9. Gesture following

9.1. Experimental objectives

Previously, we introduced the use of MediaPipe to implement gesture recognition. In this section, we use MediaPipe to combine gesture recognition with the control of the microphone wheel and the gimbal to achieve the function of the car following the hand and controlling the movement of the car with gestures

9.2. Experimental code

Source code path:

/home/pi/project_demo/08.AI_Visual_Interaction_Course/09_Gesture_follows/09_Gesture_follows.ipynb

```
import sys
sys.path.append('/home/pi/project_demo/lib')
#导入麦克纳姆小车驱动库 Import Mecanum Car Driver Library
from McLumk_Wheel_Sports import *
import cv2
import ipywidgets.widgets as widgets
import time
import sys
import math
from Raspbot_Lib import Raspbot
import threading


speed = 25
image_widget = widgets.Image(format='jpeg', width=640, height=480)
```

```
global target_valuex
target_valuex = 1500
global target_valuey
target_valuey = 850


bot = Raspbot()

# 初始化云台 Init Servo
target_servox = 90
target_servoy = 60
def servo_reset():
    bot.Ctrl_Servo(1,target_servox)
    bot.Ctrl_Servo(2,target_servoy)
servo_reset()
```

```
import PID
direction_pid = PID.PositionalPID(0.9, 0, 0.2)
yservo_pid = PID.PositionalPID(0.9, 0.2, 0.01)

from gesture_action import handDetector
hand_detector = handDetector(detectorCon=0.8)
cap = cv2.VideoCapture(0)
```

```
# 线程功能操作库 Thread function operation library
import inspect
import ctypes
def _async_raise(tid, exctype):
    """raises the exception, performs cleanup if needed"""
    tid = ctypes.c_long(tid)
    if not inspect.isclass(exctype):
        exctype = type(exctype)
    res = ctypes.pythonapi.PyThreadState_SetAsyncExc(tid,
ctypes.py_object(exctype))
    if res == 0:
        raise ValueError("invalid thread id")
    elif res != 1:
        # """if it returns a number greater than one, you're in trouble,
        # and you should call it again with exc=NULL to revert the effect"""
        ctypes.pythonapi.PyThreadState_SetAsyncExc(tid, None)

def stop_thread(thread):
    _async_raise(thread.ident, SystemExit)
```

```
def Gesture_follow():
    try:
        while True:
            global bot
            ret, frame = cap.read()
            img_height, img_width, _ = frame.shape
            hand_detector.findHands(frame, draw=False)
            if len(hand_detector.lmList) != 0:
                # 转向控制部分
                # Turning control section
                # MediaPipe中，手部最中心的指关节的编号为9
                # In MediaPipe, the index of the central finger joint is 9
                x,y = hand_detector.findPoint(9)
                cv2.circle(frame,(int(x),int(y)),5,(0,255,255),10)
                # 在x轴上控制麦轮
                # Control the mouse wheel on the x-axis
                direction_pid.SystemOutput = x
                direction_pid.SetStepSignal(int(img_width/2))
                direction_pid.SetInertiaTime(0.01, 0.05)
                target_valuex = int(direction_pid.SystemOutput)

                # 在y轴上控制云台，摄像头中心与指关节9在竖直方向的差值<25时不调节,减少抖动
                # Control the pan/tilt in the y-axis; if the difference between
the camera center and finger joint 9 in the vertical direction is <25, do not
adjust to reduce jitter
                if math.fabs(int(img_height/2) - y) > 25:
                    yservo_pid.SystemOutput = y
                    yservo_pid.SetStepSignal(int(img_height/2))
```

```
                    yservo_pid.SetInertiaTime(0.01, 0.05)
                    target_valuey = int(850+yservo_pid.SystemOutput)
                    target_servoy = int((target_valuey-500)/10)

                    if target_servoy > 110:
                        target_servoy = 110
                    if target_servoy < 0:
                        target_servoy = 0
                    bot.Ctrl_Servo(2, target_servoy)

                # 前进控制部分
                # Forward control section
                finger_number = hand_detector.get_gesture()
                finger_str=f"Number:{finger_number}"

                # 手势 0 控制小车停止
                # Gesture 0 controls the robot to stop
                if(finger_number == "Zero"):
                    stop_robot()
                else:
                    if -40 < target_valuex < 40:
                        target_valuex = 0
                    move_param_forward(speed, target_valuex)
            else:
                stop_robot()
            try:
                image_widget.value = bgr8_to_jpeg(frame)
            except:
                continue
    finally:
        stop_robot()
        cap.release()
        del bot
```

```
display(image_widget)
thread1 = threading.Thread(target=Gesture_follow)
thread1.daemon=True
thread1.start()
```

9.3. Experimental phenomenon

After the code block is run, place the hand within the visible range of the car camera. When any gesture other than gesture "0" is made, the car will track the movement of the hand center point. When the gesture "0" is made, the car will not follow the hand movement