| Name(s) | Project Number |
|---|---|
| **Kaelyn Luebke** | **S0414** |

**Project Title**

**Personal Comfort and Therapy System (PCATS): Wearables and Jedi Mind Tricks**

**Abstract**

**Objectives**
Reduce pain levels for patients, using a Personalized Comfort and Therapy System (PCATS) which leverages a Genetic Evolution Machine Learning Optimizer (GEMLO) to determine optimum real-time local pain therapy and patient intervention.

**Methods**
Test Subject response to Cold Therapy was measured, using various sensors including eSense sensors measuring skin conductivity, an ECG Watch measuring electrical heart activity and a Mindwave EEG Headset measuring brainwave activity. To assess and predict the optimum pain therapy for a specific patient, a theoretical computer model was developed, incorporating an AI algorithm from an online software library. To apply the PCATS Pain Therapy recommendation in a specified sequence, a connected device (based on Arduino) was developed to accept PCATS optimized instructions.

**Results**
None of the tested sensors reliably measured Patient Comfort. Mindwave and the ECG Watch both were unable to detect response to the Cold Therapy. eSense detected a response to Cold Therapy, though it appeared to measure external and internal stimulus, and is unlikely to be a good sensor to measure Patient Comfort. Fortunately, eSense may be used to study response to stressful stimulus as well as calming activities.
The PCATS model and optimization code rapidly optimizes simulated Therapy for an Individual Patient. Final predicted therapy sequence provides very high comfort response, making rapid progress toward the optimum, and consistently reaching it. Rapid convergence to final predicted therapy sequence occurred for most cases. An Arduino system was developed to successfully apply PCATS / GEMLO instructions.

**Conclusions**
The Personalized Comfort and Therapy System (PCATS) provides a means for assessing and predicting Patient Comfort. The GEMLO optimization code was successful in optimizing patient comfort over time, and provides a robust system to evaluate multiple discrete therapy options in future research. Additional research is needed to identify accurate Comfort sensors and incorporate this real-time input. In addition, the Arduino controller demonstrated a viable future controller concept.

**Summary Statement**

A Personalized Comfort and Therapy System was developed including an Arduino controller to apply local pain therapies, sensors to measure comfort response, and a Genetic Evolution Machine Learning Optimizer to optimize in real-time.

**Help Received**

My brother Marcus inspired my interest in Machine Learning and helped me learn about its applications. My mom helped me with data taking and provided input on my presentation. My dad lent me some of his equipment and helped me learn about different sensors for measuring body response.