Biofeedback Tools for Observer Stress Detection and Reduction

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Course code: COMP4560
Background -- Motivation

- Stress becomes more and more common in modern society
- Negative stress leads to bad performance on work & study
- Long-term or chronic stress leads to mental & physical diseases
- Currently no valid and scientific method to measure stress accurately
The development of this project is based on:

- A Computational Model of Observer Stress
  by Nandita Sharma
  A thesis submitted for PhD of ANU

Main outcome:
A computational stress model making stress degree classification based on 5 types of physiological signals:
- ECG (Electroencephalogram)
- GSR (Galvanic skin response)
- Blood Pressure
- Eye gaze
- Pupil dilation
Background -- Previous work

The development of this project is based on:

- Using Physiological Feedback to Reduce Observer Stress
  by Xuanying Zhu
  A thesis submitted for master with honors of ANU

Main outcome:
A real-time stress model showing a stress degree curve over 2 seconds sample data based on 2 type of physiological signals:
  ECG (Electroencephalogram)  GSR (Galvanic skin response)
Project Goal

Update Xuanying’s real-time stress model to a real-time stress biofeedback tool

- Use the new portable sensor: E4 wristband
- Use new pair of input data: GSR and BVP (Blood Volume Pulse)
- Improve the stress index generating rate from 2 second to 1 second
- Use Bluetooth wireless connection to replace USB cable connection

Neulog Sensors used by Xuanying

E4 wristband used in this project
Real-time stress biofeedback tool

- Real-time data streaming client (BLE client)
- Trained stress classifier
- Real-time stress curve generator
Real-time stress biofeedback tool
--Real-time data streaming client (BLE client)
Real-time stress biofeedback tool
--Trained stress classifier

- Based on GA-ANN model developed by Sharma
- Use GA (Genetic Algorithm) to select 59 best representative features from 215 candidate features
- Output is a float within -3 and 3 indicating stress degree
- Trained by Xuanying using GSR and ECG data (Why not re-train?)

Training phase for stress classifier

Structure of the stress classifier
Real-time stress biofeedback tool
--Real-time stress curve generator

- Collect sample data over one second (high sampling rate by E4)
- Use BVP data to replace ECG data directly (Why?)
  - the selected features on ECG and BVP both represent Heart Rate and HRV (Heart Rate Variability)
- Use the selected 59 features as input to stress classifier

![Diagram showing the process to generate each single stress index]
Conclusion & Future work

- The original version of real-time stress biofeedback tool completed

- A small test has been conducted to check the performance of the current tool. Test’s results match the experimental evaluation results in Xuanying’s project.

- BLE Client is also modified to be capable to collect training data

- Future work:
  A. Collect the training data on GSR and BVP
  B. Re-train the stress classifier in the tool
  C. A wide experimental evaluation under different real life environments
Q&A
Thank you for your time!