Growth Enhancement & Regulation Module (GERM)

TEXAS A&M UNIVERSITY Engineering

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TEXAS A&M UNIVERSITY 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 such as overwatering, temperature fluctuations, and insufficient lighting, all of which hinder plant growth. These challenges are addressed in the design of a system that operates minimal human intervention.

Methodology

The project is split into two subsystems with the following tasks:

Electrical & Software

- Complete the overall schematic and component layout.
- Integrate the LEDs, pump, and cooling subsystems with centralized power sources and controlled by Human Machine Interface.
- Implement protective measures for all components.
- Construct control algorithms.

Mechanical

- Develop internal layout of the water system.
- Integrate a water recycling system.
- Design HDPE funnel.

Figure 1. *GERM CAD Model.*

Mechanical

Water Distribution

To protect electronics from water and prevent leaking, several measures have been taken:

- Closed cell silicone foam tape around the wet regions of GERM.
- Redesigned sink to funnel water into water bag and throughout the pump system
- HDPE funnel to collect water from the spray nozzles and for added chemical resistance.

Figure 2. *Vacuum Formed HDPE Funnel.*

Software

GERM requires a control algorithm for light, pump, and cooling systems integrated with a Raspberry Pi touchsreen for a Human Machine Interface to communicate and control the GERM ecosystem.

Figure 3. *Human Machine Interface Touchscreen.*

Electrical

Source

- System operates using a 120V AC wall input, which is stepped down to 15V DC through a converter for pump, fan, and LEDs..
- Cooling intensity is controlled by a variable power source that adjusts the current supplied to the fans and peltier device.
- Two fuses safeguard the primary branches of the circuit against power surges.

Light System & Controls

- Signals from the Arduino UNO board manage the LED color mixing and fan power state through PWM.
- Human Machine Interface allows for control and information display on status of GERM and health of the plant.
- LED color is controlled by PWM signals from the MiniPucks, providing variable light wavelengths to support optimal plant growth at different developmental stages.
- The light component shown below inf Fig. 4 represents a single module within a 4x5 array of lights.

Figure 4. *Resoldered MiniPucks and Mosfet.*

Figure 5. *AI Raspberry Pi Camera for Plant Health Monitoring.*

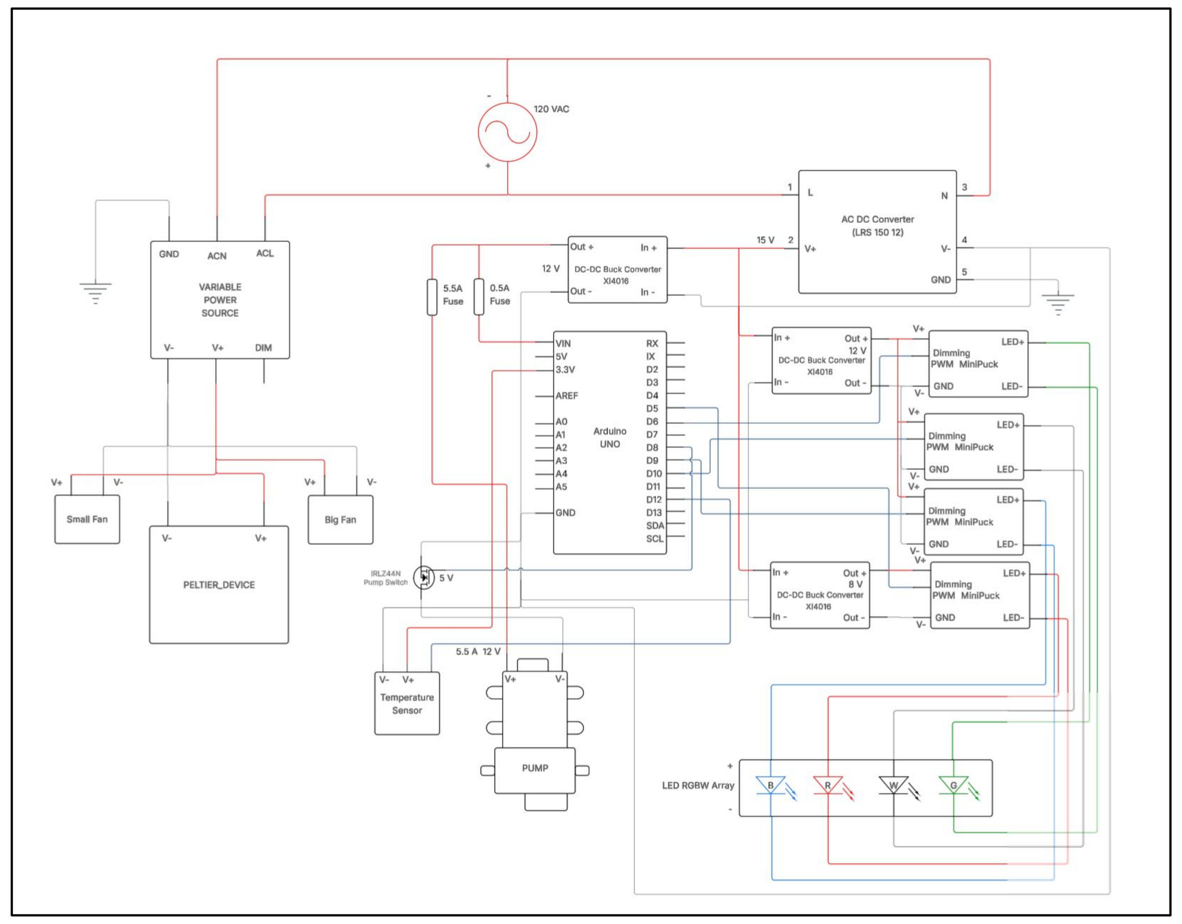

Figure 6. *Complete Schematic for System Electronics.*

Outcomes

Autonomous watering 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 in challenging environments.

Future Plans

- Implement AI plant monitoring
- Calibrate the system for basil and spearmint
- Grow first plants