ECE 4220 Project Proposal

An Embedded System for the Optimization, Monitoring, Control, and Automation of a Green House Environment

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http://www.thegrowpros.com/greenhouse-experiments/

**Introduction:** Recently I was fortunate to attend a conference at the University of California-Berkeley where a talk was given by a computer science alumni named Mike Olson called “The Engineer’s Century”. It was over how quickly civilization has progressed since man started using machines and the first industrial revolution but arguing that it was in fact this century where the most amazing changes would occur. The biggest reason for that is our ability to process data and the rapid advancement of computing technology. One particularly interesting point he made was about Monsanto. He noted that many people really dislike the company but they have done some pretty amazing things. The company had created sensors that farmers could drive around with their tractors and measure all kinds of things like soil moisture, soil grade, mineral content, Ph, and many more record them with their GPS location and upload them to be processed. The company then had another implement which fed seeds for all those locations and would plant each individual seed in the optimal growing location which showed yield gains as high as 30%. This was impressive mostly because there was no additional land or light added the gains were due almost entirely to detailed analysis of a large amount of data.

**Proposal:** My aim would be to optimize a similar system but in a greenhouse type environment rather than a field. There are a few obvious advantages of a greenhouse approach as the conditions such as medium, temperature, light, humidity, and water can be controlled and therefore monitored, studied, and then optimized. The chosen processor is the intel Galileo as it is able to run Linux as well as implement Arduino sketches and support the same architecture. The control aspect of the system would involve a small peristaltic pump which could pump fertilizer solution, a solenoid to allow water in, float sensors to monitor water levels, and a pump to pump the water to the system. The mixing tank would be the main implementation of the hardware control for the immediate project. A fan, heater, and light are described in the proposed hardware specification below though they will simply have a relay that opens and a led that signals they would be operating. The data sensing will be done using a photoresistor light sensor, and a humidity and temperature sensor.



The software is where many of the concepts from class will be utilized. The software is in large two part: Hardware Interfacing and Data Processing.



The controls process will be very important as it will interface with the physical components telling them to turn on or off. It is vital it be able to respond quickly as it could end up allowing water to overflow so it is important it have the ability to interrupt other processes. In general the tank will be able to sense when the water level is low which will cause the pump to turn off, the solenoid to open to allow water in, and the fertilizer pump to mix in. When the tank is full the pump will open and again pump out the water. The process will also turn on a fan if the temperature gets too high and a heater if too low and a light if the sensor is dark. For this process to work it must use information from the sensing process so a pipe will need to be created which the data logging process will also need to access. The data logging process is somewhat of question. The information follows the Faircom system for an arm processor which the Intel is not. If such a solution is not possible inside the time constraints data would simply be written to an SD card or transferred over the Ethernet to a pc for logging. The data would then ideally be analyzed and it could in turn fine tune the control process but that would be considered a distant goal.

**Notes:** Obviously the system will be limited to only sensing unless a more elegant solution for the logging and or processing of the data can be implemented but that alone would be a vey complicated system to design and analyze. The first stage of the process is creating the mixing tank and the vital control process around it. Then the sensing hardware and software process would be created. Finally the data logging and/or transmission would occur last. I imagine the system could be very successful and offer a somewhat affordable way of closely monitoring and controlling agricultural studies or possibly someday optimizing production.