

Embodied intelligence

Embodied intelligence

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1. Experimental purpose

This chapter learns how to combine the online large language model to realize and learn the process of embodied intelligence. This case only requires audio equipment and cameras.

Notes:

1. **Before running this case, you need to close the startup program**, please refer to the Raspberry Pi system configuration chapter **9. Close and open the APP/handle control program** This tutorial ends the startup program.
2. You need to fill in the API_KEY of the large model, please refer to the operation method of **AI large model chapter "1. Prerequisites for using the large model"**

2. Experimental steps

(This tutorial takes the Chinese version of the effect map as an example)

1. Terminal input

```
cd /home/pi/DOGZILLA/Samples/4_Big_Modle
python3 dog_agent/AIMImage_en.py
```

2. Wake-up operation

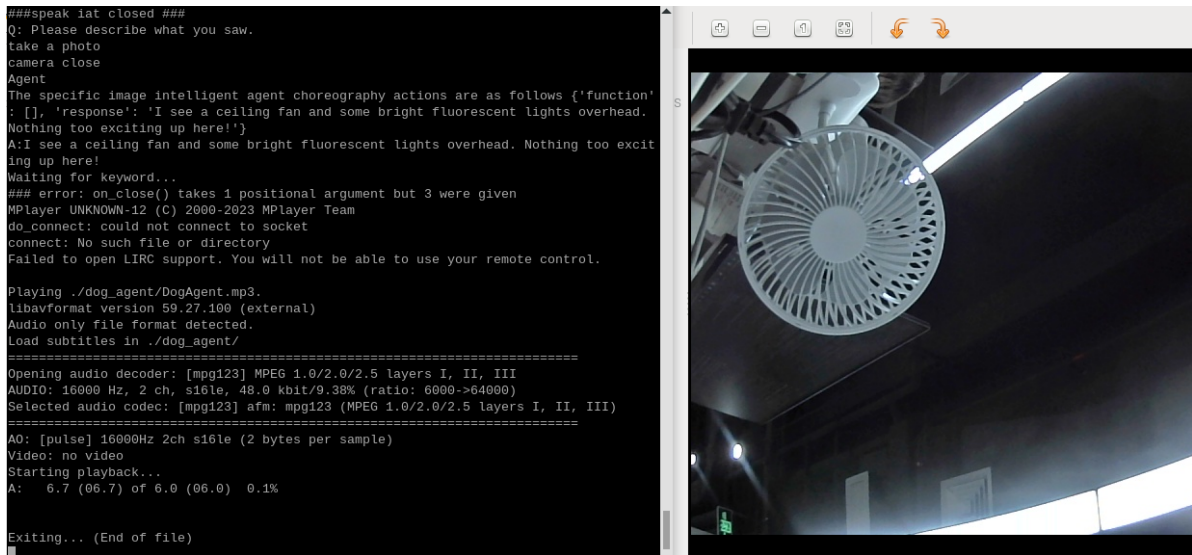
The wake-up word is: **hello yahboom**

```
pi@raspberrypi:~/DOGZILLA/Samples/4_Big_Modle $ python3 dog_agent/AIagent_go_image.py
serial /dev/myspeech open
start
Waiting for keyword...
```

After waking up, you will hear a "ding" sound, and then you can express your thoughts to the robot dog.

```
pi@raspberrypi:~/DOGZILLA/Samples/4_Big_Modle $ python3 dog_agent/AIagent_go_image.py
serial /dev/myspeech open
start
Waiting for keyword...
Keyword detected: 06.Jun 2025 05:22:42
Playing WAVE './ding.wav' : Signed 16 bit Little Endian, Rate 16000 Hz, Mono
```

3. The robot dog will first take a picture of the scene, and then process it through the big model to understand the customer's ideas, and then feedback the corresponding text results and audio playback.



4. At this point, the interactive process is over. If you need to express your ideas again, just wake up again.

3. Analysis of the main source code of the experiment

In the "/home/pi/DOGZILLA/Samples/4_Big_Modle/dog_agent/" path, "AIMImage_en.py" is a main function entry

```
while True:
    if detect_keyword() and huanxin == 0:
        huanxin = 1

    if os.path.exists('./demos/dog_agent/myrec.wav'):
        os.remove('./demos/dog_agent/myrec.wav')
        time.sleep(0.2)

    try:
        start_recording()
        time.sleep(0.2)
        rectext = rec_wav_music_en()
        #rectext = "Tell me what can you see?"
        #print(rectext)
    except:
        print("Cannot hear command,try again")
        huanxin = 0
        continue

    if rectext != "":
        print("Q:"+rectext)

        try:
            agent_plan_output = eval(Dog_agent_plan_en(rectext))
            print('**The intelligent agent arranges actions as follows**', agent_plan_output)
            response = agent_plan_output['response']
            #print('**Start speech synthesis and play**'+response)
        except:
            display_text = "try again..."
            print(display_text)

        huanxin = 0
```

```

        continue

    print("A:"+response)

    tts_thread = threading.Thread(target=Speak_Vioce)
    tts_thread.daemon = True
    tts_thread.start()

    for each in agent_plan_output['function']:
        print('Start executing action', each)
        try:
            eval(each)
        except:
            continue

    time.sleep(0.5)

else :
    print("No information was recognized, try again")
    time.sleep(0.5)
    huanxin = 0

if rectext == 0:
    break

```

1. Program flow: detect wake-up words->listen to expression semantics->combine with big model to understand->feedback answers
2. In the path of "/home/pi/DOGGZILLA/Samples/4_Big_Modle/dog_agent/", the directory structure description is as follows: only the files related to this case are listed

```

├─ AIagent_go_image.py #Main program entry Chinese version
├─ AIMImage_en.py #Main program entry English version
├─ DAgent_Image_en.py #Intelligent agent English version
├─ dog_agent_Image.py #Intelligent agent Chinese version
├─ dog_API_en.py #Online big model interface English version
├─ dog_base_control.py #Basic action interface
├─ dog_football_api.py #Football kicking interface
├─ dog_gesture_api.py #Gesture recognition interface
├─ dog_ImageAPI.py #Online big model interface Chinese version 1
├─ dog_qa_api.py #Question class interface
├─ dog_qrcode_api.py #QR code recognition interface
├─ dog_record.py #Recording interface
├─ dog_speak_iat_en.pyc #English version speech recognition interface
├─ dog_speak_iat.py #Chinese version speech recognition interface
├─ dog_tongyiAPI.py #Tongyi Qianwen model interface
├─ dog_Track_face_api.py #Face tracking interface
├─ dog_Track_food_api.py #Object tracking interface
├─ dog_Track_line_api.py #Line patrol interface
├─ dog_tts_en.pyc #Speech synthesis interface English version
├─ dog_tts.py #Speech synthesis interface Chinese version

```

3. How to add more commands and actions

- First open the DAgent_Image_en.py file to add a sample command

```

19 Turn Around:Dog_Turn_Around()
20 Crawl:Dog_Crawl()
21 Squat:Dog_Squat()
22 Three-axis rotation:Dog_3_Axis()
23 pee:Dog_Pee()
24 sit down:Dog_Sit_Down()
25 wave/To greet:Dog_Wave_Hand()
26 stretch:Dog_Stretch()
27 Wave motion:Dog_Wave_Body()
28 Rocking motion:Dog_Swing()
29 handshake:Dog_Handshake()
30 dance:Dog_Dance()
31 Climb Stairs:Climb_The_Stairs()
32 push-up:Dog_push_up()
33 Display robotic arm:Dog_show_arm()
34 The robotic arm moves upwards:arm_up()
35 Robot arm grasping:arm_middle()
36 The robotic arm moves downwards:arm_down()
37 Pick up wooden blocks of the specified color, with a total of four colors: red, yellow, blue, and green,For example, picking
38 Pick up wooden blocks of the specified color and place them in their corresponding positions. There are a total of four col
40 Kick away the balls of the designated color,There are a total of four colors for the balls: red, yellow, blue, and green. F
41 Scream (Surprise Scream):play_sound_surprised()
42 Scream (Angry Scream):play_sound_anger()
43 Introduce yourself: play_ryself()
44 Rest and wait, such as waiting for two seconds:time.sleep(2)
45 There are also some color related meanings: for example, the sky color is blue, apples are red, bananas are yellow, and lea
46 Here are some executable action groups
47 【Output JSON format】
48 You can directly output JSON, starting from {, do not output the beginning or end of JSON containing ```
49 In the 'function' key, output a list of function names, where each element is a string representing the name and parameters
50 In the 'response' key, according to my instructions and your choreographed actions, output your reply to me in the first pe
51 【Here are some specific examples】 Here are some examples of command statements
52 My instructions: Move forward for 3 seconds, then lie down, show the robotic arm, and finally pee. You output: {'function':[
53 My instructions:Start exercising.You output: {'function': ['Dog_Squat()', 'Dog_Squat()', 'Dog_push_up()', 'Dog_push_up()', 'Dog_Wav
54 My instructions:Turn around and help me pick up the yellow wooden block. You output: {'function': ['Dog_Turn_Around()', 'caw_c
55 My instructions:First, perform three-axis rotation, and then kick the green ball away. You output: {'function': ['Dog_Turn_Ar
56 My instructions:Just describe what you saw, then scream a few times and lie down. You output: {'function': ['play_sound_surpr
57 My instructions:Move forward for 3 seconds, then move the robotic arm a few times, and finally climb the stairs.You output:
58 My instructions:Show the robotic arm upwards, then turn it around, and finally show the robotic arm downwards. You output:
59 My instructions:If you see yellow, turn around; otherwise, dance and finally lie down. You output: {'function': ['Dog_Turn_Ar
60 My instruction: Put the small ball in the color of an apple that I grabbed onto the trash can on the right. You output: {"f
61 My instructions: Take two steps forward, then sit down and introduce yourself. You output: {"function": ['Dog_forward (2) '
62 Assuming there are two colors in the picture, my instructions are: if there is only one color, rotate in circles; if there
63 Assuming a male stranger appears in the picture, my instructions are: help me keep an eye on the door. If a stranger is fou
64
65 【The command format is】

```

- Then you need to encapsulate some action execution functions and save them in the dog_base_control.py file

For example, if you encapsulate a forward function, it will be as shown in the following figure

```

15 ##前进 forward
16 def Dog_forward(delay_time):
17     xgo.move_x(20)
18     time.sleep(delay_time)
19     xgo.stop()
20
21 ## 后退 back
22 def Dog_back(delay_time):
23     xgo.move_x(-20)
24     time.sleep(delay_time)
25     xgo.stop()
26
27

```

- Finally, add the encapsulated function interface and usage method to the DAgent_Image_en.py file.

```

1 from dog_API_en import *
2
3 #DOGZILLA lite Action choreography agent description
4
5 AGENT_SYS_PROMPT = '''
6 You are my mechanical dog butler. Please output the corresponding function to be run and your reply to me in JSON format according to my instructions
7
8 【Here is an introduction to all built-in functions】
9 Forward movement:Dog_forward(time) #Among them, time represents the number of seconds of the action,Advance 1 second:Dog_forward(1)
10 Step back action:Dog_back(time) #Among them, time represents the number of seconds of the action,Step back for 1 second:Dog_forward(1)
11 Left translation action:Dog_Left_move(time) #Among them, time represents the number of seconds of the action,Left shift for 1 second:Dog_Left_move(1)
12 Right translation action:Dog_Rihgt_move(time) #Among them, time represents the number of seconds of the action,Right translation for 1 second:Dog_Rihgt_move(1)
13 Left rotation action:Dog_LeftTurn(time) #Among them, time represents the number of seconds of the action,Rotate left for 1 second:Dog_Rihgt_move(1)
14 Right rotation action:Dog_RightTurn(time) #Among them, time represents the number of seconds of the action,Rotate right for 1 second:Dog_Rihgt_move(1)
15 Looking up action:Dog_Looking_up()

```

4. How to replace the large model interface

This involves a lot of DIY operations, and it is not recommended for novices to replace the model.

The big models used in this function are **OpenRouter**, **Tongyi Qianwen**

- You can first use the python version program of the platform's corresponding interface, and fill in the necessary information according to the platform's interface and instructions.
- Then encapsulate the executable file into a function. You can refer to "dog_API_en.py" or "dog_tongyiAPI.py" and put it in the directory of "/home/pi/DOGZILLA/Samples/4_Big_Modle/dog_agent/". For example, the added file name is "mychatgpt.py"

```
dog_tongyiAPI.py
1 from openai import OpenAI
2 import os
3 import base64
4 import sys
5
6
7 current_dir = os.path.dirname(os.path.abspath(__file__))
8 parent_dir = os.path.dirname(current_dir)
9 sys.path.append(parent_dir)
10
11 from API_KEY import *
12
13
14
15 # base 64 编码格式
16 def encode_image(image_path):
17     with open(image_path, "rb") as image_file:
18         return base64.b64encode(image_file.read()).decode("utf-8")
19
20 def QwenVL_api_picture(PROMPT='机械狗管家智能体'):
21     base64_image = encode_image("./dog_agent/rec.jpg")
22     client = OpenAI(
23         # 若没有配置环境变量, 请用百炼API Key将下行替换为: api_key="sk-xxx"
24         api_key= TONYI_key,
25         base_url="https://dashscope.aliyuncs.com/compatible-mode/v1",
26     )
27     completion = client.chat.completions.create(
28         model="qwen-vl-max-latest", #qwen-vl-max-latest
29         messages=[
30             {
31                 "role": "user",
32                 "content": [
33                     {
34                         "type": "image_url",
35                         "image_url": {"url": f"data:image/jpg;base64,{base64_image}"},
36                     },
37                     {
38                         "type": "text",
39                         "text": PROMPT
40                     },
41                 ],
42             },
43         ],
44     )
45     #print(completion.model_dump_json())
46     #print('大模型调用成功!')
47     result = eval(completion.choices[0].message.content)
48     #print(result)
49
50     return result
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```

31     }
32 }
33 }
34
35 result = completion.choices[0].message.content
36 #print(result)
37 return result
38
39
40
41 def encode_image(image_path):
42     with open(image_path, "rb") as image_file:
43         return base64.b64encode(image_file.read()).decode("utf-8")
44
45
46
47 def dogGPT_Image_en(inputtext):
48     client = OpenAI(
49         base_url="https://openrouter.ai/api/v1",
50         api_key=openAI_KEY,
51     )
52
53     image_path = "./dog_agent/rec.jpg"
54     base64_image = encode_image(image_path)
55
56     completion = client.chat.completions.create(
57
58         model="qwen/qwen2.5-vl-32b-instruct:free",
59         #model="meta-llama/llama-3.2-11b-vision-instruct:free",
60         messages=[
61             {
62                 "role": "user",
63                 "content": [
64                     {
65                         "type": "text",
66                         "text": inputtext
67                     },
68                     {
69                         "type": "image_url",
70                         "image_url": {"url": f"data:image/jpg;base64,{base64_image}"},
71                     }
72                 ]
73             }
74         ]
75     )
76
77     result = completion.choices[0].message.content
78     #print(result)
79     return result
80
81
82
83

```

- Open the file **DAgent_Image_en.py**

```

dog_agent_Image.py
1 from dog_ImageAPI import *
2 from dog_tongyiAPI import *
3

```

- Take this tutorial as an example: Then add from dog_API_en import * from mychatgpt import * in the header

```

1 from dog_ImageAPI import *
2 from dog_tongyiAPI import *
3 from mychatgpt import *
4

```

- Then find this place and replace it with your own encapsulated API function interface.
- 5. If you want to change the threshold for recording start and the duration of recording, you can change this file. Enter in the terminal

```
nano /home/pi/DOGZILLA/Samples/4_Big_Modle/dog_agent/dog_record.py
```

Change the recording part of this file, as shown in the figure below

```

quitmark = 0
automark = True
def start_recording(timel = 3, save_file=SAVE_FILE):
    global automark, quitmark
    start_threshold = 3000 #30000 Start threshold
    end_threshold = 1500 #2000 Stop threshold
    endlast = 15 # The total number of times detected is lower than the stop threshold, and the recording is automatically stopped
    max_record_time = 10 #The maximum recording duration

    CHUNK = 1024
    FORMAT = pyaudio.paInt16
    CHANNELS = 1
    RATE = 16000
    WAVE_OUTPUT_FILENAME = save_file

```

Parameter meaning:

- start_threshold = 3000 #Start recording when a sound higher than this value is detected. This value changes according to the environment

- end_threshold = 1500 #Sound lower than this value is detected. This value changes according to the environment
- endlast = 15 #Stop recording when the number of sounds lower than end_threshold is detected. Here it is 15 times
- max_record_time = 5 #The duration of the recorded audio, here is 5

Note: start_threshold must be greater than end_threshold

(start_threshold>end_threshold)

Generally, the ideal value of end_threshold is half of start_threshold, which can be adjusted according to your own environment.

6. If you feel that the recorded audio cannot be recognized by the online large model because the sound is too small, you can adjust the value here to amplify the recorded audio.

Terminal input

```
nano /home/pi/DOGZILLA/Samples/4_Big_Modle/dog_agent/dog_record.py
```

```
269 wf.close()
270 print(f"The recording has been saved as: {WAVE_OUTPUT_FILENAME}")
271
272 amplify_audio_librosa("recorded_audio.wav", "recorded_audio.wav" gain_factor=5.0) #放大它 Enlarge it
273
```

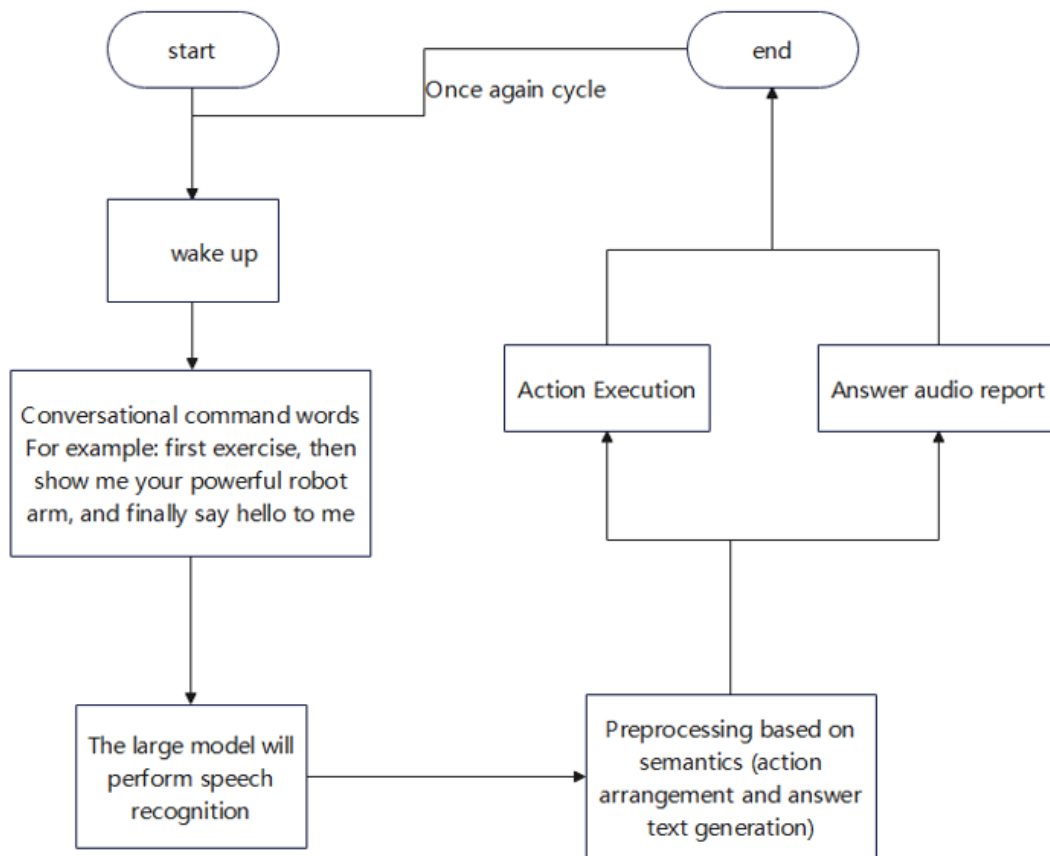
Here it is amplified 5 times, here you can make an adjustment according to the distance of the sound source.

Note: If the distance is too far to record audio at all, adjusting the parameters here will be meaningless.

It is recommended that the distance from the sound source of the recorded audio should not be greater than 1.5m.

4. Experimental summary

Based on the above description, the flowchart of this case is as follows:



If you don't know what this case means, here are some reference examples

Examples:

1. A series of action instructions, such as: dance, turn around, push-ups, move forward for 3s, wave your hand and start.
 2. Some sentences with action instructions, such as: first show your body, then turn around and lie down, and finally say hello to me.
 3. Action instructions + some questions, such as: dance, help me kick the sky-colored ball on the desktop, and finally tell me today's date.
 4. Action instructions + visual detection, such as: dance, shout twice, and then look at my gestures and make movements.
 5. You can say some speculative sentences, such as: I don't want to see the yellow ball on the desktop anymore. / I am very sad now.
 6. You can consult some questions related to the live film, such as: if you see a red ball, dance, otherwise lie down and rest for a while.
- You can use your imagination and interact boldly.

Notes

1. If this error occurs when the program starts, you can press "ctrl+C" to end the program and then restart it.

```

python3 ~/mystudy/Free_QX_4/python3/embodied_intelligence.py
serial /dev/myspeech open
Network check failed: HTTPConnectionPool(host='www.baidu.com', port=80): Max retries exc
eeded with url: / (Caused by NewConnectionError('<urllib3.connection.HTTPConnection obje
ct at 0x7fff84058610>: Failed to establish a new connection: [Errno -3] Temporary failur
e in name resolution'))
检测网络没连上, 请重启网络

```

2. If you want to terminate this case, press "ctrl+C" to end the program.

3. After entering the visual detection, you need to select the screen where the camera is turned on, and then press the lowercase "q" button on the keyboard to exit the current detection mode.

For example: gesture detection is in progress, and face tracking instructions are required later. You need to press the lowercase "q" button on the keyboard to exit gesture detection and then perform the "face tracking" instruction.

The specific switching cases include the following modes

- Gesture detection and tracking: After detecting a gesture, a tracking will be performed
- Face tracking: Follow the detected face to track the body movements
- Line patrol: You can patrol the lines of red, yellow, blue and green
- Object tracking: Follow the specified object to track the body movements
- QR code recognition: You can refer to the running effect of **8. QR code recognition action group** in the "Fun Game Tutorial" chapter

** All the above cases need to press the keyboard 'q' to exit. **

4. The object tracking case needs to fill in the Tongyi Qianwen key in API_KEY.py, otherwise you cannot enter this mode.