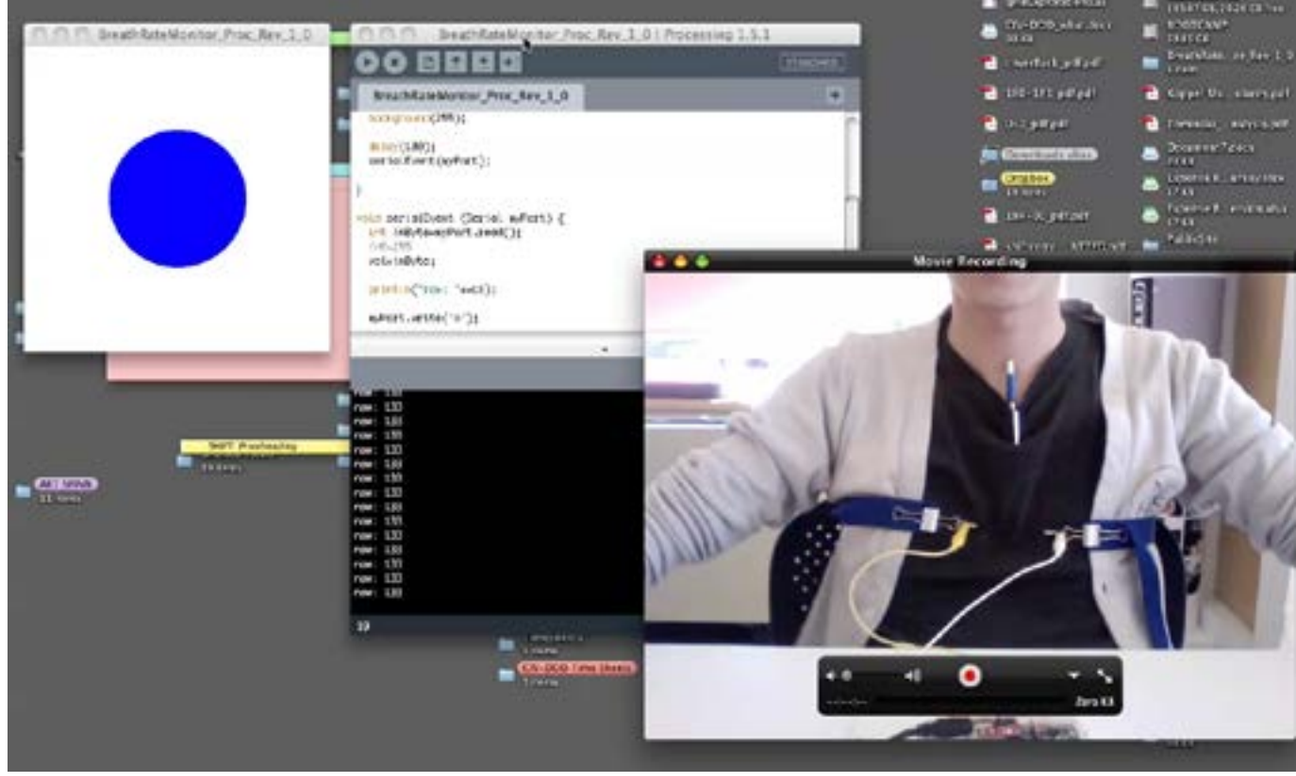
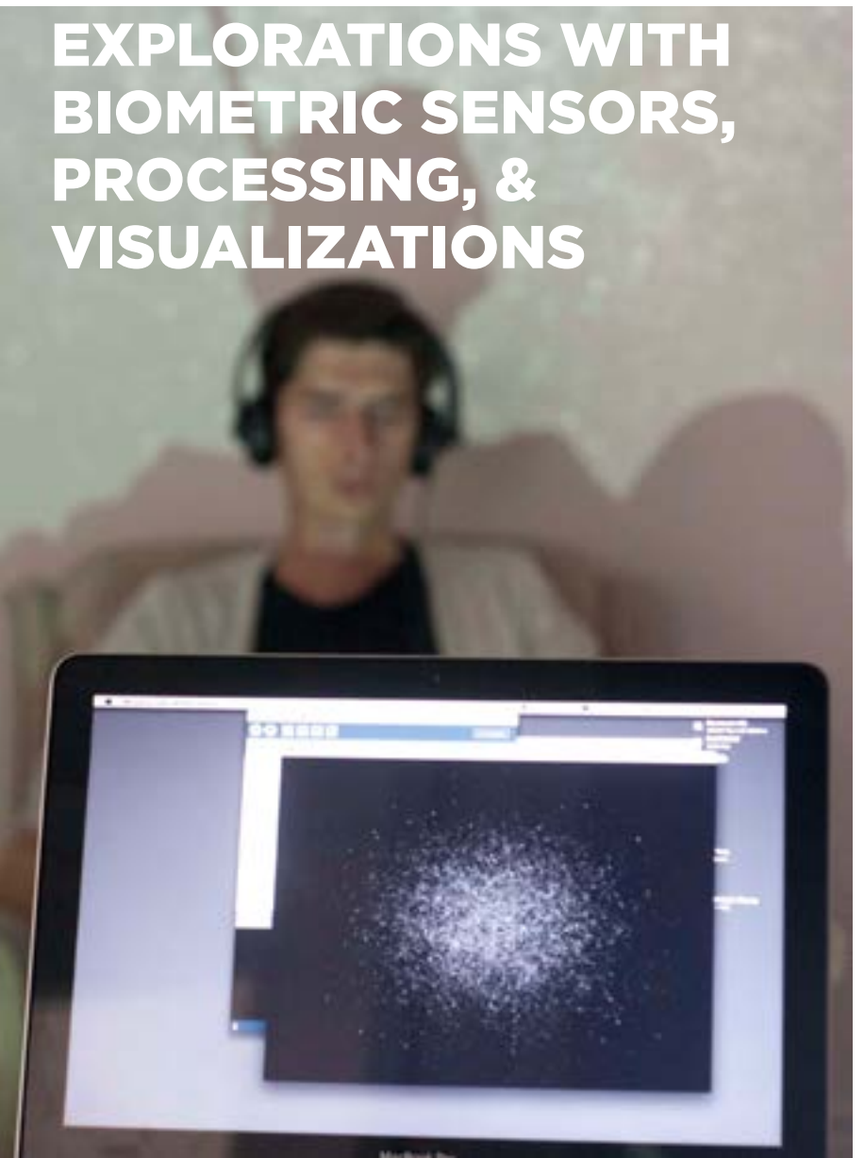
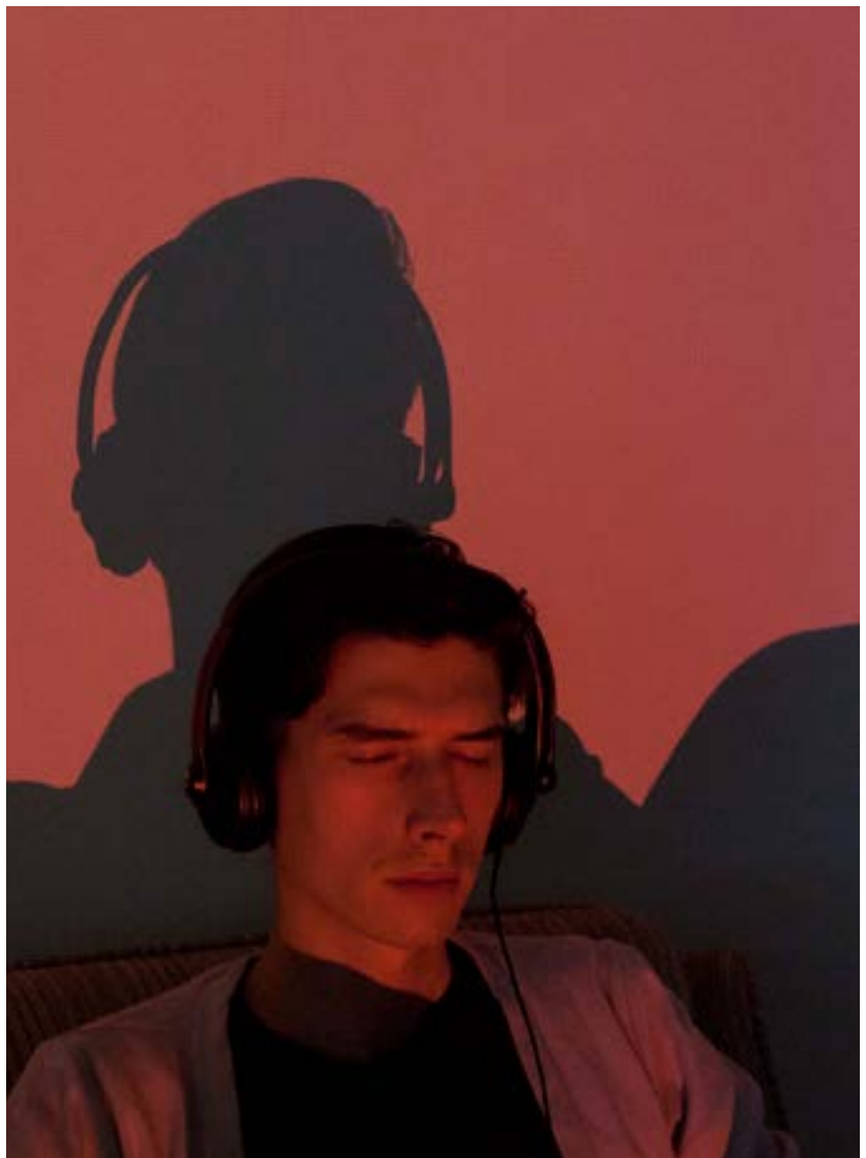


MINDFULNESS TECHNOLOGIES

EXPLORATIONS WITH BIOMETRIC SENSORS, PROCESSING, & VISUALIZATIONS





MINDFULNESS TECHNOLOGIES

Biofeedback & digital technologies to aid mindful practices for chronic stress & pain sufferers

Mike Lovas, Symon Oliver, Fareena Chanda, Heather Nicol, Paula Gardner (PI) // Mobile Experience Lab // www.mobilelab.ca // OCAD University // CPRM

BIOMETRIC DEVICES //

Electroencephalography

Electroencephalography (EEG) is commonly used to measure electrical neural activity. Certain wavelengths of this activity has been associated with particular mental states, including a "meditative-state". A commercial EEG monitor, the EMOTIV EPOC neuroheadset, is used to measure relative alpha and beta brain waves for neural feedback.

Breath Rate

Building awareness of ones breathing is a common mindfulness practice, and is also an indicator of anxiety. An elastic chest strap fitted with stretch sensors is used to measure breath rate. Passing a current through the sensor, resistance varies when the chest expands and contracts. This is an effective technique for measuring breath rate through an unobtrusive wearable device.

Heart Rate

In this context, Heart Rate (HR) is an indicator of excitement and arousal. The current HR sensor in use is the commercially available Garmin FR60 watch and chest sensor. These unobtrusive devices can be fitted under clothing and provide a reliable source of streaming data.

Galvanic Skin Response

Galvanic Skin Response (GSR) gives an indication of stress or excitement by measuring varying conductance of the skin surface. Small increases in perspiration result in an increase in skin conductance. A GSR sensor and accompanying software was developed for this project.

BACKGROUND //

Mindfulness has been defined by Jon Kabat-Zinn as: "the **awareness** that emerges through paying attention on purpose, in the present moment, non-judgmentally". Although mindfulness practices were traditionally employed as contemplative exercises in **Buddhism** (e.g. sitting meditation); more recently they have been adopted and popularized by modern medicine for the management of a variety of illnesses (Grossman, 2004). Specifically, **Mindfulness-Based Stress Reduction** programs have been successfully used to help patients reduced their stress levels and pain symptoms (Teixeira, 2008).

The practice of mindfulness and the experience of pain or stress are highly personal and subjective. **Biofeedback** offers the potential to develop a novel training system that will help personalize the practicing mindfulness by varying sound-scapes, visualizations, and verbal instructions. The aim of this project is to leverage the ubiquity of **mobile digital technology**, the ability to customize with biofeedback, and the efficacy of mindfulness practices to help patients learn to live with chronic stress or pain.

METHODS // FEEDBACK //

In the first stage of the project, a variety of modalities incorporating conceptual elements of mindfulness techniques, biofeedback combined with **aesthetic** visualizations have been explored. The aim of the project is to provide chronic pain sufferers with culturally accessible mediums for practicing mindfulness on an everyday basis.

VISUALIZATIONS /

Visualizations were developed in the software package Processing. Different "sketches" were developed and modified such that the average user would find the visuals **stimulating**, yet not overbearing. The intent was to find and/or create effects and **visual metaphors** that could help foster a state of mindfulness as well as provide interesting objects for awareness. These visualizations were projected onto closed eyes (top right image) in order to minimize the surrounding environment.

VIDEO /

A set of **immersive** videos were designed to be shown on a computer screen, or mobile device. The goal of the videos was to take the user on a non-narrative journey through space as a means of reaching a state of mindfulness. Using nature imagery, subtle shifts in color and composition aimed to foster a state of mindfulness (bottom right image).

IMMERSIVE AUDIO /

Immersive audio recordings were created as alternative feedback methods to visualizations. The recordings used layers of **binaural** nature sounds, and the sounds of bells. Used as a method of mindfulness practice, the sounds function as objects to focus one's attention on.

MINDFULNESS INSTRUCTIONS /

In addition to the previous methods of feedback, voice-based instructions were developed to guide the user through practices of mindfulness. The goal for the instructions was to develop language and tone that would be instructive and helpful to all users.

FUTURE DIRECTIONS //

The next step in this project is to link the biometric devices with the visuals, video, and audio components. This pairing of data will allow a **real-time feedback** loop to be established, such that internal states of being may be detected. Through **user-testing** and an **iterative design** process, the visuals and audio components would be substantiated with personalized instructions and further modified to user needs.

MINDFULNESS TECHNOLOGIES

CREATING MINDFULNESS-BASED MOBILE APPLICATIONS FOR CHRONIC PAIN-THERAPY