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(Autonomous College Affiliated to the University of Mumbai)
NAAC ACCREDITED with "A" GRADE (CGPA : 3.18)

Python Mini Project

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AIM / OBJECTIVE: Virtual Mouse (Track-pad)

Libraries used:

- OpenCV
- Media pipe
- NumPy
- AutoPy

CODE :

Hand Tracking Module:

```
import cv2
import mediapipe as mp
import time
import math
import numpy as np


class handDetector:
    def __init__(
        self, mode=False, maxHands=2, modelComplexity=1, detectionCon=0.5,
trackCon=0.5
    ):
        self.mode = mode
        self.maxHands = maxHands
        self.modelComplex = modelComplexity
        self.detectionCon = detectionCon
        self.trackCon = trackCon

        self.mpHands = mp.solutions.hands
        self.hands = self.mpHands.Hands(
            self.mode,
            self.maxHands,
            self.modelComplex,
```

```
            self.detectionCon,
            self.trackCon,
        )

        self.mpDraw = mp.solutions.drawing_utils
        self.tipIds = [4, 8, 12, 16, 20]

    def findHands(self, img, draw=True):
        imgRGB = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
        self.results = self.hands.process(imgRGB)
        # print(results.multi_hand_landmarks)

        if self.results.multi_hand_landmarks:
            for handLms in self.results.multi_hand_landmarks:
                if draw:
                    self.mpDraw.draw_landmarks(
                        img, handLms, self.mpHands.HAND_CONNECTIONS
                    )

        return img

    def findPosition(self, img, handNo=0, draw=True):
        xList = []
        yList = []
        bbox = []
        self.lmList = []
        if self.results.multi_hand_landmarks:
            myHand = self.results.multi_hand_landmarks[handNo]
            for id, lm in enumerate(myHand.landmark):
                # print(id, lm)
                h, w, c = img.shape
                cx, cy = int(lm.x * w), int(lm.y * h)
                xList.append(cx)
                yList.append(cy)
                # print(id, cx, cy)
                self.lmList.append([id, cx, cy])
                if draw:
                    cv2.circle(img, (cx, cy), 5, (255, 0, 255), cv2.FILLED)

            xmin, xmax = min(xList), max(xList)
            ymin, ymax = min(yList), max(yList)
            bbox = xmin, ymin, xmax, ymax

            if draw:
                cv2.rectangle(
                    img, (xmin - 20, ymin - 20), (xmax + 20, ymax + 20), (0, 255, 0),
2
                )

        return self.lmList, bbox

    def fingersUp(self):
        fingers = []
```

```
        # Thumb
        if self.lmList[self.tipIds[0]][1] > self.lmList[self.tipIds[0] - 1][1]:
            fingers.append(1)
        else:
            fingers.append(0)

        # Fingers
        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)

        # totalFingers = fingers.count(1)

        return fingers

    def findDistance(self, p1, p2, img, draw=True, r=15, t=3):
        x1, y1 = self.lmList[p1][1:]
        x2, y2 = self.lmList[p2][1:]
        cx, cy = (x1 + x2) // 2, (y1 + y2) // 2

        if draw:
            cv2.line(img, (x1, y1), (x2, y2), (255, 0, 255), t)
            cv2.circle(img, (x1, y1), r, (255, 0, 255), cv2.FILLED)
            cv2.circle(img, (x2, y2), r, (255, 0, 255), cv2.FILLED)
            cv2.circle(img, (cx, cy), r, (0, 0, 255), cv2.FILLED)
        length = math.hypot(x2 - x1, y2 - y1)

        return length, img, [x1, y1, x2, y2, cx, cy]


def main():
    pTime = 0
    cTime = 0
    cap = cv2.VideoCapture(0)
    detector = handDetector()
    while True:
        success, img = cap.read()
        img = detector.findHands(img)
        lmList, bbox = detector.findPosition(img)
        if len(lmList) != 0:
            print(lmList[4])

        cTime = time.time()
        fps = 1 / (cTime - pTime)
        pTime = cTime

        cv2.putText(
            img, str(int(fps)), (10, 70), cv2.FONT_HERSHEY_PLAIN, 3, (255, 0, 255), 3
        )
```

```
        cv2.imshow("Image", img)
        cv2.waitKey(1)


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

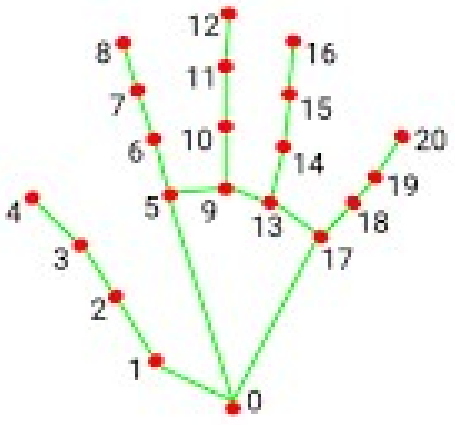
Project(OpenCV):

```
import cv2
import numpy as np
import HandTrackingModule as htm
import time
import autopy

##########################
wCam, hCam = 640, 480
frameR = 100  # Frame Reduction
smoothening = 7
#########################

pTime = 0
plocX, plocY = 0, 0
clocX, clocY = 0, 0

cap = cv2.VideoCapture(0)
cap.set(3, wCam)
cap.set(4, hCam)
detector = htm.handDetector(maxHands=1)
wScr, hScr = autopy.screen.size()
# print(wScr, hScr)

while True:
    # 1. Find hand Landmarks
    success, img = cap.read()
    img = detector.findHands(img)
    lmList, bbox = detector.findPosition(img)
    # 2. Get the tip of the index and middle fingers
    if len(lmList) != 0:
        x1, y1 = lmList[8][1:]
        x2, y2 = lmList[12][1:]
        # print(x1, y1, x2, y2)

        # 3. Check which fingers are up
        fingers = detector.fingersUp()
        # print(fingers)
        cv2.rectangle(
            img, (frameR, frameR), (wCam - frameR, hCam - frameR), (255, 0, 255), 2
        )
        # 4. Only Index Finger : Moving Mode
        if fingers[1] == 1 and fingers[2] == 0:
            # 5. Convert Coordinates
            x3 = np.interp(x1, (frameR, wCam - frameR), (0, wScr))
```

```
            y3 = np.interp(y1, (frameR, hCam - frameR), (0, hScr))
            # 6. Smoothen Values
            clocX = plocX + (x3 - plocX) / smoothening
            clocY = plocY + (y3 - plocY) / smoothening

            # 7. Move Mouse
            autopy.mouse.move(wScr - clocX, clocY)
            cv2.circle(img, (x1, y1), 15, (255, 0, 255), cv2.FILLED)
            plocX, plocY = clocX, clocY

        # 8. Both Index and middle fingers are up : Clicking Mode
        if fingers[1] == 1 and fingers[2] == 1:
            # 9. Find distance between fingers
            length, img, lineInfo = detector.findDistance(8, 12, img)
            print(length)
            # 10. Click mouse if distance short
            if length < 40:
                cv2.circle(img, (lineInfo[4], lineInfo[5]), 15, (0, 255, 0),
cv2.FILLED)
                autopy.mouse.click()

    # 11. Frame Rate
    cTime = time.time()
    fps = 1 / (cTime - pTime)
    pTime = cTime
    cv2.putText(img, str(int(fps)), (20, 50), cv2.FONT_HERSHEY_PLAIN, 3, (255, 0, 0),
3)
    # 12. Display
    cv2.imshow("Image", img)
    cv2.waitKey(1)
```

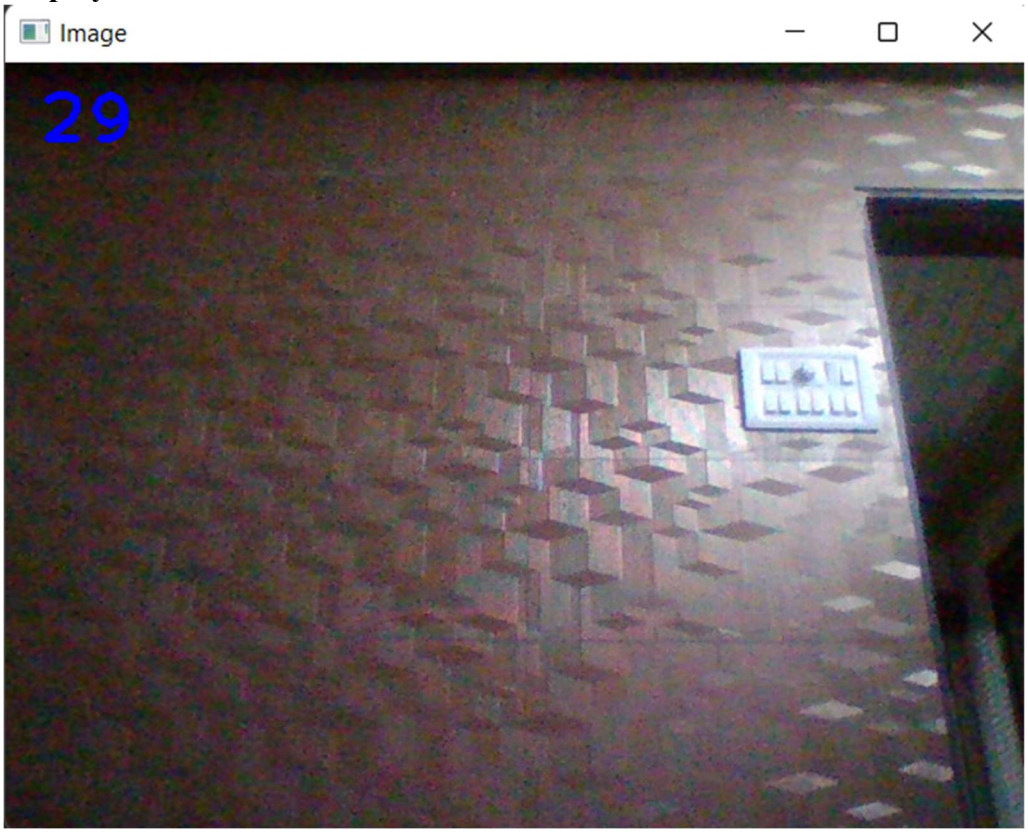
Output:

Hand key points for OpenCV

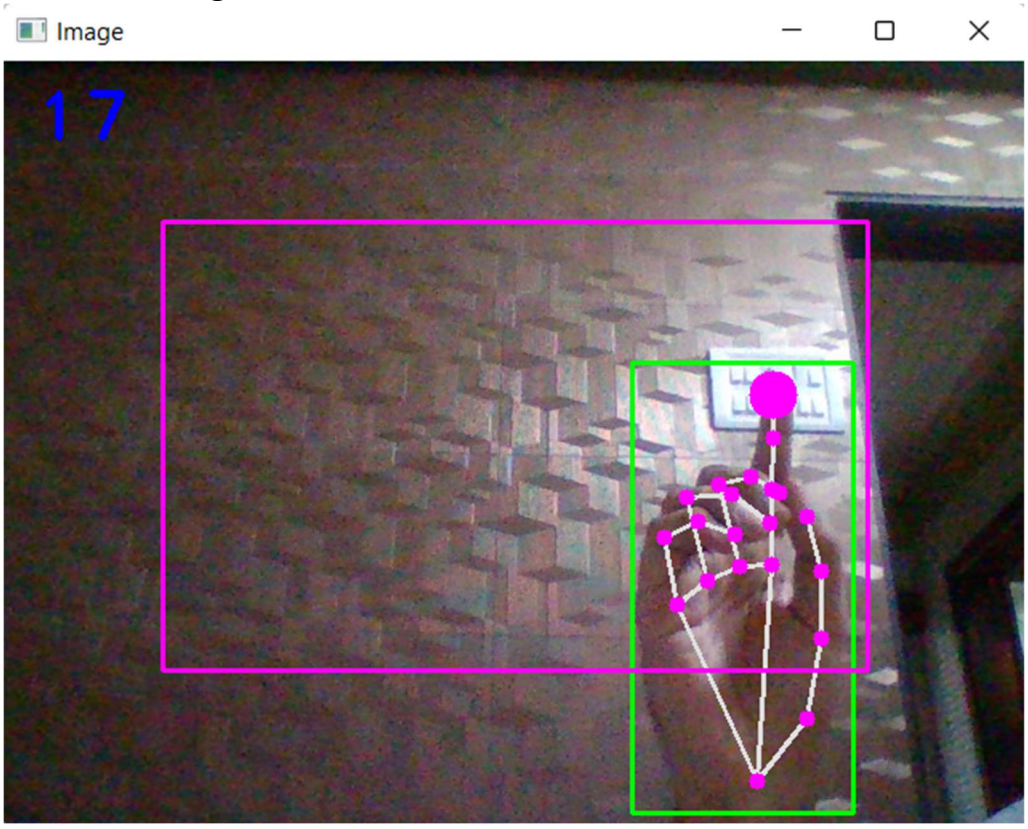


0. WRIST
1. THUMB_CMC
2. THUMB_MCP
3. THUMB_IP
4. THUMB_TIP
5. INDEX_FINGER_MCP
6. INDEX_FINGER_PIP
7. INDEX_FINGER_DIP
8. INDEX_FINGER_TIP
9. MIDDLE_FINGER_MCP
10. MIDDLE_FINGER_PIP
11. MIDDLE_FINGER_DIP
12. MIDDLE_FINGER_TIP
13. RING_FINGER_MCP
14. RING_FINGER_PIP
15. RING_FINGER_DIP
16. RING_FINGER_TIP
17. PINKY_MCP
18. PINKY_PIP
19. PINKY_DIP
20. PINKY_TIP

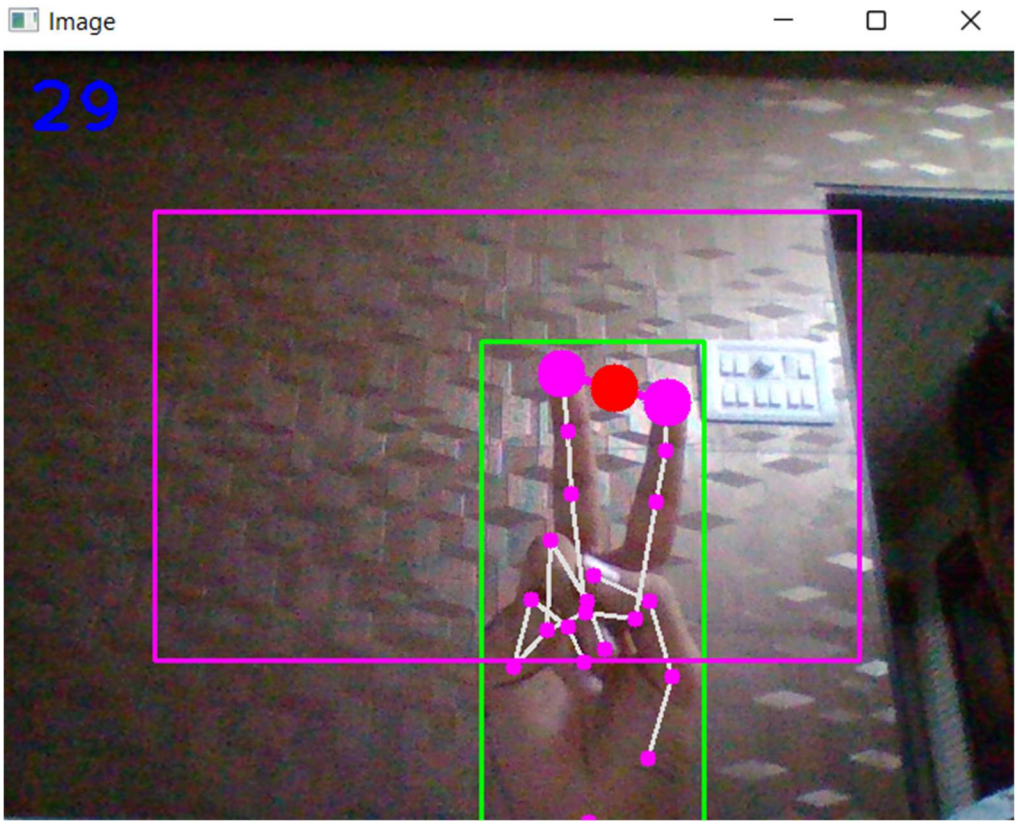
Display Window



Cursor tracking



Clicking mode



It doesn’t detect more than one hand