Automatic Aeroponic Plant System (GERM)

TEXAS A&M UNIVERSITY Engineering

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ROBOTICS TEAM & LEADERSHIP EXPERIENCE

Problem Definition

The goal of this project is to create a robot that can grow plants autonomously using adjustable lighting, an aeroponics system, and temperature control. Traditional planting systems are affected by external factors like overwatering, temperature fluctuations, and insufficient lighting, all of which hinder plant growth. These challenges are addressed in the design of a system that operates without human intervention.

Methodology

The project is split into two different subsystems, which are listed below:

Electrical

- Completed the overall schematic and component layout, integrating the LEDs, pump, and cooling subsystems with centralized power sources, and implemented protective measures for all components.

Mechanical

- Focused on the internal layout of the water system, integrating a recycling sink, attaching diffusers, and mounting the cooling system.

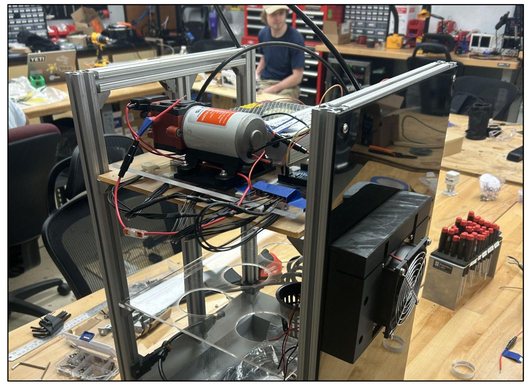

Figure 1. Electronics Shelf

Mechanical

Pump System

- The pump system includes a sink to collect and store water sprayed onto the plants.
- Pump diffusers are housed in a 3D-printed, snap-in enclosure for easy maintenance.
- Caulk sealant is applied to the seams of the multipart, 3D-printed sink to prevent leaks.

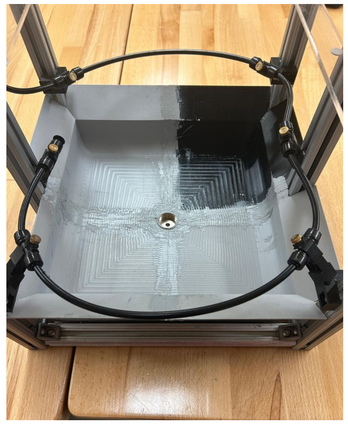

Figure 2. Sink and Diffuser Layout

Fan Mount

- A 3D-printed fan mount is used to secure the fan to the acrylic side panels.

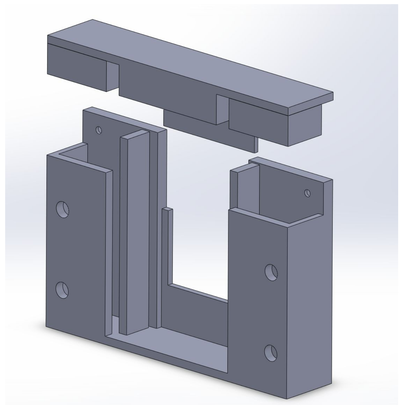

Figure 3. 3D Printed Fan Mount

Water Sealing

- Closed-cell silicone foam tape is used to seal the outer acrylic panels.
- Flex tape provides water sealing for the electronics layer and the outer edge of the sink.
- A gasket and bag enclosure protect the pump within the electronics layer.

Figure 4. Closed Cell Silicone Foam Tape

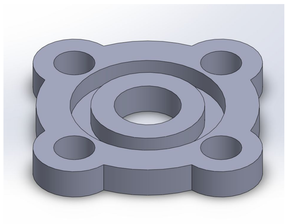

Figure 5. 3D Model of Gasket

Electrical

Source

- System operates using a 120V AC wall input, which is stepped down to 12V DC through a converter.
- Cooling intensity is controlled by a variable power source that adjusts the current supplied to the fans.
- Three fuses safeguard the primary branches of the circuit against power surges.

Control

- Signals from the Arduino UNO board manage the decoder, the pump's MOSFET, and the fan's variable power source (DIM).
- The 2x4 decoder efficiently controls the LED color output by activating the MOSFET gate for specific colors across all lights in the array.

Light System

- LED color is adjustable, providing variable light wavelengths to support optimal plant growth at different developmental stages.
- The light component shown below represents a single module within a 4x5 array of lights.

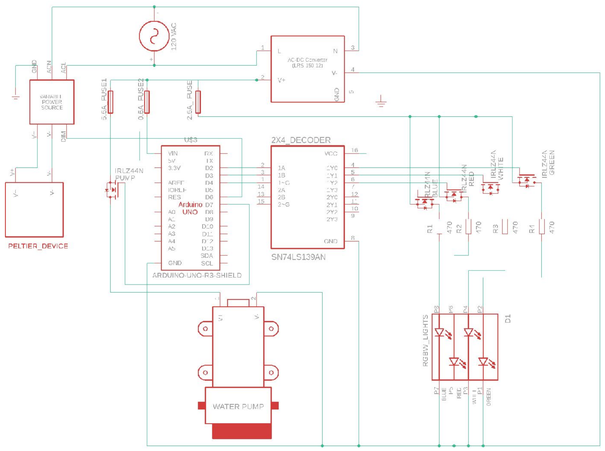

Figure 6. Complete Schematic for System Electronics

Outcomes

This project is designed to autonomously water plants using an integrated system of lighting, pumping, and cooling components.With all electronics seamlessly built into the setup, it can support a diverse range of plant types and growth requirements.

Future Plans

Calibrate the system for radishes, adjusting spray cycles, light cycles, and temperature control, while also enabling the growth of a wider variety of plants.