Do-It-Yourself Automated Aeroponic System

Sam Burbidge, Jacob Gonzalez, Brooke Hadley, Alex Kratville, Hannah Lagerquist, Jon Matheson
Michaela Maxwell, Pat Zitting, Dr. Kam Leang

THE UNIVERSITY OF UTAH
Department of Mechanical Engineering

Hooked On 'Ponics

Introduction

Our current system of food production creates a significant amount of greenhouse emissions, deforestation, and waste which contribute to climate change. A solution may reside with hydroponics, the method of growing food without soil. A sub-type of hydroponics known as aeroponics suspends the roots in the air inside a closed chamber where they receive water, nutrients, and oxygen intermittently. This indoor agricultural method results in the following disadvantages and advantages:

Advantages:

- Reuses and retains over 90% of water used
- Almost eliminates pesticide need
- Greater production per unit area
- Faster production times
- Year-round production
- Eliminates fertile land misuse

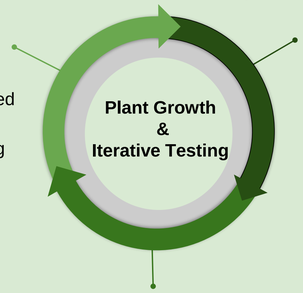
Disadvantages:

- Significant energy consumption
- High upfront costs
- Frequent maintenance to run
- Lack of engineering research for certain sub-types of hydroponics

Our Mission: Create a System That is...

1	In-home use	-Designed for in-home use -Built by a DIY user
2	Semi-automated	-Automate maintenance, monitoring, and data collection wherever possible
3	Under $600 to build	-Use off-the-shelf components -Allow users to customize the system

Methodology



Conclude & Ask New Questions

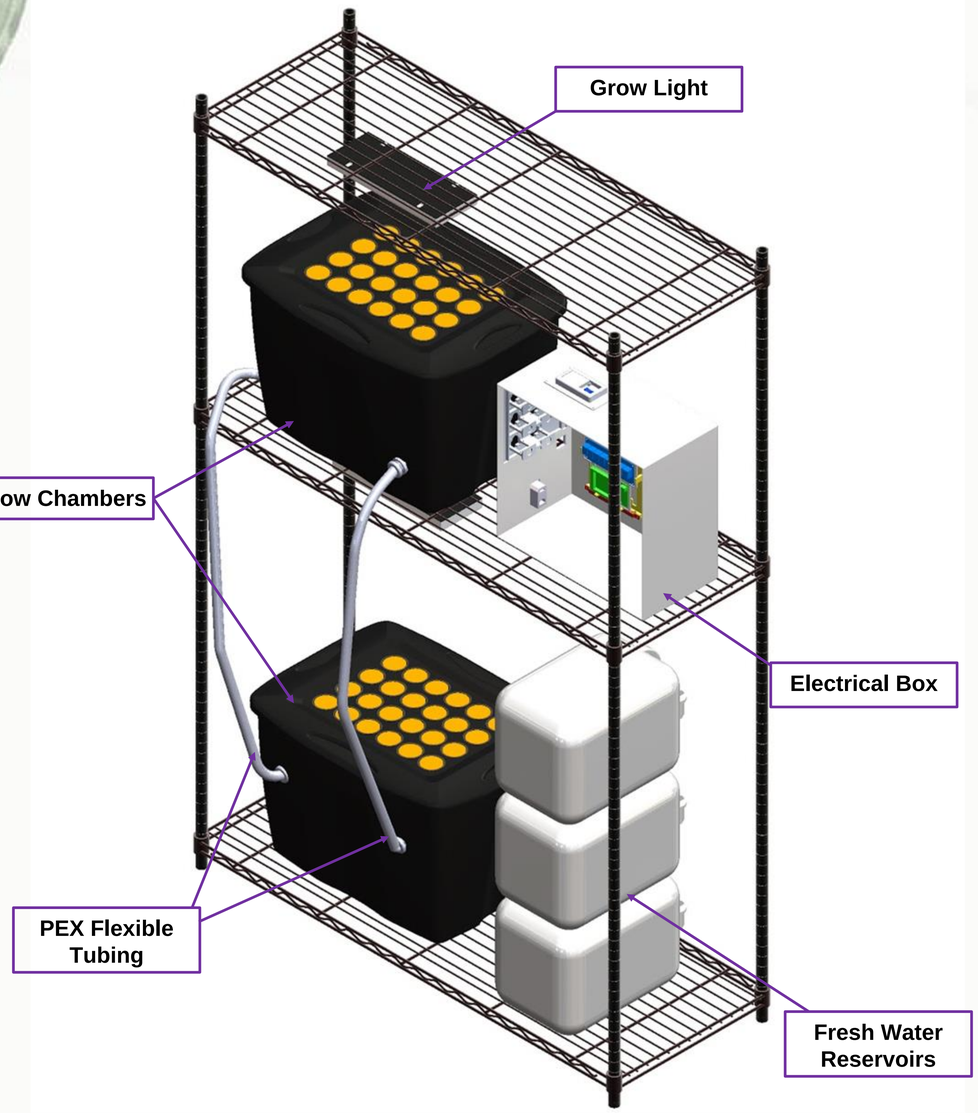
Clarify what was learned and identify new questions for upcoming experiments

Define Problem & Design Experiment

Clarify the thing being tested

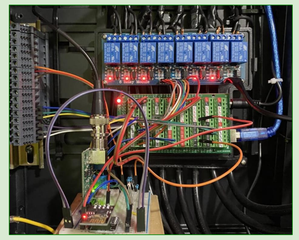
Grow & Observe

Collect data and observe system and plants over a 4-6 week growth cycle



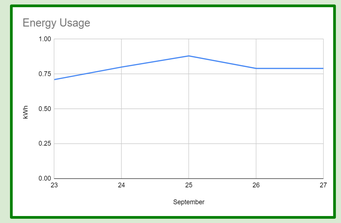
Features

Electronics Design: The system runs on an Arduino Mega microcontroller, with an ESP01 Wi-Fi chip to enable remote control. The Mega controls a series of 8 relays that turn components of the system on and off. The relays have their own power supply to minimize noise in the sensors.

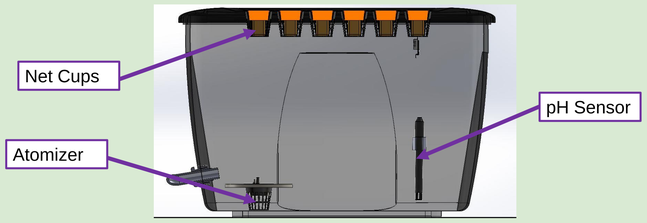


Automation: To control the system, an Arduino is used along with the Blynk app to create a custom app for the system. The app controls the light timers, the atomizers, and is constantly monitoring sensor data. It will even alert the user via a Push notification if the sensors read out of spec.

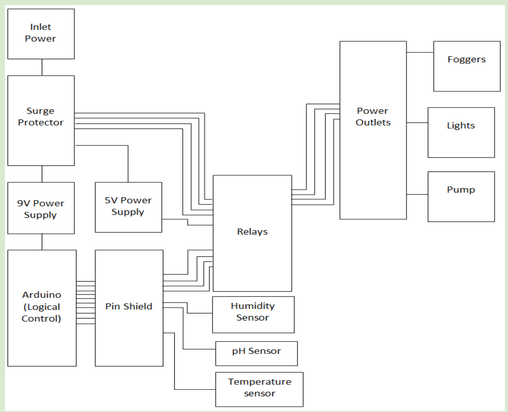
Energy Use: The aim of this project at the end of the day is sustainability, so it was important to minimize daily energy use. The graph to the right shows the use over the month of September. It does not exceed 1 KWh per day.



Cross Section View



Circuit Diagram



Physical System

In Conclusion:

Food production using fog-based aeroponics lacked research, but this project explored the unknowns of this aeroponic method with an engineering approach. Understanding the needs of DIY-ers assisted in the creation of quantifiable metrics for building a successful prototype. COVID-19 derailed the team's grand plans, but the original goals were still met.

Key Points:

- Monitoring of System - A Blynk IoT app that monitors temperature and pH, and controls light and water cycles, making the input from a human caretaker below ten minutes per week.
- Energy Efficiency - The system operates on half the power the average fridge requires making it viable for use in a home.
- Low-Cost System - By upcycling, using off-the-shelf parts, and avoiding high end tools, the upfront costs for hydroponic systems drastically drops from $1000+ to less than $600.

Suggestions for Improvement:

- More robust automation with a nutrient hopper to automatically dispense nutrients
- Video monitoring capabilities

Acknowledgements

Special thanks to Dr. Kam K. Leang, James Loomis, and the folks at Moonlight Garden Supply for their support.