

**Due date: Package Submission online: 12/5**

**Demo deadline: 12/14**

**Goals:** To apply the embedded and real-time systems concepts learned in the course. These are:

1. Ability to design and construct a complex hardware and software system, component, or process to meet desired needs using relevant software engineering principles, within realistic constraints such as economic, environmental, social, political, ethical, health & safety, manufacturability, and sustainability.
2. Ability to identify, formulate, and solve hardware and software computer engineering problems using sound computer engineering principles.
3. Ability to effectively communicate technical information in speech, presentation, and in writing.
4. Continue the learning in the course to engage in lifelong learning.
5. Ability to understand contemporary issues in this area.

**Objectives:** We plan to address the goals stated above using a hands-on project that will involve original design, and implementation, demonstration and presentation of embedded/realtime system. This is a demonstration project that includes a presentation of your completed project. For this project you will work in **groups of one or two**, no more.

**Problem Statement:** Choose a concept/idea after discussion with your team mate, TA and your instructor. The idea has to be approved by either the TA or the instructor. The scope of the project should be implementable within the time and the resources available.

1. Choose/Identify an idea that has economic, environmental, social, ethical, health and safety, manufacturing and sustainability (say, in energy) impact.
2. Formulate the solution for the problem identified using best practices learned in the course.
3. Implement and test the solution. Prepare for the demo and presentation.

We will work with Arduino ([www.arduino.cc](http://www.arduino.cc)) Uno hardware as the primary base hardware. You can use other similar small embedded system such as Raspberry PI (<http://www.raspberrypi.org/>), Maple (<http://leaflabs.com/devices/maple/>) or Crazyflie 2.0 [http://www.seeedstudio.com/depot/Crazyflie-20-p-2103.html?cPath=84\\_147](http://www.seeedstudio.com/depot/Crazyflie-20-p-2103.html?cPath=84_147) The discussion below is equally applicable to any of the platforms.

Arduino itself has many variations such as Arduino Zero, Mega, Arduino Duo etc. Arduino is a very popular hardware used in many modern/contemporary systems. Ford OpenXC is arduino compatible, for example. "The OpenXC kit includes a vehicle interface module based on the popular Arduino platform developers can use to read data from the vehicle's internal communications network. The hardware module provides real-time access to parameters like the vehicle sensors, GPS receiver and vehicle speed. The hardware module is connected to a smartphone or tablet on which apps can be written to consume and use these data. See <http://openxcplatform.com/> How about Google's driverless car? Apple's? How about the drones for various purposes?

How to choose a project idea? Think about the keyword "automation" and automating something really useful for you and your peers. Think about an innovative idea that can be presented at a "startup weekend" or at such competitions.

## What to do?

1. Choose your group members. You are allowed at most two in a group.
2. We will be using Arduino Uno hardware; For Arduino details look at the link:  
<http://arduino.cc/en/Main/Software>

This page has download details and also details of many examples. Go through the examples before deciding on your problem. (For example, do not repeat “blinking LED” as your project.)

3. You will have to get approval for your project idea either from any of the TA or me. I want the ideas finalized by this Friday (10/30) class time. Andy Willms will be of extra help for projects using CrazyFlie.
4. Once the idea is approved you will work on the project design, implementation and presentation and the documentation (in the form of Report).
5. You will submit the presentation and the report online for grading.
6. Your presentation should include a diagram of how you divided the responsibilities of your project among the team members.
7. Your report should include a Use Case diagram and a class diagram explaining the design of your application.
8. Your grade will be based on completion of your project, presentation, and your report.
9. Also part of your project 3 grade will include grade for presentation.
11. Finally, the due date for the submission of the Report and presentation online is: 12/5/2015.

## What to do with Arduino?

1. Once the Arduino development Env. is installed, go to Getting Started in the Help menu, to upload and run a sample program, “LED Blink”; observe the setup and loop functions. Setup function is used to initialize the conditions and loop function is the cyclic executive.
2. Understand the Arduino Uno hardware on the board.  
See <http://docs-asia.electrocomponents.com/webdocs/0e8b/0900766b80e8ba21.pdf>
3. Look at File the examples and run the many examples that are provided with the IDE.
4. Understand the Sketchbook concept and also sketches.
5. Arduino Uno (R3) is connected via USB port and the File Upload is used to load the “Sketch” into the board.

### Arduino Hints:

Here are some links for Arduino:

1. <http://arduino.cc/en/Guide/HomePage>
2. <http://arduino.cc/en/Main/Software> (get the Arduino IDE software from here)
3. <http://matters.com/science-projects/news/tft01-arduino-lcd-shield-in-stock>
4. <http://www.meetup.com/buffalolab/members/1627521/>
5. <http://arduino.cc/en/Reference/HomePage>
7. <http://docs-asia.electrocomponents.com/webdocs/0e8b/0900766b80e8ba21.pdf>
9. <http://www.ladyada.net/library/arduino/unofaq.html>
10. <http://randommusicdesign.blogspot.com/>