Initial Project and Group Identification Document
Divide and Conquer
Home Hydroponic System
Senior Design I
Group 18

Joshua Casserino | Computer Engineering
Richard Charmbury | Electrical Engineering
Alexander Costello | Computer Engineering
Ernest Inman | Electrical Engineering

1.0 Potential Customers

- Residents of larger cities that have limited space
- “Green movement” members.
- Farm to Table restaurants
- Medical Marijuana Patients
- Residents of places that have harsh climates that make farming difficult or expensive
- Small farmers

2.0 Project Narrative Description

2.1 Introduction

The need for food has always been a vital aspect to every civilization. Farming made it possible to feed more people, and thus made it possible for the population to grow. However, the problem of starvation was ever present. In order to stay ahead of the constant growing numbers, farming techniques improved in order to increase production rates. To solve common farming problems in the 1600s, Japanese farmers started using glass lanterns and bell jars to protect the root systems of plants. At the same time, the French and English started making green houses to aid in growing plants. These were the steps that eventually led to the current hydroponic systems. Hydroponic farming techniques make it possible to grow more food in less space and are more reliable than using traditional farming techniques.

As the popularity of home hydroponic systems rises, the current hydroponic systems aren’t meeting the requirements of casual users. The systems available are capable of maintaining the ever growing population, but face a few problems for the user. The systems are either difficult to maintain, very costly, or too time consuming. The purpose of this group’s project is to create an affordable, easy to use, automated home hydroponic system.

2.2 Motivation

A simple home hydroponic system will enable people to become less dependent on large farms for simple and daily food needs. Large farms will always focus on crops that will turn the highest profit. This business model has created a supply and demand cycle of food goods, and to fill this demand, businesses have lowered the quality of their products. The need to grow crops faster or harvest more from each crop has made farmers turn to cross breeding plants at the cost of flavor, nutrition, and overall value. This kind of system will remove some of the demand on the market for simple, easy to grow, crops.

This will be a system that the average person can run and maintain with a minimal time investment and cost. It will improve the standard of living for people of low income levels. The current moderate-cost food plan of a family of 4 (Male/Female 19-50 years old, one 2-3 year old child and one 4-5 year old child) in America is $880.30 a month. If this system was able to remove just one-quarter of that cost, it would save that family $220 a month. For a low income family this money could now be spent on other household needs; which in turn will improve their quality of life.

This kind of device will also make it possible for people living in harsh climate areas (i.e. deserts, arctic, mountainous, etc.) to have a much more varied diet. Thus it will improve the health of those individuals. By improving their health, the healthcare systems can now focus more on illnesses that are more serious. This will also help limit the spread of diseases. If there is less risk of contracting a disease or illness, people will be able live together in larger numbers. This will empower the growth of cities and society around the world.

2.3 Goals and Objectives

To design an easy to use automatic hydroponic system for at home use. This system should be small enough that it won't take up too much room in a household and will not consume a great deal of power. It will be able to grow plants with minimum human interaction.

2.4 Project Function

This hydroponic system will be designed to run in a household using a standard power outlet. The system will test the pH levels of the water in it's tank and, if needed, will add components to return the pH to acceptable levels based off the user's input settings. The device will use a pump to feed the liquid into a tank containing the plants.

The system will be Wi-Fi capable and the user will be able to adjust the setting using an android app or through a website. The website, device and app will store the information picked up from the sensors in a database. Based off the user's profile settings, the user will be alerted if the device isn't within the established setting.

3.0 Requirements and Specifications

- Housing of Hydroponic Monitoring System
    - Dimensions - No larger than 6" L by 6" W by 4" H
    - Weight - No heavier than 2 pounds
    - Enclosure - Water Tight Enclosure / Plastic Box
- Power Source for Project
    - AC/DC Conversion from Main
    - Voltage Regulation and Current Supply Circuitry
- Electronics
    - Microprocessor
        - Input Voltages - 2.5 to 7.5 Volts
        - Digital Input/Output Pins - 10 to 30 Pins
        - Analog Input/Output Pins - 5 to 10 Pins
    - PH Sensor
        - PH Range - 0 to 14
        - Offset - +/- 0.20 pH
        - Output - Serial Communication with Microcontroller
- Peristaltic Pumps
    - Control of pH Levels
    - Voltage Input - 12 Volts
    - Environmentally Friendly - Chemicals do not come in contact with motors.
    - How Many - Two - One each for pH up and pH down corrections
    - Flow Velocity - 6 to 24 mL/min
- High Dynamic Range Light Sensor
    - Accuracy - Approximates Human eye Response
    - Dynamic Range - 1 to 600,000,000 Counts
    - Lux Range - 188 μLux sensitivity, up to 88,000 Lux input measurements.

    - Dimensions - 19mm x 16mm x 1mm
    - Weight - 1.1 grams
- Wifi Module
    - Input Voltage - 3.3 Volts
    - Wifi Standard - 802.11 b/g/n
    - Dimensions - 51mm x 23mm x 8mm
    - Weight - 9.7 Grams
- Software Considerations
    - Processor will be coded using C
    - Website-Database interactions will be written using PHP
    - SQL will be used to create the Database
    - Website will be written using, at a minimum, HTML
    - Web Page Hosting
    - Website will be written to work on, at a minimum, Google Chrome browser
    - Database will be able to be modified by multiple users

3.1 Project Constraints

- Cost: The members of the group don't want to go over the $400 amount, in order to try and make the system affordable.
- Power Rating: The system must work from a standard home outlet.
- Accessibility: The site must be able to handle many users at a time.
- Time: The project must be completed within 2 semesters.
- Providing a quality product for a reasonable cost to the end user.

4.0 House of Quality

As this system is designed it was important to have an understanding the tradeoff between market needs and engineering requirements. During the design and building process there needed to be a clear path for making the best decision for a successful project. This will be the guide for making decisions for the design and implementation. The main goal is to be able to provide the highest quality product while considering market needs.

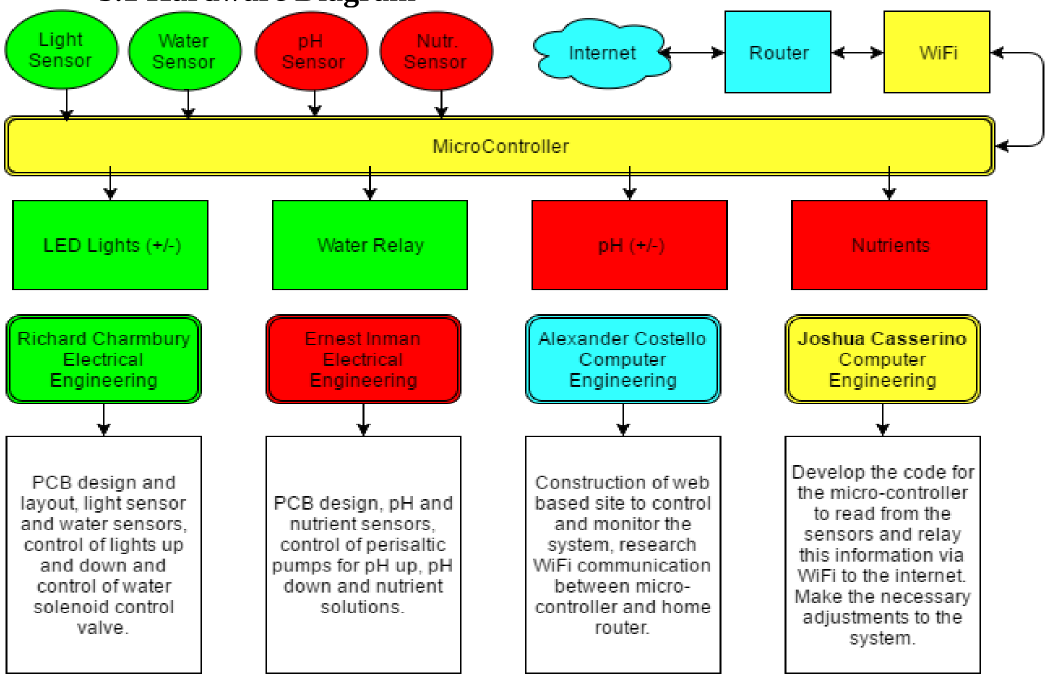
Engineering Requirement

- ↑ Positive correlation
- ↑↑ Strong positive correlation
- ↓↓ Strong negative correlation
- \+ Positive polarity (Increasing the requirement)
- \- Negative correlation (Decreasing the requirement)

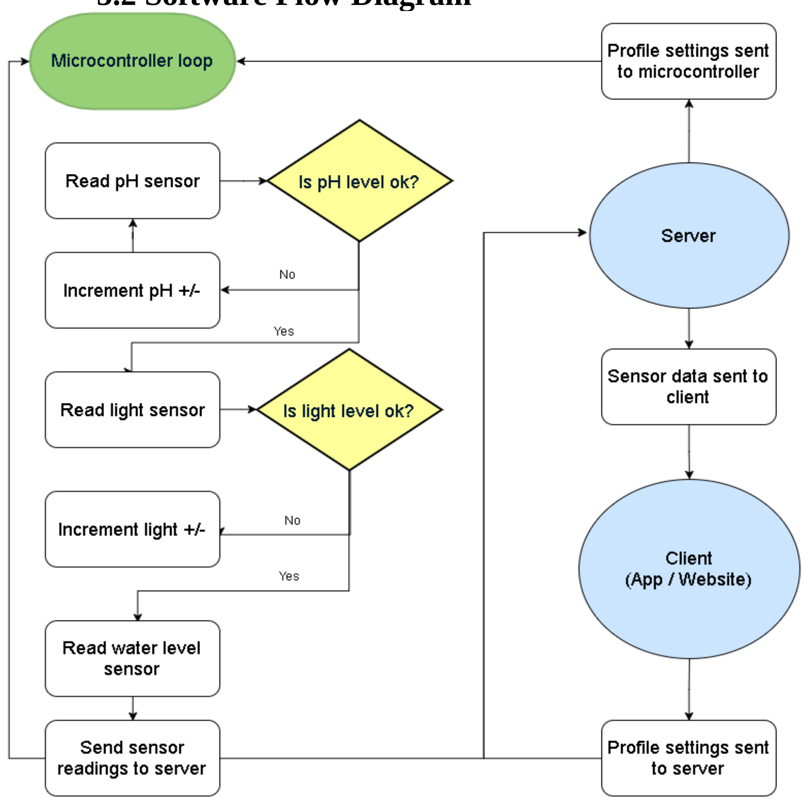
Marketing Requirements		Engineering Requirements						
		Quality	Efficiency	Install Time	Maintenance	Robustness	Aesthetics	Cost
		+	-	+	-	+	+	-
Lighting	+	↑	↑	↓↓	↑↑	↑↑	↑	↓↓
System Use	+	↑	↓↓	↑	↑	↑		↑
System Setup	-	↓	↓		↓	↓	↑↑	↓
Portability	+	↑	↓	↓	↓	↑	↑	↑
Cost	+	↑↑	↑	↑	↑↑	↑↑	↑↑	
Target for Engineering Requirements			< 20%	< 2 hours			< 20.00	< $500.00

5.0 Project Block Diagrams

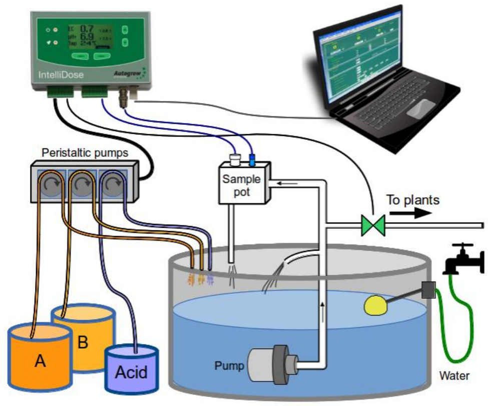
5.1 Hardware Diagram



5.2 Software Flow Diagram



5.3 System Representation



6.0 Project budget and Financing

Part Number	Quantity	Estimated Cost
Microcontroller	1	$10 - $15
Pumps	1	$30 - $40
Light Sensor	1	$5 - $10
pH Sensor	1	$125 - $135
Water Level Sensor	1	$10 - $20
Wi-Fi Module	1	$5 - $10
Web Hosting	1	$5 - $10
Database Hosting	1	$5 - $10
Tank	1	$5 - $10
Lights	1	$40 - $60
Misc. Supplies*	N/A	$25 - $50
Total		$265 - $370

*This will include all the building supplies (i.e. PVC pipes, hoses, wires, etc.).

UCF will fund up to $250 for this project and any remaining cost will be absorbed by the students. The members of this group will continue to do research on each component in an attempt to find equivalent components for a lower price. All costs are estimates of the actual prices and if possible multiple parts will be bought as fail-safes in the event of a part being damaged. This table will have to be updated as the device is being built.

7.0 Initial Project Milestones

7.1 Senior Design I

FALL 2016		
Description	Duration	Dates
Senior Design1 Project Idea	7 days	August 22 - August 28
Project Discussions	7 days	August 29 - September 4
Divide and Conquer Document	7 days	September 5 - September 9
Initial Project Documentation		September 9
Research Past Projects	14 days	September 12 - September 25
Individual Research Writing	32 days	September 26 - October 23
Group Collaboration Writing	12 days	October 24 - November 4
Table of Contents Due		November 4
Individual Research Writing	9 days	November 5 - November 13
Prototype & Code Development	14 days	November 14 - November 27
Finish Project Documentation	7 days	November 28 - December 4
Review Documentation	2 days	December 5 - December 6
Final Document Due		December 6

7.1.1 Hardware Milestones

Fall 2016		
Description	**Estimated Duration**	**Estimated End Dates**
Sensor Research and Selection	7 Days	September 16, 2016
Pump Selection	7 Day	September 23, 2016
Power Supply Design	7 Days	October 7, 2016
Analog Digital Converter	10 Days	October 7, 2016
WiFi design	14 Days	October 14, 2016
Microprocessor Selection	7 Days	October 14, 2016
Circuit Simulation	7 Days	November 18, 2016
PCB layout	21 Days	December 6, 2016
Build Prototype	30 Days	December 6, 2016
Schematic Design	30 Days	December 6, 2016

7.1.2 Software milestones

FALL 2016		
Description	Estimated Duration	Estimated End Dates
Website Design and Layout	7 Days	October 1, 2016
Database Management System Design	7 Day	October 8, 2016
Mobile App Design and Layout	7 Days	October 15, 2016
Coding Website	14 Days	October 29, 2016
Coding Database	14 Days	November 12, 2016
Coding Mobile App	14 Days	November 26, 2016
Microprocessor System Design	35 Days	December 31, 21016

7.2 Senior Design 2

Spring 2017		
Description	Duration	Dates
Test Components	14 days	January 9 - January 22
Build Prototype / Program MIC	56 days	January 23 - March 19
Test Prototype	28 days	March 20 - April 16
Finalize Project	7 days	April 17 - April 23
Prepare for Presentation	8 days	April 24 - May 1
Presentation Due		May 2

7.2.1 Hardware Milestones

Spring 2017		
Description	Duration	Dates
Run Prototype	7 Days	TBD
Test / Design Updates	7 Days	TBD
Finalize Prototype	7 Days	TBD
Finalize PCB	14 Days	TBD
Packaging Design	14 Days	TBD

7.2.2 Software milestones

FALL 2016		
Description	Estimated Duration	Estimated End Dates
Coding Microprocessor	7 Days	February 1, 2017
Testing System Interactions and Debugging	84 Days	April 22, 2017
Fine Tuning User Experience	14 Days	April 22, 2017

Outcome

The main outcome of this project will be to create a system that is self-sustaining, low cost, and increase the health of families in the community. The control system will allow a person to grow vegetables with the least amount of effort. The controller will monitor lights and grow solution to make sure the correct nutrients, ph, and lighting needs are met to efficiently grow. The benefit of a low cost system will allow people to have a healthy food source in their own household. Due to the plants being grown indoors it will also add the benefit of increasing air quality to the house by cleaning the pollutants out of the air and adding fresh oxygen to the home.