USC Viterbi
School of Engineering
Information Technology Program

ITP 348 – Introduction to Physical Computing

Units: 4

Instructor: Rob Parke
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Office Hours: TBD
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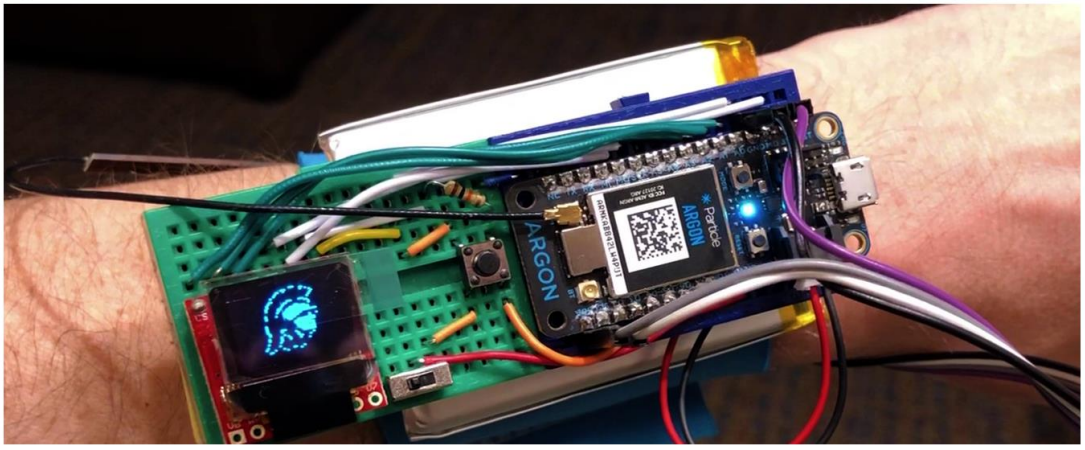
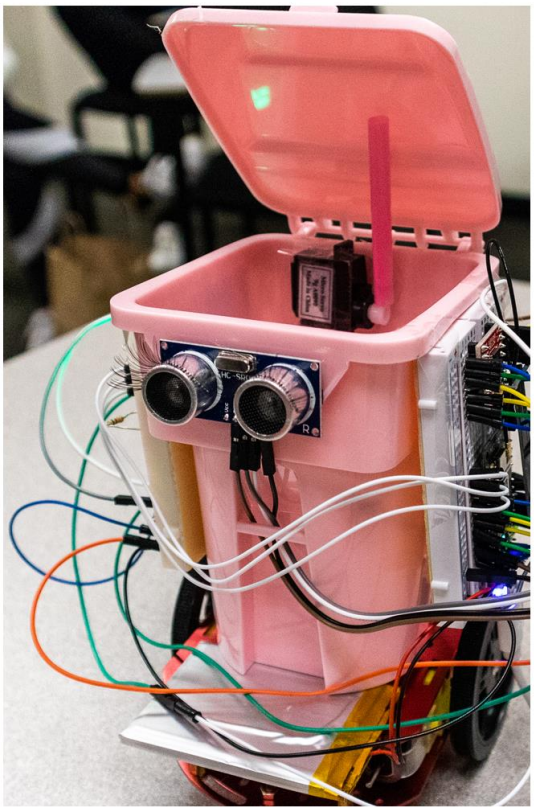
IT Help: Provided by Viterbi IT

Hours of Service: 8am–5pm M-F
Walk-in: DRB 205
Contact Info: (213) 740-0517
Email: engrhelp@usc.edu

Useful Links
Videos of Past Student Projects
Main Course Website





Course Description

This course introduces students to the fundamental concepts of physical computing systems through hands-on, real-life applications. Physical computing forms the basis of **smart devices**, **wearables** like smart watches, **e-textiles / fashion**, **IoT (Internet of Things) devices**, and hardware start-up

This course is designed specifically for a **general audience** and **all majors**. You will learn to design electronic devices that interact with the physical world. Assignments will use **motion detectors**, **robotic arms**, and **electronic music generation**.

This course teaches students to design electronic devices that interact with the physical world by building circuits and developing software algorithms that run on a microcontroller. Students are expected to be familiar with object-oriented programming, but **no prior experience with electronics or microcontrollers is necessary.**

Learning Objectives

- Design and use common electronic components to build, simple circuits.
- Produce an electronic device that measures environmental conditions and sends readings to a cloud storage platform.
- Produce an electronic device that produces effects in the physical world to accomplish a task.
- Build an interface app to enable communication between a user and a device.
- Control a device from an interface app.
- Plan features to account for accessibility.

Learning Outcomes

- Design a simple device that reads sensor data and communicates with an internet-based storage platform
- Determine the appropriate electronic component for specific operations
- Use a microcontroller to communicate with sensors and motors

Prerequisite(s): ITP 109 or ITP 165 or ITP 115 (equivalent courses or knowledge will be considered)

Format

This course will make use of Blackboard for content and assignments. Lecture slides and any supplemental course content will be posted to Blackboard for use by all students. Any and all announcements for the course will be posted to Blackboard. All assignments will be posted to Blackboard and will be submitted through Blackboard. **Students must familiarize themselves with Blackboard before the course begins**.

Course Materials

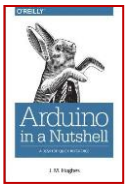
Students will be required to purchase a kit at the USC bookstore for this course. This kit is created specifically for the course and must be purchased during the first week of class. Additional components will be provided by the instructor

Required Readings

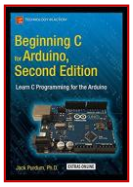
Readings will be posted on Blackboard during the semester.

Supplementary Books

Scherz, Paul, et. al. *Practical Electronics for Inventors (3rd Edition)*. McGraw-Hill Education, 2013. ISBN: 978-0071771337
Amazon



Hughes, John M. Arduino in a Nutshell: A Handbook for Technicians, Engineers, and Makers. 2015. ISBN: 978-1491921760
Amazon: http://a.co/dkklYgg



Purdum, Jack. *Beginning C for Arduino, Second Edition: Learn C Programming for the Arduino*. Apress, 2015. ISBN: 978-1484209417
Amazon: http://a.co/9NcBY1V

Hardware Assignments

There will be hardware assignments that are due 1 week after being assigned. These assignments require building a hardware device with the microcontroller. Students will typically submit code, a schematic drawing, a photograph of the finished device, and a video of the device functioning. Code from external sources may be used as a reference, as long as it is properly cited. These are to be completed individually unless otherwise noted.

Programming Assignments

There will be programming assignments which will focus on a further understanding of problem-solving, algorithms, and logical thinking using C, and are due 1 week after being assigned. Assignments are to be completed individually and submitted on Blackboard.

Final Project Details

Schedule
Week 11 – Project assigned
Week 12 – Submit project proposal
Week 13 – Receive feedback on proposal; Revise and resubmit proposal if necessary
Weeks 14 – Submit device schematic
Weeks 14 to 16 – Work on project (in-class milestone week 14)
Final exam period – Final presentation (Graded)

Basic Requirements
The final project is to create a physical device and interface. The concept of the device is up to the student, but the project proposal must be approved by the instructor. The proposal should include device functionality, part list, cost, and a general description of the app.

The final project will be graded on how it fulfills the requirements and the quality / completion of the device. A project must represent the student's sole effort; online tutorials or class examples

may be consulted, but they must be improved upon and noted in the final documentation. Failure to note and provided links to any reference material will be considered cheating.

Project Grading Breakdown

Item	Points
Proposal	10
Device schematic	20
Device firmware (C++)	25
Web or mobile interface app	20
Functional device	25
Total	100

Project Demonstration

Students will sign up for a 10 min window during the final exam time during which their will demonstrate the functionality of their project. No PowerPoint presentation is needed; rather, students will show the how their device fulfills the key project requirements. Additional time slots will be added depending on size of the class.

Course Grading Breakdown

Item	% of Grade
Participation	10
Assignments	40
In-Class Labs and Quizzes	20
Final Project	30
Total	100%

Grading Scale

Course final grades will be determined using the following scale

A	93-100
A-	90-92
B+	87-89
B	83-86
B-	80-82
C+	77-79
C	73-76
C-	70-72
D+	67-69
D	65-66
F	64 and below

Grading Timeline

Assignments will receive feedback after about one week.

Policies and Expectations

Students are expected to:

- Attend and participate in lecture discussions
- Attend and complete weekly assignments

Grading Issues

Students will have one week after graded feedback is given to contest scores (e.g. assignments, midterm, and project). After two week, scores will not be changed.

Late Policy

- Assignments are due on the stated day on Blackboard (typically at 11:59 pm)
- Students are given 3 "grace days" (self-granted extensions) which may be used for extra time without penalty
- Grace days may be used for assignments only, **not the final project**
- Grace days may be used for one assignment, distributed them across several assignments, or even better, saved them for a crisis that thankfully never comes
- Instructor-granted extensions are only considered after all grace days are used and only given in rare, exceptional situations
- **Late work will not be accepted after all the grace days have been used**

Important: it is the responsibility of the student to state in their Blackboard submission that they intend to use a grace day.

(Adapted from Stanford's EE365 policy)

Course Schedule: A Weekly Breakdown

	Topics/Daily Activities	Readings	Assignment Deliverable Due
Week 1	Intro to Physical Computing / C++ Review	Posted online	A0 - Installation
Week 2	Electricity, components, microcontrollers, Ohm's Law, LEDs	**Posted online**	A1 - Blink
Week 3	Interacting: analog to digital, buttons, serial	Posted online	A2 - Light sculpture
Week 4	Multicolored LEDs, software library, functions, variable resistors	Posted online	A3 - Scanning Light
Week 5	Voltage dividers, photoresistors, RGB LEDs	Posted online	A4 - Dice
Week 6	SPI communication, OLED, temperature sensors	Posted online	A5 - Reaction Timer
Week 7	Digital temperature sensors, serial vs. parallel, cloud functions, cloud variables	Posted online	A6 -- Environment monitor with OLED
Week 8	Piezobuzzers, ultrasonic sensor (Fall break)	Posted online	A7 - Proximity alarm
Week 9	Motion: DC motors, servos	Posted online	A8
Week 10	Bluetooth, remote controlled car	Posted online	A9 - Motors
Week 11	Cloud platform, web and mobile apps	Posted online	Project proposal
Week 12	Wearables, heart rate sensor	Posted online	(project proposal feedback given)
Week 13	Accessibility	Posted online	Proposal revision
Week 14	E-textiles, Hardware startups (Thanksgiving)	Posted online	Project schematic
Week 15	Advanced topics	Posted online	(work on project)
Final	Final project presentation		Project code, device, app, in-class demo Date: For the date and time of the final for this class, consult the USC *Schedule of Classes* at www.usc.edu/soc.

Statement on Academic Conduct and Support Systems

Academic Conduct

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Part B, Section 11, "Behavior Violating University Standards" https://policy.usc.edu/scampus-part-b/. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Support Systems

Student Counseling Services (SCS) - (213) 740-7711 – 24/7 on call
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. https://engemannshc.usc.edu/counseling/

National Suicide Prevention Lifeline - 1-800-273-8255
Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. http://www.suicidepreventionlifeline.org

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-4900 - 24/7 on call
Free and confidential therapy services, workshops, and training for situations related to gender-based harm. https://engemannshc.usc.edu/rsvp/

Sexual Assault Resource Center
For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: http://sarc.usc.edu/

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086
Works with faculty, staff, visitors, applicants, and students around issues of protected class. https://equity.usc.edu/

Bias Assessment Response and Support
Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. https://studentaffairs.usc.edu/bias-assessment-response-support/

The Office of Disability Services and Programs
Provides certification for students with disabilities and helps arrange relevant accommodations. http://dsp.usc.edu

Student Support and Advocacy – (213) 821-4710
Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. https://studentaffairs.usc.edu/ssa/

Diversity at USC
Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. https://diversity.usc.edu/

USC Emergency Information
Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible, http://emergency.usc.edu

USC Department of Public Safety – 213-740-4321 (UPC) and 323-442-1000 (HSC) for 24-hour emergency assistance or to report a crime.
Provides overall safety to USC community. http://dps.usc.edu