USING HEART RATE AND BODY MOVEMENT DATA TO FIND THE OPTIMAL WAKE-UP TIME

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MOTIVATION & BACKGROUND

- Getting enough sleep might have been a problem for everyone at some point in their lives.
- Some people go to bed early; others wake up late, but sometimes still wake up tired, restles s and dizzy.
- There is a notable trade-off between being awake and being

As students, we try to balance our lives and find efficient time-management strategies.
- The goal is to minimize the amount of time we are asleep and maximize working efficiency.
- We came up with an idea to collect sleeping data neccesary to predict the optimal wake-up time when person can wake up fully rested.

Sleep consists of several sleeping cycles. Cycle itself consists of several sleeping stages that can be divided into two main categories : REM (Rapid Eye Movement) and Non-REM.

- REM sleep:
  - Brain waves are similar to awake
  - Breathing becomes more intense
  - Blood pressure and heart rate rise
  - Most of dreaming occurs in this stage

- Non-REM Sleep:
  - Light Sleep:
    - Transition phase between awake and asleep
    - Heart rate and blood pressure are relatively high
    - Brain waves start to slow down, eyes stop moving
  - Deep Sleep:
    - Brain starts producing delta waves
    - Muscle and eye activity completely stops
    - The most difficult to wake up from this stage

The ‘Gold standard’ way to track sleep is PSG (Polysomnography) test which includes sleeing in a lab where researchers monitor the brain activity. Another method to measure sleep stages is call Actigraphy which

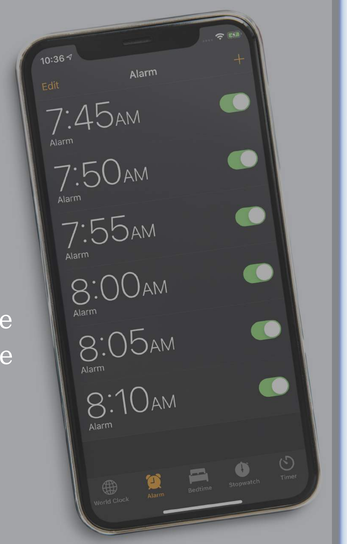
METHODS

In this research, we used Fitbit Alta HR, which is a wrist worn wearable device that tracks heart rate, body movement and sleep data. Numerous studies confirmed that Fitbit devices can determine wake, light, deep and REM stages in healthy adults “with a resonable degree of accuracy”.
We do not have access to their algorithm, but we have access to the data that they provide. When we have labeled data of every thirty second interval along with heart rate and body movement data, we let the machine learn how to classify the sleep stages.

Data Collection:
- -Using Fitbit Web API we retrieve data from the internet
- - Cleaning and organizing data into separate CSV files
- - Features:
  - - Heart rate per thirty seconds
  - - Time passed after falling asleep
  - - Calories burnt per thirty seconds

Data processing:
- - Using pandas python library to import data
- - Using scikit-learn python library to use different supervised machine learning algorithms:
  - - K Nearest Neighbor
  - - Decision Trees
  - - Random Forest
  - - Support Vector Machine
  - - Neural Networks

Data visualization:
- - Using Flask python library to visually represent results on the website
- - Using MySQL database to store algorithm results and optimize the website loading time



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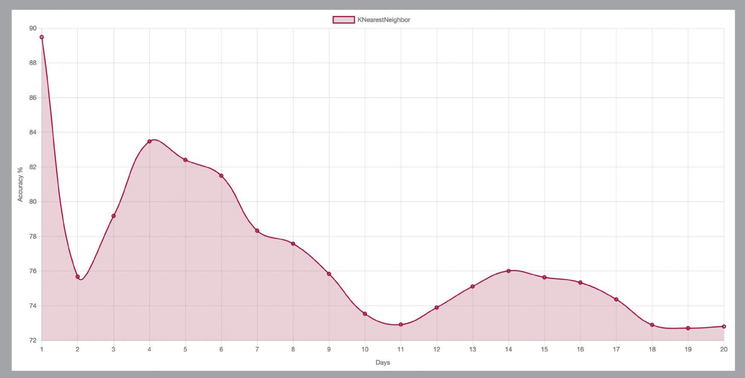
RESULTS

Results for this research are promising as we collect more data, algorithms perform with higher accuracy.

It turned out that based on two weeks of data collection and over 16000 data points, the most accurate algorithm is K Nearest Neighbor with the accuracy score of 73%.



FUTURE WORK

In the future, this algorithm can be used in a simple sleep tracking system including a mobile-phone and data collection device. The smart-alarm will ring in the light sleep in the range given by the user.

REFERENCES

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