AEROSENSE

HOME CARE ASSISSTANT

Development Guidebook

V2.0

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HISTORY

Date	Version	Modification
04-29-2021	V0.5	Release.
05-25-2021	V1.0	New format with link test tool.
2021-09-06	V1.2	Design change: remove STM32.
03-03-2022	V1.3	Design change: adopt deep learning algorithm.
03-14-2022	V1.4	New format. Edit description of deep learning.
01-25-2023	V2.0	TCP protocol.

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Before you start:

Pls make sure that you are well prepared.

What do you need?	**What it does?**
The AeroSense Assure device	A radar that monitors movements.
AeroSense Assure developer package	It contains**:** **AeroSense Assure and APP user manual** :a manual to install the device. (Please note that for developers, it is recommended to go through this file before register the radar in APP.)
	AeroSense Assure SDK guidebook : the SDK guidance for developers.
	AeroSenseAssure_SDK and sample codes: sample codes for developers.
	AeroSense Assure communication protocol
AetoSenseTool	A software for configuration.
A Windows laptop or PC. (If you are using a Mac, pls install a VMware.)	Used to setup your AeroSense Assure or to connect it to your server.
A 2.4GHz WiFi network	The AeroSense Assure need to be connected to your WiFi network to work properly.

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1. Introduction

This manual is intended as a guidance for developers to use the AeroSense Assure and to develop their own codes or functions using the SDK we provide. Please contact our tech support for the SDK and sample codes.

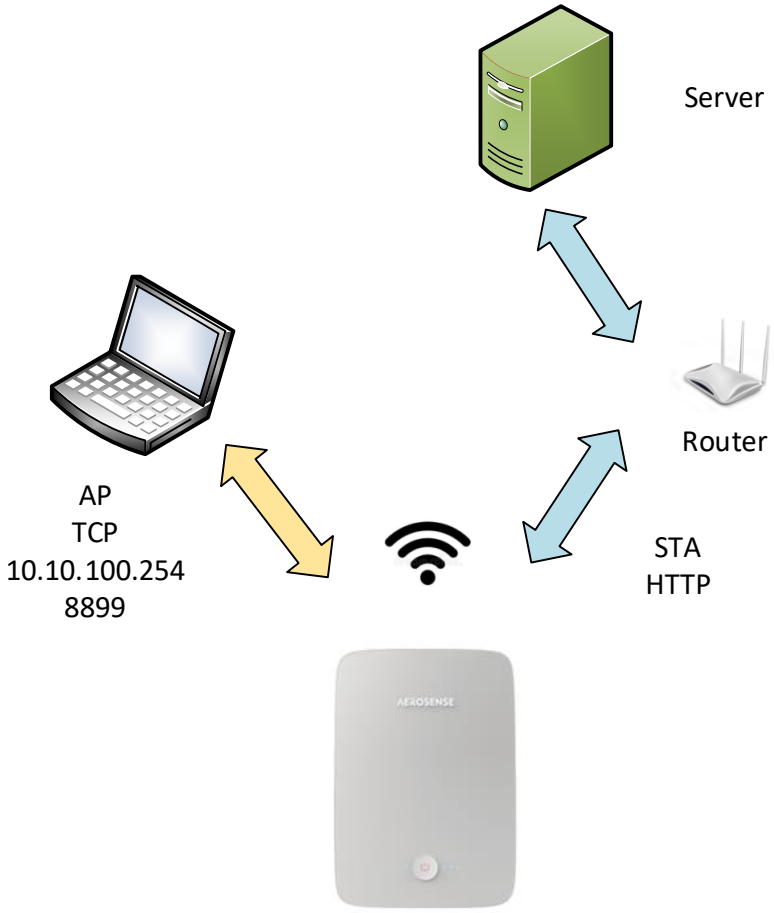


Figure 1-1 Introduction to different modes of the AeroSense (AP mode and STA mode)

The AeroSense's external interface is a WIFI protocol that supports WiFi@2.4 GHz 802.11b/g/n, and the WEP/WPA/WPA2 security modes. Its WIFI supports AP and STA modes.

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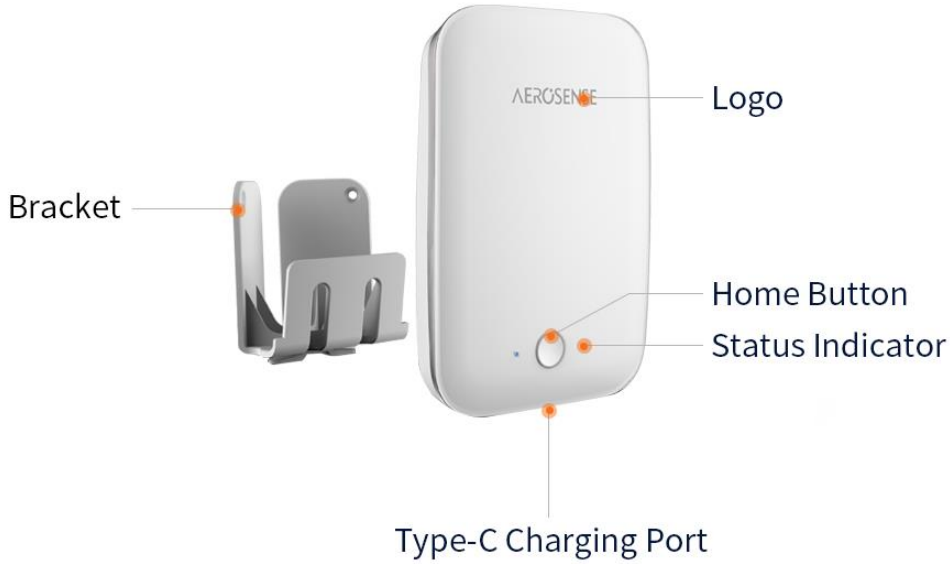


Figure 1-2 The AeroSense ASSURE: the device

AP Mode:

The AP mode is a peer-to-peer mode, and the developer can connect your cell phone or pad or PC directly to the AeroSense's SSID network (in the format of "AS_xxxxxxxx"). Your PC will be connected to the AeroSense Assure as a TCP client. When in AP mode, the developer can use the “AeroSenseTool” to dispense device parameters, for example, the SSID and password to connect the AeroSense Assure to your router, the address/port information of a specific remote server, and so on.

To enter AP mode, press and hold the home button for 3-5 seconds, until the status indicators flash blue.

STA mode:

Once the AeroSense Assure is successfully connected to the router, and the SSID and password are correctly entered in AP mode, it will be automatically switched to STA mode. In STA mode, the AeroSense will be connected to a specific router, and the messages will be sent to the server using TCP protocol.

Table 1-1 The WIFI parameters of the AeroSense in AP mode

WIFI SSID	AS_XXXXXXXXXX (The suffix is the MAC address)
WIFI password	N/A
The destination address	10.10.100.254
Port	8899
Communication protocol	TCP Server

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Table 1-2 The WIFI parameters of the AeroSense in STA mode

Communication protocol	TCP Client

2. Connecting the AeroSense Assure to the network

It is recommended to turn off the firewall of your computer to run the AeroSenseTool.

2.1. Connect the AeroSense to your network

1) Plug in your AeroSense Assure.
2) Make sure your AeroSense is in AP mode. When you get the AeroSense Assure, it should be in AP mode by default (blue flash when plugged in). Otherwise you can press and hold home button for 3-5 seconds until the status indicator flash blue.
3) Turn on your computer and connect to the "AS_xxxxxxxxx" network. The suffix is the MAC address of the AeroSense Assure.

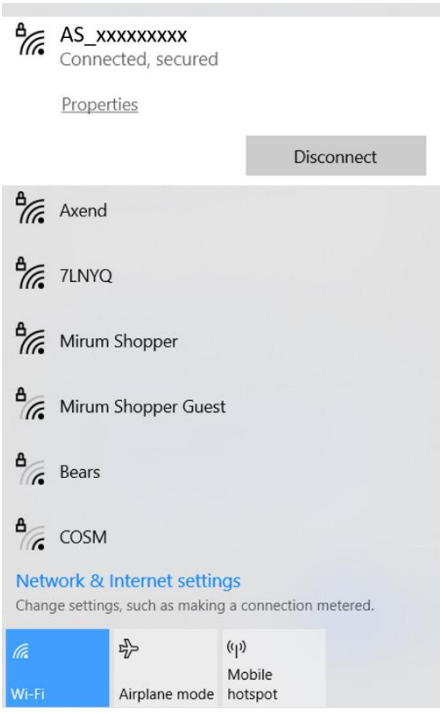


Figure 2-1 Connecting to AeroSense network (AS_xxxxxxxx) in AP mode

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4) Turn on the "AeroSenseTool.exe" and click on "Connect". You will see a green “Connected” if the connection is successful. See Figure 2-2.

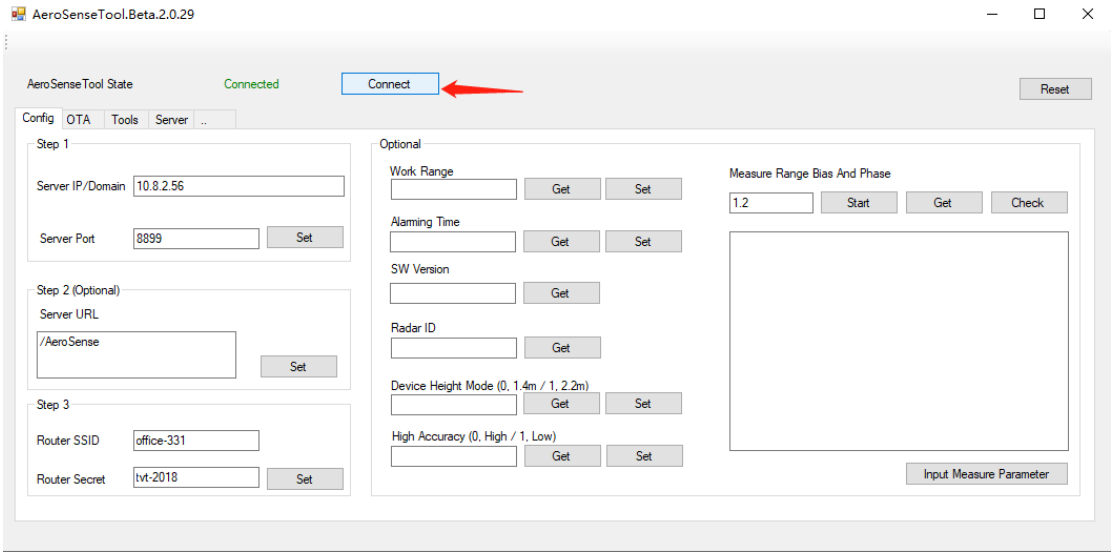


Figure 2-2 Connect the AeroSense

5) Enter the Server IP address to dispense the address of the AeroSense server. The TCP protocol supports IP only. Click on “Set”. A popup window will indicate for successful connection. See Figure 2-3.

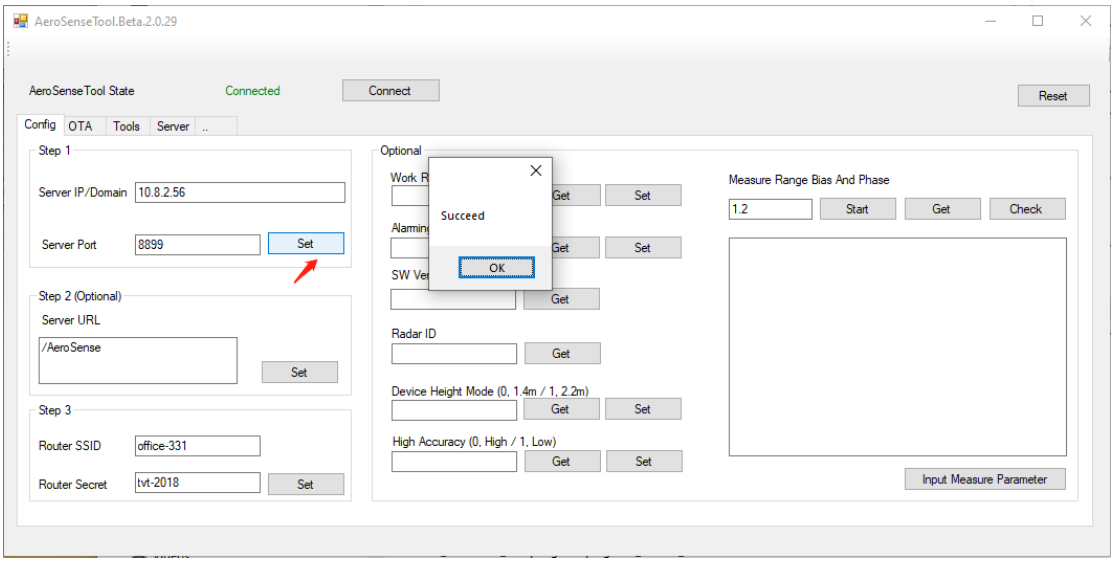


Figure 2-3 Dispense the server parameters to the AeroSense

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6) Enter the name and password of the local WIFI and dispense it to the AeroSense. The AeroSense Assure will automatically connect to the correct router, and the status indicator will be blue (constant) for about 30 s before turning off.

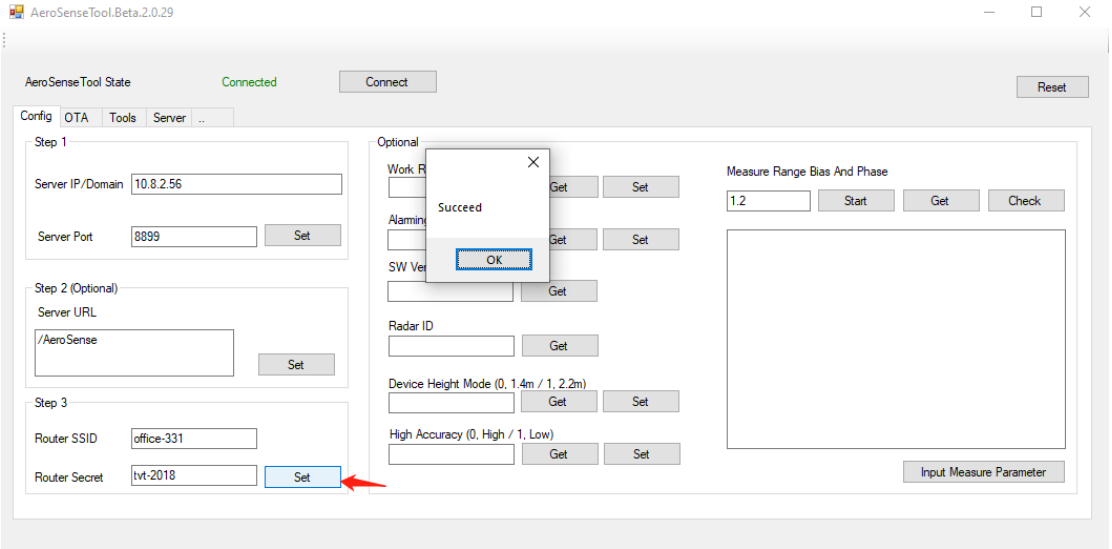


Figure 2-4 Connect the AeroSense Assure to your WIFI router

7) If the connection fails, or if you've entered a wrong WIFI or password, the AeroSense will be offline. In about 1 minute, the status indicators will be red. Please repeat step 2-6.

2.2. To Adjust the Radar Parameters

Press and hold the home button for 3-5 seconds until the status indicator flash blue to adjust the parameters of the AeroSense Assure. You can enter different values to adjust the **Work range** and the **Alarming time**, and click **Set** to dispense it to the radar, as seen in Figure 2-5.

The **work range** (1 in Figure 2-5) is the effective coverage of the radar and it should be a figure between 0.5-7.0m with a default set of 7m. It is recommended to use smaller figures for smaller rooms for better effect.

The **alarming time** (2 in Figure 2-5) is the buffer time between the radar detects a potential fall and sends out an alert and it should be a figure between 30-240s with a default set of 180s. During this time, if the radar detects any other movements that are large enough to be considered as someone else entering the FOV of the user sits up, the alert will be cancelled.

The **Device Mounted Height** (5 in Figure 2-5) is how high you've installed the AeroSense Assure. Please enter the exact figure (unit: meter).

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The **Multi-target filter** (6 in Figure 2-5) is to minimize false alerts caused by multiple reflection in small rooms, for example smaller than 3m*3m. It is usually NOT recommended to turn it on.

2.3. To get the software version and radar ID.

Please click **Get** to read the software (SW) version and ID of your radar (3 and 4 in Figure 2-5).

2.4. Machine learning

If you are a developer, it is more than likely that your device is using the firmware without the machine learning algorithm, which is designed to minimize false alerts in everyday use. This is for developers to better test the accuracy of the radar to detect falls. Once you've done the accuracy test, it is recommended to update to the firmware with learning algorithm through the AeroSense Care APP or using the AeroSenseTool for a more thorough experience of the device. Once the learning algorithm is activated, the device will be silent for 48 hours after installation for the radar to learn the room layout. It will take another 7 days for the radar to be more familiar with the activities happening within its FOV to complete the learning process. If you want to clean the learning data, please click **Reset** (7 in Figure 2-5).

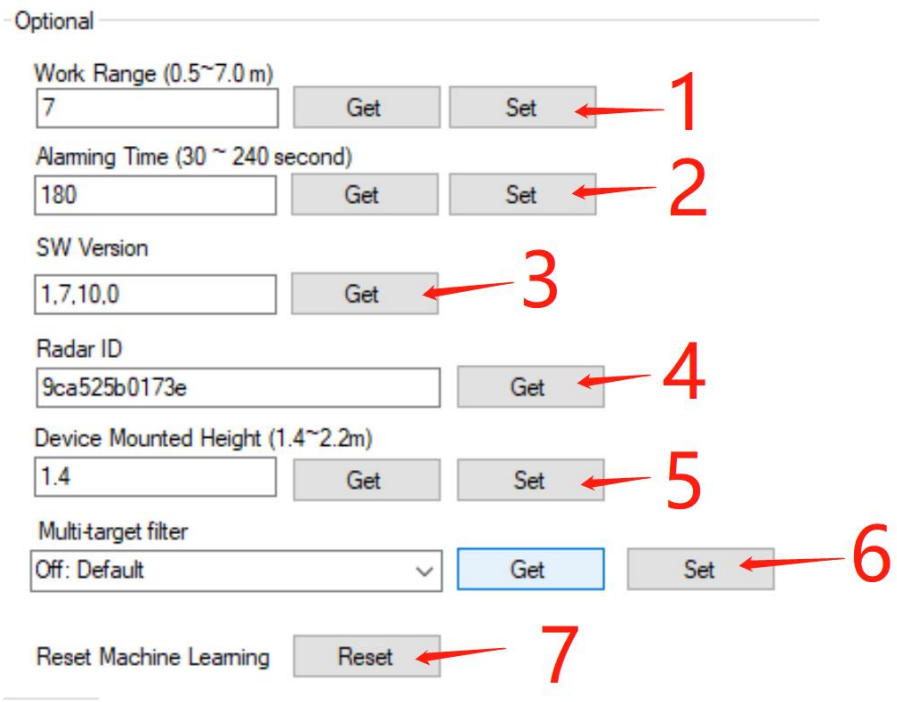


Figure 2-5 Radar parameters and machine learning

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3. Communicating between the AeroSense Assure and the server

3.1. Introduction

Once the AeroSense Assure has been connected to the server, it will act as a TCP client, and the data flow is shown in Figure 3-1. The AeroSense Assure will proactively send the registration request and the server can proactively adjust the parameters of the AeroSense Assure. Please contact tech support for the TCP communication protocol.

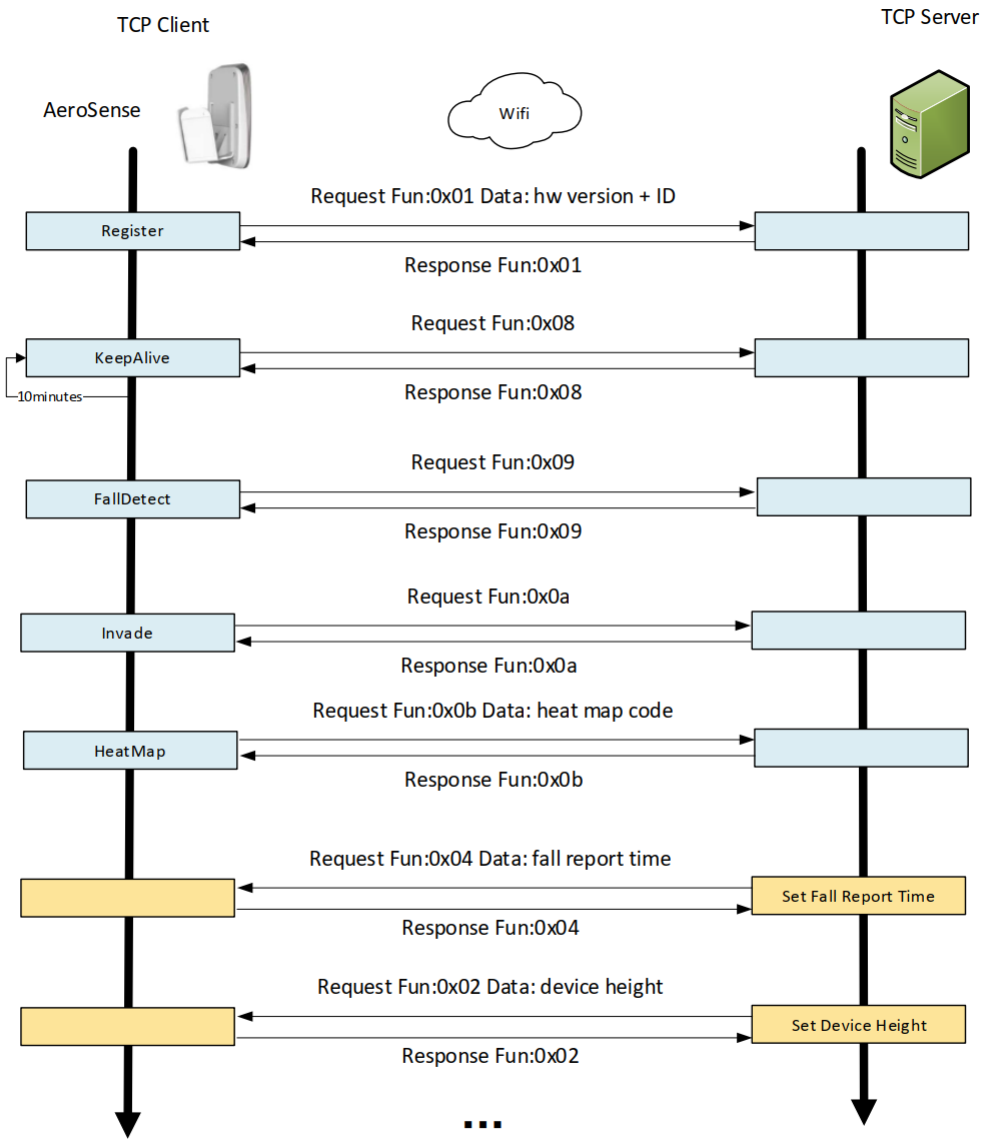


Figure 3-1 The communication flow between the AeroSense Assure and the server

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3.2. Heatmap and encoding

Table 3-1 The encoding format of the heatmap

Code name	Explanation	Format
Coordinate code	The radar detects the target and outputs the coordinates	{X,Y,N}
Frame number code	The radar does not detect the target and outputs the number of frames that have not been collected	{ the number of frames without valid targets within a certain period of time, 0, 0}

The heatmap represents the activities that are detected by the AeroSense Assure within the FOV over a period of time. The heatmap codes are compressed. When a valid target it detected, the reported codes will be consisted of three bytes, and in the format of {X, Y, N}, the **coordinate code** in Table 3-1. X and Y are the coordinates of the target in the radar coordinate system as shown in Figure 3-2. N is the number of point clouds of the target. When there is no valid target, the codes will be in the format of {the number of frames without valid targets within a certain period of time, 0, 0}, the **frame number code** in Table 3-1. For example, {130, 0, 0} means there are no targets within the 130 frames of data. This format can greatly decrease the data amount. The range of X, Y and N is shown in Table 3-2. It is also worth to mention that X and Y are in bytes and 1 byte equals to 4cm.

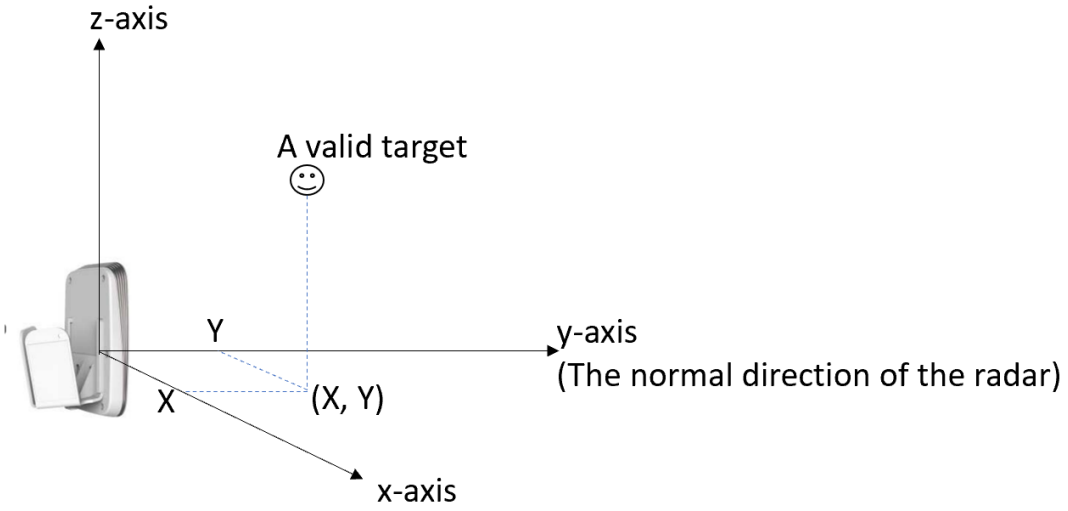


Figure 3-2 The radar coordinate system. The radar is (0, 0, 0). The y-axis is the normal direction of the radar.

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Table 3-2 Byte range of X, Y and N

	Byte range	**Actual distance range**	**Remarks**
X	-128~128	-510 cm~510 cm	1 byte = 4 cm
Y	0~255	0 cm~1020 cm	1 byte = 4 cm
N	0~255	0~255	number of point clouds

4. Upgrade the firmware

It is recommended to upgrade the firmware in STA mode. Alternatively, the user can use the AP mode.

4.1. OTA update in STA mode

An OTA update can be done by the server proactively. Please refer to the file **AeroSense Assure communication protocol**. The entire process is shown in Figure 4-1. The firmware will be sent in segments. The length of the content to be sent is (1000, 1000, …N), and the last N bytes are the remaining length. The firmware content is validated by CRC16 modbus.

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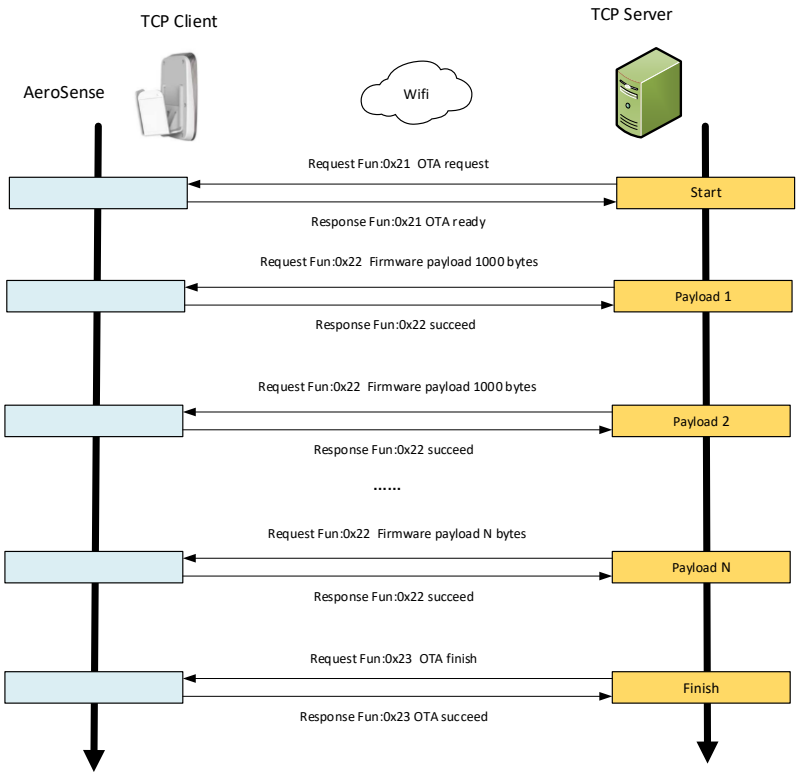


Figure 4-1 OTA update in STA mode.

4.2. OTA update in AP mode

Please make sure the radar is in AP mode.

1) Turn on your computer and connect to the AS_xxxxxxxxx network. The suffix is the Mac address of the AeroSense.

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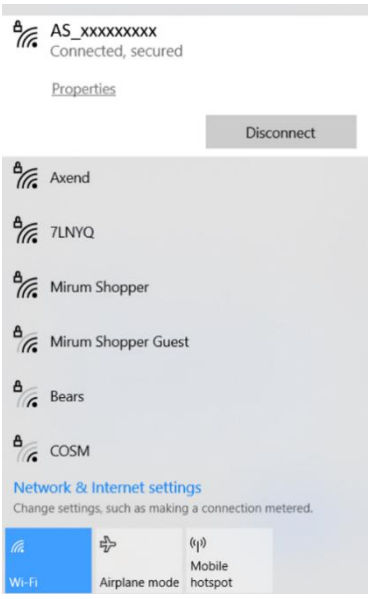


Figure 4-2 WIFI in AP mode

2) In the software **AeroSenseTool**, click the **OTA** tab, and click **Connect** (1 in Figure 4-3). Choose the firmware file (2 in Figure 4-3) and click **Start** (3 in Figure 4-3).

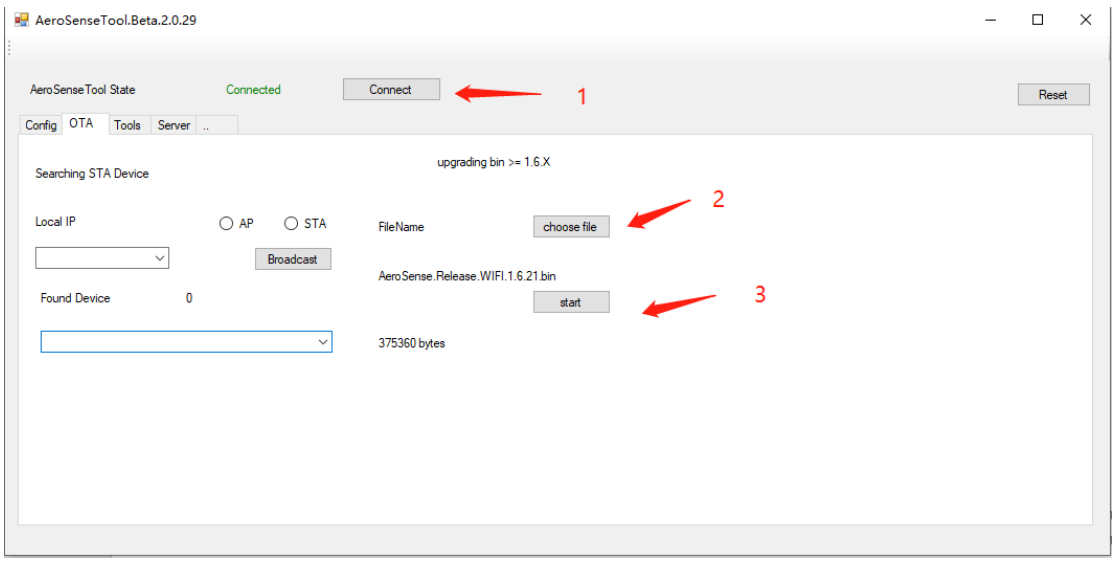


Figure 4-3 Upgrade in AP mode using the AeroSenseTool

3) If the upgrade is successful, you will see an “Upgrade Succeed” massage (Figure 4-4), otherwise please repeat the steps above.

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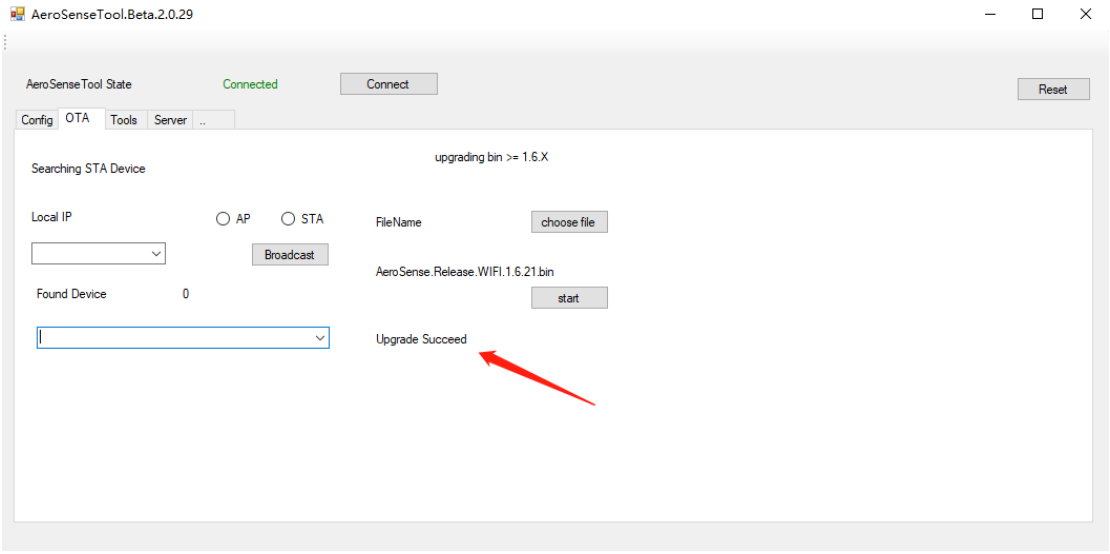


Figure 4-4 Upgrade successful

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