To Predict ▶ To Design ▶ To Perform

LSU College of Engineering
Department of Mechanical & Industrial Engineering

ME, ECE, IE Capstone Design Programs

Team 5: Automated Hydroponics Growing System

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Background

As the human population increases, there is a growing need for advancements in agricultural technology.

An adaptable, adjustable, and automated hydroponics system provides an environmentally-friendly solution with the potential for widespread distribution on a local scale.

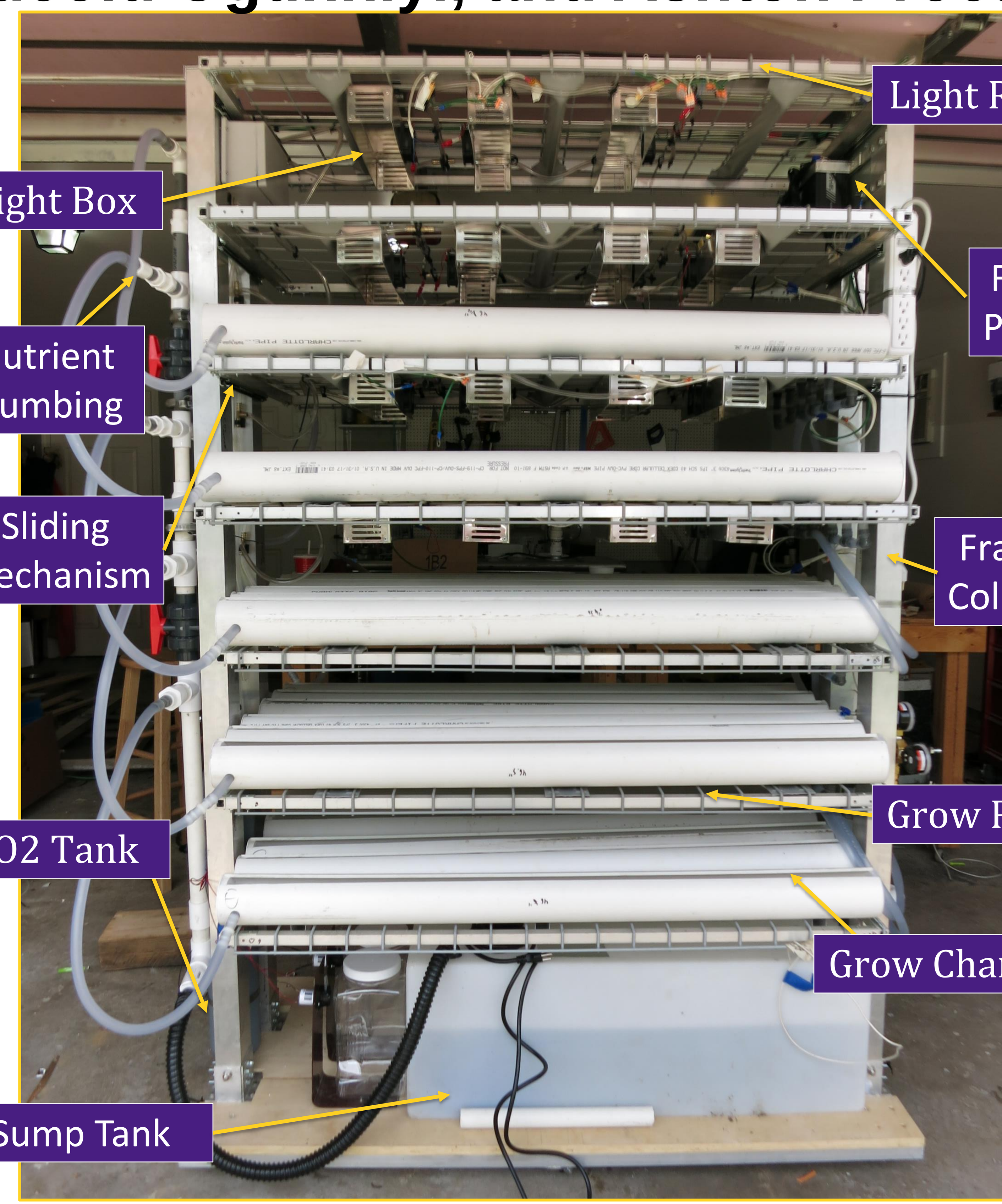
Objective

To create an automated hydroponic system for leafy greens:

- Portable and scalable
- Capable of growing plants starting from seedlings.
- Uses less water than traditional agriculture
- Able to be monitored via online applications.

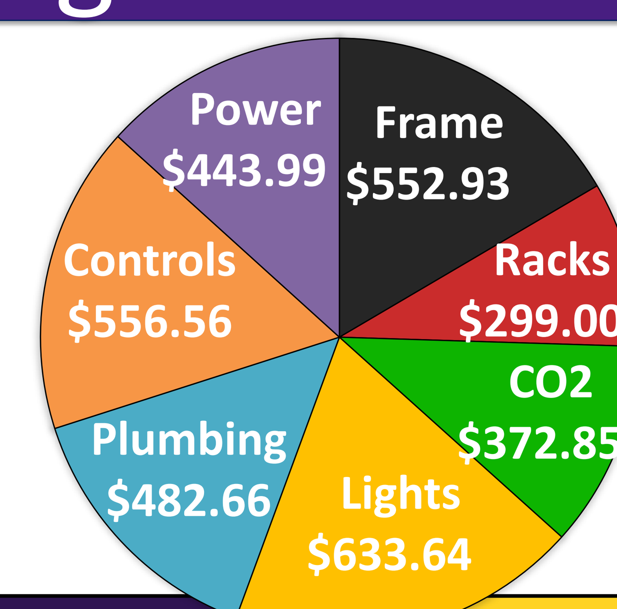
Engineering Specifications

	Considerations	Results
Total Energy Usage	Lighting, Pumps, Ventilation, Control	500 Watts
Plant Yield Per Harvest	Height/Width/Depth	200 Plants
Sensors	Water capacity and Temp. Monitoring	Interaction time/Grow Cycle
C02 Sensor	Monitoring and Delivery	400 -1200 PPM
Nutrient Delivery	Nutrient Delivery and Monitoring, Electrical Conductivity	1200 – 1300 us/cm
pH Control	pH Monitoring and Control	5.5-6.5
Weight	Loaded	800lbs
Dimensions	Space Required	Height 80” Width 24” Length 57”
DLI	Necessary DLI affected by CO2 supplementation	$13\ \frac{umol}{m^2} * day^{-1}$



Budget

Total Budget: $3341.63



- September
  - Research & Conceptualization
- October
  - Finalized Concepts
  - Prototype Design
- November
  - Completed
  - Prototype Designs
- December
  - Began Ordering and Testing
- January
  - Began Build Process
- February
  - Began Subsystem Testing
  - Coding and Testing
- March
  - Finalized Drawings and Models
- April
  - Completed Prototype

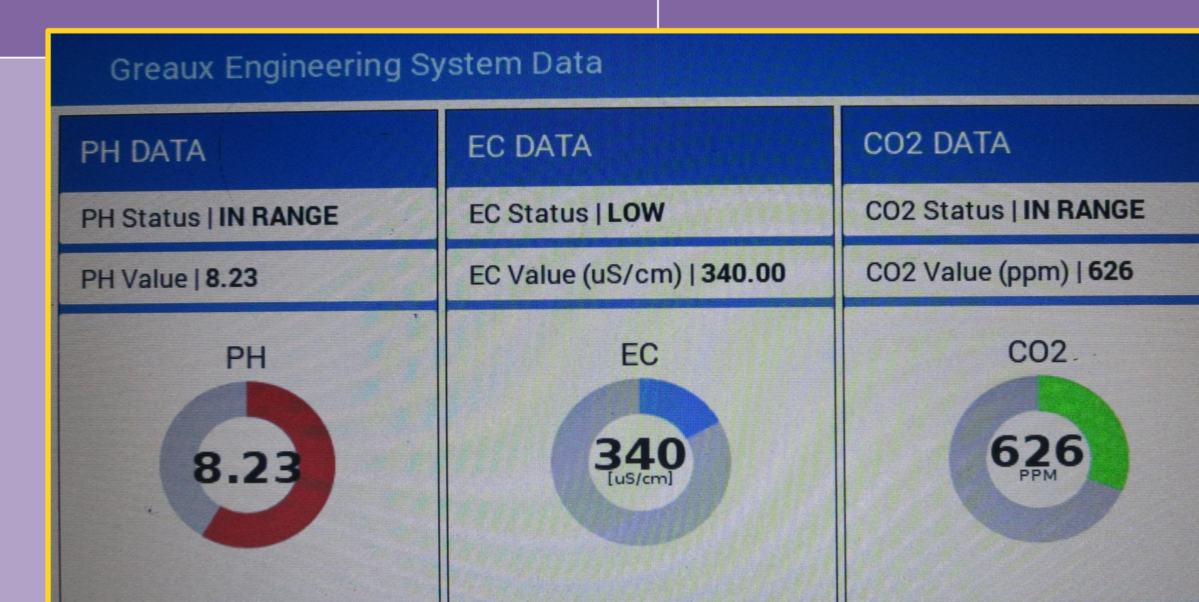
Testing and Validation

Power System:
- Tested power output, consumption, and reliability during continuous use [24 hrs].

Lights:
- Tested the heat emitted by the lights (must be below 110 degrees Celsius)

Plumbing and Nutrients:
- Flow rate testing utilizing stacked manifolds [4 gph]

Controls:
- Coding and testing done on pH, EC, and CO2 levels



Racks:
- Uniformly distributed load and deflection testing performed.

Frame Structure and Materials:
- Compression testing done on the rectangular tubing, casters, and base.

CO2:
Calculated results of the most efficient CO_2 and DLI combination.

	CO2 PPM Concentration								
DLI Level	400 1.7 pounds	450 3.1 pounds	500 4.6 pounds	550 6.0 pounds	600 7.5 pounds	650 9.0 pounds	700 10.4 pounds	750 11.9 pounds	800 13.4 pounds
12	4.46	4.09	3.79	3.54	3.33	3.20	3.03	2.87	2.72
13	4.38	4.12	3.89	3.65	3.49	3.30	3.16	3.00	2.87
14	4.42	4.13	3.92	3.68	3.53	3.40	3.24	3.09	2.97
15	4.46	4.21	4.00	3.80	3.62	3.51	3.35	3.19	3.10
16	4.40	4.17	3.97	3.80	3.63	3.48	3.37	3.23	3.09
17	4.31	4.13	3.94	3.74	3.60	3.50	3.37	3.23	3.13

Safety

- CO_2 detection sensors with installed sound alarms
- Frame and racks have a load capacity factor of safety (FOS) > 1.5
- National Fire Protection Association electrical safety standards
- NEC (National Electrical Codes) standards for electrical protection.

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