0616

國立高雄科技大學
National Kaohsiung University of Science and Technology

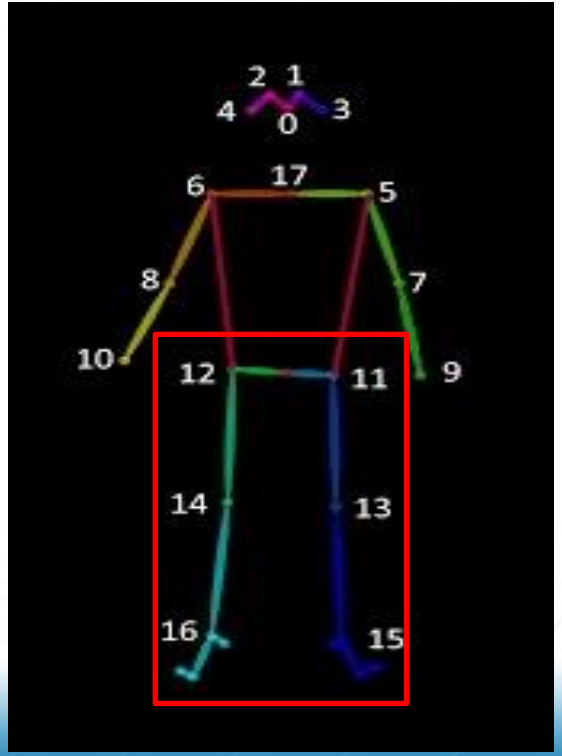
ICPS Lab
智慧網宇實體系統實驗室
Intelligent Cyber-Physical System Lab, ICPS lab.

站立屈膝演算法

動作標準

- 兩腿抬起算一次，抬起高度為站直時，髖骨與膝蓋的中間。

關節點標記(Label)方式

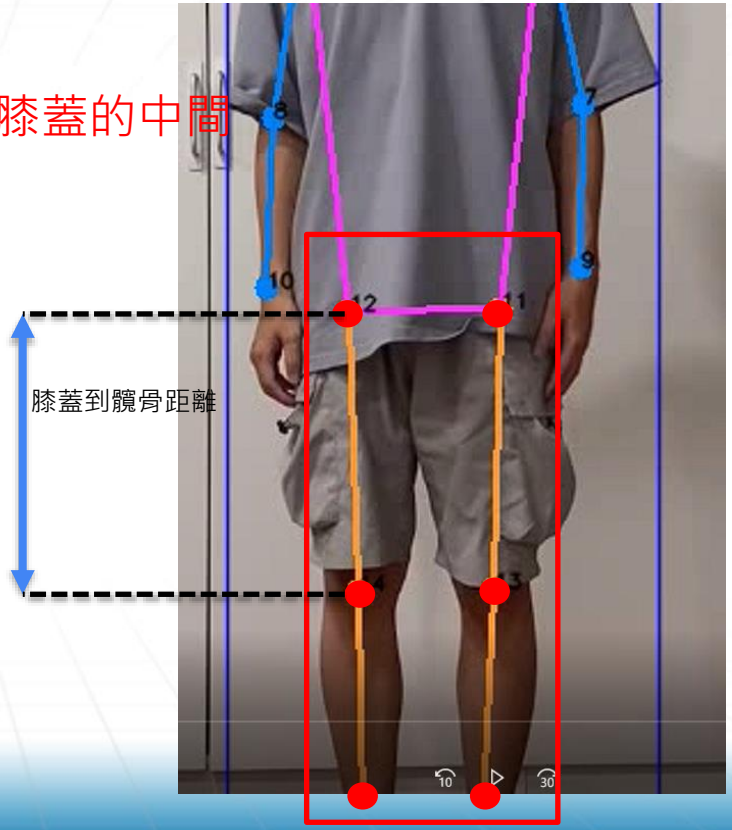


0	鼻子	9	左手腕
1	左眼	10	右手腕
2	右眼	11	左髖骨
3	左耳	12	右髖骨
4	右耳	13	左膝蓋
5	左肩膀	14	右膝蓋
6	右肩膀	15	左腳踝
7	左手肘	16	右腳踝
8	右手肘	17	脖子

抓取標準距離

- 兩腿抬起算一次，抬起高度為站直時，髖骨與膝蓋的中間

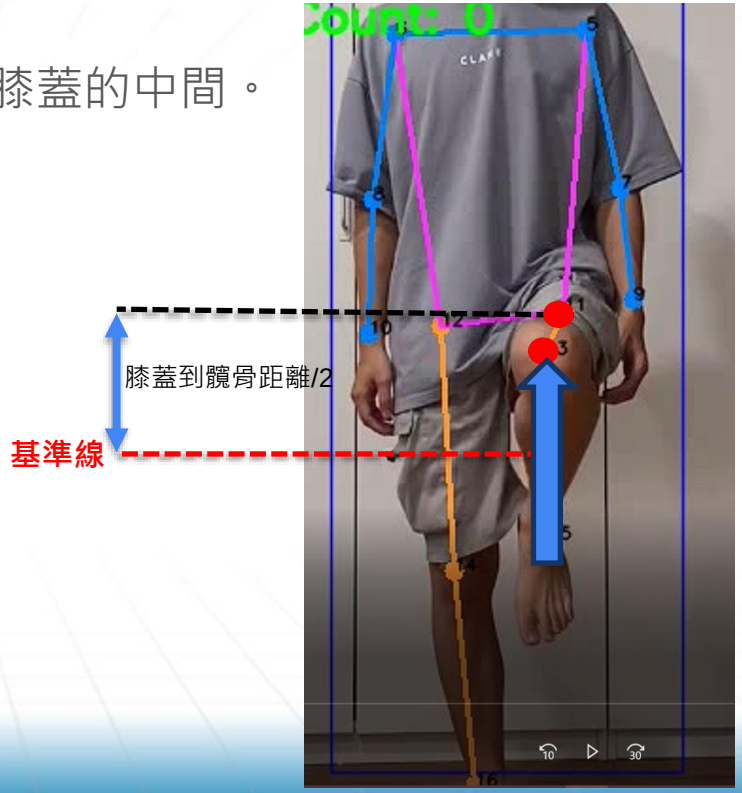
1. 判斷肩膀,髖骨,膝關節,腳踝是否可信
2. 判斷肩膀,髖骨,膝關節是否垂直
3. 判斷肩膀,髖骨,膝關節是否水平
    - 得到結果:當前狀態為站直
    - 抓取膝蓋到髖骨的距離



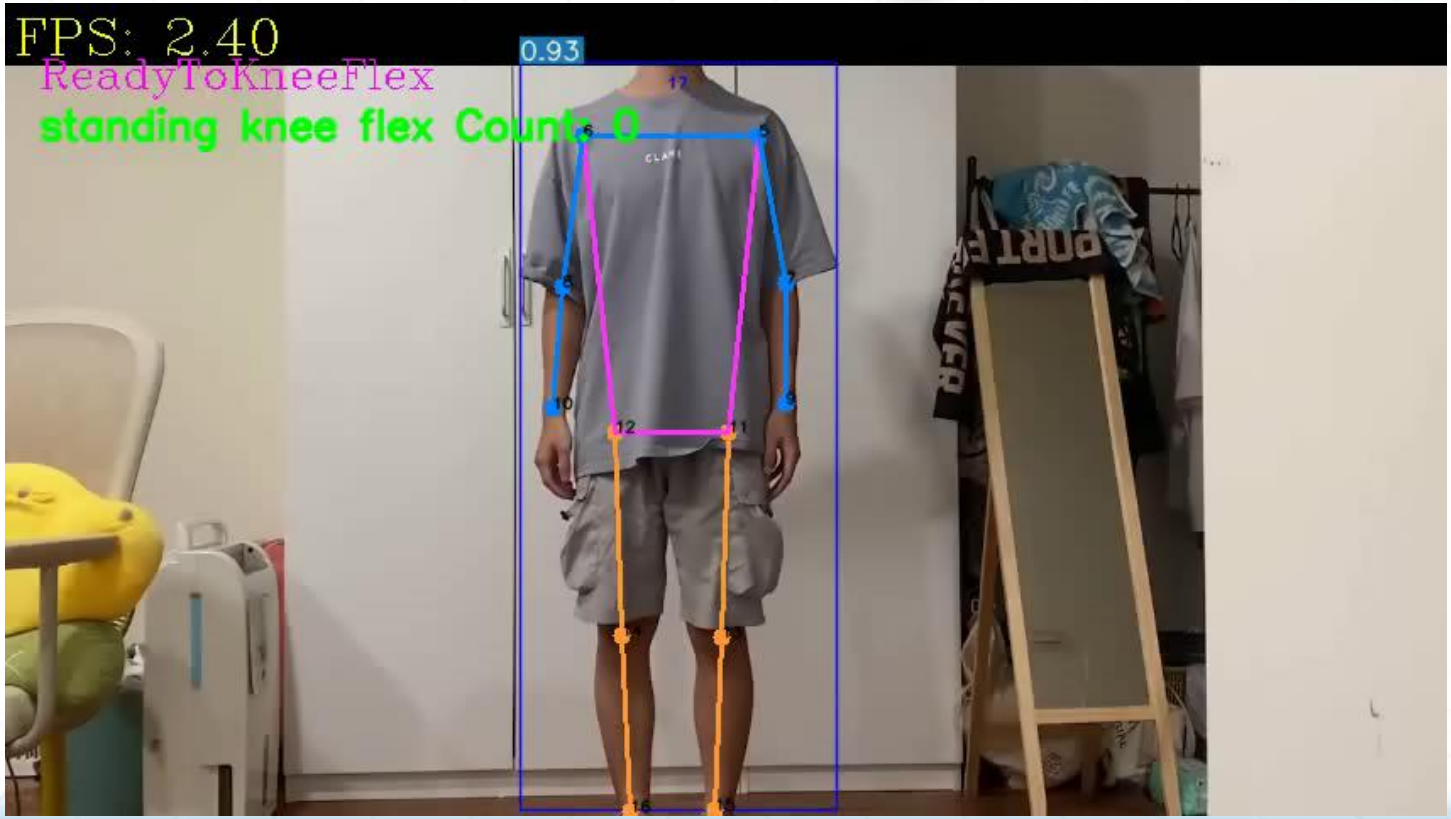
站立屈膝演算法(以左膝為範例演示)

- 兩腿抬起算一次，抬起高度為站直時，髖骨與膝蓋的中間。

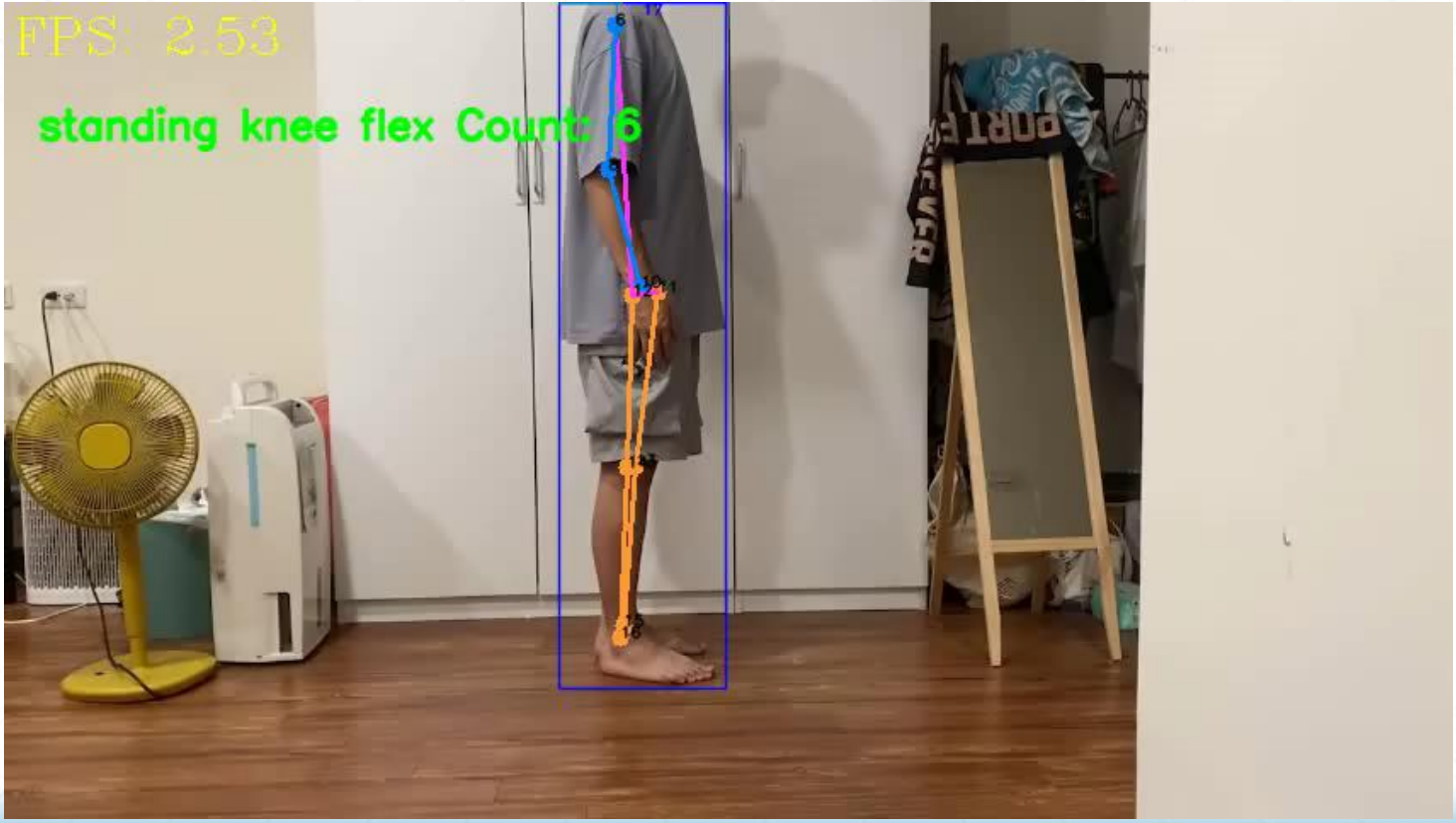
1. 以髖骨關鍵點+膝蓋到髖骨的距離/2為基準點
2. 當膝蓋高於基準點時判斷為一次單邊屈膝
3. 兩邊屈膝各一次則站立屈膝次數+1



正面Demo



側面Demo



補充資料(判斷是否站直)

```python
# 垂直對齊檢查
def is_vertical(a, b, tolerance=20):
    return abs(a[0] - b[0]) < tolerance

# 水平對齊檢查
def is_horizontal(a, b, tolerance=20):
    return abs(a[1] - b[1]) < tolerance
```

```python
# 肩膀和髖部的垂直對齊
vertical_check_1 = is_vertical(shoulders[0], hips[0])
vertical_check_2 = is_vertical(shoulders[1], hips[1])

# 髖部和膝蓋的垂直對齊
vertical_check_3 = is_vertical(hips[0], knees[0])
vertical_check_4 = is_vertical(hips[1], knees[1])

# 肩膀和髖部的水平對齊
horizontal_check_1 = is_horizontal(shoulders[0], shoulders[1])
horizontal_check_2 = is_horizontal(hips[0], hips[1])
horizontal_check_3 = is_horizontal(knees[0], knees[1])
```

```python
# 檢查所有條件
if ( vertical_check_1 and vertical_check_2 and vertical_check_3 and vertical_check_4
    and horizontal_check_1 and horizontal_check_2 and horizontal_check_3 ):
    cv2.putText(im0, f"ReadyToKneeFlex", (20, 50), cv2.FONT_HERSHEY_COMPLEX, 0.8, (255, 0, 255), 1)
    stand_stright_already=True
    #print("true")
    LeftKneeToHip_Distance = np.linalg.norm(left_knee - left_hip)
    RightKneeToHip_Distance = np.linalg.norm(right_knee - right_hip)
    return
```

補充資料(判斷屈膝次數是否增加)

```
if left_knee[1]<left_hip[1]+LeftKneeToHip_Distance*0.67:
    standing_knee_flex_status="left_knee_up"
    cv2.putText(im0, f"Left Knee Up", (20, 110), cv2.FONT_HERSHEY_SIMPLEX, 0.8, (0, 255, 0), 2, cv2.LINE_AA)
elif right_knee[1]<right_hip[1]+RightKneeToHip_Distance*0.67:
    cv2.putText(im0, f"Right Knee Up", (20, 110), cv2.FONT_HERSHEY_SIMPLEX, 0.8, (0, 255, 0), 2, cv2.LINE_AA)
    if standing_knee_flex_status=="left_knee_up":
        standing_knee_flex_count+=1
    standing_knee_flex_status="right_knee_up"
```