1.0 Project Narrative Description

1.1 Motivation of Project

This project is designed to make an energy sustainable hydroponics easy and accessible to people. People who may be unfamiliar with the solar power and botanical knowledge required to successfully deploy and maintain a hydroponics garden will benefit from this project.

1.2 Goals and Objectives

The goals and objectives of this project are to accomplish the following tasks. Create a low powered solar energy dependent system for energy sustainability. Understand and implement sensor interfacing, automation of electromechanical systems, wireless communications, system integration, web interfacing, development within the Linux environment, and electrical power systems.

1.3 Function of Project

This hydroponics system will be designed in such a way that the entire system is green energy dependent, automated, low power, user friendly, low cost and enables an easy to use user interface. The function of this project is to fully execute, automate, monitor, and report the status of the following tasks.

Solar panels for energy source to power the entire system for energy sustainable features.

Light control for the hydroponics system by turning on and off the lighting system at preprogrammed intervals.

A light distribution system will be developed for the light control system to control and operate.

The entirety of the light system will incorporate a light intensity sensor to enable a smart hydroponics operation with sensor feedback as opposed to a time dependent system.

A pH sensor will be implemented into the hydroponics system to monitor and report the changes of the pH level. Based on the plant being grown, the operator is able to preprogram a desired pH level.

The turbidity sensor will monitor and send back useful data to the user which will include the turbidity levels of the water within the hydroponics system.

The CO_2 sensor will monitor and send back useful data to the user which will include the CO_2 levels of the water within the hydroponics system.

A temperature sensor will be implemented into the hydroponics system. This will allow for the user to get useful data of the temperature within the hydroponics system.

The automated tiller system is an electromechanical component of the hydroponics system that enables the plant life to obtain and maintain appropriate nutrient levels.

A water flush system is an electromechanical component of the hydroponics system that allows for high pH water solutions or time dependent water solutions to be expelled out of the system.

The water pump system has two main functions. The first is to cycle the water through the hydroponics system at user established intervals. The second is for the water pump to pump new fresh clean water into the hydroponics system after the water flush system ends its respective function.

A web broadcaster will be enabled through the wireless network to allow the user to have access, change, monitor, record, and view all aspects of the hydroponics system.

The user interface will allow for the user to change variable thresholds, and to view the output of both the sensor data and the video feed. The user interface includes the web browser page, as well as a localized LCD output screen.

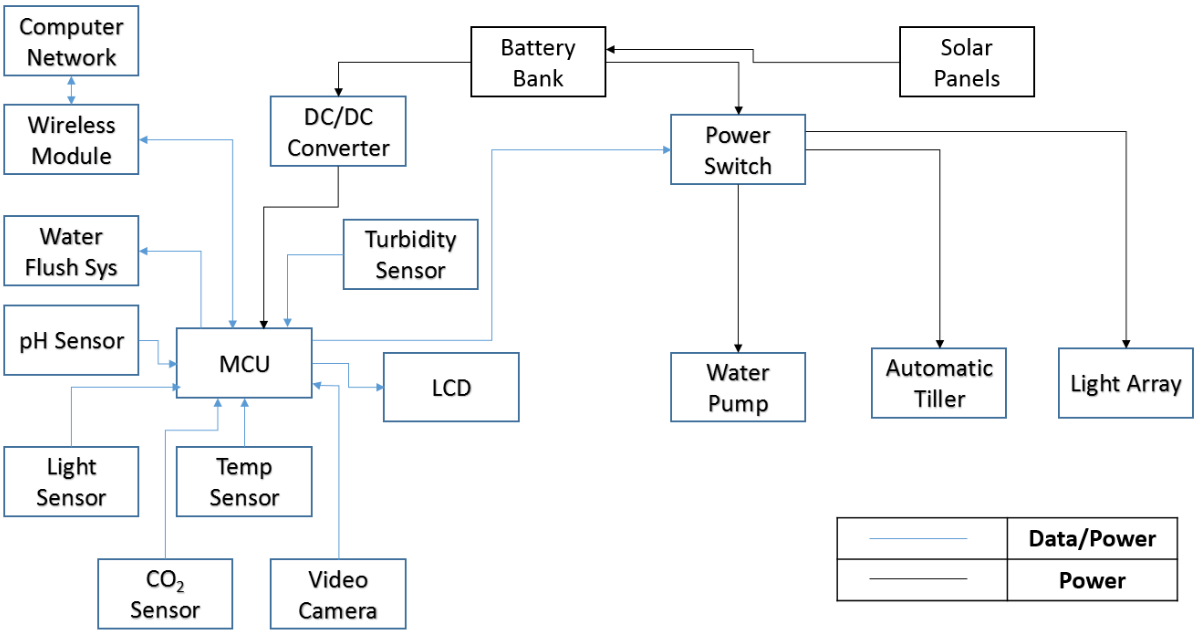
Video monitoring will be enabled for the hydroponics system. This will allow for the user to have HD video streamed to a web browser for visual monitoring of the hydroponics system.

2.0 Specifications and Requirements

An overall volume of less than 32 cubic feet. The solar panel system will provide enough power to fully and properly charge the battery bank every day, regardless of energy consumptive tasks. The lighting system uses no more than 100 watts/hour. Updates the sensor data on the web server every 5 minutes but, a manual refresh of the data stream is also accessible. Updates the sensor data on the LCD in real time. Lighting system will be user programmable and time dependent. Water pump with a max output of 5 gallons per minute. Water pump activates twice an hour for 5 minutes at a time, but can be changed by the user. The wireless network uses standard Wifi 802.11 specifications. The automatic tiller is initiated based on pH levels which are user programmable. Water flush system flushes water after a week maximum. Water flush system can also flush water based on pH readings, can be manually triggered, or the time dependent trigger can be set by the user. Light sensor can give data feedback to enable decisions of enabling or disabling the light array based on readings but, the user can also set time dependent variables. User interface auto updates every 5 minutes to correspond with sensor reading refresh. Video camera refreshes in real time through the web interface.

3.0 Project Block Diagrams

3.1 Hardware Block Diagram



- **Solar Panel**
  - James Tooles
  - The solar panel will allow for the battery bank to be properly charged during the day for all discharge processes throughout the cycle.
  - To be acquired
  - Input: Sun Light
  - Output: Electric power.

- **Computer Network**
  - Jon Spychalsky
  - The wireless network will allow for the hydroponics system to communicate and broadcast to a web server.
  - To be acquired
  - Input: all data acquired from the hydroponics system including sensor data, video feed, and hydroponics system actions with time stamps.
  - Output: user defined variables or actions.

- **Wireless Module**
  - Jon Spychalsky
  - The wireless module will be connected between the MCU and the computer network.
  - To be acquired
  - Input: all data acquired from the hydroponics system including sensor data, video feed, and hydroponics system actions with time stamps.
  - Output: user defined variables or actions.

- **Water Flush System**
  - Jon Spychalsky
  - An electromechanical system that will allow for the controlled release of the water retained within the hydroponics system.
  - Research
  - Input: a signal to open the water flush system. A signal to close the water flush system.
  - Output: none

- **pH Sensor**
  - James Tooles
  - The pH sensor will provide pH levels of the water within the hydroponics system to the MCU to be accounted for in other parts of the hydroponics system.
  - To be acquired
  - Input: none
  - Output: numerical pH level of the water.

- **Light Sensor**
  - James Tooles
  - The light sensor will provide light intensity levels that the plants are exposed to within the hydroponic system which will be sent to the MCU.
  - To be acquired
  - Input: none
  - Output: numerical light intensity level.

- **CO_2 Sensor**
  - James Tooles
  - The CO_2 sensor will provide numerical CO_2 levels that the plants are exposed to within the hydroponic system which will be sent to the MCU.
  - To be acquired

- Input: none
- Output: numerical CO_2 levels.

- **Temperature Sensor**
  - James Tooles
  - The temperature sensor will provide numerical temperature levels that the plants are exposed to within the hydroponic system which will be sent to the MCU.
  - To be acquired
  - Input: none
  - Output: numerical temperature levels.

- **Turbidity Sensor**
  - James Tooles
  - The turbidity sensor will provide numerical turbidity levels that the water level contains within the hydroponic system which will be sent to the MCU.
  - To be acquired
  - Input: none
  - Output: numerical turbidity levels.

- **Video Camera**
  - James Tooles
  - The video camera will be sent up to visually monitor the entirety of the hydroponics system. This video feed will be viewable from the web browser.
  - To be acquired
  - Input: none
  - Output: HD video feed.

- **LCD**
  - David Mascenik
  - The LCD will output all sensor data levels, time stamps of electromechanical actions, and additional numerical data.
  - To be acquired
  - Input: All sensor data from the MCU, time stamps of electromechanical actions from the MCU, and additional numerical data.
  - Output: none

- **DC/DC Converter**

- David Mascenik
- The DC/DC converter will convert the DC input voltage into another DC voltage for use by the MCU as well as the sensors.
- Research
- Input: DC Power
- Output: DC Power

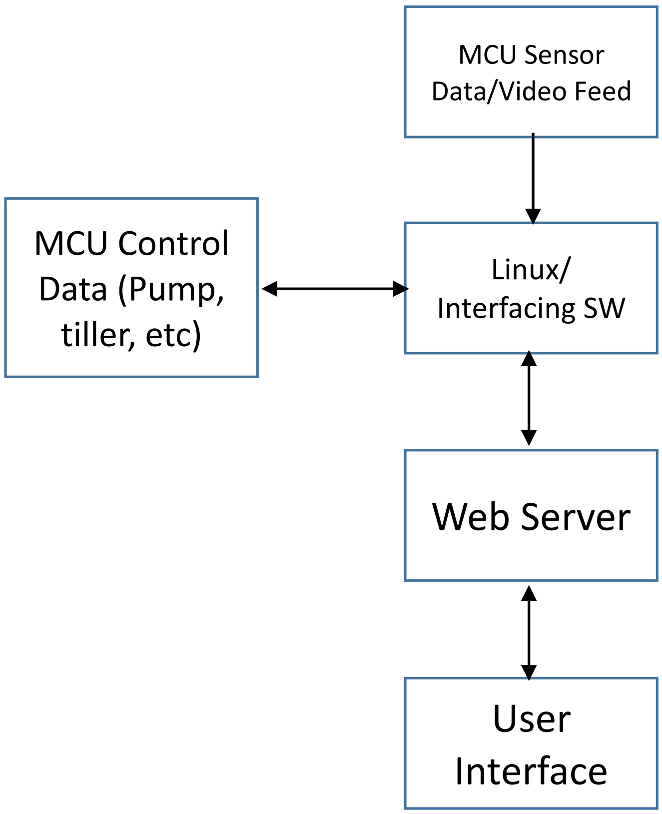
- **Power Switch**
  - Jon Spychalsky
  - The power switch will allowed for the MCU to determine when and what high power system to turn on and off.
  - Research
  - Input: Logical signal, or analog power signals to activate relays. DC power to pass through and power the high powered systems.
  - Output: DC Power

- **Water Pump**
  - Jon Spychalsky
  - The water pump will enable for water to be electrically controlled and pumped into the hydroponics system.
  - To be acquired
  - Input: Logical signal, or analog power signals to activate the water pump.
  - Output: no electrical or data output, but water output from the system.

- **Automatic Tiller**
  - Jon Spychalsky
  - The automatic tiller will enable for nutrient to be added into the water of the hydroponics system.
  - Research
  - Input: Logical signal, or analog power signals to activate the automatic tiller.
  - Output: no electrical or data output, but nutrient output into the system.

- **Light Array**
  - Jon Spychalsky
  - The light array will enable for the light to be distributed to the plants of the hydroponics system.
  - Research
  - Input: DC Power into the system.
  - Output: High intensity light.

3.2 Software Block Diagram



- **MCU Sensor Data**
  - James Tooles
  - The sensor data from the hydroponics system will be sent to the MCU
  - Research
  - Input: none
  - Output: all data acquired from the hydroponics system including sensor data, video feed, and hydroponics system actions with time stamps.

- **MCU Control Data**
  - Jon Spychalsky
  - The control data from the hydroponics system will be sent to the MCU. This control data can also be accessed from the webserver to change the variables.
  - Research
  - Input: variable status and values for the control actions of the system.
  - Output: the status of the electromechanical systems.

- **Linux/Interfacing SW**
    - David Mascenik
    - Linux is the operating system which will run the software interface to actually understand and read the data from the MCU.
    - Research
    - Input: HD video feed, all sensor data, and all control data.
    - Output: Control data for manually activating the pump, tiller, etc. Will also output to the web server for user interaction.

- **Web Server**
    - David Mascenik
    - The web server will host a few simple HTML pages that contain the user interface.
    - Research
    - Input: HD video feed, all sensor data, and time stamps of electromechanical activations. All variables set by the user within the user interface.
    - Output: User Interface.

- **User Interface**
    - David Mascenik
    - The user interface will allow for all sensor data to be monitored and viewed, as well as for variables to be changed for the hydroponics system. Time stamps for all processes will be made and reported within the data log.
    - Research
    - Input: All sensor data, HD video feed, time stamps, and all other monitoring for the hydroponics system. Variables will be able to be accessed and changed from this interface.
    - Output: all data acquired from the hydroponics system including sensor data, video feed, and hydroponics system actions with time stamps.

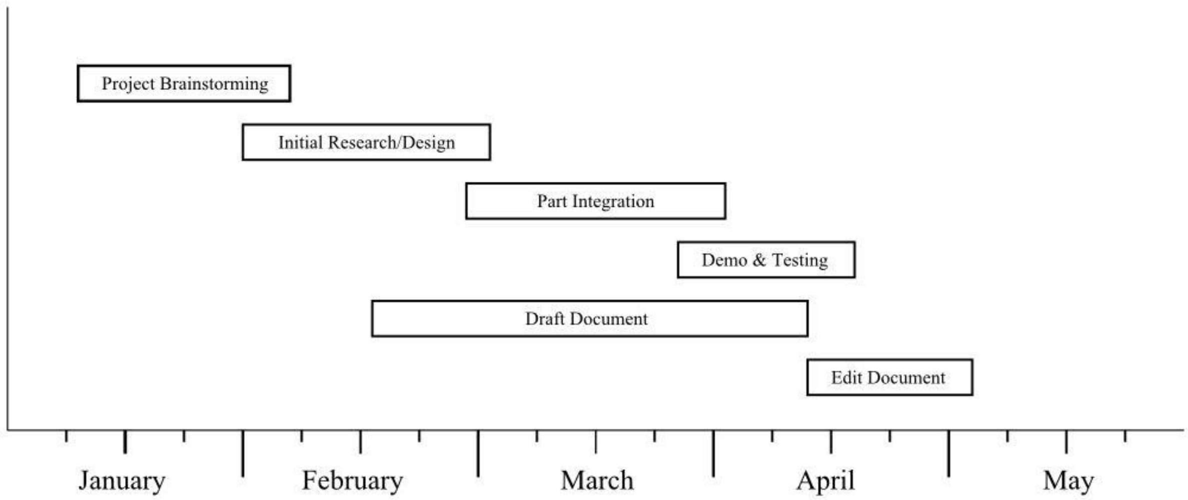
4.0 Project Budget and Financing

Item	Cost
Solar Panel	$200
Water Pump	$100
Charge Controller	$100
Automatic Tiller	$100
Battery Bank	$200
MCU	$75
Wiring	$40
Light Sensor	$25
Humidity Sensor	$25
CO2 Sensor	$25
Turbidity Sensor	$25
Temp Sensor	$25
LCD	$75
Webcam	$40
pH Sensor	$75
Wireless Module	$40
Light Array	$80
Total	**$1,250**

Financing will hopefully be coming from Duke Energy as this project is geared towards renewable and sustainable energy.

5.0 Project Milestones

5.1 Spring 2015 Project Milestones



5.2 Summer 2015 Project Milestones