Automated Hydroponics System

1 Introduction

1.1 Member Identification

Name	PIDs	Email
Matthew Dileonardo	m2761591	dileonardom@knights.ucf.edu
Justin Walker	j3180442	justinwalkerucf@knights.ucf.edu
Khalid Al Charif	k2299744	kalcharif@knights.ucf.edu
James Loomis	j2682448	loomismeister@gmail.com

1.2 Motivation

Hydroponic gardening is a great way to grow plants to their full potential. Plants are given as much nutrients and water as they can absorb. In the past, setting up a hydroponic system required research, many installation steps, and daily monitoring to ensure proper growing conditions.

Currently, implementing a hydroponic system requires research and knowledge about the type of plants to be grown. Different plants require different nutrient levels as well as PH levels. Once this information is known, a gardener must choose a hydroponic design and set it up correctly. This process can take anywhere from a day to a few weeks. A typical deep-water culture (DWC) hydroponic design requires daily PH, nutrient level, water level, temperature, and conductivity testing.

For the average gardener with a busy lifestyle, this amount of research, initial labor, and maintenance is deterring. At the moment, most gardeners find growing in soil to be less strenuous and easier than hydroponic gardening.

Our motivation for our senior design project is to create a DWC hydroponic system that lets anyone have the ability to farm his or her own hydroponic plants using a simple automated system. This system will relieve the user from a lengthy setup and daily maintenance. The user will be able specify the plants wanting to be grown through a web/mobile interface which is connected to the microcontroller running the system. The plant specific settings will be loaded and thresholds for each sensor calibrated into the microcontroller, thus eliminating any research the user needs to do. This system will perform all daily testing necessary, adjust system levels (PH, nutrients, water) as necessary, notify the user of a problem requiring action, and log all testing data for analysis. Our goal is to make hydroponic gardening just as simple as soil gardening but able to produce better results.

This design will include sensors, a power supply, at least one microcontroller, and a web/mobile interface for users to monitor sensor data. Our group consists of three electrical engineering students and one computer engineering student. This dynamic design will provide a sufficient amount of work for our group and will challenge each member to put the skills we've learned in our college careers to the test.

1.3 Goals and Objectives

Our main goals for this project are to create a system that lets anyone have the ability to farm their own hydroponic plants using an automated system in their back yard.

- Solar powered
- Wireless updates with your phone
- All in one contained solution
- Low maintenance

2 Project Impact on Sustainability

Our Automated Hydroponics system uses solar power efficiently grow plants in a hydroponics environment. We are encouraging the average person to become involved in agriculture by making it easy to grow plants right in their backyards. Our product runs off of the grid by supplying its own energy.

3 Project Specifications

Attribute	Value
Battery Life	24 hours
Number of Plants	2-4
Weight (empty)	Approx. 20 lbs.
Dimensions	Approx. 4x4x4 ft.
Water Consumption	1-15 liters daily
Water Volume	30-75 liters
Working Temperature	50-105°F
Working Humidity	10-100%
Sensor Measurements	At least once per hour
Communication	Wi-Fi/Bluetooth

The system as a whole shall be durable and weather resistant. Each sensor shall interface with the main microcontroller and be easily applied or re-locatable. In the event that user action is required, the user shall be notified via text message, email, and/or mobile app notification.

3.1 Power supply

The power for this hydroponics system is generated by solar panels. Similar hydroponics systems have used 20W of generation. The battery will store power so that the microcontroller can access a steady power supply, even when the panels are not exposed to the sun. The system will run for at least a day when the battery is fully charged.

3.2 Control

In order to analyze the data coming from the sensors in a proper way, we need to pass them to a microcontroller. This microcontroller will receive data from sensors; analyze them and send them over Wi-Fi or Bluetooth to a phone or computer to display graphs about the plants growth.

3.3 Communications

There is a real time link between the microcontroller and the connected phone or computer, and this is facilitated by an adapter which allows the controller to talk to other devices.

3.4 Sensors

We are including many different sensors to interface with our microcontroller. Many properties of the water need to be measured to make sure that the plant will grow in an optimal environment. The PH level, solid nutrient density, and conductivity of the water can all be measured with electronic sensors. A camera is included to provide pictures of the plants stages of growth, and photosensitive sensors will determine the system's exposure to the sun.

3.5 Hardware

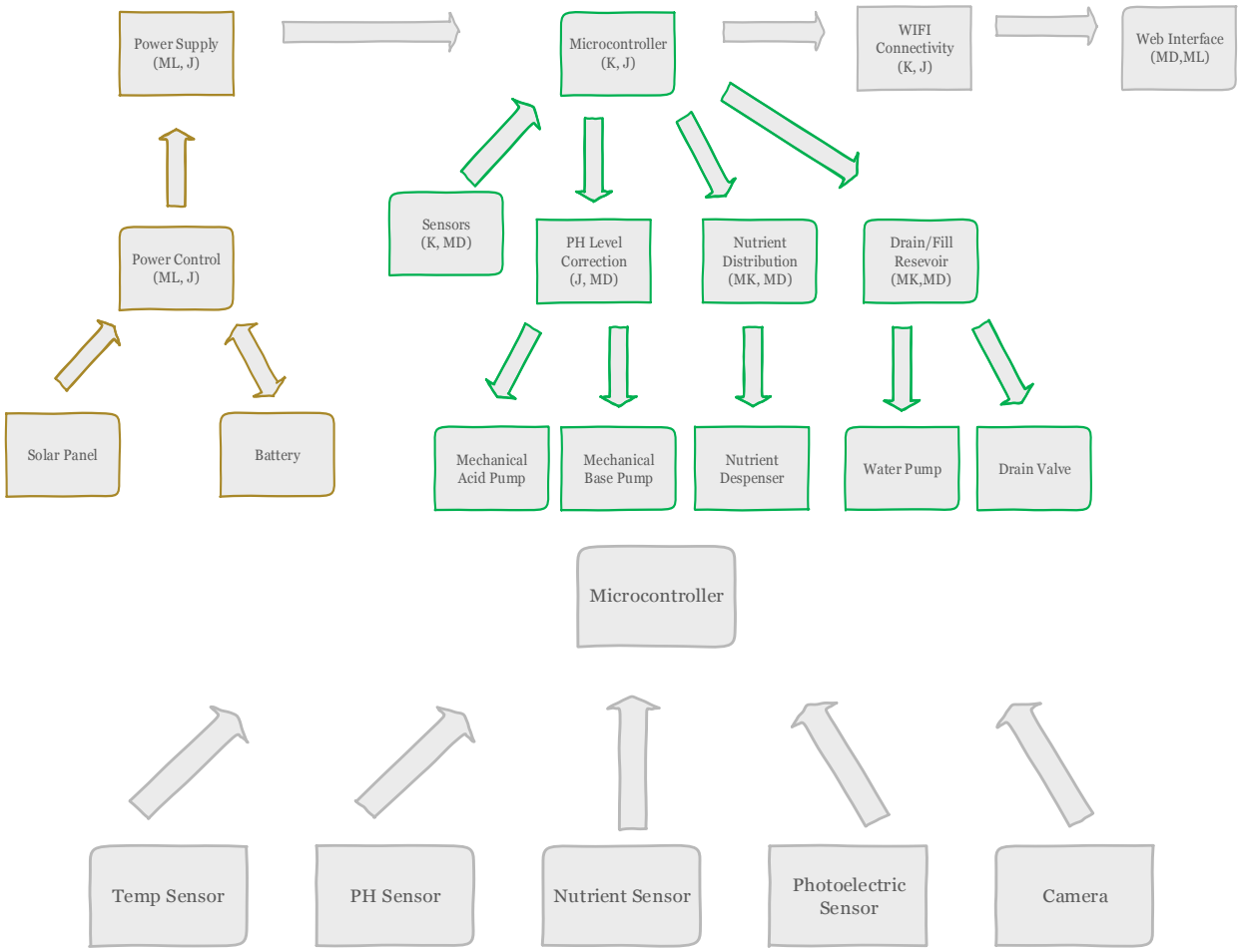
The hardware of the system consists of a containment system for the growth environment, and various pumps and filters that will be used to clean and add nutrients to the water. We are designing a hydroponics system that has minimal maintenance required, and does not create a mess in the area that it is located. The pumps and nutrient containers are connected and driven to the microcontroller, which determines when the systems need to operate.

3.6 Software

The system has companion app for any smartphone which will allow the user to change configuration options of their system. The app will also display information about the plants growth in the form of graphs. The user will also be able to look at the progression of their plant through pictures that the camera on the unit takes, like a time lapse video.

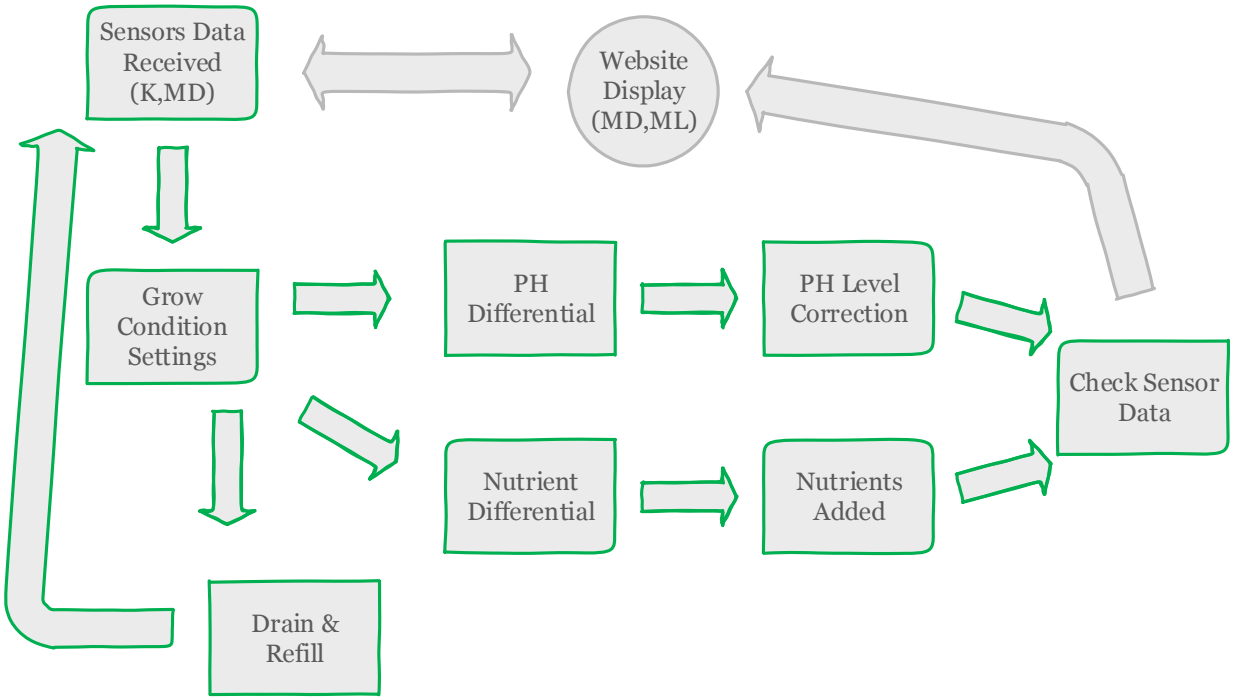
4 Project Block Diagrams

4.1 Hardware



The Block Diagram above is a basic layout of the hardware design that will be used for the Automated Hydroponics System. The power supply will consist of a battery and a solar panel that will charge the battery while in the sunlight. Designing the power supply with a solar panel to power the system makes more sense than other methods because the system will be designed for outside growing. The power supply will give power to a central unit that will house the microcontroller board that we will be using for this project. The microcontroller will receive data from the hypotonic system via many sensors located throughout the system. Using this data, the microcontroller will control the PH level of the nutrient water in the system by adding Acids and Bases and also adding more nutrients when needed. This will require two small pumps for the acid and base additions and then a third type of dispenser for adding the nutrients. Also, it will have the ability to drain and refill the hydroponic system's water if needed for various reasons which will require a water pump and a valve that can be opened to drain the water out of the reservoir. Finally, using the microcontroller's WIFI connectivity, it will send the data acquired from the sensors in the system to a web site and a mobile app. This is a very basic outline of the hardware required for the system.

4.2 Software



The block diagram above is a basic representation of how the software used for the automated hydroponics system will work. It starts off by taking the data from the sensors located in the system and displaying the data on the website. Then, with the settings for the grow system that are programmed into the microcontroller, it can find the difference between the desired value and the actual value for the PH and nutrient levels. With this calculation the software should know the approximate amount of Acid/Base or nutrients that is needed to be added to the system. The last step should be to display the updated PH and nutrient levels on the website along with the temperature of the water. Then program starts over and should be in a continuous cycle so it can maintain the PH and nutrient levels in the hydroponics system.

5 Project Budget

Item	Cost
Solar Panels 20W	$150.00
Battery power storage	$150.00
Nutrients and water quality sensors	$60.00
Camera	$30.00
Microcontroller and PCB construction	$100.00
Wireless adapters	$50.00
Pumps	$10.00
Filter	$30.00
Plastic Housing Container	$100.00
	Total: $680.00