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College of Engineering

Mission

The College of ACES commissioned a container farm project to meet UL-listed standards and operate self-sufficiently in a remote location. Our Power and Controls team was responsible for designing and testing the electrical power and control systems to ensure precision and reliability.

Key components include:

- Agrowtek GROWCONTROL GCX Cultivation Control System – Core control system for managing environmental parameters.
- Agrowtek GrowNET 8 Port Expansion Hub – Allows for expanded connectivity of sensors and devices.
- HXT TEROS12 Sensor GrowNET Interface – Enables soil moisture sensing for efficient water management.
- MX1i AC Intelligent Motor Control Relay – Provides intelligent motor control for ventilation and other motor-driven components.
- RX4i Four Outlet Intelligent Relay – Controls multiple electrical devices within the system.
- VX8i Eight Valve Irrigation Controller – Manages irrigation for optimal crop hydration.
- DXR6 Dry-Contact Relay Module – Supports control of multiple auxiliary systems with six contact relays.

By working closely with other teams and thoroughly testing our systems, we aimed to create a reliable, self-sufficient container farm.

Research

Control System

- Sensor Selection: Our team researched and selected sensors to measure critical variables, such as pH, moisture, light intensity, water level, and temperature.

Building our control system

- Designing our own control system has the potential to reduce project costs significantly.

System Recommendations:

- Our team explored using Arduino but decided not to proceed with this approach.

Power System

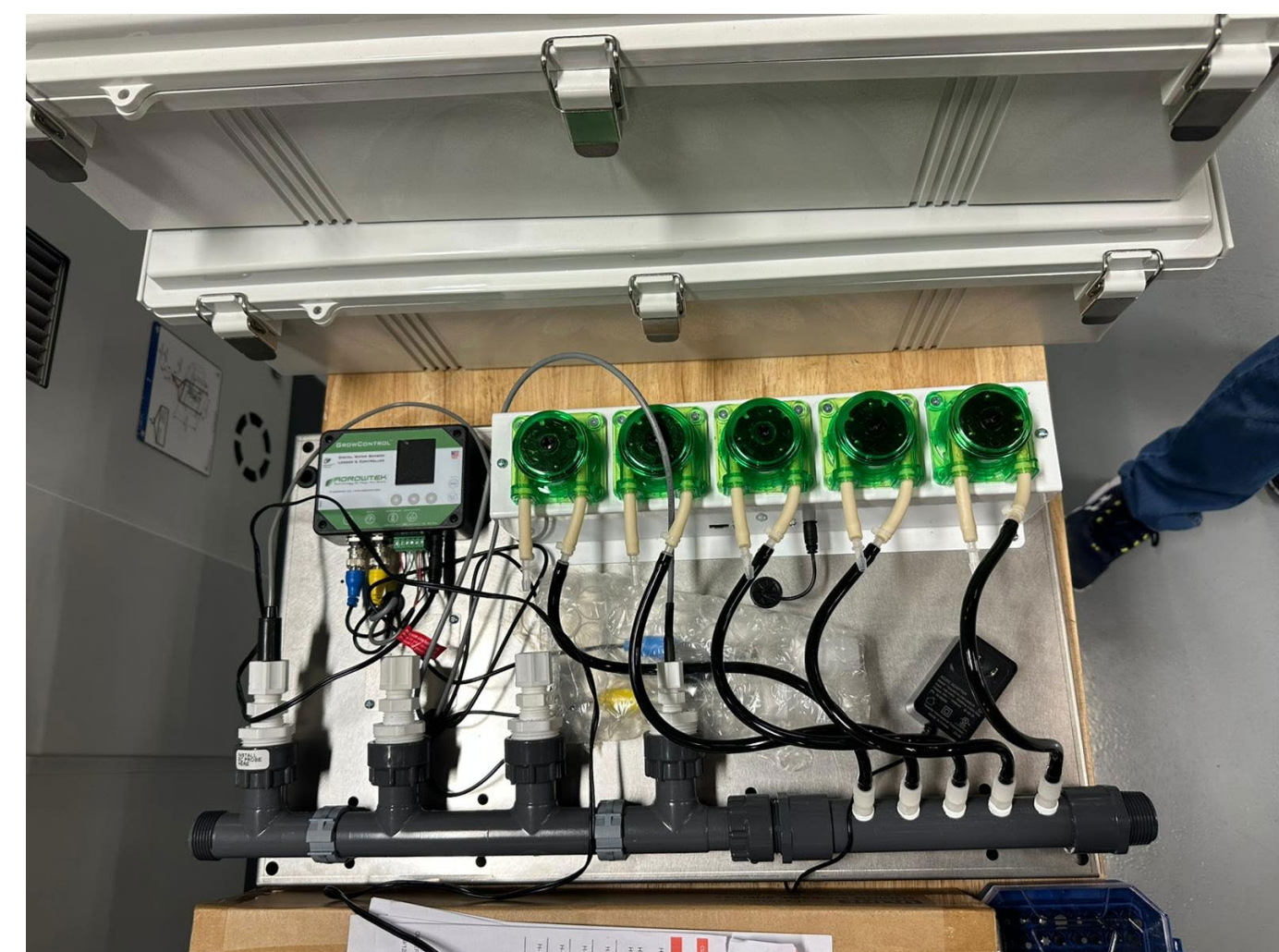
- Primary Power Supply: 120-volt electrical outlets will power most components.
- High-Voltage Requirements: A step-up transformer may be necessary for equipment that requires 230V.

NMSU Container Farm – Power and Controls

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Final Design



AgrowDose MDX Nutrient Dosing Panel



SXL-RX Liquid Level Sensor



Agrowtek GCX Controller Panel



Agrowtek Panel

Agrowtek Control System

GCX Controller

- Housed within the container to monitor all connected sensors
- Displays real-time values for crucial parameters:
- pH level in water
- Room and water temperature
- Moisture levels

SXL-RX Liquid Level Control Kit

- Measures water depth
- Controls pump operation (on/off) based on water levels

LXD Digital Lighting Module

- Controls grow light intensity

AgrowDose MDX Nutrient Dosing Panel

- Located near the water reservoir for nutrient management
- Monitors and controls critical parameters:
 - Water temperature
 - pH level
 - Electroconductivity (EC)
 - Oxidation-Reduction Potential (ORP)
- Ensures proper nutrient levels for healthy plant growth
- Allows user-defined nutrient "recipes" via the controller

Modem Integration for Remote Monitoring

- Modbus connection transfers data via Ethernet
- Devices linked to the controller and modem
- Enables remote access to plant data, eliminating the need for in-person checks

Additional Information

- We recommend that future Power and Controls teams develop a system using PLCs (Programmable Logic Controllers) and other suitable components for enhanced control and reliability.



Concept Development

Initial Design Focus:

- Our designs and calculations were initially focused on a single growing rack to simplify the development process.

Control System Design:

- Created a list of all necessary inputs and outputs for the container farm, which helped us identify the variables to be measured and the types of sensors required.
- The Agrowtek GCX controller and its compatible sensors were chosen because of their simplicity, UL listing, and pre-assembled design.

Housing Considerations

- Evaluated whether the control system should be housed inside or outside the container to optimize space and system durability.

Custom Control System:

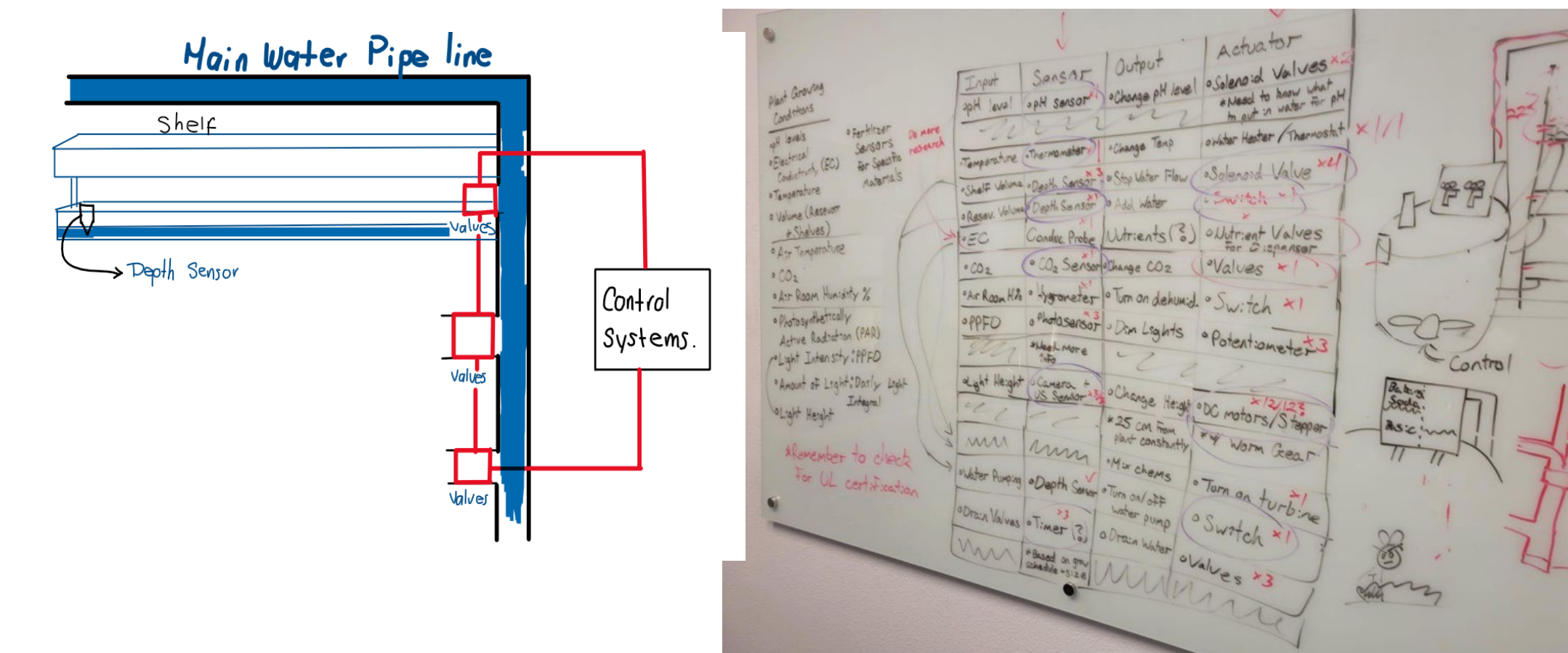
- Determined that building a custom control system was unfeasible due to the lack of UL-listed Arduino components and time constraints.

Power Distribution:

- Electrical outlets would be installed along the container walls to power internal devices independently.

Power Source for Remote Location:

- Concluded that a generator would be the most feasible power source due to the high cost of solar panels for this application.



References

- Agrowtek Inc. Grow Controls for Greenhouses, Hydroponics & Indoor Growing, www.agrowtek.com/.
- <https://www.freightfarms.com>
- <https://store.arduino.cc>