Daily Activity Tracking

Efficacy of Minimalist Tracking of Daily Human Activities

John Endris

Introduction & Background

-There are many people around the world who suffer from memory loss

-TBI (Traumatic Brain Injury)

-Alzheimer's

-Help tracking daily tasks

-Looking for unobtrusive solution

Activities

1. Cooking Eggs
   1. Only the stovetop
2. Handwashing Dishes
3. Walking
4. Folding Laundry
   1. Sitting down
5. Shaving
   1. Rotary Razor
6. Brushing Teeth
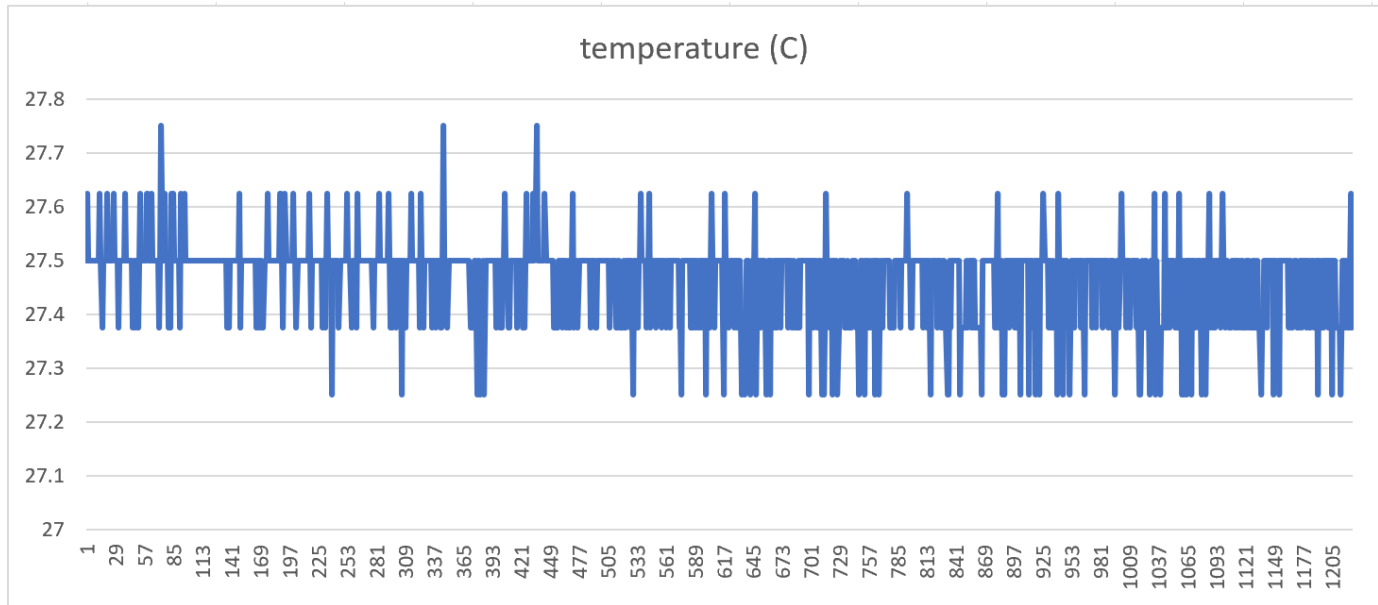   1. Non-electric toothbrush

Data Collection Methods
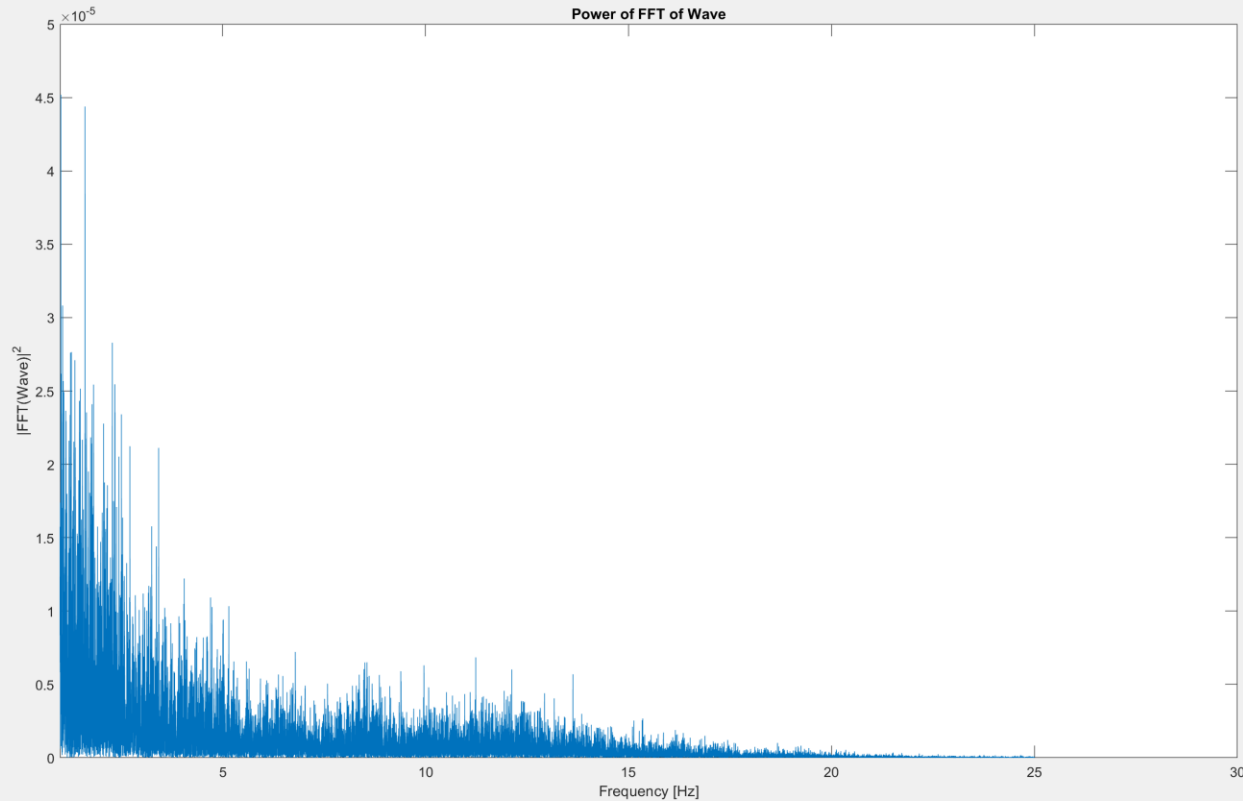
- Sensor Placement: Wrist

-        - Want sensor to be convenient

- Sensors Used: Accelerometer, Gyro

- Sampling Rate: 50 Hz

- Wanted Continuous activities
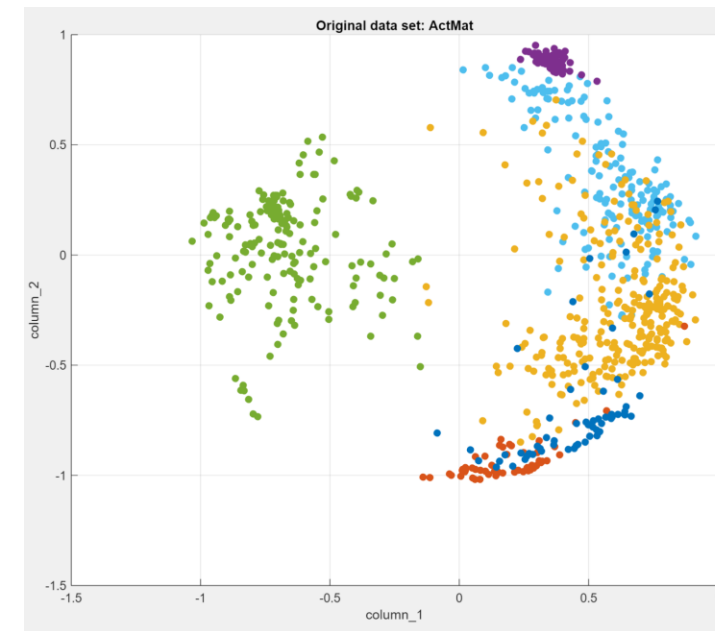 - Took timestamps of start and end of each activity

Heat Test

temperature (C)

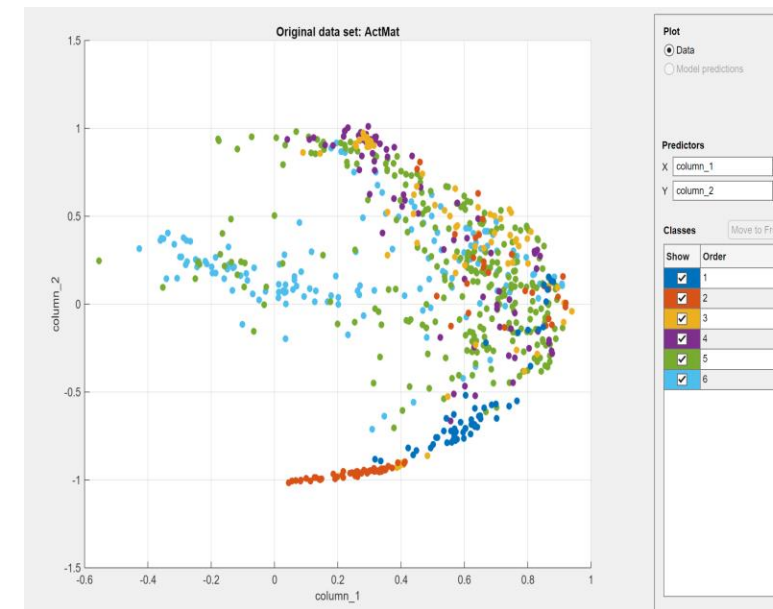-The temperature did not change significantly while cooking

3

Data Collection

-3 Sets of data was collected total

-The first set was continuously measured

-The 2nd and 3rd sets were piecemeal

2

1

Features Selection Using MRMR Algorithm: Set 3

#	Feature Name
1	Mean Accelerometer X
2	Mean Accelerometer Y
3	Mean Accelerometer Z
4	Mean Gyro X
5	Mean Gyro Y
6	Mean Gyro Z
7	Variance Acc. X
8	Variance Acc. Y
9	Variance Acc. Z
10	Variance Gyro X
11	Variance Gyro Y
12	Variance Gyro Z
13	Acc. Power X Band 1
14	Acc. Power Y Band 1
15	Acc. Power Z Band 1
16	Acc. Power X Band 2
17	Acc. Power Y Band 2
18	Acc. Power Z Band 2
19	Acc. Power X Band 3
20	Acc. Power Y Band 3
21	Acc. Power Z Band 3
22	Acc. Power X Band 4
23	Acc. Power Y Band 4
24	Acc. Power Z Band 4
25	Acc. Power X Band 5
26	Acc. Power Y Band 5
27	Acc. Power Z Band 5

Feature Ranking Algorithm

| None | MRMR | Chi2 | ReliefF | ANOVA | Kruskal Wallis |

Feature Selection

◉ Select highest ranked features

Num features to keep   10

◯ Select individual features

| Add All | Remove All |

	Select	Features	MRMR	
1	☑	column_2	0.5315	
2	☑	column_12	0.4888	
3	☑	column_4	0.3134	
4	☑	column_20	0.0420	
5	☑	column_21	0.0385	
6	☑	column_13	0.0349	
7	☑	column_3	0.0345	
8	☑	column_1	0.0335	
9	☑	column_10	0.0308	
10	☑	column_9	0.0304	
11	☐	column_26	0.0297	
12	☐	column_22	0.0276	
13	☐	column_7	0.0271	
14	☐	column_8	0.0256	
15	☐	column_15	0.0253	
16	☐	column_6	0.0247	
17	☐	column_14	0.0224	
18	☐	column_16	0.0219	
19	☐	column_11	0.0213	
20	☐	column_23	0.0198	
21	☐	column_27	0.0194	

ℹ No draft models exist. Options will be applied to future models created using the Models gallery.

Choosing Features

-Using the MRMR algorithm I determined that the top three features were most important

-However, during testing, I found that the top ten yielded the most accurate models

-One feature stood out above the rest in all sets, that being the mean of the accelerometer data in the y-axis. It was the top feature in every model. The next most important features were variance gyro data Z-axis, and the mean gyro X-axis, the mean gyro X-axis, and the 4rth power band in the Z-axis.

|			
☆	**1** Tree		Accuracy (Validation): 58.5%
	Last change: Removed 17 features		10/27 features
☆	**2.1** Tree		Accuracy (Validation): 58.5%
	Last change: Fine Tree		10/27 features
☆	**2.2** Tree		Accuracy (Validation): 68.4%
	Last change: Medium Tree		10/27 features
☆	**2.3** Tree		Accuracy (Validation): 58.0%
	Last change: Coarse Tree		10/27 features
☆	**2.4** KNN		Accuracy (Validation): 60.4%
	Last change: Fine KNN		10/27 features
☆	**2.5** KNN		Accuracy (Validation): 68.1%
	Last change: Medium KNN		10/27 features
☆	**2.6** KNN		Accuracy (Validation): 67.4%
	Last change: Coarse KNN		10/27 features
☆	**2.7** KNN		Accuracy (Validation): 67.8%
	Last change: Cosine KNN		10/27 features
☆	**2.8** KNN		Accuracy (Validation): 67.7%
	Last change: Cubic KNN		10/27 features
☆	**2.9** KNN		Accuracy (Validation): 59.6%
	Last change: Weighted KNN		10/27 features
☆	**3** Ensemble		Accuracy (Validation): 71.3%
	Last change: Boosted Trees		10/27 features

Model Analysis

-I just tested a bunch of models and looked for the most accurate ones

-Best Choices: KNN Cosine, KNN Medium, Boosted Trees

-Boosted Tree Accuracy: 71.3%

7/10/2025

9

Boosted Tree Model From Set 3
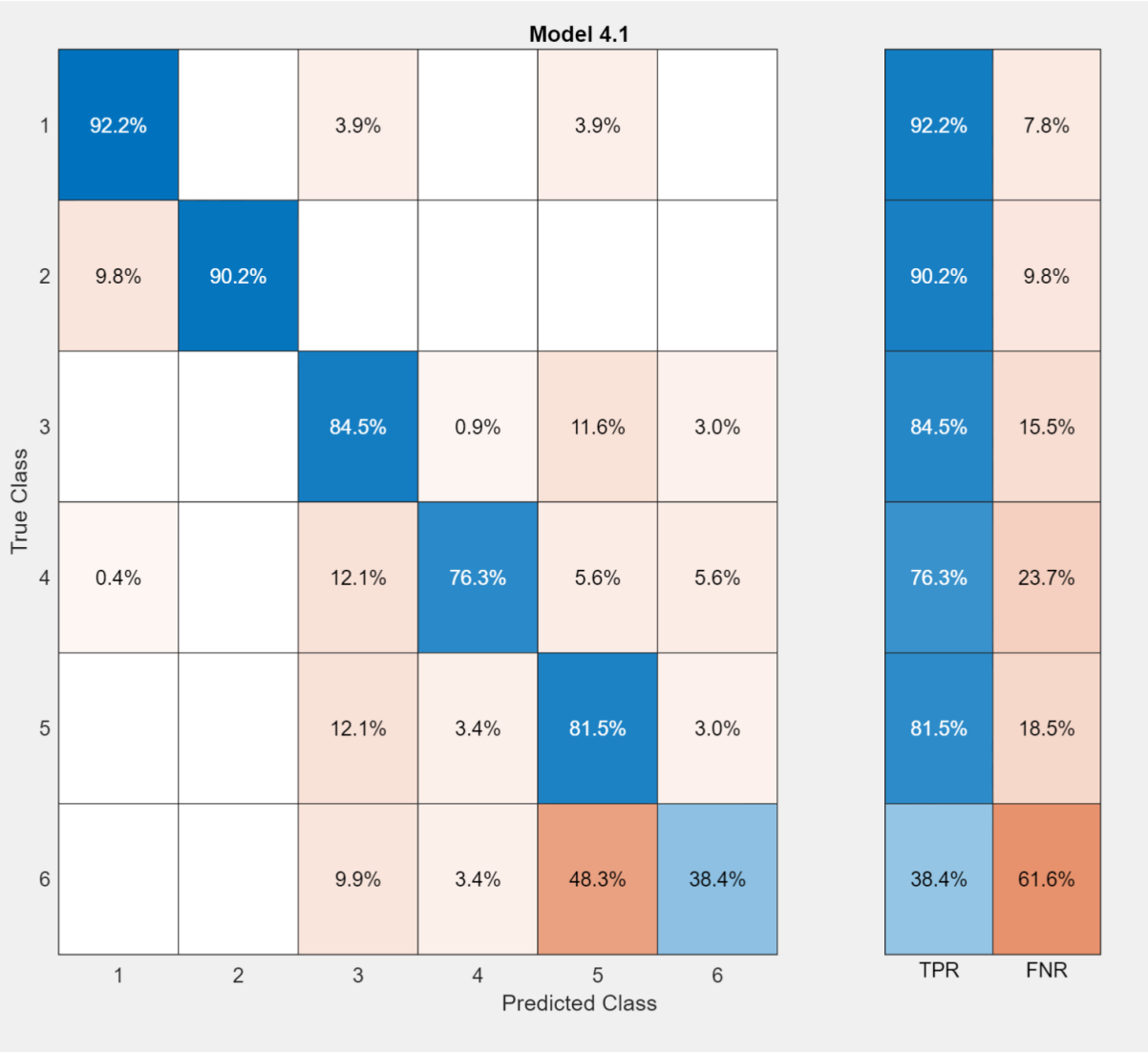
Viewing the confusion matrix of the Boosted Tree Ensemble, we see that brushing teeth and shaving once again have the highest accuracy of correct labeling. The least accurate feature was by far the washing of the dishes. This makes a ton of sense as the dishes that were washed varied greatly. In the first set, pots and pans were washes, however all that I had to wash the second and third time were silverware. This washing was confused with cooking 48.3% of the time. However, the rest of the activities were all above 70% TPR which is excellent.

ROC Curves
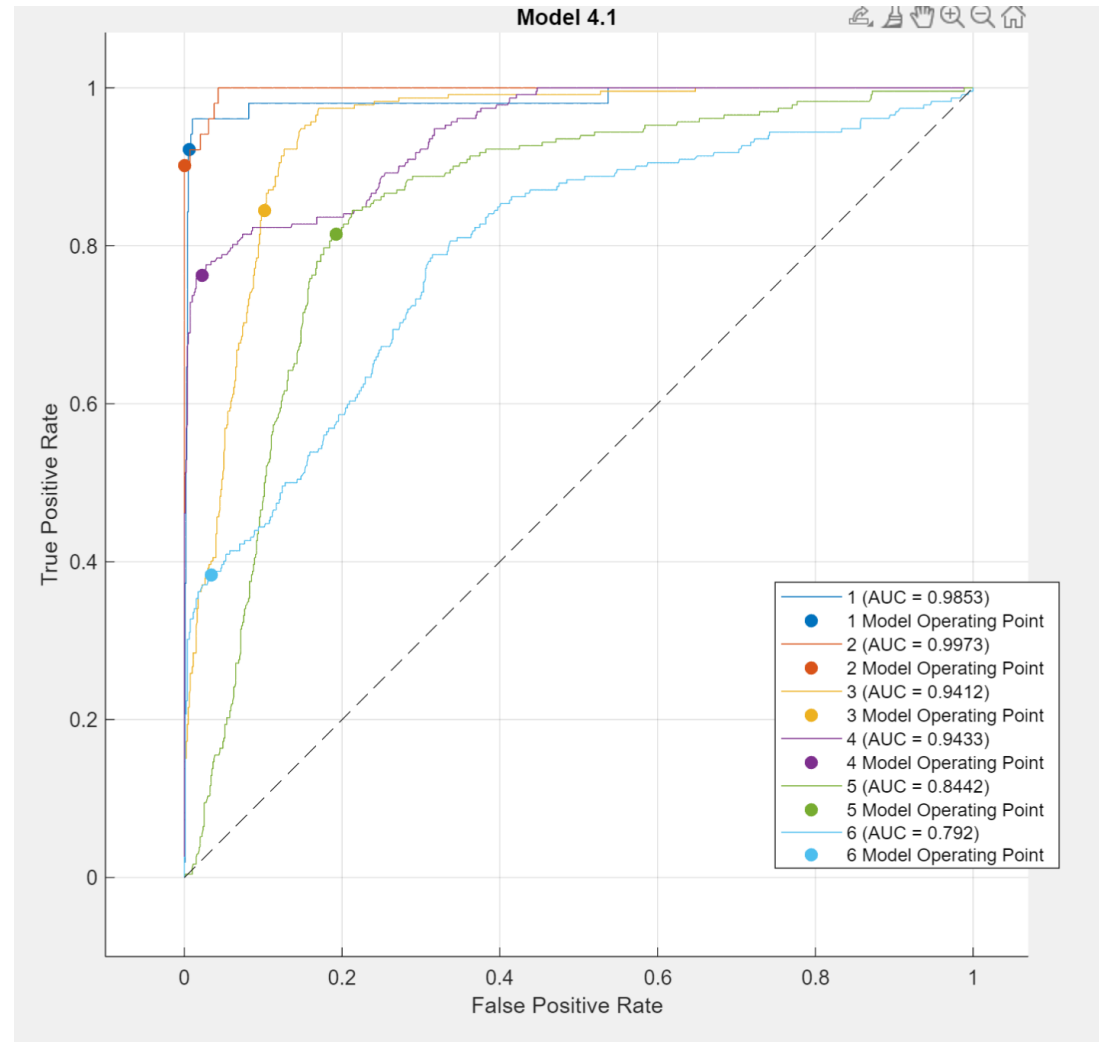
Conclusion

- Highest model accuracy was 71.3%

- The average of all models was about 60%

- It is therefore possible to get semi-accurate classification from a simple wrist mounted sensor
  - The addition of gyroscope and 5 band power data is critical

- There is lots of room for variation and error

- For higher accuracy use cameras and microphones in addition to wrist mounted accelerometer and gyroscope.