EECS 498-06: Project Proposal

The proposal is due by 2pm on Oct 3rd. You are to turn in a hard copy in class and submit an electronic version via e-mail by the deadline. They should be e-mailed to brehob@umich.edu and nashj@umich.edu.

1. The assignment

Your group is to write a detailed proposal for your project. It will cover the following topics:

- ***Design Intent***—what problem is the design solving?
- ***Design & Engineering Criteria***—a list of features/characteristics that are required.
- ***Proposed Solutions***—describe at least two distinct solutions that meet the Intent and Criterion described above. Pick one of those solutions[1] and provide
  - ***Budget and Bill of Materials***—a list of materials that will be used.
  - ***Gantt Chart—***a list of topics to be done, when they will be done and what they are dependent on.
- ***Team Agreement***—what are the group expectations? When and where will regular meetings be held?

In addition, you will be generally expected to include a number of drawings or sketches of your product both as a stand-alone device and in the context where it will be used. We realize that not every group will have a great artist, but a basic sketch, either freehand or with a drawing program, will help make clear what you are trying to build.

Writing the document

Ideally writing this document will be an iterative process. Work on the design criteria as a group. Discuss the high-level design and give someone the task of writing up a draft of that section for discussion the next day. Using the Pugh chart methodology to actually list your options and goals can be very useful if there are more than two design choices. As you discuss implementation issues you will likely find flaws in your high-level design or maybe even your design criteria. Don't grow too attached to the words you have on the paper—they will change. In any case, we recommend you write the design criteria first and write the executive summary last.

As far as report length goes, while there is no page requirement we do expect proposals will be in the 8-20 page range without the two required appendices. Don't write words just to fill space if you are short. But if you are finding yourself over 20 pages consider tightening your language and structure.

1.1 Assignment Body

Your proposal should include the sections listed below.

[1] If you are struggling with design choices and find it hard to choose among various options, a Pugh chart, while a bit corny, might be helpful. See http://web.mit.edu/ruddman/www/iap/designprocess.pdf or http://www-personal.umich.edu/~bobden/me450_pugh_chart.pdf
In addition, please be aware you might end up changing solutions at some point…

Executive summary

Provide a quick overview of the entire report. What is the problem being solved? Why is it important? How might you solve it? This should be between a third and two-thirds of a page in length. It should have a bit of a "pitch" aspect to it in that it should endorse the existence of a problem and your solution to that problem, but a "just the facts" quality should be dominant. There should be, at some point, a short, one-sentence (or less) summary of the *project objective* and that should be highlighted in some way. Something like "reduce traffic accidents" or "gather photographic data of Mars".

High-level description

This section should start out detailing the ***design intent*** and background. Why is this product helpful? Who will use it? Why do you believe it will see use? It should be very clear about the problem your product is solving. Parts of this will have a fair bit of overlap with the design criteria table you will supply in an appendix, but it will be written in prose and be at a higher level. If relevant, cost, reliability, safety, production or similar requirements should be discussed here.

Once you have established a need, provide a high-level overview of at least two solutions. Some idea of the physical manifestation of the project (how it will look) and basic means of functioning (how it does what it does) should be included for each. The basic technical components of your solution should be mentioned, but the focus should be on how the design meets the design goals (intents) you discussed above. For example, if low-power is an issue, briefly detail the power budget. If low-cost is a driving factor, detail the major cost points. If low false-positives are key, explain how you will achieve that. So while your overall designs are important to discuss here, you are mainly explaining how you are addressing the problems described above. Once you have detailed at least two solutions, you should explain the trade-offs and why you chose the solution you did.

This section should convince the reader that your group:

A. Understands the problem(s) being addressed
B. Understands the design requirements and identified reasonable design intents
C. Have considered all reasonable high-level solutions settled on the best one.

Implementation issues

This is where you dig into the technical nature of your ***proposed solution***. What are the inputs and the outputs of your device? What sensors, actuators, and communication schemes are you planning on using? A high-level drawing of the various parts is almost always useful here[2]. You should discuss the major components of your design and why you have chosen a particular part (or what parts you are still considering and on what basis you will make the decision). Describe trade-offs you have made (cost or weight or power vs. functionality; engineering effort vs. part cost etc.) in making the choices you have made. Here a Pugh chart might be useful. This section should be fairly detailed. If your group debated (or is still debating) lower-level design options and alternatives, that should go here too.

This section should convince the reader that your group:

A. Has done "due diligence" in considering various implementation options
B. Your group either chosen the right solutions given your design intents or have a clear plan for making those decisions in a timely way.

[2] Sometimes this drawing should include the physical environment, sometimes it should just be how the parts are connected. It's a tricky balance, but avoid useless figures that don't add anything as well as figures that are so busy it's hard to get useful information out.

Way forward and schedule

Your group has a plan of what to build, now how will you implement it? Describe the major tasks that need to be done. Create a ***Gantt chart*** that *includes the dependencies* between the various tasks. You should end up with 3-5 major tasks and perhaps 6-10 smaller tasks. Explain what dependencies exist and why you are ordering tasks the way you are. Where are things most likely to go wrong? Does your schedule give you room to deal with those problems?

In addition you should indicate what your planned status will be for each of the milestones. What will you be able to show? It may be obvious from the Gantt chart, but make it explicit. Demonstrations for the milestones are ideal but often not worth the effort. Instead simply saying "the prototype is working in highly-controlled environments" or "PCB is back" are usually enough. The goal is to have specific tasks where success is easy to evaluate.

This section should convince the reader that your group:

A. Has a realistic and thought-out plan for finishing the project on time.
B. Has recognized where problems are most likely to occur and has contingency plans formed.

Budget and materials

Depending on how detailed your implementation section is, this might consist of nothing more than a filled in table with budget information. But it will likely include more details about part choices and decisions still to be made. Indicate your total budget ($250/person) and provide a table which indicates

1. A description of each part you need
2. Cost per part
3. Number of parts
4. Who the vendor is for the part[3]
5. What the URL is for the part[3]
6. Estimated shipping costs[4]

Design Expo and final presentation

What will you have done for the Design Expo? How will you demonstrate it? Do you have any particular needs (large space, outside, etc.)? How about for your final class presentation?

Conclusion

This short section just ties the report together. It should likely touch on the risk factors and difficulties but focus on why success is likely.

[3] It might be best to leave this out in the body of the document and include it in an appendix, perhaps in landscape mode with a smaller font.

[4] You may want to express this per vendor.

1.2 Required Appendices

In this proposal you will be supplying two appendices that would not normally show up in a formal proposal document. One will detail your goals and their relative importance in a table format. The other will be a team agreement about work plans, known conflicts, etc. These appendices are here to clearly specify the groups goals both in terms of a final product but also in terms of their group dynamics.

Design/Engineering Criteria

Here you will list the criteria for a successful design and how important each criterion is. You are laying out how you will know if your design is successful. This should be divorced from *implementation* issues. That is, things like "C5515 processor communicates with base station" wouldn't be a design criterion, but "vehicle's status reliably communicated to base station at highway speeds" would be. This may include cost, power/energy or other things. But it should be about the *design* not the *implementation.* Criteria are ideally stated in very few words.

Next, you are to indicate the *importance* of each criterion. You are to label each criterion as either "fundamental" (the project wouldn't be useful without meeting the criterion), "important" (the product would be functional but not nearly as useful) or "optional" (nice, but not needed for the basic functionality).

You also will indicate what you expect and hope to do. You should indicate if meeting that criterion is something you *will* accomplish even if the project is scaled back, *expect* to accomplish or if it is a *stretch* goal. Obviously there should be some correlation with importance, but you need to be realistic in what you think you can do. Starting off by trying to do too much or too little can both cause extra work.

Design criteria	**Importance**	**Will/Expect/Stretch**

Group agreement

This appendix should include things like:

- How many hours/week are expected per person.
- When during the week each person is generally free and when they are not.
- When the team plans on doing most of its work.
- When and on what the team members will work as a group and when they will work individually.
- Who will be largely responsible for which tasks. This should include technical things (mechanical drawing, soldering, programming) as well as non-technical things (scheduling meetings, taking minutes, requirements gathering)
- Known conflicts that will take each person away from school for a while (interviews, family gatherings, holidays, weddings, MCAT, etc.) or other major class deadlines that will likely take a person away from the project for more than a day.
- When and where team meetings will be held. We recommend scheduling at least one non-work meeting a week to touch base and two might be better. Holding such meetings over lunch is often a good idea.

Each person should sign this section indicating that they have read and agree with it. Of course things will change, but changes should be either made with group consensus (moving meetings etc.) or made clear to the group as quickly as possible (leaving town for an interview, etc.)