Emotional State Classification with Biometric Sensor Data

Group 4:

David Havrilla

Andrew Rendler

Justin Teufel

Project Description

Our objective is to develop a model that will evaluate wearable-generated biometric information and return a prediction of the user's current level of stress or excitement, defined by three potential states:

- Neutral
- Stress
- Amusement

Questions

- Is temperature a good predictor for stress? What is a better predictor of stress?
- How do we identify an emotional state, as to alert a user that they may be approaching a stressed state?

Datasets

WESAD (Wearable Stress and Affect Detection) Data Set

Https://uni-siegen.sciebo.de/s/pYjSgfOVs6Ntahr/download

Each member of our team has an independent copy of the source data.

Prior Work

The original WESAD work will be our primary reference material, along with other related research.

Introducing WESAD, a Multimodal Dataset for Wearable Stress and Affect Detection

Schmidt, Philip & Reiss, Attila & Duerichen, Robert & Marberger, Claus & Van Laerhoven, Kristof. (2018)

https://dl.acm.org/doi/10.1145/3242969.3242985

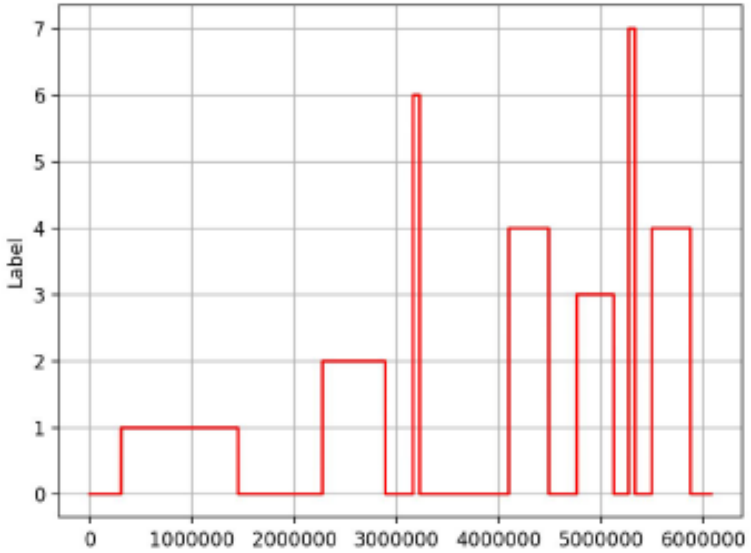
Tools

Python

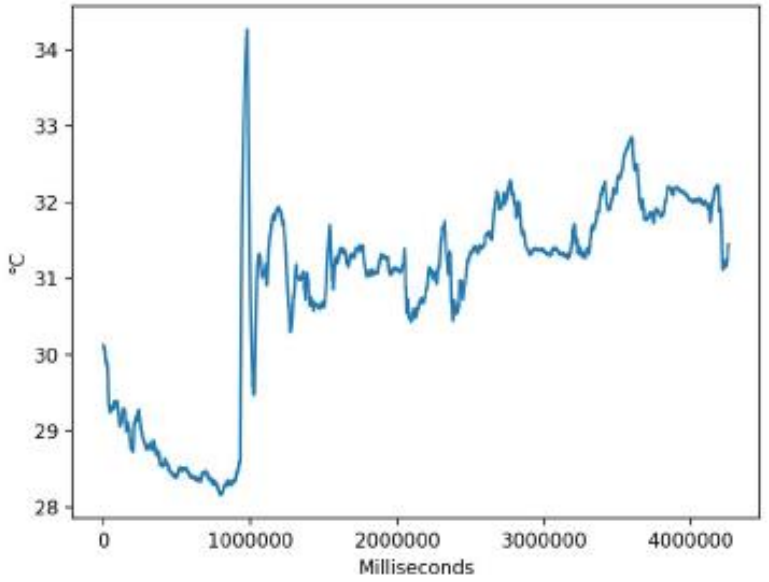
- pandas: open-source, statistical analysis
- numpy: user-friendly computation
- matplotlib: graph plotting library
- sklearn: machine learning library

Graphs – Subject 4

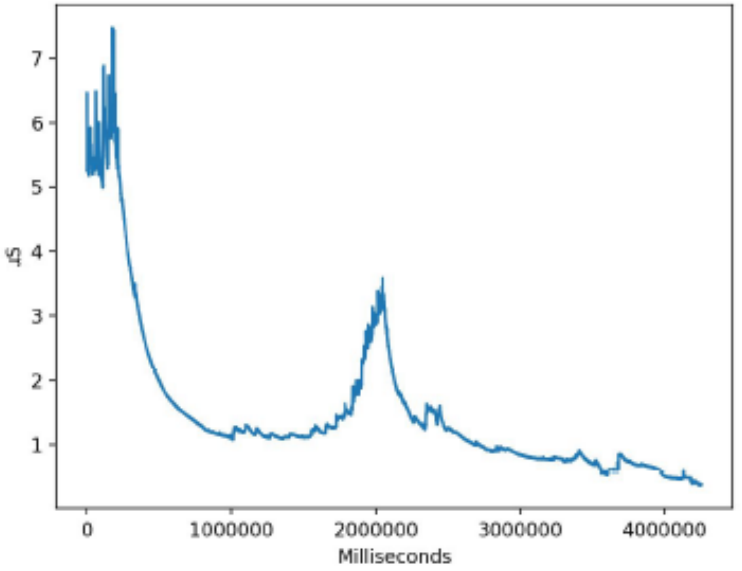
Label



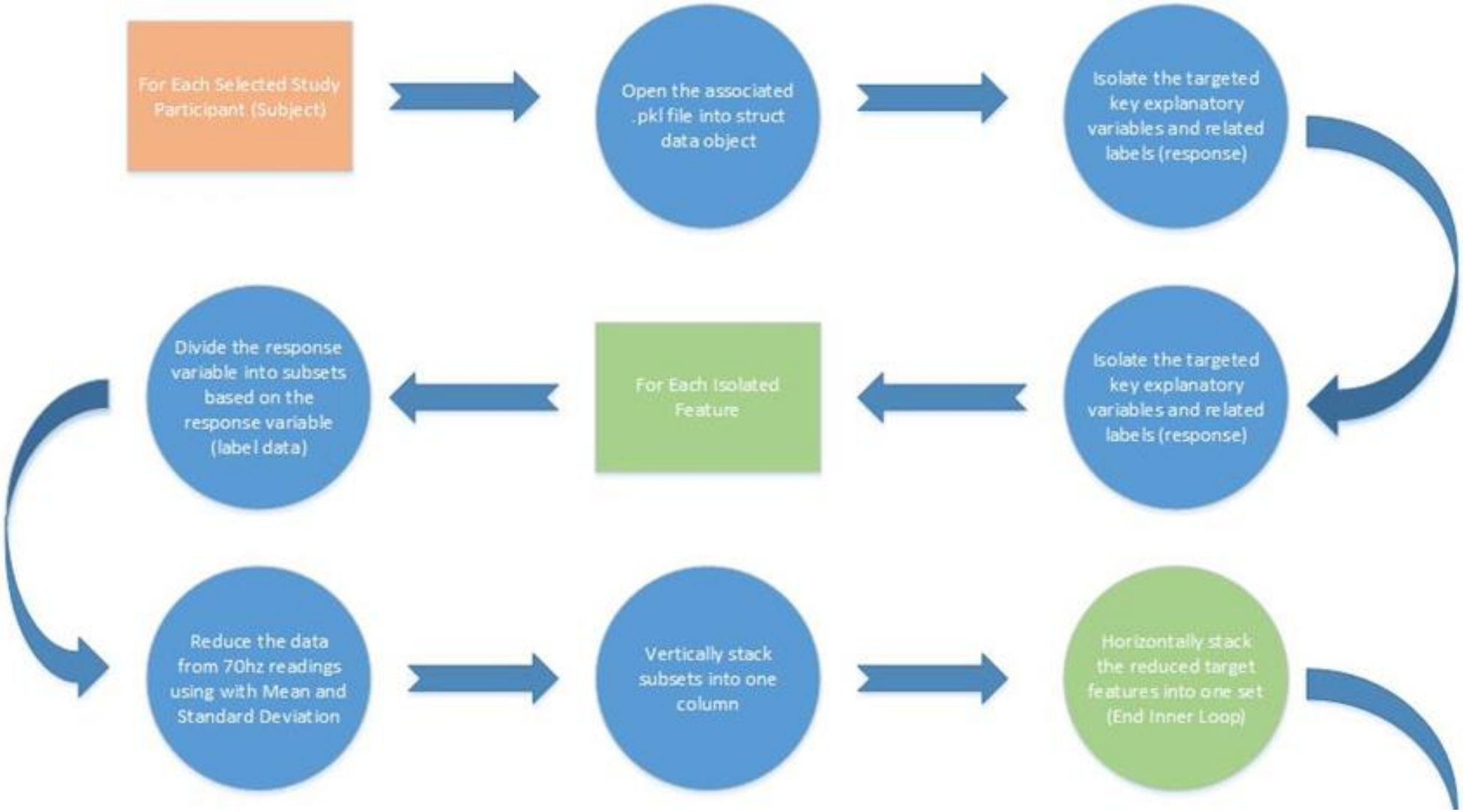
EDA



Temperature



Data Preparation Work



Classification/Clustering/etc.

- Initial approach evaluate performance of multiple approaches/models:
  - Linear-regression
  - Decision-tree
  - Linear-discriminate analysis
  - K-nearest neighbors
- K-nearest neighbors classification provided best performance
  - Average ~99.9% accuracy

Knowledge Gained

- Chest monitor had higher accuracy
- ECG, Temp, EDA, and EMG were variables most strongly related to emotional state
- Able to preemptively identify user’s emotional state

How That Knowledge Can Be Applied

- Many Applications Possible
  - Consumer Use
  - Workplace Use
- This type of technology could be applied in the area of workplace ergonomics, for example in high stress environments like police work.
  - Protection in the workplace
  - Worker safety