ECE4440/4991 – Capstone

Capstone Final Project Report

Learning Objective

To fully summarize in report format a long-term, open-ended project for a specific customer. This is representative of any number of project reports done for government or industry to communicate between the engineering team and the end-users, investors, and/or funding managers. A successful report will let the customer know they got their money's worth from the project.

Description

This will outline what your project is, described for the benefit of your customer, with sufficient detail that they would be able to replicate the project using the material presented in the report. The report should include the following sections:

Statement of Work

In this section, each team member should provide 1 or 2 paragraphs describing their individual contributions to the project. This needs to be detailed and list several specific examples of work performed and how it fit within the context of the whole project.

Table of Contents

Your report should have a Table of Contents showing each section. You should also have a Table of Figures that lists all figures, pictures, and diagrams.

Abstract

This should be a 1 paragraph overview of your project. It should be concise but give the reader a clear sense of what your project is about.

Background

Here you should lay the groundwork for your project. Why you chose it, what similar projects have been done in the past (include references as necessary), what differentiates your project from past work by others, and how your coursework background has prepared you to work on this project.

Project Description

This is a detailed description of the project. It should explain in sufficient detail that would allow a 4th year undergrad to duplicate your results at the beginning of their fall semester. You should include the following, with each bullet point having its own subsection:

- Performance objectives and specifications. Include features geared specifically for the end-user. Note that these may have evolved from the ones in your proposal; be sure to explain why.
- How it works, including block diagrams, schematics, and board layouts
- Technical details of your design decisions, modifications, and engineering tradeoffs you made. Include mathematical analysis and references that document your work on the project. This should include 10 to 15 references to journal papers, parts specs, and technical documents (Wikipedia does not count).
- The test plans that were used to verify the project functionality for each subsystem and overall performance. Include any modifications you made to the test plans in your proposal and explain any redesigns you made as a result of your testing.

Physical Constraints

These would include

- Design and manufacturing constraints, such as CPU limitations, software availability, manufacturing limitations, the limits imposed by our PCB suppliers, parts availability in the necessary timeframe, etc.
- Tools utilized on the project. You should list and explain the application of all of the major tools you used this semester. This includes software for math analysis (e.g. MATLAB), software for programming, i.e. LabVIEW or C/C++ including Code Composer, and tools for simulation and design, e.g. Multisim. Explain what role each played in your work, and which tools you had to learn, or improve your skills on, in doing your project.
- Cost constraints that affect the price of the prototype and the projected price of a production version.
- Consider what would need to be done to make a production version of the prototype (.

Societal Impact

Considerations for all the stakeholders with relation to public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors as appropriate. You should be thorough in your analysis here; consider it an ethical, even moral, obligation. Or if you are short on morals, consider it a way to cover all your bases in case you get sued for negligence.

External Standards

In this section, you should explain any external industry standards that came into play during the course of your project. For example, if your project uses a wireless interface then you dealt with IEEE standards for wireless Ethernet. If your project dealt with AC line voltages in anything other than a wall transformer you dealt with NEMA standards. The part spacing and track spacings on your PCB's were derived from IPC standards. You should provide references to these standards and explain how they were considered in your project.

Intellectual Property Issues

In this section you should discuss the patentability of your project. You should include references to 3 US patents whose claims encompass material similar to your project and explain why (or why not!) you feel your project might be patentable in light of those claims. Your

project does not have to be patentable, but you need to explain why, or why not. You should list specific claims in the patents and explain if they are dependent or independent claims.

Timeline

This section should include the Gantt chart from your proposal as well as a final chart (showing the differences). You should explain the following and how your timelines changed throughout the course of the semester. Make sure your Gantt chart is legible! You may need to alter the format or break the Gantt chart up into sections so that when it is presented in the report, the text will still be large enough to be read.

Costs

In this section, you should outline your costs, with a detailed spreadsheet in your appendix. You should also consider how costs would change if you were to manufacture in 10000 unit quantities, i.e. look at Digi-key to get estimates of costs in large quantities, and consider if automated equipment could be used to assemble your device and how that might influence costs.

Final Results

In this section you should explain the functionality of your final prototype in detail. You should honestly assess and explain which of the success criteria defined in your proposal you met and which you did not.

Engineering Insights

What did you learn working on this project? Include both new technical skills you had to develop, and important lessons you learned about the engineering process, particularly with regard to time and resource management, teamwork, communication, and morale. If you had to give advice to a future Capstone student, what would you tell them?

Future Work

In this section you should offer suggestions as to how the project might be improved or expanded upon if a future group of students wished to create a new project based upon yours. You should consider difficulties that were not foreseen at the beginning and offer advice on pitfalls to watch for.

References

These should be done in IEEE reference format [1]. An example is shown below. A great tool for doing this is found at Zotero.org [2]. You should have 10 to 15 references for a good proposal, none of which should be Wikipedia. You may have one ‘popular science’ reference; the rest should be professional sources. This can include manufacturers’ websites and .edu sites. If you use hobby sites, you should reference them, but they do not count toward your reference total. At least 2 sources should come from IEEE or ACM databases.

References

[1] C. Freid, "Are required courses meeting industry demands?," *IEEE Potentials*, vol. 20, no. 3, pp. 39-40, 2001.

[2] "Zotero: Your personal research assistant," [Online]. Available: www.zotero.org. [Accessed 02 Sep 2020].

Appendix

In this section you should include helpful information that does not fit into the above categories but will be helpful in understanding and assessing your work. Your budget outline should also go here.

Grading

Your submission should be delivered as a pdf, and have a file name format: CapstoneFinalReport_*YourTeamName*.pdf

You will be graded on the following:

Professional document (20%): Your proposal should be clear, well-written, and properly formatted. This includes 10 to 15 IEEE formatted references.

Technical Description and Analysis (30%): Thoroughness and validity of the technical aspects of the project. This must be supported with calculations and references.

External Constraints and Considerations (30%): Thoroughness and validity of the external factors (societal impact, physical constraints, external standards, patents) that impact the project.

Engineering Aptitude (20%): How well you managed your resources, time and material, as well as how you handled challenges, both anticipated and unforeseen. This is not grading whether your project had problems or you made mistakes (that is a given for any project), but how you dealt with them.

You can view the full rubric on the Final Project Report Assignment on Canvas.