Stress Modeling with Facial Expression and Electrodermal Activity Sensor

Task 1: Data Collection

We have already performed a data collection during your 2-min madness project proposal presentation.

- The participants had to put on the hat with the camera and the Electrodermal Activity (EDA) wrist band. Please note that EDA is also referred as Galvanic Skin Response (GSR).
- We collected the video and the EDA data in the following two period:
    - Stressful Period: Each subject will then be asked to perform a presentation task for 2 minutes (some of you went way over that).
    - No-Stress Period: Each subject will then be asked to relax

Link to the data:
https://drive.google.com/drive/folders/1GFGnJHeZlZHfSgDqWib8kDwRJez5tYTc?usp=sharing

- We have already processed the raw face videos with OpenFace library which is a popular open source library for facial attribute analysis. Face features can be found in "Face_Features/***.csv" files. You can find more detailed information in the readme file. We have separated the data collected during the presentation and the resting period. The file name rule is: `Name-Class(Present or Rest)_YYYY-MM-DD_HH_MM`
- The EDA data can be found under "EDA_Data_csv/***.csv". The EDA csv files are also separated based on the period of data collection (i.e., presentation or resting).
- For our analysis, we will assume that the face feature data and the EDA data starts at the same time.
- The face feature data was sampled with a rate of 30 Hz while the EDA data was sampled with a rate of 16 Hz.
- A detailed description of different face features can be found on the readme file in the Google drive link.

In this project, you will be responsible for data cleaning, preprocessing, feature extraction, feature selection and sensor fusion. No code will be provided. Whether you want to use Matlab or Python is up to you. You will need to use all the data from all the groups (link above) for this assignment.

Task 2: Feature Extraction

We have already processed your We will extract features from the EDA and face video data. For feature extraction, we will use a **window size of 10 seconds** with **the window shift of 0.5 seconds**. We will use this window size for both EDA and face data.

[Points: 10] Firstly, From the EDA data, we will extract the following features:

1) Mean, maximum and minimum EDA level.
2) Slope of the EDA data (calculated by a linear regression).
3) Mean EDA peak height.
4) Number of EDA peaks.

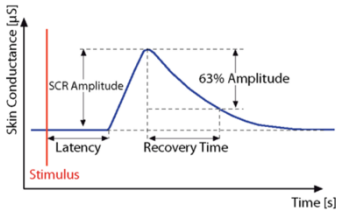

Fig. 1. Ideal SCR with typically computed features.

For more Information about EDA features please check the following paper. "Discriminating Stress From Cognitive Load Using a Wearable EDA Device" Cornelia Setz, Bert Arnrich, Johannes Schumm, Roberto La Marca, Gerhard Troster, and Ulrike Ehlert

[Points: 10] For Face features, we will extract the following time domain features by applying the following statistical functions on each of the face attributes within a certain window (e.g., standard deviation of AU01_r):
1. Standard deviation
2. slope from a linear approximation
3. mean
4. median
5. max

Task 3: Feature Selection

[Points: 15] Rank your features individually based on the performance metric (e.g., F score) with a simple binary classifier (it's up to you to decide which classifier you will use). Use 70% of the data for training and 30% of the data for testing. Generate a bar plot to show the F score (in the y axis) and the features (in the x axis). You can easily find the most important feature from the plot.

[Points: 15] Similarly, find out what pairs of features enable us to reach the highest performance. Be aware that it may not be the top 2 features from the previous step.

[Points: 25] Implement Forward Feature selection algorithm from scratch where the input is all of your complete feature set (i.e., features estimated from each window and their corresponding labels (stress vs no-stress)) and the number of features to be selected. You can use any simple binary classifier to implement the forward feature selection algorithm. And use the F measure as an evaluation metric.

Task 4: Sensor Fusion

[Points: 25] Find out whether feature level sensor fusion between EDA and face feature helps the stress classification. You can do so by
1. training a classifier with a subset of N features consisting of both EDA and face features
2. training a classifier with a subset of N features consisting of only EDA features
3. training a classifier with a subset of N features consisting of only face features
4. compare the performances in terms of recall, precision, accuracy and f measure.