TSIU03, SYSTEM DESIGN

Guidelines to Write Technical Documents

by Mario Garrido and Kent Palmkvist

This document provides guidelines to write the technical documents that the students have to submit for the project.

General Guidelines

- Store the documents in the proper disk area that you have been assigned.
- Before submitting a document, use the spell checker.
- Before submitting a document, print a copy and read it carefully in order to see that the whole document makes sense and remove mistakes (some typical ones are wrong references to figures, lack of commas that make sentences difficult to understand and missing spaces).
- Documents to be discussed in meetings must be submitted by mail to the supervisor at least 24h before the meeting.
- The documents must be submitted in ODT format (libreOffice) or PDF format. A Linux system is used by the teachers. If you use another operating system to generate the documents, check that there are not problems with the format when you open them in Linux.
- Use the format: Grxx_yymmdd_DocName.odt or Grxx_yymmdd_DocName.pdf for the name of the documents. For instance, if you send the project plan on the 28th of September 2014 and your group number is 45, write: GR45_140928_ProjectPlan.odt
- In the subject of the mail, please write 'TSIU03 GRxx ' followed by the reason for the mail, so that we can identify the mails easily.

Requirement Specification (for the 2nd meeting)

- A very good thing with TSIU03 is that you have the chance to choose your project. The board that you are going to program has a lot of possibilities. What you have to do first is to think of an interesting system that you are willing to implement. Groups that work on an inspiring and stimulating project are more motivated, get very good results and have a very good time in the course. Projects that include friendly graphical interfaces, interactivity, nice and useful functionality, analysis of signal properties, or cool audio effects are very popular. So just start by dreaming about your amazing system. Later, if the project is too ambitious, the teachers will tell you.
- Once you know what you have to do, imagine that you are the user of this product. What would you demand from it? What will you see on the screen? How will the output sound be? How will you control the system?, etc.
- Then, transform your wishes into measurable requirements that guarantee your wishes. They can be either purely technical such as "the resolution of the screen must be 640 x 480 pixels", or based on the user perception such as "the user should not perceive any distortion in the output sound". In any

case, what is important is that the requirements are measurable. For instance, "a good sound quality" is not a proper requirement, because it is not measurable.

- Note that the requirements say WHAT you want to do, but not HOW you are going to do it. This is why the requirements are connected to the user. The user wants something, but he/she does not worry about how it is implemented, as far as he/she gets what he/she wants. For instance, the user may want a system that splits the signal in different frequency bands, so that he/she can tune each band independently. However, for the user it does not make any difference if the bands are internally obtained by the Fourier transform or by a filter bank.
- Obviously, when you write the requirement specification you will have some ideas about how to implement the system. Do not write them in the requirement specification, but save them, because you will have to include them in the design specification. During the meetings, discuss these ideas with the supervisor, so that he/she can give you some feedback of the feasibility and complexity of your approach.

Design Specification (for the 3rd meeting)

- The Design Specification should include **all design decisions that can be taken before implementing the system in VHDL.**
- Now you are the engineers who receive the requirement specification. What you have to do is to propose a solution that fulfills the requirements of the system.
- Contrary to the Requirements Specifications, now you have to think about HOW you are going to meet the requirements.
- The Design Specification must describe the entire system. Think about the main blocks that your system will have, the functionality of each block and the interaction between them, i.e., which information they have to send to each other. Explain the functionality of the blocks and their interaction from a signal processing point of view, i.e., how the audio, video, etc are processed in each block and which information is transmitted between blocks. You can provide some equations to show the algorithms that are applied. Note that this is very different from providing the hardware interfaces between the blocks.
- Later, think about the difficulties that you will find in hardware and the hardware limitations (timing, bandwidth, word length, etc.) and check that your design is viable. Some calculations may be necessary. For instance, if a requirement says that the system must be able to delay the audio signal 1 second, you will probably think of using a memory in order to meet the requirement. Then you should make some calculations to check how big the memory must be and if it fits in the FPGA or if you need to use an external memory.
- The Design Specification must be described from the system level. Please, avoid details that are not relevant at that level. Make also sure that the person that reads the document can get a clear idea of the entire system.
- As a result, the design specification must be a technical proposal that shows that you have analyzed the problem and found the difficulties that you will face, and provides a first approach to the solution. A good approach for writing the design specification is to present a block diagram of the system, provide a high-level description (at signal processing level) about the functionality of each block and how the blocks interact, and show which requirements present challenges and how you will solve them in hardware.

Project Plan (for the 3ʳᵈ meeting)

The Project Plan is a document that gives a general overview of the project:
- who are the members of the group,
- who is the customer,
- which are the resources for the project,
- which documents must be submitted,
- which are the activities or tasks of the project,
- which time is allocated for each task,
- who is going to do each task,
- and which are the deadlines.

For the Project Plan it is not expected that you write a long and detailed document. What is expected is that you think about the project from a general perspective. A brief explanation of each section is enough to show this.

First Presentation (Examination)

- The First Presentation should discuss **all design decisions that can be taken before implementing the system in VHDL.**
- The first examination of the project consists of a presentation of the hardware design that the students plan to implement in VHDL. This presentation will be followed by questions from other students and the teachers of the course.
- You will have a projector available.
- Every member of the group has to do a part of the presentation.
- The time for the presentation is approximately 15 min.
- Due to the time limit, the presentation should include around 10-12 slides.
- Include the slide numbers, so that it is easy to refer to them.
- In principle, each slide should show a single idea.
- The presentation should describe technically the hardware system that is going to be implemented. Students should present the functionality of the system and justify HOW this functionality is going to be achieved with hardware circuits. For this purpose, it is suggested to show the main block of the system, how they interact and which information is sent among them, and how each block is implemented internally. The students should go down to a level of detail where the adopted solution is easy to understand.
- Send the presentation by mail to the supervisor and the examiner the day before the work is presented.

Project Report

- The Project Report presents the results of your project. The main part is the description of the system. The project report also includes possible improvements, a user guide, the experiences in the project and a reference to the files of the project.

- The description of the system must include an overview of the system and an a discussion of the main design challenges. At signal processing level, give an overview of the system and its functionality (emphasizing those features that differ from other projects) and show the functionality of the different modules and how they interact. At hardware level, give a general overview on how the modules are implemented. In addition to this, highlight the main difficulties of the design (both at algorithmic and hardware levels) and show how you solved them and how you assure that the requirements of the system are met. In depth discussions about things that are straightforward (or are done in the same way as the rest of the project groups) are not very interesting.
- The user guide must show how the user can operate the system and the functionality of the system, i.e., what the system can do, how to control it, which is the information that will appear on the screen, etc. Note that this is information for the user, so you do not have to discuss internal details about the implementation.
- The experiences in the project are a reflections about the development of the project. Here, specify in detail what has been the contribution of each person in the project. Did it work according to the initial plan? What was easier or harder than expected? Which problems and difficulties did you find? What caused them? How was the interaction between the group members? What have you learned from the experience? Did you have a good time? Is there something in the course that could be improved?
- For the section about improvements, think what could be improved in the system and which additional features could be added.
- For the reference to the files of the project write where they can be found and what each file contains.

Final Presentation (Examination)

- The final examination of the project consists of a presentation, a demo of the system, questions from other students and questions from the teachers of the course.
- You will have the board and a projector available.
- Every member of the group has to do a part of the presentation.
- You have 15 min for the presentation and demo. We recommend 12 min for the presentation and 3 for the demo.
- Due to the time limit, the presentation should include around 10-12 slides.
- Include the slide numbers, so that it is easy to refer to them.
- In principle, each slide should show a single idea.
- IMPORTANT: The presentation must include a brief description about the functionality of the system, the blocks that it consists of and how they interact, hardware considerations that are relevant, the main challenges of the design and how they have been solved technically. Also explain briefly the experience of working in group, how you have managed it, hours spent in the project, etc.
- In the presentation, focus on those features that distinguish your project from other designs. Do not explain in depth parts of the circuits that are obvious or that are implemented by the rest of the groups in the same way.
- The presentation is followed by a demo of the project. Show the basic functionality and nice features of your project.
- Send the presentation by mail to the supervisor and the examiner the day before the work is presented.