



ProsthetiSENSE

Prosthetic Socket Pressure Sensor Array

Progress Report

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Introduction and Background

Ensuring patients a perfect fit to their prosthetic socket is essential for their quality of life. Axolo Metrics has designed and is in the final implementation stages of a proof of concept force sensor array system, ProsthetiSense. ProsthetiSense will be used by prosthetists to assist in the customization and fitting of prosthetic sockets for patients with lower-limb amputations. Utilizing a large array of sensors and microcontroller, ProsthetiSense will collect and transmit data to a mobile application. A 3D model will be generated and updated in real time, to provide both the patient and prosthetist, a quantitative and visual map of high pressure areas inside the socket.

This document contains an update on the ProsthetiSense project to date. It compares actual progress against the original schedule as set out in January, as well as funding and expenditures to date. Finally, the document details the progress Axolo Metrics has made on the proof of concept, and what is expected to be completed for the final presentation.

Schedule

Axolo Metrics has been working diligently to stay on the schedule set forth in January's project proposal. Most aspects of the project are either on, or ahead, of schedule. Preliminary development, as defined in the project proposal to be sourcing parts, creating the application shell, researching sensor implementations, and designing electronics were all completed by the February 15th deadline. In addition, general development is almost on schedule. The firmware, iOS shell, and JavaScript application have been completed to a functional degree. While a scaled down version of the sensor array has been completed, the full scale proof of concept sensor array is slightly behind schedule. The internal due date was March 28th, but actual completion is anticipated by March 31st. Post development, including testing and preparing for the final presentation is expected to be completed on time.

Financial

The project proposal was pitched to the ESSEF directors who awarded \$700 in funding. Further, BioInteractive Technologies and Barber Prosthetics clinic have fully funded the remainder of the project and will be reimbursing the ESSEF fund for the full amount awarded. The table below shows expenditures to date.

Component	Price
Sensors	\$1025.60
Electronics/Other Hardware	\$321.96
Software (Developer License)	\$133.28
Total	\$1,480.84



While the proposed budget was \$1206, the \$280 in unforeseen expenses will be covered by the funding sources outlined above.

Progress

Mobile app/Firmware

After finishing the research and settling on Bluetooth Low Energy (BLE) as the means of wireless communication, Axolo Metrics implemented and successfully transmitted analog sensor data between the microcontroller and iOS application. Thus, the highest priority requirement of creating an app for the iOS platform is fulfilled. A low priority Android iteration is now in progress, however any unforeseen issues will take precedence over its implementation.

3D modelling

The cross-browser core of the app that performs the actual 3D modelling is nearly finished and is at the stage of integration with the complete sensor array. Research on the relationship between the Force Sensitive Resistor (FSR) resistance and the applied force has been performed. The models created from the research were confirmed by experimental measurement to have reasonable accuracy. A code representation of that characteristic and a user-friendly ability to define the color-to-pressure map was coded and successfully tested. The algorithm for calibration of flex sensors has also been finished and tested on a smaller sensor array. In order to avoid inaccuracy in flex sensor measurements, the team has added and tested a function to turn off the real-time 3D shape change. Finally, ProsthetiSense app's functionality to save settings such as the calibration data and the user-defined color map was successfully implemented and tested.

Electronics and Sensor Array

A multiplexing PCB Arduino Shield has been designed and manufactured. The testing for this circuit has also been completed and is ready to be used on the final proof of concept. A scaled down version of the ProsthetiSense sensor array has been completed. This scaled down proof of concept included 12 sensors, and was fully integrated into the mobile application (for a fully working ProsthetiSense system). Axolo Metrics is now in the final stages of manufacturing a sensor array consisting of 72 sensors. Throughout development, scalability has been taken into consideration, and therefore it can be said with confidence that the final sensor array will be completed by March 31st.

Summary/Conclusion

Axolo Metrics has been making very steady progress over the planning and development phases of the ProsthetiSense project. Due to the tremendous effort of all team members, the project is on schedule and the team is confident the proof of concept will be operational by the final presentation.