HERB CHAMBER

SDP21 Team 28

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Advisor: Prof. Siqueira
Problem Statement

Many people are thinking about becoming more self-sufficient and growing some of their own herbs at home but are stopped at the starting point due to many requirements they need to care for the plants. Even without a green thumb, the Herb Chamber can monitor every factor that is needed to grow a garden successfully and take care of it for you, such as soil moisture, air temperature, air humidity, lighting duration and more. Herb Chamber can send you a reminder when it is time to harvest and will allow you to see your home garden from anywhere in the world. This allows you to cross the threshold without needing to do much work yourself.
System Specifications

1. Compact indoor form that fits on most tables
   a. Bed size 23” x 5.25” x 6”
   b. Compact tent enclosure 23” x 23” x 42”

2. Power supply
   a. Low cost, low power system that delivers 105W/H

3. IP65 water and dust resistance rating

4. Water system
   a. 1x 12V DC pump with ½ inch tubing
   b. 6x 12V DC solenoid controlled watering channel with ½ inch tubing

5. Light System
   a. Indoor grow light

6. Sensor System
   a. Humidity/temperature module
   b. Moisture sensor

7. Product app interface
   a. Connected with a wifi module allowing remote access
   b. Alarm notification when set harvest time is approaching
   c. Displays various measured parameters
   d. Adjustable nutrient/water/light given to plants
   e. Default plant directory for optimal growth
System Block Diagram

**Power Unit:** 12V, 5A  
**Control Unit:** Arduino  
**Cloud Unit:** ESP8266  
**Sensors:**  
Capacitive Soil Moisture  
DHT11 Air Temperature and Humidity  
**Relay Unit:** Controlling fans, light, and solenoids
Nam’s Part: Power Unit and Serial Communication

Power Unit:
• Calculated the overall DC power usage of the system (not counting the AC light source) to be under 50W/H
• Decided to use a 12V, 60W power supply
• Split the power source to 12V and 5V using a voltage regulator
• Schematic:
Nam’s Part: Power Unit and Serial Communication

5V DC Relay is not reliable in term of safety for switching AC powered units.

Solution: A power tail switch functions similarly to a relay, but is mainly used for controlling AC devices.

Specification:
- 5V input
- Switching 120VAC

How to wire:
- Power -> +in
- Signal -> -in
- Gnd -> Ground
Nam’s Part: Power Unit and Serial Communication

Serial Communication between
Arduino and
ESP8266 NodeMCU:

- Connected pin 5 and 6 of the arduino to D5 and D6 of NodeMCU to establish serial connection (RX/TX)
- Arduino can proceed to send any data after establishing a common baud rate between the 2 devices
Duoc’s Part: Host Server Communication

Create Cloud Host Server
- Google Firebase
- Link authorisation key and project URL with code
- Testing real time data collection with Sensor subsystem

Organization and Collection of Data
- Collect various data from sensor
- Format data in presentable form
Data collection:

- 580-720 for soil moisture in contact with air
- 310-350 for moisture with direct contact with water
- Formatting that data to easily understandable percentages with air contact as 0% and water contact 100%
- Moisture from fresh soil ranges around 25%
- Temperature and humidity are in stand US metrics

Host Authorization Code

- Snippet of code to connect to cloud
- https://github.com/ncube3/HerbChamber
App: Blynk

- premade, user customizable app
- Keep real time data, depends on the delay set
- set parameters that when met sends a notification
- basic app for testing purposes
- when moving forward, we will create a unique app
- current app does not allow much for customization
## Current Project Expenditure

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<tr>
<th>Item Description</th>
<th>Link</th>
<th>Unit Price</th>
<th>Qty</th>
<th>Line Total</th>
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<tr>
<td>Relays</td>
<td><a href="https://www.amazon.com/ELEGOO-Channel-Optc">https://www.amazon.com/ELEGOO-Channel-Optc</a></td>
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<td>Moisture sensors (x2)</td>
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<td>Growth tent</td>
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<tr>
<td>Growth light</td>
<td><a href="https://www.amazon.com/Growing-Spectrum-Hyd">https://www.amazon.com/Growing-Spectrum-Hyd</a></td>
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<td>120mm fans</td>
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<td>Garden Soil</td>
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<td><a href="https://www.homedepot.com/p/AvcoGarden-1-Lite">https://www.homedepot.com/p/AvcoGarden-1-Lite</a></td>
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<td>Fabric Grow Bags</td>
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Future Expected Expenditure

ESP8266 - $13-26
Mini Nano/Arduino - $13-18
Heating coil - $10
PCB - $20-70

Miscellaneous - $30
ATMEGA328P - $10-15
Crystal 16MHz - $5
Current Expenses - $304
Total Expected - $405-478
Christian’s Part: Light Source and Water

Parameters
- **Light Source**
  - Wavelengths (UV, IR, Red, Blue)
    - ranges from 390 nm to 730 nm
  - How long it should be on depends on the stage
- **Water**
  - $V = \pi r^2 h$, where $h = 1$ inch, $r = 6$ inches
  - Volume of water is 113 in$^3$
  - Given the water pump rate, it takes 28 seconds to water 113 in$^3$ precisely
  - Will be watered when the moisture sensor reads the soil is dry

<table>
<thead>
<tr>
<th>Stage</th>
<th>Seeding Stage</th>
<th>Vegetative Stage</th>
<th>Flower/Fruit Stage</th>
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<tr>
<td>On for</td>
<td>12-14 Hours on</td>
<td>14-16 hours on</td>
<td>14-18 Hours on</td>
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Christian’s Part: Circuit

Building the Arduino Circuit
- Connected to 12 volts and 5 volt power supplies
- Connected sensors to 5 volt source, ground, and analog pins
- Wired the Relays (12 volt supply, Arduino, Fans, Solenoids)
- Attached Pump to the solenoids
Hardware Plan for FPR

- ATmega328P, ESP8266, RTC, etc

- Hardware Plan for FPR -- tell us what you plan to put on your custom PCB and list any single board computers or breakout boards that your team has requested or will request to use at FPR
Project Management/Gantt Chart

**Nam: Team Coordinator**
- Replacing Arduino with ATMega328P
- Faulttite System
- Replacing Arduino code with C code (add libraries)
- Altium Research
- PCB Design
- Enclosure setup/Testing
- PCB Testing
- Bed Creation
- Optimization of Bed Layout
- Power Supply Refinement
- Heating System
- Web UI for Admin
- Integration of Everyone’s Code
- App Creation
- Firebase authentication between user and admin
- Implement User features
- Modify/Optimize App for better GUI
- Data Logging
- Data Retrieval
- Final Testing

**Simon: Budget Lead**
- Simon

**Duoc: Cloud Server/Application Lead**
- Duoc & Nam
- Nam & Christian
- Nam

**Christian: Altium Lead**
- Christian & Simon
MDR Deliverables

- Assembled main structure and water system
- Communication with sensors and actuators
- Working power subsystem for components
- Cloud Firebase Communication with Sensor system
DEMO