Final Project: Short Course on Humanitarian Feedback Control Engineering

Humanitarian Challenges for Colombia

June 29, 2015

** Text in this document in blue is clickable and will take you to web sites or to your email client.*

1 IEEE Humanitarian Challenge Contest, Colombia 2015

Please see the document (at the short course web site)

HumanitarianChallengeColombia2015.pdf

The best solutions from this final project from the category of appropriate technology for Colombia (see below) will be recommended for submission to this competition. Passino/Quijano will work with the chosen group(s) after the final project submission deadline for this course to prepare the submission for November, 2015.

2 Final Project Rules

Project guidelines:

- **Read:** Sections 4.6.1–4.6.3 of the book by Kevin M. Passino, Humanitarian Engineering: Creating Technologies That Help People, Edition 2, Bede Pub., Columbus, OH, 2015.
- **Team size:** Greater than or equal to 3 and less than or equal to 5. Recommend splitting the project in pieces, but be sure to integrate the pieces for your final report. You may get help on this project from *anyone* and any source (e.g., the internet); however, you must cite your sources.
- **Scientific/Technical:** Your report should contain significant technical content. Justify your claims with authoritative sources, underlying science, mathematical analysis, and sound engineering methodology.
- **Bibliography:** Use good practices in bibliographic referencing, including to the internet and conversations with people outside your group. Credit your sources. Do not copy directly from sources without proper quotes and references. It is easy to compare your submitted e-report to what is on the internet (e.g., via "Turnitin"); if you engage in plagiarism this will be discovered and dealt with severely.
- **Final report:** Must be submitted electronically (MS Word or .pdf, e.g., from LaTeX). No limitations on length. There should be a written portion, but inclusion of photos and/or videos, as appropriate, can be useful.
- **Due Date:** Monday, July 6, 12:00pm (Bogotá time). Late submissions penalized 15% per day (one minute late, counts as one day late). Submit to both Kevin Passino (passino.1@osu.edu) and Nicanor Quijano (nquijano@uniandes.edu.co).

Agreement: It must be agreed that the instructors may share the solution materials for your project (reports, presentation, etc.) by posting it on the web and for these please provide a MS Word file or a .pdf. If you do not want your name on the project, do not include it. Of course, the project grades will not be shared.

3 Final Project Choice Options and Guidelines

Your team may pick one of the following projects (or a combination of them):

1. *Feedback Control for a Financial Advisor for the Poor:* Extend the approach in Chapter 1 where a PID controller was used by considering two additional approaches to feedback control for that problem (e.g., adaptive control or model predictive control). You must evaluate your control designs using Monte Carlo simulation and compare their performance to that of the PID controller, including for the following two cases: (i) when the person does not perfectly follow the financial advise from the controller, and (ii) where there are thefts from the person's savings (a type of shock). Extra credit will be given if (i) you can demonstrate that your approach is better than the PID one in the book, and/or (ii) you implement an appropriate technology to implement the feedback controller (e.g., on a phone or microfinance institution computer).

2. *Models, Dynamics, and Analysis of the Common Good:* Solve Problem 2.42 in the textbook. You must include a properly designed, and useful, Monte Carlo simulation. Extra credit will be given if (i) your model can be made specific to Colombia and/or (ii) you can design an appropriate technology that would promote the common good.

3. *STEM Education:* Science, technology, engineering, and mathematics (STEM) education is discussed in Section 4.8 of the book, and of particular relevance to this project are Sections 4.8.6, 4.8.8, and 4.8.10. Design a technology that can be used for educating children or university students. Some ideas along these lines, including some "current challenges" can be found under the iSTEM program here.

4. *Additional Appropriate Technologies for Colombia:* Using the sources identified in the book in Chapter 4, choose an "appropriate technology" for Colombia and develop it. For instance, this could be one for personal energy supply, housing, lighting, water filtration, cooking, etc. One idea for Colombia would be to design low-cost refugee housing, an idea of Luis Felipe Giraldo Trujillo (from Ibagué). Another would be wind-based energy generation, an idea of David Castaneda Vergara (from Montería). Yet another idea would be to design/implement a technology for homeless people (see book, Section 4.6.4 and progress in this area here). Other ideas are in the attached document "HumanitarianChallengeColombia2015.pdf." You may produce either a "paper design" (i.e., only an electronic report) or an actual implementation. Extra credit will be given for a physical implementation and/or a computational study of the appropriate technology design. Submit a photo or video of an implementation, if you complete one. It seems doubtful that a submission to the Humanitarian Challenge could win without an implementation.

These problems are open-ended. A good solution will go "above and beyond" simply a minimal attempt to meet the requirements for the project. It is possible to combine projects 2. and 4. via an appropriate "community technology," perhaps one that implements the "cooperative management of community technology" (see Chapter 4 of the book). Of course, feedback control could play a central role in the common good problem.

For the appropriate technology cases above, the team *must* complete the following:

1. *Evaluate needs and priorities:* To the greatest extent possible, evaluate needs and priorities of the people. Make this for a specific community or region. Justify your claims with data/reports, if possible.

2. *Evaluate relevance of culture:* To the greatest extent possible, evaluate the impact of culture on your technology.

3. *Evaluate context:* Here, context includes many things, such as weather (temperature, humidity, rainy vs. dry seasons), local housing situations, availability of local resources, etc.

4. *Evaluate design options:* Evaluate options for the technology your project will focus on. Consult the literature and brainstorm. This must have significant technical content (e.g., science, math, engineering).

5. *Develop specifications:* Specifications quantify the characteristics of the physical make up and operation of the technology. They specify desirable characteristics of the technology that your design aims to achieve. You should, as appropriate, include the social context.

6. *Evaluate impact on environment:* This can include resources used (e.g., materials), pollution during operation, and how environmentally-friendly it is to recycle the technology at end-of-life.

7. *Evaluate cost:* This should evaluate the costs of all aspects of the technology, from materials, construction, and operation. Include an analysis of whether local people could afford to buy the technology.

8. *Evaluate needs and priorities, broadly:* To the greatest extent possible evaluate needs and priorities of a much broader region for the need you identified above. This evaluation should be at the country level, and is done to consider if it is possible to scale up your technology.

If appropriate, you may want to also consider social business opportunities for your technology; see Chapter 3 of the book.