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Height Calculator
## CSS 487 - Fall Quarter 2019

What we were trying to accomplish:
- Estimate the height of a person using a detectable object in the image as a reference scale to compare to the person

What we did accomplish:
- Estimate the height of a detected person using a detected piece of paper in the image as a reference scale
- Display their estimated height on the piece of paper, or overlay an image on the paper if given

Process
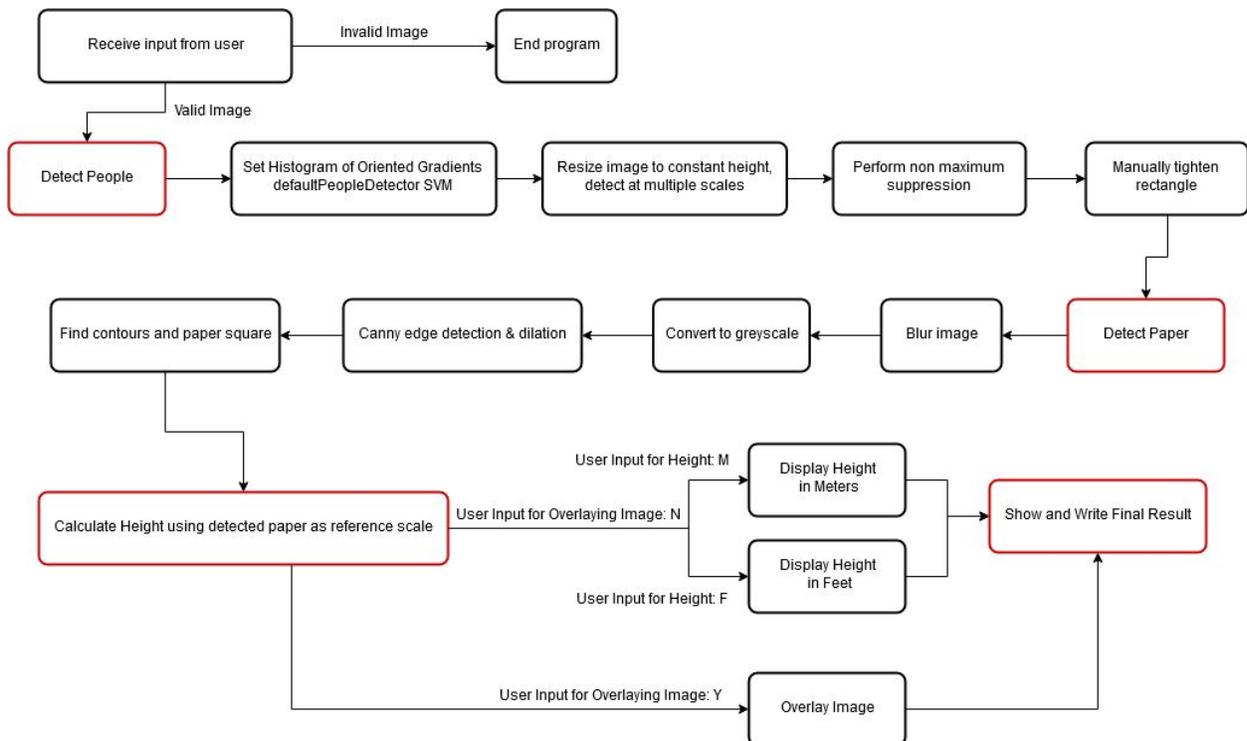
1. Detect People
    a. Set Histogram of Oriented Gradients defaultPeopleDetector SVM
    b. Resize image to constant height for accuracy, consistency in detecting, and speed
    c. Detect at multiple scales
    d. Perform non-maximum suppression
    e. Manually tighten rectangle for common overestimation
2. Detect Paper
    a. Down-scale and upscale image to filter out the noise
    b. Convert the image to grayscale
    c. Apply several threshold levels, Canny edge detection, dilation to remove potential holes between edge segments
    d. Find contours
    e. Find squares in each contour by approximating contours with accuracy proportional to the contour perimeter
3. Calculate Height
    a. Get height of box detecting person.
    b. Store user input values for paper size.
    c. Find pixel length of long edge of detected paper.
    d. Divide pixel length of person box by pixel length of paper box to get multiplicative factor.
    e. Multiply the actual length of the long side of the paper by the multiplicative factor.
    f. Adjust length by a factor of 0.9 to account of overestimation of height in personDetector.
    g. Convert calculated length (in inches) to feet and meters.
4. Show and Write Image
    a. User inputs preferences (see below).
    b. Display image to console with both person box and paper box added. Additionally, displays the calculated height or an overlay image onto the identified paper.

Example Input (Run from IDE):

```
Please input filename you would like to test.
Jamie.jpg
Would you like height displayed in meters or feet? (F or M)
F
Would you like an image ('overlay.jpg') overlayed onto the
paper? (Y or N)
N
```
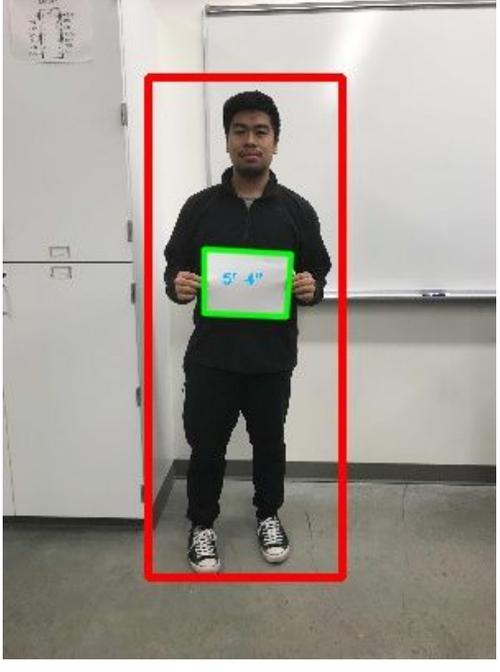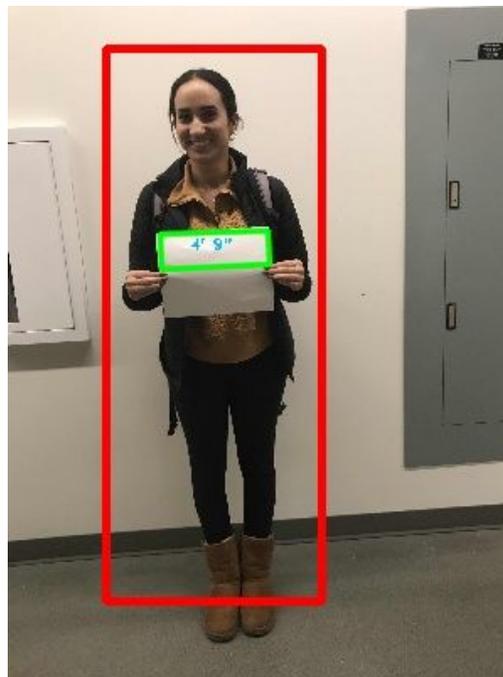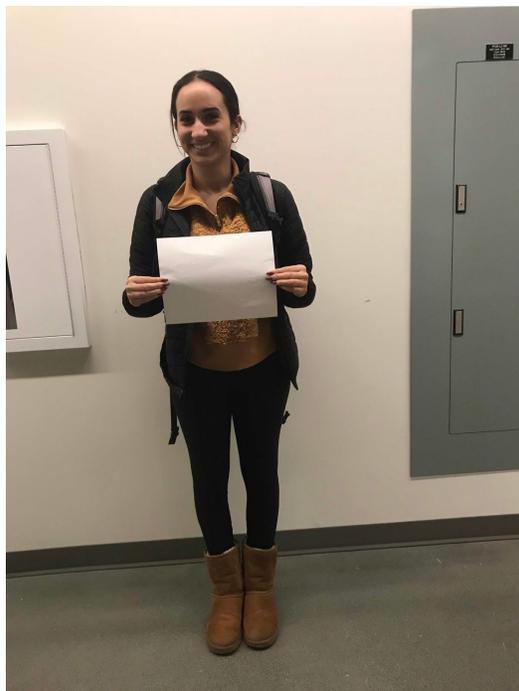
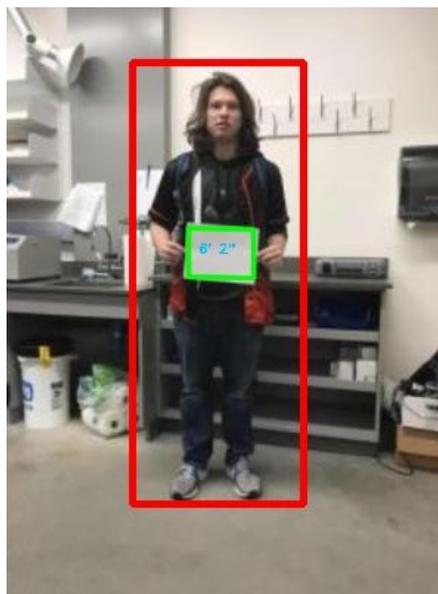Results

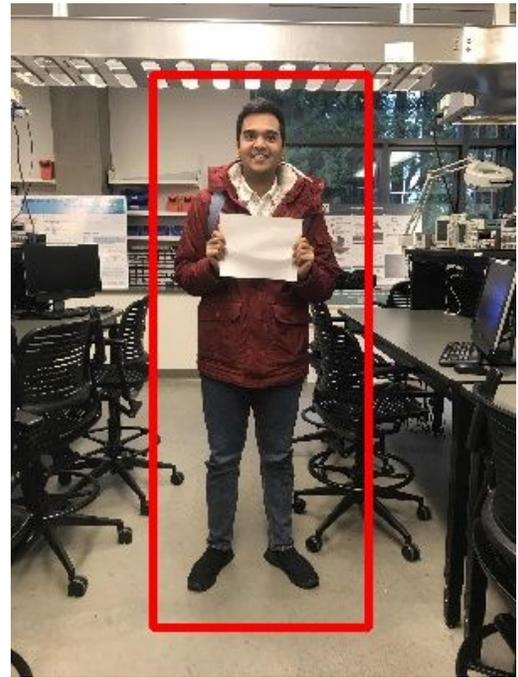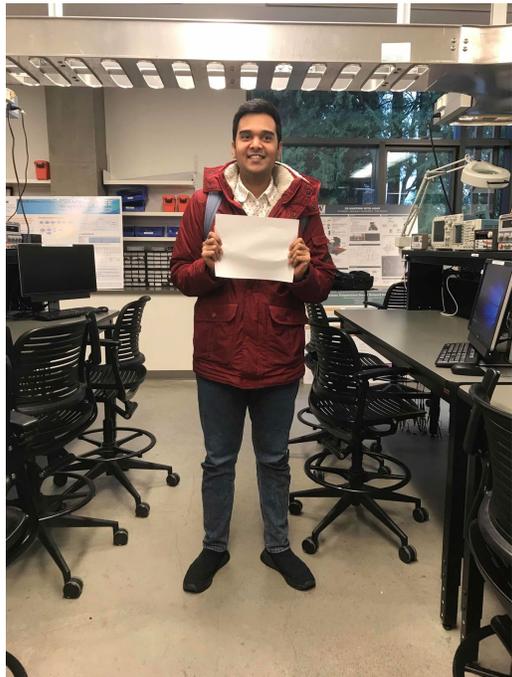| Input	Output
	 Estimated: 5' 4" Actual: 5' 4"
	 Estimated: 5' 11" Actual: 5' 11"

Estimated: 4' 9"
Actual: 5' 4"
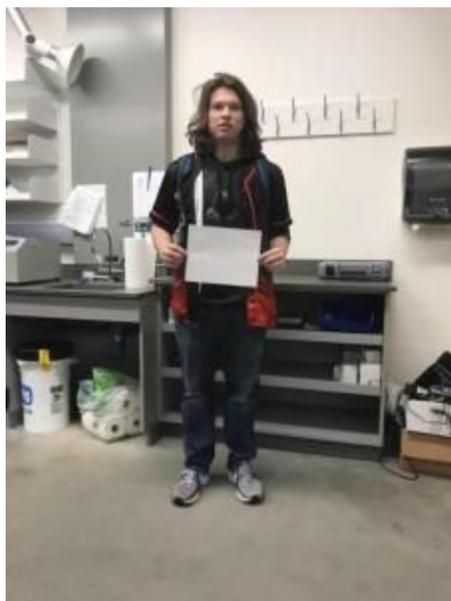
Estimated: 6' 2"
Actual: 5' 9"
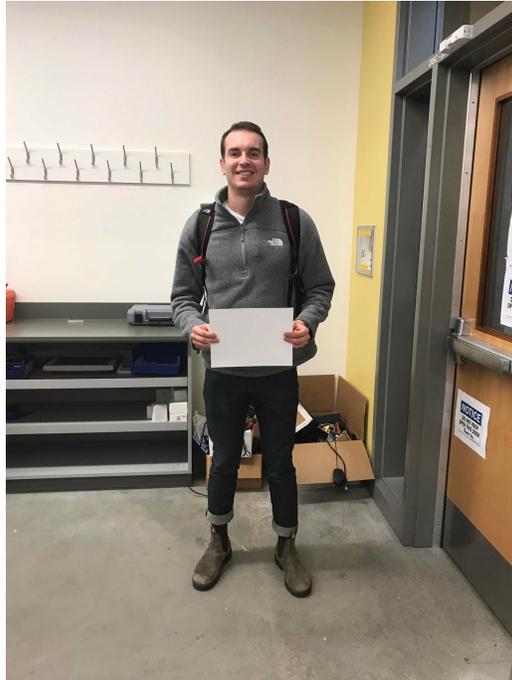
Estimated: 6' 1"
Actual: 6' 0"

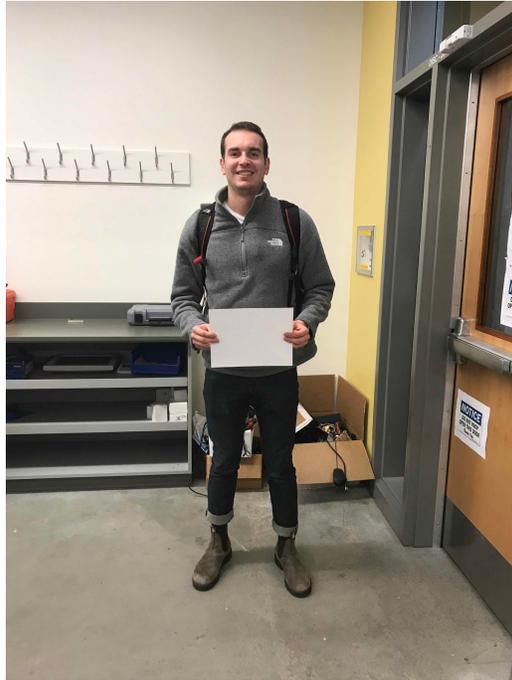Estimated: Paper Not Found
Actual: 6' 2"

Image Overlay on Paper

Lessons Learned:
- Using Histogram of Oriented Gradients for detection
- The difficulties of varying image sizes and how they can affect results and speed
- Calculating the height of something based on a reference scale of pixels
- Using contours
- Using Canny edge detection
- Using ApproxPolyDP
- Difficulties and limitations of Computer Vision
- Overall increased OpenCV knowledge