

Physical World / Computer Interaction

Nuno Alves (nuno@brown.edu)

Course Description

In this 10-week course, students will learn how micro-controllers (another name for very simple and inexpensive computers), can be used to effectively create interfaces between the computer and the physical world. These interactions can be as simple as automatically watering a plant when the soil is too dry, or as complex as enabling a computer to autonomously fly a small plane under varying weather conditions.

In this class we provide the students with the practical skills to successfully design and implement their “*Physical world / computer Interaction*” ideas. These skills can be extremely useful to many; from artists looking to create interactive designs and artworks, to architects trying to get a basic understanding of the capabilities of environment modifying technologies.

The philosophy behind this course is that technology and computer code should not be tools solely for computer scientists or engineers, and that no one be intimidated or shy away from working with and exploring electronics, hardware and code. While this course has no specific knowledge requirements, the student must have a good familiarity with computers (from a user’s perspective) and a keen interest in learning how electric/computer components work. This course was designed so that both a high-school student and a working professional can grasp its concepts.

This course will cover the following topics: the programming language C , software development for the arduino micro-controller, basic electronic and circuit concepts and implementation, physical controls (eg: potentiometers,vibration sensors) and physical feedback (eg: stepper motors, LCD screens).

Additional Course Information

Class structure:

Each class session is composed of two hour long sections. In the first hour the instructor will teach the some fundamental concept. In the second hour the students, with the help of the instructor will implement the discussed concepts into an arduino micro-controller. By the second lecture, each student is required to have purchased an arduino board (and respective cables), and bring it to class, together with a laptop. Any additional materials necessary for the hands on demos will be provided by the instructor.

Class requirements:

- 1) Arduino Main Board (sku: DEV-00666) - \$29.95 - Available at <http://www.sparkfun.com>

2) USB Cable A to B - (sku: CAB-00512) - \$3 - Standard issue USB 2.0 cable. This is the most common A to B Male/Male type peripheral cable - Available at any electronic store and also at <http://www.sparkfun.com>

Suggested readings:

1) Programming Interactivity: A Designer's Guide to Processing, Arduino, and Openframework by Joshua Noble - ISBN-13: 978-0596154141

Tentative Lecture Plan:

Lecture #	Topics	Hands on Experiment	Suggested Readings
1	Introduction to micro-controllers, Arduino hardware description, practical uses for micro-controllers.	n/a	
2	Recognizing components, assembling circuits, running code on arduino.	Running and configuring arduino boards.	Noble 91-127
3	Variable types, arrays, operators, control statements, debugging code.	Reading Input/ Output from boards.	Noble p21-40
4	Binary operations, loops, functions and scope.	Pushing buttons to control LEDS.	Noble p40-51, p270-272
5	Voltage, current, power, linear and non-linear circuit elements.	Measuring voltage, current & power.	Handout
6	Building, testing and reading schematics of circuits	Designing and implementing a logic NOT gate.	Handout
7	Physical description of sound-waves, manipulating sound with arduino	Programming melodies	Noble p193-p214
8	Potentiometers, touch and vibration sensors	Implement a circuit with physical feedback.	Noble p245-p262
9	Steeper motors, servos, vibration devices, LED matrices	Moving a car with servos.	Noble p380-p397
10	LCD displays, arduino and household appliances with relays	Programming LCD displays.	Noble p404-421