ECE 411 Practicum Project Information and Requirements

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Overview

Your team will be responsible for designing, constructing, and demonstrating a small project as part of ECE 411. The project is intended to both give you some necessary implementation skills and experience as well as serve as a model for your capstone experience. In fact, the capstone evaluation forms and worksheets will be used in evaluating and grading your practicum project. You will get experience with PCB schematic and layout tools, project documentation and management tools, revision control systems, PCB assembly, and (depending upon your project) microcontroller IDEs. MORE importantly, you will create project requirements, test plans, schedules, and documentation as you would for your capstone project (or any project in industry).

Requirements Overview

Your project can do almost anything but must satisfy the following course requirements:

- Have one or more sensors (inputs)
- Have one or more actuators (outputs)
- Have one or more processors, which control actuators based on sensors.
- Use a two or more layer PCB
- Use 10% or more surface mount components that can be hand or reflow soldered

Grading Criteria

Your project will be evaluated using the capstone evaluation forms found on the capstone web site. Other aspects are evaluated as part of your project demonstration: final project presentation, design documentation, communication (e.g. weekly progress reports).

Intellectual Property

Ideally, you should choose an original project idea or a new implementation of an existing idea. If you choose to implement an existing design or incorporate existing work (including but not limited to schematics, layout, or code), **you must clearly disclose both what you've borrowed and the source. Use of existing work that is <u>not</u> disclosed will result in a practicum grade of F.**

All new material must fall under a license. Please choose one. I encourage you to release under the open source GNU GPL v3 license.

Recommendations

It's far more important that your project be complete and functioning than original or complex. It's essential that you complete all aspects of the project from idea generation through requirements definition, design description/modeling, layout, construction, test, debug, and documentation. It's important that you demonstrate a working project.

A simple project designed and implemented completely by the team using the disciplined design process taught in class and demonstrably working will beat out an overly ambitious project that's incomplete, non-functioning, or haphazardly implemented. Consider this when choosing a project.

That's not to suggest you shouldn't be imaginative or ambitious. Everything else being equal, a creative or a challenging project (that's complete and works) will earn more points. Just keep in mind this is only a 2 credit hour course, and you should be having fun, not stressing out debugging a very complicated

embedded system.

Formal Specifications

You will design, build, test, document and demonstrate a single device designed by your team of 4 students that:

MUST

- **Project Concept**
  - Have ≥ 1 sensor.
    - Sensors route information into the processor.
  - Have ≥ 1 actuator.
    - Actuators route information out of the processor.
  - Have ≥ 1 processor.
    - Processors process information from sensors to control actuators
  - Has to be safe.
- **Schematic**
  - Be in a schematic capture program.
  - Be at least forward annotated with your PCB design.
- **PCB**
  - Have at least 2 copper layers, with solder mask and at least a top-side silk screen.
  - Have an area between > 9 cm^2 and < 900 cm^2.
  - Have no linear dimension < 2 cm or > 30 cm.
- **Processor**
  - Have the processor or processor board mounted on your PCB
  - Be able to program your processor without removing the processor from the PCB.
- **Components**
  - Have ≥ 10% surface mount components.
    - NB: “assembled by hand” below.
- **Assembly and debug**
  - Be assembled by hand (yes, your hands).
  - Be tested.
- **Work**
  - At least 1 complete system must demonstrably work.
- **Documentation**
  - Have live documentation.
  - Have all documentation and design files under revision control.
  - Use collaborative documentation tools (e.g., Github wiki, Redmine wiki, Google Docs).

SHOULD

- **Project Concept**
  - Have a novel or interesting purpose.
  - Be packaged in an enclosure.
  - Have more complex sensors and actuators.
- **Processor**
  - Have your processor IC(s) soldered directly on your PCB.
- **Firmware**
  - Program “bare metal”, or with a real RTOS (i.e., don’t use the Arduino ecosystem)
    - NB: This does *not* exclude Arduino since this is a SHOULD, not a MUST
- **PCB**
  - Be as small as possible.
- **Components**
  - Have almost all surface mount components.
- **Assembly and debug**
  - Use reflow soldering (requires a stencil and solder paste).
  - Use SMT components that are not hard to hand assemble.
  - All parts $\geq$ 0603, no or very few QFNs, no BGAs, etc.
- **Documentation**
  - Use your collaboration tool's issue tracking system.
  - Have each component choice documented.

MAY

- **Project Concept**
  - Move / Explode.
    - NB: “Be safe” is in MUST.
  - Have a cool custom enclosure or mechanism.
  - Be aesthetically pleasing.
- **Processor**
  - Microchip ATMega328 or ATMega32U4 (supported in ECE 411)
- **Schematic**
  - Use KiCAD (supported in ECE 411).
- **PCB**
  - Use KiCAD (supported in ECE 411).
- **Documentation**
  - Use Github for collaboration (supported in ECE 411).
  - Have a video describing concept, use, and technology overview.

Do you have questions, issues, comments, or feedback on these requirements? Please comment!!