CS6650 Homework 1 Report

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Smartphone-based Photoplethysmography (PPG)

A. Warmup - Data Collection

I have captured the blood-flow videos using the flash of my phone.

Case 1: resting on the bed (1.mp4)

Case 2: after a moderate walk (2.mp4)

Case 3: after a vigorous exercise (3.mp4).

To get the best results I have reduced the resolution of the videos to 853*480 pixels. Then I read videos and stored frames using Opencv. Also found out the frame count and frames per seconds.

Output:

```
1.mp4, Frame Count: 325.0, FPS: 30.0
2.mp4, Frame Count: 307.0, FPS: 29.0
3.mp4, Frame Count: 323.0, FPS: 30.0
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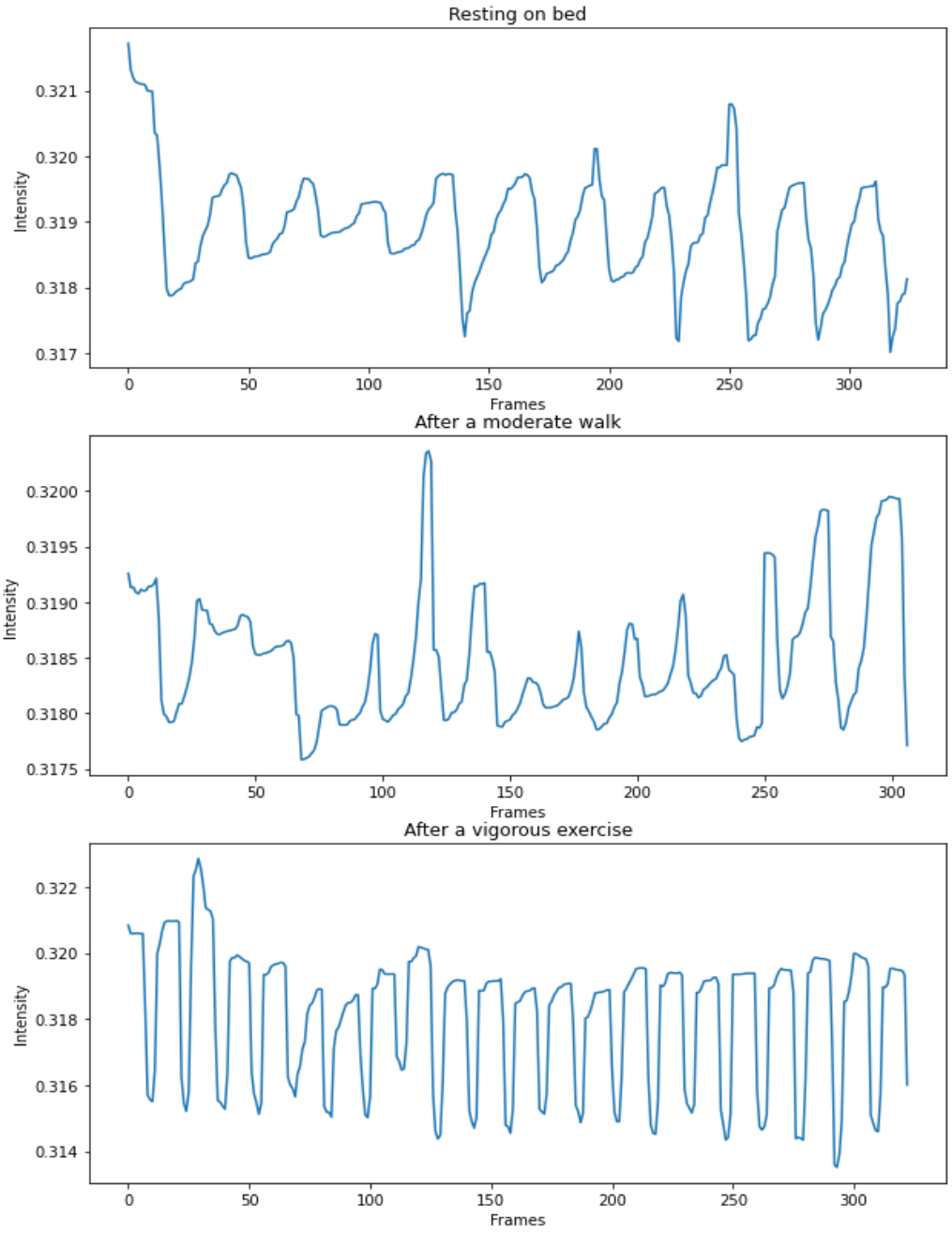
B. Sensing Metric

I have used mean as the sensing metric. First I normalized intensities between 0 and 1. I have found out the mean intensity for each frame in all 3 cases and plotted the mean intensity v/s frame number graph. We can clearly see rapid intensity variations in the running case compared to the resting case.



C. Temporal Variation of Intensity Value

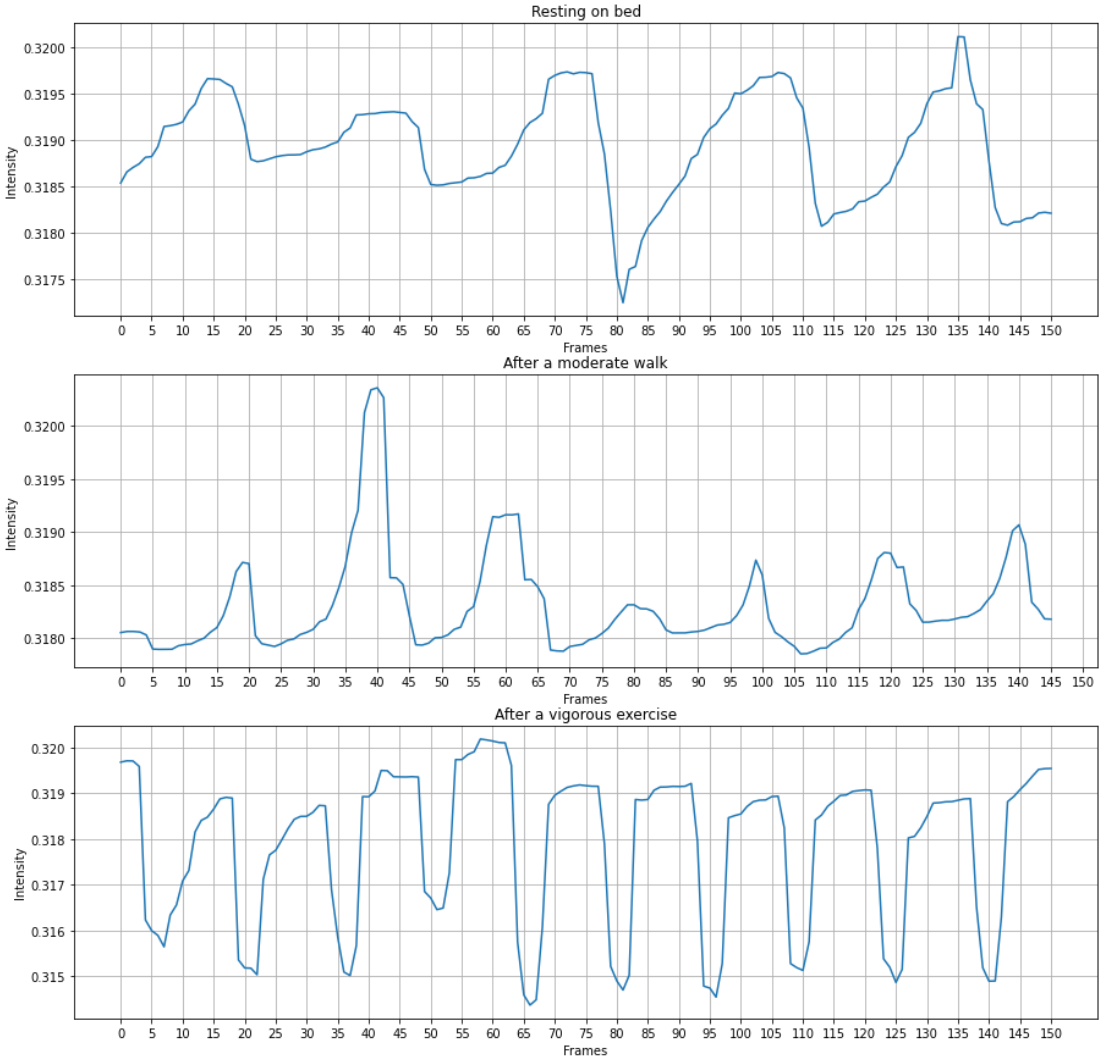
For choosing a random 5- second chunk of three videos. First I chose a random integer. Then starting from that random int frame to 150 frames I collected video frames.

BPM measurement

Case 1(Resting): 5 cycles in 5 secs for 60 secs 5*(60/5) = 60 bpm

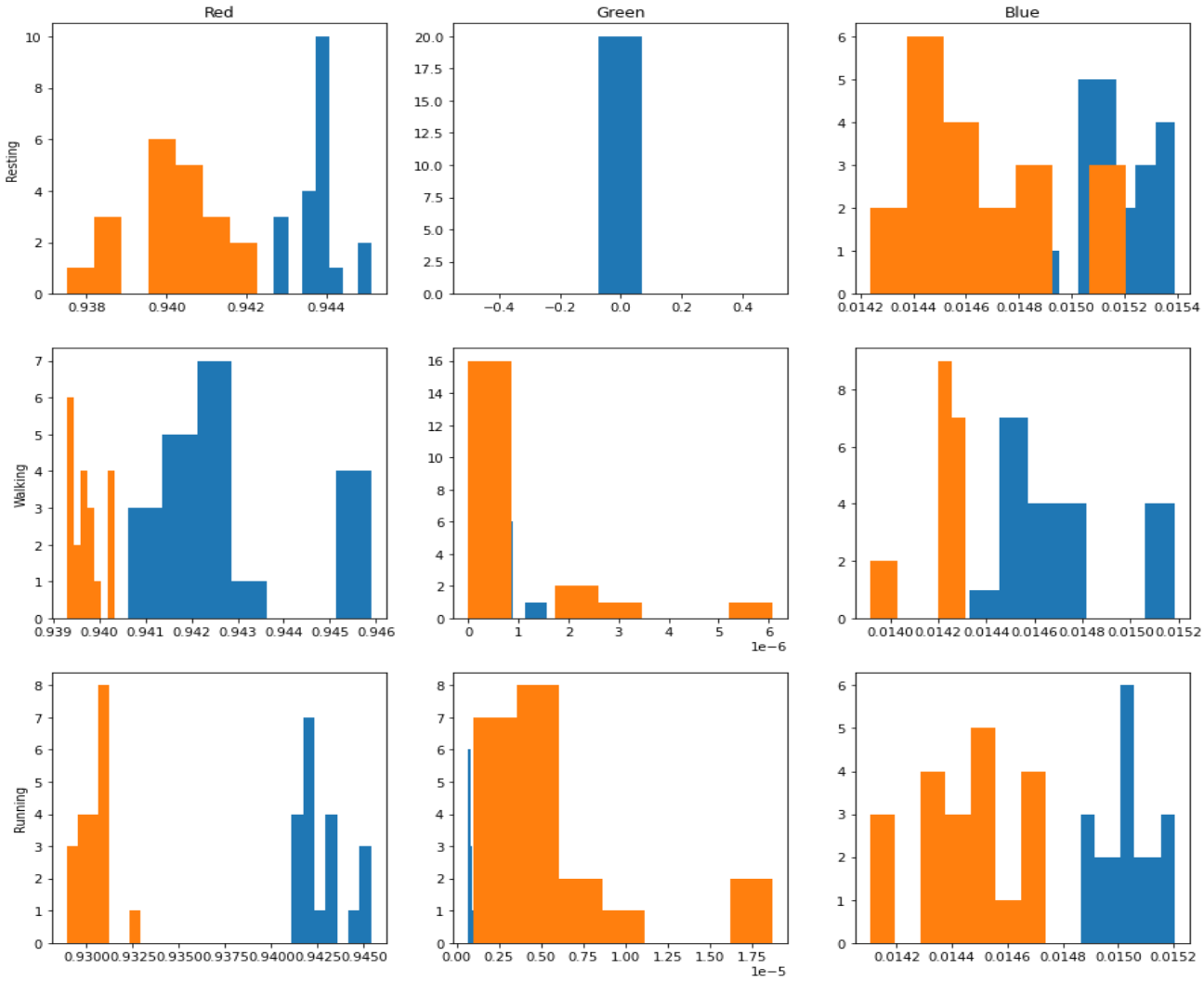
Case 2 (Walking): 7 cycles in 5 secs for 60 secs 7*(60/5) = 84 bpm

Case 3 (Exercise): 9 cycles in 5 secs for 60 secs 9*(60/5) = 108 bpm



D. Likelihood Distributions

I have stored 20 frames which are close to maxima and 20 frames which are close to minima. And plotted histograms for each pixel for R, G, B in 3 cases.
As you can clearly see "R" produces the most separable distributions

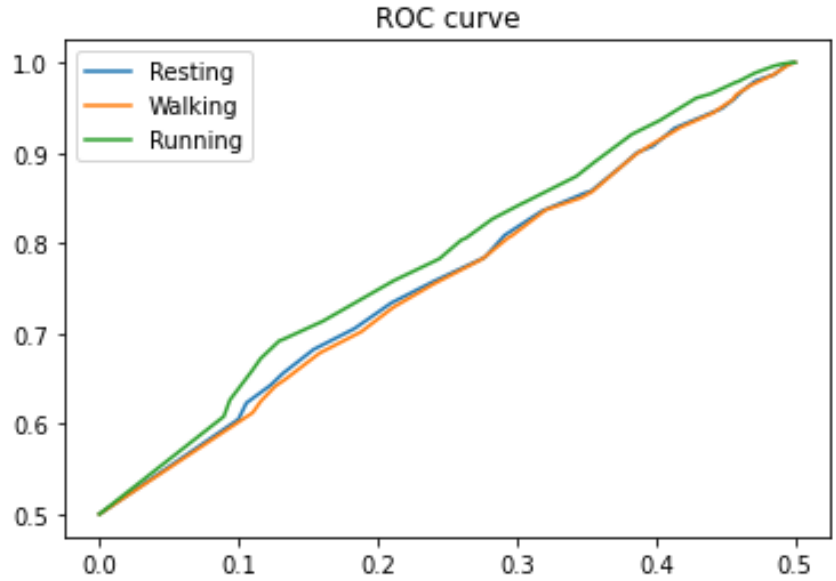


E. Threshold Based Detection and ROC curve

First we need to randomly select 500 pixels from each of 40 frames. Then find
Probability of detection(Pd): counting the pixels which belong to case:1(Maxima) and above the given threshold and dividing it by 20000
Probability of false alarm(Pfa): counting the pixels which belong to case:2(Minima) and above the given threshold and dividing it by 20000

For plotting ROC, i.e Pd v/s Pfa we need to vary the threshold from 0 to 1.

Higher the ROC curve better the performance. As you can see from above the plots, Dataset 3 (Running) has the best ROC curve.



F. Are "good" samples spatially correlated?

From the histograms, we can infer that at Topt = 0.9405 because here Pd is maximum and Pfa is minimum. And the Pd to Pfa ratio is maximum. This threshold will separate case 1 from case 2.

True Positive: pixels which belong to case-1(Maxima) and above the given threshold
True Negative: pixels which belong to case-2(Minima) and below the given threshold
False Positive: pixels which belong to case-2(Minima) and above the given threshold
False Negative: pixels which belong to case-1(Maxima) and below the given threshold

Good Samples - True Positive and True Negative
Bad Samples - False Positive and False Negative

Then plotted good samples and bad samples
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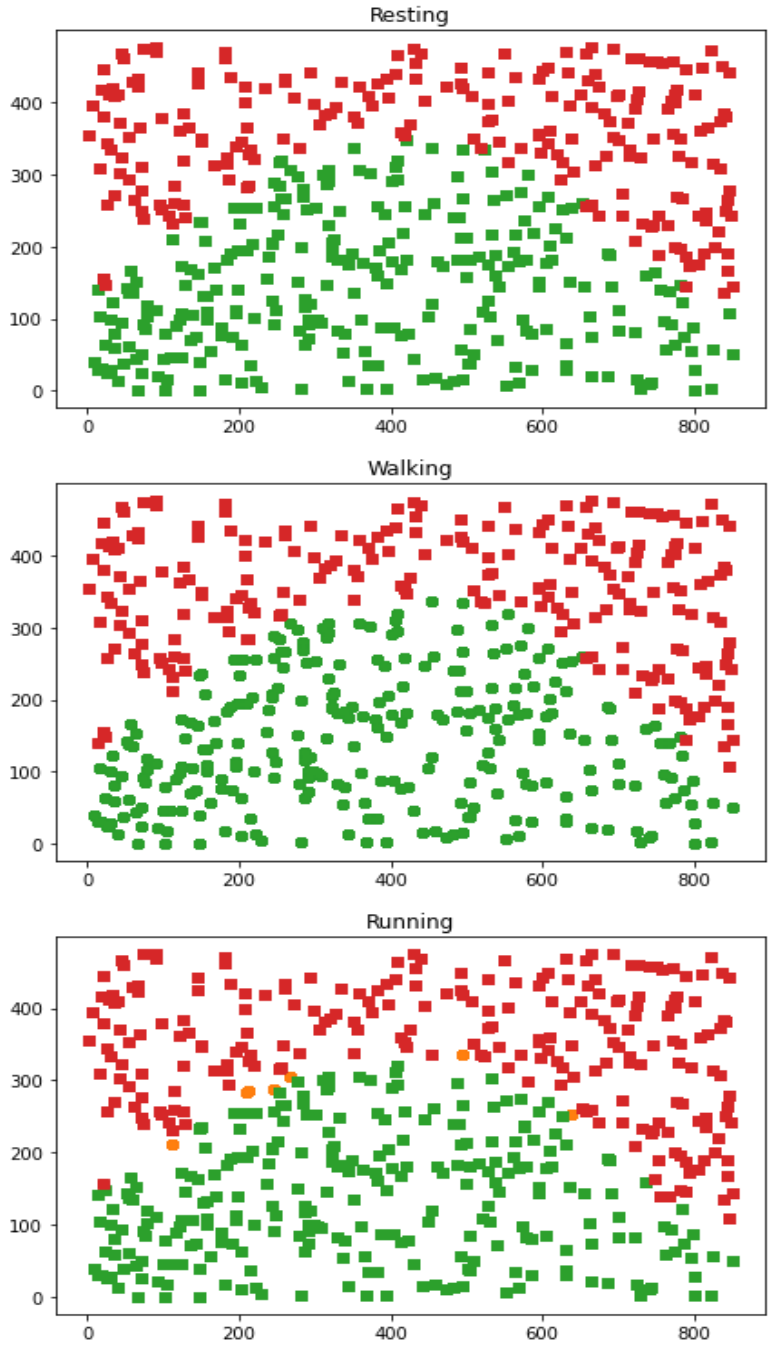

Good samples are in green and negative samples are in red.

We can clearly see from the plots that good samples and bad samples are spatially correlated. The good samples are concentrated at the center and the bad samples are crowded at the corners