CAPSTONE/SENIOR DESIGN EXPERIENCE

Modified Hydroponic Shipping Container (MHSC)

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Introduction

As food security issues become more challenging around the world, alternative farming methods are being created. Shipping containers are being used to grow leafy greens and vegetables. These systems could become the future of urbanized agriculture.

Objective

Create a controlled environment growing system within a shipping container. Once completed the Modified Hydroponic Shipping Container will be placed at The Imagination Station, Lafayette's Children's Museum with a virtual display of the process to educate children about alternative growing practices and used for continuous research by Purdue University staff and students.

Criteria and Constraints

- Limited Space
  - (40' X 8' X 9" standard shipping container)
- Budget (relying heavily on sponsors)
- Design new electrical schematics
- 100 AMP power load
- Complete before May 2019

Impact and Sustainability

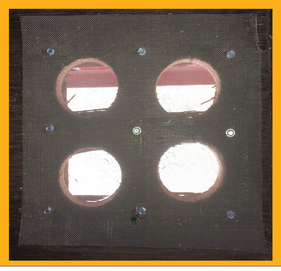
- Reduce transportation
- Increase shelf life
- Solution for food deserts
- Year-round production
- Eliminate use of pesticides
- Access to local and FRESH produce
- 90-95% less water usage

Alternatives Considered

- Hanging lights
  - Ropes
  - Ratchet hanger
- Reservoirs
  - Metal tubs
  - Storage containers
- Lights
  - Florescent

Fabrication —> Installation

Air Intake Holes



The intake of outside air increases the carbon dioxide levels within the shipping container, required for plant growth. There are a total of 16 air intake holes in the MHSC.

Plastic Paneling And Mylar Film

Electrical Components

1. Advantech APAX 5580
- **a.** APAX-5580-433AE
- **b.** APAX-5002L (2 slot backplane for I/O modules)

2. Advantech I/O Module Analog
- **a.** APAX-5017 (12-ch Analog Input Module)

3. Advantech I/O Module Digital
- **a.** APAX-5045 (24-ch, Digital 12 input, 12 output)

4. 100A Service circuit breaker box

5. 14 120v Circuit Breakers
- **a.** 1 Amp x2
- **b.** 5 Amp x4
- **c.** 15 Amp x4
- **d.** 20 Amp x4

6. (3) 24v Circuit Breakers
- **a.** 10 Amp x1
- **b.** 7 Amp x1
- **c.** 3 Amp x1

7. 4 Position Receptacles x12

8. 120V 4 Pole Contactor rated for 25 Amps

9. 120V 1 Pole Contactor rated for 15 Amps

10. 24v - 120v Relays x2

11. 6 Standard light switches

Computer

- This is a UNO with Codesys and visualization. Development software is free and the driver for Ethercat is included
- This gives some modern remote I/O and fieldbus technology along with remote Browser based visualization

Reservoirs and Pumps

There are four 55 gallon reservoirs installed in the MHSC. Each reservoir holds the nutrient solution required for optical plant growth and four ECOrate adjustable flow rate of 172 GPH water pumps.

PVC Grow Tubes

Each growing tray consists of four, 4" PVC pipes which are 15' long. There are 88-2" holes in each growth tube, totaling 352 holes for each growing tray. Each growing system contains four sets of legs (eight total). The legs are adjustable, providing various heights and slopes of the growing tray during growth cycles. Each leg height ranges from 23.5" to 33.5.

Advantages:

Easy to clean, cost efficient, easily customizable, and durable.

LED Lights

- 6-10 lights per grow unit (24-40 total)
- 4-8 lights for the nursery
  - Nursery will have 2-3 shelves for plants/ lights
- 6 work lights between grow units

Current Inventory:

* (6) Lumi bars
* (2) F-grow Tri Proof
* (2) VQ-GLLL060z202
* (3) Sfm sunntek
* (1) Bar 30
* (2) Ecospeed

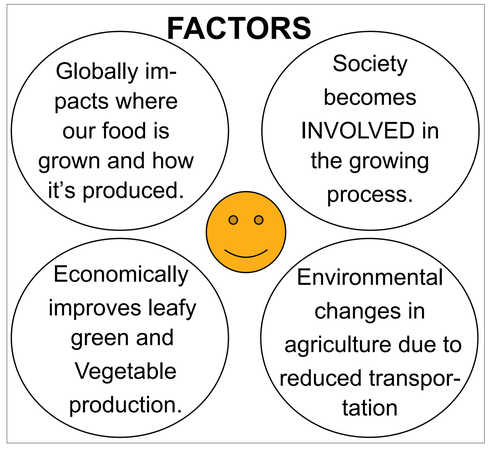
Future Plans

→Create a Sponsor board
→Secure remaining LED lights
→Secure florescent lights for alley way
→Install Nursery
→Fresh paint on exterior
→Install cameras/ visual output
→Secure small heater
→Secure humidity and temp. sensors
→Create educational boards for children

2018-2019 Economic Analysis

Item	Quantity	Cost
Water Pumps	16 Pumps	$274.88
Reservoirs	4 Totes	$68.00
FRP Adhesive	1 Pail	$57.00
Plastic Wall Paneling	12 Panels	$258.72
6 Mil Mylar	4ft X 100 ft	$86.95
	TOTAL:	$745.55

FACTORS



Sponsors:
Advantech (Computer)
EEL, Inc. (Shipping Container)
Huston Electric (Electrical)
Grand Industrial (Transportation)
Kundinger (Electrical Plans)
Heliponix (LED Lights)
LumiGrow (LED Lights)

Instructors:
Robert Stwalley
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