Last updated: 14/02/2018

SMARTPILLOW: TECHNICAL DATA SHEET

1. MODULES

Accelerometer Datasheet: LIS3DH and Microphone: MAX4465

A. Custom Libraries

i. SmartPillow uses its own custom drivers for these modules. We have also built our libraries with reusability in mind:

1. *The LIS3DH module converts the readings of the accelerometer into m/s^2. All options are set as constants, easily alterable. The library was inspired by Adafruit's Circuit Python library[1].*
2. *The MAX4465 module converts the readings of the microphone into dB, based on the values obtained from the ADC. We then scale to an appropriate value based on our ambient sound research.*

2. ALGORITHMS

A. SmartPillow sleep analysis

The sleep analysis algorithm takes the converted data readings from the accelerometer and microphone. It then uses these data values to model sleep according to the following phases:

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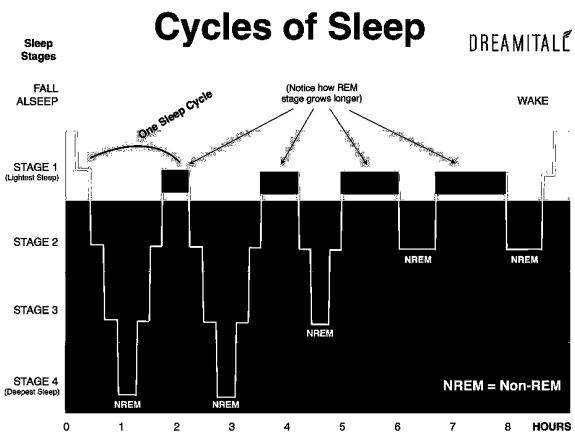
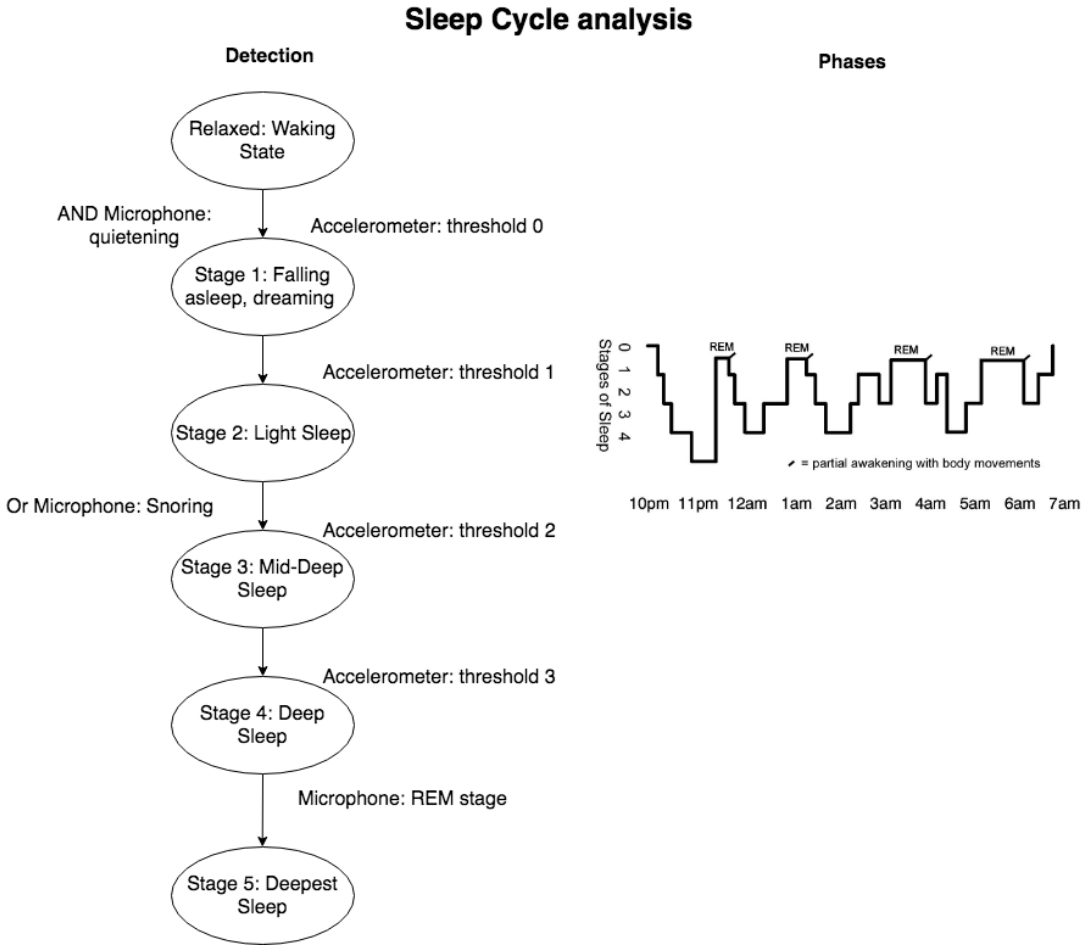
[1] https://github.com/adafruit/Adafruit_CircuitPython_LIS3DH



[2]

The algorithm built works by building states of the above model. Although the generic model has four stages, our research found that the sleep stages are better divided into five stages:



[2] http://www.freshmednyc.com/fresh-blog/2017/5/17/what-is-sleep

B. SmartPillow sleep quality

i. An ideal good night's sleep is difficult to predict, however we have produced what an ideal sleeping pattern should look like. Statistical analysis, including cross correlation, are then performed against your sleep cycle data to provide a rating of your sleep.

$$norm\_corr(x,y) = \frac{\sum_{n=0}^{n-1} x[n] * y[n]}{\sqrt{\sum_{n=0}^{n-1} x[n]^2 * \sum_{n=0}^{n-1} y[n]^2}}$$

ii. Factors such as shortening your sleep means that certain phases are never reached. The quality analysis algorithm will use the hours awake, as 0, when one should have been awake.

3. WEBSITE: ANALYSE YOUR SLEEP IN REAL TIME

The website updates automatically with the latest data from the client end. We provide real time information so that your sleep, or someone else's sleep, may be monitored directly by a doctor for example. It is believed that this will especially benefit those who suffer from insomnia. The rating is also constantly rendered, but it is recommended that the rating only be considered after an entire night's sleep.