

Home Grown Hydroponics Controller

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About me



Tech entrepreneur for 30+ years, now semi-retired and having fun with my DIY projects including Voron 3D printer, hydroponics controller, pet communicator etc.
Background is in engineering and business.



Problem

I want to grow fresh food year-round...
... but I'm too lazy to garden 😊

Other constraints

Build

Use my 3D printers for much of the build

Open-Source

Leverage as many existing open-source solutions out there.

Tools

Use as many free tools as possible for mechanical, electrical and software design

Productive

Looking for low code or no-code to improve productivity. Goal is to have everything designed and operational in less than 6 months.



Solution

Vertical Grow tower

3D printed tower in a standard 5-gallon bucket

Controller

Water levels, temperature, pH, nutrients, lighting, fans and alarms

Individual pods

From 3 to 15 pods for leafy greens and herbs inserted in a weekly rotation

Home Assistant

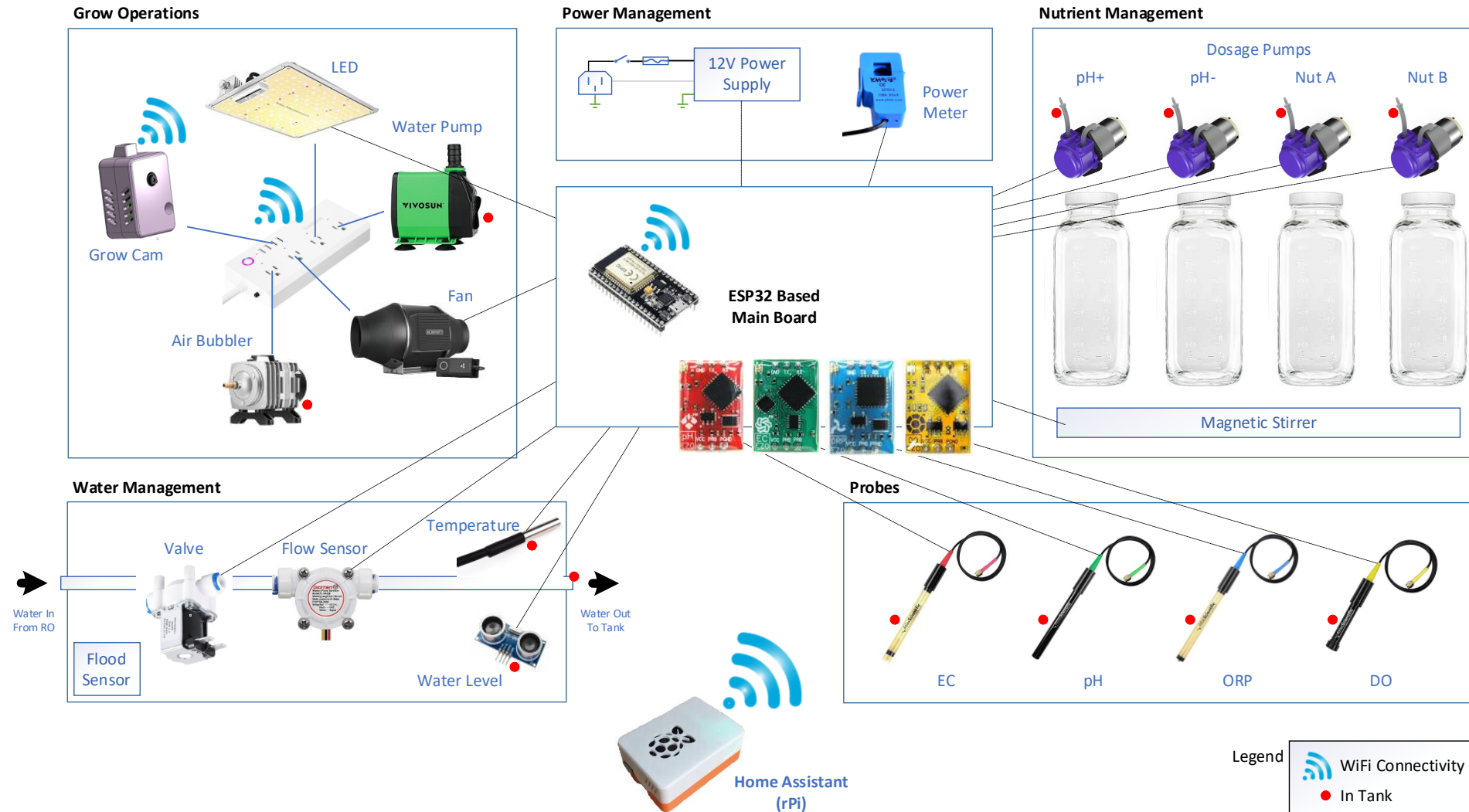
Simple monitoring, notifications etc. so that the entire family can check up on things

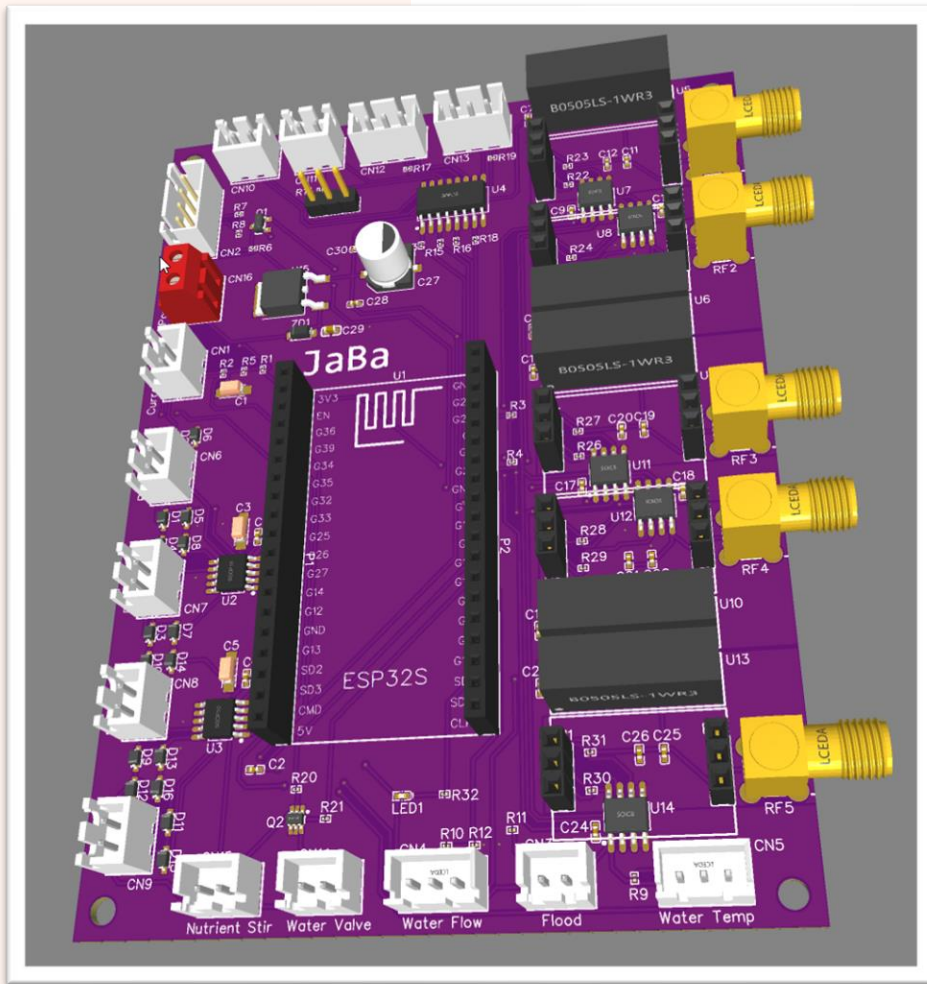




Design overview

Block Diagram





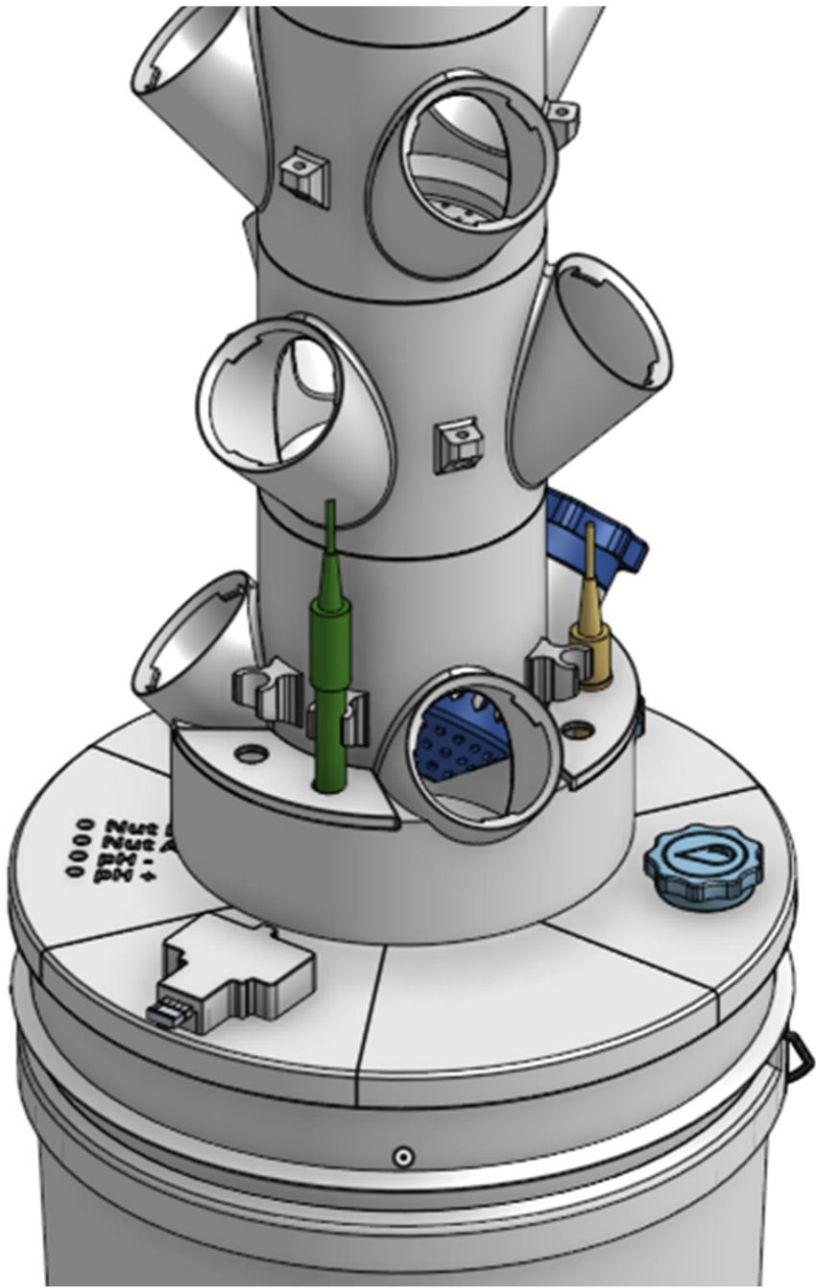
Main Controller

- Designed with browser-based tool EasyEDA
- PCBs fabricated and populated at JLCPCB
- Relatively low cost



Grow Tower

- Modification of a popular 3D printed tower on thingiverse
- Fits any 5-gallon bucket
- Lid customized designed to accommodate this design
- Features a unique basin to hold and sample water from the probes
- Uses OnShape (live demo)





Grow Cam

- ESP32-Cam module with new PCB backend
- Measures temperature, pressure, humidity inside the grow tent
- Can view growth of the plants via the camera (live demo)

Software Overview

Home Assistant

Quarterback of the system
Excellent at managing devices in
one central place
Excellent UI and notifications
built-in

ESPHome

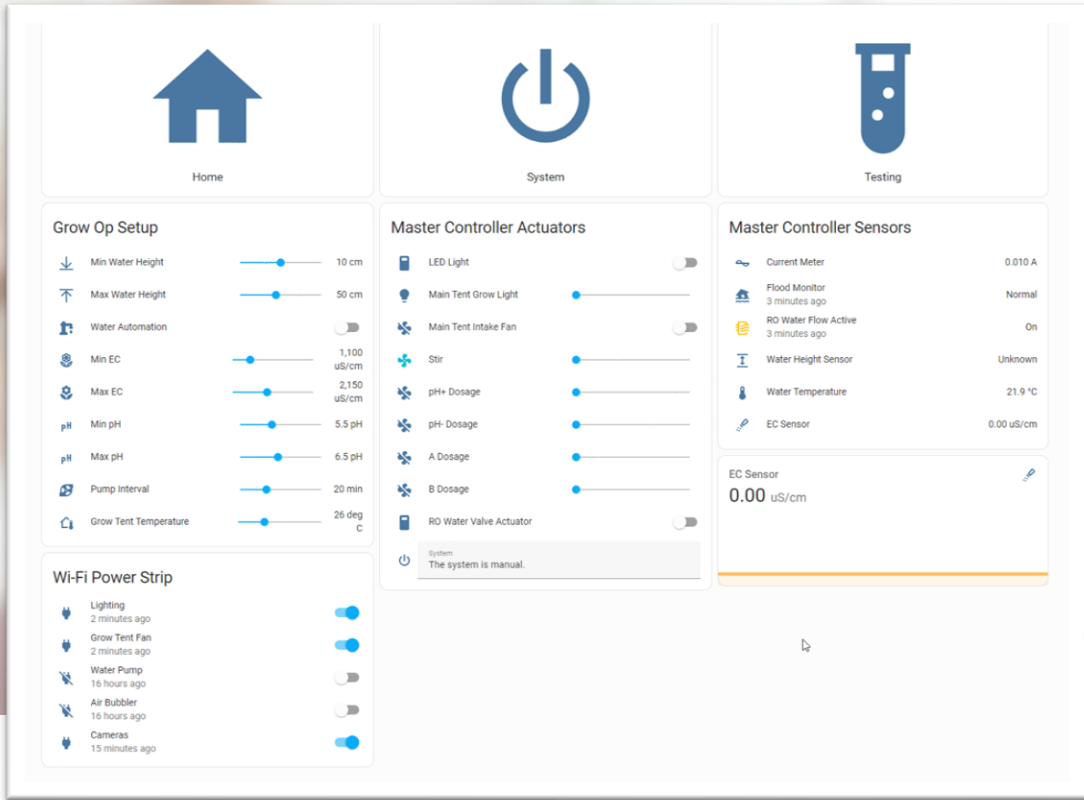
For attaching peripherals to ESP32
device easily
Uses configuration to generate
code (Arduino C++ framework)
Compiles, links and uploads files
wirelessly (live demo)

Node Red

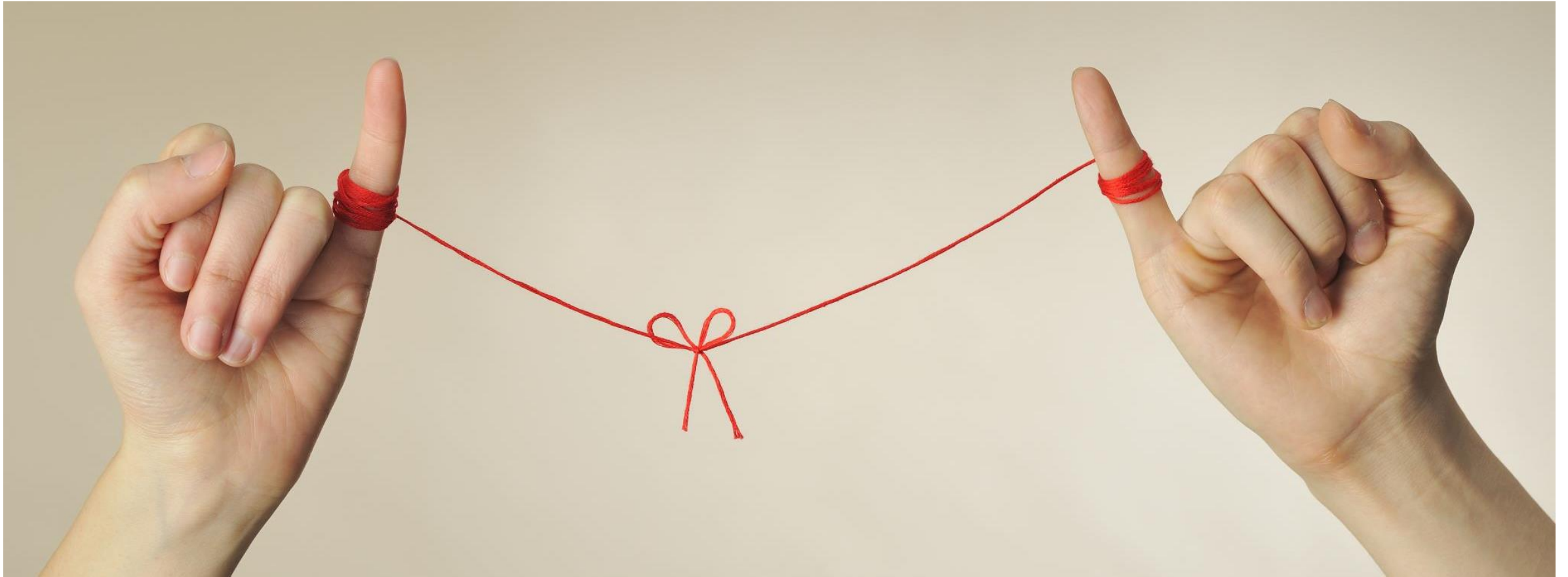
- Flow-based development tool
for visual programming
- browser-based flow editor built
into Home Assistant
- Specific nodes built for home
Assistant (in blue)
- Can create your own JavaScript
functions.



Home Assistant & ESPHome



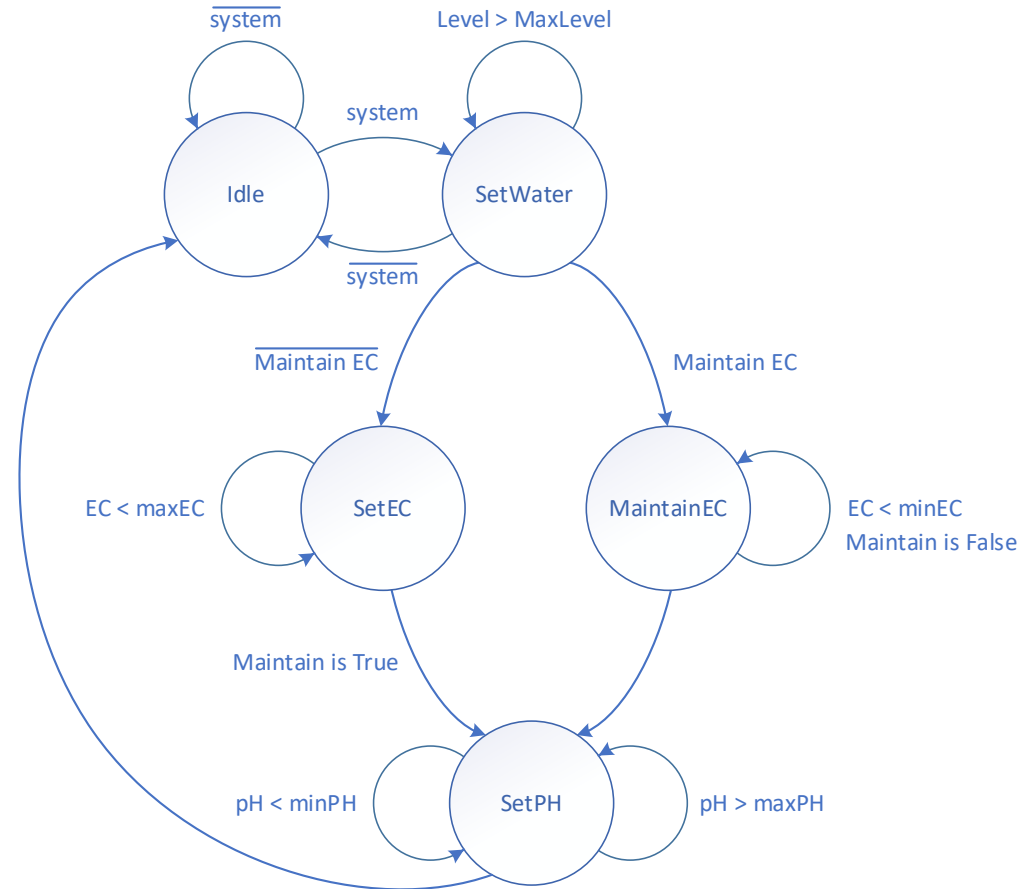
Live Demo



Node Red

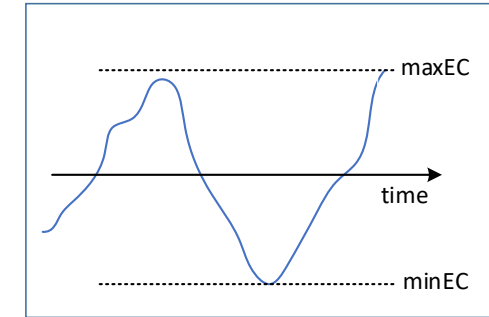
Live Demo

Nutrient State Machine Example

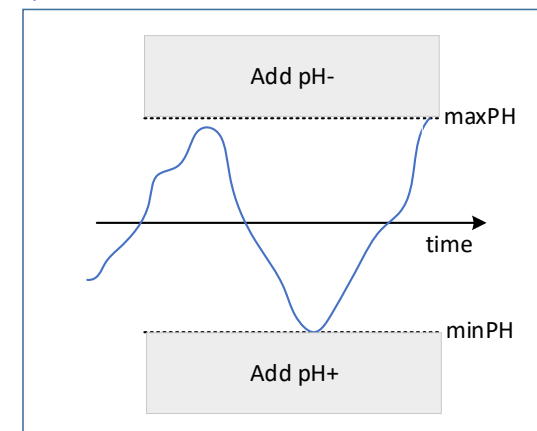


Actions:
0 - turn on water
1 - activate pumps
2 - notify user
3 - do nothing

EC Control



pH Control



Review of this Approach

Pros

- Able to accomplish a lot of work without the need for expensive tooling or equipment
- Low code, no-code approach allows for the build up of complex systems quickly

Cons

- Limited to operations within your home with HA
- More elaborate built-in self test not possible
- Debugging can be challenging when you are not the originator of the software.



Final thoughts

- Still testing now. Will be happy to come back and give an update once my wife and I grow something 😊
- I plan to open source the project (in my github repo) once I have a working system in place
- 20 years ago, this project would have taken several person-years to complete and cost a lot more to build

Standing on the shoulders of giants

- <https://www.youtube.com/@Kyle.Gabriel> (OG hydroponics controller)
- <https://www.youtube.com/@LEDGardener> (hydroponics controller)
- <https://www.youtube.com/@EverythingSmartHome> (home assistant)
- <https://www.youtube.com/@TheHookUp> (node red)
- <https://www.thingiverse.com/thing:3405964/files> (Grow Tower)
- And many more...



Thank you

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