Brush

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 for building and using multiple 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 (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 Packet, Stream, Calculator, Graph and Subgraph.

  Features of MediaPipe：

  - End-to-end acceleration: Built-in fast ML inference and processing accelerates even on commodity hardware.
  - Build once, deploy anywhere: Unified solutions 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: frameworks and solutions under Apache2.0, fully extensible and customizable.

2、Brush

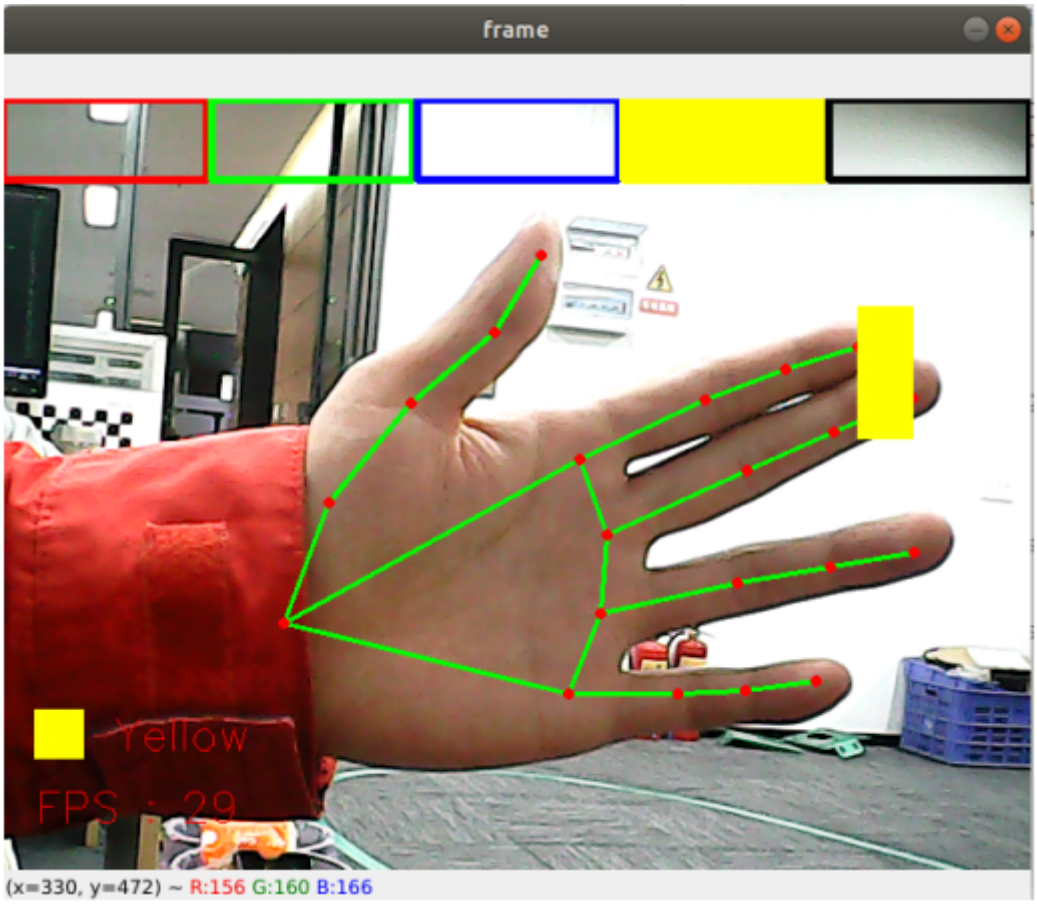
When the right and middle fingers are merged, they are in the selection state, and a color selection box pops up. When the two fingertips move to the corresponding color position, select the color (where 'is an eraser');

The middle and middle fingers are in a drawing state and can be drawn freely on the drawing board.

2.1、Start

After entering the docker container, enter the following command in the terminal.

```
cd ~/yahboomcar_ws/src/yahboomcar_mediapipe/yahboomcar_mediapipe
python3 09_VirtualPaint.py
```



2.2、Code

After entering the docker container, the location of the source code of this function is as follows

```
/root/yahboomcar_ws/src/yahboomcar_mediapipe/yahboomcar_mediapipe/09_VirtualPaint.py
```

```
#!/usr/bin/env python3
# encoding: utf-8
import math
import time
import cv2 as cv
import numpy as np
import mediapipe as mp

xp = yp = pTime = boxx = 0
tipIds = [4, 8, 12, 16, 20]
imgCanvas = np.zeros((480, 640, 3), np.uint8)
brushThickness = 5
eraserThickness = 100
top_height = 50
Color = "Red"
ColorList = {
    'Red': (0, 0, 255),
    'Green': (0, 255, 0),
    'Blue': (255, 0, 0),
    'Yellow': (0, 255, 255),
```

```
    'Black': (0, 0, 0),
}

class handDetector:
    def __init__(self, mode=False, maxHands=2, detectorCon=0.5, trackCon=0.5):
        self.tipIds = [4, 8, 12, 16, 20]
        self.mpHand = mp.solutions.hands
        self.mpDraw = mp.solutions.drawing_utils
        self.hands = self.mpHand.Hands(
            static_image_mode=mode,
            max_num_hands=maxHands,
            min_detection_confidence=detectorCon,
            min_tracking_confidence=trackCon )
        self.lmDrawSpec = mp.solutions.drawing_utils.DrawingSpec(color=(0, 0, 255),
thickness=-1, circle_radius=15)
        self.drawSpec = mp.solutions.drawing_utils.DrawingSpec(color=(0, 255, 0),
thickness=10, circle_radius=10)

    def findHands(self, frame, draw=True):
        self.lmList = []
        img_RGB = cv.cvtColor(frame, cv.COLOR_BGR2RGB)
        self.results = self.hands.process(img_RGB)
        if self.results.multi_hand_landmarks:
            for handLms in self.results.multi_hand_landmarks:
                if draw: self.mpDraw.draw_landmarks(frame, handLms,
self.mpHand.HAND_CONNECTIONS, self.lmDrawSpec, self.drawSpec)
                else: self.mpDraw.draw_landmarks(frame, handLms,
self.mpHand.HAND_CONNECTIONS)
            for id, lm in enumerate(self.results.multi_hand_landmarks[0].landmark):
                h, w, c = frame.shape
                cx, cy = int(lm.x * w), int(lm.y * h)
                # print(id, cx, cy)
                self.lmList.append([id, cx, cy])
        return frame, self.lmList

    def fingersUp(self):
        fingers=[]
        # Thumb
        if (self.calc_angle(self.tipIds[0],
                            self.tipIds[0] - 1,
                            self.tipIds[0] - 2) > 150.0) and (
                self.calc_angle(
                    self.tipIds[0] - 1,
                    self.tipIds[0] - 2,
                    self.tipIds[0] - 3) > 150.0): fingers.append(1)
        else:
            fingers.append(0)
        # 4 finger
        for id in range(1, 5):
            if self.lmList[self.tipIds[id]][2] < self.lmList[self.tipIds[id] - 2]
[2]:
                fingers.append(1)
```

```
            else:
                fingers.append(0)
        return fingers



    def get_dist(self, point1, point2):
        x1, y1 = point1
        x2, y2 = point2
        return abs(math.sqrt(math.pow(abs(y1 - y2), 2) + math.pow(abs(x1 - x2), 2)))

    def calc_angle(self, pt1, pt2, pt3):
        point1 = self.lmList[pt1][1], self.lmList[pt1][2]
        point2 = self.lmList[pt2][1], self.lmList[pt2][2]
        point3 = self.lmList[pt3][1], self.lmList[pt3][2]
        a = self.get_dist(point1, point2)
        b = self.get_dist(point2, point3)
        c = self.get_dist(point1, point3)
        try:
            radian = math.acos((math.pow(a, 2) + math.pow(b, 2) - math.pow(c, 2)) /
(2 * a * b))
            angle = radian / math.pi * 180
        except:
            angle = 0
        return abs(angle)



if __name__ == '__main__':
    capture = cv.VideoCapture(0)
    capture.set(6, cv.VideoWriter.fourcc('M', 'J', 'P', 'G'))
    capture.set(cv.CAP_PROP_FRAME_WIDTH, 640)
    capture.set(cv.CAP_PROP_FRAME_HEIGHT, 480)
    print("capture get FPS : ", capture.get(cv.CAP_PROP_FPS))
    hand_detector = handDetector(detectorCon=0.85)
    while capture.isOpened():
        ret, frame = capture.read()
        # frame = cv.flip(frame, 1)
        h, w, c = frame.shape
        frame,lmList = hand_detector.findHands(frame, draw=False)
        if len(lmList) != 0:
            # print(lmList)
            # tip of index and middle fingers
            x1, y1 = lmList[8][1:]
            x2, y2 = lmList[12][1:]
            fingers = hand_detector.fingersUp()
            if fingers[1] and fingers[2]:
                # print("Seclection mode")
                if y1 < top_height:
                    if 0 < x1 < int(w / 5) - 1:
                        boxx = 0
                        Color = "Red"
```

```
                    if int(w / 5) < x1 < int(w * 2 / 5) - 1:
                        boxx = int(w / 5)
                        Color = "Green"
                    elif int(w * 2 / 5) < x1 < int(w * 3 / 5) - 1:
                        boxx = int(w * 2 / 5)
                        Color = "Blue"
                    elif int(w * 3 / 5) < x1 < int(w * 4 / 5) - 1:
                        boxx = int(w * 3 / 5)
                        Color = "Yellow"
                    elif int(w * 4 / 5) < x1 < w - 1:
                        boxx = int(w * 4 / 5)
                        Color = "Black"
                cv.rectangle(frame, (x1, y1 - 25), (x2, y2 + 25), ColorList[Color],
cv.FILLED)
                cv.rectangle(frame, (boxx, 0), (boxx + int(w / 5), top_height),
ColorList[Color], cv.FILLED)
                cv.rectangle(frame, (0, 0), (int(w / 5) - 1, top_height),
ColorList['Red'], 3)
                cv.rectangle(frame, (int(w / 5) + 2, 0), (int(w * 2 / 5) - 1,
top_height), ColorList['Green'], 3)
                cv.rectangle(frame, (int(w * 2 / 5) + 2, 0), (int(w * 3 / 5) - 1,
top_height), ColorList['Blue'], 3)
                cv.rectangle(frame, (int(w * 3 / 5) + 2, 0), (int(w * 4 / 5) - 1,
top_height), ColorList['Yellow'], 3)
                cv.rectangle(frame, (int(w * 4 / 5) + 2, 0), (w - 1, top_height),
ColorList['Black'], 3)
            if fingers[1] and fingers[2] == False and math.hypot(x2 - x1, y2 - y1) >
50:
                # print("Drawing mode")
                if xp == yp == 0: xp, yp = x1, y1
                if Color == 'Black':
                    cv.line(frame, (xp, yp), (x1, y1), ColorList[Color],
eraserThickness)
                    cv.line(imgCanvas, (xp, yp), (x1, y1), ColorList[Color],
eraserThickness)
                else:
                    cv.line(frame, (xp, yp), (x1, y1), ColorList[Color],
brushThickness)
                    cv.line(imgCanvas, (xp, yp), (x1, y1), ColorList[Color],
brushThickness)
                cv.circle(frame, (x1, y1), 15, ColorList[Color], cv.FILLED)
                xp, yp = x1, y1
            else: xp = yp = 0
        imgGray = cv.cvtColor(imgCanvas, cv.COLOR_BGR2GRAY)
        _, imgInv = cv.threshold(imgGray, 50, 255, cv.THRESH_BINARY_INV)
        imgInv = cv.cvtColor(imgInv, cv.COLOR_GRAY2BGR)
        frame = cv.bitwise_and(frame, imgInv)
        frame = cv.bitwise_or(frame, imgCanvas)
        if cv.waitKey(1) & 0xFF == ord('q'): break
        cTime = time.time()
        fps = 1 / (cTime - pTime)
        pTime = cTime
```

```
        text = "FPS : " + str(int(fps))
        cv.rectangle(frame, (20, h - 100), (50, h - 70), ColorList[Color],
cv.FILLED)
        cv.putText(frame, Color, (70, h - 75), cv.FONT_HERSHEY_SIMPLEX, 0.9, (0, 0,
255), 1)
        cv.putText(frame, text, (20, h-30), cv.FONT_HERSHEY_SIMPLEX, 0.9, (0, 0,
255), 1)
        cv.imshow('frame', frame)
    capture.release()
    cv.destroyAllWindows()
```