Project Year
2014-2015

Project Title
BME Builds: Online Tutorials in Medical Electronics

Project Team
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Audience
Most biomedical engineering students enter freshman year without having the skills to design and use circuits. Moreover, many students would like to learn these skills—to pursue independent design projects, or to broaden their engineering skillset—but cannot commit to the several semesters of necessary electrical engineering coursework. Our project will be tailored to provide these students with an accessible, engaging introduction to practical medical electronics, and to familiarize students with the equipment and facilities at their disposal in the BME design labs. To accomplish this, we propose a series of online videos to give BME students of any background knowledge they need as a foundation for any medical electronics project they wish to pursue.

Pedagogical Issue
The design and use of hardware and electronics is crucial to the BME discipline. With the exception of one upper-level instrumentation class, this part of the curriculum is almost entirely outsourced to the electrical engineering (EE) department. However, the available EE coursework does not adequately prepare BME students to tackle some of the challenges presented by the biomedical field. Furthermore, learning practical electronics skills independently, and applying those skills to real-world problems, can be daunting, as the information presented by electronics companies is focused towards those who have a technical background, making the barrier to entry high. With an anticipated new design space in Clark Hall, students will be provided the opportunity to use technical resources to independently design their own projects. What is needed to facilitate use of this space is information on how to use these resources, and the skills and knowledge required to learn, design, and build.

Solution
We propose a series of online videos discussing core technical skills that will be hands-on and engaging. These videos will cover:

- fundamentals of medical electronics design
- methods of designing devices
- integration of devices with software
- utilizing services provided by the industry
- understanding the information provided by the industry and using it for proper part selection

These tutorials will be application-based, with videos focusing on projects that students may pursue and complete as evidence of their technical capabilities, providing students the opportunity to learn by doing. Our goal is to expose students to skills and knowledge that will make hardware design accessible and fun.

Assessment Strategy

These online video tutorials will be assessed based on the following:

1. Feedback from students: We will use Blackboard to track how often each video is viewed. We will provide students with a short survey addressing their knowledge of the subject before and after watching the tutorial, allowing us to gauge how much students learned. We will also provide an anonymous comments section so that students may provide their input on the effectiveness of each video and how it may be improved.
2. Student work: Many of the videos will end with a project that students can do with the knowledge they learned. To ensure that the tutorials are giving students the necessary knowledge to successfully tackle real world problems we will contact students who watch the videos and complete these projects and ask to assess their build results.

Since BME students specialize in a variety of different focus areas, there are several technical skills to cover. Our plan is have this as a framework for future technical tutorials, have students add more tutorials to the website, and update these tutorials annually. This will help to provide information that is for students, made-by students and can further help facilitate use of the Clark design labs.

Faculty Statement

The BME Department was recently awarded a Gateway Sciences Initiative Grant to develop a Whiting Biomedical Design Studio (WBDS). This studio will not only be used for teaching (580.111, 112, 211, 212, 311, 312, 411, 412) but will also be a place for all BME students to brainstorm, create, prototype, and test their ideas. Currently, the majority of BME students use borrowed lab and teaching facilities scattered across the Homewood and medical school campuses. The WBDS will provide an environment that supports teamwork, where students can collaborate, design, build, evaluate, and refine their experiments, designs, and prototypes. The WBDS will be built this summer, and will be stocked and ready for our students by Fall 2014. But, while some of our students have significant experience in building devices, there are many others who learn quickly but could use some assistance.

The fellows plan to develop tutorials and prepare “learning kits” with all the supplies and guidance needed for novice designers to get started. The large number of required courses in BME doesn’t allow much flexibility for our students to add electronics or device development classwork to their schedule. The proposed tutorials, and the available equipment in the WBDS, will allow students to teach themselves what they need for their own projects.

In the past, we have received Technology Fellowships to develop a suite of online videos that provide background information on Molecules and Cells lectures. These short (less than 5 minutes), easy-to-understand videos were widely viewed by students, and received extremely positive feedback. We also developed a popular Matlab tutorial, which provides our freshman students the background they need to get started on complex programming projects. Results from a 2012 survey of students in *Modeling and Design* indicated that many of our BME students are visual learners; therefore, using digital media in our project would allow for greater understanding of the material. Based on the past success of these videos, we believe that the proposed electronics tutorials will be an effective method of teaching BME students valuable technical skills.

All fellows plan to start on this project immediately for implementation during the Fall 2014 semester. Max and George have extensive backgrounds in electronics and have been students in Dr. Haase’s courses (*Modeling and Design, Molecules and Cells, Systems Bioengineering Lab I* and *II*) for the past

three years. Dr. Haase will meet with the fellows regularly to provide feedback and guidance on the subject material. She has also arranged for our Lab Manager, Chris Browne, who has a strong background in electronics, to assist the fellows. We also plan to work closely with the Digital Media Center and the Center for Educational Resources to help make exceptionally informative videos and simulations.

Dr. Haase has been teaching *Modeling and Design* since 2006, and has previously worked with Dr. Harry Goldberg, School of Medicine, to incorporate online and active learning into the classroom. Her prior Technology Fellowships for *Molecules and Cells* and introductory Matlab tutorials continue to be used every semester to enhance student learning.