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Mobile Computing
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Lab 1 Report

Algorithm Design

Through a graphic analysis of the accelerometer and gyroscope data for activities in the training set, we observed that the variation of sensor data in the direction of different axes was sufficiently indicative of the correct activity. Consequently, we were able to parse the data and extract the variance of the x-, y-, and z- axes of both the accelerometer and gyroscope to find thresholds for our classification.

From our calculations, we were able to derive the following thresholds:

- If the standard deviation of the acceleration on the z-axis is greater than 600, we predict that the activity is jumping. This is a reasonable metric, as jumping is the only activity that would produce a large variance in vertical acceleration.
- If the sum of the x- and y-axis standard deviations of the rotational motion sums to greater than 200, we predict that the activity is walking. Walking seemed to have produced higher rotational movements compared to the later activities, which only rotated in the z-axis or not at all.
- If the standard deviation of the rotational motion along the z-axis is greater than 150, while motion along the other axes is less than 200, we predict the activity is driving. This is intuitive because there would be rotational motion in the form of turning in the z-axis, which is indicative of driving. Furthermore, changes in the x- and y-axes are not substantial enough to indicate driving, where a high variance in rotational motion in these directions would not make sense.
- Lastly, if the standard deviation of the aforementioned sensor metrics is less than those thresholds, we predict that the activity is standing. Since any variance in the gyroscope and accelerometer readings high enough to be a different activity would be captured by our previous thresholds, we can safely infer that the last activity is standing, as all rotational motion and acceleration in all directions remains relatively constant.

Our algorithm uses the described thresholds to classify between the four activities.

Code Explanation

We used Pandas for making our data more easy to make computations on, as well as matplotlib for interpreting our data

- read_txt_file(filepath): reads and parses the given file into a dictionary

- calculate_speed: uses accelerometer data to calculate average speed. To do this first we get approximate velocity at each point in time by using the equation v_t = v_{t-1}+a_t*dt. We did this for both the x and y directions. Then, we used these velocities to calculate the speed at each point in time. Lastly, we used Riemann integration and the Average Value Theorem to calculate the average speed.
- classify(path): takes the path to a directory of activity text files and writes the predicted activities into “results.txt”. Predictions are calculated through the algorithm described above.

Results

Activity	**Prediction**	**Speed (mm/s)**
1	Jumping	
2	Driving	201.348461
3	Driving	251.384577
4	Standing	
5	Standing	
6	Standing	
7	Walking	
8	Walking	
9	Driving	638.812241
10	Standing	
11	Jumping	
12	Jumping	
13	Standing	
14	Standing	
15	Walking	
16	Walking	

17	Driving	633.974092
18	Jumping	
19	Walking	
20	Driving	294.959167
21	Driving	320.608231
22	Jumping	
23	Jumping	
24	Walking	