AquaWhisper: Listens to plants and delivers perfect drops

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Problem Statment

- Water scarcity is a major issue in Tucson due to a **warming climate**, dry conditions, and the local desert environment.
- Many communities face **water waste** from unintentionally over-watering desert plants.
- About **40% of residential water** use in the Tucson metro area goes toward landscape irrigation (City of Tucson).

Proposed Solution

- A smart watering system that gives each plant the e**xact amount of water** it needs.
- An **app** lets users pick the plants they have, and it uses a **plant database** to know how much water each one needs.
- The flow sensor shows how much **water is used,** so people can see their **savings** in the app.

Objective

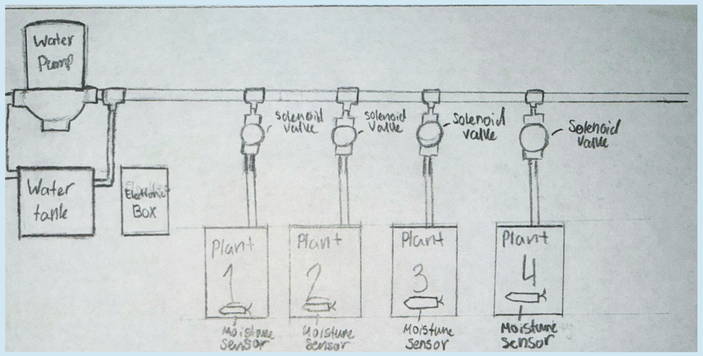
Primary Objective:

- Provide the **right amount of water** for each plant based on its, environment, species.
- **Reduce unnecessary water** use for homeowners in **drought-prone areas**.
- Make the system and app **user friendly**.

Secondary Objective:

- Offer **clear data** on water usage.
- Develop a **scalable system** for any garden size

Prototype



- **Irrigation system sketch, including water tank, pump, and 4 plant boxes. Water flows from the tank to the pump, to the long PVC pipe, and to the plants through the solenoid valves. Each Plant box has their own moisture/humidity sensor.(Top Left)**

User Requirements

- The system must be **easy to set up**, with all electronics connecting smoothly to the irrigation system and plants.
- It must be **customizable** for different plant types through an app that lets users adjust water amounts for each plant.
- It must be **expandable**, using a modular design to support more plants and **larger garden areas.**

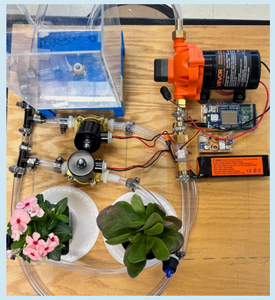
Implicit Requirements:

- The system must function reliably while the **user is out of town**, continuing to operate through the app easily and effectively for any duration.

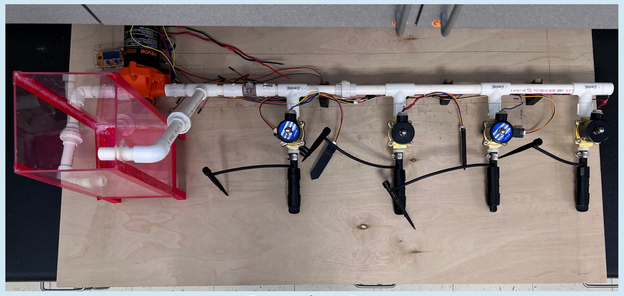
Citations

Interview with User 1:
Name: Luis Carlos
Occupation: Landscaper
Location: Tucson, Arizona
Reason for need: Luis is a landscaper in a desert setting with many clients who need assistance with maintaining the health of their plants.
Types of plants they work with: Lantanas, Agave, Palo Verde, etc.
Interview with User 2:
Name: Rashmitha Pallath
Occupation: Teacher
Location: Tucson, Arizona
Reasons for need: Enjoying gardening, she wants to find a cost-effective way to keep her plants from being overwatered or underwatered.
Types of plants they work with: Okra, Moringa, onions, tomatoes, and non-native chilies.

Design Process/Iterations



Iteration 1

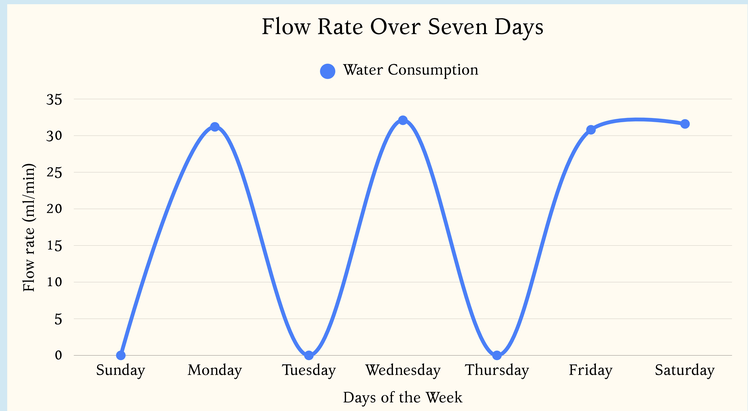


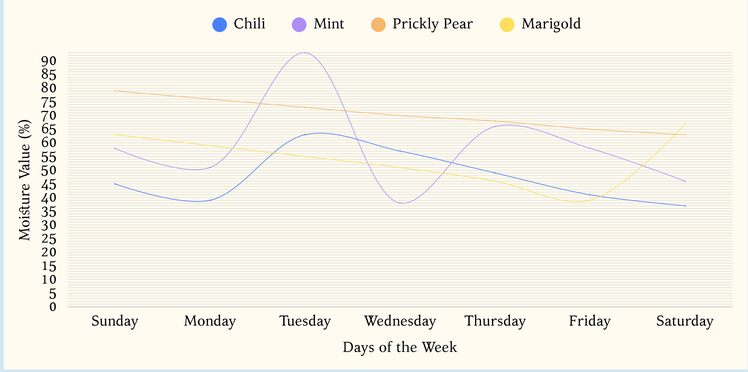
Iteration 2

- **Assemble and test water flow**: Build tubing system (pump → sensor → T-split → valves → plants), clamp everything, and verify leak-free flow.
- **Add electronics in stages:** Test pump control, then add Valve 1, flow sensor, and finally Valve 2, confirm each works before combining.
- **Integrate + finalize:** Program automatic watering logic, tune power for smooth flow, then mount and organize all components.

Data

- Gathered **flow rate** from sensors using different voltages from the pump to determine water needed.





Results/Conclusion

- The plants get **successfully watered** with the exact amount needed with the excess water going back into the water tank, **preventing** any **water wastage.**
- The user is able to leave town and still have the **app fully functional.**
- The user is able to **identify savings** through the app, and doesn't have to worry about the amount of water being delivered for each plant.
- In the future, this model can be **expanded to large garden** areas, and even be hooked up to a humidity sensor, taking weather conditions into account.