McMaster Engineering Competition

Programming Challenge

October 21st, 2017 – October 22nd, 2017

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PHASE ONE

General Rules:

- All questions regarding the case details must be asked during the welcome and briefing session. Problem statement questions will not be answered once the design and creation stage has begun.
- Competitors can only use the approved resources and materials they entered the competition area with. This means no trips to the library or visitors dropping off material during the competition period.
- Online communication tools (instant messengers, iMessage, e-mail, etc.), social media sites (Facebook, Twitter, etc.) and other communication methods are prohibited. Violation of this rule will result in immediate disqualification.

Permitted Tools:

During the competition period, the following tools will be permitted for use by competitors:

- Computers & Internet

Competitors must use their own computers for the demo and presentation.

A projector and screen will be provided during the presentation period.

Use of all other tools must be cleared by the competition director prior to use.

Schedule (Estimated):

Saturday, October 21st, 2017

2:30PM – 3:30PM	Registration Competition Briefing
3:30PM – 9:30PM	All allocated time to brainstorm, create and perfect report and presentation
9:30PM – 10:00PM	Qualifications Round

Sunday, October 22nd, 2017

8:00AM – 9:00AM	Registration & Breakfast
9:00AM – 11:30AM	Final Round – Top 6-8 Present to Judges
11:30AM – 2:00PM	Lunch & Awards

Deliverables:

The Programming requires the following 3 deliverables:

Mockup Program – A mockup program placing the control system under test. You may simulate real-time mechanisms using whatever methods you wish. It is not necessary to create a user interface, but you are encouraged to do so if time permits. The control system must be wrapped by the test bench as a unit-under-test, rather than the test bench incorporated into the control system's own code.

Presentation & Report - The purpose of this report is to explain your solution. The report should include a problem overview/analysis, assumptions, technical details and flow in a cohesive way from start to end. Use the format guidelines below.

1. A high level concept presentation, using MS PowerPoint or as a PDF file; detailing the control system that you have chosen as well as the scope of your design along with any accompanying models, flow charts and other visuals.
2. A fully specified design document (PDF) which details the form and function of all system inputs, the description of all internal machine states (including inputs, outputs, transition mechanisms, and internal functions), and the cause of and meaning of all error messages. Adherence to a standard format is not strictly required but the document as a whole must follow a consistent structure. Furthermore, if a particular section is not applicable to a component in your design, you should mark it as such rather than leave it out.

Teams will have 15 mins to present and demo their solutions, followed by 5 minutes for questions and answers.

The following guidelines should be adhered to in your report:

- Title page, table of contents, references, relevant appendices
- Must have Team Number (Header) and Slide/Page # (Footer).
- No more than 10 pages, double spaced, 11pt font for the body of the report
- Ensure all references are presented using consistent formatting
- Be clear, concise and professional. No "we", "us" or "I"

All deliverables for use during the final presentation must be submitted any time before the expiry of the six (6) hour competition time. Any materials submitted after the competition end time will not be permitted to be used during the presentation and will not be judged. Use of any changed materials during the presentation will be grounds for disqualification. Please submit both report and presentation files to the team's Google drive folder.

Background

The livelihoods of over 200,000 farmers in Canada are dependent on the successful growth of their crop and livestock. [[stats and numbers]]
Timely data about the crop's growth progress/hindrance due to crop pests, diseases or effect of Mother Nature can help farmers protect their crop before any major damage can occur.

Challenge Statement

Develop a system to help farmers who face many daily challenges from crop pest and diseases to the uncontrollable elements. The challenge is to develop an app to use crowd-sourced information and/or online datasets so local farmers have the information about all the factors affecting their crops and the effects on their harvest. The resulting data could be creatively mapped or displayed graphically, e.g. by mapping the spread with time of the pests/disease.
The key benefits of this application:

- ✓ Works as an early detection system for farmers in neighbouring regions, providing them with information in advance about specific pests/diseases they will need to protect their crops from. It could help to reduce the overuse of pesticides through more targeted preventative measures being identified.
- ✓ Provision of an additional data source for scientists to investigate the links between crop pest/disease spread and the contributing economic, social and meteorological factors.

Objectives, Requirements & Constraints

You will be designing one of several different systems that will be used by these farmers:

- Weather monitoring system for crops and livestock
- Pests and disease monitoring system
- Irrigation control system to maintain plantation
- Livestock management system
- Network system, an ad hoc system between all the farmers in the region for live alerts
- Emergency alert system to transmit messages to people stranded in a given area

All these systems can be created through crowd sourcing, online datasets, data gathered by drones or a combination of the three. The scope of this design challenge is open ended and you're not required to create a broad or complex design; you will not be accessed on matters that are not included in your scope. These systems would take roughly around 6 hours to develop and implement.
You may explicitly declare some matters to be out of scope along with any assumptions that you are making. However, you could be penalized for making assumptions that would lead to the creation of an unsafe system. Do not assume for instance that all hardware components are always online, as this could lead to improper data being recorded. Designs that go into making the system safer and more redundant may be given extra credit for doing so.

> **Any additional assumptions must be clearly stated within your oral presentation and report. Ensure these assumptions are reasonable within the best of your abilities.**

Requirements

1. **Minimum requirements for each system includes the following**
    a. At least 6 user configurable parameters (set points, boundaries, Boolean values) and if required must include units that are appropriate.
    b. At least 2 different sensors or feedback mechanisms
    c. At least 2 different controlled devices or output mechanisms
    d. At least 2 different feedback loops
2. **Each control system must contain these features**
    a. A mechanism for detecting, reporting, and logging anomalies and errors
    b. A mechanism for detecting and safely dealing with unsafe or hazardous conditions (if system faces damage)
    c. A mechanism for self-correction in the event of a transient or long-duration power failure
    d. A mechanism for resetting to a consistent and safe ground state upon demand
    e. Must be able to validate hardware sensors (if applicable)
    f. Every system must provide an interface to get data; ability to set data is optional not needed, and all diagnostic information must be available through this interface as well
    g. If the system could benefit from the Ad Hoc network of nodes, then make use of the information available
3. **A GUI related to the system you choose to design**
    a. GUI must be able to be switched to a test mode to feed test data into the system and be able to observe the system's reaction
    b. GUI must be able to display current system values along with appropriate units and design considerations for viewing the data
4. **Some factors to consider**
    a. Ocean weather conditions may damage certain components, and must be able to either recover or transmit the Ad Hoc network's information
    b. FM and AM bands can become flooded if every node is broadcasting on the same frequency, ensure that each band is clear when transmitting
    c. Satellite communication should factor in a long latency and the inability to get strong signal unless there is direct line of sight with the satellite

Scoring

Design & Performance ..... /75

Does the design work?
How well does the design meet the requirements of the project?
Does the solution include relevant extra components on top of those requested?
Did the solution come with appropriate user documents?
Did the solution include an install package?
Did the QA volunteers find any bugs that were not reported?
Does the program use a simple interface? Does the program utilize mouse and keyboard?

Penalties

Misuse of time – late handing in solution to QA volunteers ..... -5/minute, up to -100
Plagiarism ..... -100
Product does not include install package (if required) ..... /-10
Product does not include user documents ..... /-15

Bugs

Are there any reported bugs/issues?..... ./-15 (-5 per bug/issue)
Are there any non-reported bugs/issues? ..... /-50 (-25 per bug/issue)

Management & Presentation ..... /25

Did the members of the team appear to work well as a team?
Did all members contribute to the problem solving process?
Did the team appear professional? Were all members available?
Were the benefits and principles of the design clearly explained?
Was time used appropriately?
Does the program code made in a systematic method?
Are there sufficient amount of comments to read the code?
If the solution had error, were they identified during the presentation?
Did all team members participate equally in the presentation?
Were the user documents and install packages included in the presentation?
Was the product's components demonstrated thoroughly?
Were any open source components made apparent?
Was the presentation interesting? Easy to follow?
Did the presentation have proper use of color, images and text?
Was the team communication clear? Such as: Proper use of jargon? Not extremely technical?

6 Tips for Success from the Case Creator

1. **Play to your team's strengths** – you'll notice that there are a variety of routes for your team to go down within this case. Take some time at the beginning to ensure you're choosing the option that aligns closest with your team's knowledge and abilities. Beyond just picking the topic, ensure you're applying this throughout the whole case. Not everyone will be the best researcher or presenter or report formatter; this isn't a group project where everyone needs to do everything equally. Play to your team's strengths.

2. **Be creative and think outside the box** – maybe you read one of the options and think "this one is easy, we just have to do 'x' and it'll work". Feasibility is critical – however, creativity is the most important ingredient to coming out on top. You need to dig into something that stands out, maybe was the riskier choice, and something that excites you to present and speak about to your judges and peers.

3. **The judges know you only have 6 hours** – this isn't going to be a situation where you have the ability to come up with an extremely detailed solution, nor will you be able to foresee every possible flaw in your plan. The judges know this, and will score you accordingly. The purpose of this challenge is to test your ability to think and act quickly with the best possible quality you can muster.

4. **Don't leave your report or presentation to the very end** – you don't have enough time to only start your deliverables at hour three. You need to be creating them as soon as possible so that you can edit, change and perfect them along the way. Whatever idea you come up with, you need to think of it within the context of how you will be communicating out your idea; it cannot be beyond comprehension when you explain it.

5. **Have way too much fun** – cases are stressful and activate parts of your brain that you don't use every day. Not to mention you've been given an impossible task of solving some extremely difficult problems in no time at all! This is the nature of consulting cases. Might as well enjoy becoming an expert in a field you maybe knew nothing about, trying to convince judges that your solution is the only possible answer, and getting to know your teammates better than you ever did before!

6. **Give it your all, it's your only chance** – this could be the start of something amazing. From McMaster to Ontario to Canada to an International competition! You've got the brains, you've got the stamina, and you've got the charm… now let's see you shine!