Nurture: Autonomous Plant Care System

SDDEC24-16

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Project Motivations

Problem:

- Gardener frustration with plant care.
- Lack of knowledge and experience.
- Reliance on plant visual indicators.

Solution:

- Automated plant care device & app.
- Hands-off watering and fertilization.
- Sensor-based data visualization of plant health indicators.

Context:

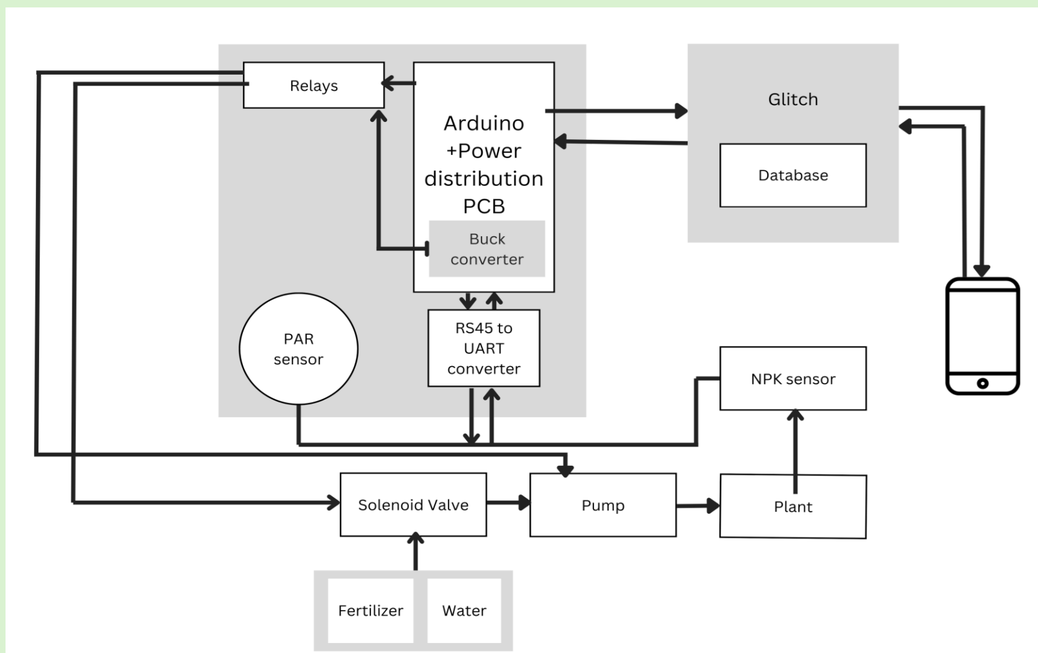
Intended Users:

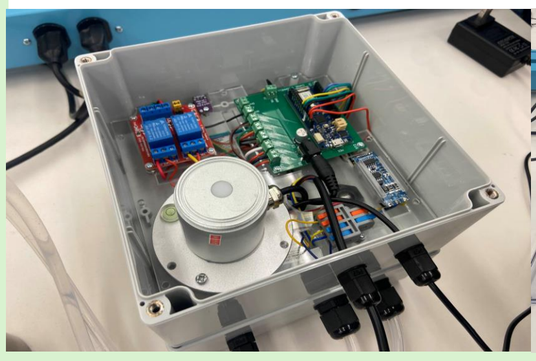
- Amateur Gardeners
- Intermediate Gardeners

Usage:

- Primary: Indoor potted plants.
- Outdoors with protected outlets.
- User required for setup and refilling liquids, device handles the rest.

System Diagram





Design Specification

Design Requirements:

Physical:

- 3+ inch diameter pot compatibility.
- Electronics protected from liquids both internally and externally.
- Compatible with 120VAC wall outlets.
- Budget of $500.

UI / UX:

- Graphical and numerical data on app.
- Account database with persistent data.
- Low maintenance plant system.
- Reliable and predictable functionality.

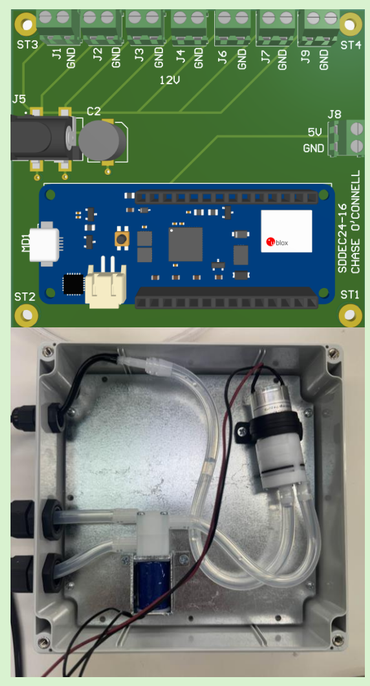
Engineering Standards:

- Communications: 802.11ac Wi-Fi Standard
- Dust and Water Resistance: IP55
- Components: RoHS Compliance
- Screw Hole Sizing: ASME B18.2.8

Technical Overview

Electrical:

- Custom Power Distribution PCB
  - 2-layer, barrel jack, bulk capacitor
- 12V to 5V Buck Converter
- Arduino MKR Wi-Fi 1010 MCU
- RS485 Modbus: NPK and PAR Sensors
  - TTL (UART) Converter



Liquid Distribution:

- 600ml Water + Fertilizer Reservoirs
- Pump + Solenoid Valve w/ Relays
- Waterproof Cable Glands

Data Handling:

- Nested schema for easy retrieval.
- MongoDB Database: Storage
- Glitch Server
  - Facilitates data requests and responses:
    - App, Arduino, and MongoDB.

Testing and Results

Testing Procedure:

- RS485 Sensors:
  - Response from TTL converter.
  - Arduino Serial Monitor to check raw data.
- PCB:
  - Multimeter to check voltages, re-solder as necessary.
- Mobile App Backend:
  - Postman "post" and "put" commands to update database.

Results:

- One week of NPK and PAR sensor data
- Working threshold system for watering and fertilizer tested separately.
- Full-loop data transmission: sensor data made its way to the mobile app.

Limitations:

- Availability of NPK nutrients decreases linearly with soil moisture.
  - Moisture between 40-50% RH to compare to NPK threshold values.