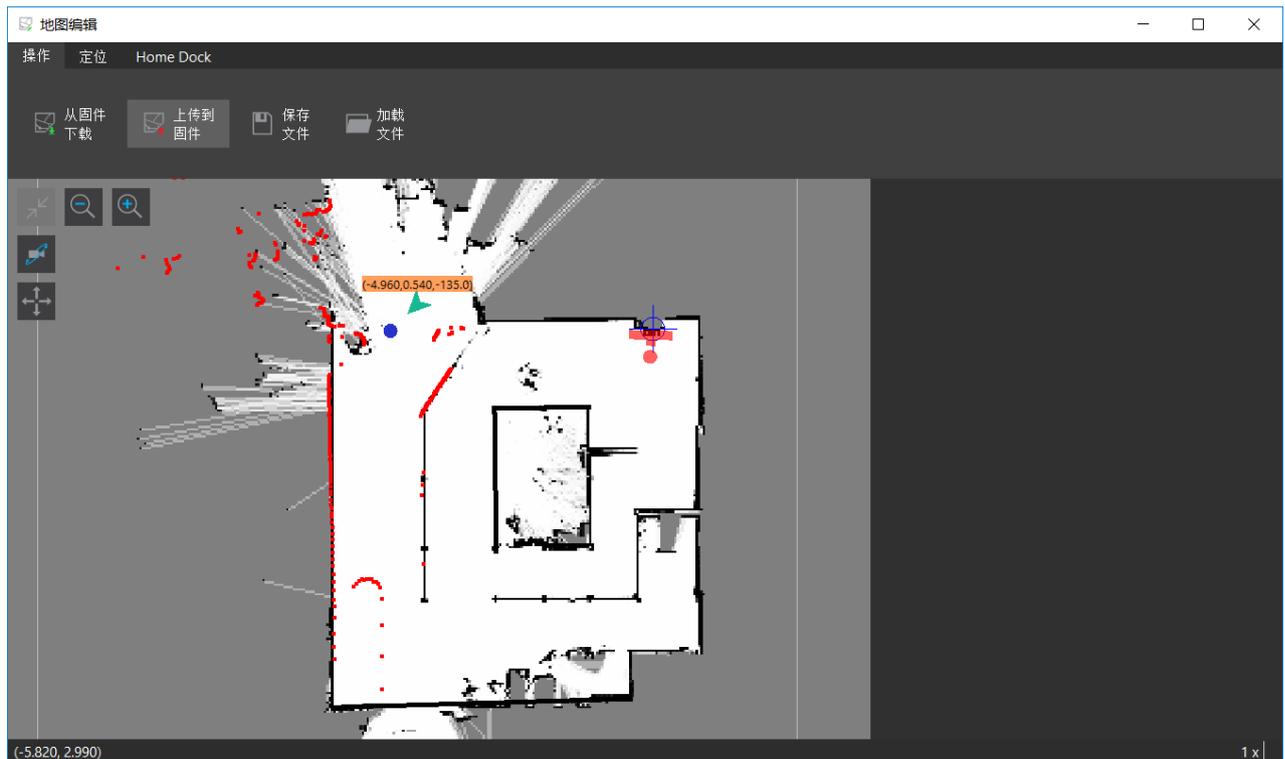


Figure 4-5 RoboStudio Robot Map Editing Window

#### 4. Launch Host Computer and Load the Map

The following code shows how to finish loading specified map by using SDK on the upper computer.

```

1.  /*
2.  * upload map file to apollo
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 apollo_ip = "192.168.11.1"; //the ip of apollo
17.         int apollo_port = 1445; //the port of apollo ,default is 1445
18.
19.         rpos::robot_platforms::SlamwareCorePlatform apollo =
20.             rpos::robot_platforms::SlamwareCorePlatform::connect(apollo_ip, apollo_port);
21.         //connect to the apollo
22.         rpos::robot_platforms::objects::CompositeMapReader cmapreader;
23.         //map reader
24.         rpos::core::Pose apollo_pose = rpos::core::Pose(rpos::core::Location(0, 0, 0));
25.         //the Apollo pose in map(apollo_pose should be the apollo's real pose in new map)
26.         //using apollo.getpose() to get the old apollo pose
27.         auto map = cmapreader.loadFile(map_path);

```

```
28. //load map
29. apollo.setCompositeMap(*map, apollo_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 apollo.gethomepose() to get the old home pose
34. apollo.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. }
```

Please refer to our SDK reference for more movement deployment.

## Connect to Computer

### Wired Connection

According to the requirements from actual application development, we have designed a RJ45 Ethernet port on the extended platform of Apollo. Therefore, user can directly connect Apollo to PC via network cable for extension or further development.

### Wireless Connection

To help our user test Apollo and meet the requirements in future actual application scenarios, Apollo also supports wireless connection. User can connect to the SSID of Apollo with a computer and then connect to Apollo with its default IP address 192.168.11.1. In addition, user can use our Web Portal tool to distribute a specific IP address for Apollo and use it for connection.

## Debug Tools

### RoboStudio

RoboStudio graphical tool is used for testing and controlling Apollo. Please download it from our official website as below:

<http://www.slamtec.com/cn/RoboStudio>

In the same page, we also provide a document to introduce the usage of this tool.

### Web Portal Tool

During developing, testing and controlling the SLAMTEC robots like Apollo, our users can do many things to our robot via the Web Portal tool, such as checking basic information, upgrading firmware and configuring WiFi. (Default username: *admin*. Default password: *admin111*)

Our Web Portal currently supports the following features:

1. Check the information of the robot;
2. Restart the SLAMWARE module;
3. Upgrade firmware

Slamtec provides Apollo firmware renewal and upgrade regularly. Our users can upgrade firmware via the Web Portal tool. Please ask for the latest firmware from our support engineers or sales representatives. The upgrade progress lasts for 5~10 minutes and the buzzer beeps during the upgrade process.

Apollo will restart once the upgrade finished. Before that, please ensure that Apollo has sufficient electricity.

4. WiFi configuration;
5. Start diagnosing SLAMWARE core;
6. Modify admin password;

For usage details, please refer to the following document:

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

## Charging and Battery

There are two ways to charge Apollo battery.

### Contact Charging

Apollo has a charger supported automatically recharging. When the battery is lower than 30%(this value can be adjusted by the upper system according to actual requirements), Apollo will find the charger by itself and start recharging automatically.

### Manual Charging in Emergency

In some unexpected situations, like Apollo cannot recharge itself temporarily, user can use emergency charging cable to charge Apollo. The emergency charging port of Apollo is shown in the following figure. Please use the emergency charging cable to connect the emergency charging port on the charger and the charging port on Apollo.

Once the fan inside the charger starts work, the charger starts charging for Apollo.

Note: there is no indicator lighting up for charging in emergency.

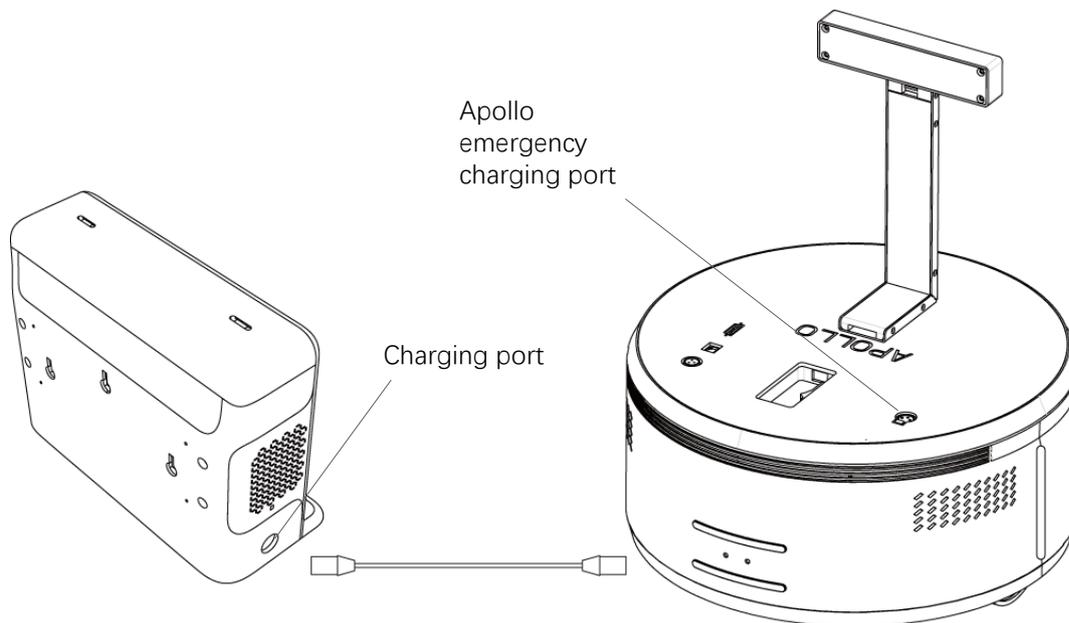


Figure 4-6 Manual Charging Connection

## Battery Attention

### Charging

Do not charge Apollo or its battery with non-official charging devices.

The battery should be charged within the range of temperature specified in the products Specification. Stop charging immediately when the surface temperature of the battery is over 50°C.

Before charging, please ensure the polarities of the battery are connected properly. Reverse charging is strictly prohibited. Reverse charging cannot charge the battery. Inversely, it will induce fatal damage to the battery and even lead to battery heating, swelling, leaking, fire and explosion.

### Storage

The battery should be stored in a cool and dry place. If you are intend to keep the battery for a long time (3 months or longer), it is recommended that the battery should be stored under the dry environment with temperature during 10-25°C and without corrosive gas. And the battery should be charged at least one time every six months to ensure the voltage of the battery is between 3.6V-3.9V.

### Attentional Notes

Since the battery is softly packaged with aluminum foil, it is vulnerable to sharp objects. Please do not place the battery with sharp objects.

Do not fall, hit or bend the battery or it may lead to fire.

Do not disassemble the battery in any circumstances or it may cause internal short-circuit that results in swelling and fire.

Do not directly connect the positive and negative anodes of the battery or it may lead to fatal damage to the battery and even fire.

Do not put the battery into fire or it may cause danger.

Do not put battery into liquid, such as water.

Do not charge the battery in a car.

Avoid violent vibration, shock and pressing during the transportation of the battery and handle it gently when carrying it. The battery should be packaged and protected with soft packing material.

- Handle Apollo base gently (do not kick, thrust or drag Apollo).
- Do not spill any liquid on Apollo.
- Do not use the recharging function of Apollo when it is walking on a soft carpet which can sag more than 2cm.
- Ensure that Apollo always starts on its charger.
- Do not change or replace anything in the machine without authorization.
- Ensure that the load of Apollo meets the requirement of the specification.
- Do not use Apollo on slope.
- Do not use Apollo under environment with too many highly transparent materials.

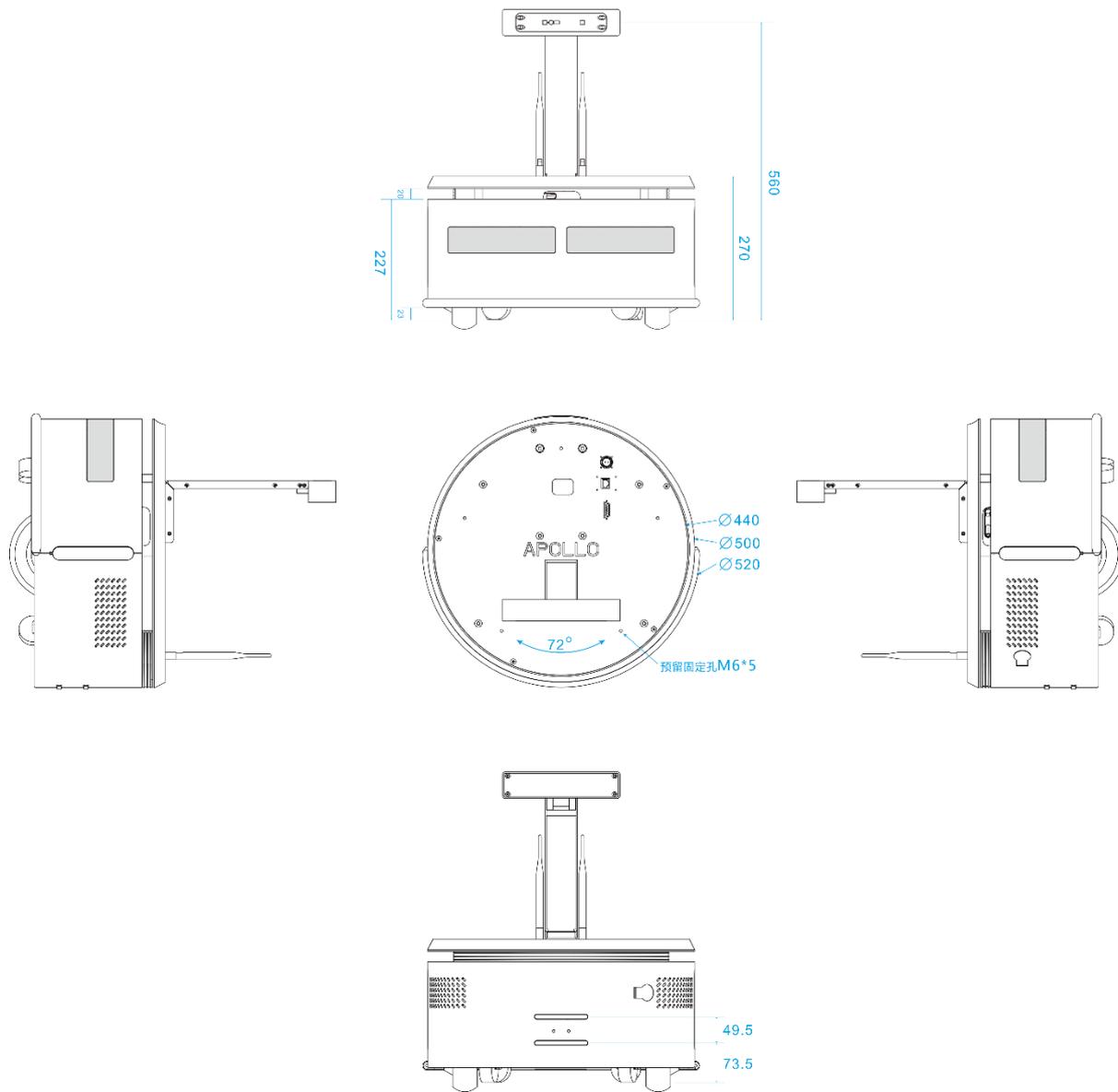


Figure 6-1 Apollo Mechanical Dimensions

## Image and table index

FIGURE 1-1 CONNECTION BETWEEN APOLLO AND EXTERNAL SYSTEM .....	4
FIGURE 2-1 APOLLO SENSOR CONFIGURATION.....	4
FIGURE 2-2 APOLLO INTERFACES CONFIGURATION.....	5
FIGURE 2-3 APOLLO CHARGER .....	5
FIGURE 3-1 APOLLO EXTENDED PLATFORM.....	7
FIGURE 3-2 INTERFACE DEFINITION OF APOLLO EXTENDED PLATFORM .....	7
FIGURE 3-3 PIN DEFINITION OF APOLLO EXTENDED PLATFORM CONTROL PORT .....	8
FIGURE 3-4 SUPPORTED SWITCH TYPE OF APOLLO EXTENDED PLATFORM CONTROL PORT.....	9
FIGURE 3-5 APOLLO REFERENCE DESIGN.....	10
FIGURE 4-1 APOLLO AIR SWITCH AND SYSTEM SWITCH.....	12
FIGURE 4-2 ROBOSTUDIO ROBOT INTERFACE .....	12
FIGURE 4-3 ROBOSTUDIO ROBOT CONNECTION DIALOG BOX.....	13
FIGURE 4-4 ROBOSTUDIO ROBOT CONNECTION .....	13
FIGURE 4-5 ROBOSTUDIO ROBOT MAP EDITING WINDOW.....	14
FIGURE 4-6 MANUAL CHARGING CONNECTION .....	18
FIGURE 6-1 APOLLO MECHANICAL DIMENSIONS .....	21