CS48007: 1st Assignment, Part 1

Group 7

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1 Visualizing Data

After preprocessing data which includes removing gravity (subtracting the mean value from each acceleration axis), calculating magnitude and applying low pass filter we get following two plots for every motion. First plot represents raw x, y and z values from sensor and the second one shows values after preprocessing. Additionally, in our values, 1 unit represents 9.81 $\frac{\text{m}}{\text{s}^2}$ of acceleration since we are plotting data from an iOS app.

1.1 Standing

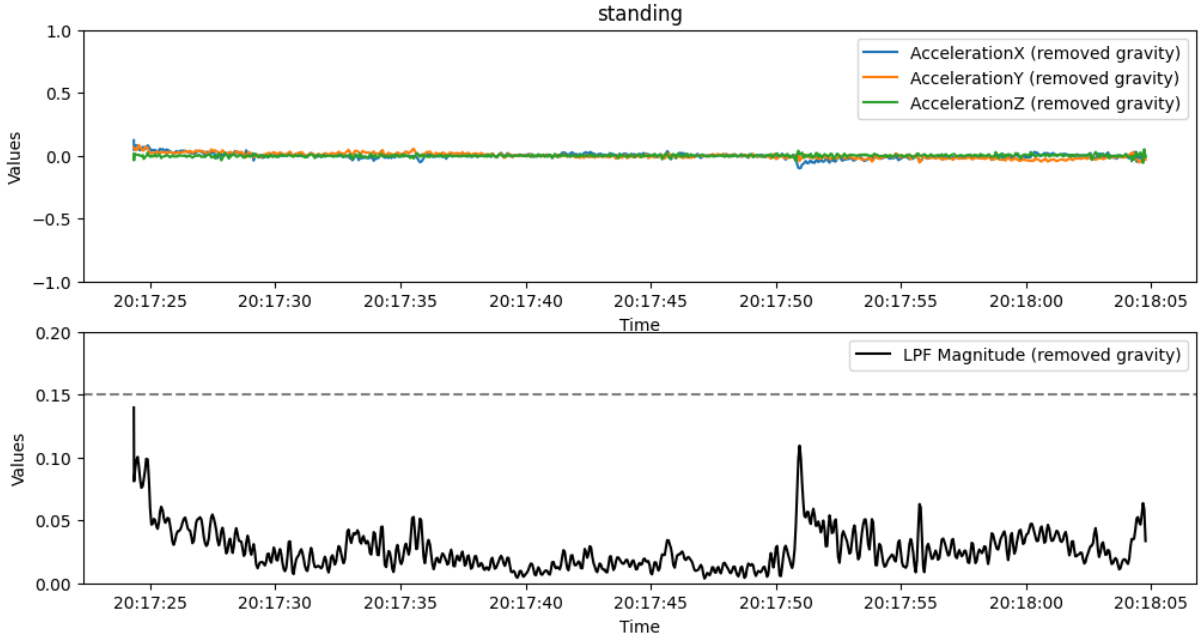

Figure 1: Plots for standing motion

When we plot standing motion we can see that the magnitude spikes are very minimal, in our case:

$$standing\_magnitude \approx [0, 0.15]$$

This is because the phone is mostly stationary during standing with occasional slight movements. So we can use this feature to ignore them if the magnitude values are close to 0 with some allowed deviation and classify the motion as standing or in next case as sitting.

1.2 Sitting

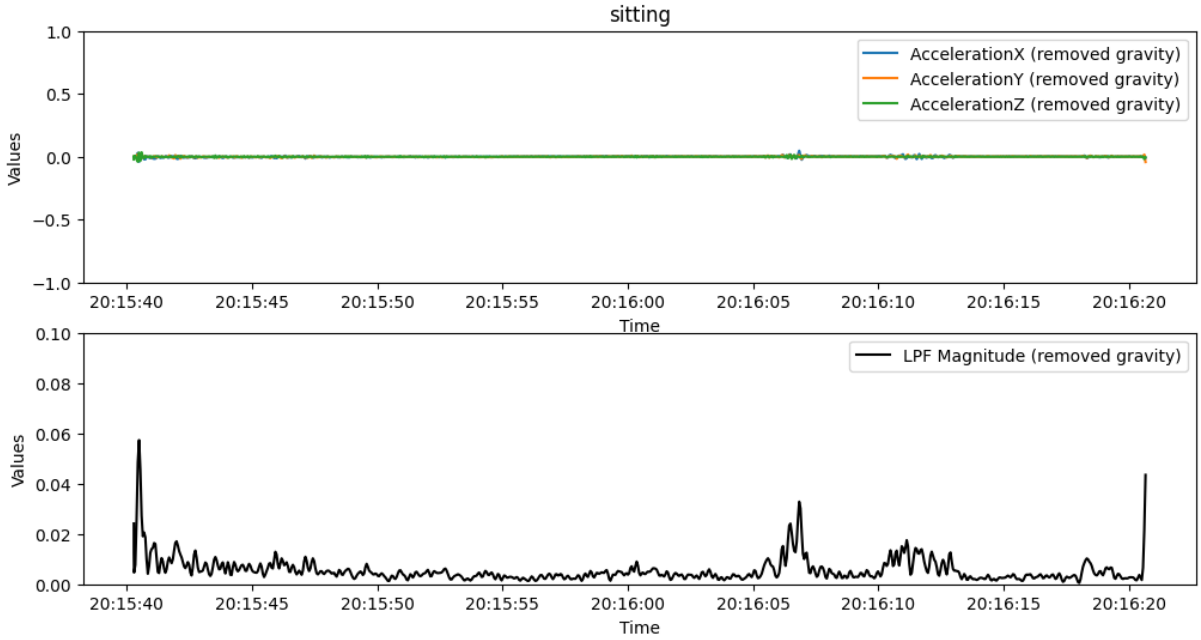

Figure 2: Plots for sitting motion

As we can observe, the sitting motion gives us similar plots as standing. But in this case we can notice that the spikes have even smaller peaks:

$$sitting\_magnitude \approx [0, 0.05]$$

During sitting we usually do less motion then when standing and we can apply this fact to distinguish between the two. So again, we could check if the magnitude values are close to 0 with some allowed deviation. Then we compare extremes to some threshold variable that we would define. For example, in our case that could be $magnitude\_threshold = 0.1$. If certain percentage of values would be above that threshold we would classify that as standing or if below as sitting. But there can be a case when person is slightly moving during sitting (e.g. balancing a chair or rotating left and right) and that would give us false standing.

1.3 Walking

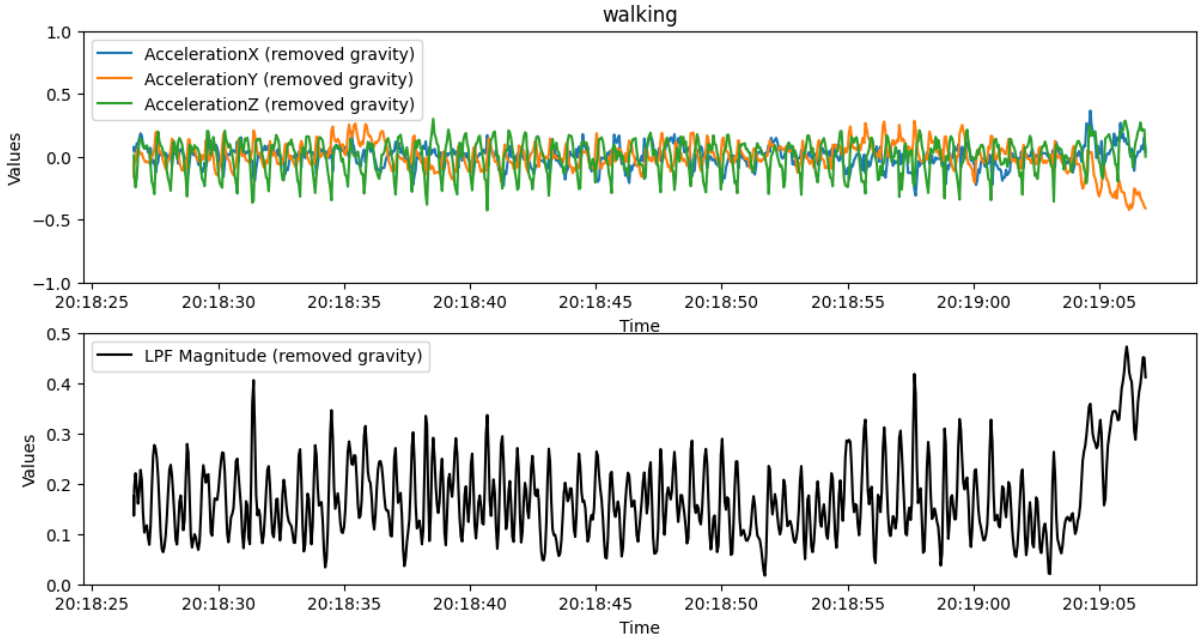

Figure 3: Plots for walking motion

After plotting the walking motion we can notice obvious repeating spikes which have much greater extremes than during sitting or standing:

$$walking\_vmagnitude \approx [0, 0.5]$$

Every peak of the spike in our case represents one step and we can use that to count the number of steps. So here our feature is a peak above certain height. The actual implementation of step counting can be achieved with sliding window algorithm.

1.4 Running

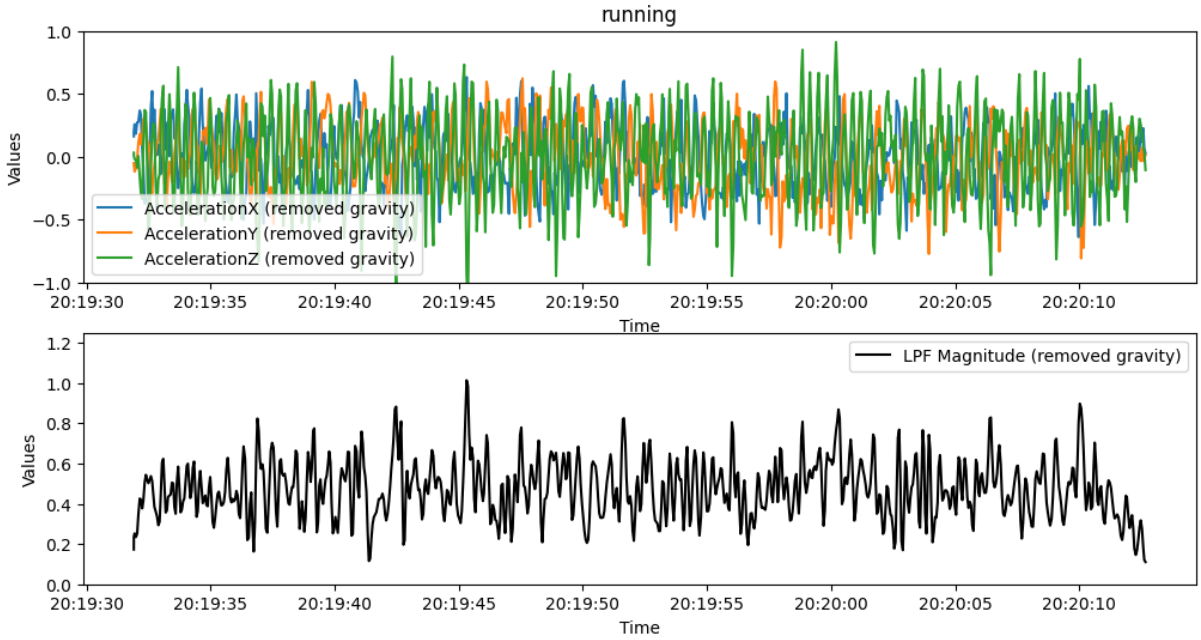

Figure 4: Plots for running motion

Plot for running is similar to walking but we can notice that the spikes are more frequent and have larger extremes (can even approach values close to 1). We can take a same approach as we did with walking and count the peaks with sliding window algorithm. Our feature here can be step frequency and we could define a frequency threshold. If the step frequency is greater than threshold we classify that as running otherwise as walking. Also comparing the heights of peaks can give us more accurate estimation since in the case of running motion they are larger.