# Team members

Ken Lee Shu Ming (A0125546E) Group 3

Abel Lim Jun Hong (A0141780J) Group 22

\*We consist of mixed groups as our old team members left us ☹

# Setup Instructions

Install packages listed in requirements.txt

Run mqtt\_read.py

# The Algorithm

Our algorithm detects each of the three activity states dependently.

IDLE/WALKING Detection

The accelerometer readings were used to evaluate whether the user was idle or walking. We have used an exponential moving average (EMA) and placed against a threshold to determine whether the user had been walking or staying still. An EMA allows for newer data to have a higher weightage in determining the current average as opposed to using a simple average. We have used two threshold values to determine when to switch. For instance, the user walks slowly after starting to WALK, thus the threshold to switch to IDLE was given a much lower value than to start walking.

FLOORCHANGE/NOFLOORCHANGE Detection

The barometer readings were used to evaluate this, the idea was based off the paper referenced in the assignment [1]. We evaluated this as a time dependent reading and filtered the last 10 seconds of the barometer readings with timestamp, then calculated the gradient of it. The gradient degree was then checked against a threshold to determine the state. Similar to IDLE/WALKING, we have used two threshold values for it. We have noted that the barometer readings can fluctuate wildly, thus we have included a dampening function to regulate the readings if the current reading differs too much from the previous value.

INDOOR/OUTDOOR Detection

The luminosity readings were used to evaluate this, the idea was based off another paper referenced in the assignment [2]. Similar to FLOORCHANGE/NOFLOOR CHANGE, we have kept the last 10 seconds of the readings and calculated the average sum and checked against two threshold values to determine the state.

# Accuracy with ground truth

For sample input 1 with perfect data.

| **Truthy Time, Activity** | **Detected** |
| --- | --- |
|  | 14070,WALKING |
|  | 28031,IDLE |
|  | 38031,WALKING |
|  | 94148,IDLE |
|  | 104148,WALKING |
|  | 114148,IDLE |
| 167195,WALKING | 163398,WALKING |
| 176218,OUTDOOR | 207218,OUTDOOR |
| 197210,FLOORCHANGE | 207710,FLOORCHANGE |
| 212210,NOFLOORCHANGE | 219710,NOFLOORCHANGE |
|  | 274226,INDOOR |
|  | 311250,OUTDOOR |
| 323250,INDOOR | 330250,INDOOR |
| 365250,FLOORCHANGE | 375750,FLOORCHANGE |
| 385250,NOFLOORCHANGE | 391750,NOFLOORCHANGE |
| 432226,IDLE | 434757,IDLE |
| 470226,WALKING | 468039,WALKING |
| 520226,IDLE | 522523,IDLE |

False positives for the walking/idle states were present in the first 100k timestamp as the accelerometer fluctuates wildly. There is one false negative classification, due to the high initial luminosity rating.

For sample input 2 with perfect data.

| **Truthy Time, Activity** | **Detected** |
| --- | --- |
|  | 48679,FLOORCHANGE |
|  | 58679,NOFLOORCHANGE |
| 97164,WALKING | 98367,WALKING |
| 162195,FLOORCHANGE | 179203,FLOORCHANGE |
| 179203,NOFLOORCHANGE | 190210,NOFLOORCHANGE |
| 221218,OUTDOOR | 218218,OUTDOOR |
|  | 295726,FLOORCHANGE |
|  | 310734,NOFLOORCHANGE |
|  | 327234,FLOORCHANGE |
|  | 337734,NOFLOORCHANGE |
| 336218,IDLE | 340031,IDLE |
| 397218,WALKING | 395609,WALKING |
|  | 426250,INDOOR |
| 429242,FLOORCHANGE | 436242,FLOORCHANGE |
| 443242,NOFLOORCHANGE | 451742,NOFLOORCHANGE |
|  | 459250,OUTDOOR |
| 455242,FLOORCHANGE | 461742,FLOORCHANGE |
| 468742,NOFLOORCHANGE | 475750,NOFLOORCHANGE |
| 515250,FLOORCHANGE | 532750,FLOORCHANGE |
| 531250,NOFLOORCHANGE | 542750,NOFLOORCHANGE |
| 545265,INDOOR |  |
| 566234,IDLE | 570000,IDLE |

False positives for the indoor/outdoor states were present as the barometer readings fluctuates wildly. There was one false negative classification for indoor, due to the high luminosity rating.

[1] Mohammad, Mobashir, Raj Joshi, and Mun Choon Chan. "EleTrack: Ultra-Low-Power Retrofitted Monitoring for Elevators," *International Conference on Embedded Wireless Systems and Networks* (EWSN) 2018.

[2] Zhou, Pengfei, et al. "Iodetector: A generic service for indoor outdoor detection." *Proceedings of the 10th acm conference on embedded network sensor systems* (Sensys) ACM, 2012.