

Capstone

Osmo, an open-source and modular plant care system

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Osmosis •/äz'mózəs/

Noun

1. The movement of water from a place of high concentration to an area with a lower concentration of water
2. The process of gradual assimilation to ideas, knowledge, etc.

For starters,

Osmo is an autonomous and modular plant care system equipped with sensors and powered by Raspberry Pi.

Project timeline

Co-Op at Local Grown Salads(LGS) (Fall Semester)

- Gained hands on experience in agile development
- Introduction to vertical farming practices
- Introduction to the perils of start ups

Industry Research (Spring Semester)

- Problem finding
- Research on food-systems

Development of Osmo (Spring Semester)

- Hardware Development
- Software Development

Co-op work at LGS

- **Research and development on automation of their hydroponic irrigation system**
- **Idea procurement for our individual project**
- **Perils of working at a startup**
- **Resume builder!**

Food Systems Research

Current U.S Food-System issues:

- **Sustainability**
- **Accessibility**
- **Privacy of Data**

Food System: All steps involved in food creation including, production, processing, distribution, consumption, and waste management

Sustainability

Issues that arise from the inefficiencies of industrial-agriculture:

- Soil degradation
- Water depletion
- Greenhouse gas emissions

Irrigation is the largest use of water in agriculture ... it makes up about **65% of total** consumptive water use [USDA, 2021].... the average **efficiency of irrigation systems** in the United States is only around **50%**[Pacific Institute, 2012]."

Create a product that effectively irrigates your plants

- Data-aware solution
- Real time autonomous decisions

Accessibility in U.S Ag-tec and Food-Systems

- Food Insecurity
- Barriers of entry
- Farmers don't know how to code!

*"We are all in agreement that we need **modular** architectures in the design of software. We also need to take a more **human-centered approach** to the design of our tools by taking a **participatory approach** with the **users**, the **technologists** and **vice versa**."* Ankita Raturi (2019)

Democratize our product

- Allow ease of access to our technology
- Human-centered approach
- Ensure access to efficient means of plant care -> Access to fresh and well maintained produce

Privacy in Ag-Tech

- Inefficient data gathering practices
- Concentration of power
- Network Security

*"It's not necessary that all data should be accessible to the public. "Sharing" is a cultural phenomenon that we can **support through tech**, not necessarily enforce. No one is entitled to anybody else's data because there are privacy and ethics concerns. Instead, I would argue we need **openness** in the way in which **data is collected.**"* Ankita Raturi (2019)

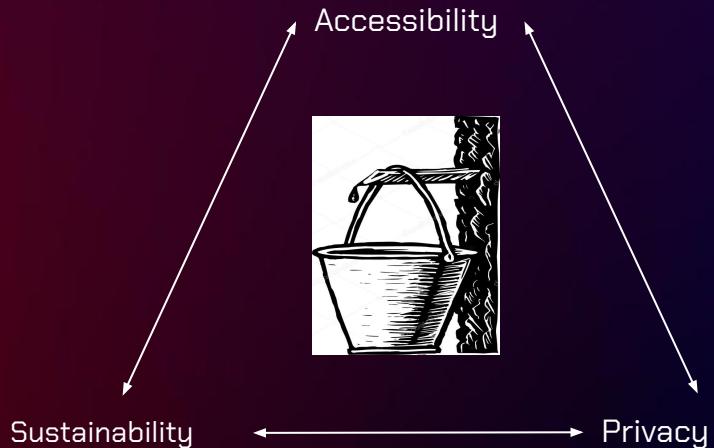
Create a product that has privacy at the forefront

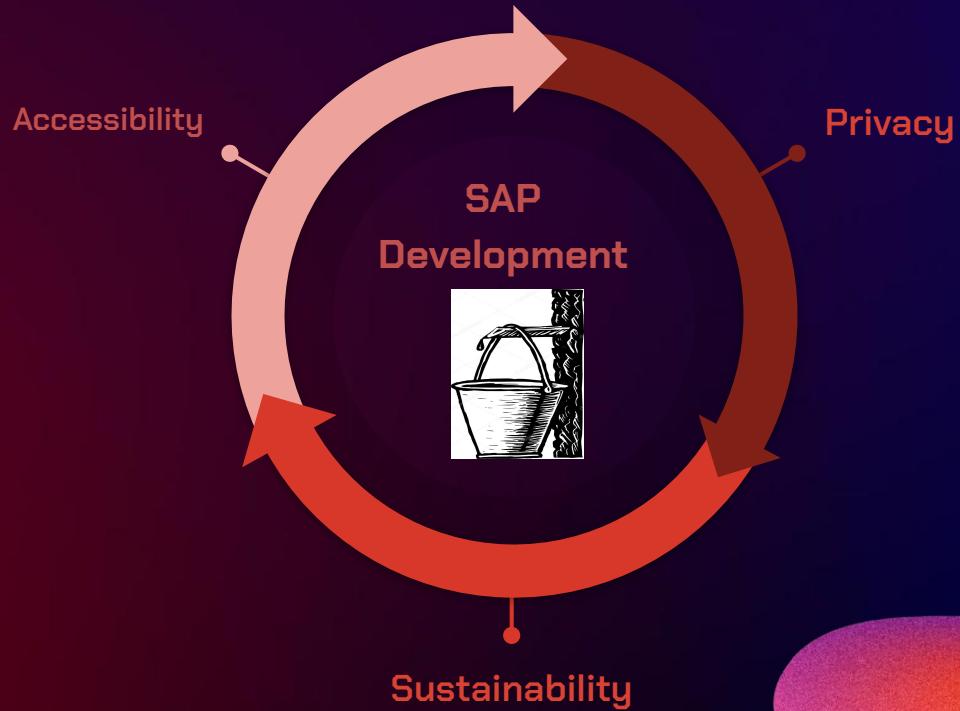
- Agency over data
- Secure network
- Dispersed & self-actualized data

SAP Development

Sustainable, Accessible, and Private Development

Modern Development Cycle





Let's talk tangibles

- IoT Network Design
- Framework
- Hardware
- Software

Developing Ideas (Osmo .25)

- Keeping scale in mind
- What will we be growing? How much are we growing?
Who are we growing for? Who are we competing against? Who is using Osmo?
 - Users needs at the forefront of design.
 - Use modularity to our advantage

Osmo should:

- **Solve an issue of sustainability**
- **Serve many with low barriers of entry**
- **Provide folks with self-actualized & democratized data**
- **Act as a way of thinking/solving problems**



Into the good stuff

Code, frameworks, more code, hardware, and
ceramics?

Osmo IoT Network Design

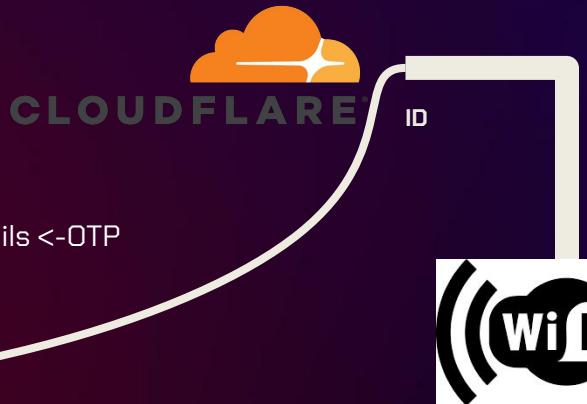
Users



Authentication



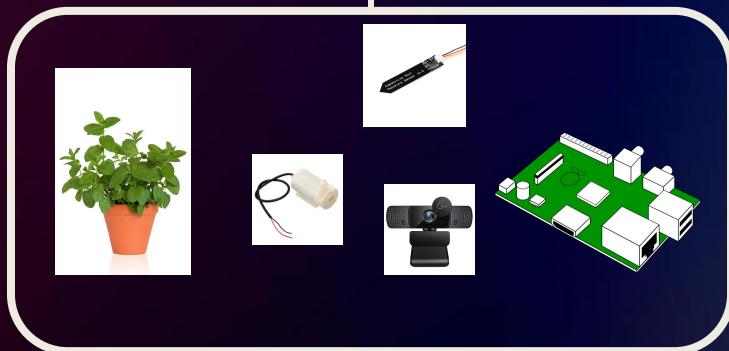
Emails <-OTP



Authorization

- Access to Rpi via tunnel "id"

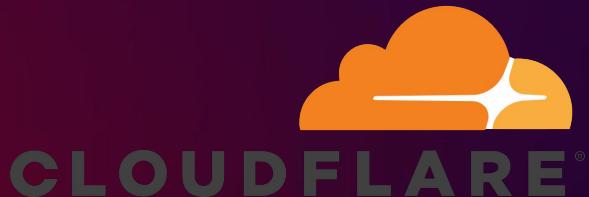
← Policy -> Allow



IoT/Hardware

Frameworks

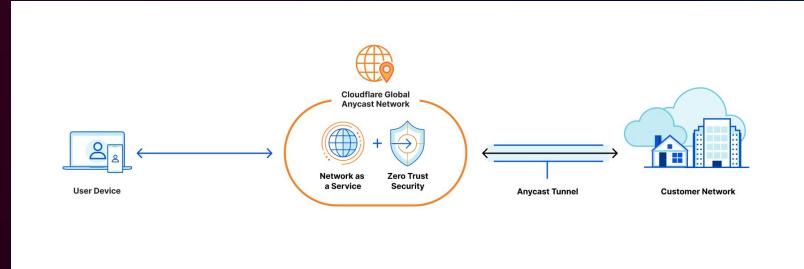
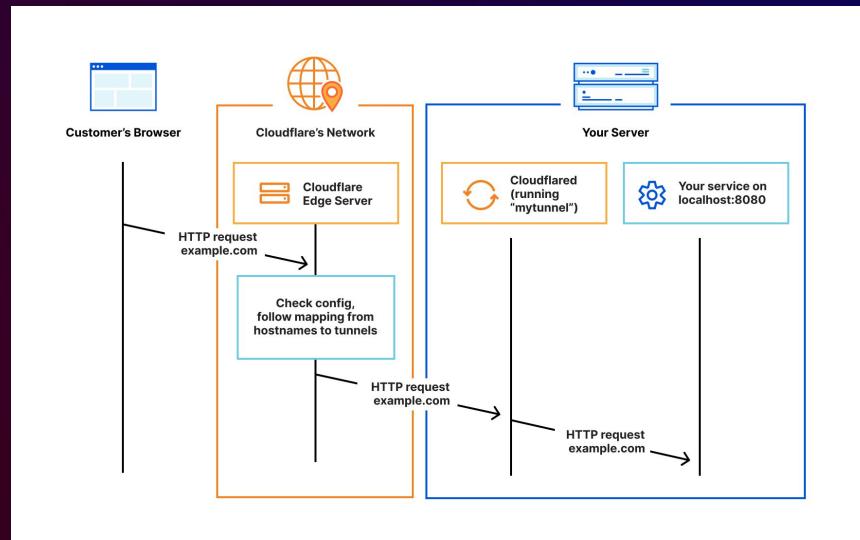
Multithreaded Irrigation and Imaging scripts written in python enabled by Flask and OpenCV. Secured by cloudflare zero-trust tunneling infrastructure.



Cloudflare Zero-trust

Cloudflare Tunnel creates a secure, outbound-only connection

- Authenticate users on the global edge network
- Onboard third-party users seamlessly
- Security Broker to safeguard data in the cloud.



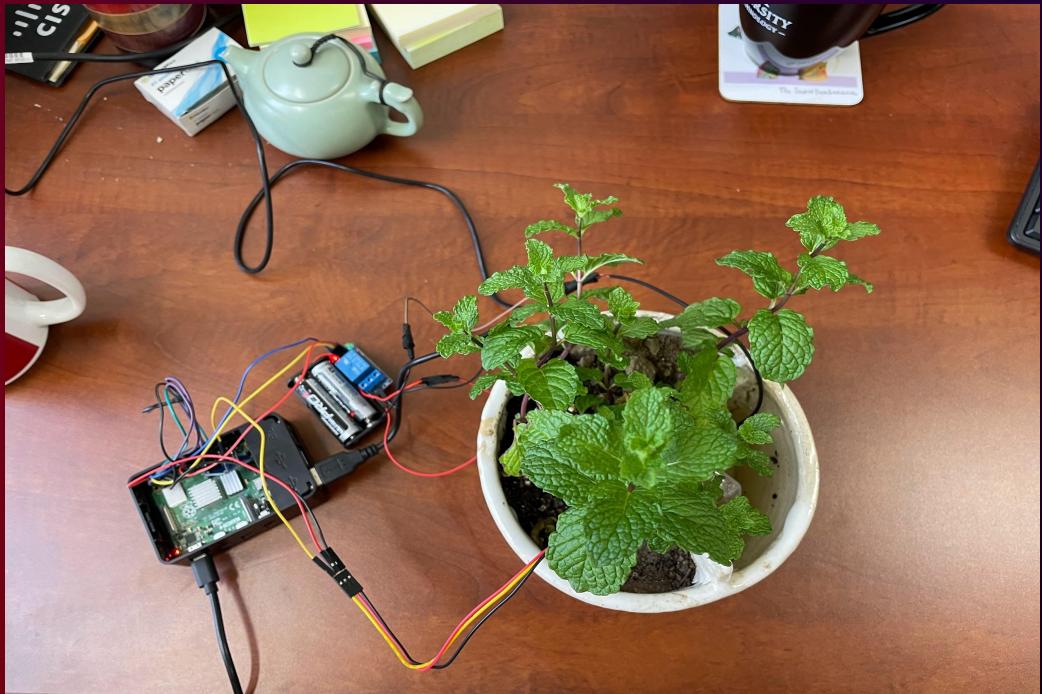
Why Cloudflare?

- A Secure Web Gateway to protect users and devices.
- A fast and reliable solution for remote browsing.
- Safeguard data in the cloud.

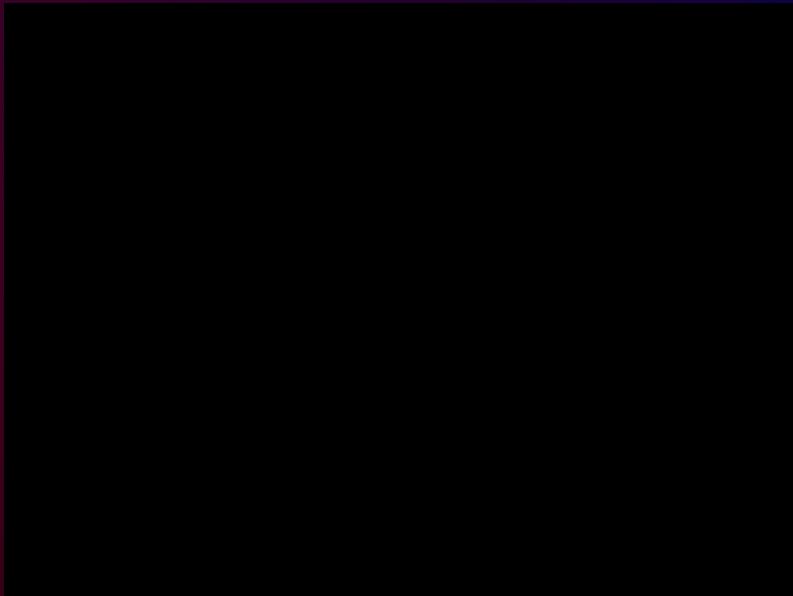


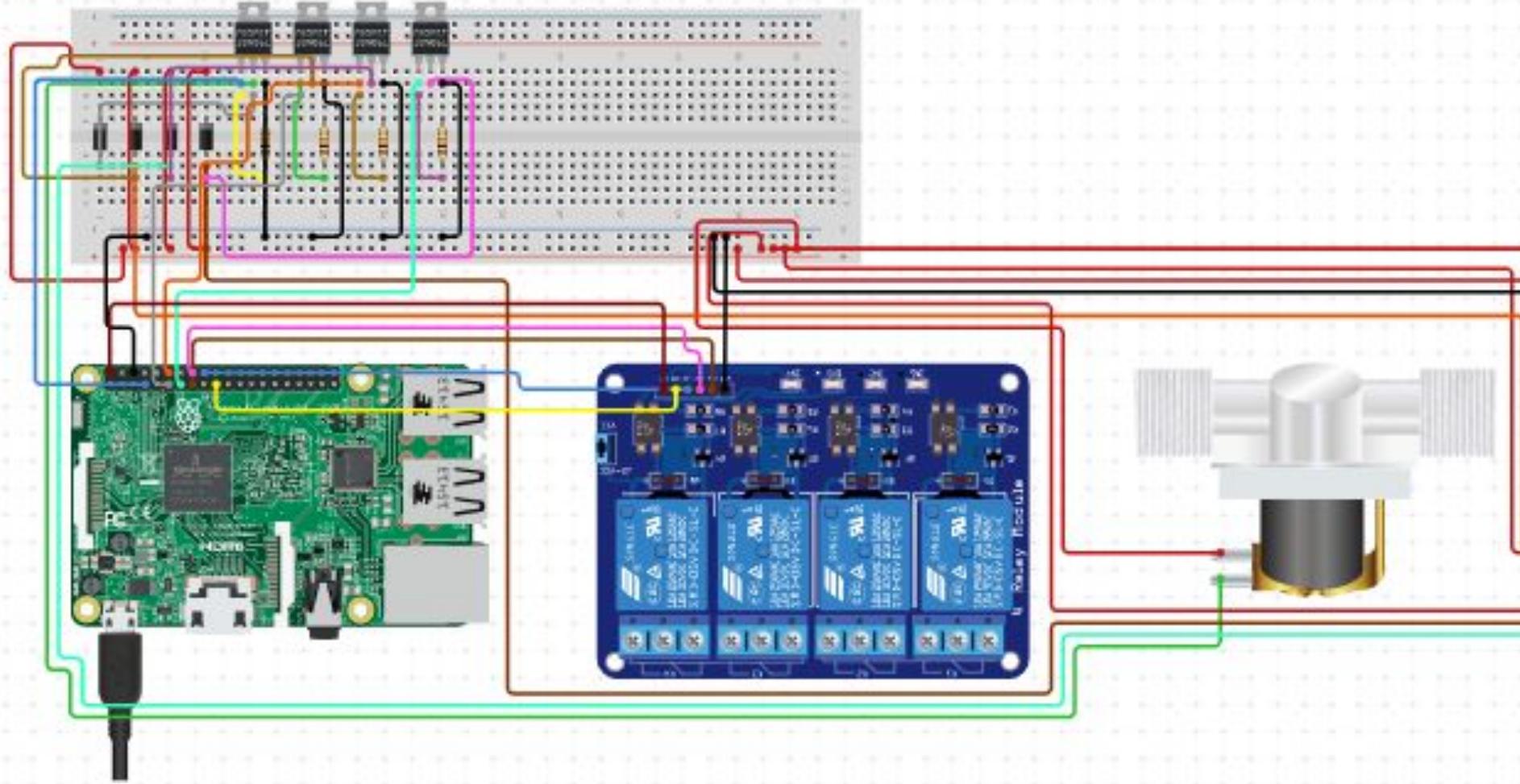


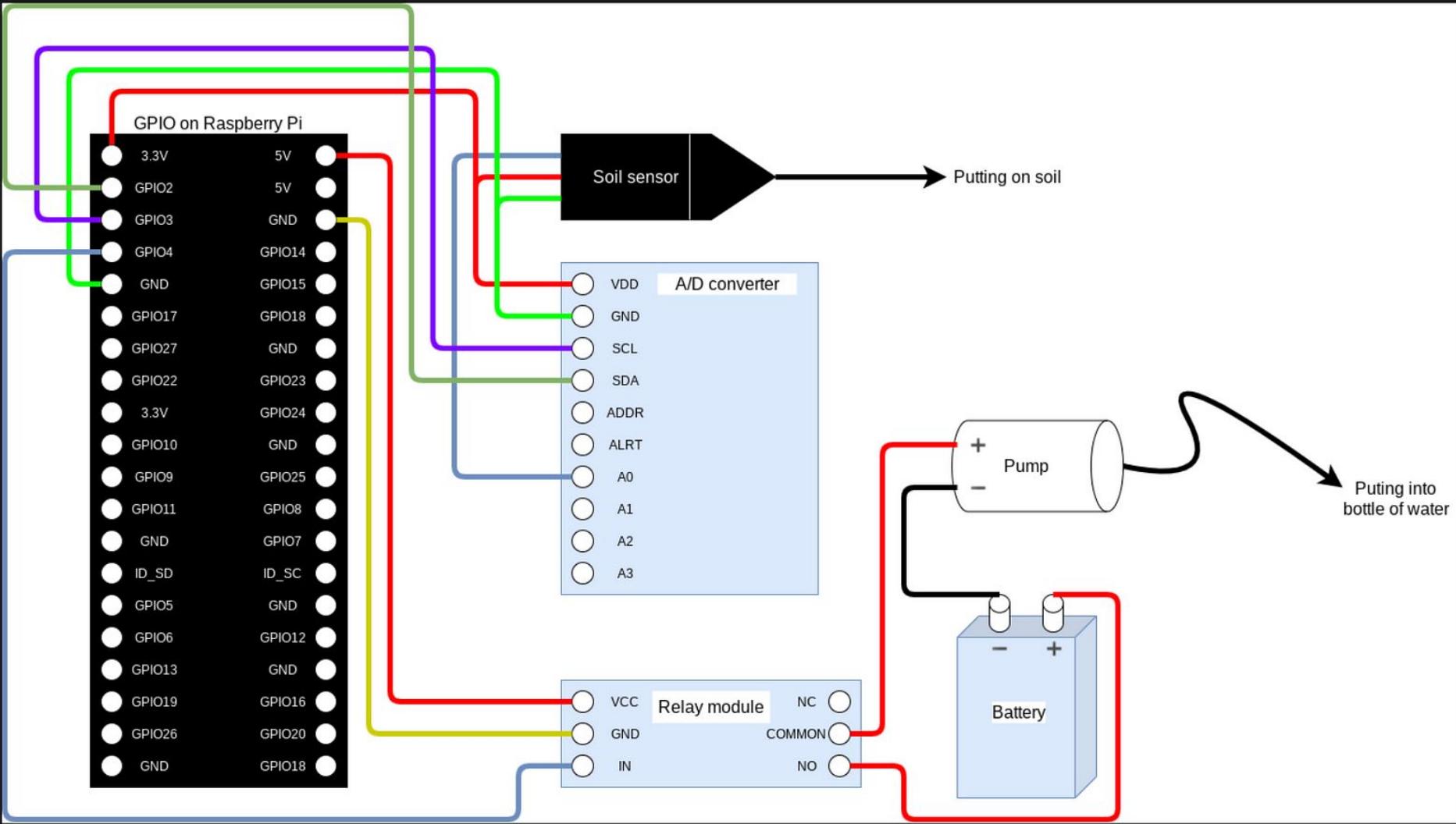
**Lets see Osmo
in action**



Demo of irrigation







Demo of front-end

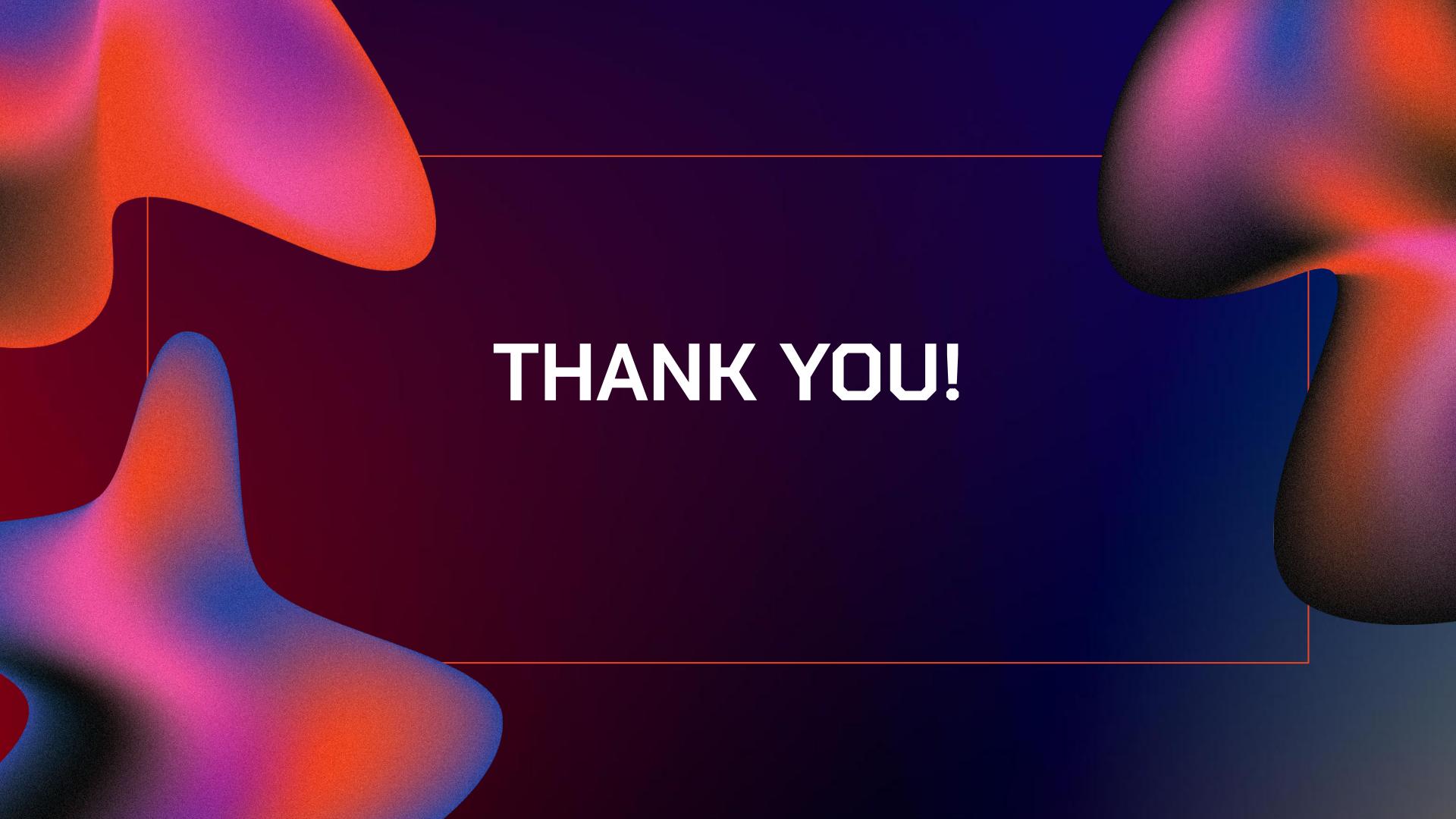
<https://plant.vford.com>

Problems faced

- Tasks running in parallel
 - Solution: Parallel Computing/Multithreading
- Remote Access
 - Solution: Cloudflare tunnel

Future Plans

- Maintain open source
- Perpetuate the idea of SAP development



THANK YOU!

CREDITS

Thank you

Dr. Ford

Team Members



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