12. Mediapipe arm attitude control robotic arm

12.1. Using

After the program starts, the camera captures the image, and the right arm is raised. After the buzzer is not heard, the robotic arm will synchronously imitate the movement of the arm (straighten, bend the palm to close).

Note: [R2] of the remote controller has the function of [pause/on] for this gameplay.

Feature package path： ~/yahboomcar_ws/src/arm_mediapipe/

Robot side

```
#You need to enter docker first, perform this step more
#If running the script to enter docker fails, please refer to 07.Docker-orin/05,
Enter the robot's docker container
~/run_docker.sh
roslaunch arm_mediapipe mediaArm.launch # Robots
```

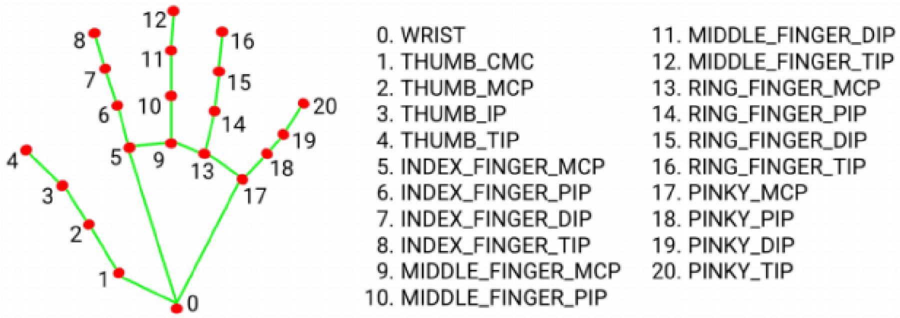
Virtual machine side (recommended)

```
rosrun arm_mediapipe PoseArm.py
```

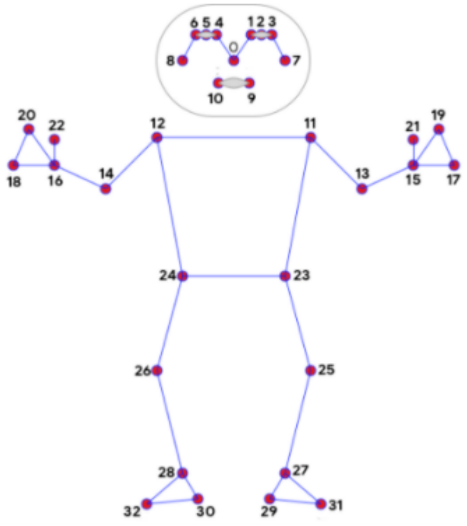
After the program starts, press the R2 key on the handle to turn on this function, stand in front of the camera, and make the entire arm appear on the screen. At this time, the buzzer will sound.This is written in the program to prevent the robotic arm from moving after the arm is put down, causing confusion in the program. We raised our elbows and waited for the buzzer to go off, and the robotic arm would simulate the movement of the arm. You can straighten, bend the elbow, wrist, shoulder, open/close the palm to control the robotic arm.

12.2. Principle of realization

MediaPipe Hands infers 3D coordinates of 21 hand-valued joints from one frame



The landmark model in MediaPipe Pose predicts the location of 33 pose coordinates (see figure below).



0. nose
1. left_eye_inner
2. left_eye
3. left_eye_outer
4. right_eye_inner
5. right_eye
6. right_eye_outer
7. left_ear
8. right_ear
9. mouth_left
10. mouth_right
11. left_shoulder
12. right_shoulder
13. left_elbow
14. right_elbow
15. left_wrist
16. right_wrist
17. left_pinky
18. right_pinky
19. left_index
20. right_index
21. left_thumb
22. right_thumb
23. left_hip
24. right_hip
25. left_knee
26. right_knee
27. left_ankle
28. right_ankle
29. left_heel
30. right_heel
31. left_foot_index
32. right_foot_index

In this program, all we need is the coordinates of the part of the right arm. By calculating the angle formed by these coordinates, we can calculate how much angle each steering gear of the robotic arm needs to turn.

12.3.Core code analysis PoseArm.py

Code reference path：~/yahboomcar_ws/src/arm_mediapipe/scripts

- Import critical libraries

```
from media_library import *
```

- Get the information of each joint of the right arm

```
frame, pointArray, lhandptArray, rhandptArray =
self.pose_detector.findHolistic(frame)
#This pose_detector.findHolistic function prototype is in media_library.py
```

- Here is an explanation of how the angles formed by the lower shoulder joint, elbow joint, wrist joint, palm opening and closing are calculated:

  1）、 As can be seen from the above figure, the three points 12-11-13 form the shoulder, so the angle of the shoulder joint can be calculated by obtaining the coordinate values of these three points;

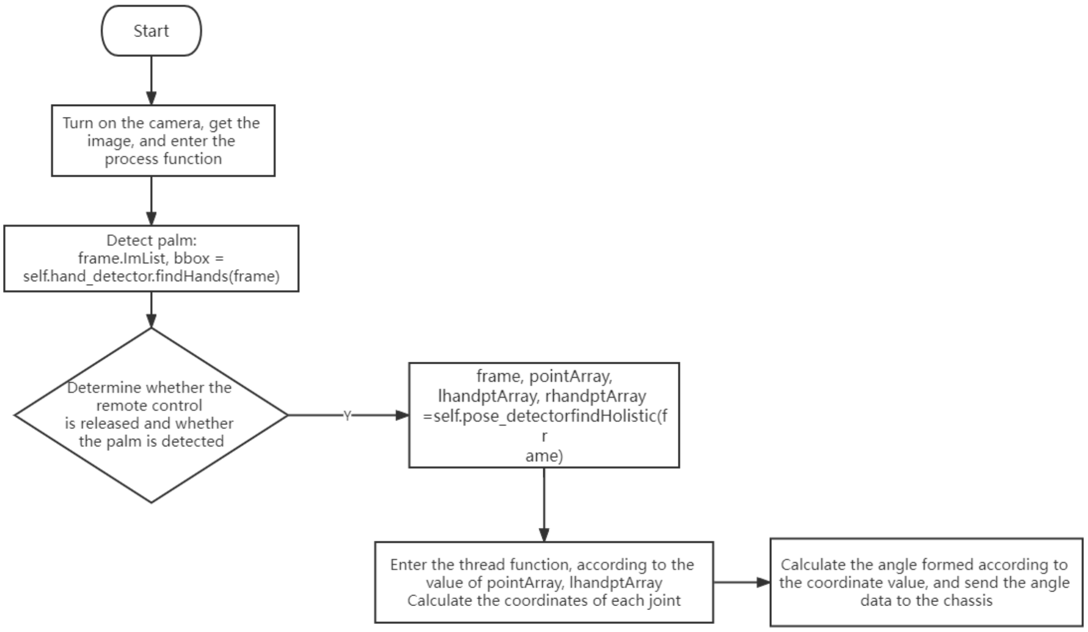
  2）、As can be seen from the above figure, the three points 11-13-15 form the elbow, therefore, the angle of the elbow joint can be calculated by obtaining the coordinate values of these three points;

  3）、As can be seen from the above figure, the three points 13-0 (palm wrist joint)-8 (top of index finger) form the wrist joint. Therefore, the coordinate values of these three points can be obtained to calculate the angle of the wrist joint;

  4）、As can be seen from the above figure, the three points of 4 (the top of the thumb)-0 (the palm wrist joint)-8 (the top of the index finger) form the angle of the gripper. Therefore, the coordinate values of these three points can be obtained to calculate the gripper angle at which the claw needs to be clamped;

The above-mentioned 4 key joint codes are specifically realized,you can look at the program source code.

12.4. Program flow chart


Start
Turn on the camera, get the image, and enter the process function
Detect palm:
frame.lmList, bbox =
self.hand_detector.findHands(frame)
Determine whether the remote control
is released and whether the palm is detected
Y
frame, pointArray,
lhandptArray, rhandptArray
=self.pose_detectorfindHolistic(f
r
ame)
Enter the thread function, according to the value of pointArray, lhandptArray
Calculate the coordinates of each joint
Calculate the angle formed according to the coordinate value, and send the angle data to the chassis