

# Multimodal visual understand + visual following(Voice Version)

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## 1. Course Content

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1. Learn to use the robot's vision combined with the car-following function
2. Analyze newly discovered key source code

## 2. Preparation

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### 2.1 Content Description

This course uses the Raspberry Pi 5 as an example. For Raspberry Pi and Jetson Nano boards, you need to open a terminal on the host computer and enter the command to enter the Docker container. Once inside the Docker container, enter the commands mentioned in this course in the terminal. For instructions on entering the Docker container from the host computer, refer to **[01. Robot Configuration and Operation Guide] -- [5.Enter Docker (For JETSON Nano and RPi 5)]**. For Orin boards, simply open a terminal and enter the commands mentioned in this course.

📝 This example uses `model:"qwen/qwen2.5-v1-72b-instruct:free", "qwen-v1-latest"`

⚠️ The responses from the large model may not be exactly the same for the same test command and may differ slightly from the screenshots in the tutorial. If you need to increase or decrease the diversity of the large model's responses, refer to the section on configuring the decision-making large model parameters in the **[03.AI Model Basics] -- [5.Configure AI large model]**.

⚡ It is recommended that you first try the previous visual example. This example adds voice functionality to the singleton example. The functionality is largely the same, so I will not further debug the program and describe the results in detail!!

## 3. Running the Example

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### 3.1 Starting the Program

**For Raspberry Pi 5 and Jetson Nano controllers, you must first enter the Docker container. For Orin boards, this is not necessary.**

Open a terminal in Docker and enter the following command:

```
ros2 launch largemodel largemodel_control.launch.py
```

```

root@raspberrypi:~# ros2 launch largemodel largemodel_control.launch.py
[INFO] [launch]: All log files can be found below /root/.ros/log/2025-08-21-10-12-00-300402-raspberrypi-167
[INFO] [launch]: Default logging verbosity is set to INFO
----- robot_type = A1, rplidar_type = tmini, camera_type = nuwa -----
-----robot_type = A1-----
[INFO] [ydlidar_ros2_driver_node-10]: process started with pid [198]
[INFO] [ascamera_node-1]: process started with pid [179]
[INFO] [joint_state_publisher-2]: process started with pid [181]
[INFO] [robot_state_publisher-3]: process started with pid [183]
[INFO] [Ackman driver A1-4]: process started with pid [185]
[INFO] [base_node A1-5]: process started with pid [187]
[INFO] [imu_filter_madgwick_node-6]: process started with pid [189]
[INFO] [ekf_node-7]: process started with pid [191]
[INFO] [yahboom_joy A1-8]: process started with pid [194]
[INFO] [joy_node-9]: process started with pid [196]
[INFO] [static_transform_publisher-11]: process started with pid [200]
[INFO] [static_transform_publisher-12]: process started with pid [203]
[INFO] [static_transform_publisher-13]: process started with pid [205]
[INFO] [model_service-14]: process started with pid [207]
[INFO] [action_service_nuwa-15]: process started with pid [216]
[INFO] [asr-16]: process started with pid [219]
[static_transform_publisher-12] [WARN] [1755742321.694729544] []: Old-style arguments are deprecated; see --help for new-style arguments
[static_transform_publisher-13] [WARN] [1755742321.697421267] []: Old-style arguments are deprecated; see --help for new-style arguments
[static_transform_publisher-11] [WARN] [1755742321.746809586] []: Old-style arguments are deprecated; see --help for new-style arguments
[base_node A1-5] [INFO] [1755742321.781909482] [base_node]: Received parameters - linear_scale_x: 1.000000, linear_scale_y: 1.000000
[static_transform_publisher-12] [INFO] [1755742321.835452718] [static_transform_publisher_NsHZgx6RV606usnB]: Spinning until stopped - publishing transform
[static_transform_publisher-12] translation: ('0.000000', '0.000000', '0.000000')
[static_transform_publisher-12] rotation: ('0.000000', '0.000000', '0.000000', '1.000000')
[static_transform_publisher-12] from 'ascamera_hp60c_camera_link_0' to 'ascamera_hp60c_color_0'
[static_transform_publisher-13] [INFO] [1755742321.843429316] [static_transform_publisher_om1N7fFRQ5f16jI6]: Spinning until stopped - publishing transform
[static_transform_publisher-13] translation: ('0.000000', '0.000000', '0.000000')
[static_transform_publisher-13] rotation: ('-0.500000', '0.500000', '-0.500000', '0.500000')
[static_transform_publisher-13] from 'ascamera_link1' to 'ascamera_hp60c_camera_link_0'

```

After initialization is complete, the following content will be displayed.

```

root@raspberrypi: /
File Edit Tabs Help
root@raspb... x root@raspb... x
[ascamera_node-1] [INFO] [1755742325.676302145] [ascamera_hp60c_camera_publisher]: 2025-08-21 10:12:05[INFO] [XuCmdCameraHp60c.cpp] [458] [getMjpegSize] mjpeg
size: 640x480
[ascamera_node-1] [INFO] [1755742325.676362496] [ascamera_hp60c_camera_publisher]: camera opened
[ascamera_node-1] [INFO] [1755742325.676390292] [ascamera_hp60c_camera_publisher]: get config info, ret 0, is Registration 1
[ascamera_node-1] [INFO] [1755742325.678129343] [ascamera_hp60c_camera_publisher]: #camera[0x55564c2500c0] SN[ASC60CE17000849]'s firmware version:DLS_VER74a4a
=V01_06_2023072616:V01.17_2023072616:L01:002
[ascamera_node-1] [INFO] [1755742325.678840037] [ascamera_hp60c_camera_publisher]: set depth resolution: 640 x 480 @ 25fps
[ascamera_node-1] [INFO] [1755742325.679411456] [ascamera_hp60c_camera_publisher]: set rgb resolution: 640 x 480 @ 25fps
[ascamera_node-1] [INFO] [1755742325.684650497] [ascamera_hp60c_camera_publisher]: 2025-08-21 10:12:05[INFO] [CameraHp60c.cpp] [259] [startStreaming] start st
reaming
[ascamera_node-1] [INFO] [1755742325.684724015] [ascamera_hp60c_camera_publisher]: 2025-08-21 10:12:05[INFO] [CameraSrv.cpp] [206] [onAttached] attached end
[ascamera_node-1] [INFO] [1755742326.685640640] [ascamera_hp60c_camera_publisher]: 2025-08-21 10:12:06[INFO] [CameraHp60c.cpp] [278] [stopStreaming] stop stre
aming
[asr-16] [INFO] [1755742420.791490573] [asr]: The online asr model :gummy-chat-v1 is loaded
[asr-16] [INFO] [1755742420.803568408] [asr]: asr_node Initialization completed
[model_service-14] [INFO] [1755742422.101257058] [model_service]: LargeModelService node Initialization completed...
[action_service_nuwa-15] [INFO] [1755742422.278906546] [action_service]: action service started...
[ascamera_node-1] [INFO] [1755742422.453538585] [ascamera_hp60c_camera_publisher]: 2025-08-21 10:13:42[INFO] [CameraHp60c.cpp] [259] [startStreaming] start st
reaming
[ascamera_node-1] [INFO] [1755742425.278313363] [ascamera_hp60c_camera_publisher]: 2025-08-21 10:13:45[INFO] [CameraHp60c.cpp] [1148] [streamCallback] set gai
n ret 0, gain 4
[ascamera_node-1] [INFO] [1755742425.447423367] [ascamera_hp60c_camera_publisher]: 2025-08-21 10:13:45[INFO] [CameraHp60c.cpp] [911] [setInternalParameter] mjpeg
info: size(640x480)
[ascamera_node-1] [INFO] [1755742425.685786343] [ascamera_hp60c_camera_publisher]: SN [ ASC60CE17000849 ]'s parameter:
[ascamera_node-1] [INFO] [1755742425.685857232] [ascamera_hp60c_camera_publisher]: irfx: 425
[ascamera_node-1] [INFO] [1755742425.685873750] [ascamera_hp60c_camera_publisher]: irfy: 425
[ascamera_node-1] [INFO] [1755742425.685886454] [ascamera_hp60c_camera_publisher]: ircx: 314.577
[ascamera_node-1] [INFO] [1755742425.685898269] [ascamera_hp60c_camera_publisher]: ircy: 237.151
[ascamera_node-1] [INFO] [1755742425.685909436] [ascamera_hp60c_camera_publisher]: rgbfx: 571
[ascamera_node-1] [INFO] [1755742425.685920473] [ascamera_hp60c_camera_publisher]: rgbfy: 571
[ascamera_node-1] [INFO] [1755742425.685931973] [ascamera_hp60c_camera_publisher]: rgbcx: 332.029
[ascamera_node-1] [INFO] [1755742425.685943695] [ascamera_hp60c_camera_publisher]: rgbcy: 235.042
[ascamera_node-1] [INFO] [1755742425.693371872] [ascamera_hp60c_camera_publisher]: publish color(rgb) info
[ascamera_node-1] [INFO] [1755742425.695505070] [ascamera_hp60c_camera_publisher]: publish rf info

```

## 3.2 Test Case

Here are some reference test cases. Users can create their own test commands.

- Start xx Follow

Color/Face/Object/Machine Code/QR Code/Gesture Recognition/Human Posture

Color tracking, including red, green, blue, and yellow (color calibration is required according to the **AI Large Model Preparation** tutorial).

Object tracking

- ⚡ Note for gimbal servo USB camera users: **No object tracking!**
  - The following example uses the principle of near-increase-increase and far-out-increase. The tracking effect is dependent on the size of the object being followed and the area detected. For program debugging, please refer to the single example.

o	Tracking Examples	Recommended Reference Object Size
	Color Tracking	3x3cm Building Blocks
	Face Tracking	Face in a Mobile Phone Image
	AprilTag Machine Code Tracking	3x3cm Building Blocks
	QR Code Tracking	QR Code Printed on A5 Paper
	Mediapipe Gesture Tracking	Human Gesture
	Mediapipe Human Posture Tracking	Human Posture

### 3.2.1 Example 1: "Start Following Red"

First, wake the robot with "Hi, yahboom" The robot responds, "I'm here, please." After the robot responds, the buzzer beeps briefly (beep—). The user can then speak, and the robot will detect sound activity. If there is sound activity, it will print 1; if there is no sound activity, it will print -. When the speech ends, it will detect the end of the tone. If there is silence for more than 450ms, the recording will stop.

The following figure shows the dynamic voice detection (VAD):

```

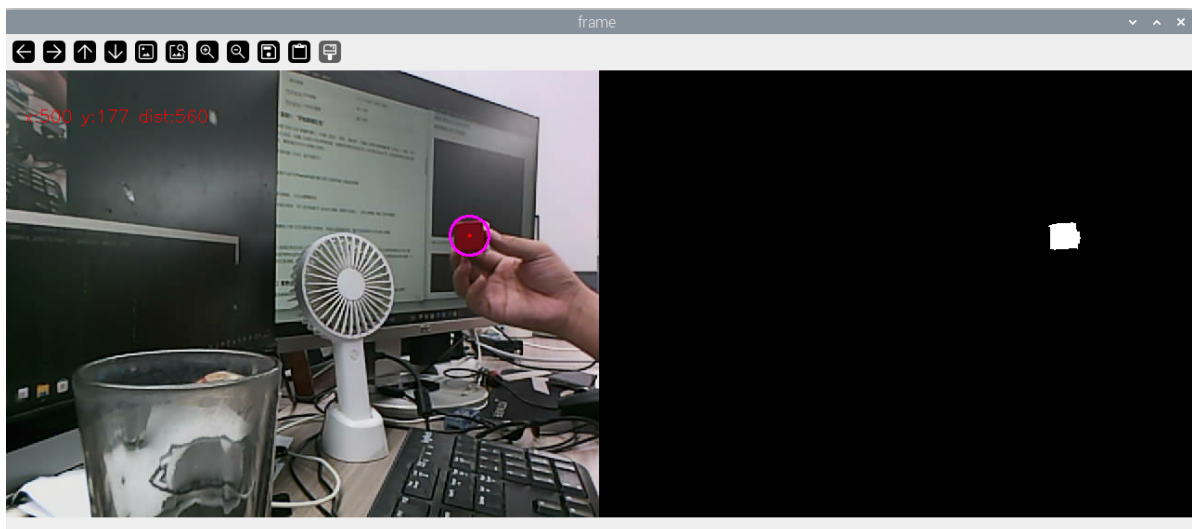
root@raspberrypi: /
File Edit Tabs Help
root@raspb... x root@raspb... x
[asr-16] ALSA lib conf.c:5178:(_snd_config_evaluate) function snd_func_refer returned error: No such file or directory
[asr-16] ALSA lib conf.c:5701:(snd_config_expand) Evaluate error: No such file or directory
[asr-16] ALSA lib pcm.c:2664:(snd_pcm_open_noupdate) Unknown PCM surround71
[asr-16] ALSA lib pcm.c:2664:(snd_pcm_open_noupdate) Unknown PCM cards.pcm.hdmi
[asr-16] ALSA lib pcm.c:2664:(snd_pcm_open_noupdate) Unknown PCM cards.pcm.hdmi
[asr-16] ALSA lib pcm.c:2664:(snd_pcm_open_noupdate) Unknown PCM cards.pcm.modem
[asr-16] ALSA lib pcm.c:2664:(snd_pcm_open_noupdate) Unknown PCM cards.pcm.modem
[asr-16] ALSA lib pcm.c:2664:(snd_pcm_open_noupdate) Unknown PCM cards.pcm.phoneline
[asr-16] ALSA lib pcm.c:2664:(snd_pcm_open_noupdate) Unknown PCM cards.pcm.phoneline
[asr-16] ALSA lib pcm_dmix.c:1032:(snd_pcm_dmix_open) unable to open slave
[asr-16] Cannot connect to server socket err = No such file or directory
[asr-16] Cannot connect to server request channel
[asr-16] jack server is not running or cannot be started
[asr-16] JackShmReadWritePtr::~JackShmReadWritePtr - Init not done for -1, skipping unlock
[asr-16] JackShmReadWritePtr::~JackShmReadWritePtr - Init not done for -1, skipping unlock
[asr-16] [INFO] [1755747083.562065241] [asr]: 1
[asr-16] [INFO] [1755747083.622169740] [asr]: 1
[asr-16] [INFO] [1755747083.682102406] [asr]: 1
[asr-16] [INFO] [1755747083.743061270] [asr]: 1
[asr-16] [INFO] [1755747083.802260459] [asr]: 1
[asr-16] [INFO] [1755747083.862057923] [asr]: -
[asr-16] [INFO] [1755747083.922413920] [asr]: -
[asr-16] [INFO] [1755747083.982066495] [asr]: -
[asr-16] [INFO] [1755747084.042102050] [asr]: -
[asr-16] [INFO] [1755747084.102058994] [asr]: -
[asr-16] [INFO] [1755747084.162083178] [asr]: -
[asr-16] [INFO] [1755747084.224099683] [asr]: -
[asr-16] [INFO] [1755747084.282113769] [asr]: -
[asr-16] [INFO] [1755747084.342303730] [asr]: -
[asr-16] [INFO] [1755747084.402154508] [asr]: -
[asr-16] [INFO] [1755747084.462710263] [asr]: -
[asr-16] [INFO] [1755747084.522190451] [asr]: -
[asr-16] [INFO] [1755747084.582094432] [asr]: -
[asr-16] [INFO] [1755747084.642142912] [asr]: -
[asr-16] [INFO] [1755747084.702773146] [asr]: -

```

The robot will first communicate with the user, then respond to the user's instructions. The terminal will print the following information:

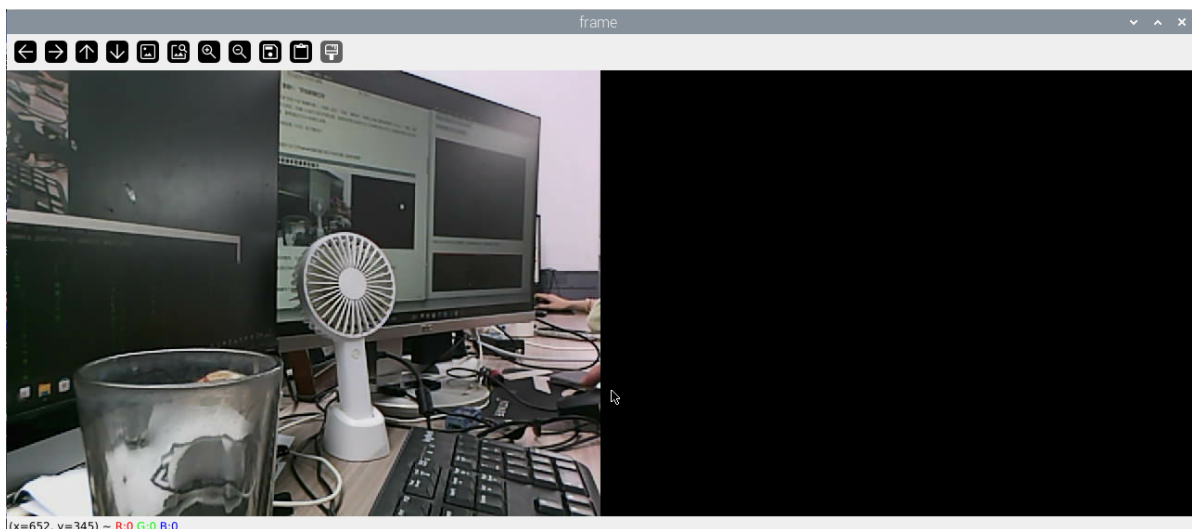
```
root@raspb... x root@raspb... x
[asr-16] [INFO] [1755747086.262199412] [asr]: -
[asr-16] [INFO] [1755747086.322241707] [asr]: -
[asr-16] [INFO] [1755747086.382179336] [asr]: -
[asr-16] [INFO] [1755747086.442223521] [asr]: -
[asr-16] [INFO] [1755747086.502252094] [asr]: -
[asr-16] [INFO] [1755747086.563122162] [asr]: -
[asr-16] [INFO] [1755747086.622392092] [asr]: -
[asr-16] [INFO] [1755747086.682703404] [asr]: -
[asr-16] [INFO] [1755747086.742193258] [asr]: -
[asr-16] [INFO] [1755747086.802330183] [asr]: -
[asr-16] [INFO] [1755747086.862205164] [asr]: -
[asr-16] [INFO] [1755747086.922498791] [asr]: -
[asr-16] [INFO] [1755747086.982193552] [asr]: -
[asr-16] [INFO] [1755747087.042391476] [asr]: -
[asr-16] [INFO] [1755747087.102528993] [asr]: -
[asr-16] [INFO] [1755747087.162525530] [asr]: -
[asr-16] [INFO] [1755747087.223795465] [asr]: -
[asr-16] [INFO] [1755747087.282487677] [asr]: -
[asr-16] [INFO] [1755747087.342246493] [asr]: -
[asr-16] [INFO] [1755747087.402276288] [asr]: -
[asr-16] [INFO] [1755747087.462274621] [asr]: -
[asr-16] [INFO] [1755747087.522970838] [asr]: -
[asr-16] [INFO] [1755747087.582242527] [asr]: -
[asr-16] [INFO] [1755747087.642268767] [asr]: -
[asr-16] [INFO] [1755747087.702228119] [asr]: -
[asr-16] [INFO] [1755747087.762355525] [asr]: -
[asr-16] [INFO] [1755747087.822801206] [asr]: -
[asr-16] [INFO] [1755747087.882748484] [asr]: -
[asr-16] [INFO] [1755747087.942453726] [asr]: -
[asr-16] [INFO] [1755747088.001063819] [asr]: 开始跟随红色。
[asr-16] [INFO] [1755747088.062435680] [asr]: okay, let me think for a moment...
[model_service-14] [INFO] [1755747091.374845303] [model_service]: 决策层AI规划:1.调用跟随指定颜色方块函数, 参数为'red'
[model_service-14] [INFO] [1755747093.899436555] [model_service]: "action": ['color_follow(red)'], "response": "好的呀, 我现在开始跟随红色物体啦, 就像一只专注的小猫追着红点跑"
```

A window titled **frame** will open on the VNC screen, displaying the current robot-viewing angle.



If the object is moving slowly, the robot will follow it.

If there is no target to track in the image, the program will count the time. After 10 seconds, a 5-second countdown will be printed on the terminal, and the process will automatically terminate, indicating the task is complete.



```
root@raspberrypi: /
File Edit Tabs Help
root@raspb... x root@raspb... x
[action_service_nuwa-15] [INFO] [1755747156.134334131] [ColorTracker]: 2
[action_service_nuwa-15] [INFO] [1755747156.172938271] [ColorTracker]: 2
[action_service_nuwa-15] [INFO] [1755747156.219159936] [ColorTracker]: 2
[action_service_nuwa-15] [INFO] [1755747156.264502404] [ColorTracker]: 2
[action_service_nuwa-15] [INFO] [1755747156.299098774] [ColorTracker]: 2
[action_service_nuwa-15] [INFO] [1755747156.381607927] [ColorTracker]: 2
[action_service_nuwa-15] [INFO] [1755747156.436723295] [ColorTracker]: 2
[action_service_nuwa-15] [INFO] [1755747156.485780386] [ColorTracker]: 1
[action_service_nuwa-15] [INFO] [1755747156.546577476] [ColorTracker]: 1
[action_service_nuwa-15] [INFO] [1755747156.609861569] [ColorTracker]: 1
[action_service_nuwa-15] [INFO] [1755747156.662165214] [ColorTracker]: 1
[action_service_nuwa-15] [INFO] [1755747156.701168629] [ColorTracker]: 1
[action_service_nuwa-15] [INFO] [1755747156.758575723] [ColorTracker]: 1
[action_service_nuwa-15] [INFO] [1755747156.806621672] [ColorTracker]: 1
[action_service_nuwa-15] [INFO] [1755747156.861550856] [ColorTracker]: 1
[action_service_nuwa-15] [INFO] [1755747156.922464519] [ColorTracker]: 1
[action_service_nuwa-15] [INFO] [1755747156.949533863] [ColorTracker]: 1
[action_service_nuwa-15] [INFO] [1755747156.999018656] [ColorTracker]: 1
[action_service_nuwa-15] [INFO] [1755747157.045069785] [ColorTracker]: 1
[action_service_nuwa-15] [INFO] [1755747157.084688401] [ColorTracker]: 1
[action_service_nuwa-15] [INFO] [1755747157.145385640] [ColorTracker]: 1
[action_service_nuwa-15] [INFO] [1755747157.194562027] [ColorTracker]: 1
[action_service_nuwa-15] [INFO] [1755747157.253279130] [ColorTracker]: 1
[action_service_nuwa-15] [INFO] [1755747157.297254588] [ColorTracker]: 1
[action_service_nuwa-15] [INFO] [1755747157.367424136] [ColorTracker]: 1
[action_service_nuwa-15] [INFO] [1755747157.423400609] [ColorTracker]: 1
[action_service_nuwa-15] [INFO] [1755747157.482205286] [action_service]: stop process.....
[action_service_nuwa-15] [INFO] [1755747157.487036829] [action_service]: Published message: 机器人反馈: 执行跟随任务完成
[action_service_nuwa-15] publisher: beginning loop
[action_service_nuwa-15] publishing #1: geometry_msgs.msg.Twist(linear=geometry_msgs.msg.Vector3(x=0.0, y=0.0, z=0.0), angular=geometry_msgs.msg.Vector3(x=0.0, y=0.0, z=0.0))
[model_service-14] [INFO] [1755747159.587303254] [model_service]: "action": ['finishtask()'], "response": 我已经成功开始跟随红色物体啦, 任务完成得漂漂亮亮的!
```

To manually terminate the task, wake the robot with the voice command "Hi, yahboom" The robot will respond, "I'm here, please." This will interrupt the program, automatically terminate the process, and allow you to proceed to the next command.

```
root@raspberrypi: /
File Edit Tabs Help
root@raspb... x root@raspb... x
[asr-16] [INFO] [1755747346.73776779] [asr]: 开始跟随红色。
[asr-16] [INFO] [1755747346.738507163] [asr]: okay, let me think for a moment...
[model_service-14] [INFO] [1755747349.025614088] [model_service]: "action": ['color_follow(red)'], "response": 好的呀, 我现在又开始跟随红色物体啦, 就像一只专注的小猫追着红点跑 -
[action_service_nuwa-15] [INFO] [1755747356.919710313] [ColorTracker]: Loaded 5 color profiles
[asr-16] [INFO] [1755747363.219548990] [asr]: I'm here
[action_service_nuwa-15] [INFO] [1755747363.235224928] [action_service]: stop process.....
[action_service_nuwa-15] publisher: beginning loop
[action_service_nuwa-15] publishing #1: geometry_msgs.msg.Twist(linear=geometry_msgs.msg.Vector3(x=0.0, y=0.0, z=0.0), angular=geometry_msgs.msg.Vector3(x=0.0, y=0.0, z=0.0))
[asr-16] ALSA lib pcm_asym.c:105:(snd_pcm_asym_open) capture slave is not defined
[asr-16] ALSA lib pcm_dmix.c:1032:(snd_pcm_dmix_open) unable to open slave
[asr-16] ALSA lib pcm.c:2664:(snd_pcm_open_noupdate) Unknown PCM cards.pcm.rear
[asr-16] ALSA lib pcm.c:2664:(snd_pcm_open_noupdate) Unknown PCM cards.pcm.center_lfe
[asr-16] ALSA lib pcm.c:2664:(snd_pcm_open_noupdate) Unknown PCM cards.pcm.side
[asr-16] ALSA lib confmisc.c:1369:(snd_func_refer) Unable to find definition 'cards.0.pcm.surround51.0:CARD=0'
[asr-16] ALSA lib conf.c:5178:(snd_config_evaluate) function snd_func_refer returned error: No such file or directory
[asr-16] ALSA lib conf.c:5701:(snd_config_expand) Evaluate error: No such file or directory
[asr-16] ALSA lib pcm.c:2664:(snd_pcm_open_noupdate) Unknown PCM surround21
[asr-16] ALSA lib confmisc.c:1369:(snd_func_refer) Unable to find definition 'cards.0.pcm.surround51.0:CARD=0'
[asr-16] ALSA lib conf.c:5178:(snd_config_evaluate) function snd_func_refer returned error: No such file or directory
[asr-16] ALSA lib conf.c:5701:(snd_config_expand) Evaluate error: No such file or directory
[asr-16] ALSA lib pcm.c:2664:(snd_pcm_open_noupdate) Unknown PCM surround21
[asr-16] ALSA lib confmisc.c:1369:(snd_func_refer) Unable to find definition 'cards.0.pcm.surround40.0:CARD=0'
[asr-16] ALSA lib conf.c:5178:(snd_config_evaluate) function snd_func_refer returned error: No such file or directory
[asr-16] ALSA lib conf.c:5701:(snd_config_expand) Evaluate error: No such file or directory
[asr-16] ALSA lib pcm.c:2664:(snd_pcm_open_noupdate) Unknown PCM surround40
[asr-16] ALSA lib confmisc.c:1369:(snd_func_refer) Unable to find definition 'cards.0.pcm.surround51.0:CARD=0'
[asr-16] ALSA lib conf.c:5178:(snd_config_evaluate) function snd_func_refer returned error: No such file or directory
[asr-16] ALSA lib conf.c:5701:(snd_config_expand) Evaluate error: No such file or directory
[asr-16] ALSA lib pcm.c:2664:(snd_pcm_open_noupdate) Unknown PCM surround41
[asr-16] ALSA lib confmisc.c:1369:(snd_func_refer) Unable to find definition 'cards.0.pcm.surround51.0:CARD=0'
[asr-16] ALSA lib conf.c:5178:(snd_config_evaluate) function snd_func_refer returned error: No such file or directory
[asr-16] ALSA lib conf.c:5701:(snd_config_expand) Evaluate error: No such file or directory
```

The robot will then enter a free conversation mode again, but all conversation history will be retained. At this point, you can wake yahboom up again and click "End Current Task" to end the current task cycle, clear the conversation history, and start a new one.

```
root@raspberrypi: /
File Edit Tabs Help
root@raspb... x root@raspb... x
[asr-16] [INFO] [1755744416.290451318] [asr]: -
[asr-16] [INFO] [1755744416.260011088] [asr]: -
[asr-16] [INFO] [1755744416.319848655] [asr]: -
[asr-16] [INFO] [1755744416.380166890] [asr]: -
[asr-16] [INFO] [1755744416.440416644] [asr]: -
[asr-16] [INFO] [1755744416.499837893] [asr]: -
[asr-16] [INFO] [1755744416.560682522] [asr]: -
[asr-16] [INFO] [1755744416.619931105] [asr]: -
[asr-16] [INFO] [1755744416.680634954] [asr]: -
[asr-16] [INFO] [1755744416.739822351] [asr]: -
[asr-16] [INFO] [1755744416.799840327] [asr]: -
[asr-16] [INFO] [1755744416.859815617] [asr]: -
[asr-16] [INFO] [1755744416.919994315] [asr]: -
[asr-16] [INFO] [1755744416.979859382] [asr]: -
[asr-16] [INFO] [1755744417.039816745] [asr]: -
[asr-16] [INFO] [1755744417.0999221461] [asr]: -
[asr-16] [INFO] [1755744417.159885157] [asr]: -
[asr-16] [INFO] [1755744417.219853242] [asr]: -
[asr-16] [INFO] [1755744417.279913143] [asr]: -
[asr-16] [INFO] [1755744417.340039784] [asr]: -
[asr-16] [INFO] [1755744417.399850721] [asr]: -
[asr-16] [INFO] [1755744417.459922492] [asr]: -
[asr-16] [INFO] [1755744417.519850114] [asr]: -
[asr-16] [INFO] [1755744417.579984070] [asr]: -
[asr-16] [INFO] [1755744417.639859692] [asr]: -
[asr-16] [INFO] [1755744417.699912611] [asr]: -
[asr-16] [INFO] [1755744417.759887103] [asr]: -
[asr-16] [INFO] [1755744417.819954448] [asr]: -
[asr-16] [INFO] [1755744418.740477871] [asr]: 结束当前任务。
[asr-16] [INFO] [1755744418.741591709] [asr]: okay👌, let me think for a moment...
[model_service-14] [INFO] [1755744422.110675962] [model_service]: "action": ['finish_dialogue()'], "response": 好的, 任务已经结束了, 有需要再叫我哦
[action_service_nuwa-15] [INFO] [1755744426.622450607] [action_service]: Published message: finish
[model_service-14] [INFO] [1755744426.623203499] [model_service]: The current instruction cycle has ended
```

### 3.2.2 Example 2: "Please follow the object in my hand" (Depth Camera)

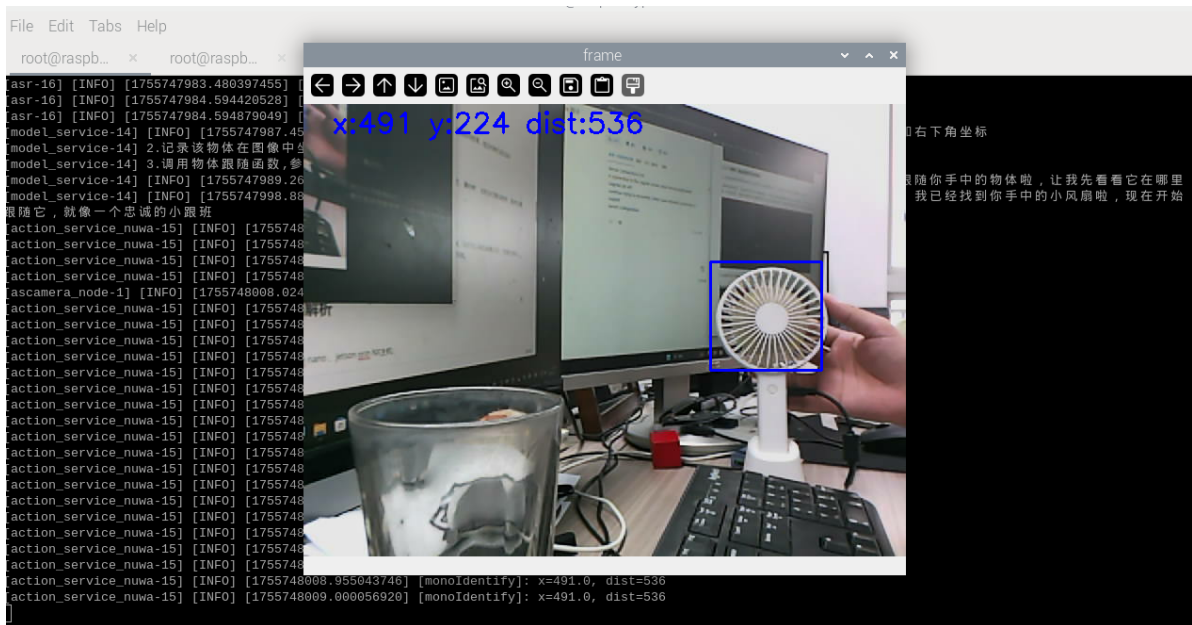
⚠ The coordinates obtained by following the object in this example are entirely derived from the inference of the large AI model. Therefore, it is recommended to use a newer model for better results!

Similar to the test in Example 1, first wake the robot with "Hello yahboom." After the robot responds, the buzzer will beep briefly (beep--). The user can then speak. After the speech is completed, the robot will respond to the user and move according to the command. Hold any object in your hand and hold it in the field of view until the tracking box appears.

```
root@raspberrypi: /
File Edit Tabs Help
root@raspb... x root@raspb... x
[asr-16] [INFO] [1755747982.70860908] [asr]: -
[asr-16] [INFO] [1755747982.760463494] [asr]: -
[asr-16] [INFO] [1755747982.820463630] [asr]: -
[asr-16] [INFO] [1755747982.880507119] [asr]: -
[asr-16] [INFO] [1755747982.941581336] [asr]: -
[asr-16] [INFO] [1755747983.000483540] [asr]: -
[asr-16] [INFO] [1755747983.060566120] [asr]: -
[asr-16] [INFO] [1755747983.120371828] [asr]: -
[asr-16] [INFO] [1755747983.180640780] [asr]: -
[asr-16] [INFO] [1755747983.240363192] [asr]: -
[asr-16] [INFO] [1755747983.300379142] [asr]: -
[asr-16] [INFO] [1755747983.360417314] [asr]: -
[asr-16] [INFO] [1755747983.420810119] [asr]: -
[asr-16] [INFO] [1755747983.480397455] [asr]: -
[asr-16] [INFO] [1755747984.594420528] [asr]: 请跟随我手中的物体。
[asr-16] [INFO] [1755747984.594879849] [asr]: okay👌, let me think for a moment...
[model_service-14] [INFO] [1755747987.459094787] [model_service]: 决策层AI规划:1.调用视觉函数获取该物体在画面中的左上角和右下角坐标
[model_service-14] 2.记录该物体在图像中坐标为x1,y1,x2,y2
[model_service-14] 3.调用物体跟踪函数,参数为x1,y1,x2,y2
[model_service-14] [INFO] [1755747989.268159555] [model_service]: "action": ['seewhat()'], "response": 好的, 我准备开始跟随你手中的物体啦, 让我先看看它在哪里
[model_service-14] [INFO] [1755747998.888091150] [model_service]: "action": ['KCF_follow(432,165,550,280)'], "response": 我已经找到你手中的小风扇啦, 现在开始跟随它 就像一个小忠实的小跟班
[action_service_nuwa-15] [INFO] [1755748006.983489491] [monoIdentify]: self.x1:=432
[action_service_nuwa-15] [INFO] [1755748006.983928790] [monoIdentify]: self.y1:=165
[action_service_nuwa-15] [INFO] [1755748006.984298218] [monoIdentify]: self.x2:=550
[action_service_nuwa-15] [INFO] [1755748006.984660868] [monoIdentify]: self.y2:=280
[ascamera_node-1] [INFO] [1755748008.024255255] [ascamera_hp60c.camera.publisher]: publish depth info
[action_service_nuwa-15] [INFO] [1755748008.032863914] [monoIdentify]: roi=(432, 165, 118, 115)
[action_service_nuwa-15] [INFO] [1755748008.078734112] [monoIdentify]: x=491.0, dist=536
[action_service_nuwa-15] [INFO] [1755748008.246059183] [monoIdentify]: x=491.0, dist=536
[action_service_nuwa-15] [INFO] [1755748008.306784815] [monoIdentify]: x=491.0, dist=536
[action_service_nuwa-15] [INFO] [1755748008.358623490] [monoIdentify]: x=491.0, dist=536
[action_service_nuwa-15] [INFO] [1755748008.417005016] [monoIdentify]: x=491.0, dist=536
[action_service_nuwa-15] [INFO] [1755748008.473164567] [monoIdentify]: x=491.0, dist=536
[action_service_nuwa-15] [INFO] [1755748008.508384743] [monoIdentify]: x=491.0, dist=536
```

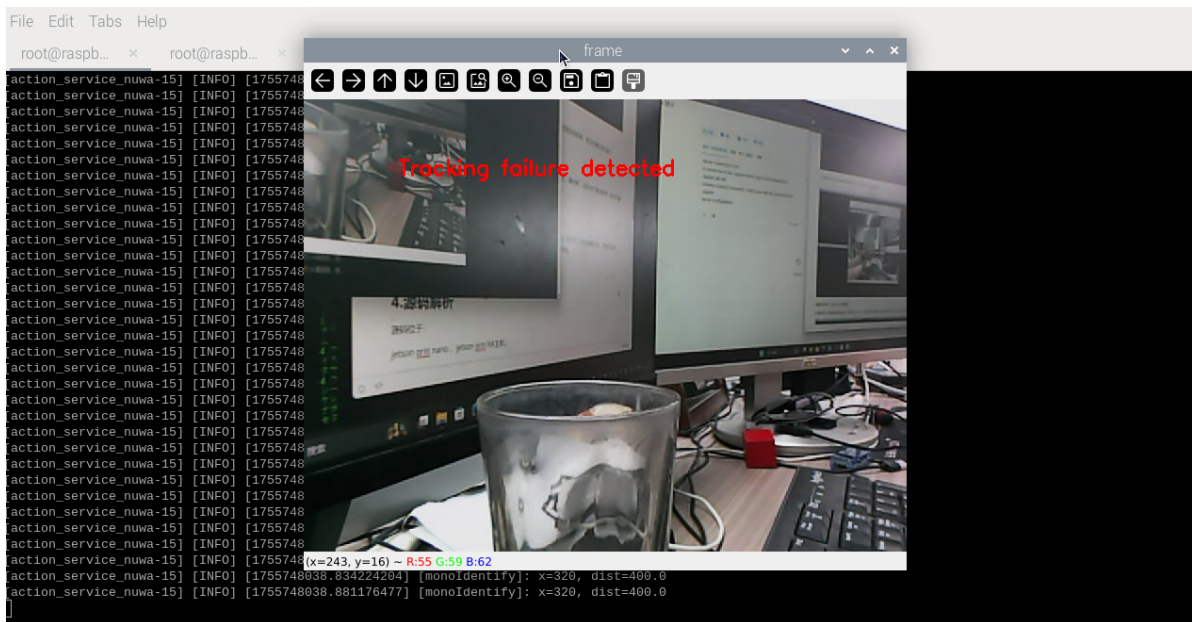
A window titled **frame** will open on the VNC screen, displaying the current robot's view.





Move the object slowly, and the robot will follow.

If there is no target to follow in the image, the program will count down for 10 seconds, and the terminal will print a 5-second countdown. The process will automatically end, and the task will be considered complete.



```
root@raspberrypi: /
File Edit Tabs Help
root@raspb... x root@raspb... x
[action_service_nuwa-15] [INFO] [1755748044.016831049] [monoIdentify]: x=320, dist=400.0
[action_service_nuwa-15] [INFO] [1755748044.047103328] [monoIdentify]: 1
[action_service_nuwa-15] [INFO] [1755748044.048420390] [monoIdentify]: x=320, dist=400.0
[action_service_nuwa-15] [INFO] [1755748044.104453166] [monoIdentify]: 1
[action_service_nuwa-15] [INFO] [1755748044.112346872] [monoIdentify]: x=320, dist=400.0
[action_service_nuwa-15] [INFO] [1755748044.152988109] [monoIdentify]: 1
[action_service_nuwa-15] [INFO] [1755748044.154043485] [monoIdentify]: x=320, dist=400.0
[action_service_nuwa-15] [INFO] [1755748044.212546069] [monoIdentify]: 1
[action_service_nuwa-15] [INFO] [1755748044.214230170] [monoIdentify]: x=320, dist=400.0
[action_service_nuwa-15] [INFO] [1755748044.242860274] [monoIdentify]: 1
[action_service_nuwa-15] [INFO] [1755748044.247159499] [monoIdentify]: x=320, dist=400.0
[action_service_nuwa-15] [INFO] [1755748044.279487880] [monoIdentify]: 1
[action_service_nuwa-15] [INFO] [1755748044.280997666] [monoIdentify]: x=320, dist=400.0
[action_service_nuwa-15] [INFO] [1755748044.341034869] [monoIdentify]: 1
[action_service_nuwa-15] [INFO] [1755748044.342518987] [monoIdentify]: x=320, dist=400.0
[action_service_nuwa-15] [INFO] [1755748044.401391703] [monoIdentify]: 1
[action_service_nuwa-15] [INFO] [1755748044.403022711] [monoIdentify]: x=320, dist=400.0
[action_service_nuwa-15] [INFO] [1755748044.433355250] [monoIdentify]: 1
[action_service_nuwa-15] [INFO] [1755748044.436342375] [monoIdentify]: x=320, dist=400.0
[action_service_nuwa-15] [INFO] [1755748044.507007649] [monoIdentify]: 1
[action_service_nuwa-15] [INFO] [1755748044.508090321] [monoIdentify]: x=320, dist=400.0
[action_service_nuwa-15] [INFO] [1755748044.539114826] [monoIdentify]: 1
[action_service_nuwa-15] [INFO] [1755748044.541232151] [monoIdentify]: x=320, dist=400.0
[action_service_nuwa-15] [INFO] [1755748044.611138329] [monoIdentify]: x=320, dist=400.0
[action_service_nuwa-15] [INFO] [1755748044.621625214] [action_service]: stop process.....
[action_service_nuwa-15] [INFO] [1755748044.623419686] [action_service]: Published message: 机器人反馈: 执行跟随任务完成
[action_service_nuwa-15] Waiting for at least 1 matching subscription(s)...
[action_service_nuwa-15] publisher: beginning loop
[action_service_nuwa-15] publishing #1: geometry_msgs.msg.Twist(linear=geometry_msgs.msg.Vector3(x=0.0, y=0.0, z=0.0), angular=geometry_msgs.msg.Vector3(x=0.0, y=0.0, z=0.0))
[action_service_nuwa-15]
[model_service-14] [INFO] [1755748048.640161543] [model_service]: "action": ['finishtask()'], "response": "我已经成功跟随你手中的小风扇啦, 任务完成得漂漂亮亮的!"
!
```

To manually end a task, wake up the robot with the voice command "Hi, yahboom" The robot will respond, "I'm here, please." This will interrupt the program and automatically end the process, allowing you to proceed to the next command.

```
root@raspberrypi: /
File Edit Tabs Help
root@raspb... x root@raspb... x
[action_service_nuwa-15] [INFO] [1755748497.705314664] [monoIdentify]: x=479.0, dist=618
[action_service_nuwa-15] [INFO] [1755748497.758680782] [monoIdentify]: x=479.0, dist=620
[action_service_nuwa-15] [INFO] [1755748497.815284531] [monoIdentify]: x=479.0, dist=618
[action_service_nuwa-15] [INFO] [1755748497.868289575] [monoIdentify]: x=479.0, dist=619
[action_service_nuwa-15] [INFO] [1755748497.902633562] [monoIdentify]: x=479.0, dist=619
[action_service_nuwa-15] [INFO] [1755748497.944375993] [monoIdentify]: x=479.0, dist=619
[action_service_nuwa-15] [INFO] [1755748497.960262871] [monoIdentify]: x=479.0, dist=620
[asr-16] [INFO] [1755748498.017102207] [asr]: I'm here
[action_service_nuwa-15] [INFO] [1755748498.032357116] [action_service]: stop process.....
[action_service_nuwa-15] [INFO] [1755748498.065382732] [monoIdentify]: x=479.0, dist=618
[asr-16] ALSA lib pcm_asym.c:105:(_snd_pcm_asym_open) capture slave is not defined
[asr-16] ALSA lib pcm_dmix.c:1032:(snd_pcm_dmix_open) unable to open slave
[asr-16] ALSA lib pcm.c:2664:(snd_pcm_open_noupdate) Unknown PCM cards.pcm.rear
[asr-16] ALSA lib pcm.c:2664:(snd_pcm_open_noupdate) Unknown PCM cards.pcm.center_lfe
[asr-16] ALSA lib pcm.c:2664:(snd_pcm_open_noupdate) Unknown PCM cards.pcm.side
[asr-16] ALSA lib confmisc.c:1369:(snd_func_refer) Unable to find definition 'cards.0.pcm.surround51.0:CARD=0'
[asr-16] ALSA lib conf.c:5178:(_snd_config_evaluate) function snd_func_refer returned error: No such file or directory
[asr-16] ALSA lib conf.c:5701:(snd_config_expand) Evaluate error: No such file or directory
[asr-16] ALSA lib pcm.c:2664:(snd_pcm_open_noupdate) Unknown PCM surround21
[asr-16] ALSA lib confmisc.c:1369:(snd_func_refer) Unable to find definition 'cards.0.pcm.surround51.0:CARD=0'
[asr-16] ALSA lib conf.c:5178:(_snd_config_evaluate) function snd_func_refer returned error: No such file or directory
[asr-16] ALSA lib conf.c:5701:(snd_config_expand) Evaluate error: No such file or directory
[asr-16] ALSA lib pcm.c:2664:(snd_pcm_open_noupdate) Unknown PCM surround21
[asr-16] ALSA lib confmisc.c:1369:(snd_func_refer) Unable to find definition 'cards.0.pcm.surround40.0:CARD=0'
[asr-16] ALSA lib conf.c:5178:(_snd_config_evaluate) function snd_func_refer returned error: No such file or directory
[asr-16] ALSA lib conf.c:5701:(snd_config_expand) Evaluate error: No such file or directory
[asr-16] ALSA lib pcm.c:2664:(snd_pcm_open_noupdate) Unknown PCM surround40
[asr-16] ALSA lib confmisc.c:1369:(snd_func_refer) Unable to find definition 'cards.0.pcm.surround51.0:CARD=0'
[asr-16] ALSA lib conf.c:5178:(_snd_config_evaluate) function snd_func_refer returned error: No such file or directory
[asr-16] ALSA lib conf.c:5701:(snd_config_expand) Evaluate error: No such file or directory
[asr-16] ALSA lib pcm.c:2664:(snd_pcm_open_noupdate) Unknown PCM surround41
[asr-16] ALSA lib confmisc.c:1369:(snd_func_refer) Unable to find definition 'cards.0.pcm.surround51.0:CARD=0'
[asr-16] ALSA lib conf.c:5178:(_snd_config_evaluate) function snd_func_refer returned error: No such file or directory
[asr-16] ALSA lib conf.c:5701:(snd_config_expand) Evaluate error: No such file or directory
[asr-16] ALSA lib pcm.c:2664:(snd_pcm_open_noupdate) Unknown PCM surround45
```

The robot will now enter a free conversation mode, but all conversation history will be retained. You can wake yahboom up again and select "End Current Task" to end the current task cycle, clear the conversation history, and start a new one.



```
root@raspberrypi: /
File Edit Tabs Help
root@raspb... x root@raspb... x
[asr-16] [INFO] [1755748537.601473047] [asr]: -
[asr-16] [INFO] [1755748537.661519688] [asr]: -
[asr-16] [INFO] [1755748537.721513496] [asr]: -
[asr-16] [INFO] [1755748537.781468397] [asr]: -
[asr-16] [INFO] [1755748537.841468019] [asr]: -
[asr-16] [INFO] [1755748537.901516550] [asr]: -
[asr-16] [INFO] [1755748537.961507043] [asr]: -
[asr-16] [INFO] [1755748538.021497462] [asr]: -
[asr-16] [INFO] [1755748538.081892491] [asr]: -
[asr-16] [INFO] [1755748538.141493095] [asr]: -
[asr-16] [INFO] [1755748538.201465662] [asr]: -
[asr-16] [INFO] [1755748538.261489099] [asr]: -
[asr-16] [INFO] [1755748538.321463759] [asr]: -
[asr-16] [INFO] [1755748538.381499974] [asr]: -
[asr-16] [INFO] [1755748538.441485874] [asr]: -
[asr-16] [INFO] [1755748538.501521496] [asr]: -
[asr-16] [INFO] [1755748538.561544285] [asr]: -
[asr-16] [INFO] [1755748538.621489630] [asr]: -
[asr-16] [INFO] [1755748538.681497882] [asr]: -
[asr-16] [INFO] [1755748538.741510134] [asr]: -
[asr-16] [INFO] [1755748538.801533645] [asr]: -
[asr-16] [INFO] [1755748538.861521175] [asr]: -
[asr-16] [INFO] [1755748538.921500871] [asr]: -
[asr-16] [INFO] [1755748538.981527031] [asr]: -
[asr-16] [INFO] [1755748539.041558523] [asr]: -
[asr-16] [INFO] [1755748539.101529201] [asr]: -
[asr-16] [INFO] [1755748539.161746527] [asr]: -
[asr-16] [INFO] [1755748539.221531180] [asr]: -
[asr-16] [INFO] [1755748539.992168551] [asr]: 结束当前任务。
[asr-16] [INFO] [1755748539.992604495] [asr]: okay, let me think for a moment...
[model_service-14] [INFO] [1755748542.555192809] [model_service]: "action": ['finish_dialogue()'], "response": "好的，任务已经结束了，有需要再叫我哦"
[action_service_nuwa-15] [INFO] [1755748547.033473895] [action_service]: Published message: finish
[model_service-14] [INFO] [1755748547.033791469] [model_service]: The current instruction cycle has ended
```

## 4. Source Code Analysis

Source code is located at:

Jetson Orin Nano:

```
#NUWA camera user
/home/jetson/yahboomcar_ros2_ws/yahboomcar_ws/src/largemodel/largemodel/action_service_nuwa.py
#USB camera user
/home/jetson/yahboomcar_ros2_ws/yahboomcar_ws/src/largemodel/largemodel/action_service_usb.py
```

```
/home/jetson/yahboomcar_ros2_ws/yahboomcar_ws/src/largemodel/largemodel/model_service.py
```

Jetson Nano, Raspberry Pi host:

You need to first enter Docker.

```
#NUWA Camera User
/root/yahboomcar_ros2_ws/yahboomcar_ws/src/largemodel/largemodel/action_service_nuwa.py
#USB Camera User
/root/yahboomcar_ros2_ws/yahboomcar_ws/src/largemodel/largemodel/action_service_usb.py
```

```
/root/yahboomcar_ros2_ws/yahboomcar_ws/src/largemodel/largemodel/model_service.py
```

### 4.1 Example 1

### 4.1.1 Nuwa Depth Camera, action\_service\_nuwa.py

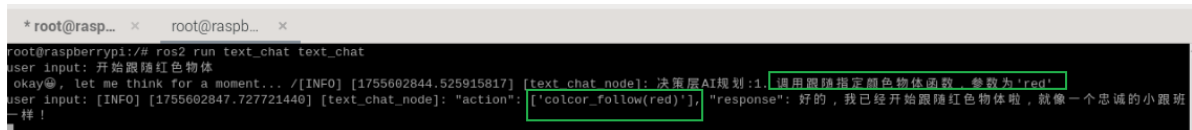
Example 1 uses the **seewhat**, **colcor\_follow**, and **stop\_follow()** methods in the **CustomActionServer** class.

The **seewhat** function primarily retrieves the color image from the depth camera.

The **colcor\_follow(self, color)** function performs color following.

The **stop\_follow()** function issues a stop command to follow.

This section focuses on the **colcor\_follow(self, color)** function, which requires a color parameter, which can be 'red', 'green', 'blue', or 'yellow'.



#Start the color line patrol subprocess

```
process_1 = subprocess.Popen(['ros2', 'run', 'yahboomcar_voice_ctrl_depth',  
'voice_colorTracker', '--ros-args', '-p', f'colcor:={target_color}'])
```

The source code path of the subprocess in the program,

~/yahboomcar\_ros2\_ws/yahboomcar\_ws/src/yahboomcar\_voice\_ctrl\_depth/yahboomcar\_voice\_ctrl\_depth/follow/voice\_colorTracker.py

```
def colcor_follow(self,color):  
    self.colcor_follow_future = Future() #Reset Future object  
    color = color.strip('"') # Remove single and double quotes  
    if color == 'red':  
        target_color = float(1)  
    elif color == 'green':  
        target_color = float(2)  
    elif color == 'blue':  
        target_color = float(3)  
    elif color == 'yellow':  
        target_color = float(4)  
    else:  
        self.get_logger().info('color_sort:error')  
        return  
  
    #Start the color line patrol subprocess  
    process_1 = subprocess.Popen(['ros2', 'run', 'yahboomcar_voice_ctrl_depth',  
'voice_colorTracker', '--ros-args', '-p', f'colcor:={target_color}'])  
  
    #waiting to stop following instructions  
    while not self.colcor_follow_future.done():  
        if self.interrupt_flag:  
            break  
        time.sleep(0.1)  
  
    self.kill_process_tree(process_1.pid)  
    self.cancel()
```

When the main model receives the user input of the "Stop Following" or "End Following" command,

or if the target being followed is lost for more than 10 seconds,

the **stop\_follow** method is called, sending the future.done signal. The `while not self.colcor_follow_future.done()` block in the **colcor\_follow** function then exits. The **kill\_process\_tree** method is then called to recursively kill the child process tree. Finally, the status of the execution action is reported to the main model at the execution layer.

### 4.1.2 USB Camera, action\_service\_usb.py

Example 1 uses the **seewhat**, **colorFollow**, and **stop\_track()** methods in the **CustomActionServer** class.

- The **seewhat** function primarily retrieves the camera's color image.
- The **colorFollow(self, color)** function performs color tracking.
- The **stop\_track()** function issues a stop tracking command.

This section focuses on the **colorFollow(self, color)** function, which requires a color parameter (red, green, blue, and yellow).

```
*root@raspb... x root@raspb... x
root@raspberrypi:~/ros2_ws/src/yahboomcar_voice_ctrl/yahboomcar_voice_ctrl$ ros2 run text_chat text_chat
user input: 开始跟随红色物体
okay, let me think for a moment... / [INFO] [1755602844.525915817] [text_chat_node]: 决策层AI规划:1. 调用跟随指定颜色物体函数 参数为'red'
user input: [INFO] [1755602847.727721440] [text_chat_node]: "action": ["colcor_follow(red)"], "response": "好的，我已经开始跟随红色物体啦，就像一个小跟班一样！"
```

```
#Start the color line patrol subprocess
process_1 = subprocess.Popen(['ros2', 'run', 'yahboomcar_voice_ctrl',
                              'colorFollow', '--ros-args', '-p', f'target_color:={target_color}'])
```

The source code path of the subprocess in the program,

`~/yahboomcar_ros2_ws/yahboomcar_ws/src/yahboomcar_voice_ctrl/yahboomcar_voice_ctrl/colorFollow.py`

```
def colorFollow(self,color):
    try:
        self.colorFollow_future = Future()
        color = color.strip("\ ")
        if color == 'red':
            target_color = int(1)
        elif color == 'green':
            target_color = int(2)
        elif color == 'blue':
            target_color = int(3)
        elif color == 'yellow':
            target_color = int(4)
        else:
            target_color = int(1)
        process_1 = subprocess.Popen(['ros2', 'run', 'yahboomcar_voice_ctrl',
                                      'colorFollow', '--ros-args', '-p', f'target_color:={target_color}'])
        while not self.colorFollow_future.done():
            if self.interrupt_flag:
                break
            time.sleep(0.1)
        self.get_logger().info(f'killed process_pid')
        self.kill_process_tree(process_1.pid)
        self.cancel()
    except:
        self.get_logger().error('colorFollow Startup failure')
```

```
return
```

When the main model receives the user input of the "Stop Following" or "End Following" command,

or if the tracking target is lost for more than 10 seconds,

the **stop\_track** method is called, sending the future.done signal. The `while not self.colorFollow_future.done()` block in the **colorFollow** function then exits. The **kill\_process\_tree** method is then called to recursively kill the child process tree. Finally, the status of the action execution is reported to the main model at the execution layer.

## 4.2 Example 2

### 4.2.1 nuwa Depth Camera, action\_service\_nuwa.py

Example 2 uses the **seewhat**, **KCF\_follow**, and **stop\_track** methods in the **CustomActionServer** class.

- The **seewhat** function primarily obtains the camera's color image.
- The **KCF\_follow(self,x1,y1,x2,y2)** function performs object tracking. - **stop\_track()** issues a stop command to follow the function.

The **seewhat** function primarily retrieves the camera's color image. The **KCF\_follow(self,x1,y1,x2,y2)** function takes as parameters the coordinates of the upper-left and lower-right vertices of the object's bounding box (the upper-left corner of the image is the pixel origin). For example, the coordinates of the outer bounding box of the identified green square in Example 2 can be found from the large model's response: the upper-left corner is (230, 345) and the lower-right corner is (235, 350).

```
#Start the object tracking subprocess
process_1 = subprocess.Popen(['ros2', 'run', 'yahboomcar_voice_ctrl_depth',
                              'voice_KCF_Tracker', '--ros-args', '-p', f'x1:={x1}', '-p', f'y1:={y1}', '-p', f'x2:={x2}', '-p', f'y2:={y2}'])
```

The startup program source code path is:

```
~/yahboomcar_ros2_ws/yahboomcar_ws/src/yahboomcar_voice_ctrl_depth/yahboomcar_voice_ctrl_depth/kcf/voice_KCF_Tracker.py
```

```
def KCF_follow(self, x1, y1, x2, y2):
    self.KCF_follow_future = Future() #Reset Future object
    x1 = int(x1)
    y1 = int(y1)
    x2 = int(x2)
    y2 = int(y2)
```

```

process_1 = subprocess.Popen(['ros2', 'run', 'yahboomcar_voice_ctrl_depth',
'voice_KCF_Tracker', '--ros-args', '-p', f'x1:={x1}', '-p', f'y1:={y1}', '-p', f'x2:={x2}', '-p', f'y2:={y2}'])
# time.sleep(1.0)#Sleep for 2 seconds to wait for the thread to stabilize

while not self.KCF_follow_future.done():
    if self.interrupt_flag:
        break
    time.sleep(0.1)

self.kill_process_tree(process_1.pid)
self.cancel()

```

When the main model receives the user input of the "Stop Following" or "End Following" command,

or if the target is lost for more than 10 seconds,

the **stop\_follow** method is called, sending the future.done signal. The `while not self.KCF_follow_future.done()` block in the **KCF\_follow** function is then exited. The **kill\_process\_tree** method is then called to recursively kill the child process tree. Finally, the status of the execution action is reported to the main model at the execution layer.