***Workshop for the design and creation of microcontroller-based LED analog clocks***

Duke IEEE Student Branch

Student Project Proposal

By Tom Wu

**Objectives:**

The objective of this project is to bring together students interested in electrical engineering, hardware design, etc. and create a product that each student will have role in the final design. In its entirety, this project is a workshop that provokes independent thought and creativity because each student will design his/her clock with different methods of displaying time. The workshop provides interested members the ability to experiment with various hardware designs as well as with different implementations of microcontroller-operated LED patterns. The exposure to electronic components, such as clock chips, crystal oscillators, and RGB-LEDs configured as an I2C-bus, will inspire students to take on other projects, which bolster the intellectual environment at Duke University. Members interested in hardware design will learn how to use tools in the machine shop to build their clocks. At the same time, they will become more familiar with the abundant resources at Duke University.

**Project Scope:**

Although analog clocks are ubiquitous, this project gives students at Duke the opportunity to build and design one from scratch. Every participating student has the freedom to customize his/her clock with a unique personal vision because this workshop will teach students how to program their clocks using the Arduino microcontroller.

Unlike most analog clocks, the students’ clocks display the time in a 12-hour format by illuminating individually addressable NeoPixel RGB-LEDs. A clock chip wired to a 32 kHz quartz crystal oscillator keeps track of time internally, and a microcontroller relays that information to a circular array of NeoPixel LEDs. There will also be at least two buttons for adjusting time in the final product.

In addition to its programmability, students will use the laser-cutter and other machining tools to build the acrylic casings for their clocks. Each student has the option to design his/her casing in a CAD program, such as DraftSight. The process of designing and machining teaches students transferrable skills for any project and encourages them to think independently.

The project team has already created a proof-of-concept analog clock that incorporates the internal circuitry of the clock. Students are going to build off of this prototype by using Eagle CAD to design PCB boards for making the final product more compact. They will learn how to solder all the components when the product is ready to be assembled. By the end of this workshop, every contributor will have built a unique clock. Our goal is to demonstrate to each student the power of electronics by providing an opportunity to design and build firsthand his/her own product out of low-level components. We will have shown, using a hands-on approach, that electrical engineering is not an isolated field of study but instead, one that demands collaboration with other disciplines, including computer-aided design and machining.

**Project Cost:**

This table shows the projected cost of this workshop.

|  |  |  |  |
| --- | --- | --- | --- |
| **Item** | **Cost** | **Quantity** | **Total** |
| Acrylic Sheets | $25 | 5 | $125.00 |
| Prototyping Arduinos | $30 | 3 | $90.00 |
| ATMEGA328P | $5 | 12 | $60.00 |
| WS2812 LEDs | $0.60 | 144 | $86.40 |
| DS1302 clock chips | $5 | 12 | $60.00 |
| 32.768 kHz quartz crystal oscillators | $1 | 12 | $12.00 |
| PCB manufacturing | $5 | 12 | $60.00 |
| 5V wall wart | $4 | 12 | $48.00 |
| DC barrel jack | $0.25 | 12 | $3.00 |
| **Total** |  |  | $544.40 |

*Table 1: Projected cost for the clocks based on the prototype’s cost.*

**Project Completion Schedule:**

Table 2 presents an overview of the project completion plan for the analog clock workshop, up until the assembly of every product.

|  |  |  |
| --- | --- | --- |
| **Task** | **Start Date** | **Completion Date** |
| Planning phase for prototypes | 9/20/14 | 9/27/14 |
| Build prototypes | 9/27/14 | 10/04/14 |
| Design revisions and planning for final products | 10/04/14 | 10/11/14 |
| Implementation of button functionality | 10/11/14 | 10/18/14 |
| Custom design phase | 10/18/14 | 10/25/14 |
| Assembly of final products | 10/25/14 | 11/01/14 |

*Table 2: Completion plan for analog clocks****.***