PURDUE UNIVERSITY | Agricultural and Biological Engineering

CAPSTONE/SENIOR DESIGN EXPERIENCE 2020

Modified Hydroponics Shipping Container (MHSC)

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Figure 1: Exterior View of MHSC

1 Project Background

In 2016, graduate Student John Houtman completed a research and design project entitled "Design and Plan of a Modified Hydroponics Shipping Container For Research" as his thesis for a Master of Science. Since then, department professor Dr. Robert M. Stwalley has contracted an agreement with the local children's museum *The Imagination Station* to receive the fully-assembled, fully-functional hydroponics shipping container for educational purposes. Dr. Stwalley has enlisted the help of ABE seniors in the container's completion as part of the past two academic year's capstone projects.

2 Problem Definition

The local children's museum, *The Imagination Station,* is in contract to receive the completed hydroponics shipping container project in order to educate the local youth of the advancements being made in agriculture, specifically urban agriculture and the possibility of implementing agricultural practices like this hydroponics system in space!

3 Criteria

- Requires some assembly
- Educate local children
- Provide live-stream of container activities

Constraints

- Learning capacity of children
- Physical
  - Max Vol.: 76.3 m^3 (2,693 ft^3)
  - Max Wt.: 30,480 kg (67,200 lb.)
- Codes and standards
  - Local municipal code No. 2018-31, 2018 (no public occupancy)
  - NEC70 (Nation Electric Code)
- Budget: $500-$800
- Timeline: Complete by May 2020

4 Project Impacts

- Environmental
  - Climate-independent
    - Vegetation growth regardless of exterior environmental conditions
  - Pollution control
    - Closed environment eliminates chemical runoff
  - Energy efficient
    - LED grow lighting requires low electrical load demand
  - Economic
    - Multiple annual grow seasons = more produce-to-market throughout the year
  - Social & Cultural
    - Variable crop production capability

5 Solution

Partial Assembly

- Grow units/tables

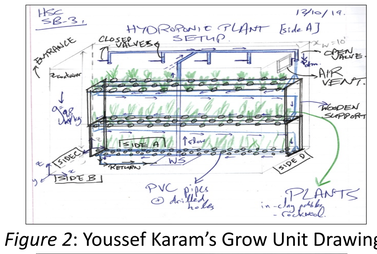

Figure 2: Youssef Karam's Grow Unit Drawings

Figure 3: SB-3 Team Assembling Grow Units

Informational PDF

- Internet accessible
- Embedded link to live stream

Figure 4: PDF Cover Page

Educational Lesson Plan

- Based on 4H worksheets
- Targeting middle-school level of education

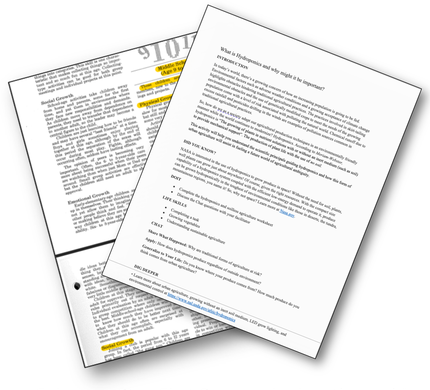

Figure 5: Lesson Plan First Page and education guide

6 The Path to the PDF Solution

What are we wanting to communicate?

- Principals of hydroponics
- Scientific and technological systems involved

What's the best channel for this?

- Video
- Posters
- ☆ The internet

How will this be accomplished?

- Model a PDF that houses informational messaging
- Provide links to supplemental information

7 Camera Live-Stream

Reolink PoE 5MP IP camera ($71.99) → YouTube Live Stream

8 Future Project Needs

- Create Sponsor Board
- Organize and install water pumps, tubing, and reservoirs for grow units
- Secure remaining LED lighting
- Secure florescent lighting for walkway
- Painting needs
- Finishing ventilation needs: duct work needed
- Securing all laminate and reflective walling
- Secure HVAC donation for wall-mounted heating/cooling unit

Container Schematic

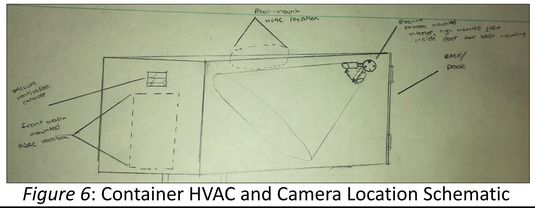

Figure 6: Container HVAC and Camera Location Schematic

Project Sponsors

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

Instructors

Dr. Margaret Gitau
Dr. John Lumkes
Dr. John Evans

Project Sponsor

Dr. Robert Stwalley

Tech Mentor

Dr. Jian Jin

Additional Acknowledgements

Scott Brand
David Wilson
Eric Kong
Stanley Harlow
Dr. Natalie Carroll
Chloe Richards
John Houtman