3. Overall detection

3.1. Introduction

MediaPipe is an open-source data stream processing machine learning application development framework developed by Google. It is a graph-based data processing pipeline used to build data sources in various forms, such as video, audio, sensor data, and any time series data. MediaPipe is cross-platform and can run on embedded platforms (Raspberry Pi, etc.), mobile devices (iOS and Android), workstations and servers, and supports mobile GPU acceleration. MediaPipe provides cross-platform, customizable ML solutions for real-time and streaming media.

The core framework of MediaPipe is implemented in C++ and provides support for languages such as Java and Objective C. The main concepts of MediaPipe include packets, streams, calculators, graphs, and subgraphs.

Features of MediaPipe:

- End-to-end acceleration: built-in fast ML inference and processing can be accelerated even on ordinary hardware.
- Build once, deploy anywhere: unified solution for Android, iOS, desktop/cloud, web and IoT.
- Ready-to-use solution: cutting-edge ML solution that demonstrates the full functionality of the framework.
- Free and open source: framework and solution under Apache2.0, fully extensible and customizable.

3.2, MediaPipe Hands

Refer to the content of hand detection [1.2] in the first section, which will not be repeated here.

3.3, MediaPipe Pose

Refer to the content of hand detection [2.2] in the first section, which will not be repeated here.

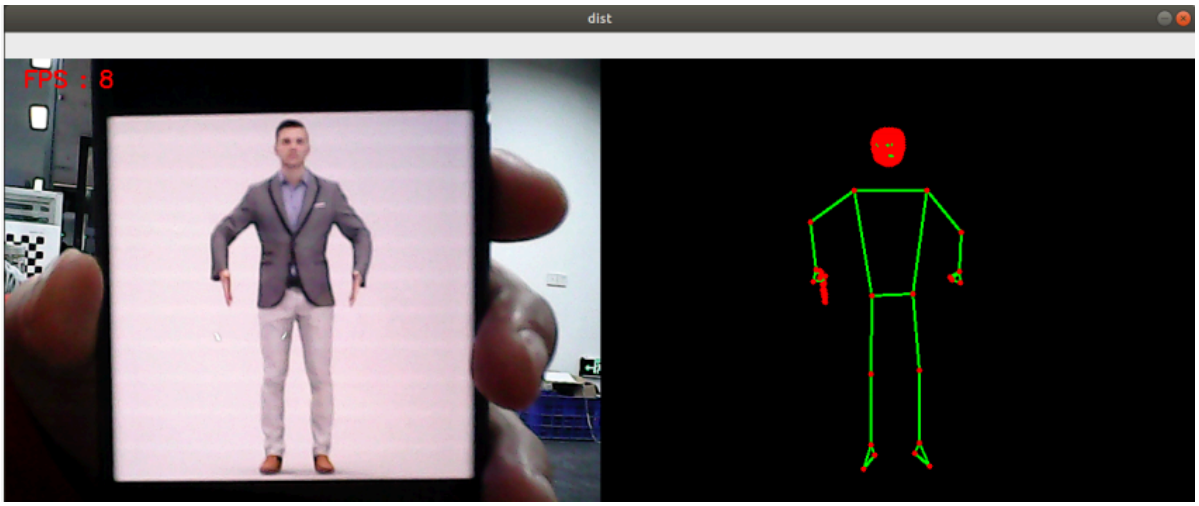
3.4, overall detection

Combining the content of the previous two sections, the routine in this section implements the function of detecting both palms and human bodies.

3.4.1, Start

- Enter the following command to start the program

```
rosrun2 jetcobot_mediapipe 03_Holistic
```



3.4.2, Source code

Source code location: ~/jetcobot_ws/src/jetcobot_mediapipe/jetcobot_mediapipe/03_Holistic.py

```
#!/usr/bin/env python3
# encoding: utf-8
import time
import rclpy
from rclpy.node import Node
import cv2 as cv
import numpy as np
import mediapipe as mp
from geometry_msgs.msg import Point
from jetcobot_msgs.msg import PointArray
from sensor_msgs.msg import Image
from cv_bridge import CvBridge, CvBridgeError
from jetcobot_utils.grasp_controller import GraspController

class Holistic(Node):
    def __init__(self, staticMode=False, landmarks=True, detectionCon=0.5,
trackingCon=0.5):
        super().__init__('holistic_detector')
        self.graspController = GraspController()
        self.graspController.init_pose2()
        self.publisher_ = self.create_publisher(PointArray, '/mediapipe/points',
10)
        self.bridge = CvBridge()

        self.mpHolistic = mp.solutions.holistic
        self.mpFaceMesh = mp.solutions.face_mesh
        self.mpHands = mp.solutions.hands
        self.mpPose = mp.solutions.pose
        self.mpDraw = mp.solutions.drawing_utils
        self.mpholistic = self.mpHolistic.Holistic(
            static_image_mode=staticMode,
            smooth_landmarks=landmarks,
            min_detection_confidence=detectionCon,
            min_tracking_confidence=trackingCon)

        self.lmDrawSpec = mp.solutions.drawing_utils.DrawingSpec(color=(0, 0,
255), thickness=-1, circle_radius=3)
```

```
        self.drawSpec = mp.solutions.drawing_utils.DrawingSpec(color=(0, 255, 0),
thickness=2, circle_radius=2)

        self.capture = cv.VideoCapture(0, cv.CAP_V4L2)
        self.capture.set(6, cv.VideoWriter.fourcc('M', 'J', 'P', 'G'))
        self.capture.set(cv.CAP_PROP_FRAME_WIDTH, 640)
        self.capture.set(cv.CAP_PROP_FRAME_HEIGHT, 480)

        if not self.capture.isOpened():
            self.get_logger().error("Failed to open the camera")
            return

        self.get_logger().info(f"Camera FPS:
{self.capture.get(cv.CAP_PROP_FPS)}")
        self.pTime = time.time()

        self.timer = self.create_timer(0.03, self.process_frame)

    def process_frame(self):
        ret, frame = self.capture.read()
        if not ret:
            self.get_logger().error("Failed to read frame")
            return

        frame, img = self.findHolistic(frame, draw=True)

        cTime = time.time()
        fps = 1 / (cTime - self.pTime)
        self.pTime = cTime
        text = "FPS : " + str(int(fps))
        cv.putText(frame, text, (20, 30), cv.FONT_HERSHEY_SIMPLEX, 0.8, (0, 0,
255), 2)

        combined_frame = self.frame_combine(frame, img)
        cv.imshow('HolisticDetector', combined_frame)

        if cv.waitKey(1) & 0xFF == ord('q'):
            self.get_logger().info("Exiting program")
            self.capture.release()
            cv.destroyAllWindows()
            self.destroy_node()
            rclpy.shutdown()
            exit(0)

    def findHolistic(self, frame, draw=True):
        pointArray = PointArray()
        img = np.zeros(frame.shape, np.uint8)
        img_RGB = cv.cvtColor(frame, cv.COLOR_BGR2RGB)
        self.results = self.mpholistic.process(img_RGB)

        if self.results.face_landmarks:
            try:
                if draw: self.mpDraw.draw_landmarks(frame,
self.results.face_landmarks, self.mpFaceMesh.FACE_CONNECTIONS, self.lmDrawSpec,
self.drawSpec)
```

```
                self.mpDraw.draw_landmarks(img, self.results.face_landmarks,
self.mpFaceMesh.FACE_CONNECTIONS, self.lmDrawSpec, self.drawSpec)
            except:
                if draw: self.mpDraw.draw_landmarks(frame,
self.results.face_landmarks, self.mpFaceMesh.FACEMESH_CONTOURS, self.lmDrawSpec,
self.drawSpec)
                self.mpDraw.draw_landmarks(img, self.results.face_landmarks,
self.mpFaceMesh.FACEMESH_CONTOURS, self.lmDrawSpec, self.drawSpec)

            for id, lm in enumerate(self.results.face_landmarks.landmark):
                point = Point()
                point.x, point.y, point.z = lm.x, lm.y, lm.z
                pointArray.points.append(point)
        if self.results.pose_landmarks:
            if draw: self.mpDraw.draw_landmarks(frame,
self.results.pose_landmarks, self.mpPose.POSE_CONNECTIONS, self.lmDrawSpec,
self.drawSpec)
            self.mpDraw.draw_landmarks(img, self.results.pose_landmarks,
self.mpPose.POSE_CONNECTIONS, self.lmDrawSpec, self.drawSpec)
            for id, lm in enumerate(self.results.pose_landmarks.landmark):
                point = Point()
                point.x, point.y, point.z = lm.x, lm.y, lm.z
                pointArray.points.append(point)
        if self.results.left_hand_landmarks:
            if draw: self.mpDraw.draw_landmarks(frame,
self.results.left_hand_landmarks, self.mpHands.HAND_CONNECTIONS, self.lmDrawSpec,
self.drawSpec)
            self.mpDraw.draw_landmarks(img, self.results.left_hand_landmarks,
self.mpHands.HAND_CONNECTIONS, self.lmDrawSpec, self.drawSpec)
            for id, lm in enumerate(self.results.left_hand_landmarks.landmark):
                point = Point()
                point.x, point.y, point.z = lm.x, lm.y, lm.z
                pointArray.points.append(point)
        if self.results.right_hand_landmarks:
            if draw: self.mpDraw.draw_landmarks(frame,
self.results.right_hand_landmarks, self.mpHands.HAND_CONNECTIONS,
self.lmDrawSpec, self.drawSpec)
            self.mpDraw.draw_landmarks(img, self.results.right_hand_landmarks,
self.mpHands.HAND_CONNECTIONS, self.lmDrawSpec, self.drawSpec)
            for id, lm in enumerate(self.results.right_hand_landmarks.landmark):
                point = Point()
                point.x, point.y, point.z = lm.x, lm.y, lm.z
                pointArray.points.append(point)
        self.publisher_.publish(pointArray)
        return frame, img

    def frame_combine(self, frame, src):
        if len(frame.shape) == 3:
            frameH, frameW = frame.shape[:2]
            srcH, srcW = src.shape[:2]
            dst = np.zeros((max(frameH, srcH), frameW + srcW, 3), np.uint8)
            dst[:, :frameW] = frame[:, :]
            dst[:, frameW:] = src[:, :]
        else:
            src = cv.cvtColor(src, cv.COLOR_BGR2GRAY)
            frameH, frameW = frame.shape[:2]
```

```
            imgH, imgW = src.shape[:2]
            dst = np.zeros((frameH, frameW + imgW), np.uint8)
            dst[:, :frameW] = frame[:, :]
            dst[:, frameW:] = src[:, :]
        return dst

def main(args=None):
    rclpy.init(args=args)
    node = Holistic()
    try:
        rclpy.spin(node)
    except KeyboardInterrupt:
        pass
    finally:
        node.capture.release()
        cv.destroyAllWindows()
        node.destroy_node()
        rclpy.shutdown()

if __name__ == '__main__':
    main()
```