Rd-03D_V2 Quick Start Document

Version V1.0.0

Document Revision History

Version	Date	Description of Changes	Authored by	Approved by
V1.0.0		First edition	Wei Jie	Xu Hong

1 Firmware Flashing Instructions

The serial port flashing wiring for Rd-03D_V2 is as follows:

Rd-03D_V2	USB-to-TTL
5V	5V
GND	GND
TX	RX
RX	TX

The module can be connected either through the right-side pin header or by soldering to the pads in the upper-left corner, as shown in Figure 1.1 and Figure 1.2.

Figure 1.1 Rd-03D_V2 Module Connected to Serial Tool via Right-side Pin Header

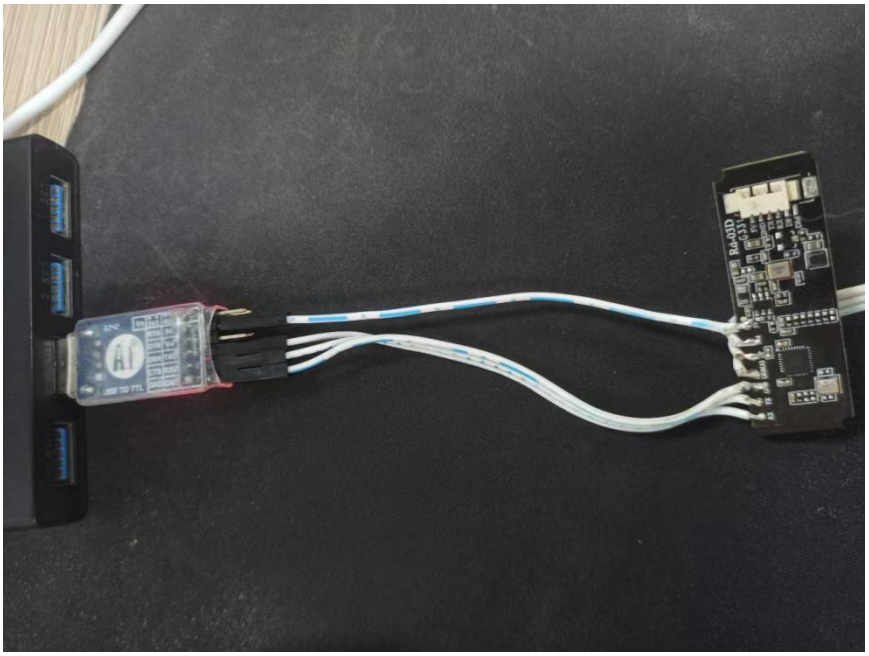

Figure 1.2 Rd-03D_V2 Module Connected to Serial Tool via Solder Pads

After the wiring is completed, open the firmware upgrade tool: ICLM_Download_JIELI.exe

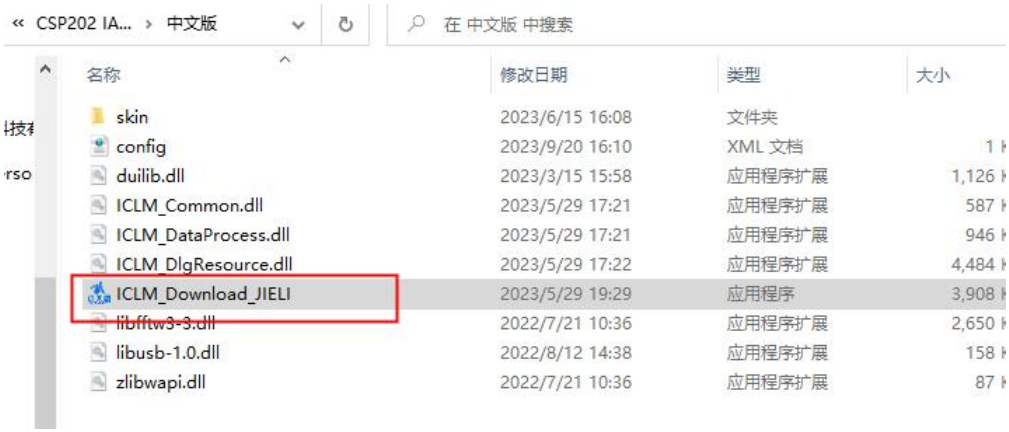

Figure 1.3 Open Firmware Upgrade Tool

After opening the firmware upgrade tool, click the “Refresh Device” button. Select the serial port number of the radar module from the “Port Number” drop-down list. The baud rate is 256000.

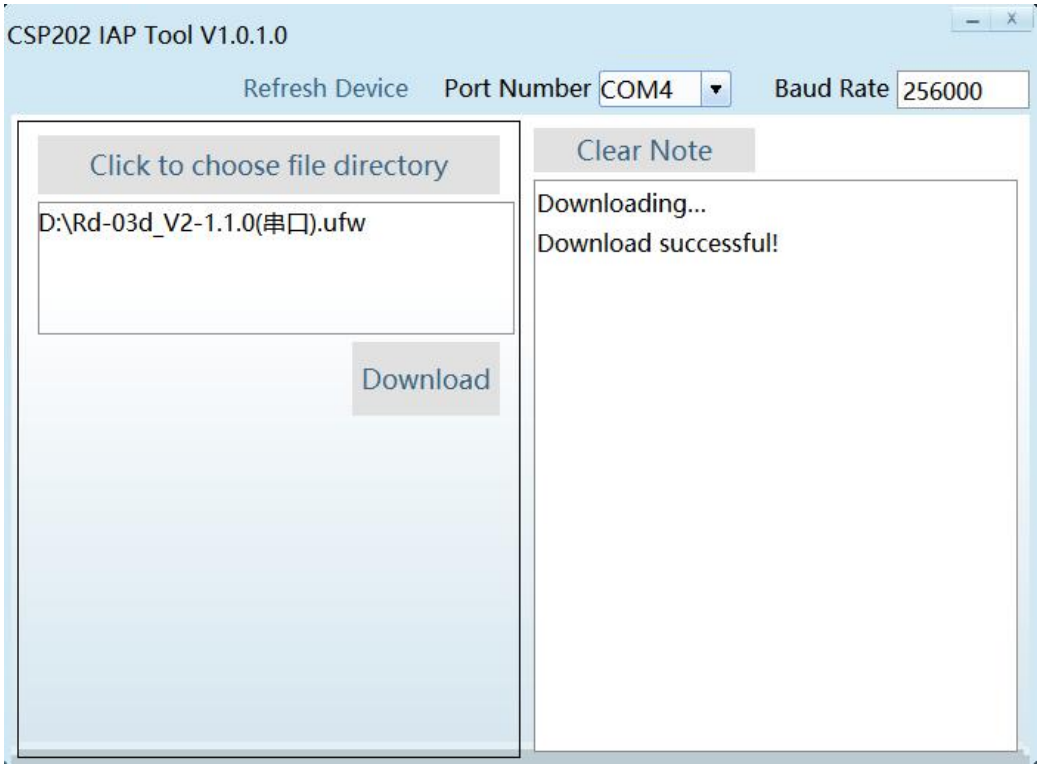

Figure 1.4 Firmware Upgrade Tool Configuration

Click the “Click to choose file directory” button to select the ufw file to be upgraded; then click the “Download” to start the firmware upgrade. The prompt box on the right will display the download results in real time, and the download progress will be shown below the prompt box.

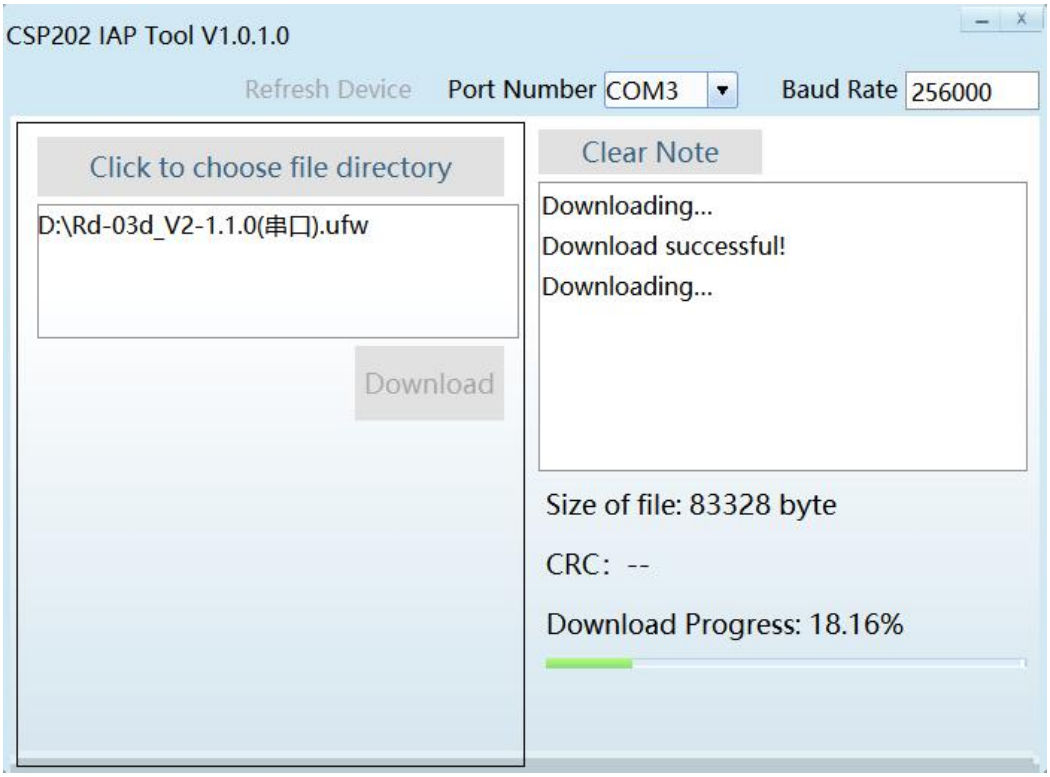

Figure 1.5 Firmware Upgrade Tool Download Progress

After the firmware upgrade succeeds, the prompt box will display “Download Successful!”. If the firmware upgrade fails, the prompt box will display the corresponding error information.

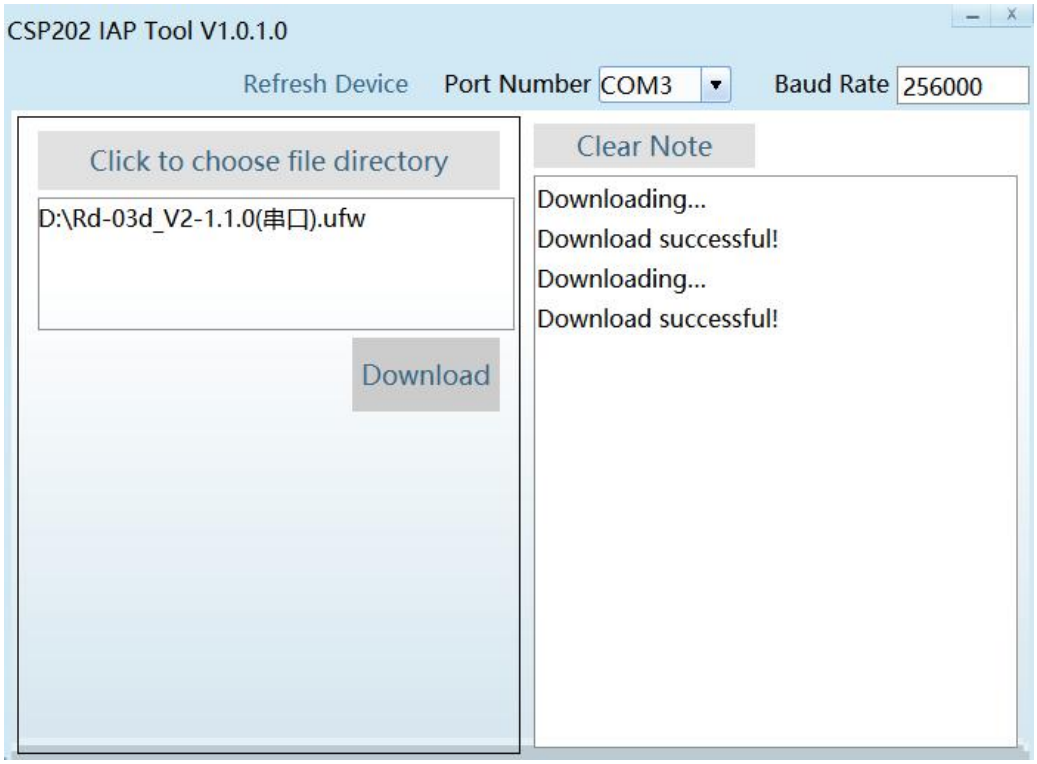

Figure 1.6 Firmware Upgrade Tool Download Successful Prompt

2 Host Computer User Guide

2.1 Host Computer Connection

The host computer tool ICL_MTT.exe is a portable software tool specially developed for Rd-03D_V2. After connecting the host computer to the Rd-03D_V2 hardware, the tool can display, record, save, and replay radar data.

Step 1: Use a cable to connect the Rd-03D_V2 module to the serial tool, as shown in Figures 1.1.1 and 1.1.2 above. Connect the module to the host computer via the serial tool.

Step 2: Double-click to open the host computer tool “ICL_MTT.exe”, and the demo tool interface will pop up, as shown in Figure 2.1.1.

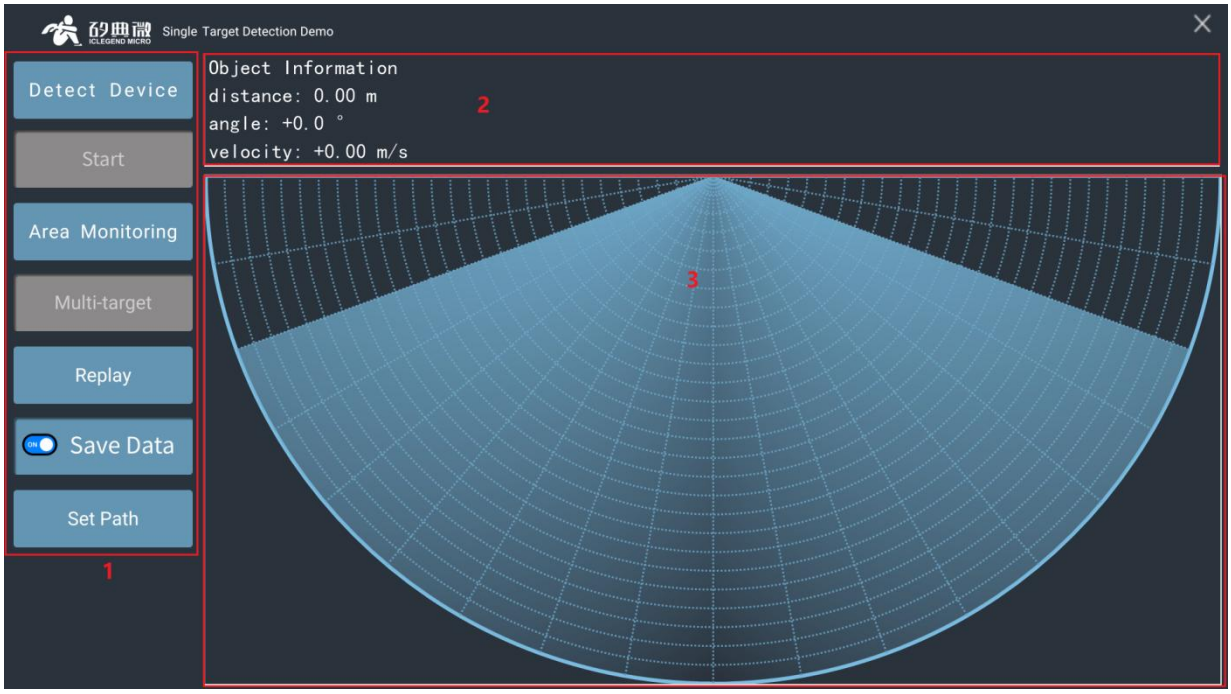

Figure 2.1.1 Demo Tool Interface

The visualization tool interface is mainly divided into the “Function Button Area 1”, “Data Area 2”, and “Target Display Area 3”, with the functions of each area as follows:

1. Function Button Area
    - Detect Device: Used to check whether the Rd-03D_V2 module is successfully connected.
    - Start/Stop: Used to start or stop receiving radar data.
    - Area Monitoring: Used to set the monitoring area and configure the blind-zone ranges.
    - Multi-target/Single-target: Used to switch between single-target and multi-target detection modes.
    - Replay/Stop: Used to replay recorded radar data.
    - Save Data ON/OFF : Used to start recording radar data.
    - Set Path: Used to set the storage path for radar data.
2. Data Area: Display the distance, angle, and velocity of the tracked target in real time.
3. Target Display Area: Visually display the position of the located and tracked target within the detection area on the radar chart.

2.2 Host Computer Tool Usage

2.2.1 Single-Target/Multi-Target Detection

The specific operation steps for using the single-target or multi-target detection function of the host computer are as follows:

Step 1: Connect the Rd-03D_V2 module and the serial port tool according to the steps in Section 2.1, and open the host computer tool.

Step 2: Click the “Detect Device” button on the interface. If the serial port connection is correct, a prompt box will appear displaying “COM Device Detected”, as shown in Figure 2.2.1. Click “确认” (OK) to continue.

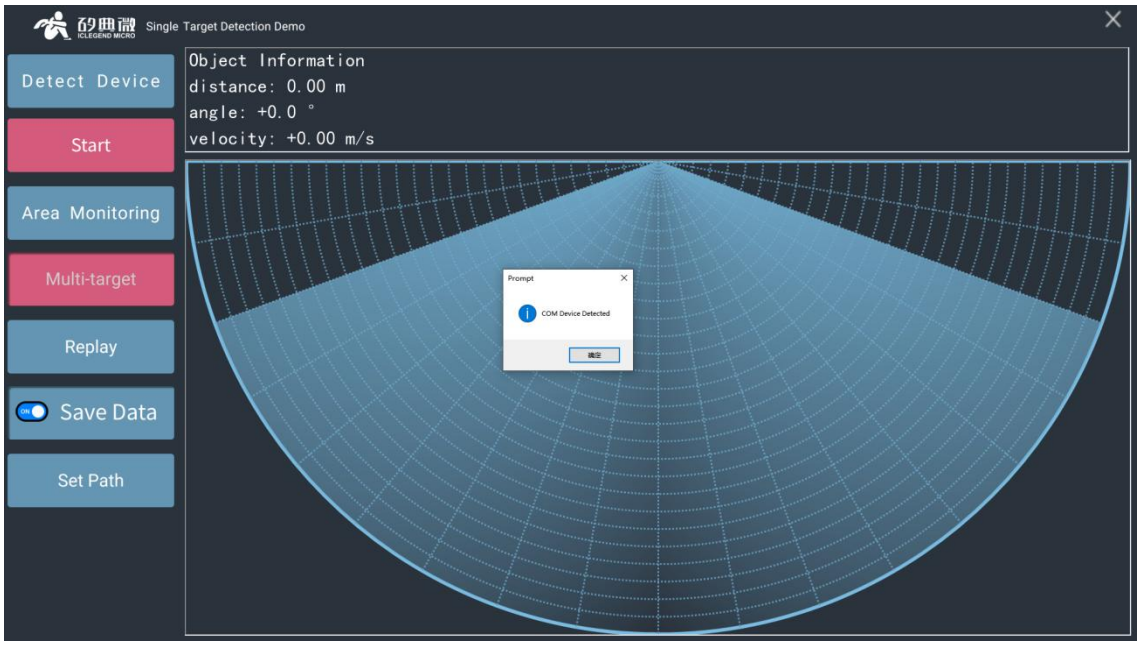

Figure 2.2.1 Device Detected Successfully

Step 3: Click the “Start/Stop” toggle to display the position of the target relative to the radar, as shown in Figure 2.2.2.

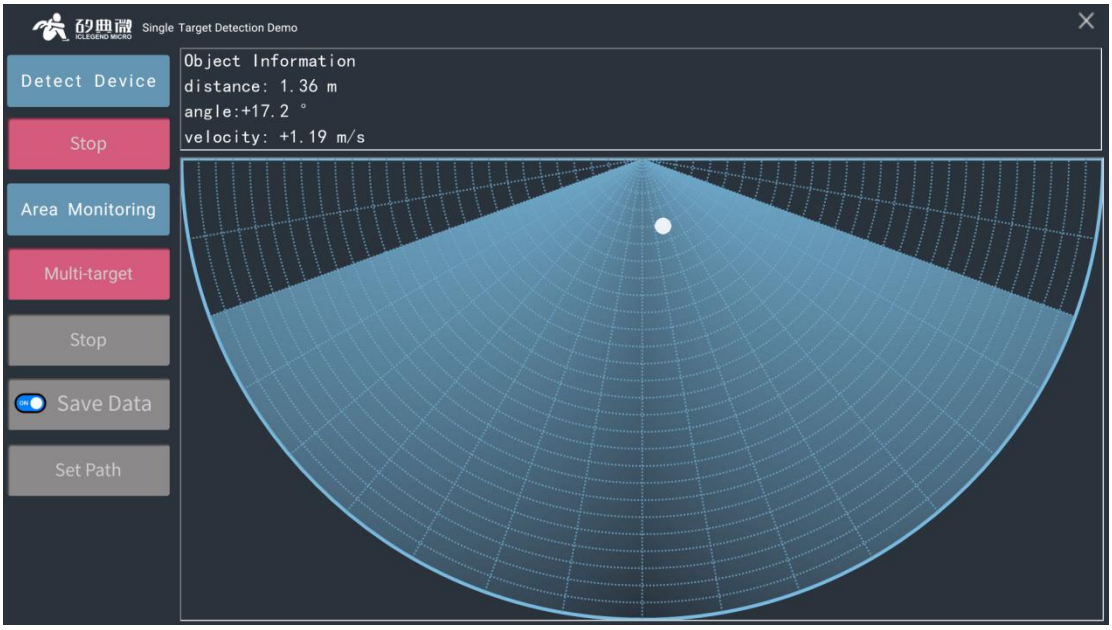

Figure 2.2.2 Single-target Detection Demo

Step 4: After the host computer is opened, it defaults to “Single-target Detection Demo”. Click the “Multi-target Detection/Single-target Detection” button will switch to the “Three-target

Detection Demo" interface, as shown in Figure 2.2.3. Click the button again will switch back to the "Single-target Detection Demo" interface. Note: The "Single-target Detection" mode is not suitable for tracking and detecting multiple targets.

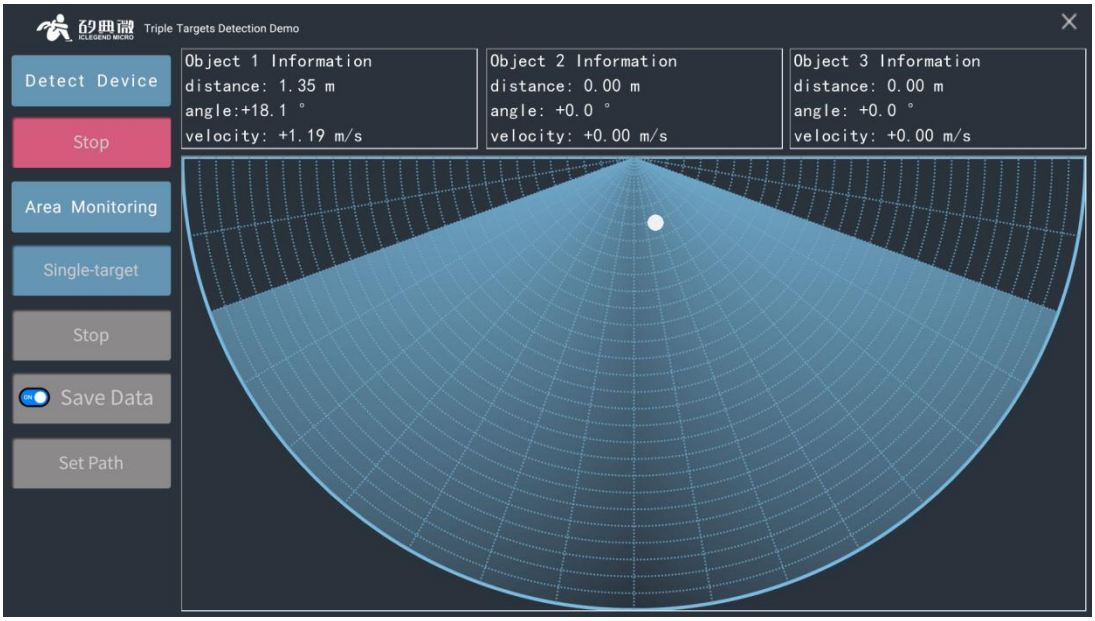

Figure 2.2.3 Multi-target Detection Demo

2.2.2 Area Monitoring and Blind-Zone Settings

The host computer provides area monitoring and blind-zone setting functions. Area monitoring means users can set one or more polygonal areas of interest within the detection area. Once a human target enters the area, the color of the area changes immediately.

The blind-zone setting means that users can define the radar detection and tracking range of interest, and disable detection and result display for certain range-gate areas. The operation steps for zone monitoring and blind-zone setting are as follows:

Step 1: Connect the radar module to the host computer according to Section 4.2.1, and start target detection.

Step 2: Click the "Area Monitoring" button, and the interface shown in Figure 2.2.4 will appear. The functions of each part of the interface are described below:

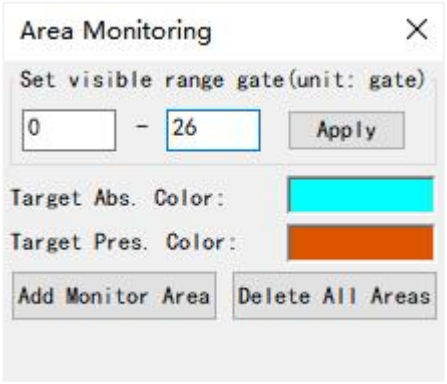

Figure 2.2.4 "Area Monitoring" Settings Interface

Set visible range gate: The default is 0–26 range gates, meaning there is no blind zone. Users can manually set the nearest and farthest blind zones. For example, setting it to 1–24 means setting 1 range gate as the nearest blind zone and 2 range gates (26-24) as the farthest blind zone (each

range gate is 33 cm). After clicking the “Apply” button, the interface will appear as shown in Figure 2.2.5, where the red area indicates the blind-zone position.

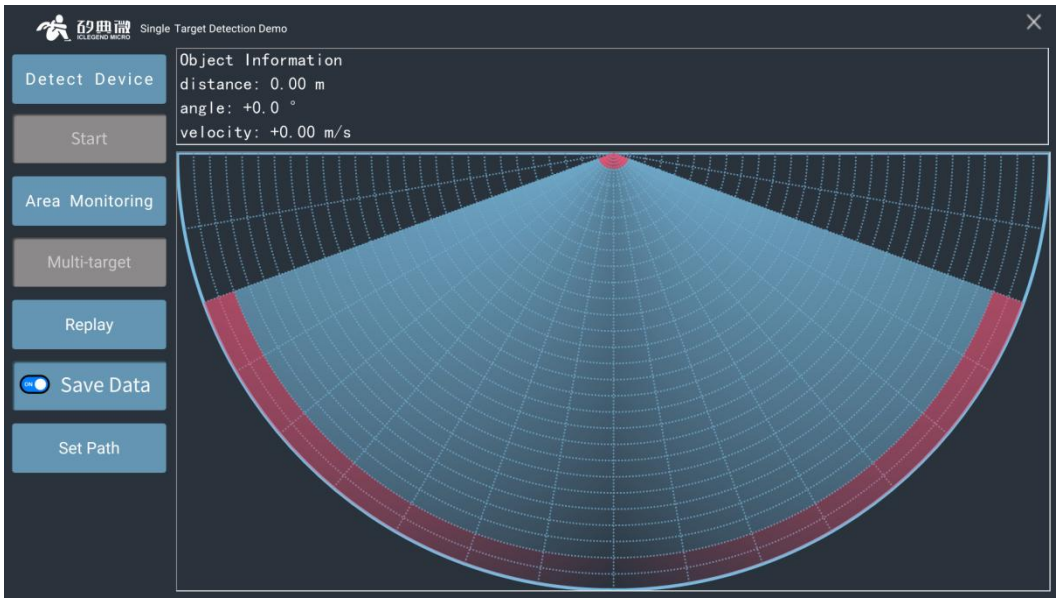

Figure 2.2.5 Blind-zone Setting Example

Target Abs. Color: The color displayed when there is no human target in the monitoring area.

Target Pres. Color: The color displayed when a human target appears in the monitoring area.

Add Monitor Area: Start defining a monitoring area. After clicking this button, left-click on the interface to add vertices of the area, and right-click to end the definition process.

Delete All Areas: Delete all defined monitoring areas.

Step 3: Click the “Add Monitor Area” button on the “Area Monitoring” settings page to start setting up the monitoring area: On the interface, left-click within the fan-shaped area to set the vertices of the monitoring area, and right-click to finish setting the monitoring area. The host computer tool will connect the vertices in the order of mouse clicks to form a polygon displayed on the interface. The area enclosed by this polygon is the monitoring area. Figure 2.2.6 shows a quadrilateral monitoring area. When someone enters the monitoring area, the background color of the monitoring area changes to “Target Abs. Color”; after the person leaves the detection area, the area color reverts to “Target Pres. Color”, as shown in Figures 2.2.7 and 2.2.8.

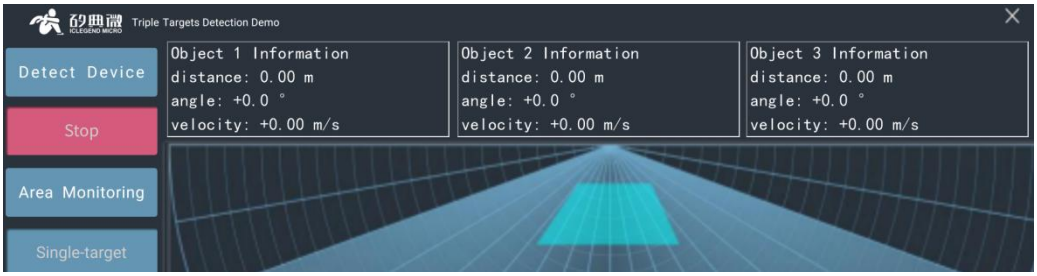

Figure 2.2.6 Defined Monitoring Area

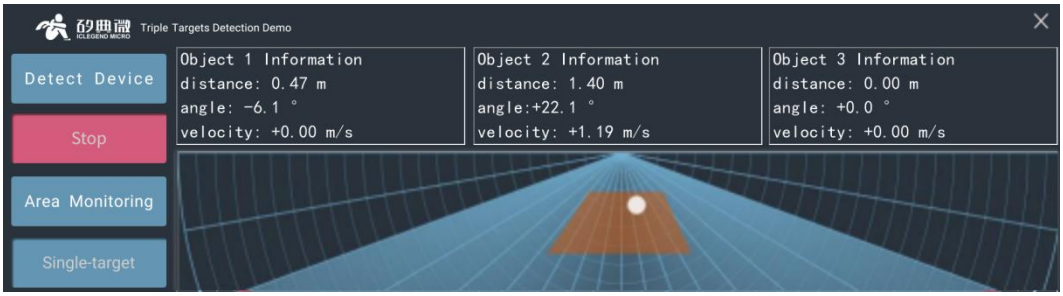

Figure 2.2.7 Target Present in Monitoring Area

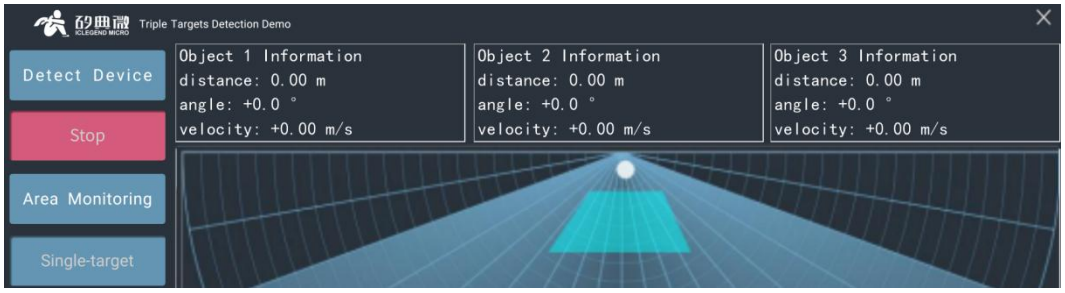

Figure 2.2.8 No Target in Monitoring Area

Step 4 (Optional): Repeat Step 3 to set up multiple monitoring areas of interest.

Step 5 (Optional): Click the “Area Monitoring” button, then in the pop-up window, click “Delete All Areas” to delete all monitoring areas within the fan-shaped detection area.

2.2.3 Radar Data Recording and Playback

The steps for a user recording and replaying radar data using a host computer tool are as follows:

Step 1: Connect the radar module and the host computer software according to Section 2.1, and select a suitable target detection mode.

Step 2: When the “Start/Stop” toggle button displays “Start”, as shown in Figure 2.2.9 (b), click the “Save Path” button to set the radar data storage path. The default data storage path is the SaveData folder under the host computer tool directory.

(a) Data Recording/Playback Buttons Unavailable

(b) Data Recording/Playback Buttons Available

Figure 2.2.9 Data Recording/Playback-related Buttons Unavailable During Radar Detection

Step 3: The “Save Data” status on the host computer is OFF by default. If the user wants to enable the “Save Data” mode, click the “Save Data” when it is in a clickable state (as shown in Figure 2.2.10 (a)). Clicking the “Save Data” button again will disable this mode.

(a) Function Disabled (Text in White) (b) Function Enabled (Text in Gray) (c) Not Clickable

Figure 2.2.10 Data Recording/Playback-related Buttons Unavailable During Radar Detection

Step 4: When the “Save Data” function is enabled, click the “Start” button to start the target detection. Areas 2 and 3 of the host computer tool will display human body information in the detection area.

Step 5: Click the “Start/Stop” toggle button to stop detection. The saved radar data can then be found in the path set in Step 2. The data folder naming format is a timestamp: “yyyy_mm_dd_hh_mm_ss”.

Step 6: Click the “Replay/Stop” toggle button, then select a set of radar data from the storage path. Area 2 and Area 3 will start replaying the target information in the radar data.

Step 7: Click the “Replay/Stop” toggle button to stop data playback.

3 Serial Communication Protocol

This communication protocol is mainly intended for users who need secondary development without using the host computer demo tool.

The Rd-03D_V2 module communicates with external devices through a serial port at TTL level, with a default baud rate of 256000, 1 stop bit, and no parity bit.

3.1 Enable Configuration Command

Any other command sent to Rd-03D_V2 must be sent only after this command is issued; otherwise, it is invalid.

Sent Data

Frame Header	In-frame Data Length	Command Word	Command Value	Frame Tail
FD FC FB FA	04 00	FF 00	01 00	04 03 02 01

ACK (Success)

Frame Header	In-frame Data Length	Command Word	ACK	Protocol Version	Buffer Size	Frame Tail
FD FC FB FA	08 00	FF 01	00 00	01 00	40 00	04 03 02 01

3.2 End Configuration Command

After executing the end configuration command, Rd-03D_V2 returns to working mode. If other commands need to be sent again, the enable configuration command must be sent first.

Send data

Frame Header	In-frame Data Length	Command Word	Frame Tail

FD FC FB FA	02 00	FE 00	04 03 02 01

ACK (Success):

Frame Header	In-frame Data Length	Command Word	ACK	Frame Tail
FD FC FB FA	04 00	FE 01	00 00	04 03 02 01

3.3 Version Number Query

The Rd-03D_V2 version query command is as follows:

Frame Header	In-frame Data Length	Command Word	Frame Tail
FD FC FB FA	02 00	00 00	04 03 02 01

ACK (Success, data is an example)

Frame Header	In-frame Data Length	Command Word	ACK	Version Length	Version Number	Frame Tail
FDFCFBFA	0E00	0001	0000	0080	00000100010000000	04030201

3.4 Baud Rate Setting

The Rd-03D_V2 baud rate setting command is shown below. (Example of sending data to set the baud rate to 9600)

Frame Header	In-frame Data Length	Command Word	Command Value Corresponding to Baud Rate	Frame Tail
FDFCFBFA	0400	3100	0100	04030201

Command Value and Corresponding Baud Rate:

0x0001	0x0002	0x0003	0x0004	0x0005	0x0006	0x0007	0x0008
9600	19200	38400	57600	115200	230400	256,000	460800

ACK (Success, data is an example)

Frame Header	In-frame Data Length	Command Word	ACK	Frame Tail
FDFCFBFA	0400	3101	0000	04030201

3.5 Single/Multi-target Mode Switching

The radar has two modes: single-target and multi-target. The default mode is single-target. The switching commands are as follows:

Mode	Command
Single-target	FD FC FB FA 02 00 80 00 04 03 02 01
Multi-target	FD FC FB FA 02 00 90 00 04 03 02 01

Single-target Mode ACK (Success)

Frame Header	In-frame Data Length	Command Word	ACK	Frame Tail
FD FC FB FA	04 00	80 01	00 00	04 03 02 01

Multi-target Mode ACK (Success)

Frame Header	In-frame Data Length	Command Word	ACK	Frame Tail
FD FC FB FA	04 00	90 01	00 00	04 03 02 01

3.6 Output Data Protocol

The radar outputs detected target information, including the X coordinate and Y coordinate in the area (the definitions of the X-axis and Y-axis are shown in Figure 3-1, with the direction of the arrow indicates the positive coordinate direction), as well as the target's velocity. The radar-reported data frame format is as follows.

Frame Header	In-frame Data	Frame Tail
AA FF 03 00	Target 1 Information Target 2 Information Target 3 Information	55 CC

The information contained in a single target is as follows.

Target X Coordinate	Target Y Coordinate	Target Velocity	Pixel Distance Value
Signed int16 type; The highest bit 1 corresponds to the positive coordinate. 0 corresponds to negative coordinate. The remaining 15 bits represent the the absolute value of the X coordinate, in mm.	Signed int16 type; The highest bit 1 corresponds to a positive coordinate. 0 corresponds to negative coordinate. The remaining 15 bits represent the the absolute value of the Y coordinate, in mm.	Signed int16 type; The highest bit 1 indicates positive speed, 0 indicates negative speed. Moving toward the radar is negative. The remaining 15 bits represent the absolute value of speed, in cm/s.	uint16 type Single pixel distance value, in mm.

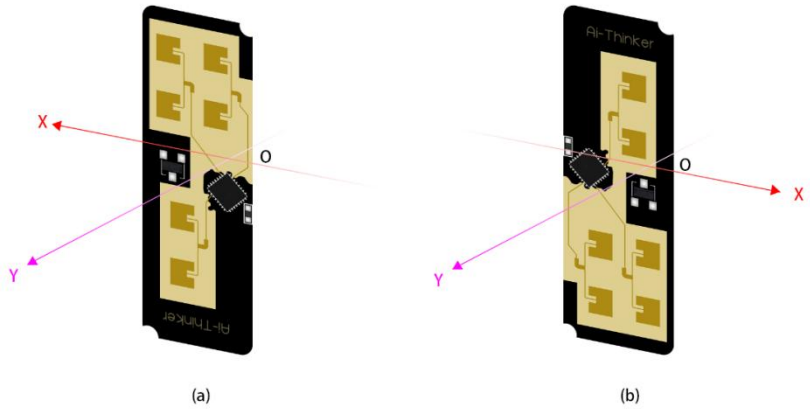

Figure 3-1 Target Position Coordinate System Under Recommended Installation Method

Data example: AA FF 03 00 0E 03 B1 86 10 00 4A 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 55 CC

This set of data indicates that the radar has tracked one target, namely Target 1 (shown in blue in the example). Targets 2 and 3 (shown in red and black, respectively, in the example) do not exist, so their corresponding data segments are 0x00. The process by which the module converts the data of Target 1 into relevant information is shown as follows:

Target 1 X Coordinate: 0x0E + 0x03 * 256 = 782

0 - 782 = -782 mm;

Target 1 Y Coordinate: 0xB1 + 0x86 * 256 = 34481

34481 - 2^15 = 1713 mm;

Target 1 Velocity: 0x10 + 0x00 * 256 = 16

0 - 16 = -16 cm/s

Target 1 Distance Resolution: 0x4A + 0x01 * 256 = 330 mm.

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