CENG3430 Rapid Prototyping of Digital Systems
Final Project Specification

Objective:

To learn and practice how to employ Hardware Description Languages (HDLs), C/C++, Shell Scripts, embedded Linux, and Field Programmable Gate Array (FPGA) to build useful digital systems

Requirement:

1) Your project should be designed based on Xilinx ZedBoard™
2) In your project, the following parts should be included: input(s), output(s), control unit (FSM)
3) Your project should use at least one Pmod device as your input(s) or output(s)
4) VGA output is highly suggested for better display
5) At most two students in one group (you need to ask for approval for one-student or three-student group)

Marking scheme:

1) **Proposal Presentation (25%): March 25 (Monday), 2019 16:30~18:15**
   Each group will be given 5 minutes to present your proposal during the lecture time (16:30~18:15) on March 25 (Monday). Your presentation should include the following issues:
   a) Project Title and Objectives
   b) Group member(s)
   c) Prototyping style (introduced in Lecture 07)
   d) The finite-state machine diagram of your digital system
   e) Plan with time schedule
   f) Additional equipment needed:
      - Each group can buy additional components/equipment (no more than HKD300, keep the receipts, reimburse later through TAs) for the project. E.g. Buying "pmod" cards for the zedboard, see:
      - https://en.wikipedia.org/wiki/Pmod_Interface
      - Search "pmod" in: http://store.digilentinc.com/, https://world.taobao.com, etc.
      - Must get permission from the tutor or TAs before purchasing
2) **Demonstration (50%): April 16 (Tuesday), 2019 16:30~18:15**
   Each group will be given 5 minutes to demonstrate your project to us during the lab time (16:30~18:15) on April 16 (Tuesday). The project will be evaluated based on:
   a) The techniques used in the project (15%)
   b) Completeness of the project (15%)
   c) Creativity of your project (10%)
   d) Presentation performance (10%)
3) **Report (25%)**

Deadlines:

1) **Proposal Presentation**: (late presentation is not allowed)
   - Time: March 25 (Monday), 2019 from 16:30 to 18:15 (lecture time)
   - Venue: ERB 404

   (We will discuss with each group individually on March 26 (Tuesday) during the lab time)
2) **Demonstration**: (late demonstration is not allowed)
   - Time: April 16 (Tuesday), 2019 from 16:30 to 18:15 (lab time)
   - Venue: SHB 102
3) **Report**: (late submission is not allowed)
   - Submission Deadline: May 5 (Sunday), 2019 23:59 (one week after the final exam)

References:

http://hamsterworks.co.nz/mediawiki/index.php/FPGA_Projects

Report Specification:

Your report should be typed on A4 papers **(max. 12 pages including appendices, figures, etc., 1 inch margins, 10pt., single-line spacing, no title page)** with the following elements:

Abstract (15%)

- About 100 words, this summarizes the whole report – from Introduction to Conclusion.
- You may rephrase some contents used in the introduction and conclusion here.
- Abstract is an independent passage, it has no chapter index.

1. **Introduction (15%)**
   This is the real beginning of your report. Since the abstract only presents a brief summary to readers, therefore you may repeat what you have written in the abstract here.
   An introduction can be a chapter containing the answers of the following questions:
   - What is the problem you want to solve? (Problem definition)
   - Why the problem is important? (Motivation)
   - What are the previous solutions by yourselves or others? (Review, include cross references)
   - What have you achieved in this project? And how good the result is compared with other approaches? (Contribution)
   - What is the structure of this report? (Content of the report; Chapter 3 is the description of the theory and design etc.)

2. **Theory and design (20%)**
   - Overview: describe the architecture and overview of your project. Use flowcharts and block diagrams for better presentation.
   - Always remember to tell readers what is the input of your system (e.g. image features, IR sensor inputs etc.), and what is the output (e.g. model, pose, motor speed, output voltage etc).
   - Module descriptions: discuss each module of the system clearly and the interactions among them. The guidelines are as follows.
     - Justify the selection and applications of the modules (the mechanical parts, hardware parts and software).
     - Give name/model numbers of the components. Insert diagrams if possible,
     - Declare assumptions: For example, you may assume there is no Radio Frequency (RF) noise exist when using an RF remote controller, etc.
     - Circuits: Block diagrams are preferable, detailed circuits should be placed in the appendix. Explain the operations of the circuit and explain why such circuits are necessary.
     - Software: Describe the algorithms by using flow diagrams or pseudo code, explain why these algorithms are necessary. Insert screenshots of your GUI designs if possible. Source code maybe placed in the appendix if necessary.

3. **Implementation and experimental result (20%)**
   - Implementation: describe how the system was integrated to become the final product. Use past tense to write this part.
   - Experimental result: Any system built should be tested to evaluate its performances. State the procedures of the experiments (past tense) and show the results.
     - Use tables or graphs: For example, for a temperature control system, you can plot a graph showing the temperature change against time.
     - Avoid using qualitative description to describe results (e.g. large, small, heavy etc), use quantitative measures instead (e.g. temperature in degree Celsius, power in Watts etc).
   - Answer the following questions:

- Does the result match your expectation?
- What have you learned from the result obtained?

4. Discussions (15%)

- Expectations: Have you realized the preset goals and how good it is?
- Discussion of the evaluation results in the section of "implementation and experimental results".
- Difficulties encountered during the implementation, limitations.
- Others: e.g. trade-off of the system (like memory-time trade-off), cost of production (is the design suitable for massive production)……
- Further improvement and possibilities.

5. Conclusion (15%)

State clearly what you have achieved in this project.

- What is the problem you want to solve? (problem definition)
- What have you achieved in this project? And how good the result is compared with other approaches? (contribution)

6. References (No section index; optional, may use web links as references)

7. Appendix (optional)