Project Year

2015-2016

Project Title

Synchronized Heart Rate Acceleration Recording Device (SHARD)

Project Team

Eileen Haase, Whiting School of Engineering, Biomedical Engineering, Faculty
Michael Mudgett, Whiting School of Engineering, Biomedical Engineering, Fellow
Rachel Yung, Whiting School of Engineering, Biomedical Engineering, Fellow

Audience

Students enrolled in the BME freshman course, *Modeling and Design*, will utilize the new and improved Synchronized Heart Rate Acceleration Recording Device (SHARD) during their class trip to Six Flags. At the minimum, the device will record heart rate and acceleration data to be transferred to a computer or other electronic device for analysis.

Pedagogical Challenge

Freshman BME students are required to take a class called BME Modeling and Design. In this class, one project involves a trip to Six Flags to collect data using SHARDs while riding rollercoasters. The current devices are outdated and difficult to use, repair, and replace. They are inaccurate, bulky, and the available quantity is low. This project will address these issues and provide an intuitive and accurate device enabling students to fully complete and understand the project.

Solution

The new SHARD will be easier to use, easier to carry, and more reliable. This project will involve researching and analyzing the most cost effective way to create a low profile device that can record data accurately. A device similar to the commercial FitBit bracelets could be created, or a smaller, more modern redesign of the current model. These different device ideas will be investigated and the design that most efficiently uses materials and records data will be the final result. Students will be able to spend less time learning how to use the new SHARD and more time collecting and analyzing data.

Assessment Strategy

The impact of this project can be measured through student and faculty surveys and feedback. At the end of each course, students must complete course evaluations; questions regarding the use of the new device can be added to these. Student feedback on the ease of use, interest in the experiment, and concepts learned will help assess the impact. Faculty feedback on student performance, interest, and behavior will also be useful. Asking for pros and cons experienced while using the device can allow for further improvement and fine-tuning. In addition, students who have used the old SHARD models in the past can test the new models and compare. They can decide how much easier the new device is to use. Finally, faculty who teach *Modeling and Design* can analyze the student reports which involve the SHARD devices and determine whether or not students who use the new SHARD are able to create more descriptive reports. If the new devices are easier to operate and collect more accurate data, students should be able to record more data and interpret it properly.

Faculty Proposal

In Modeling and Design, BME freshmen are exposed to the vast field of biomedical engineering and the Hopkins approach of learning in groups via a series of labs and hands on design projects. This quasi-seminar/lab course is both informative and instructive for aspiring biomedical engineers. One of the five projects involves developing a physiological model of the cardiovascular system. Students use dimensional analysis to develop a mathematical model of the relationship between blood flow and pressure. They use circuits to develop an electrical analog of flow through vessels in series and parallel. By combining the results of these two models students gain an understanding of the factors which can change our blood pressure. Models have meaning only if they can accurately predict a physiological system, so BME students need to develop experiments to test all of their models.

The experiment we have used for years to test our cardiovascular model involves a field trip to Six Flags Amusement Park, where students simultaneously measure their heart rate and the acceleration of the ride. The current SHARDs were developed by a BME Design Team over a decade ago, and were individually made by our own technician. The number of students in the BME program has increased, and consequently two groups of five students need to share a SHARD at Six Flags. In addition, the SHARDs have been more and more difficult to maintain. Additional SHARDs would allow each group the opportunity to obtain their own data. We can test the accuracy of the new SHARDs through side-by-side comparisons and student feedback. Technology has changed and both of the fellows have presented new ideas to obtain data which should not only be more accurate, but also easier for the students to use. The updated SHARDs would be less expensive to build and easier to maintain.

The final project for Modeling and Design is an independent project. Students have often requested use of the SHARDs for these projects. We have been limited in our ability to lend SHARDs to the students for their final projects, often requiring that students use them only in the lab. Additional, easily repaired and replaced SHARDs could be checked out by our freshmen to use off campus for their projects. Our BME design teams could also use the SHARDs for their projects.

Dr. Haase has been teaching Modeling and Design since 2000. She has successfully advised students for five prior Technology Fellowship projects: an online Matlab tutorial, short videos for Molecules and Cells, online quizzes and simulations for Molecules and Cells, videos and handouts for Modeling and Design, and a series of electronic tutorials for the BME students.

Rachel Yung and Michael Mudgett will be starting on this project over the summer. We hope to have a working prototype available for testing this fall. Both Rachel and Michael were students in Modeling and Design and have experience using the SHARDs. They are bringing their expertise and fresh ideas together to generate SHARD 2.0. I will arrange for both fellows to obtain the resources they need to work on this project, as well as meet with them regularly to discuss their progress.