Mobileyes

Computer Vision + Human Mobility

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PROJECT STORY

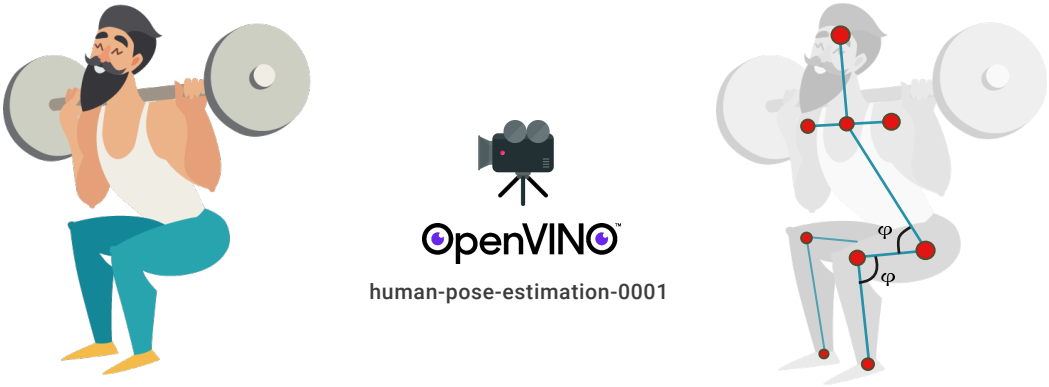
Having run track competitively for 8 years, I figured I knew how to put one foot in front of the other with flawless form. This past January, my body finally decided to let me know that I was wrong. After many icepacks and x-rays, I realized that instead of internalizing the mechanics of efficient running, I had learned what are known as compensation patterns.

Compensation patterns are movement patterns that arise as the body adapts to misalignment in one area by creating a counterbalancing misalignment in another area. In my case, chronic tightness in my hips lead to pronation in my feet, which in turn caused the unpleasant heel pain known as plantar fasciitis.

Since then, I've been re-teaching myself how to correctly perform the most essential everyday movement patterns, such as squatting down to pick up a stack of folded laundry. Along the way, I've become enamored with human anatomy and the mechanics behind our movement.

When I discovered the human-pose-estimation-0001 model in the Open Model Zoo, I saw an exciting opportunity to experience myself move in an entirely new way. Moreover, I imagined how it could accelerate my learning process as well as help others who suffer from the same hidden mobility issues.

PROJECT BLUEPRINT



Using the pose estimation network, we can track the geometry of the user's movements in realtime and benchmark them against a reference pattern to provide a standardized measure of movement execution and efficiency.

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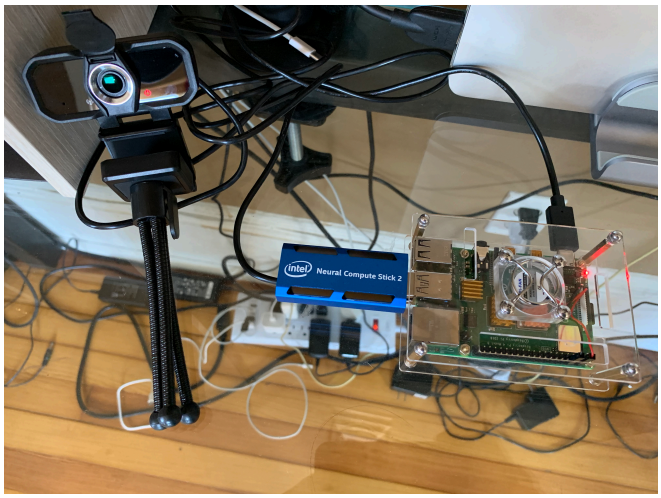
PROJECT SETUP



- Raspberry Pi4 w/ 4GB RAM
- Intel Movidius NCS2
- USB Webcam
- openvino_2020.1.023

PROJECT PROGRESS

```
In [1]: model_type = 'POSE'
        model_xml = './models/human-pose-estimation-0001.xml'
        device_type = 'VPU'
        data = './images/squat-standing.jpg'
```

```
In [11]: model_type = 'POSE'
         model_xml = './models/human-pose-estimation-0001.xml'
         device_type = 'VPU'
         data = './images/squat-seated.jpg'
```




Above, we see the red circles marking the model's keypoint detections for the standing and seated position of the squat. The code snippet below shows the code for drawing the keypoints onto the original input image.

```
In [27]: heatmaps = model_output['Mconv7_stage2_L2']

         for i in range(len(heatmaps[0])):

             # resize heatmap to original input image size
             resized_heatmap = cv2.resize(
                 heatmaps[0][i],
                 image.shape[:2][::-1]
             )

             # find minimum and maximum on confidence map
             _, max_conf, _, max_loc = cv2.minMaxLoc(resized_heatmap)

             # draw circle at each keypoint
             cv2.circle(image, max_loc, 3, (0, 0, 255), thickness=-1, lineType=cv2.FILLED)
```

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PROJECT NEXT STEPS

Looking ahead, my next steps in development are to:

1. Complete drawing algorithm by adding connecting lines

2. Implement the angular calculations at the knee and hip joints

3. Incorporate a VideoStream class to support realtime positioning

My ultimate goal is to provide a realtime side-by-side view comparing a user's current position to a reference shape and use the measurements to provide cues that guide the user to the proper form. This can then be extended to a full movement pattern such as the squat, deadlift, and many more.

With fine-grained feedback being provided in realtime, Mobileyes can help individuals uncover their latent compensation patterns and provide corrective guidance. Over time, this can teach user's to internalize the biomechanics of healthy movement, which will allow for a more active and pain-free life.

Thanks for taking the time to read about my project.
All forms of feedback are welcome and encouraged,
so please reach out to matthew.woop@gmail.com
with any thoughts or comments.

Cheers,

Matt