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 capabilities 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, this section's routine implements the function of detecting both palms and human bodies.

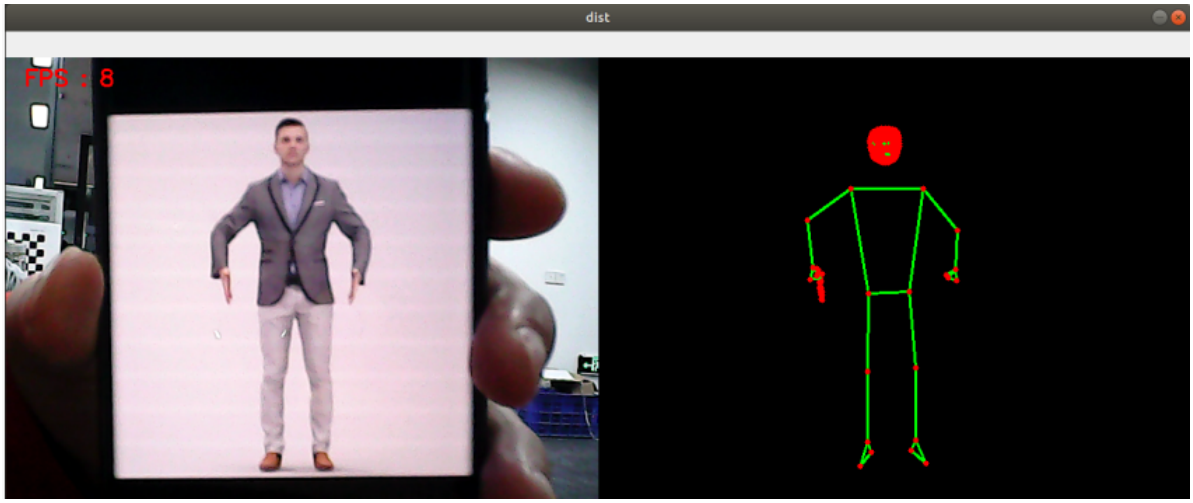
3.4.1, Start

Start the camera

```
ros2 launch ascamera hp60c.launch.py
```

Open a new terminal and input,

```
ros2 run yahboomcar_mediapipe 03_Holistic
```



3.4.2, Source code

Source code location:
~/ascam_ros2_ws/src/yahboomcar_mediapipe/yahboomcar_mediapipe/03_Holistic.py

```
#!/usr/bin/env python3
# encoding: utf-8

import rclpy
from rclpy.node import Node
from geometry_msgs.msg import Point
from sensor_msgs.msg import Image
import mediapipe as mp
from yahboomcar_msgs.msg import PointArray
import cv2 as cv
import numpy as np
import time
from cv_bridge import CvBridge

print("import done")

class Holistic(Node):
    def __init__(self, name, staticMode=False, landmarks=True, detectionCon=0.5,
trackingCon=0.5):
        super().__init__(name)
        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)

        # Create publisher to publish pose points
        self.pub_point = self.create_publisher(PointArray, '/mediapipe/points',
1000)

        # Initialize CvBridge to convert ROS Image messages to OpenCV format
```

```
        self.bridge = CvBridge()

        # Create subscription to the image topic
        self.create_subscription(Image,
'/ascamera_hp60c/camera_publisher/rgb0/image', self.image_callback, 10)

        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)

        # FPS variables
        self.pTime = 0
        self.exit_flag = False  # Flag to indicate exit condition

    def image_callback(self, msg):
        # Convert ROS Image message to OpenCV format
        frame = self.bridge.imgmsg_to_cv2(msg, desired_encoding='bgr8')

        # Process the frame for holistic (pose, hands, face mesh) detection
        frame, img = self.findHolistic(frame, draw=False)

        # Calculate FPS
        cTime = time.time()
        fps = 1 / (cTime - self.pTime)
        self.pTime = cTime
        text = "FPS : " + str(int(fps))

        # Display FPS on frame
        cv.putText(frame, text, (20, 30), cv.FONT_HERSHEY_SIMPLEX, 0.9, (0, 0,
255), 1)

        # Combine the frames (original and holistic detection result)
        dist = self.frame_combine(frame, img)

        # Show the combined image
        cv.imshow('Holistic Detection', dist)

        # Exit the program if 'q' is pressed
        if cv.waitKey(1) & 0xFF == ord('q'):
            self.exit_flag = True

    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:
            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)

        # Publish the detected points
        self.pub_point.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 run(self):
        # Custom loop for handling ROS 2 callback and OpenCV events
        while rclpy.ok() and not self.exit_flag:
            rclpy.spin_once(self)  # Process one callback
            if self.exit_flag:
                break
        cv.destroyAllWindows()


def main():
    print("start it")
    rclpy.init()
    holistic = Holistic('holistic')

    try:
        holistic.run()
    except KeyboardInterrupt:
        pass
    finally:
        holistic.destroy_node()
        rclpy.shutdown()


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