

Project Title

DESIGN DOCUMENT

Team Number

Client

Advisers

Team Members/Roles

Team Email

Team Website

Executive Summary

Development Standards & Practices Used

List all standard circuit, hardware, software practices used in this project. List all the Engineering standards that apply to this project that were considered.

Summary of Requirements

List all requirements as bullet points in brief.

Applicable Courses from Iowa State University Curriculum

List all Iowa State University courses whose contents were applicable to your project.

New Skills/Knowledge acquired that was not taught in courses

List all new skills/knowledge that your team acquired which was not part of your Iowa State curriculum in order to complete this project.

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List of figures/tables/symbols/definitions (This should be the similar to the project plan)

1 Introduction

1.1 ACKNOWLEDGEMENT

If a client, an organization, or an individual has contributed or will contribute significant assistance in the form of technical advice, equipment, financial aid, etc, an acknowledgement of this contribution shall be included in a separate section of the project plan.

1.2 PROBLEM AND PROJECT STATEMENT

– This is included so that the reader will have the correct conception of the problem and the solution approach upfront. Each shall be written in a non-technical manner that a lay person would understand.

– Consists of two components, each separated and clearly identified:

-General problem statement – defines the general problem area

-General solution approach – defines the proposed solution approach

-This section should also highlight the purpose of the project, what you are trying to do.

Explain what is driving this project. Why is it important?

Explain what the project is.

Explain what you hope to accomplish. What are the outputs of the project?

1.3 OPERATIONAL ENVIRONMENT

– For any end product other than simply a calculation or simulation, it is essential to know the environment in which the end product will be used or to which it is expected to be exposed or experience. For example, will the end product be exposed to dusty conditions, extreme temperatures, or rain or other weather elements?

– This information is necessary in order to design an end product that can withstand the hazards that it is expected to encounter.

1.4 REQUIREMENTS

List all requirements for your project – functional requirements within your project context, economic/market requirements, environmental requirements, UI requirements, and any others relevant to your project.

1.5 INTENDED USERS AND USES

– To properly design an end product that will provide the maximum satisfaction and perform in the most efficient manner, it is essential to understand the end user and the associated end uses.

1.6 ASSUMPTIONS AND LIMITATIONS

- Two separate lists, with a short justification as needed.
- Extremely important, as it can be one of the primary places where the client can go to determine if the end product will meet their needs.
- Examples of assumptions: The maximum number of simultaneous users/customers will be ten; Blue is the best background color and will be used; The end product will not be used outside the United States.
- Example of limitations: The end product shall be no larger than 5"x8"x3" (client requirement); The cost to produce the end product shall not exceed one hundred dollars (a market survey result); The system must operate at 120 or 220 volts and 50 or 60 Hertz (the most common household voltages worldwide).
- For limitations, include tests not performed, classes of users not included, budget/schedule limitations, geographical constraints, etc.

1.7 EXPECTED END PRODUCT AND DELIVERABLES

These tie in with the goals. What deliverables are necessary to meet the goals outlined in the introduction?

List the end product and any other items, along with a brief description, that will be delivered to the client prior to the end of the project.

- If the end product is to be commercialized, the description shall be of the commercialized end product.
- It shall be in the form of a technical product announcement, as opposed to a product advertisement, and shall not include a list of technical specifications.
- Any other items that will be delivered to the client shall also be included and described unless their definition and description are obvious.
- Examples might include a household power supply to eliminate the need for batteries, a user's manual, or other project reports.
- There shall be at least a one-paragraph description for each item to be delivered.
- Delivery dates shall also be specified.

2 Project Plan

2.1 TASK DECOMPOSITION

In order to solve the problem at hand, it helps to decompose it into multiple tasks and subtasks and to understand interdependence among tasks.

2.2 RISKS AND RISK MANAGEMENT/MITIGATION

Consider for each task what risks exist (certain performance target may not be met; certain tool may not work as expected) and assign an educated guess of probability for that risk. For any risk factor with a probability exceeding 0.5, develop a risk mitigation plan. Can you eliminate that task and add another task or set of tasks that might cost more? Can you buy something off-the-shelf from the market to achieve that functionality? Can you try an alternative tool, technology, algorithm, or board?

2.3 PROJECT PROPOSED MILESTONES, METRICS, AND EVALUATION CRITERIA

What are some key milestones in your proposed project? It may be helpful to develop these milestones for each task and subtask from 2.1. How do you measure progress on a given task? These metrics, preferably quantifiable, should be developed for each task. The milestones should be stated in terms of these metrics: Machine learning algorithm XYZ will classify with 80% accuracy; the pattern recognition logic on FPGA will recognize a pattern every 1 ms (at 1K patterns/sec throughput). In an agile development process, these milestones can be refined with successive iterations/sprints. ML accuracy target might go up to 90% from 80%.

2.4 PROJECT TIMELINE/SCHEDULE

- A realistic, well-planned schedule is an essential component of every well-planned project
- Most scheduling errors occur as the result of either not properly identifying all of the necessary activities (tasks and/or subtasks) or not properly estimating the amount of effort required to correctly complete the activity
- A detailed schedule is needed as a part of the plan:
 - Start with a Gantt chart showing the tasks (that you developed in 2.1) and associated subtasks versus the proposed project calendar. The Gantt chart shall be referenced and summarized in the text.
 - Annotate the Gantt chart with when each project deliverable will be delivered
- Project schedule/Gantt chart can be adapted to Agile or Waterfall development model.

How would you plan for the project to be completed in two semesters? Represent with appropriate charts and tables or other means.

2.5 PROJECT TRACKING PROCEDURES

What will your group use to track progress throughout the course of this and the next semester. This could include Git, Github, Trello, Slack or any other tools helpful in project management. You may wish to tie it in with your choice of development process in 3.6.

2.6 PERSONNEL EFFORT REQUIREMENTS

Include a detailed estimate in the form of a table accompanied by a textual reference and explanation. This estimate shall be done on a task-by-task basis and should be the projected effort in total number of person-hours required to perform the task.

2.7 OTHER RESOURCE REQUIREMENTS

Identify the other resources aside from financial (such as parts and materials) required to complete the project.

2.8 FINANCIAL REQUIREMENTS

If relevant, include the total financial resources required to conduct the project.

3 Design

3.1 PREVIOUS WORK AND LITERATURE

Include relevant background/literature review for the project

- If similar products exist in the market, describe what has already been done
- If you are following previous work, cite that and discuss the **advantages/shortcomings**
- Note that while you are not expected to “compete” with other existing products / research groups, you should be able to differentiate your project from what is available

Detail any similar products or research done on this topic previously. Please cite your sources and include them in your references. All figures must be captioned and referenced in your text.

3.2 DESIGN THINKING

Detail any design thinking driven design “define” aspects that shape your design. Enumerate some of the other design choices that came up in your design thinking “ideate” phase.

3.3 PROPOSED DESIGN

Include any/all possible methods of approach to solving the problem:

- Discuss what you have done so far – what have you tried/implemented/tested?
- Some discussion of how this design satisfies the **functional and non-functional requirements** of the project.
- If any **standards** are relevant to your project (e.g. IEEE standards, NIST standards) discuss the applicability of those standards here
- This design description should be in **sufficient detail** that another team of engineers can look through it and implement it.

3.4 TECHNOLOGY CONSIDERATIONS

Highlight the strengths, weakness, and trade-offs made in technology available.

Discuss possible solutions and design alternatives

3.5 DESIGN ANALYSIS

- Did your proposed design from 3.3 work? Why or why not?
- What are your observations, thoughts, and ideas to modify or iterate over the design?

3.6 DEVELOPMENT PROCESS

Discuss what development process you are following with a rationale for it – Waterfall, TDD, Agile. Note that this is not necessarily only for software projects. Development processes are applicable for all design projects.

3.7 DESIGN PLAN

Describe a design plan with respect to use-cases within the context of requirements, modules in your design (dependency/concurrency of modules through a module diagram, interfaces, architectural overview), module constraints tied to requirements.

4 Testing

Testing is an **extremely** important component of most projects, whether it involves a circuit, a process, or software.

1. Define the needed types of tests (unit testing for modules, integrity testing for interfaces, user-study or acceptance testing for functional and non-functional requirements).
2. Define/identify the individual items/units and interfaces to be tested.
3. Define, design, and develop the actual test cases.
4. Determine the anticipated test results for each test case
5. Perform the actual tests.
6. Evaluate the actual test results.
7. Make the necessary changes to the product being tested
8. Perform any necessary retesting
9. Document the entire testing process and its results

Include Functional and Non-Functional Testing, Modeling and Simulations, challenges you have determined.

4.1 UNIT TESTING

- Discuss any hardware/software units being tested in isolation

4.2 INTERFACE TESTING

- Discuss how the composition of two or more units (interfaces) are to be tested. Enumerate all the relevant interfaces in your design.

4.3 ACCEPTANCE TESTING

How will you demonstrate that the design requirements, both functional and non-functional are being met? How would you involve your client in the acceptance testing?

4.4 RESULTS

- List and explain any and all results obtained so far during the testing phase
 - Include failures and successes
 - Explain what you learned and how you are planning to change the design iteratively as you progress with your project
 - If you are including figures, please include captions and cite it in the text

5 Implementation

Describe any (preliminary) implementation plan for the next semester for your proposed design in 3-3.

6 Closing Material

6.1 CONCLUSION

Summarize the work you have done so far. Briefly re-iterate your goals. Then, re-iterate the best plan of action (or solution) to achieving your goals and indicate why this surpasses all other possible solutions tested.

6.2 REFERENCES

List technical references and related work / market survey references. Do professional citation style (ex. IEEE).

6.3 APPENDICES

Any additional information that would be helpful to the evaluation of your design document.

If you have any large graphs, tables, or similar data that does not directly pertain to the problem but helps support it, include it here. This would also be a good area to include hardware/software manuals used. May include CAD files, circuit schematics, layout etc., PCB testing issues etc., Software bugs etc.