Emotional Responses in Virtual Environments: Guidelines for the ERVE Methodology

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1 INTRODUCTION

In this document we provide a detailed outline of the steps required for the processing and classification of Electrodermal Activity (EDA) and Heart Rate (HR) data as acquired from the Empatica E4 Wristbands [1]. Please refer to our paper published at ISMAR '19, "Measuring Cognitive Load and Insight: A Methodology Exemplified in a Virtual Reality Learning Context", for the context of application and background. Should any issues be encountered, the reader should contact the corresponding author of this document.

2 INSTALLING THE DEVELOPMENT ENVIRONMENT

Install MATLAB for Session Splitting, and Heart-Rate Variability (HRV) processing tools. Download and install Anaconda for Python 2.7, and install the following Python packages:

- numpy: 1.9.2

- scipy: 0.14.0

- pandas: 0.16.0

- sklearn: 0.16.1

- pickle

- matplotlib: 1.3.1

- imp

- PyWavelets: 0.2.2

- Os

- cvxopt

3 SPLITTING THE EMPATICA FILES INTO SESSIONS

By using "splitCsvFile.m" [2], recorded files in the Empatica cloud can be divided into different sessions. Session durations should be provided as parameters.

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4 EDA PREPROCESSING AND FEATURE EXTRACTION METHODS

Install the EDA-Explorer tool from [3]. This is the EDA Explorer toolbox of Sara Taylor MIT [4]. We added feature extraction and batch processing to this tool. First run:

- python EDA-Artifact-Detection-Script.py

Then run the following:

- python EDA-Peak-Detection-Script.py

Change the working directory to "Inzva/" and run:

- python extract_artifact_reader.py

These scripts will clean the artifacts from the EDA signal, extract features, and produce "peakProps.csv".

5 HRV PREPROCESSING AND FEATURE EXTRACTION METHODS

Install HRV toolkit from [5]. After that download and run "FilterInterpolateWithPercentage.m" with batch processing giving the directory "Inzva/" from earlier. These scripts will detect the artifacts, interpolate the artifacts with cubic spline interpolation and extract time and frequency features. The csv file generated is Hrprops.csv.

6 WEKA TOOLKIT CLASSIFICATION

Install the Weka toolkit from [6]. First apply the NumericToNominal conversion to the last feature to under preprocessing tools. After that, use the Resample method under the same category. This method will multiply the minority class and crop the majority class. In the classification tab, apply MLP, SVM, Random Forest, LDA and kNN classifiers.

REFERENCES

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[3] EDA_scripts —Yekta Said Can BitBucket. Available: https://bitbucket.org/ysaidcan/eda_scripts/src/master/.

[4] Scripts to detect artifacts in EDA data., MIT Media Lab Affective Computing Group, 16-May-2019. Available: https://github.com/MITMediaLabAffectiveComputing/eda-explorer.

[5] HRVToolkit by Marcus Vollmer. Available: https://marcusvollmer.github.io/HRV/.

[6] Weka 3 - Data Mining with Open Source Machine Learning Software in Java.Available: https://www.cs.waikato.ac.nz/ml/weka/.