Pose Detection

Orin board users can directly open the terminal and input the tutorial commands to run directly. Jetson-Nano board users need to enter the docker container first, then input the tutorial commands in the docker to start the program.

1. Introduction

MediaPipe is a data stream processing machine learning application development framework developed and open-sourced by Google. It is a graph-based data processing pipeline used to build applications that use various forms of data sources such as video, audio, sensor data, and any time series data. MediaPipe is cross-platform and can run on embedded platforms (Jetson nano, 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 Packet, Stream, Calculator, Graph, and Subgraph.

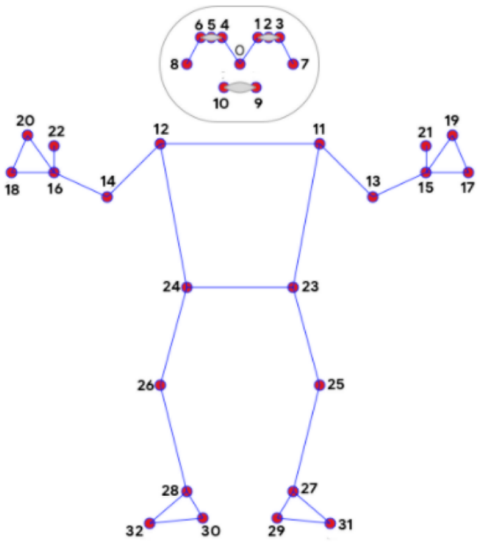
Features of MediaPipe:

- End-to-end acceleration: Built-in fast ML inference and processing accelerates even on ordinary hardware.
- Build once, deploy anywhere: Unified solution for Android, iOS, desktop/cloud, web and IoT.
- Ready-to-use solutions: Cutting-edge ML solutions that showcase the full capabilities of the framework.
- Free and open source: Framework and solutions under Apache2.0, fully scalable and customizable.

2. MediaPipe Pose

MediaPipe Pose is an ML solution for high-fidelity body pose tracking, utilizing BlazePose research to infer 33 3D coordinates and full-body background segmentation masks from RGB video frames. This research also powers the ML Kit pose detection API.

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



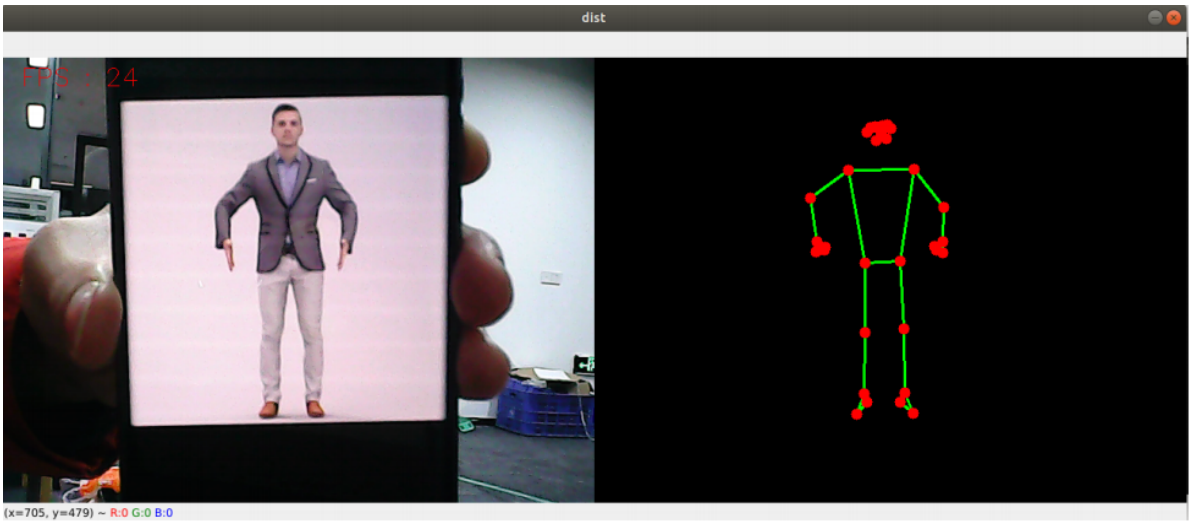
0. nose
1. left_eye_inner
2. left_eye
3. left_eye_outer
4. right_eye_inner
5. right_eye
6. right_eye_outer
7. left_ear
8. right_ear
9. mouth_left
10. mouth_right
11. left_shoulder
12. right_shoulder
13. left_elbow
14. right_elbow
15. left_wrist
16. right_wrist
17. left_pinky
18. right_pinky
19. left_index
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

3. Pose Detection

3.1. Launch

- Enter the following command to start the program

```
ros2 run dofbot_pro_mediapipe 02_PoseDetector
```



3.2. Source Code

Source code location:

```
# Jetson-Nano users need to enter the docker container to view
~/dofbot_pro_ws/src/dofbot_pro_mediapipe/dofbot_pro_mediapipe/02_PoseDetector.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 dofbot_pro_msgs.msg import PointArray
from sensor_msgs.msg import Image
from cv_bridge import CvBridge

class PoseDetector(Node):
    def __init__(self):
        super().__init__('pose_detector')
        self.publisher_ = self.create_publisher(PointArray, '/mediapipe/points',
10)
        self.bridge = CvBridge()

        self.mpPose = mp.solutions.pose
        self.mpDraw = mp.solutions.drawing_utils
        self.pose = self.mpPose.Pose(
            static_image_mode=False,
```

```
            smooth_landmarks=True,
            min_detection_confidence=0.5,
            min_tracking_confidence=0.5 )

        self.lmDrawSpec = mp.solutions.drawing_utils.DrawingSpec(color=(0, 0,
255), thickness=-1, circle_radius=6)
        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.pubPosePoint(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, 0.9, (0, 0,
255), 1)

        combined_frame = self.frame_combine(frame, img)
        cv.imshow('PoseDetector', 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 pubPosePoint(self, frame, draw=True):
        pointArray = PointArray()
        img = np.zeros(frame.shape, np.uint8)
        img_RGB = cv.cvtColor(frame, cv.COLOR_BGR2RGB)
        self.results = self.pose.process(img_RGB)

        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)

        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 = PoseDetector()
    try:
        rclpy.spin(node)
    except KeyboardInterrupt:
        pass
    finally:
        node.capture.release()
        cv.destroyAllWindows()
        node.destroy_node()
        rclpy.shutdown()

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