LixelKity K1 Compact Handheld Scanner User Manual

I. Product Overview

LixelKity K1 is a lightweight and compact handheld real-time 3D reconstruction device launched by XGRIDS. Weighing in at less than 1kg, whilst integrating 56 million pixel panoramic vision and 360° LiDAR, generating centimeter-level color models in real time. For professional, small and medium-sized customers and 3D enthusiasts, we provide convenient 3D reality capture and modeling solutions.

II. Basic operation

(1) First use: Installation, activation, check

1. Installation and inspection

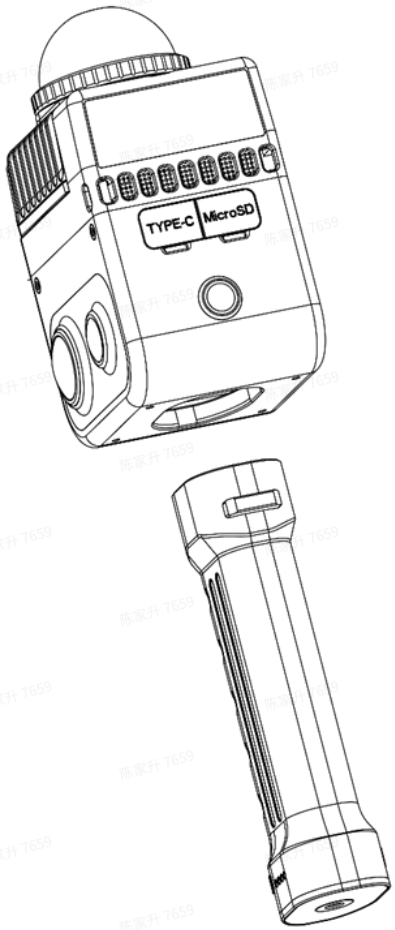
1.1 Battery installation

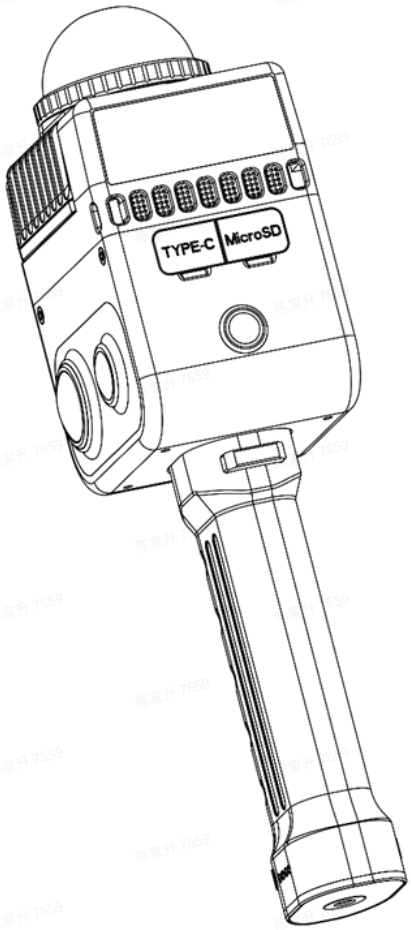
1.1.1 Press the battery buckle

1.1.2 Insert the battery into the bottom of the device and ensure it is inserted tightly.

1.1.3 Loosen the buckle and confirm that the battery is locked.

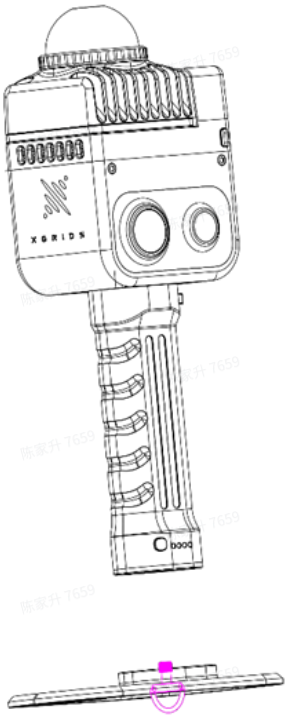
- Note: Failure to lock the battery may cause the device to slip.

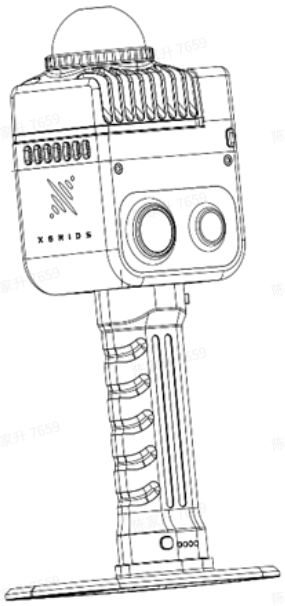




1.2 Base mounting

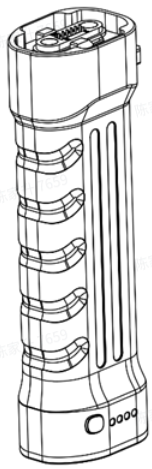
The battery handle has a threaded hole at the bottom, clip the device into the base, lock the bottom bolt, and place the device in a flat position.

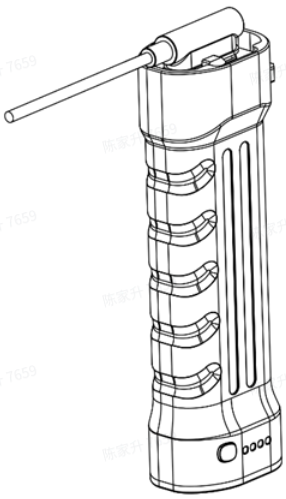




1.3 Battery charging

Use the provided charging cable, connect the charging adapter to the battery, once the indicator light starts flashing, the battery is charging.





Battery full charge time: about 2 hours. During the charging process, the indicator light indicates the current battery level. Please refer to the table below for details.

Battery Light	Battery Level
One green lights	0-24%
Two green lights	25%-49%
Three green lights	50%-74%
Four green lights	75%-99%

1.4 Function key operation

Function	Button operation	Device status
Power on	Long press the device button for 4 seconds	The indicator light blue light flashes slowly, start preparing, and the green light is on after the preparation is completed
Shut down	Long press the device button for 4 seconds	Indicator light off, equipment shutdown completed
Start scanning	When the green light is on, quickly double-click the device	Green light flashes quickly, start scanning preparation, green light flashes slowly, start scanning
End scanning	When the green light flashes slowly, quickly double-click the device	Green light flashes, device starts to end scanning, green light flashes, end scanning completed, can start the next scan

1.5 Indicator light description

Device light flashing mode	**Explanation**
No flash	Device not powered on
Blue light always on	USB transfer mode
Blue light flashing slowly	The device is starting up.
Green light is always on	Standby state
Green light flashing rapidly	Start/stop scanning
Green light flashing slowly	Scanning
The red light is always on	Serious failure

Yellow light is always on	Device is not activated
The traffic lights flicker alternately	Firmware upgrading

2. Device activation and connection

2.1 LixelGO Introduction

LixelGO is a mobile app that comes with the Lixel L and K series scanner. It can be connected and synchronized through WiFi and 5G/4G real-time transmission services, switch between true color and elevation preview modes quickly, support viewing and managing projects, and achieve management of digital 3D space assets in cloud.

2.1.1 Android version

Scan the code to install the latest version of the app.

2.1.2 IOS version

Go to the App Store and search LixelGo to download and install the latest version of the app.

2.2 Recommended installation environment

Recommended phone configuration :

CPU : Recommended Snapdragon series, preferably Snapdragon 8 or above

Random Access Memory : Minimum 8GB, preferably 16GB or more

Display chip : It is best to have an independent display chip

Other: to support Bluetooth function, storage memory is more convenient, battery life is longer

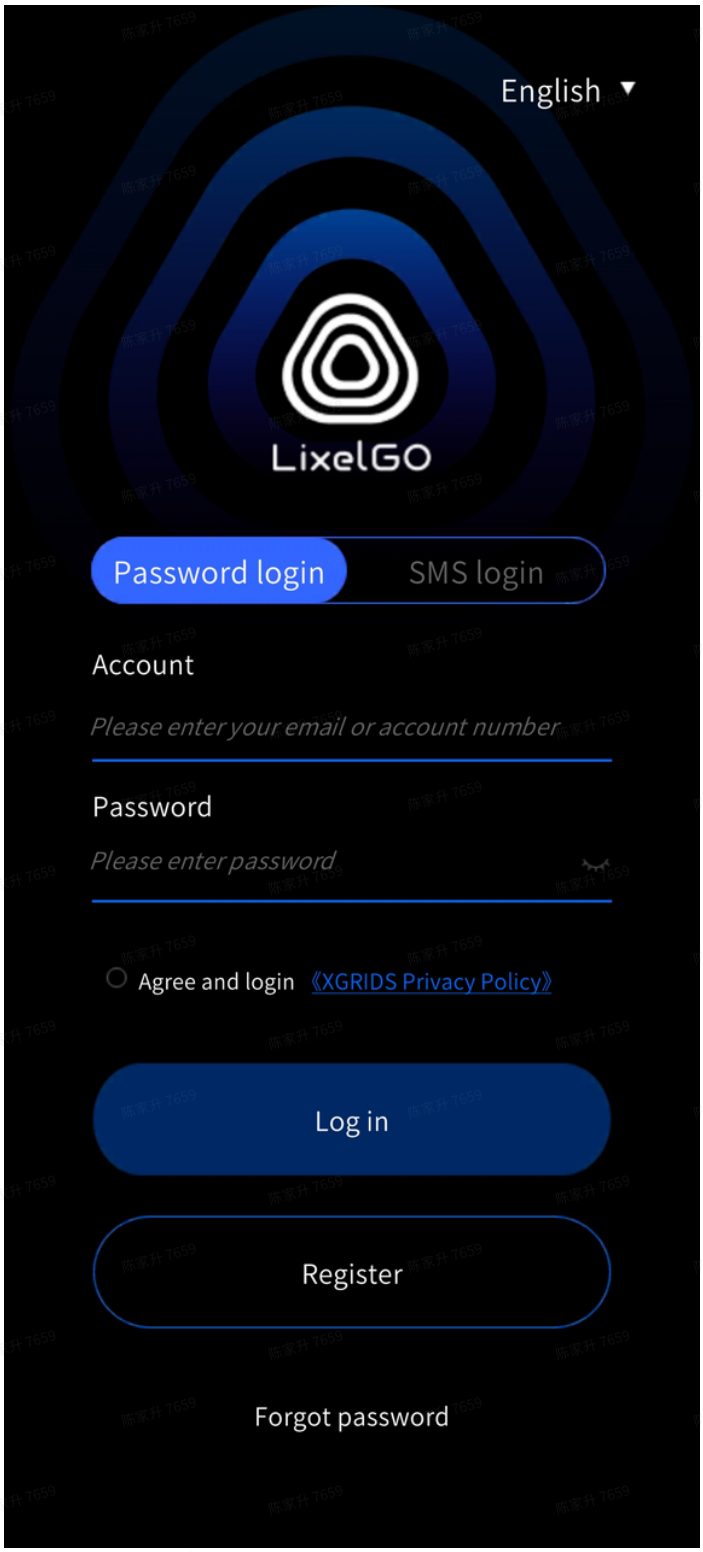
Recommended :

Brand	Product	Processor CPU	Random Access Memory	Graphics card GPU
VIVO	IQOO NEO 6	The first generation Snapdragon 8 + mobile platform	12GB	Adreno 730
Redmi	Redmi K50 E-sports Edition	Qualcomm Snapdragon 8 Gen 1	8GB	Adreno 730
Huawei	Huawei P50E	Snapdragon 778G	8GB	Adreno 642L
OPPO	OPPO K10	Dimensity 8000-MAX Mobile Platform	8GB	Mali-G510 MC6
APPLE	iPhone 13 and above	Hexa-core, 2x3.23 GHz Avalanche + 4x1.82 GHz Blizzard, 64-bit	4GB	Apple GPU 4-core

2.3 Device activation

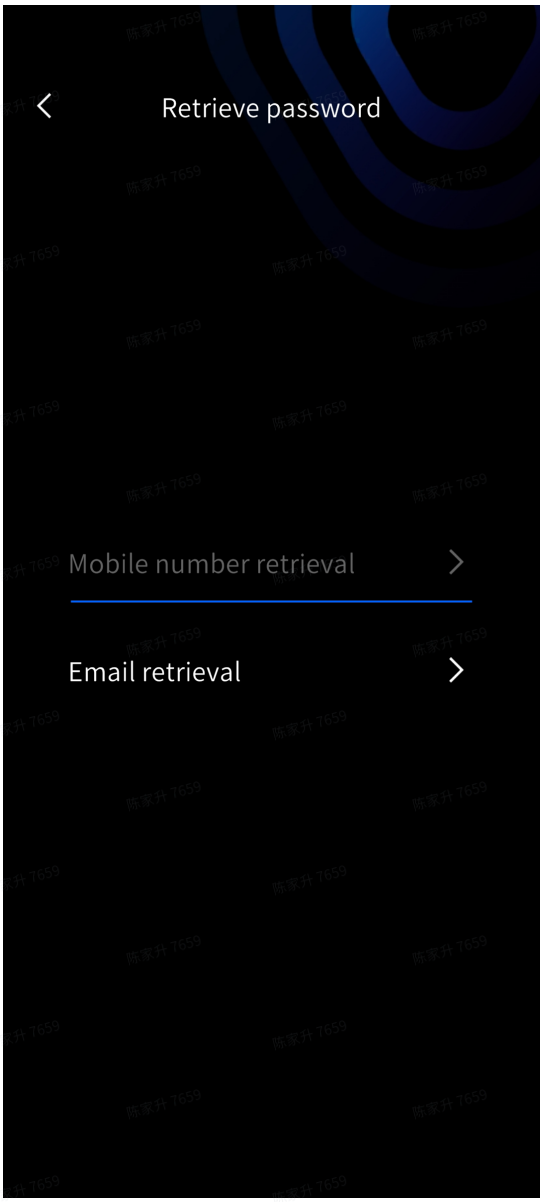
2.3.1 Register and log in to LixelGO.

After installing LixelGO, open the app and click Use now to enter the login/registration interface. New users should choose to register by email or mobile phone number. Registered users can log in by account and password or mobile phone verification sms.



2.3.2 Forgot password

If you have registered an account but forgot your password, you can click "Forgot password" to reset it through the registered phone number or email.



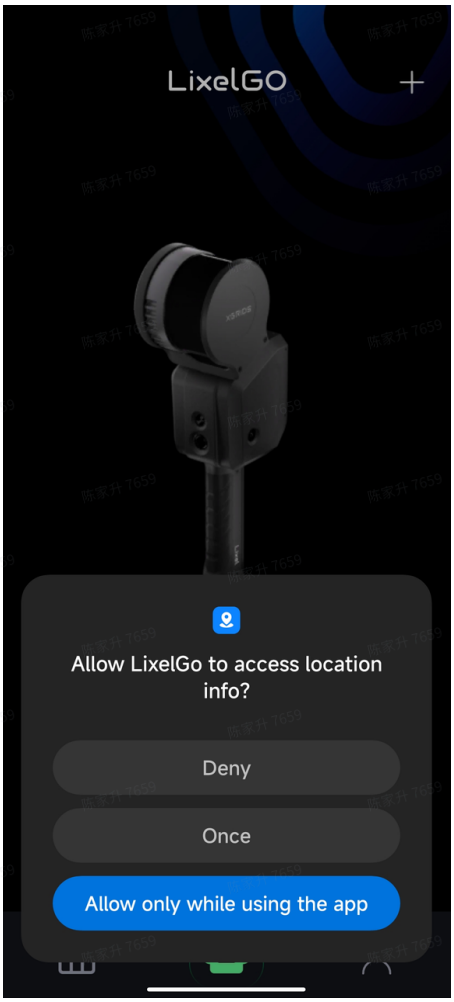
2.3.3 Switch language

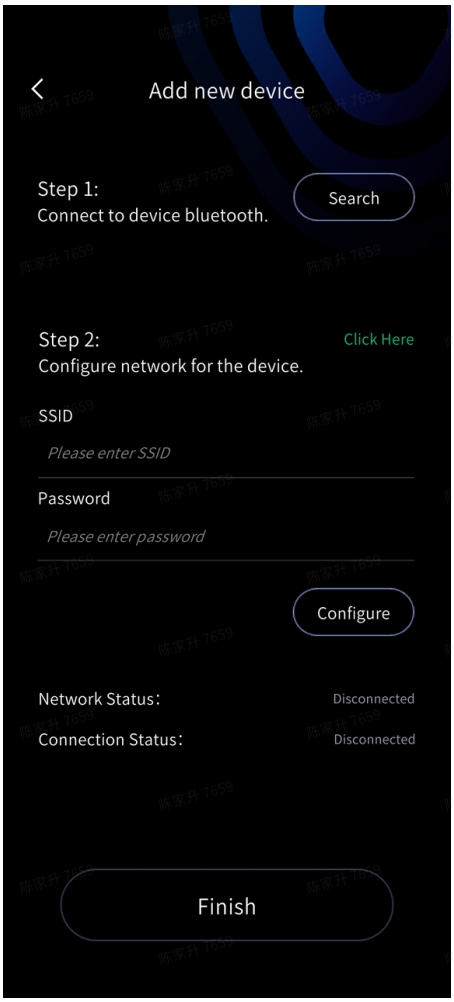
By clicking on the lower right corner of the screen to setting and switch languages, currently supports Simplified Chinese and English two language modes.

2.3.4 Add new devices

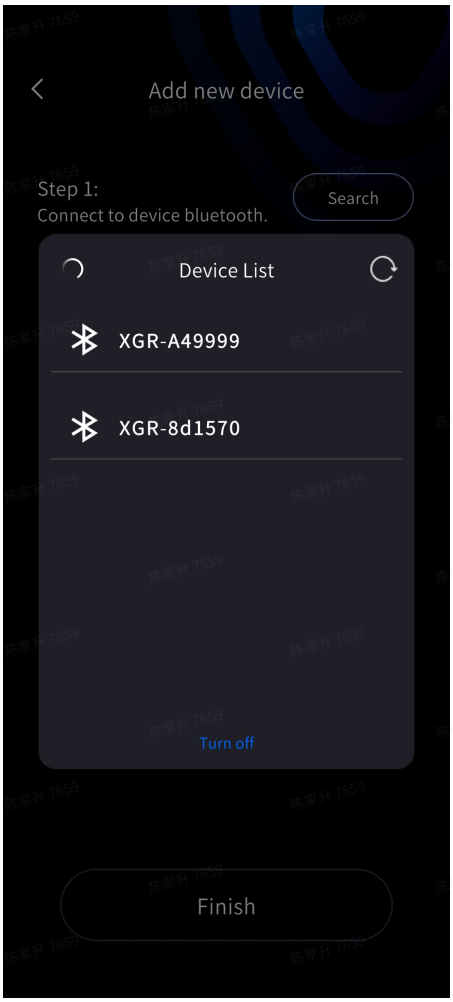
2.3.4.1 Android version

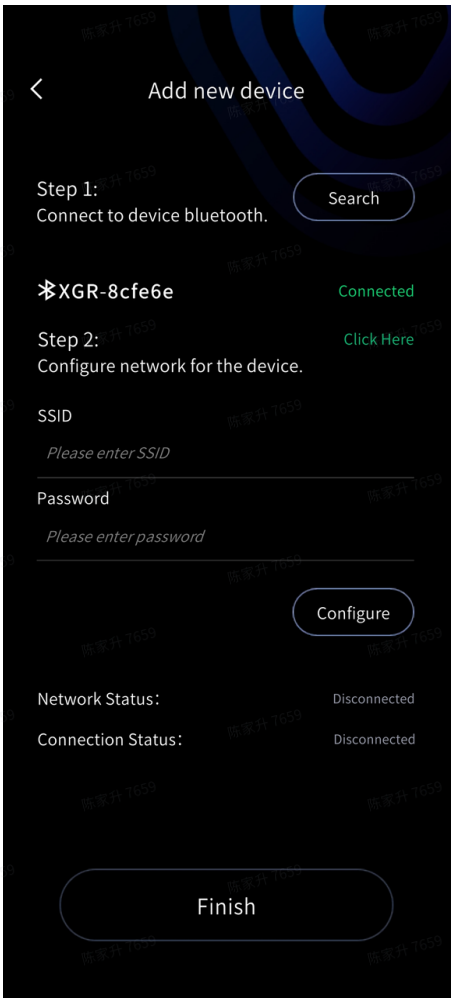
- Press and hold the power button to turn on the handheld scanning device, and the indicator light will flash from blue to green for successful startup.
- **Direct Connect Mode:** Click Add new device, enable permissions, and then follow the steps.

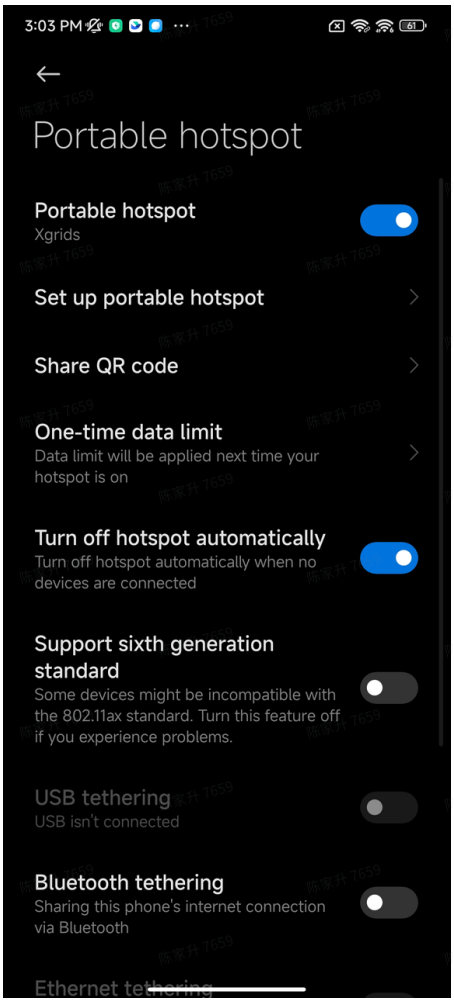


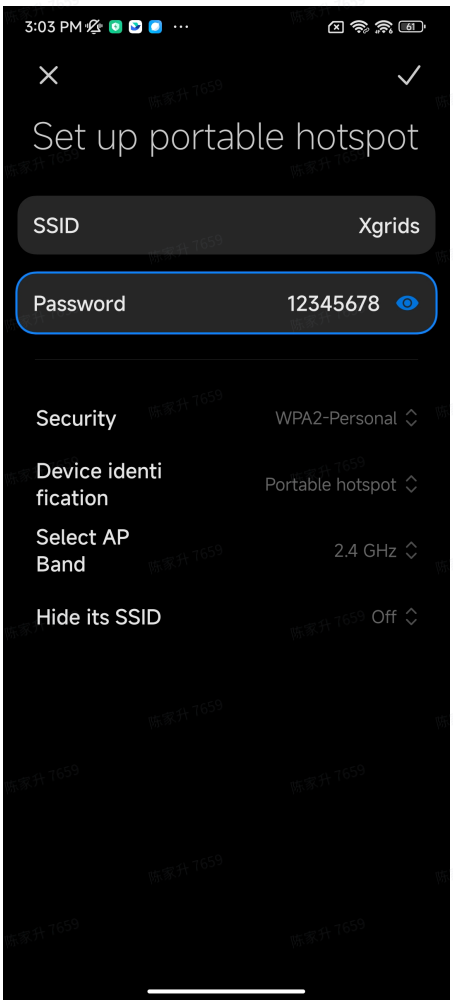


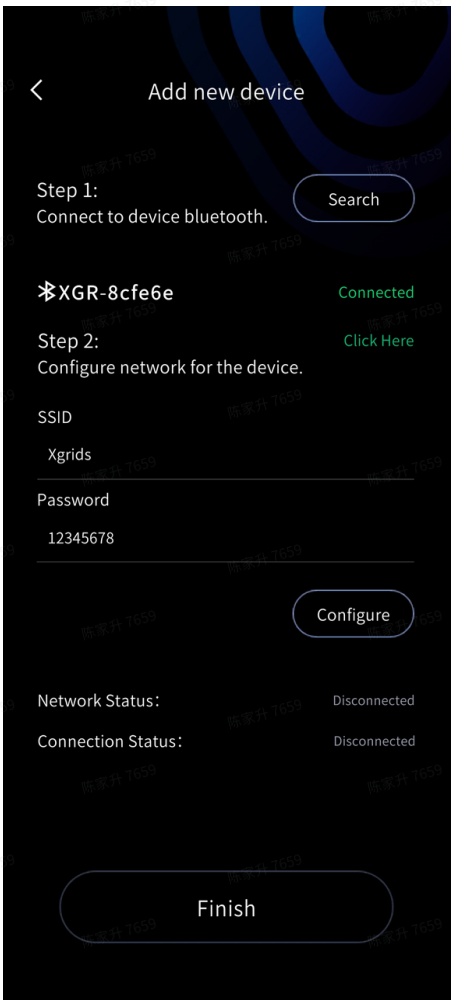
The first step is to turn on the phone's Bluetooth, search for and connect to the corresponding device's Bluetooth. The second step is to configure the network for the device. First, open the phone hotspot [set the hotspot name and password as simple as possible], enter the hotspot name and password, click on Configure, and the app will automatically connect to the phone hotspot.

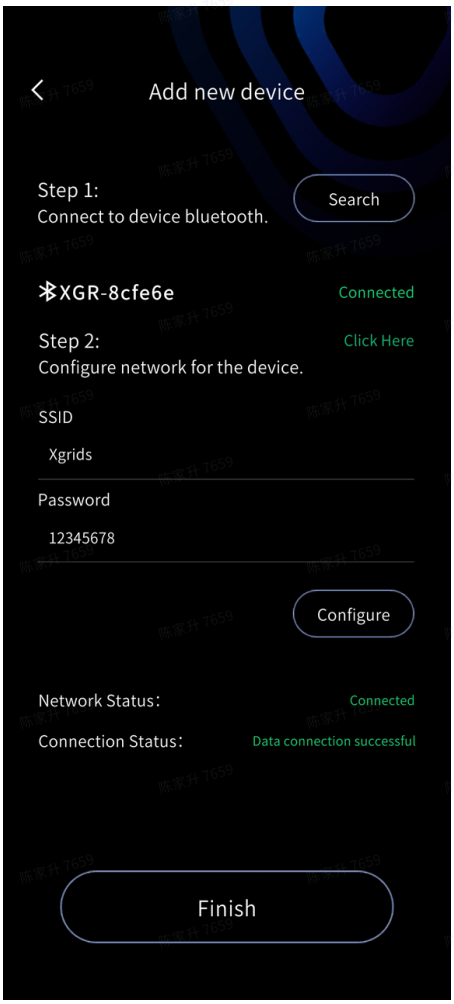

Add new device
Step 1:
Connect to device bluetooth.
Search
Device List
XGR-A49999
XGR-8d1570
Turn off
Finish


Add new device
Step 1:
Connect to device bluetooth.
Search
XGR-8cfe6e
Connected
Step 2:
Click Here
Configure network for the device.
SSID
Please enter SSID
Password
Please enter password
Configure
Network Status:
Disconnected
Connection Status:
Disconnected
Finish

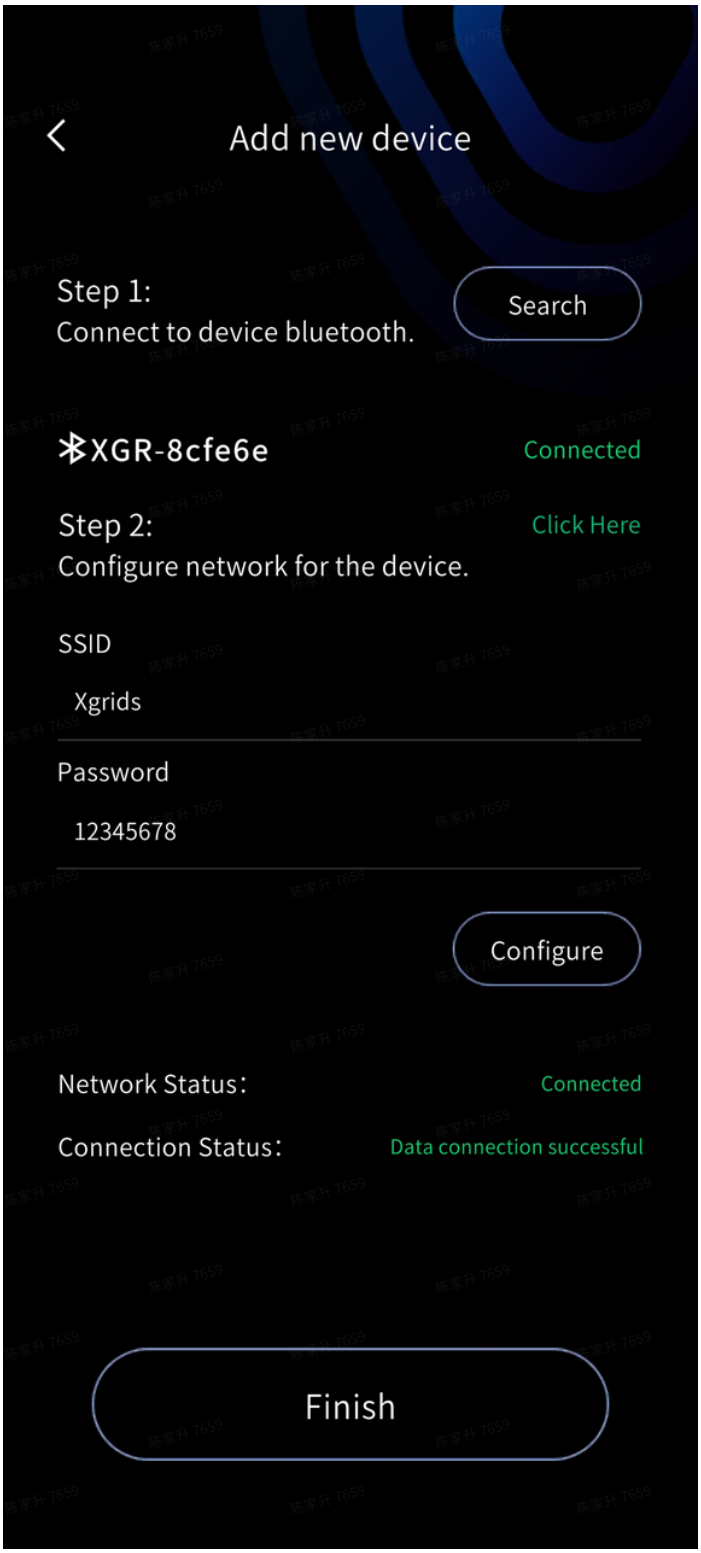

3:03 PM
Portable hotspot
Portable hotspot
Xgrids
Set up portable hotspot
Share QR code
One-time data limit
Data limit will be applied next time your hotspot is on
Turn off hotspot automatically
Turn off hotspot automatically when no devices are connected
Support sixth generation standard
Some devices might be incompatible with the 802.11ax standard. Turn this feature off if you experience problems.
USB tethering
USB isn't connected
Bluetooth tethering
Sharing this phone's internet connection via Bluetooth
Ethernet tethering

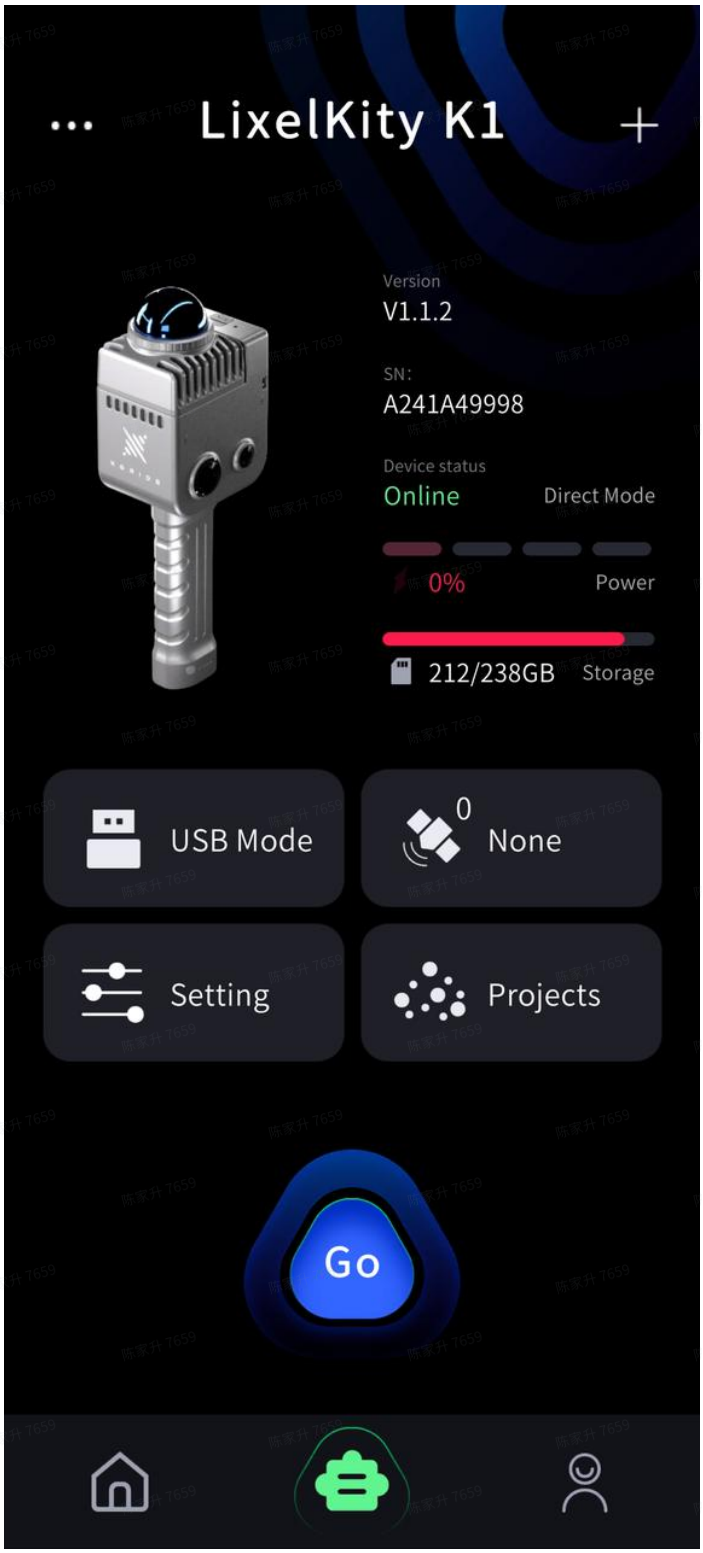

3:03 PM
Set up portable hotspot
SSID
Xgrids
Password
12345678
Security
WPA2-Personal
Device identi fication
Portable hotspot
Select AP Band
2.4 GHz
Hide its SSID
Off


Add new device
Step 1:
Connect to device bluetooth.
Search
XGR-8cfe6e
Connected
Step 2:
Click Here
Configure network for the device.
SSID
Xgrids
Password
12345678
Configure
Network Status:
Disconnected
Connection Status:
Disconnected
Finish

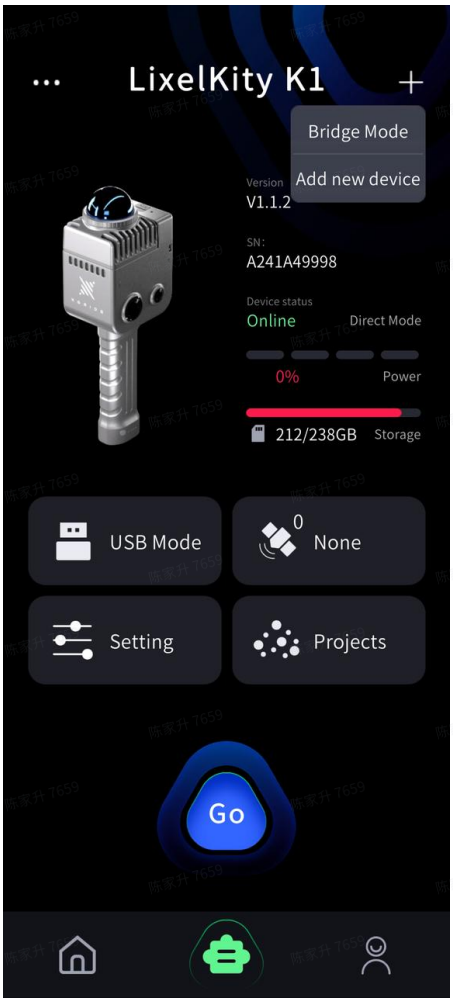

Add new device
Step 1:
Connect to device bluetooth.
Search
XGR-8cfe6e
Connected
Step 2:
Click Here
Configure network for the device.
SSID
Xgrids
Password
12345678
Configure
Network Status:
Connected
Connection Status:
Data connection successful
Finish

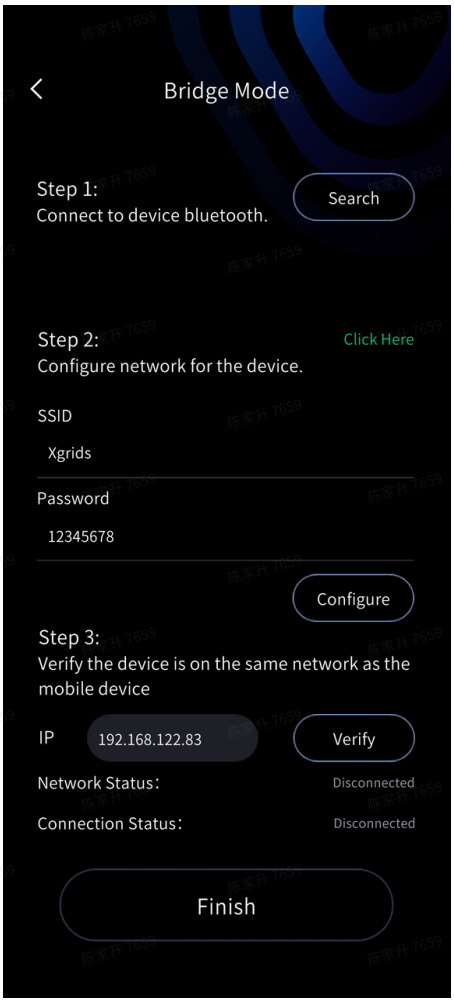
When both the network connection status and data connection status are displayed as successful, click Finish to view the basic information of the currently connected device.

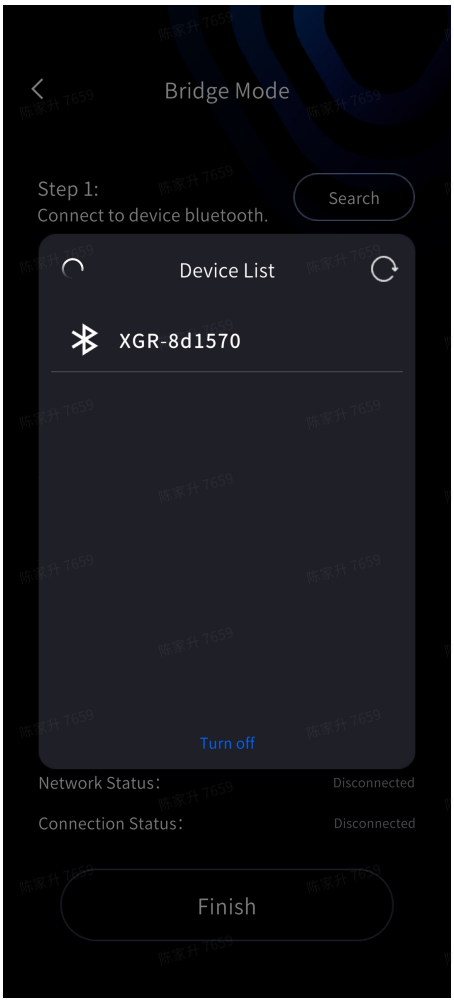




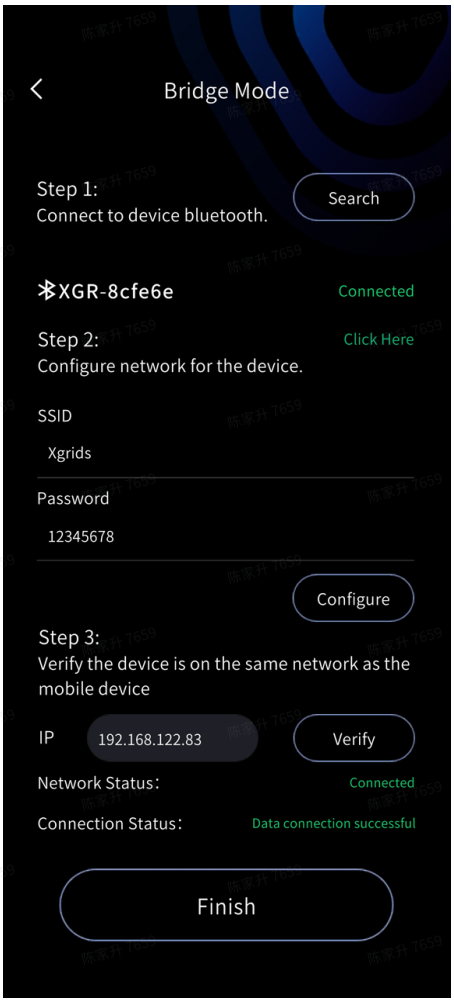
- **Bridge Mode :** Click the plus sign in the upper right corner of the interface, select Bridge Mode, enter the interface, and then follow the operation steps.

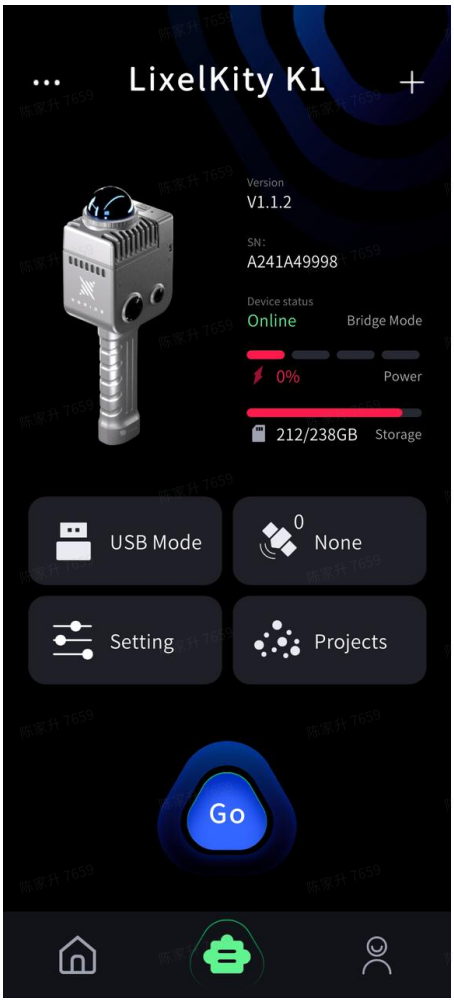






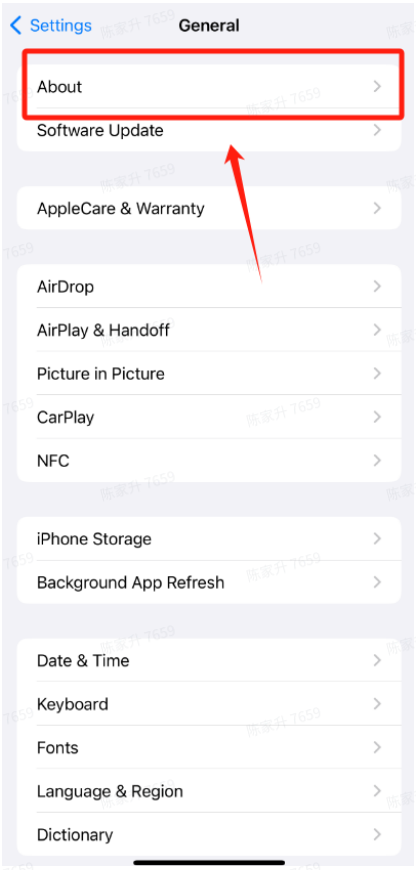
The first step is to retrieve the device's Bluetooth. The second step is to configure the network and verify it. After the correct connection, click Finish to view the device's basic information.

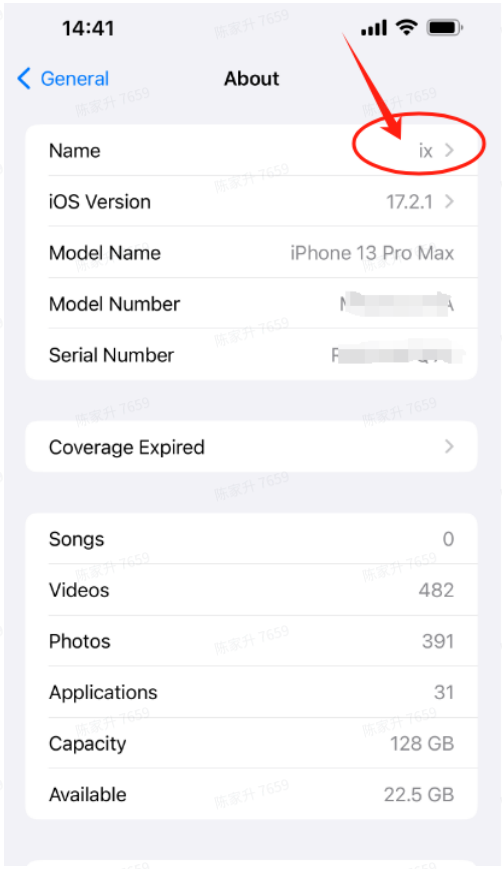




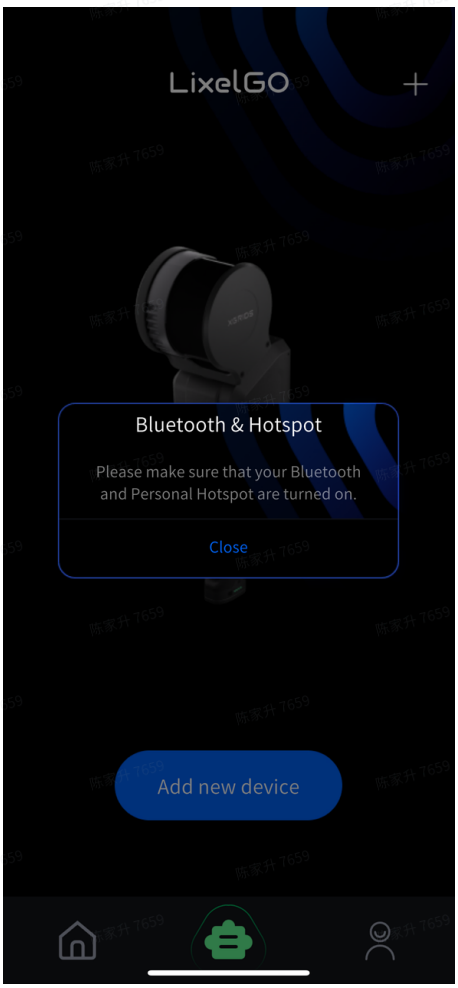
2.3.4.2 IOS version

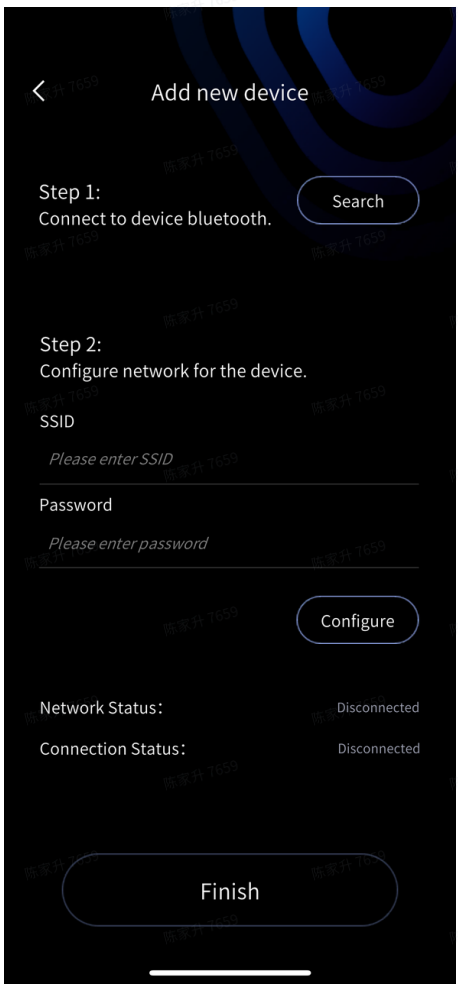
- Before using the app, you need to do some settings for your iPhone first. Click on "Settings" to enter "General," then go to "About." Modify the "Name" field to contain only English characters without using any spaces or special characters. This "Name" is used as the SSID for the phone.





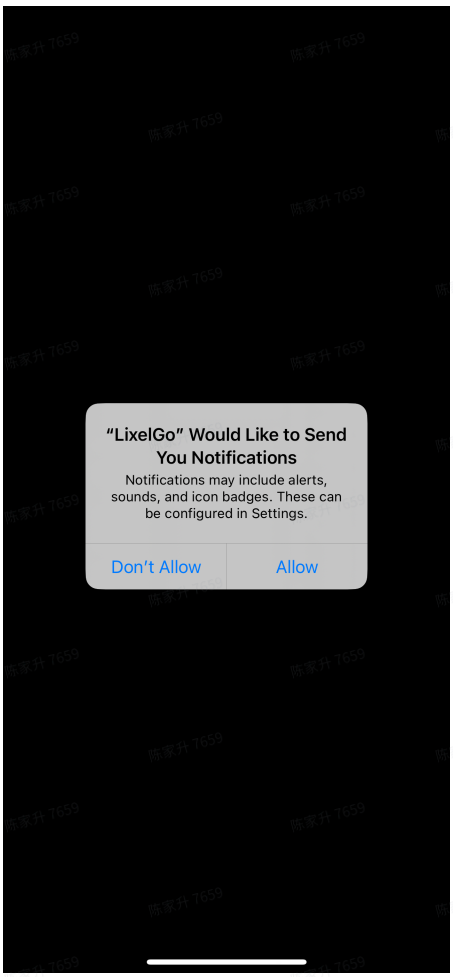
- Press and hold the power button to turn on Lixel K1, and the indicator light will flash from blue to green for successful startup.
- **Direct Connect Mode:** Click Add new device, click close, and then follow the steps.

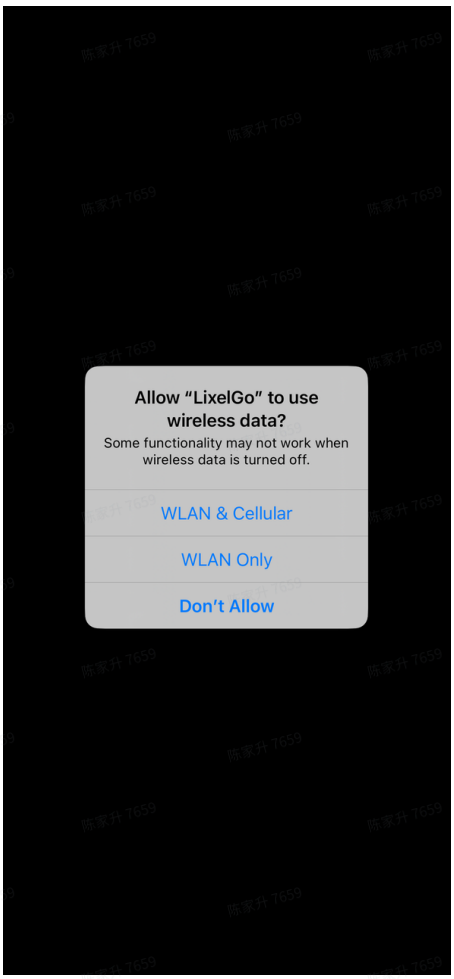


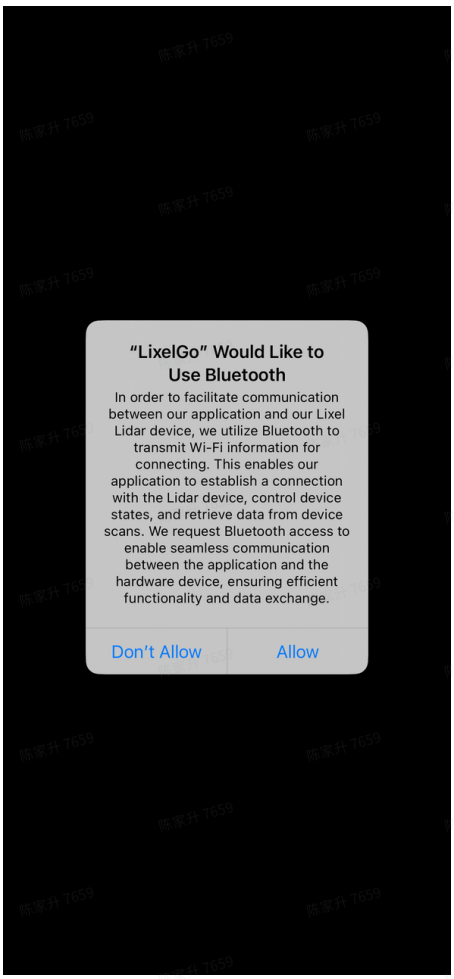


First Time Connection:

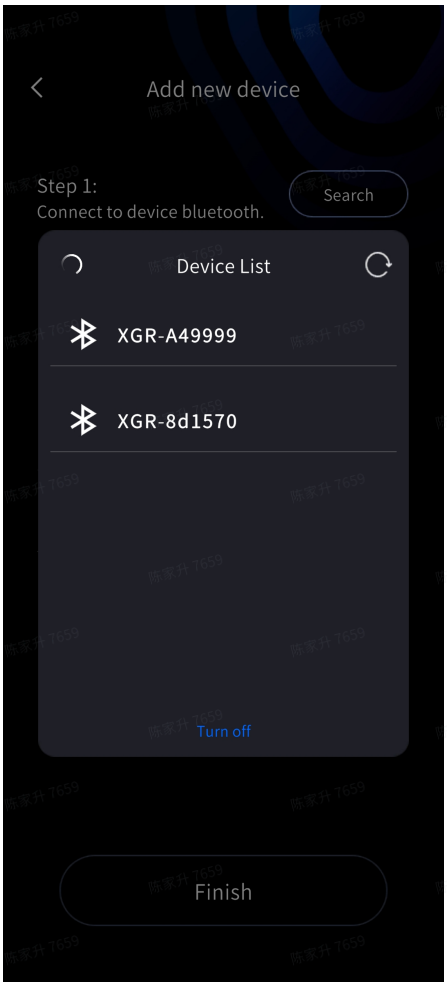
- Permission requires clicking "Allow."
- Select "WLAN & Cellular."
- Permission requires clicking "Allow."

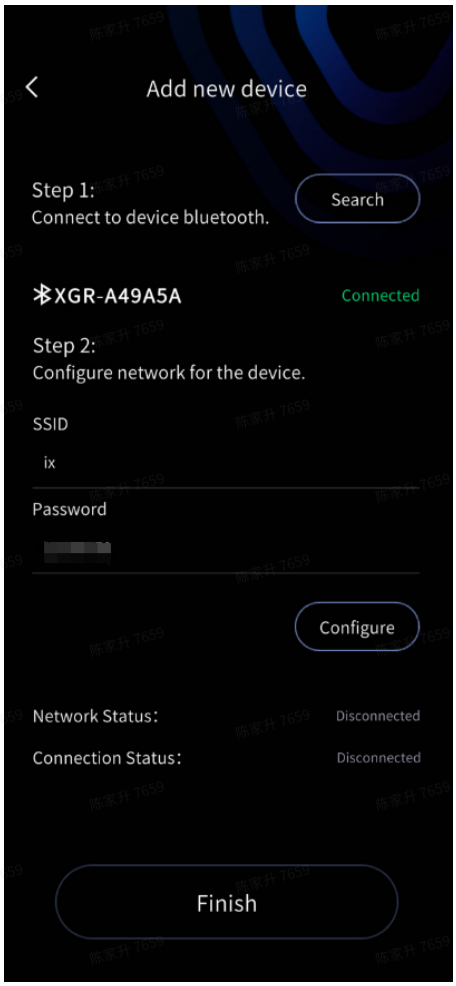


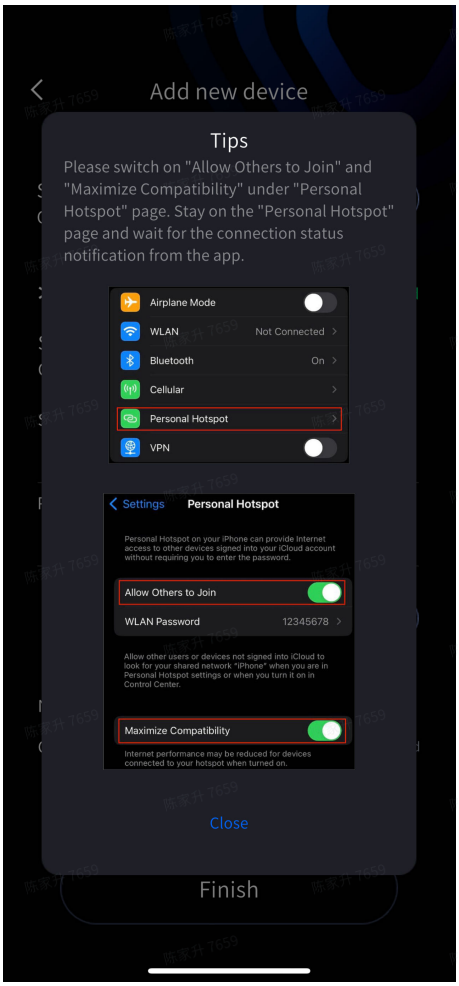




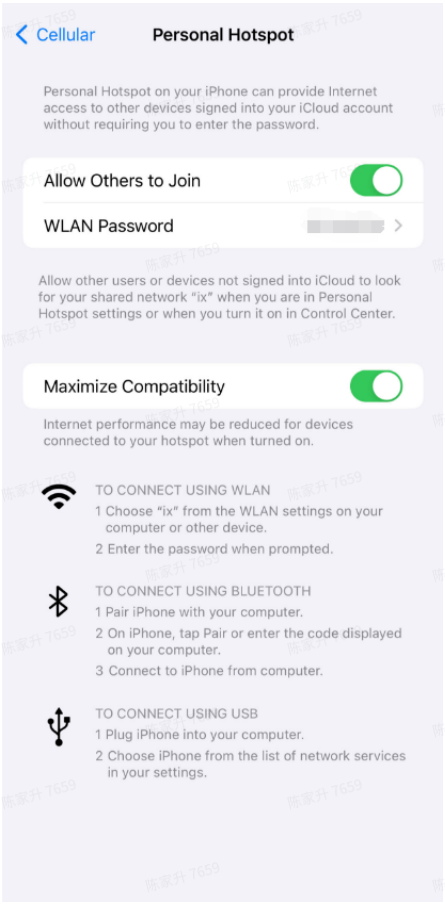
- Turn on the phone's Bluetooth, search for and connect to the corresponding device's Bluetooth. The second step is to configure the network for the device. Enter the device name of your iPhone and the password of your hotspot. Set the password as simple as possible. Click on Configure, read the tips carefully.

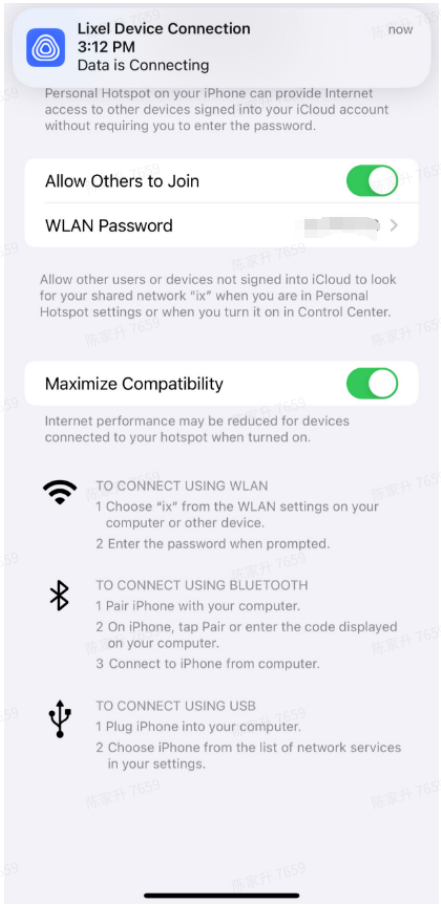




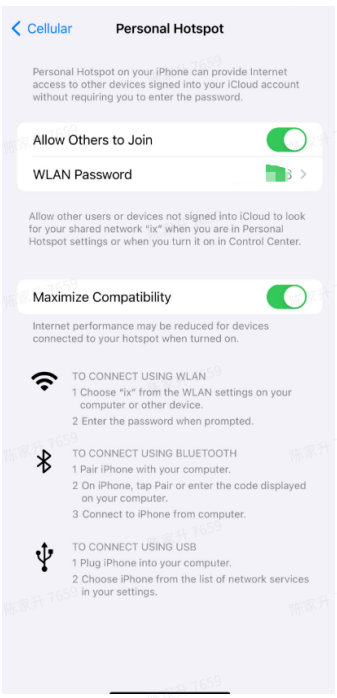


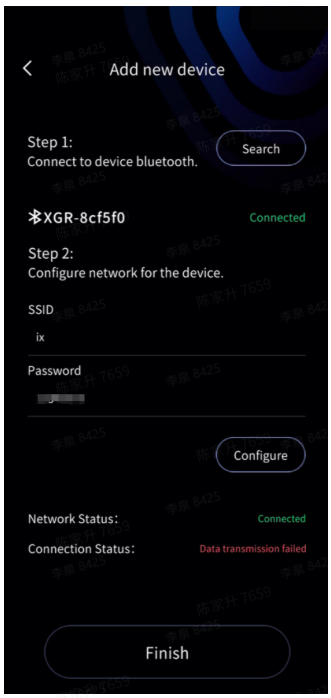
- When enabling the hotspot, cellular data (mobile network) must be turned on. (Changing the Wi-Fi connection status will affect the hotspot toggle.)
- Only when staying on the "Personal Hotspot" page can you confirm that the phone hotspot is enabled. Also, ensure that the "Allow Others to Join" toggle is switched on to allow devices to connect and discover the Wi-Fi. The hotspot selection must be set to maximum compatibility for successful connection.
- Staying on the "Personal Hotspot" page, you will see messages pop out. Only when you see "Data Connection Successful!". You can go back to the LixelGo app.

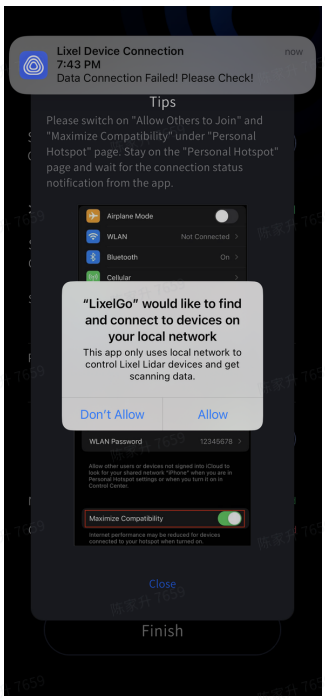


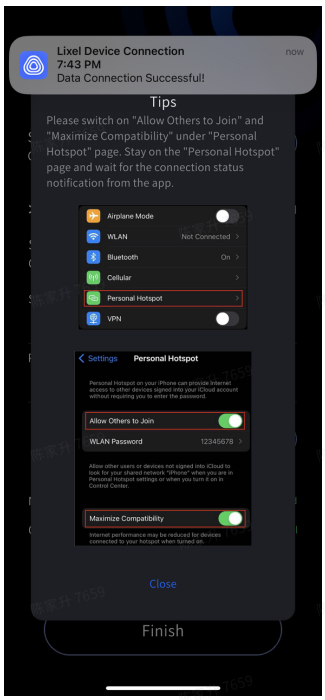


- During the first connection, data connection may fail due to permission reasons. After returning to the application, clicking "Configure" will prompt the permission dialog again. Selecting "Allow" will immediately establish a successful connection.

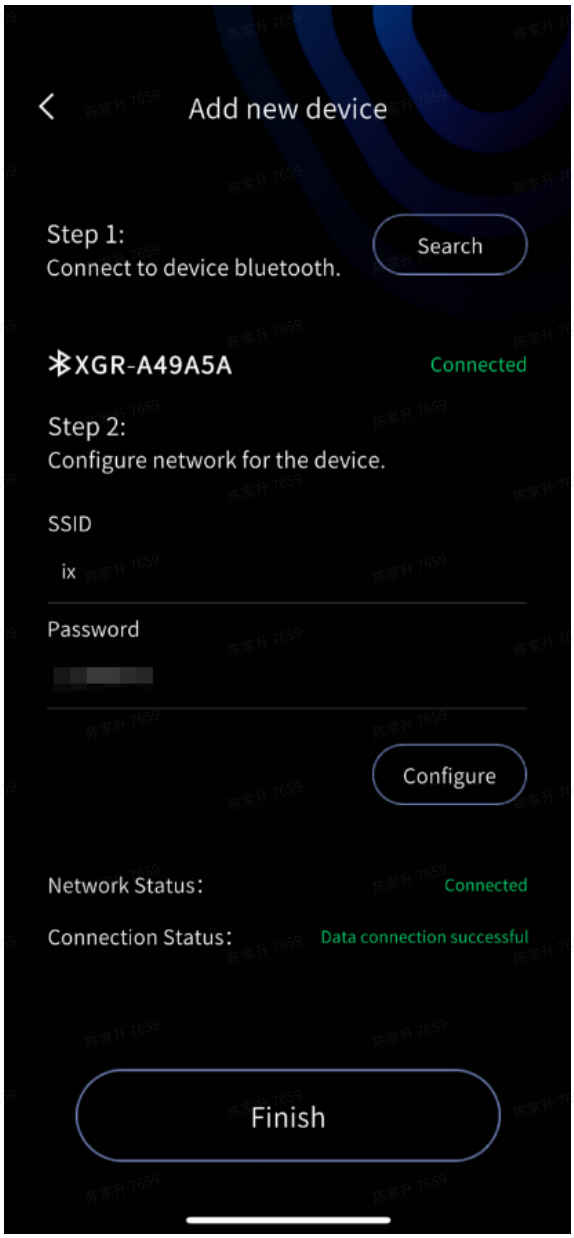


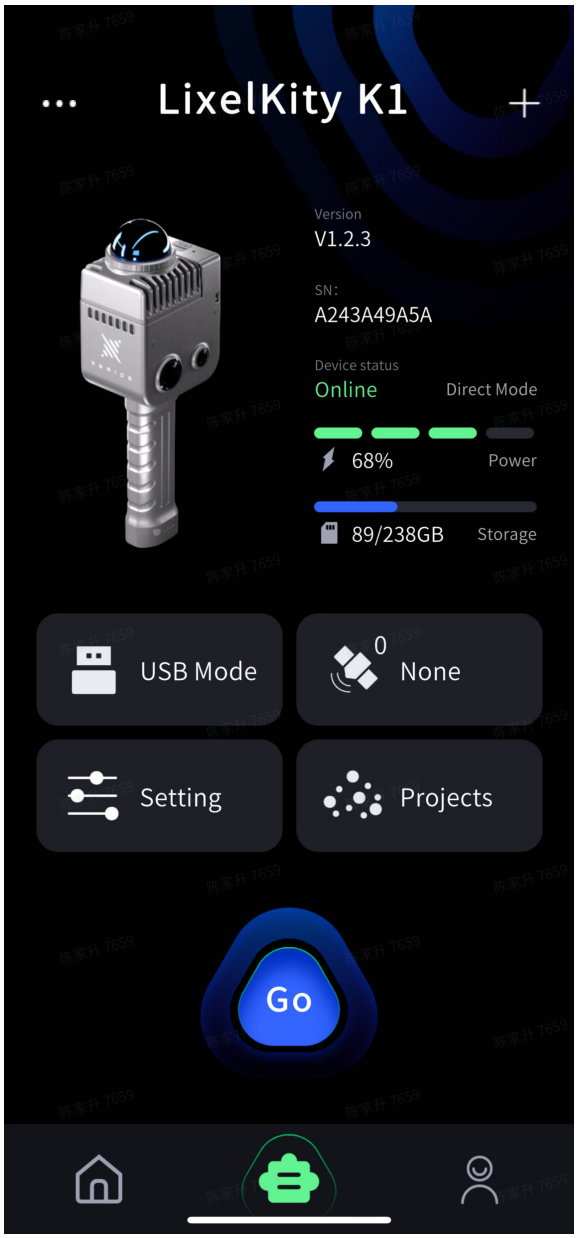




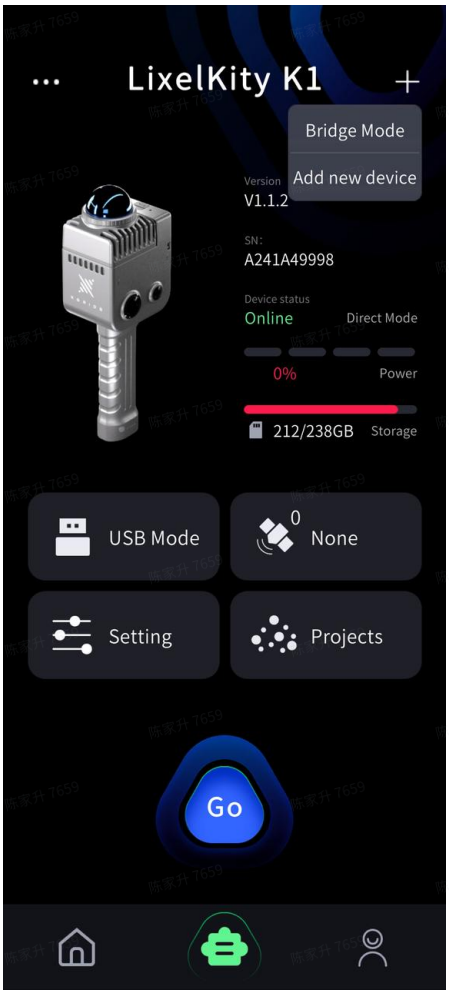


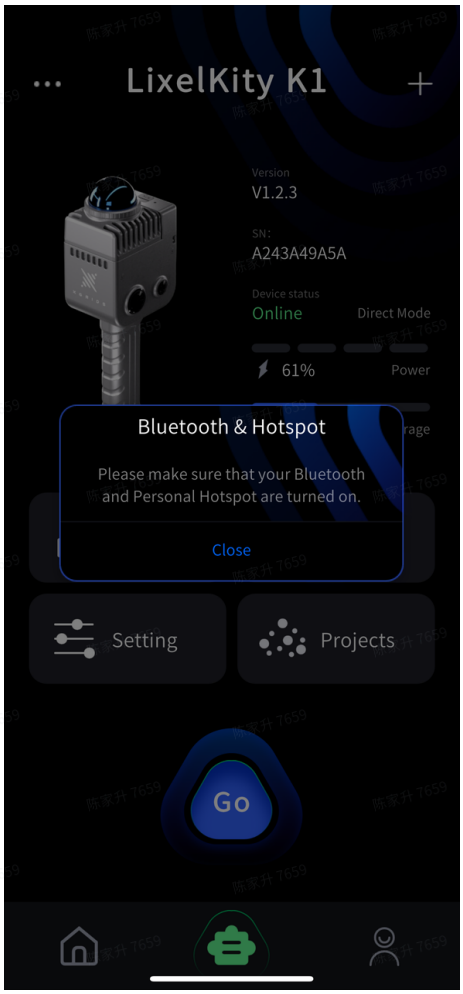
When both the network connection status and data connection status are displayed as successful, click Finish to view the basic information of the currently connected device.

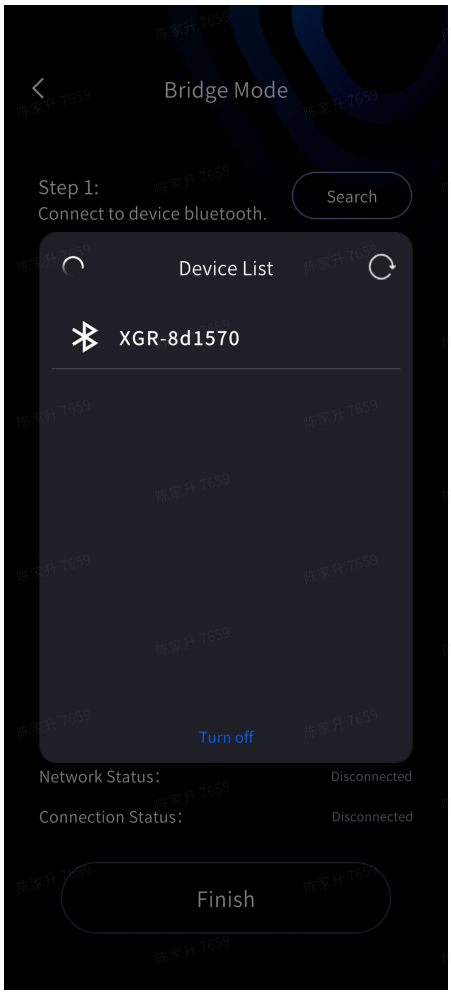




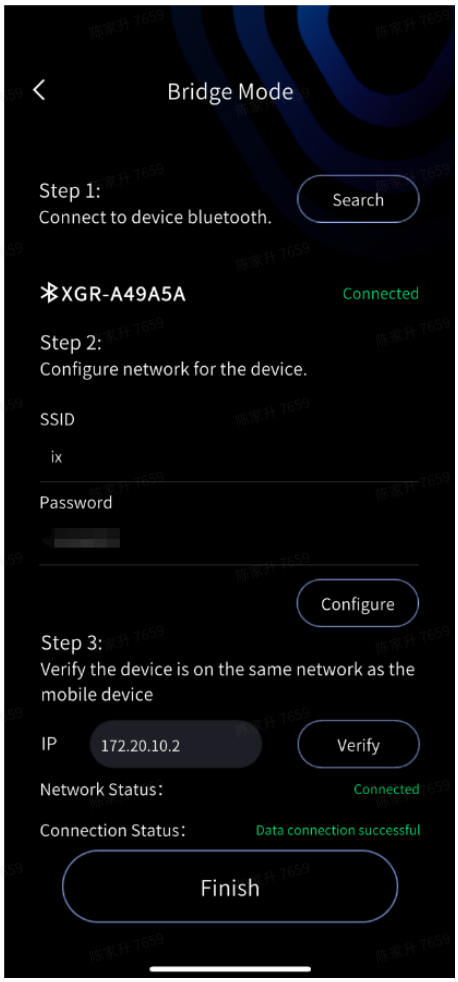
- **Bridge Mode :** Click the plus sign in the upper right corner of the interface, select Bridge Mode, enter the interface, and then follow the operation steps.

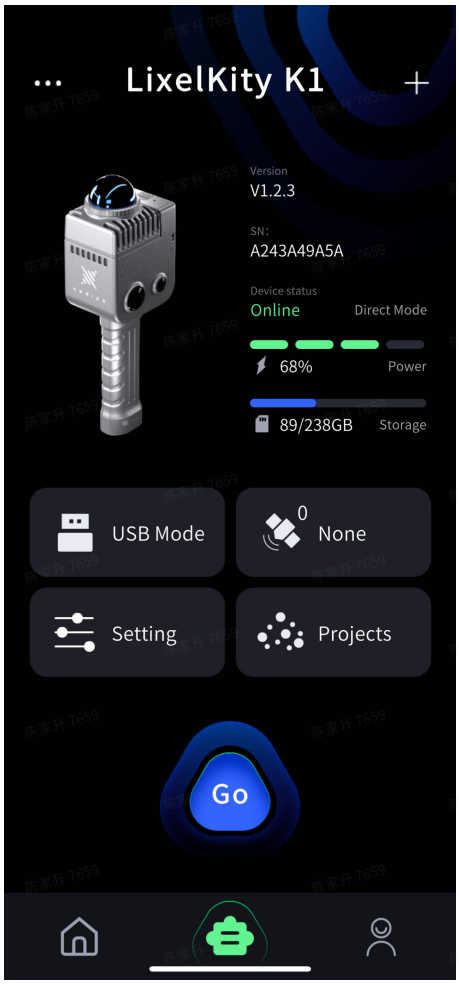






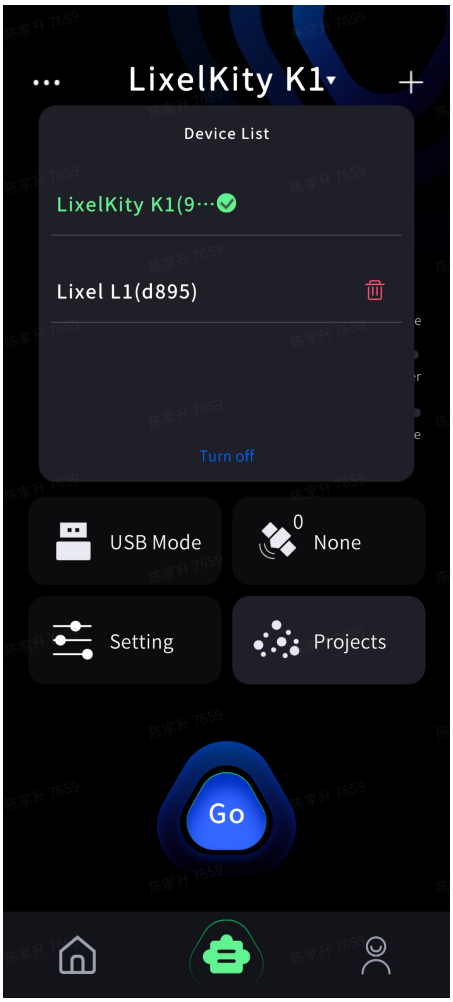
Click "close" and go to the connect page. First search the device's Bluetooth and connect. The second step is to configure the network. See the above steps in direct connect mode for details. After the correct connection, click Finish to view the device's basic information.

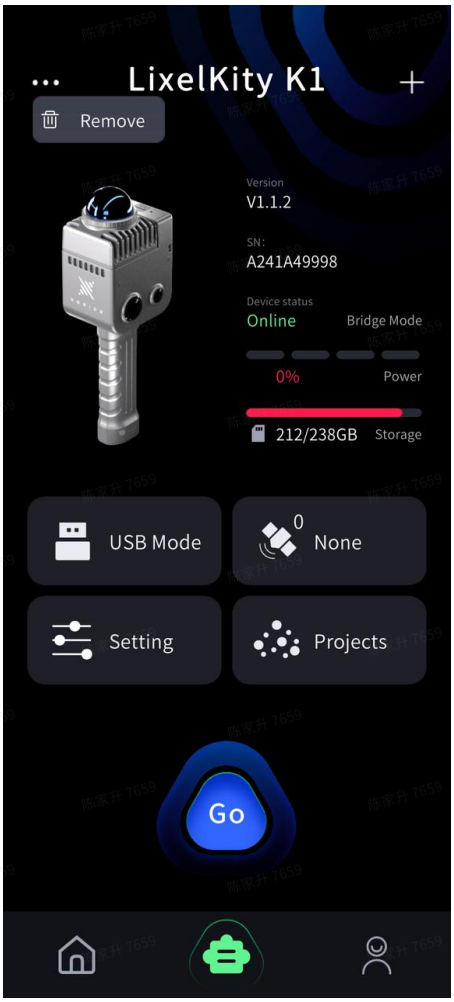


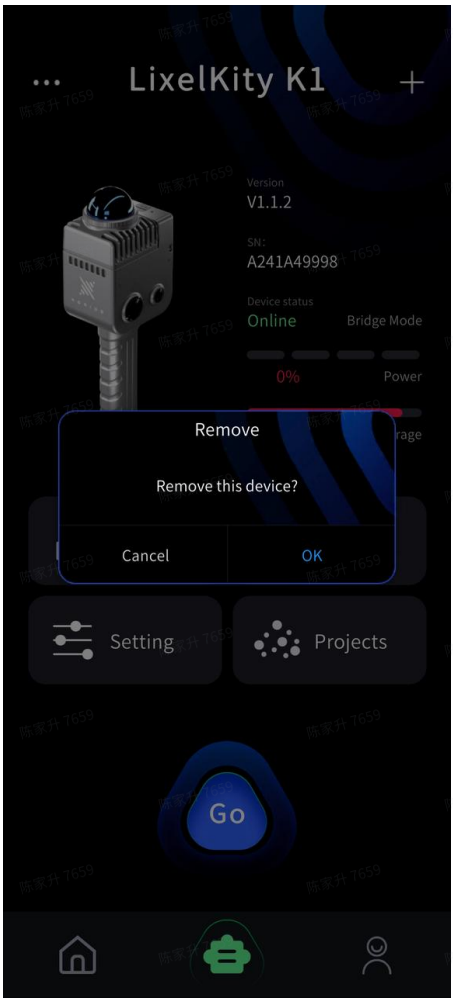


2.3.5 Device Management

In the device interface, click and pull down the device name at the top of the screen to manage connected devices. Click Remove Device to remove the connection to the device.







2.3.6 Device activation

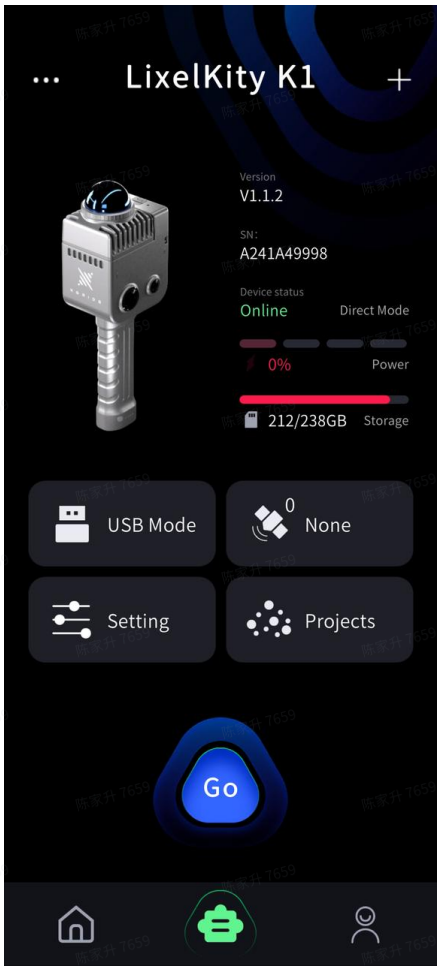
Click "Go", and confirm the activation and binding of the device.

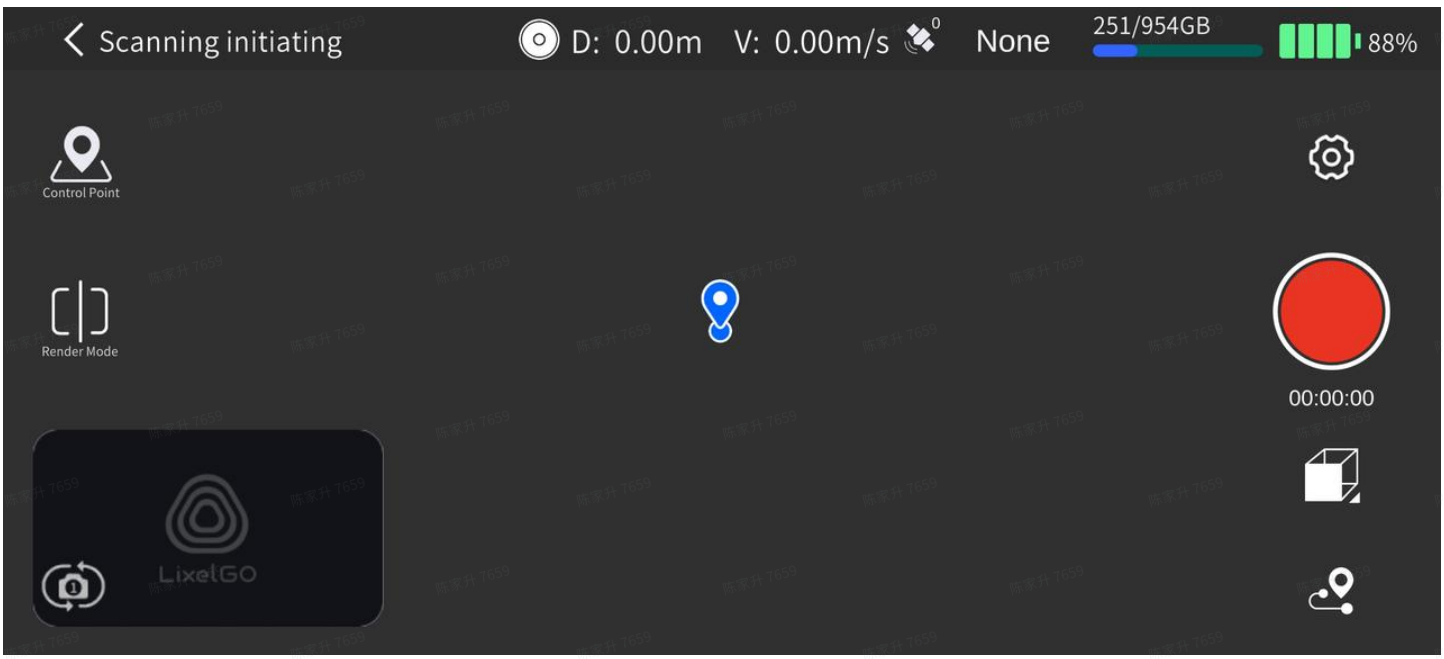
(2) Startup, start/stop collection, and shutdown

2. Scanning workflow

2.1 Connected the device

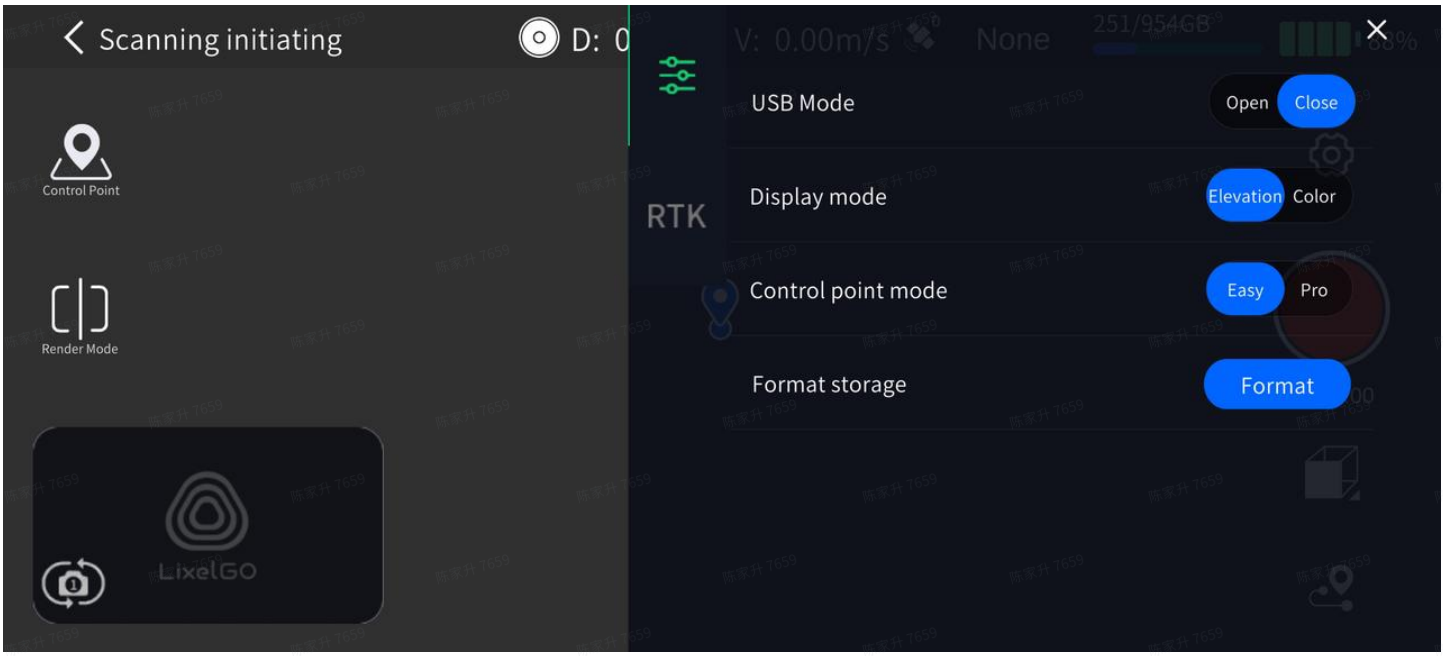
Click "Go" to enter the scanning windows so that the device is to be started.





2.2 Display mode selection

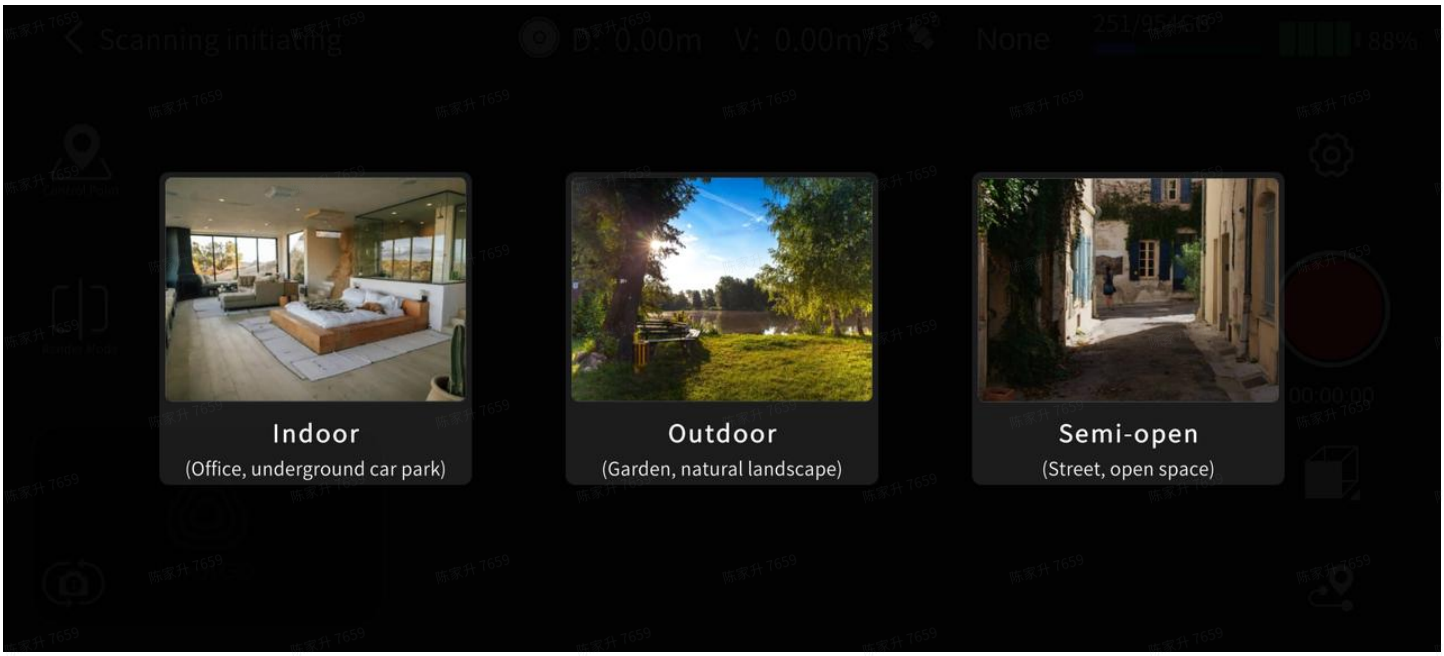
Before scanning, click the settings button in the upper right corner to select the real-time display point cloud display mode.



2.3 Scan mode settings

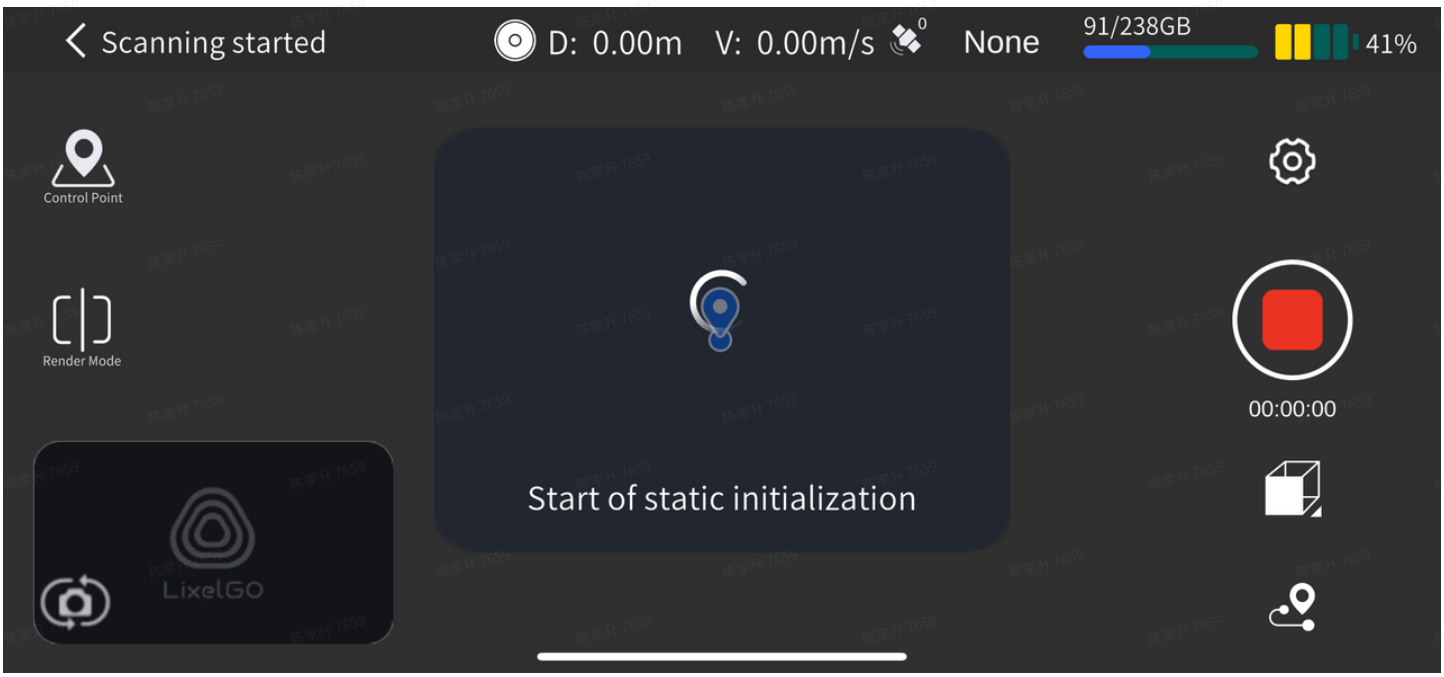
Click the red Record button on the right side of the screen and select the appropriate scanning mode according to the specific scenario.

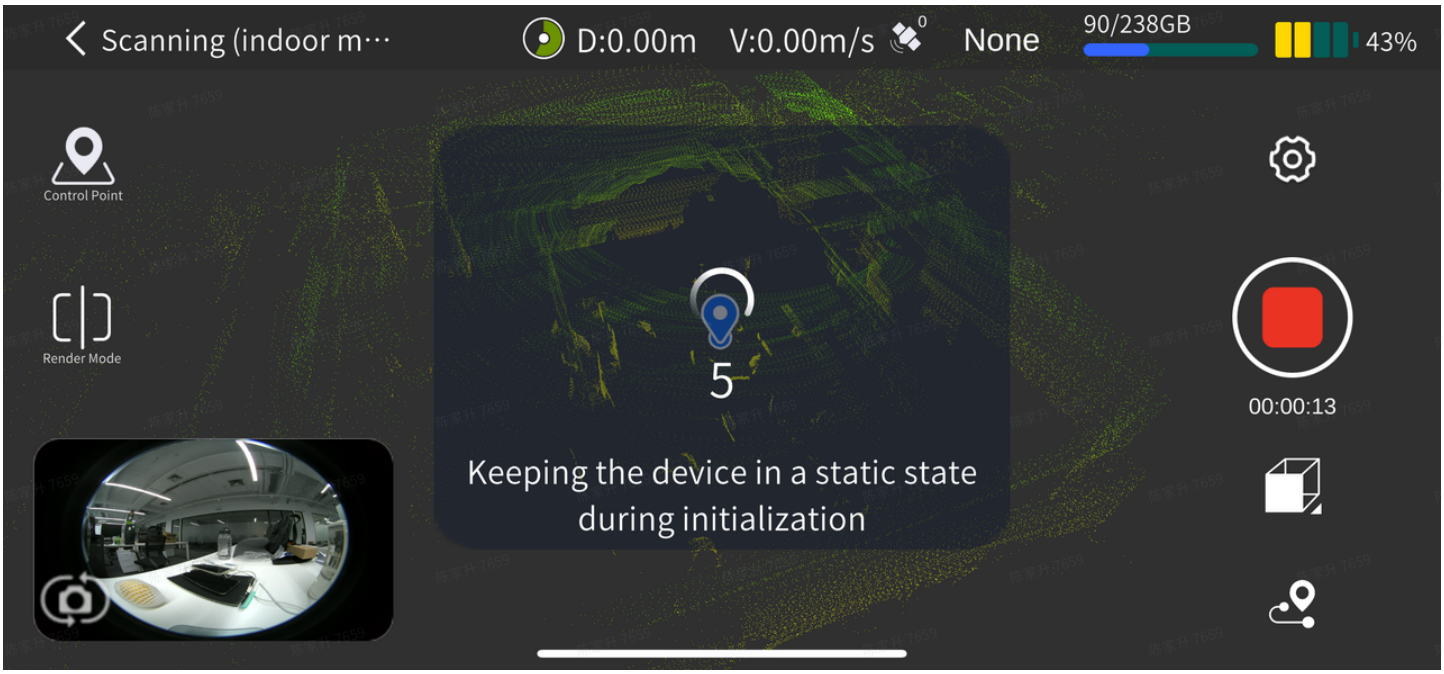
Scan mode	Scenes discription	Typical scenario
Outdoor mode	The LiDAR's working range can cover wide open areas (over 40 meters) without obstruction.	Gardens, industrial parks, streets, blocks, neighborhoods, etc
Indoor mode	Stairs, small and medium-sized indoor scenes, most laser spots are within 10-20 meters.	Office, classroom, meeting rooms, etc
Semi-open mode	The scenes in which there are ceilings at the top but empty on all sides.	Indoor parking lots, factories, etc

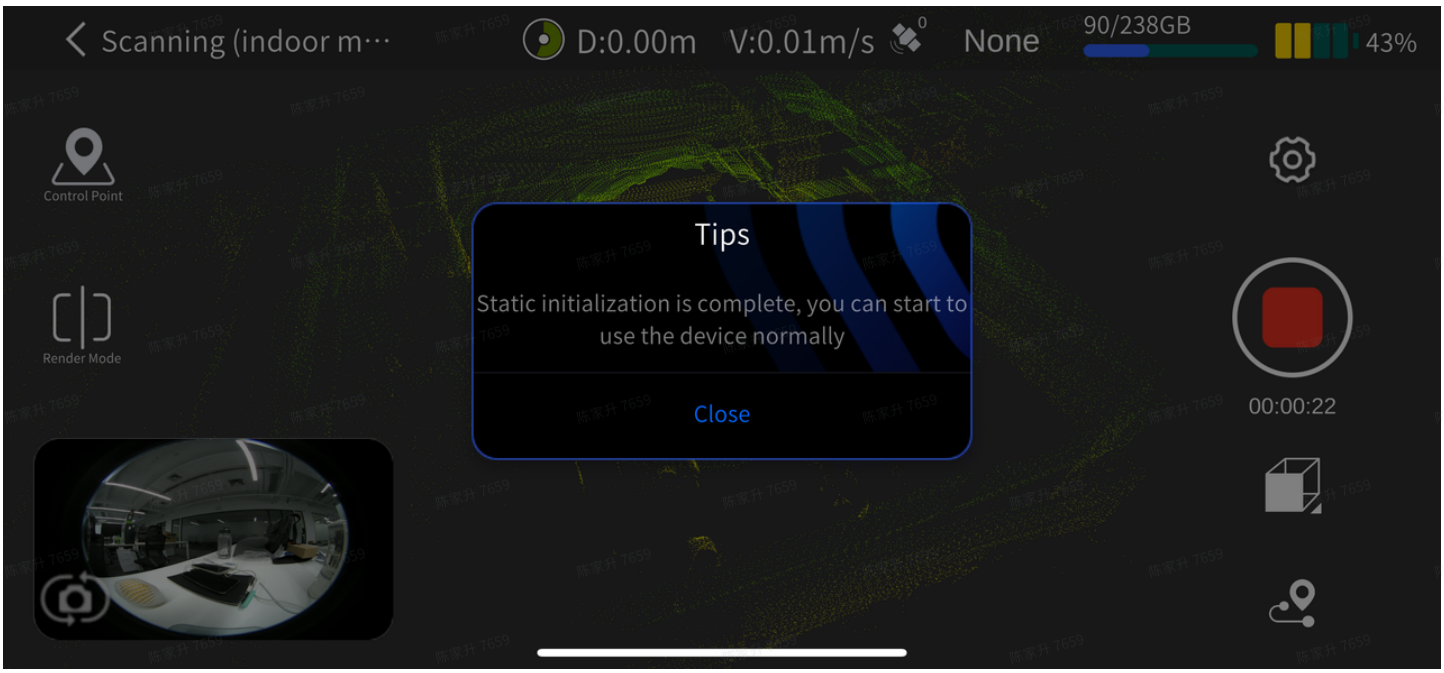


2.4 Start scanning

After the scanning mode selection is completed, the LiDAR starts working. The indicator light turns green and flashes. And the app prompts that static initialization has started, and then starts a 15s static initialization countdown. During this process, do not move the device to ensure that the device is always in a stable state. After the countdown ends and a pop-up window prompts that static initialization is complete, close the pop-up window, pick up the device, walk around, and start scanning according to the planned route.

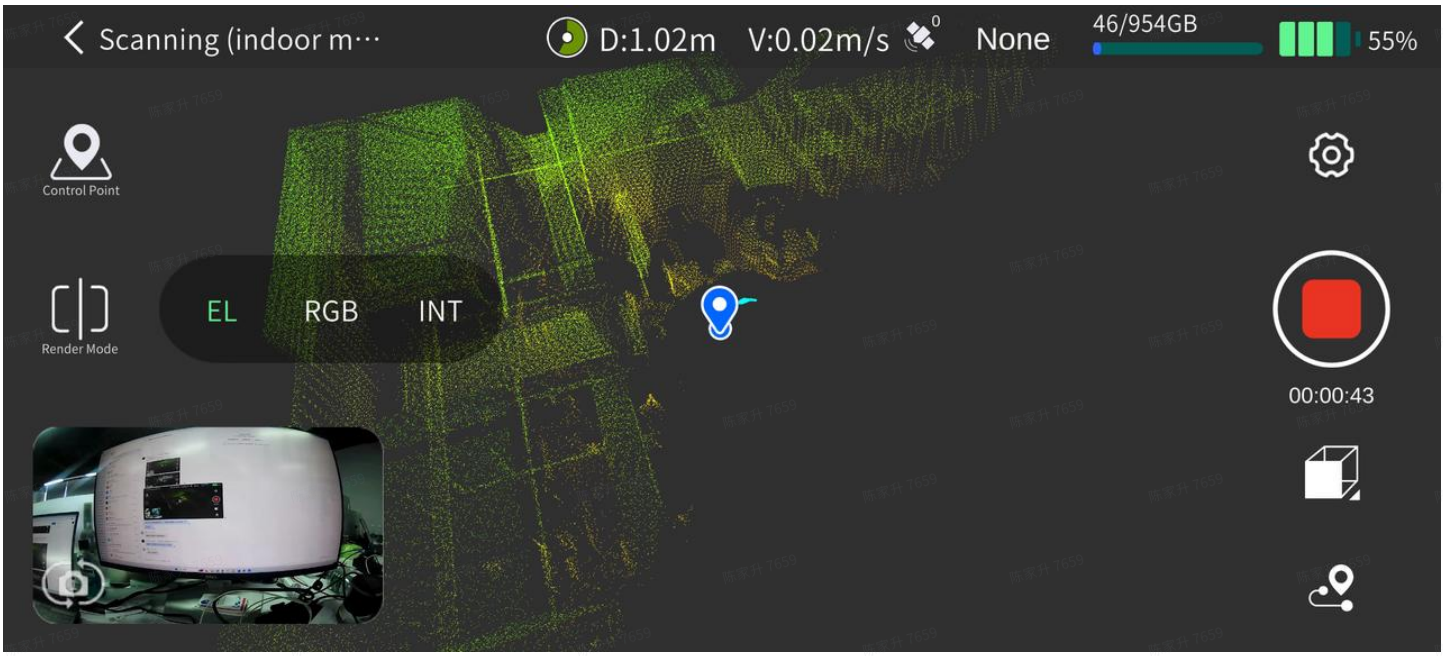


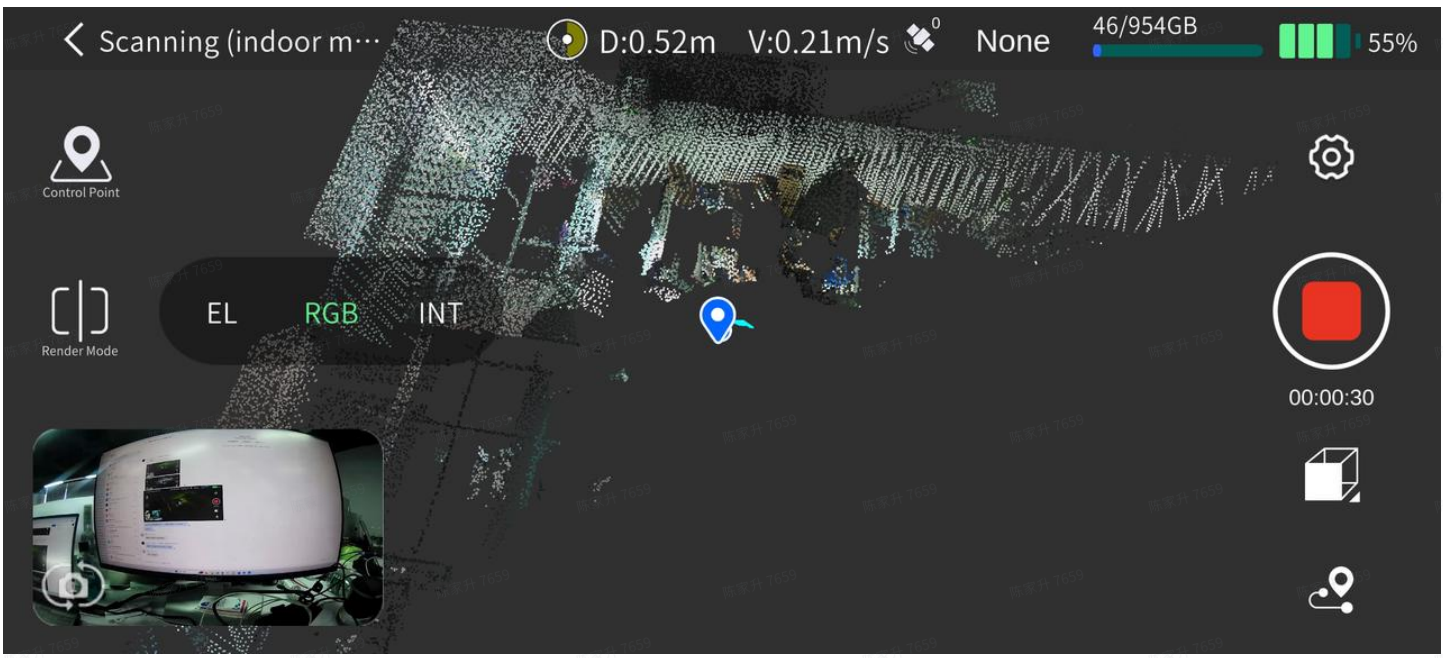


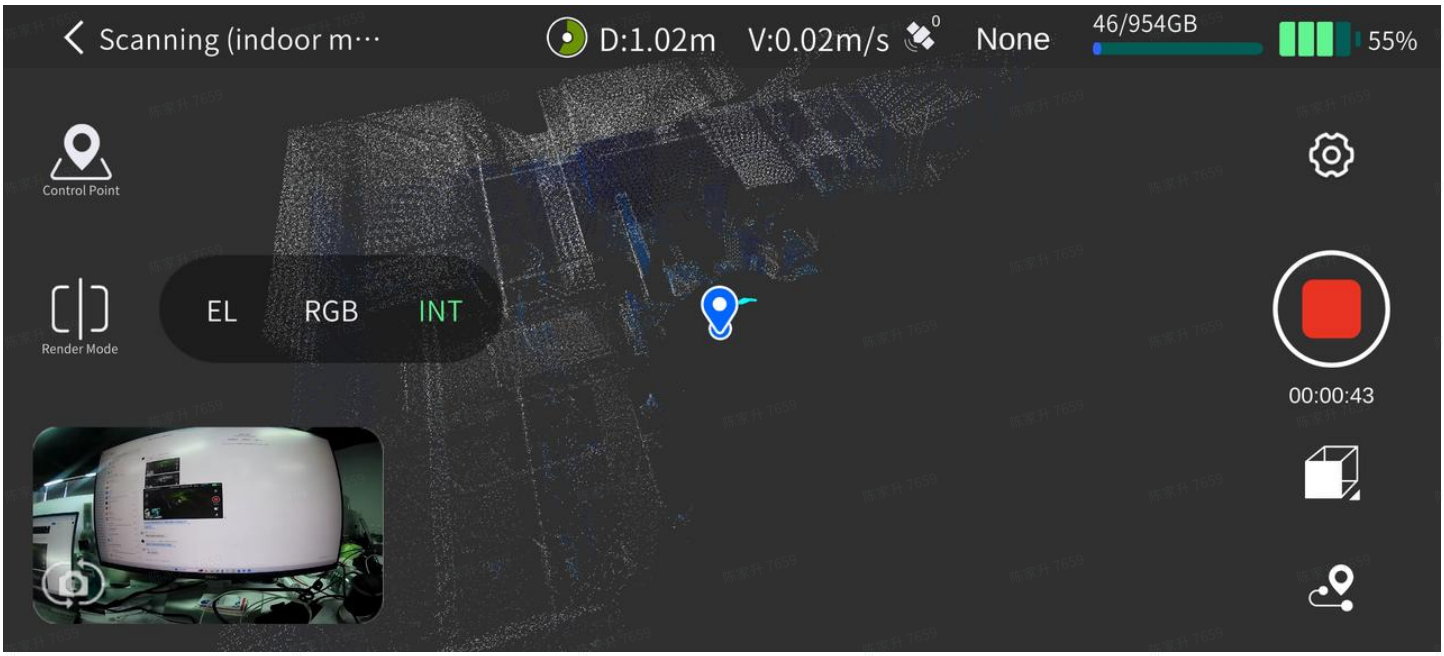


2.5 Rendering mode

Click the "Render Mode" button on the left side of the screen to modify the real-time point cloud rendering method. Currently, there are three modes available: " EL " - elevation, " RGB " - real color, and " INT " - intensity

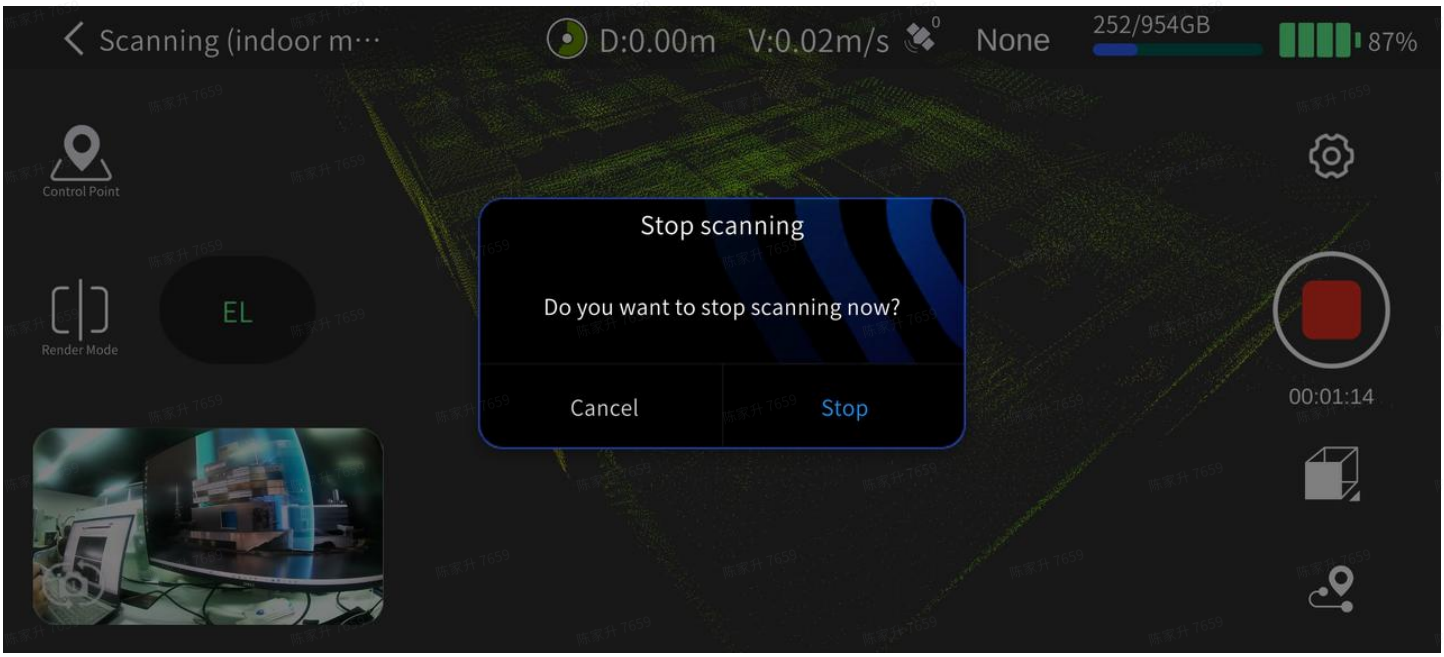

Scanning (indoor m···
D:1.02m
V:0.02m/s
None
46/954GB
55%
Control Point
Render Mode
EL
RGB
INT
00:00:43

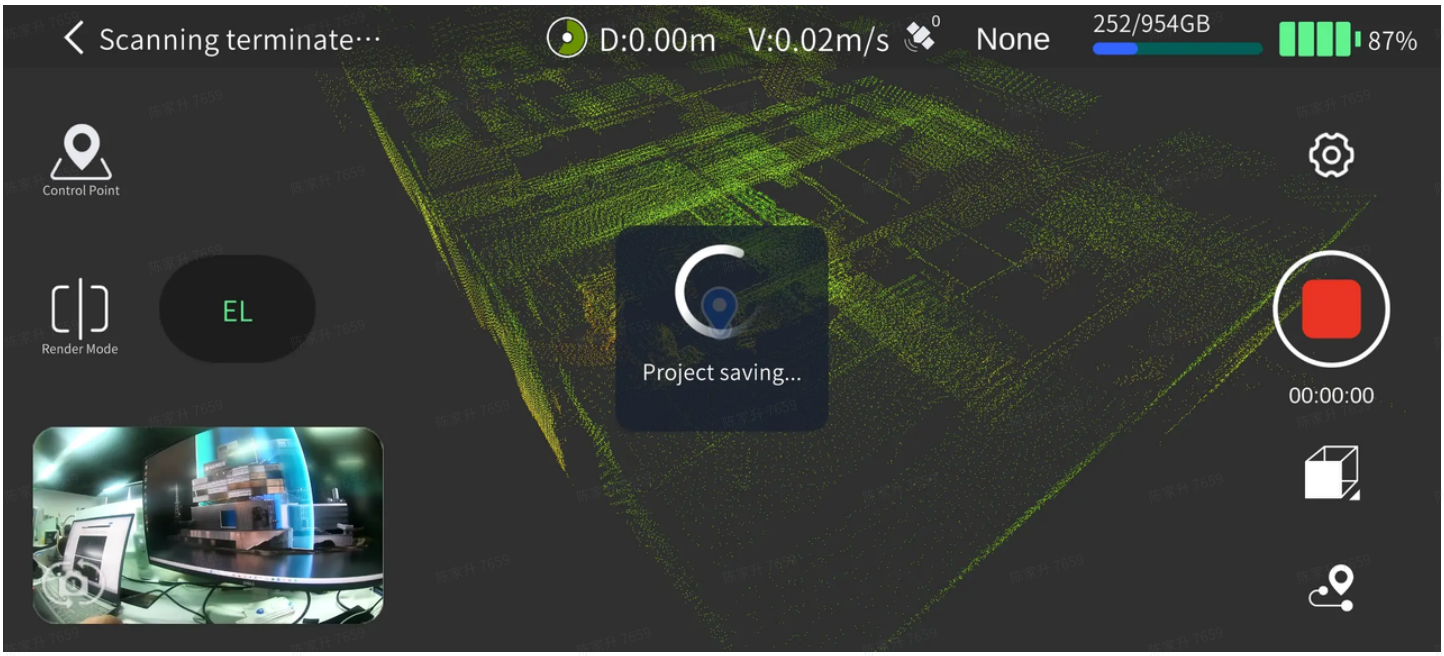

Scanning (indoor m···
D:0.52m
V:0.21m/s
None
46/954GB
55%
Control Point
Render Mode
EL
RGB
INT
00:00:30

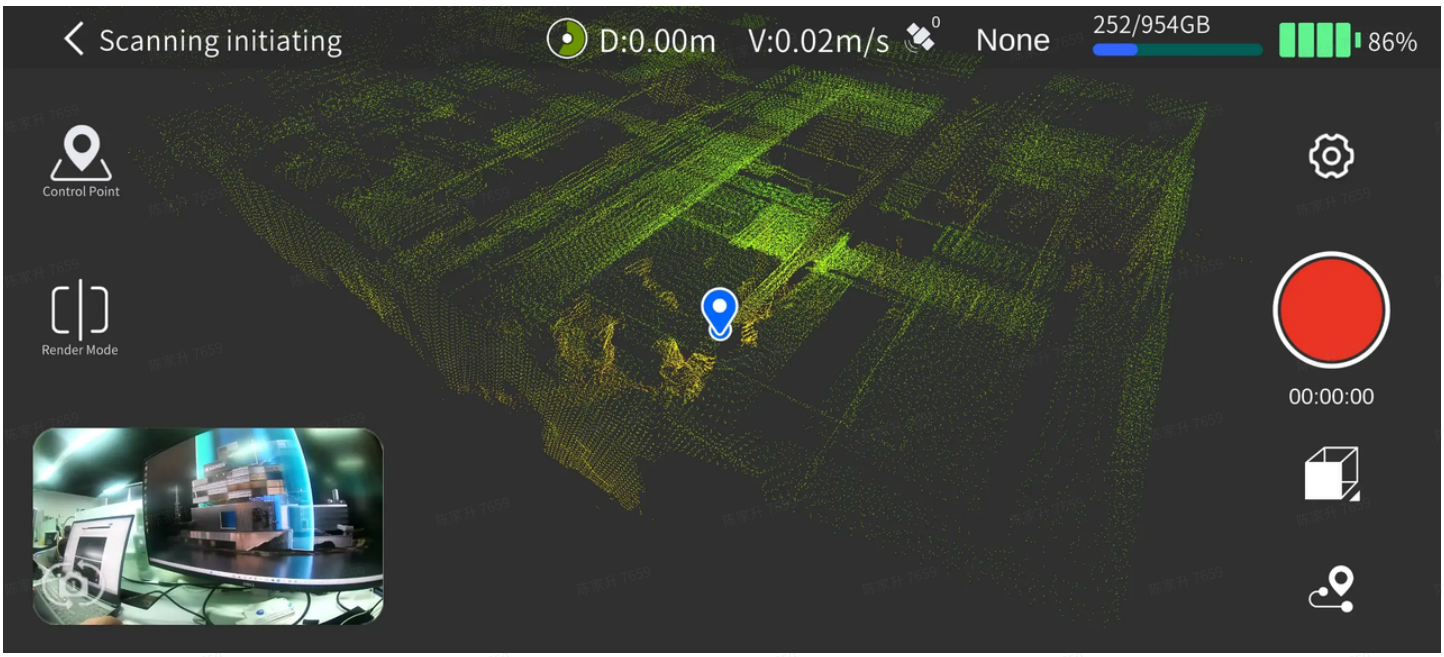


2.6 Stop scanning

Click the red Record button on the right side of the screen. After confirming the stop, the device's green light will flash, and the device will turn green and stay on after the scanning is completed. Then you can shut down the device or start the second scan.





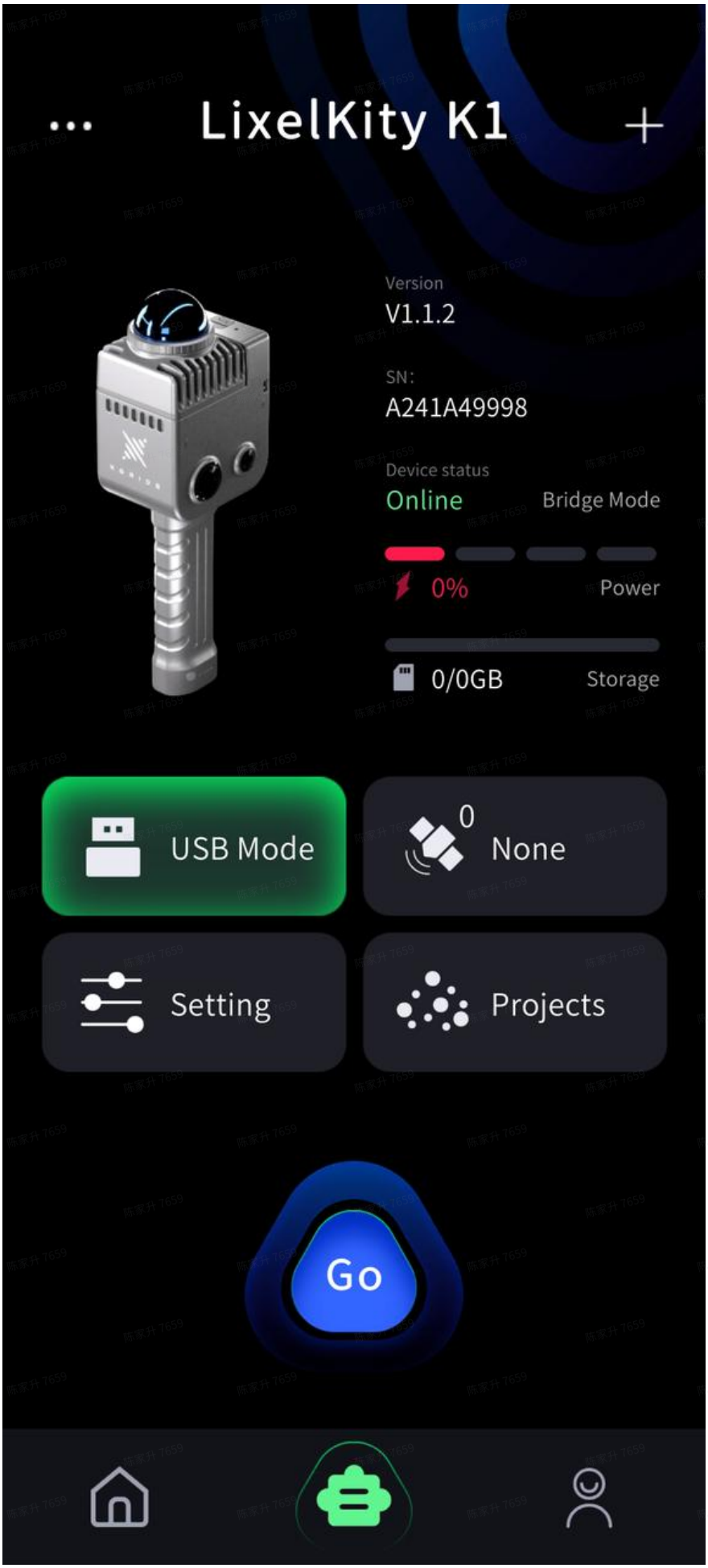


2.7 Viewing scan data

If you need to quickly check the quality of the data, you can use the point cloud data and trajectory displayed in real-time in the app. For scans with start-to-end closure, you can observe the start-to-end trajectories to determine whether there are layers in the point cloud.

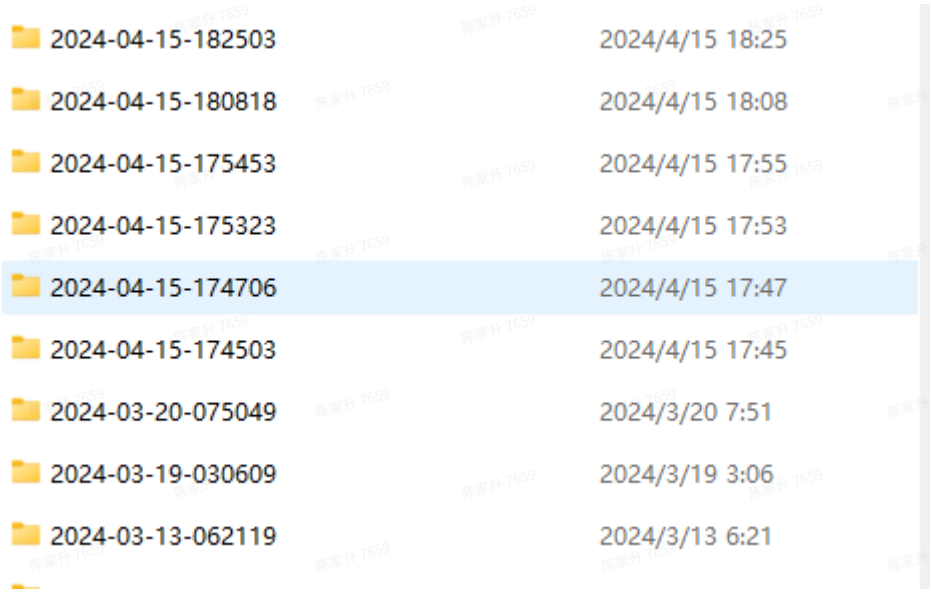
2.8 Downloading scan data

Turn on the device, set the device to USB mode in the app, and then use a Type-C cable to connect the device to the computer.



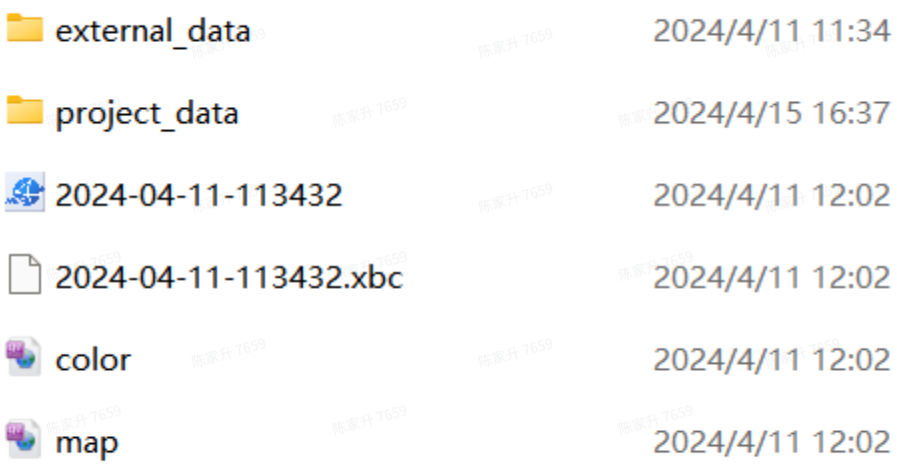
In the **model** file in the directory of USB disk mode, select the corresponding project file [project files name after the time of scan starting: **year-month-day-specific time**]. And you can copy it

to the appropriate directory of the computer.



2.9 Data project file structure

The project file contains two folders, a .hbc file, a .xbc file and two las point cloud data. The map.las file is the point cloud data directly output by the scanning device in real time, and color.las is the colored point cloud data output directly by the scanning device in real time. Please note: The direct point cloud data is downsampled. If you need complete point cloud data, please use LixelStudio software for post-processing. .hbc and .xbc are the raw sensor data recorded by the device.



- project_data folder

Contains a log folder and 4 files. The log folder records the relevant log information of the device.

control_points.csv: A file that records control point information when using the app to add control points.

gnss.csv: A file that records GNSS information when using RTK.

poses.csv: Record the trajectory file during the scanning process.
project.jason: Record device-related information.

- external_data folder

This folder is empty when the data is initially copied from the handheld device. It is mainly used to copy and store external file data required for post-processing in LixelStudio, such as video files of external panoramic cameras and gnss.csv files after coordinate conversion.

III. Acquire point cloud data with absolute coordinate

(1) Through existing Ground Control Points (GCP)

You can achieve coordinate conversion through the existing Ground Control Points (GCP) you marked during the scan, by which the accuracy of the point cloud data can be optimized as well.

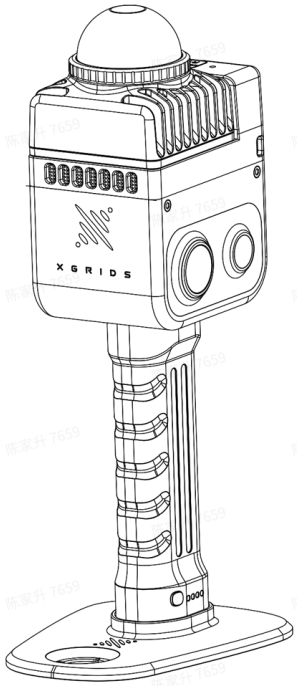
Note: The number of control points in the sacnning area is determined according to the accuracy requirements. And the layout of control points should be evenly distributed. To ensure subsequent coordinate conversion to be successful, at least 3 or more control points reasonably distributed are required for a single scan. The more high-precision control points covered by scanning, and the more evenly distributed, the higher the accuracy will be. Do remember the points cannot be distributed on a straight line.

1. Scanner installation

1.1 Equipment list

1. LixelKity K1 Handheld Scanner, battery, control Point Base

1.2 Installation diagram



2. Field work: scanning

2.1 Field survey and planning

2.1.1 Control point planning

If there is a corresponding topographic map of the scanning area, the control points can be designed according to the map, and the on-site inspection and design can be carried out synchronously. If there is no corresponding topographic map, the design will be carried out according to the on-site environment.

The distribution of control points should be as reasonable as possible, which means evenly distributed in the scanning area. And the distance between control points should be within 50 meters.

2.1.2 Scan route planning

According to the distribution of control points and scanning environment, plan a reasonable scanning route.

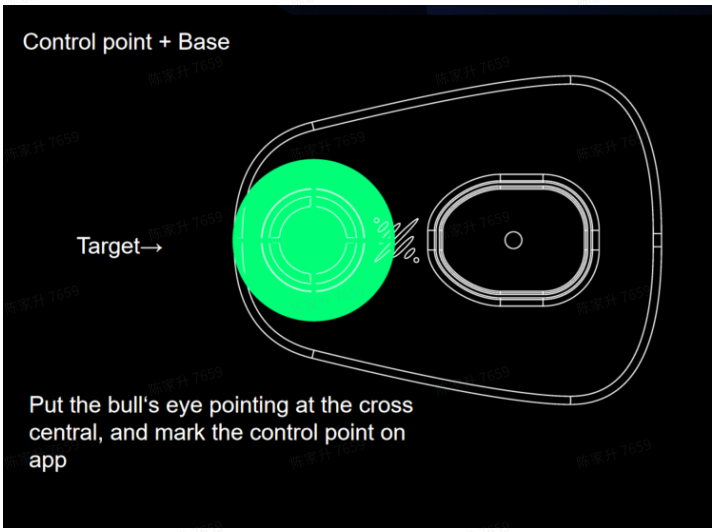
2.2 Start scanning

Turn on the scanner, and start scanning through the LixelGO App or the button on Lixel K1. For specific steps, please refer to the Scanning Workflow.

2.3 Mark the ground control points (GCP) during the scan

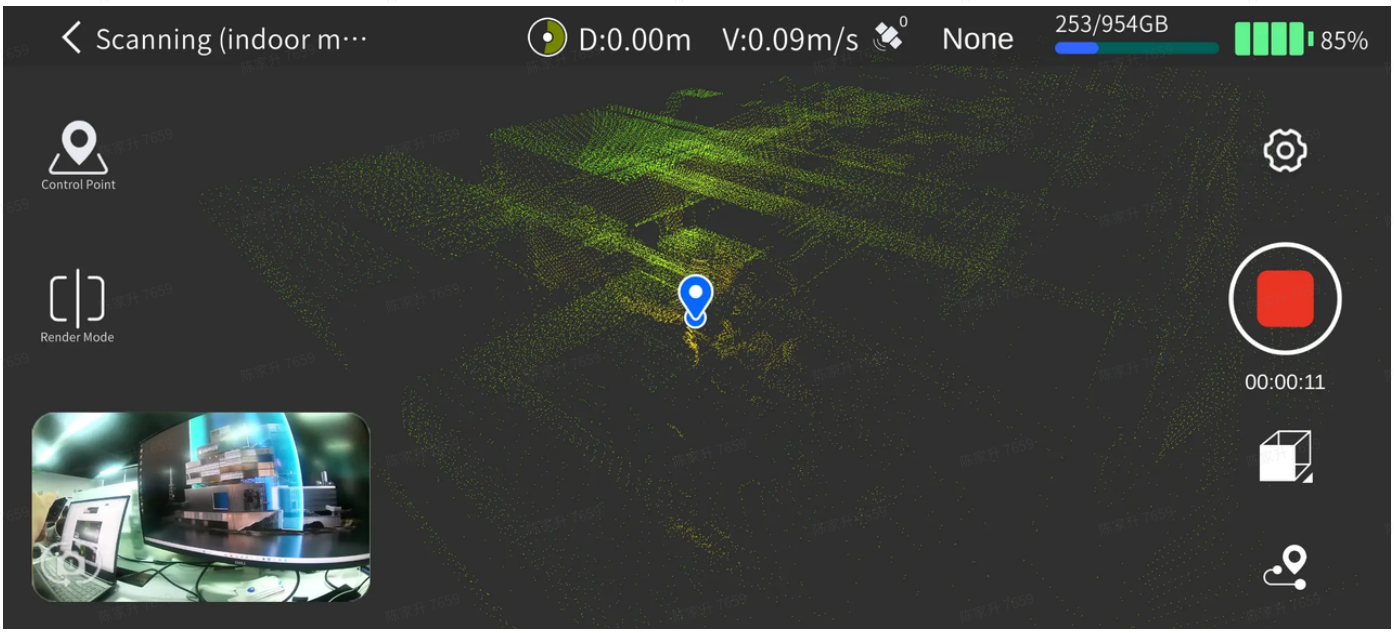
2.3.1 Marking operation

When scanning on the route across the areas covering the control point, align the sharp corner of the front end of the scanner control point base with the control point, and then click to add the control point in the App.

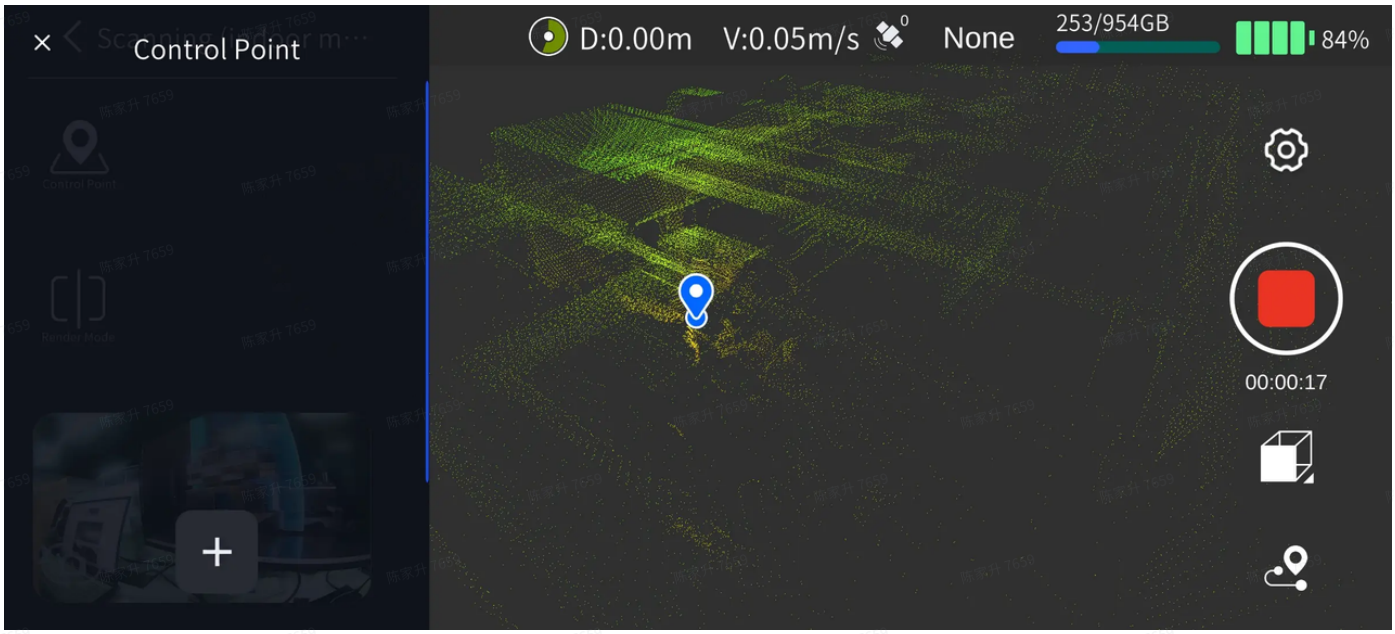


2.3.2 App operation

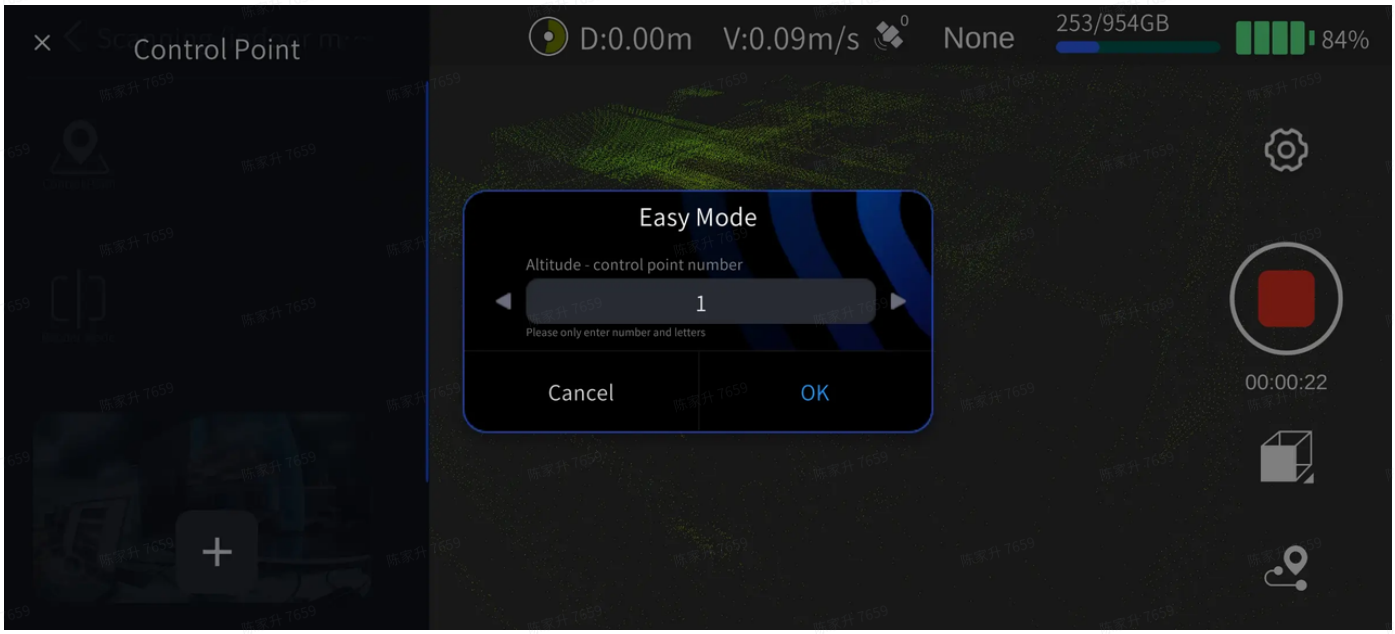
a. Click "Control Point Mode" on the left side of the screen.

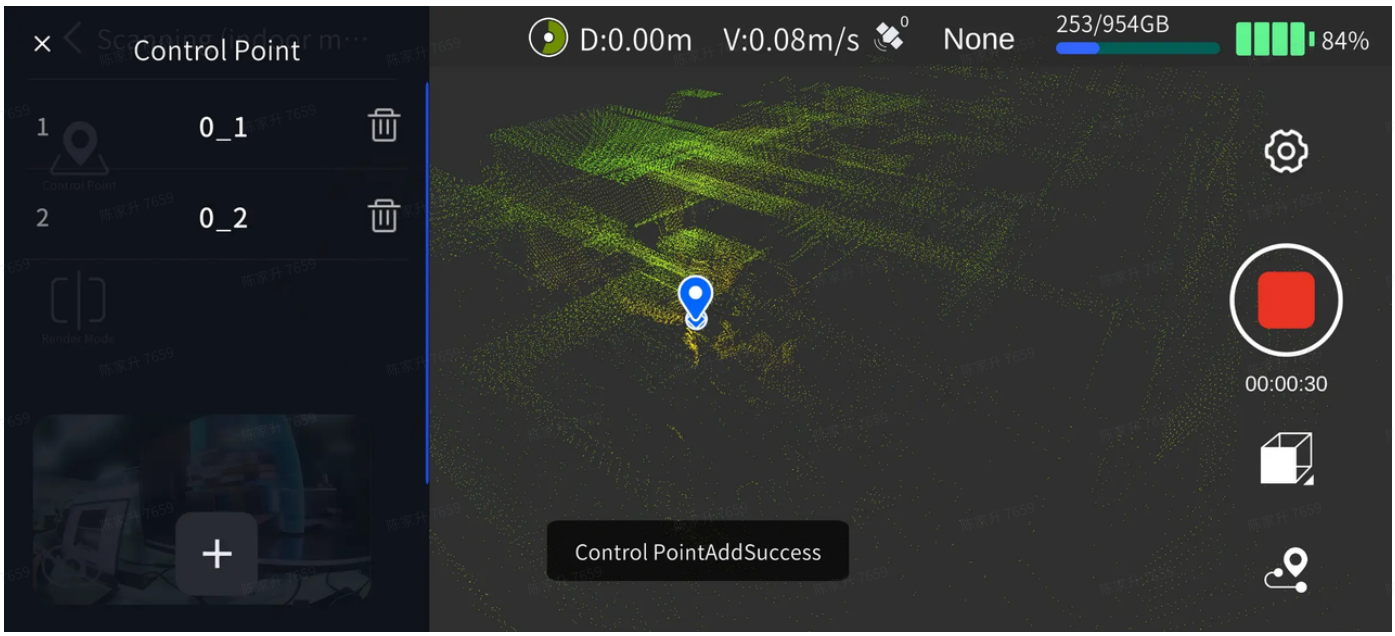


b. Click "+" on the left side of the screen to add a control point.



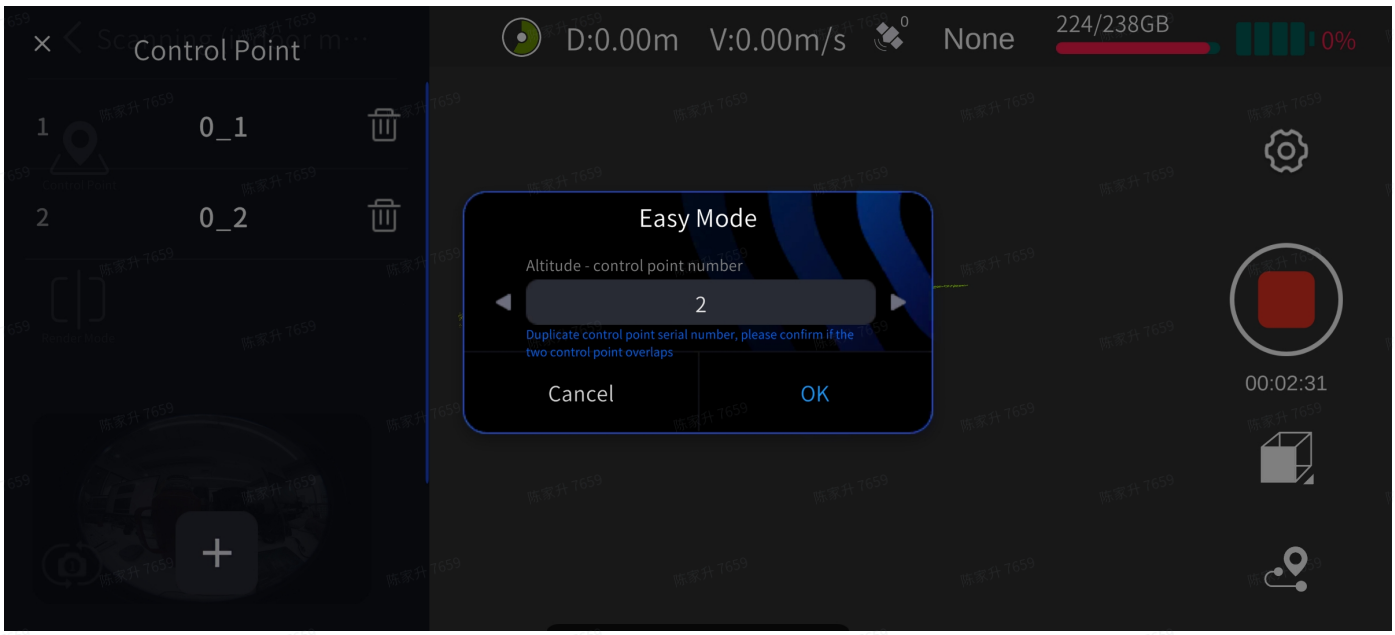
a. Enter the control point number, then click OK, and the screen will pop up "The control point was added successfully", indicating that the control point was successfully marked.

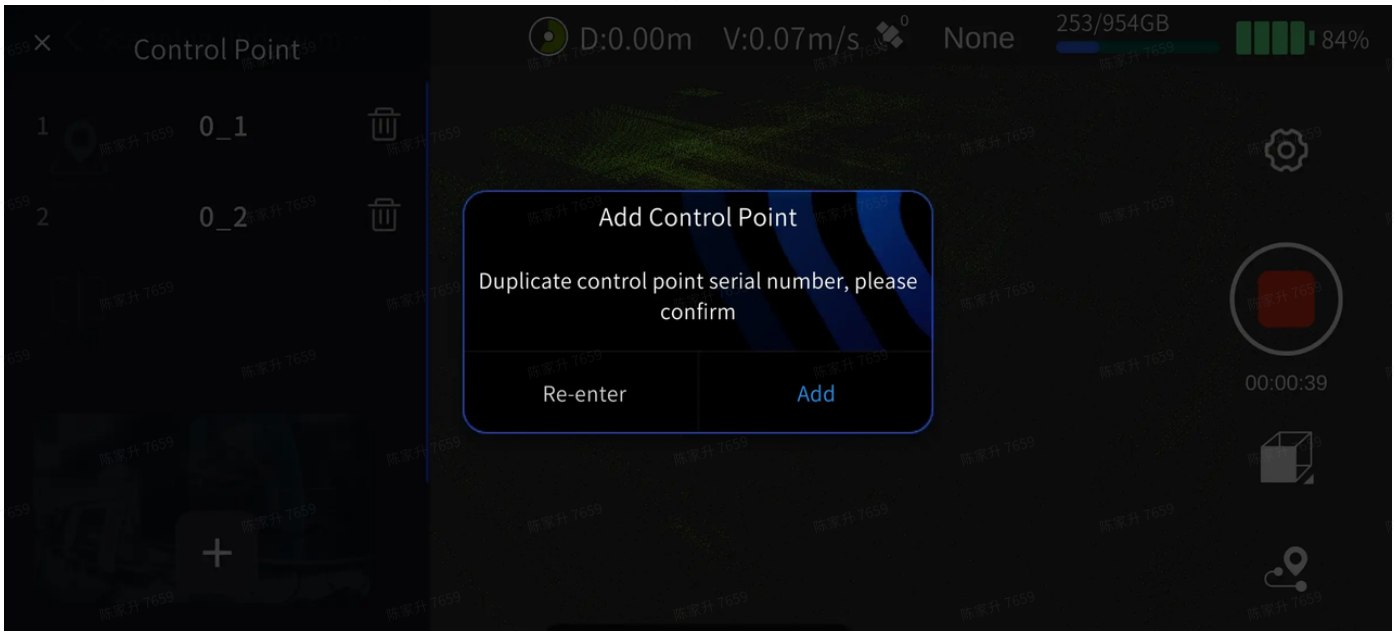


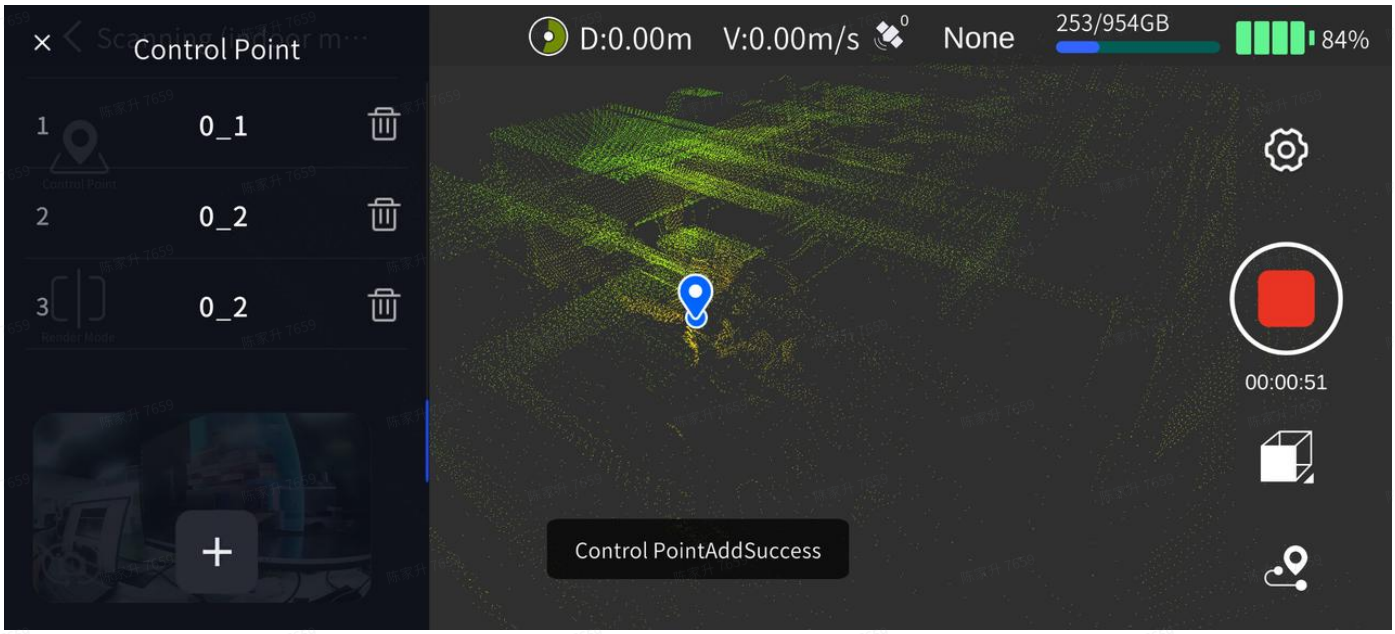


Pay attention to the names and order of the control points marked on the app when tapping. When you do the processing in LixelStudio later, you need to ensure that the file names of the imported control points correspond to the names of the control points marked during the scan.

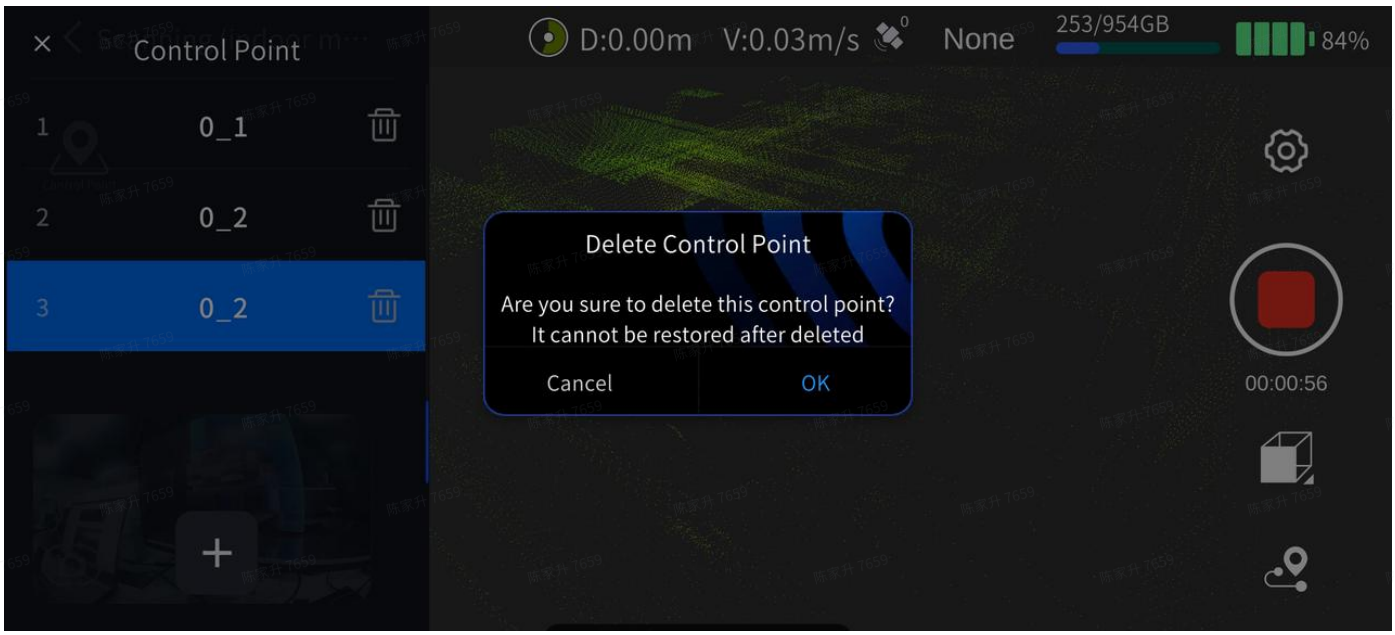
d. If the name of the added control point is repeated, the app will pop up a reminder, please judge and and modify it according to the specific situation.

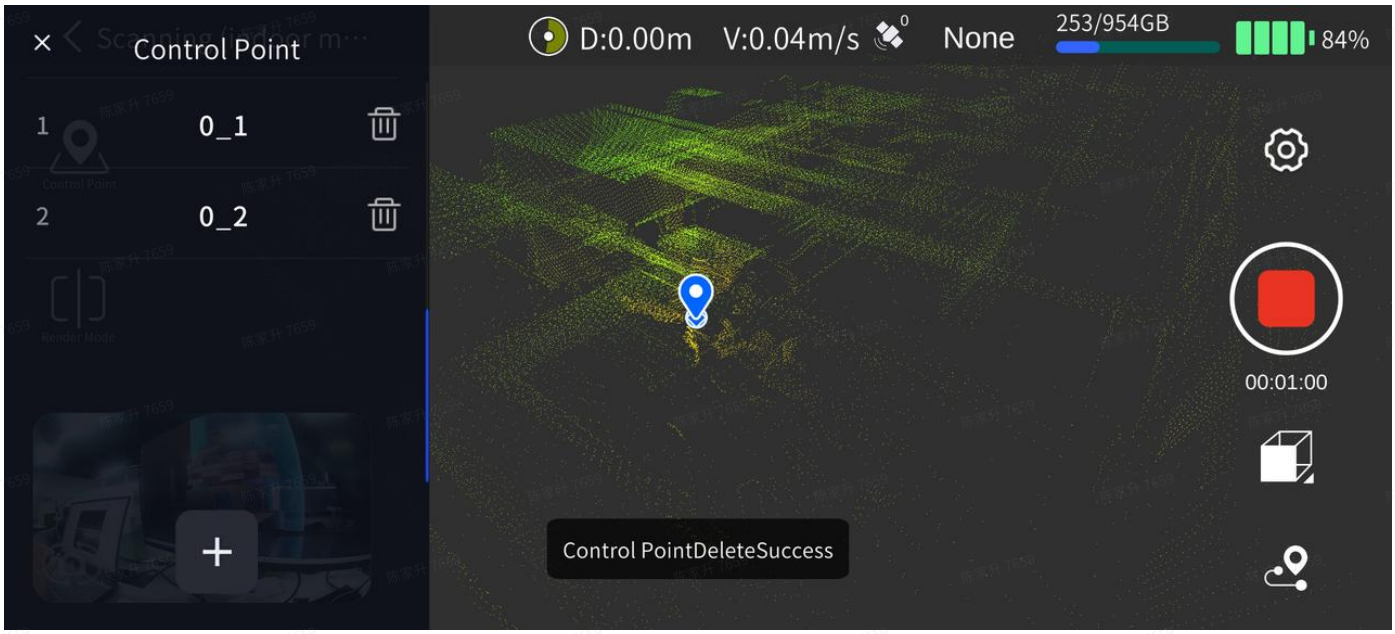






e. You can view the collected control points and delete control points in the "Control Point List" on the left side of the plane. Click the Delete button on the right side of the control point to delete the corresponding control point.





2.4 Stop scanning

Click the red End Recording button on the right side of the screen, the green light of the device flashes, and the indicator light turns green and always on after scanning. Then you can shut down the scanner or start a second scan.

3. Office work: data processing

See the LixelStudio user manual for details.

(2) Through the RTK module

With the RTK module, absolute coordinate information can be directly obtained during the scanning process, and the overall accuracy of point cloud data can be improved.

Note: In order to ensure good performance, please use this mode to scan when the outdoor RTK signal is good.

1. Scanner installation

1.1 Equipment list

1. LixelKity K1 Handheld Scanner, battery, base
2. RTK module, RTK bracket

1.2 Installation indication

Note :

RTK module indicator lights have three statuses: red, blue and green.

Red: RTK not connected; Blue: RTK connected, not fixed; Green: RTK connected and has a fixed solution.

2. Field work: scanning

2.1 Scan route planning

According to the scanning environment, plan the scanning route reasonably, and ensure that the RTK signal is good during the scanning as much as possible. If you need to ensure the accuracy of point cloud after processing in LixelStudio, please ensure that RTK with no fixed solution does not exceed 50m during the scanning.

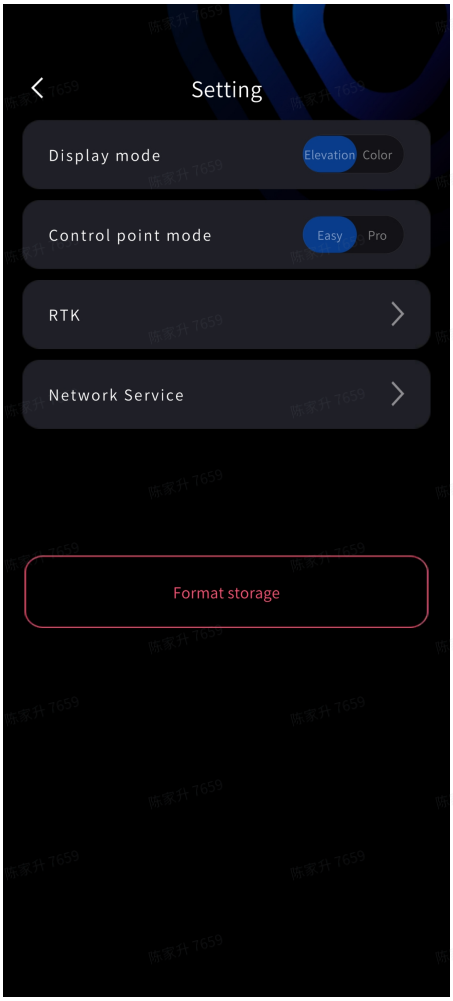
2.2 Connect the device

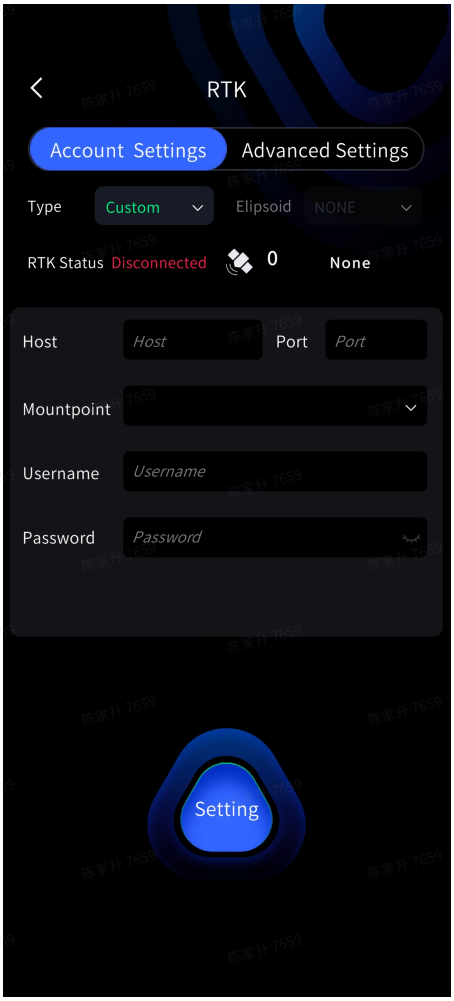
Turn on the scanner and connect the scanner through the LixelGO App. For specific steps, please refer to the Scanning Workflow.

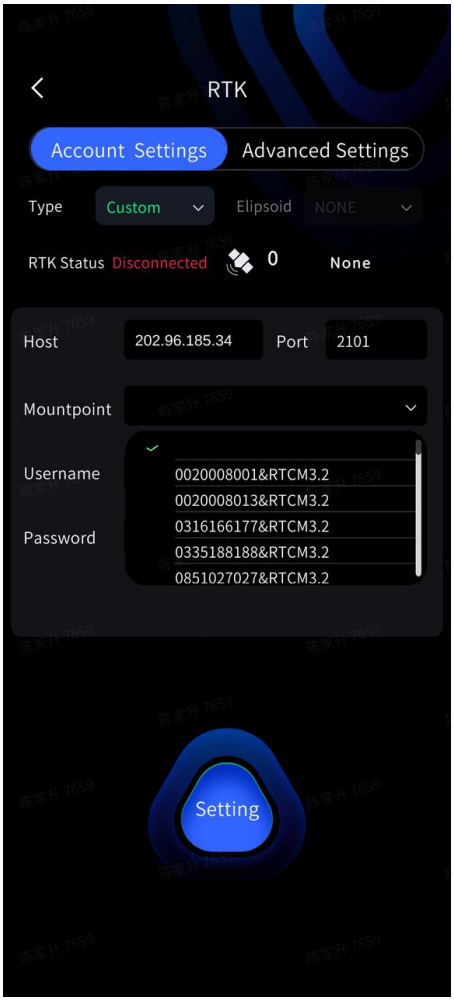
2.3 RTK Account Settings

Enter the device windows, click RTK settings (satellite icon button), enter RTK settings. Currently there are 3 types of RTK configuration, custom, Qianxun SI, and China Mobile. Users can configure it according to the specific situation in different areas.

- Custom







- Qianxun SI and China Mobile: Users can log in by entering the corresponding account and password.

Attention :

a. Currently, it supports Qianxun SI, China Mobile and custom RTK . To use a custom RTK, you need to ensure that the RTK data format is a common format, otherwise it cannot be used normally

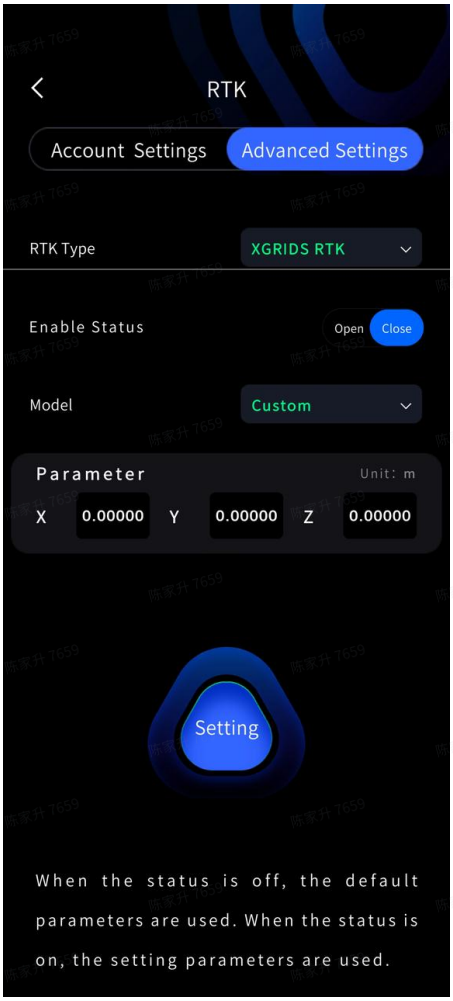
b. The first time the device and RTK account are set up, the RTK account information will be automatically recorded, and subsequent use will be automatically logged in.

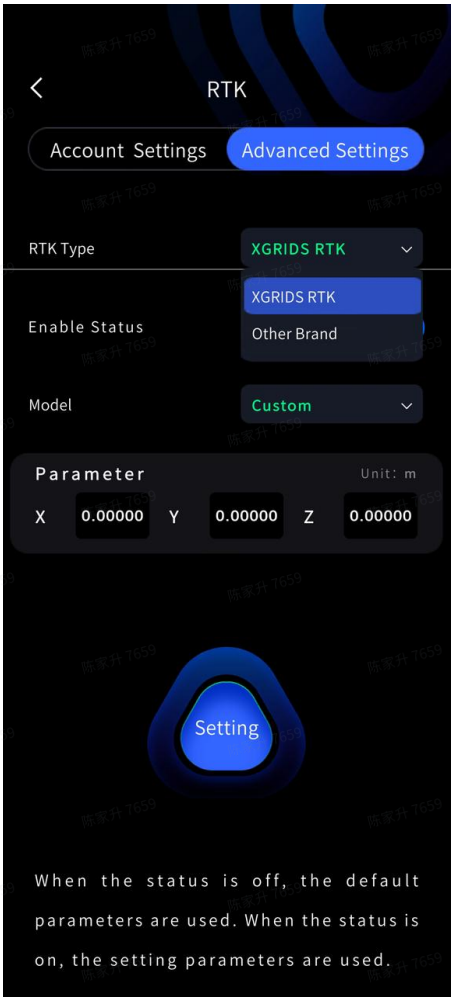
c. If you want to change the RTK coordinate system, there will be a delay of about 5 minutes. It is recommended to start the operation after the change for 5 minutes

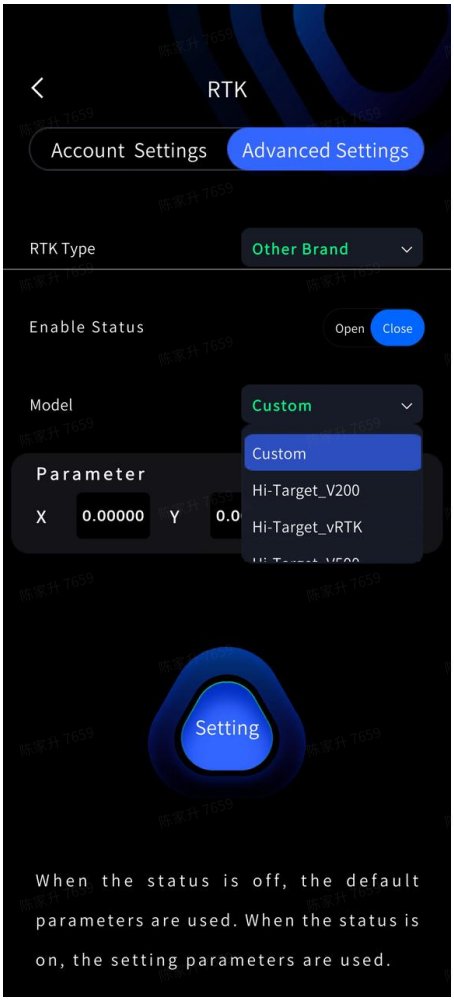
d. At present, RTK module is adaptive to WGS84, CGCS2000 and ITRF2008 reference coordinate system. And the height acquired is geodetic height.

2.4 RTK Advanced Settings

RTK advanced settings mainly support users to choose different forms of RTK modules. The default is the "XGRIDS RTK". And users do not need to configure other parameters.







2.5 Start scanning

In RTK mode, you need to wait for the RTK module indicator light to turn green, and the App displays that the RTK signal becomes Fixed before picking up the scanner and starting the scanning operation.

Attention :

a. RTK mode only supports scenes with RTK signals outdoors. RTK will not be able to obtain a fixed solution in indoor scenes.

b. During the RTK fixed solution, the RTK module indicator light turns green. If the light turns blue, pay attention to the satellite number.

c. Only if the satellite status on the App is fixed, you can start the scan. It can not be NONE, float, or single.

d. In order to ensure accuracy, it is recommended to make it sure that the device is in a fixed solution state most of the time during the scanning process. It is necessary to ensure that the **RTK valid data is > 100** to achieve coordinate conversion successfully in LixelStudio.

e. When scanning, keep the scanner vertical and avoid tilting. When walking, the inclination angle of the scanner generally does not exceed 20°. In special cases, such as when scanning a small space or ground targets, the inclination angle of the device should not exceed 30°.

f. Pay attention to the scan space, and ensure that the scanning range is above 10m.

2.6 Stop scanning

Click the red End Recording button on the right side of the screen, the green light of the device flashes, and the device turns green and always on after scanning. Then you can shut down the scanner or start a second scan.

3. Office work: data processing

See the LixelStudio instruction user manual for details.

IV. Acquiring point cloud data with RGB information (color point cloud)

1. Field work: scanning

1.1 Scan route planning

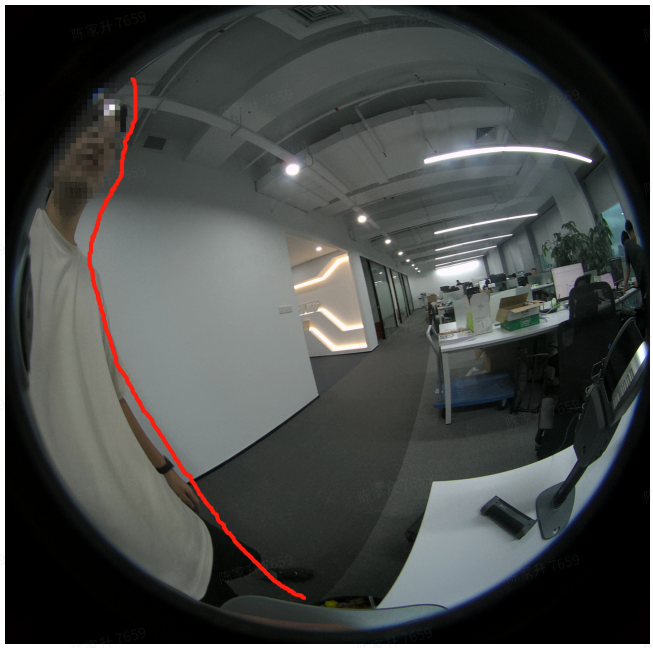
Based on the on-site scanning environment, plan the scanning route reasonably to get good colorization effect and ensure that the site is in a balanced light environment, not too light or too dark.

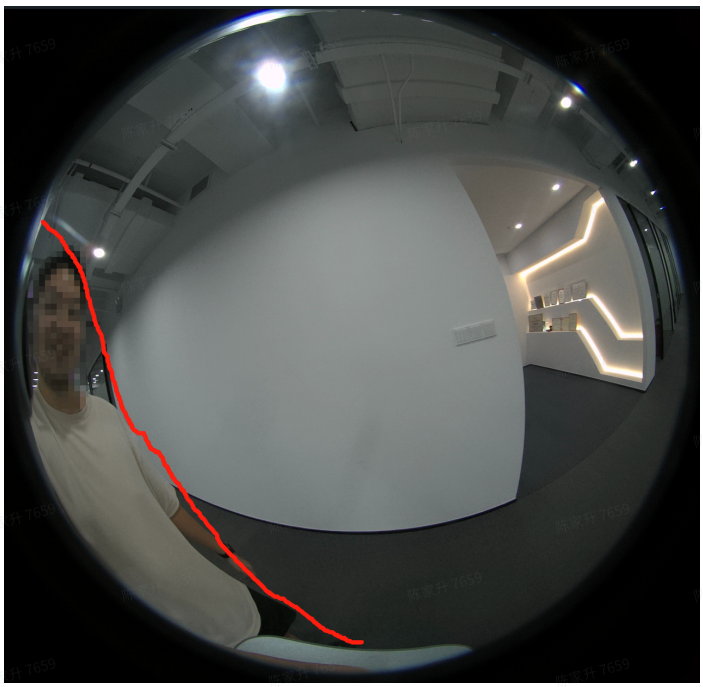
2. Suggestions for colorization through camera

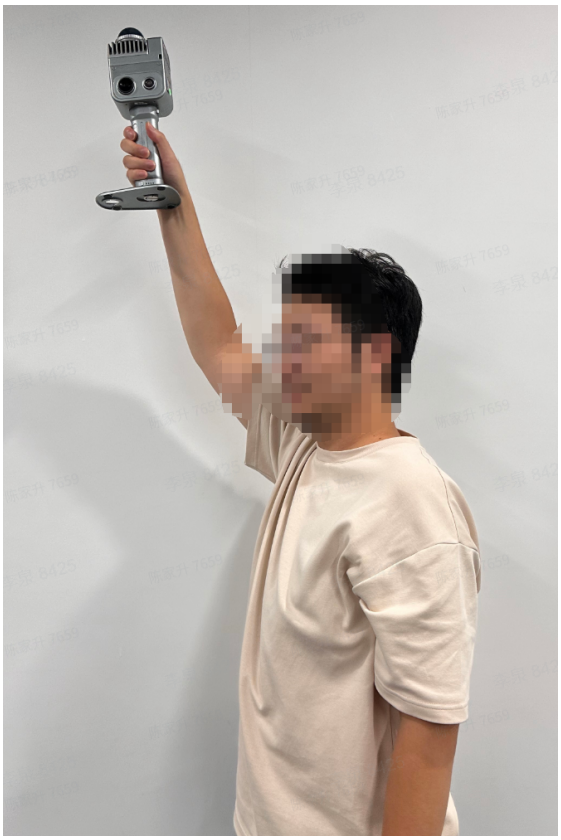
2.1 Handheld device usage suggestions

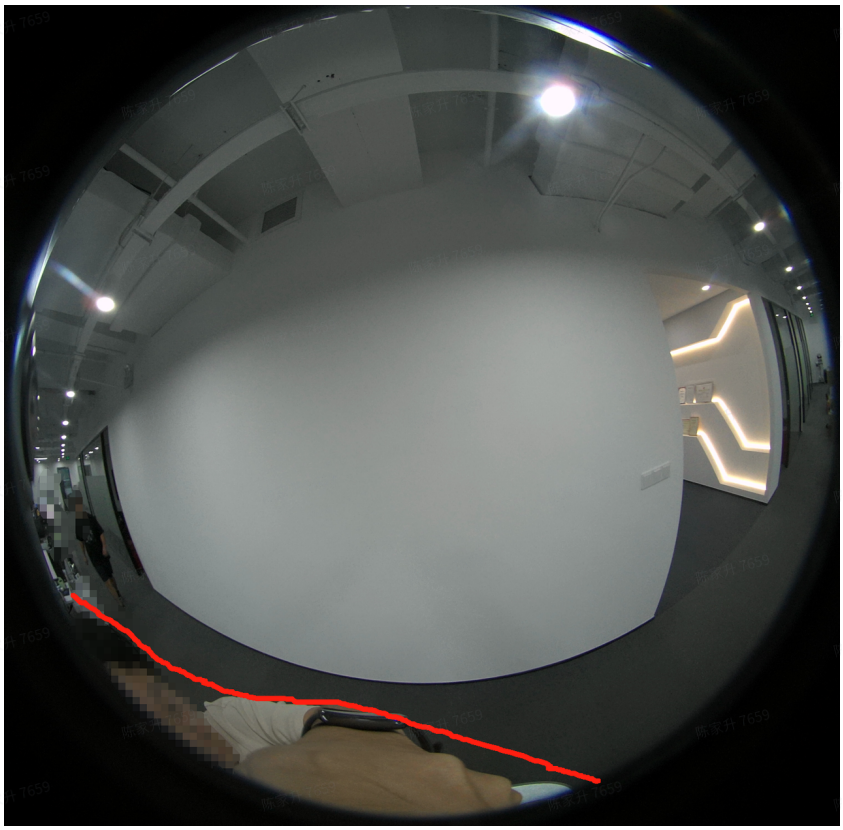
When scanning, keep the device away from the body to reduce the proportion of the body in the camera's field of view. For example, lifting the scanner above the head or at the far end of the chest can reduce the proportion of the body in panoramic camera view and improve the colorization effect.

The following are four posture situations of the human body proportion in the panoramic camera view. Considering the convenience of mobile scanning, it is recommended to use the first posture.









2.2 Scan route suggestion

When scanning, try to choose a scanning route with a wide FOV. Such as scanning in the middle of the road, which can improve the coverage of the color point cloud and improve colorization accuracy.

When acquiring color point clouds in some small space scenes, such as the gap between buildings in urban villages, narrow roads in alleys, etc., mobile scanning needs to be slower than normal walking, and posture 4 needs to be used if necessary. And it even needs to be scanned in the condition that there are no other shadows or dynamic objects in the scanning process, in order to obtain the correct and better colorization effect point cloud.

V. Map Fusion

When there are effective control points and RTK data, multiple point clouds project can be seamlessly merged automatically. When there is absolute coordinate information, absolute coordinates can also be converted for point clouds. It can avoid overlapping area layering caused by RTK or control point accuracy problems when using global optimization alone.

Through control points or RTK

1. ### Field work: scanning

   Refer to "III. Acquire point cloud data with absolute coordinates" for specific operation.

   Other notes :

i. For map fusion, no matter using control points or RTK data, in order to achieve better fusion effect, there should be as much overlapping path of a certain length between the two adjacent fused maps as possible. It is recommended that the overlapping path length should be >15m, and 15-30m is recommended. And the adjacent overlapping areas should be in scenes with rich features as much as possible, and avoid degraded scenes such as open space, long corridors, and smooth tunnels.

ii. When using control points, when the control points are with referenced coordinates, make sure that there is a scanning overlap area of >15m between adjacent projects. If the control points do not have referenced coordinates, while ensuring there is a scanning overlap area of >15m between adjacent projects, it is necessary to effectively record the control points in the overlapping area, and ensure that the position and name of the equipment are consistent when two projects use the same control point.

iii. Minimum requirements for coordinate transformation: there must be a connection between all maps (relative control points or ground control points), and the number of ground control points with referenced coordinates in all maps is at least 3 or more (and the control points are not in a straight line).

iv. If the requirements are not met, data fusion cannot proceed normally.

2. In-house: data processing

See the LixelStudio user manual for details.

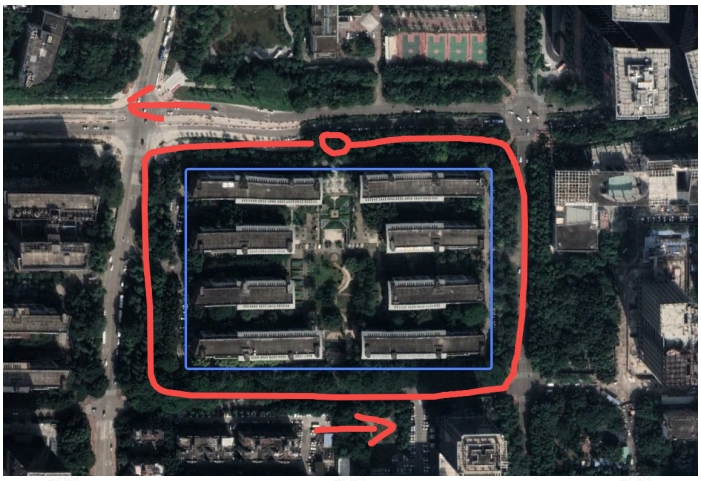
VI. Route planning suggestions for typical scenes

(1) Principles of the overall scanning route

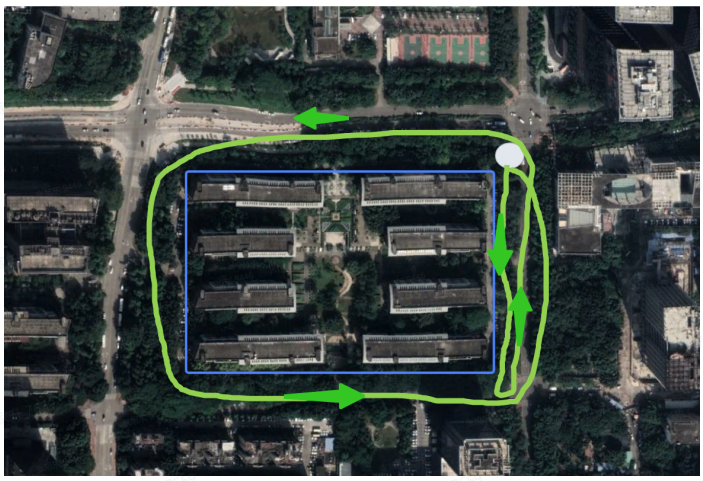
- Ensure as many features as possible during the scanning process.
- Avoid scanning new areas all the time, and making some loops as much as possible.
- Avoid the impact of dynamic objects as much as possible.

(2) Outdoor scenes

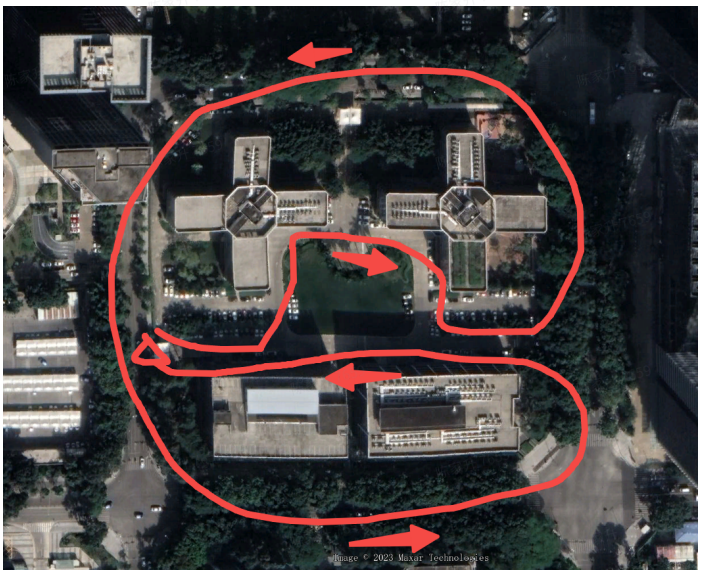
Typical scenarios: parks, campuses, buildings, etc



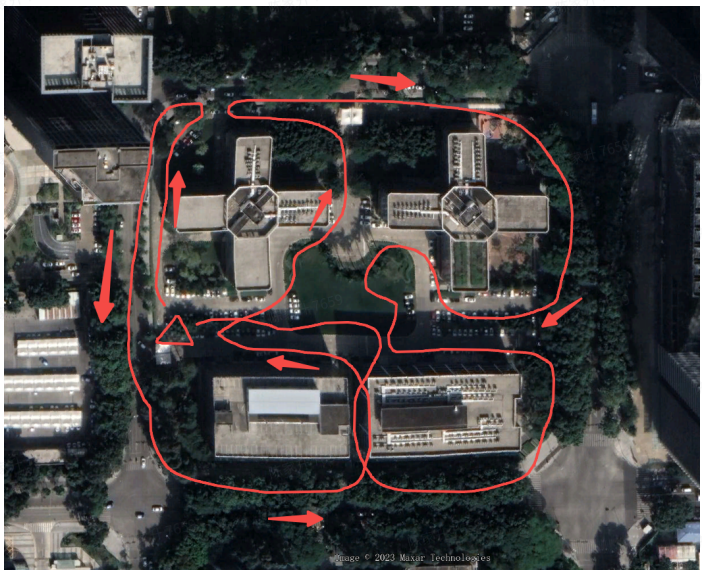
Not recommended route



Recommended route



Not recommended route



Recommended route

(3) Indoor scenes

Taking common office as an example

1. Route planning

a. Such as indoor parking lots those are more than one floor, it is recommended to scan from top to bottom and snake around.

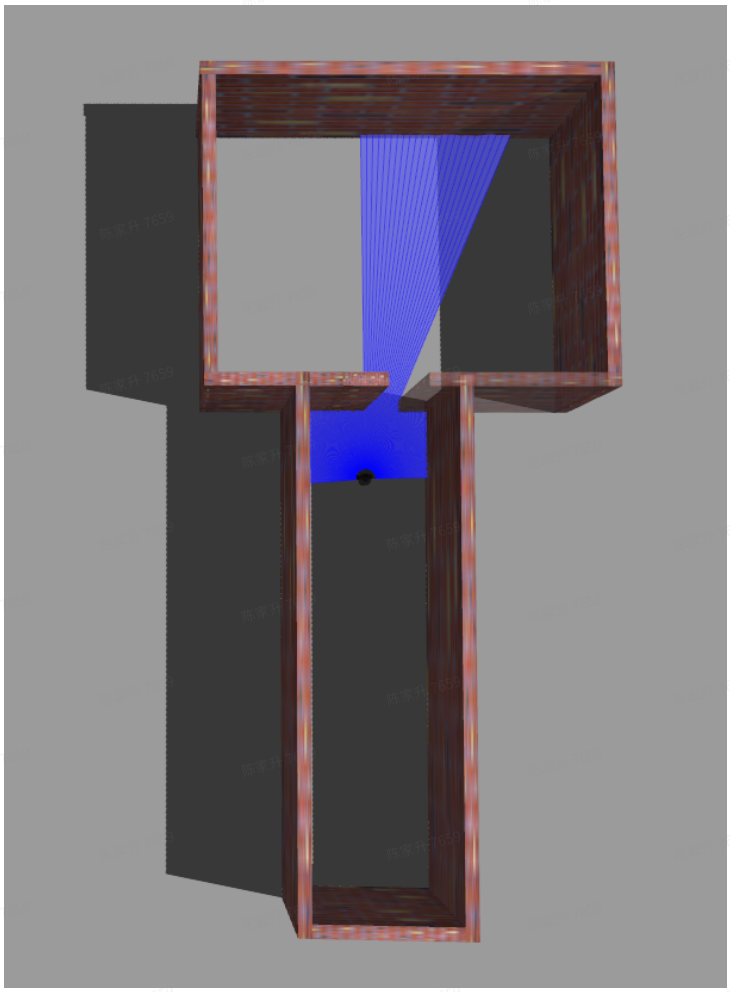
b. The control point recording method is consistent with the parking lot scene, and the absolute coordinate control point is selected to record with the core area.

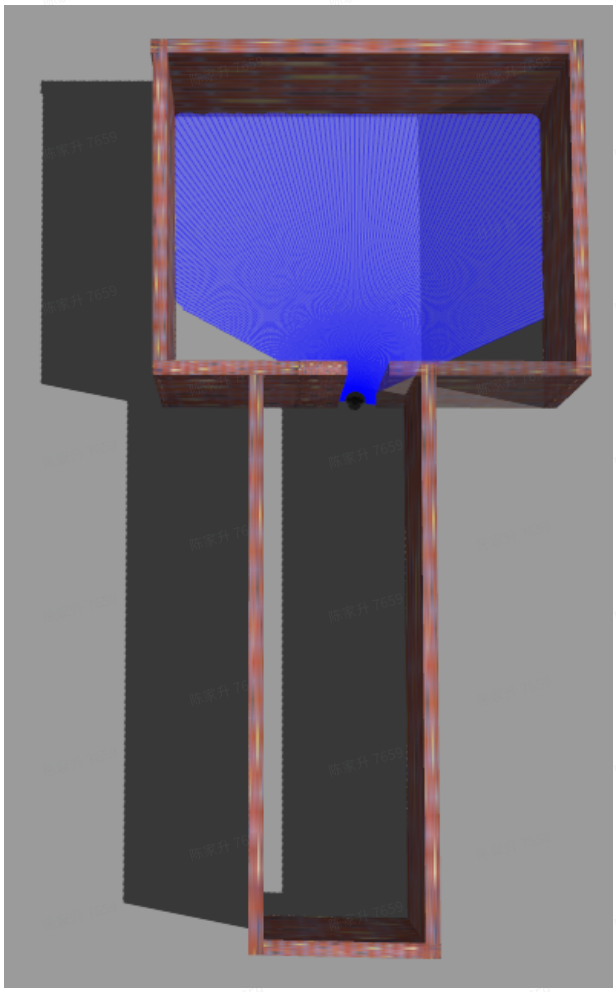
2. Notes

Appropriate posture and mobile scanning methods during indoor scanning can effectively improve data quality and avoid point cloud layering problems

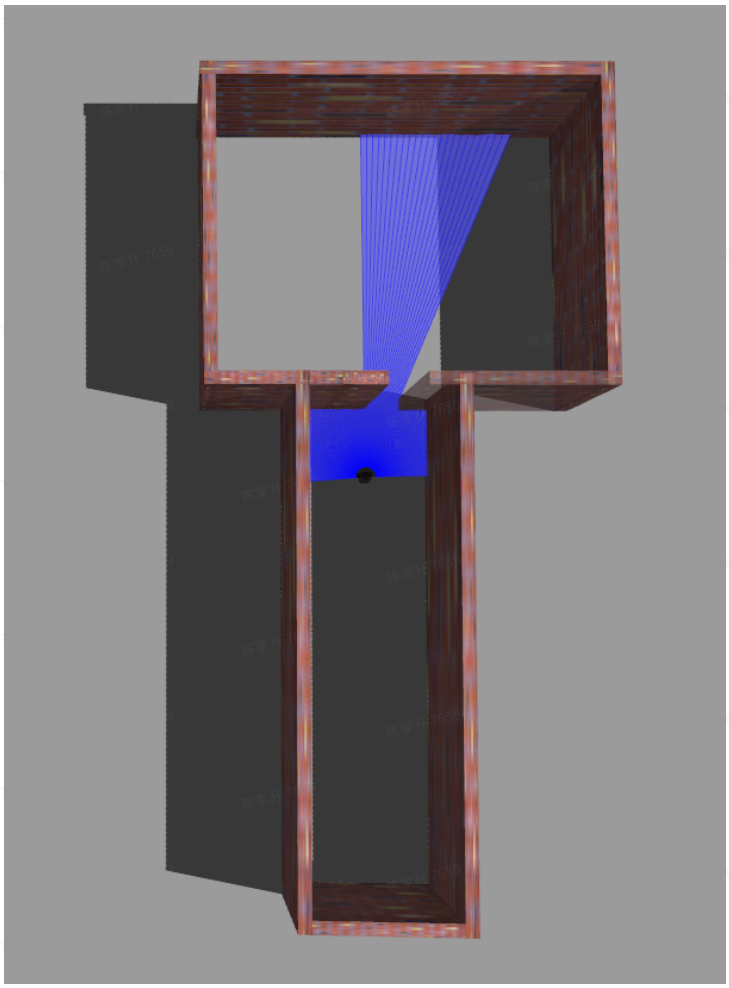
2.1 In and out

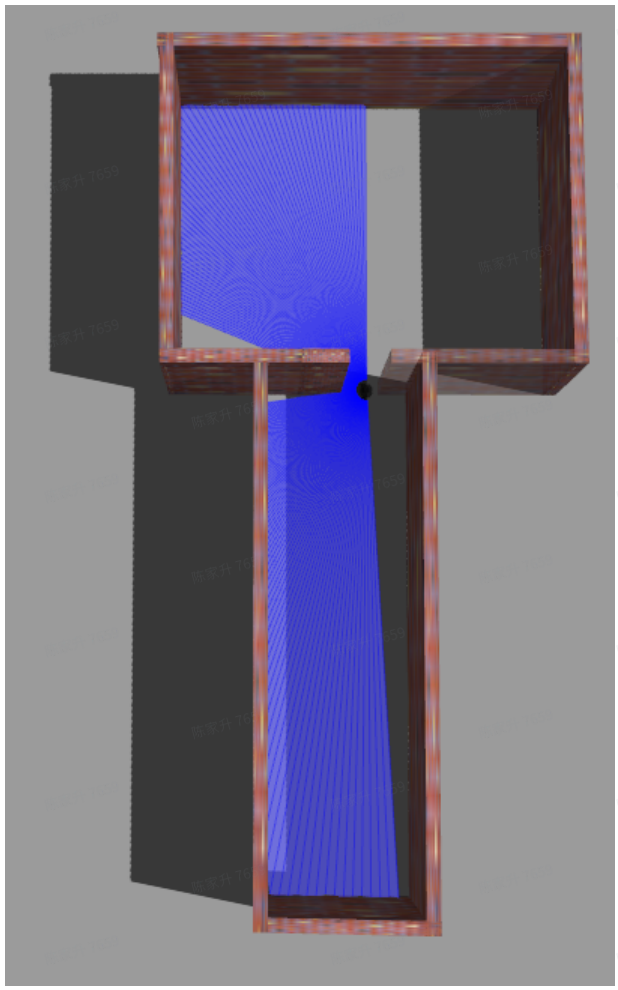
Error example: Entering through the door from the front will make the indoor and outdoor laser point cloud data lose the common FOV, lose the reference, and cause the data to be skewed.





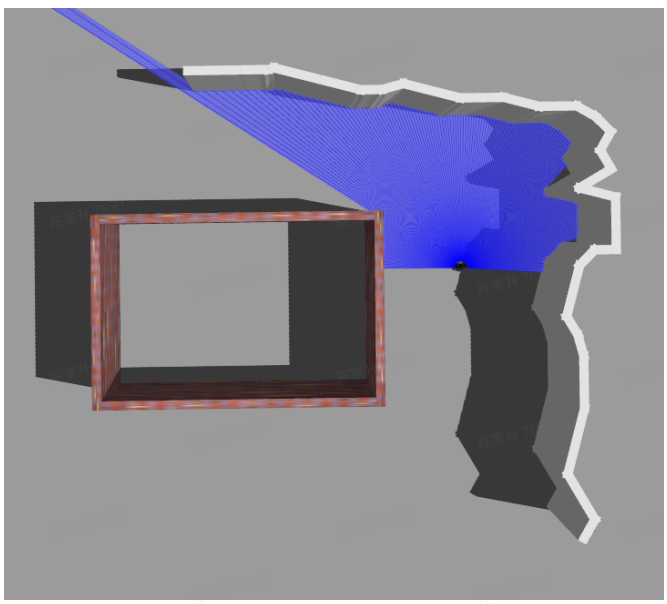
The correct example is to get through the door sideways to ensure that the indoor laser point cloud and the scanning field before entering the door have a common FOV, better connection, indoor and outdoor data.

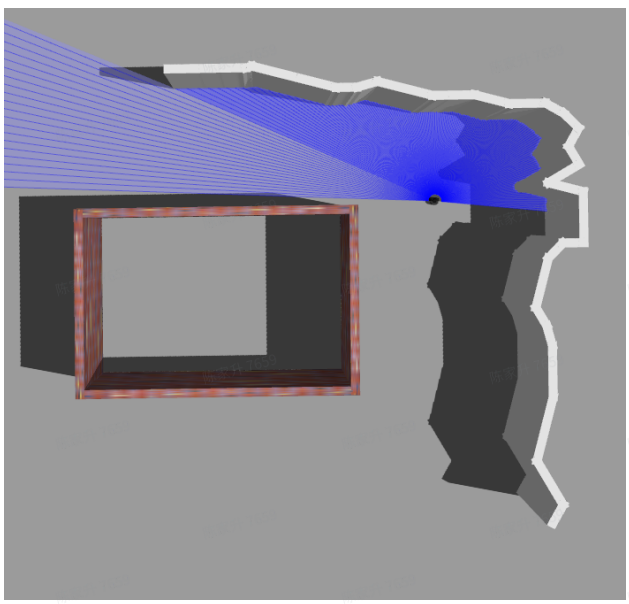




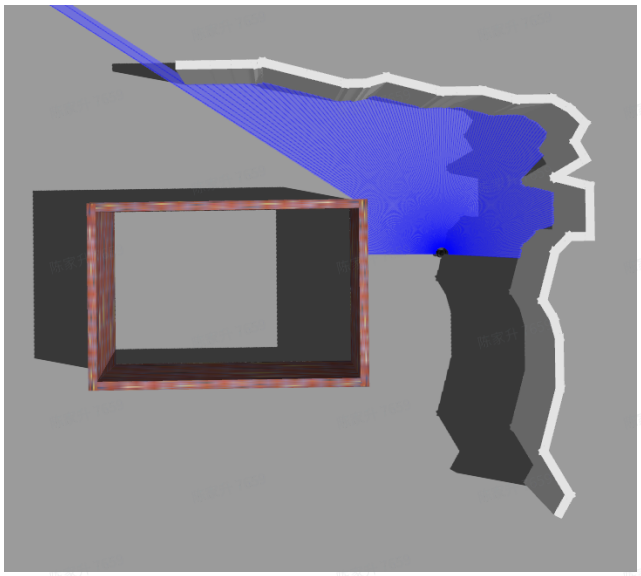
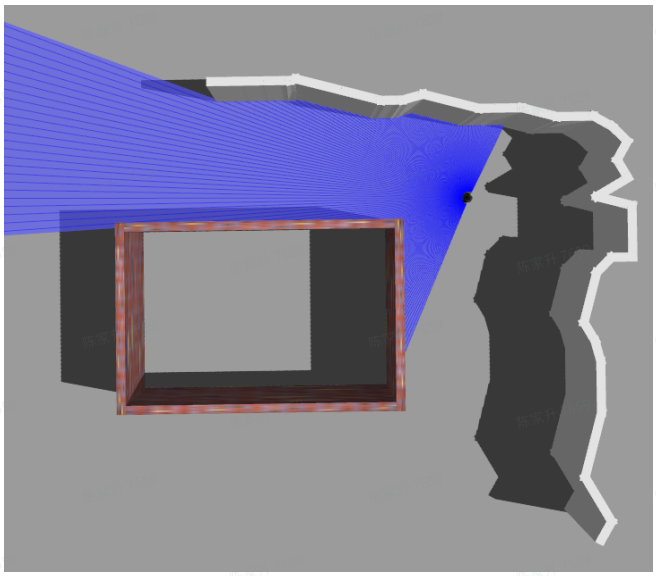
2.2 Hanging corner

Error example: Go straight ahead resulting in the loss of the wall view in the lower left corner. And the laser point cloud lacks a reference and is prone to misalignment.





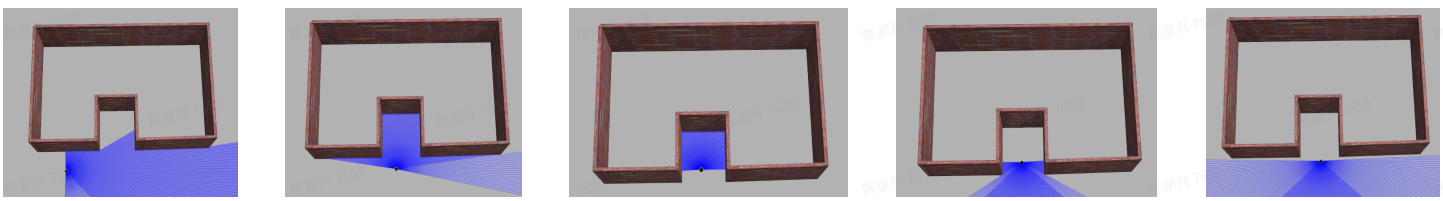
Correct example: When turning, turn sideways at a certain angle to ensure that the laser can scan the lower left corner wall and the right side contour at the same time, which can better connect the data.

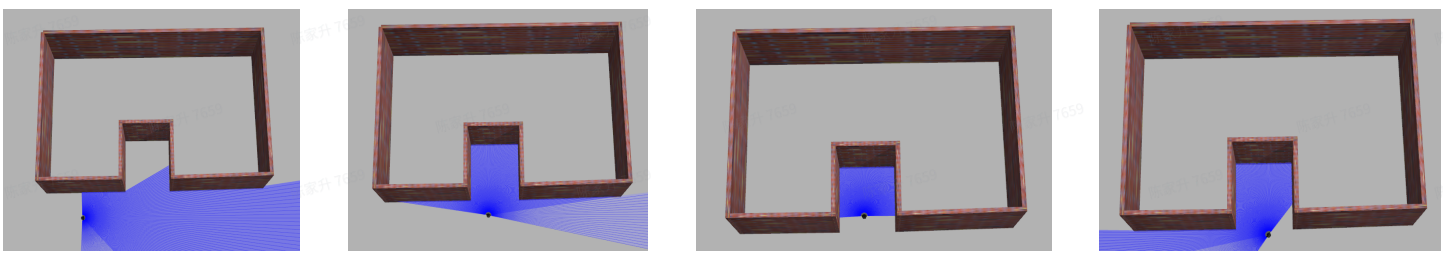
2.3 In and out of confined spaces

After scanning a small space and exiting from the space, it is necessary to observe whether the reference objects are sufficient and whether the structural features are obvious during the scanning process. If the above two conditions are not met, when exiting, try to align the perspective with areas with good structural features as much as possible, while avoiding excessive perspective switching.

Error example: Directly turning around and exiting. This will result in missing reference objects and insufficient structural feature constraints of reference objects.



Correct example: exit by **moving back or exiting sideways**



VIII. Precautions

(1) Basic usage specifications

a. The Lixel K1 handheld scanner is a kind of precision surveying and mapping equipment. Falling or being hit by external forces may damage the equipment, leading to abnormal work or bad accuracy, or even complete damage to the equipment.

b. When using a tripod, make sure to tighten the tripod and the device cartridge battery to prevent the device from falling.

c. After the Lixel L series scanner is turned on, the LiDAR module will return to zero and remain stationary. It is recommended not to manually rotate the LiDAR at this time.

d. After the Lixel K1 scanner starts recording, it is not allowed to manually or use other objects to rotate the LiDAR module, otherwise it may cause data anomalies.

e. The protection level of the Lixel K1 canner is IP54 . Please pay attention to the environment when using it and do not use it in an environment exceeding this protection level. It is recommended to use a soft dry cloth or a self-cleaning cloth to clean the equipment. Please keep the LiDAR module and lens parts clean and do not touch them directly with your hands.

f. During use, the equipment will generate heat. Please do not touch the body part to prevent burns.

g. Do not cover or touch the heat dissipation part of the equipment during use. When the device temperature is too high during use, it may automatically shut down.

(2) Scanning specifications

1. Startup (Instrument Initializing)

a. During initialization, it is recommended to place the device on a flat surface for static startup. Do make sure that the scanner is stable and without shaking (if possible, you can properly hold the device steady), and do not have people or obstructions in front of the LiDAR. After startup, wait for at least 10 seconds for the point cloud to appear on the phone interface. If using the latest version 1.1.0 LixelGo APP, please follow the APP prompts to initialize successfully before picking up the device. And then pick up the device for scanning. When picking it up for scanning, pick it up slowly and avoid violent movements.

b. When initialization, the collector should not block the LiDAR and stay a little bit away from the device. The LiDAR should be aimed at areas with more features, avoiding environments with fewer features such as open plains, environments with refraction such as large areas of glass, and areas with lots of dynamic objects, to ensure sufficient initialization features and obtain better data results.

2. During scanning

2.1 General notes

a. Avoid rapid and drastic body movements or sudden stops, which may cause the device to deflect and swing rapidly and drastically, affecting the accuracy and effect of point cloud mapping to a certain extent.

b. When scanning, it is recommended to walk at a normal walking speed. For situations with fewer features, narrow spaces, turns, etc., it is recommended to slow down.

c. When scanning, tilt the device slightly forward about 15° to obtain a more complete field of view. In normal walking conditions, the device should not be tilted more than 20°. If you need to scan the entire ground in some narrow areas or need to scan ground targets, the device can be tilted more than 20° temporarily, but can not exceed 30°.

d. Avoid long-term obstruction of large objects within the 1m field of view of the LiDAR, and avoid obstruction exceeding 50% of the LiDAR field of view.

e. To ensure the scanning effect and accuracy, try to keep at least 0.5m away from the scanned object when scanning.

f. To ensure the scanning data results, when scanning some important ground data, try to scan at a closer distance and ensure the scanning posture: hold the scanner in the center of the body and avoid being too close to the ground.

g. For outdoor scenes such as roads and streets where there are lots of dynamic objects such as people and vehicles, be careful not to aim the LiDAR at dynamic objects when scanning. If conditions permit, if there are many dynamic objects on one side, aim the LiDAR on the other side to avoid having too many dynamic object features in the LiDAR field of view.

h. If the indoor scene involves scanning multiple rooms or floors, please open the door in advance, and scan slowly when passing through the door, and stay sideways for a while to scan to ensure that the features on both sides of the door can be scanned at the same time. If the door is not opened during scanning, turn around slowly before approaching the door, turn the instrument back to the door, open the door with your back, and enter slowly.

2.2 Ground control mode

a. When putting down the scanner to mark control points, avoid large collisions with the ground to avoid vibrations. When picking up the scanner after marking the control points, do it slowly and steadily, otherwise violent movements will affect accuracy.

b. Mark the control point first. After the APP reports that the control point has been added successfully, pick up the scanner and walk around the control point 1-2 times or stay there for a while to obtain a more complete point cloud around the control point.

c. After marking the control point, if you want to end the project, please wait for more than 15 seconds before ending the project.

d. To ensure the accuracy of post-processing, the distance between two control points should be less than 50m and evenly distributed within the scanning area. Note: The control points cannot be on a straight line.

2.3 RTK mode

a. The RTK module can only be used when there is an RTK differential signal. And it cannot be used when there is no signal indoors.

b. Pay attention to the holding method. For the new tilt RTK bracket, under normal circumstances, ensure that the device is tilted no more than 20°. That is, the RTK antenna is vertical; the maximum tilt of the RTK antenna cannot exceed 10°.

c. In order to ensure the accuracy of post-processing point cloud conversion, pay attention to the scanning space range when scanning, and ensure that the scanning area range is more than 10m. Moreover, it is necessary to ensure that the RTK valid data is > 20 to perform coordinate conversion normally, otherwise the conversion will fail. (When using LixelStudio software to set RTK, if the valid data is less than 20, coordinate conversion will not be possible).

d. If accuracy check is needed, the acquisition route must be more than 100m and not a straight line.

e. To ensure the accuracy of point cloud post-processing, try to ensure that the RTK continuous unfixed solution is less than 50m.

2.4 Colorization mode

a. In order to ensure the colorization results, during scanning, it is necessary to ensure that the scanning duration is more than 2 minutes, and there must be movement during scanning, and the scanner should not be stationary in the same position.

b. Point cloud 's coloring effect depends on the surrounding environment and ambient light . For dark environments, if colorization is needed, it is recommended to light up to ensure uniform brightness around. Avoid excessive light and overexposure during the scanning process.

c. When scanning, pay attention to the way the scanner is held, and try to avoid the panoramic camera or the built-in cameras being blocked or having objects on one or both sides of the cameras for a long time, so as not to affect the coloring effect.

2.5 Accuracy Check

a. For accuracy check, the points where the target is pasted need to be scanned around the target or stay at the target appropriately to obtain a more complete target point cloud so as to improve the success rate of automatic target point extraction in subsequent accuracy check in LixelStudio.