

VA455/555 – Physical Computing

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Class Hours: 12:40 pm - 3:30 pm Tuesdays

Course Description

This course explores various methods and design systems for collaboratively applying physical computing while building an interactive physical environment with basic prototyping. Basics of building circuits and developing software to communicate with microcontrollers and embedded systems will be introduced. Students enrolled in this course will be expected to work in teams to design and build a project that explores the ideas and technology that fall into the realm of physical computing. Contribution to the team project, class discussions, and project reviews are essential.

Keywords: Embedded Systems, Circuit Design, Human-Technology Interactivity, Sensor Reading, Communication Protocols, Haptic Design, Assistive Technologies, 3D Printing / Prototyping

Learning Outcomes

- . Understand the importance of prototyping in interaction design
- . Find possible hardware and software to use in prototypes of computational things
- . Understand basic technical specifications of electronic components
- . Perform basic programming of micro-controllers connected to sensors and actuators of various kinds
- . Handle communication between microcontrollers and ordinary computers

Software:

- Arduino IDE
- Autodesk Fusion 360 – 3D Printing

Textbook:

- Arduino Programming Notebook: Brian W.Evans: Creative Commons 2007
- Practical Arduino: Cool Projects for Open Source Hardware, Jonathan Oser and Hugh Blemings 2009
- Arduino Booklet, Massimo Banzi
- <https://learn.sparkfun.com/tutorials>

Video Tutorials:

- Lynda Fusion 360 - Basic Part Modeling
- Fusion 360 - 3D Printed Product Enclosure

Grading Policy: 50% Design Challenges + % 30 Final Project + 20% Attendance and Participation

Weekly Schedule Tentative

Week 1: Introduction, Course Objectives, Students' Expectations [01.03.2022]

Motivation
Introduction to Physical Computing

Week 2: Seeding the Curiosity [08.03.2022]

Design Challenge One: Break the given electronic equipment into its components and create a character.

Week 3: Digital I/O Prototyping on a breadboard [15.03.2022]

Getting Our Hands Dirty Programming for Embedded Systems, Breadboarding, Arduino IDE, Digital in/outputs,

Blinking a LED, S.O.S. Task

Design Challenge One Presentation

Tutorial Session 01 (Introduction to Arduino): Follow the Tutorials on

1)
<https://learn.sparkfun.com/tutorials/sik-experiment-guide-for-the-arduino-101genuino-101-board/all#download-and-setup-the-arduino-software>

2)
<https://learn.sparkfun.com/tutorials/sik-experiment-guide-for-the-arduino-101genuino-101-board/all#experiment-1-blinking-an-led>

3)
<https://learn.sparkfun.com/tutorials/sik-experiment-guide-for-the-arduino-101genuino-101-board/all#experiment-3-driving-an-rgb-led>

Week 4: Analog Sensors: Photocell/PWM Example, Soldering Tips [22.03.2022]

Reading Schematic Diagrams, Conductivity, Electricity: The Basics, Basic Electronic Components

Tutorial Session 02 (Digital Buttons): Follow the Tutorials on

1)
<https://learn.sparkfun.com/tutorials/sik-experiment-guide-for-the-arduino-101genuino-101-board/all#experiment-5-reading-a-button-press>

Design Challenge Two: Build a circuitry that lights random LED each time button is pressed.
Equipment: 7 x LEDs, Button, 10kOhm Resistor, 7 x 220 Ohm Resistor, Breadboard, Arduino

Week 5: Building your own Standalone Arduino on a Breadboard [29.03.2022]

Design Challenge Two Presentations

Sensors, Analog Input/Output, Analog

Design Challenge Three: Build a smart circuitry that changes the color of an RGB LED each time tilted up.

Equipment: Reed Switch with Mercury Contact, RGB LED, Arduino Components

Week 6: Building your own Standalone Arduino on a Perfboard [05.04.2022]

Noise Filtering / Handling, Kalman Filters, Median Filters

Measuring Voltage, Measuring Current, Resistance, Ohm's Law

Building a Circuit, Standalone Arduino Developing / Soldering

Design Challenge Four: Build a standalone Arduino on a breadboard

Week 7: Building your own Standalone Arduino on a Perfboard (cont) [12.04.2022]

Building a Circuit, Standalone Arduino Developing / Soldering on a perfboard

Design Challenge Five: Build a standalone Arduino on a perfboard with soldering its components

Week 8: Introduction to Prototyping with 3D Printing [19.04.2022]

Continuing: Building a Circuit, Standalone Arduino Developing / Soldering on a perfboard

Week 9: Accurate Prototyping with 3D Printing [26.04.2022]

Design Challenge Six: Build a small table / 3D Print

[03.05.2022] **NO CLASSES: National Holiday**

Week **10**: Working with Human Interfaces
[10.05.2022]

Design Challenge Six Submissions

Design Challenge Seven Accurate prototyping for a circuitry

Week **11**: Final Project in progress
[17.05.2022]

Final Project to be introduced

In Class Tasks 1,2,3

Week **12**: Final Project in progress
[24.05.2022]

In Class Reviews

Week **13**: Final Project in progress
[31.05.2022]

In Class Reviews

Week **14**: Final Project Presentations / Submissons
[07.06.2022]

In Class Presentations