CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

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Project Number

J1010

Project Title

Sonification of Accelerometers for the Training of Elite Gymnasts

Abstract

Objectives/Goals

Inspired by my own gymnastics training and an article I read about sonification used for training Olympic swimmers, I wanted to apply the techniques of sonification to aid in the development and mastery of gymnastics skills. The goal was to build a prototype device small enough for a gymnast to wear, which produced a clear sound that both the gymnast and coach could monitor during skill development.

Methods/Materials

Recorded the acceleration and angular rate of a gymnast executing giants on a strap bar. Processed the measured data through the Sonification Sandbox 6.1 Toolkit from Georgia Tech to explore different algorithms. Developed a breadboard prototype using the SparkFun Digital Sandbox Electronics Kit. Developed a compact, wearable prototype using the Arduino Pro Mini 328. Tested and iterated the design through table top testing and strapped to a gymnast.

Results

The recorded data showed inertial sensors do capture unique signatures for each skill. The Sonification Sandbox application was difficult to use, but it provided guidance on possible algorithms. The breadboard prototype proved the concept and helped experiment with algorithms, but it was too big, required a computer power source, and lacked a clear tone. The wearable prototype achieved the final objective of a compact device with clear sound for real-time feedback.

Conclusions/Discussion

The prototypes demonstrated that real-time auditory feedback can aid in the training of elite gymnasts. Accelerometers were tested first due to their simpler analog-to-digital interface to the Arduino processor. Angular rate sensors should be explored in the future due to their better ability to distinguish good versus poor technique. The magnitude to frequency algorithm proved to be the best among the algorithms investigated. Sound quality can be further improved with custom coding rather than the open source Tone function used in this prototype.

Summary Statement

This project investigated techniques and developed working prototypes for transforming acceleration measurements into acoustic sound for use in training elite gymnasts.

Help Received

I designed, built, and tested the prototypes myself. I learned Arduino programming at an iD Tech summer camp. I used lab equipment from Controlled Dynamics Inc. under the supervision of Mr. Brian Weltmer and Dr. Scott Green.