P18023: Quantitative Approach to Assessing Stress in Individuals with Autism

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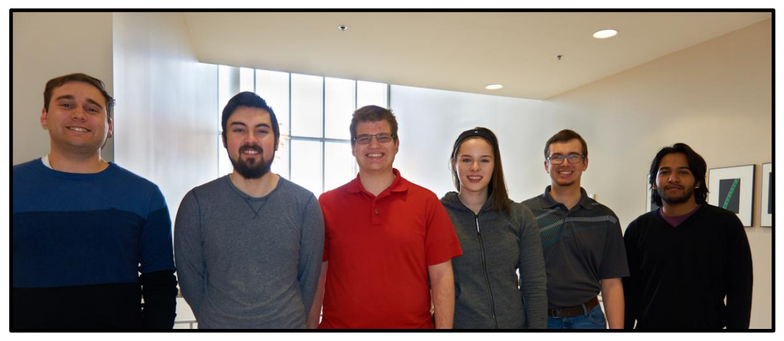

(Pictured from left to right)

Project Summary

In the US today, there are approximately 3.5 million individuals living with autism. Hypersensitivity is a common trait in individuals with autism, where the individual experiences sensory overload from stress and stressful situations. Team MoSAIC Stress Monitoring Apparel is a wearable technology that monitors biometrics of a user such as heart rate, skin conductivity, and body temperature to determine if the user is experiencing an elevated level of stress. When a stress pattern is detected, this technology will alert the user via push notification through a mobile application, and display a soothing message to alleviate stress. Current methods to combat hypersensitivity utilize a weighted vest to put pressure on the user to simulate a hug; however, issues lie in the heaviness and unsightly appearance of the vest.

Project Goal

The goal of this project is to assess methods of detecting and alerting a user of high stress levels through the use of wearable biosensors. An experiment will be designed and conducted to collect data of normal and high stress biometric signals, which will be utilized in a machine learning (**ML**) model. A mobile application will then be developed to monitor biometric signals and notify the user and his or her guardian of these high stress levels when detected by the machine learning model.

Customer Requirements

- Stress detection algorithm
- IRB approved human subject study on stress
- Front end mobile application to notify users
- System of sensors to measure biometrics
- Lightweight and machine washable
- Wearable device (shirt / vest)
- 8 hour battery life

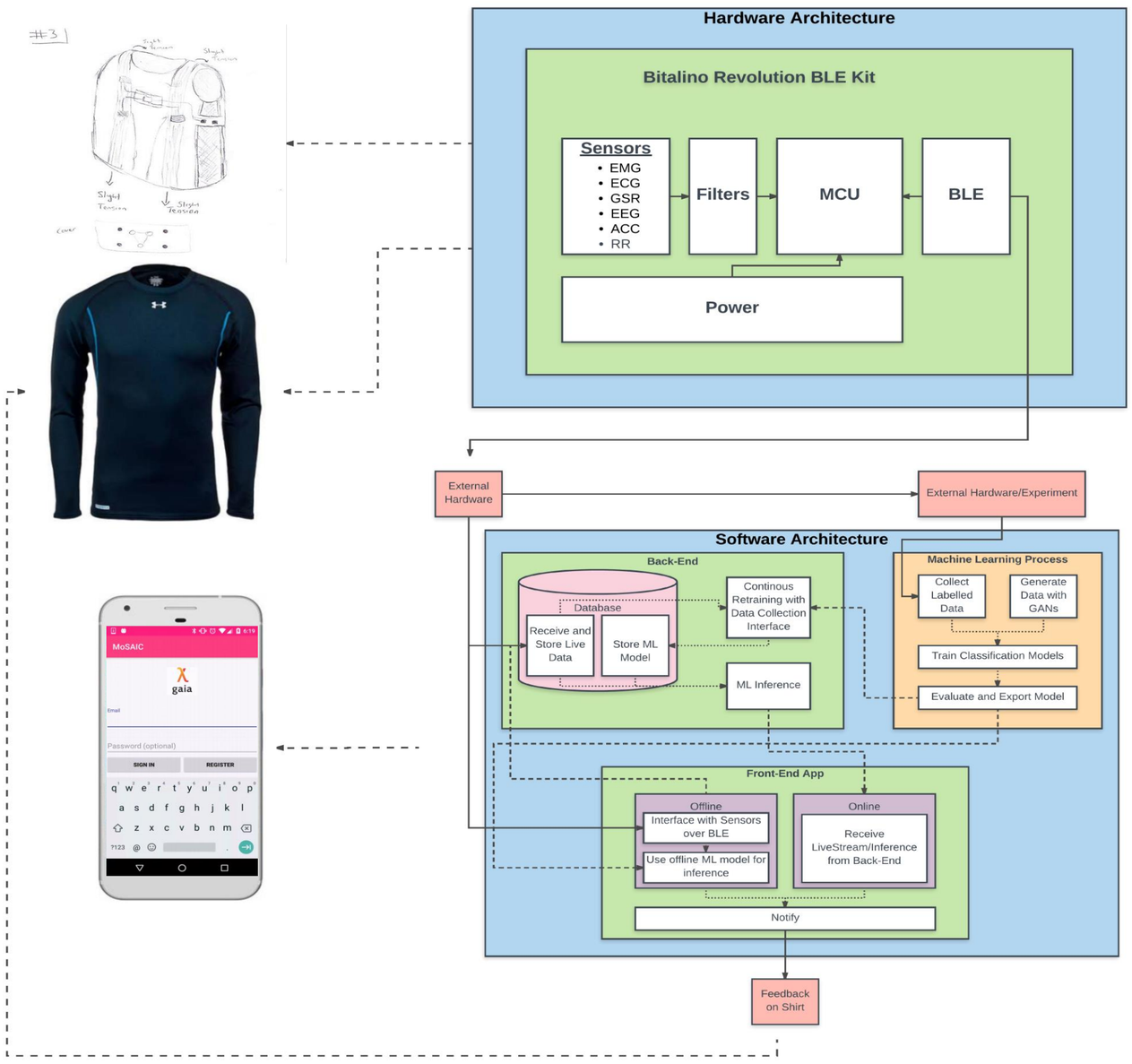

Figure 1: Operations flow of the hardware and the software architecture (above).

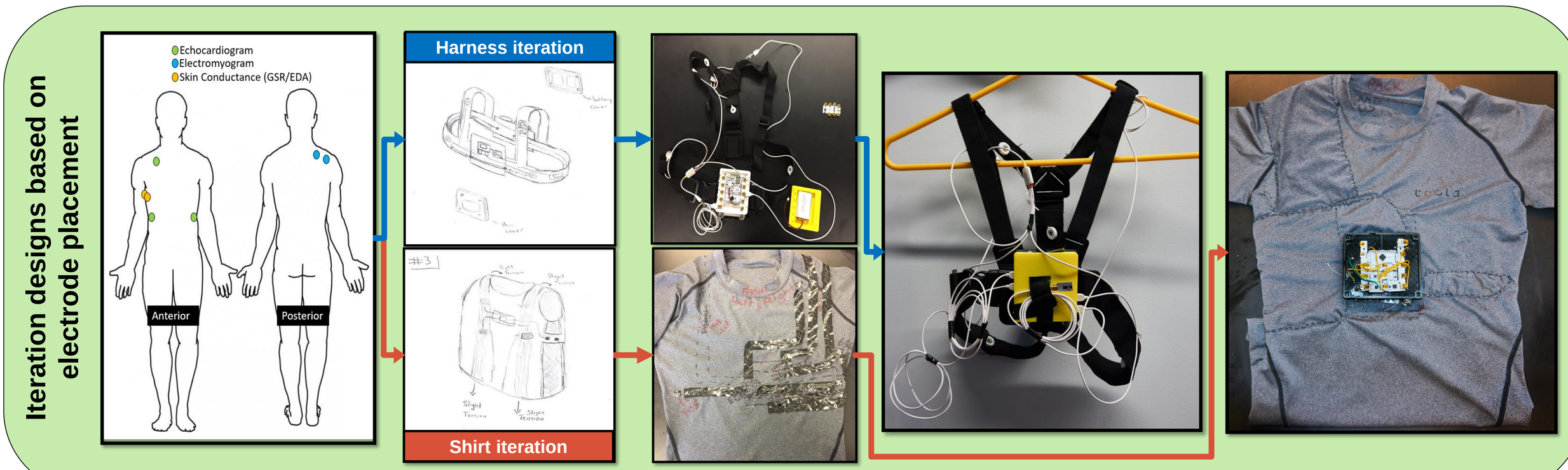

Figure 2: Diagram of electrode placement on the surface of the skin. Concept drawings of the harness and shirt iterations. Pictures of the build progress. Pictures of the final designs of both iterations of prototype.

Human Subject Testing

The goal of this study was to quantitatively "define" stress by measuring biometric signals in human subjects while exposing them to a stressful, and non-stressful situation. A baseline dataset was recorded for each subject, and then the alternating stressful and non-stressful situations were presented in triplicate. This data was analyzed in an ML algorithm to discover patterns exhibited in the biometric signals of the sample group during both situations. The study was approved by the RIT Institutional Review Board and did not exceed minimal risk.

Acknowledgements

We would like to thank Dr. DeBartolo, Mike Zona, Michelle Horan

Performance vs. Requirements

- Microcontroller system acquires data within 90% of the industry standard for all biometric signals measured
- Operating time exceeds 16 hours
- System monitors biometrics of user
- Detects when user is stressed
- Notifies user and guardian of stress
- Shirt iteration has removable housing to allow for machine washing

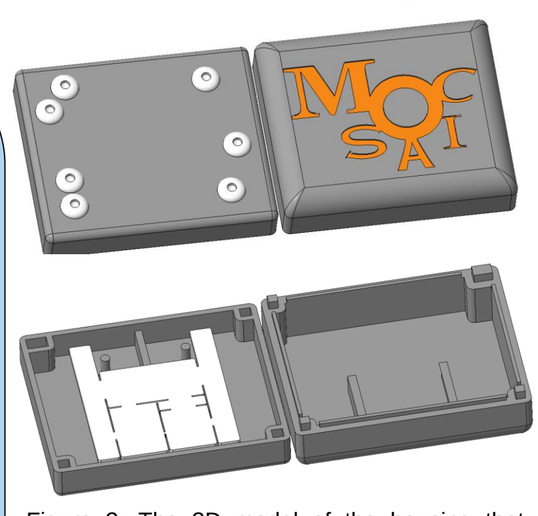

Figure 3: The 3D model of the housing that integrates with the shirt iteration. The microcontroller is soldered onto metal snaps in the housing which contact the snaps sewn into the shirt. The snaps in the shirt are connected to the electrodes with conductive thread.

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MULTIDISCIPLINARY SENIOR DESIGN
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