Reducing Freshwater Waste on Farms

The process of crop irrigation has been a process for almost as long as mankind has been around. The process in which this irrigation has been done has changed drastically, starting in the ancient world, water was piped in the forms of aqueducts, and nowadays, many irrigations are in the IoT (Hodge, 1893; Keswani et al, 2019). However, it is now a more ever-demanding need for more modern irrigation solutions to keep up with our ever-changing weather patterns and conditions (Dennings et al., 2024). There are currently lots of automatic irrigation systems; however, most of these systems are not smart and do not integrate many necessary metrics, such as weather and soil moisture metrics. Irrigation on farms uses 85% of water resources worldwide (Shylaja and B. Srinivas, 2016).

The current automatic irrigation controllers can leave much to be desired with their lack of ability to integrate current soil and weather conditions. Farms that use these automatic irrigation controllers can cause large waste as often the water is set to a timer, which will turn on every day no matter what the current metrics are, and this can lead to soil ponding and unnecessary water waste, leading to additional evaporation and increasing humidity (Gencoglan et al, 2004). To combat this, a few solutions have been tried, but they still contain their flaws.

One of the current market solutions is systems that use soil moisture sensors to determine if the soil really has enough water. These systems function by using a capacitive soil moisture sensor and monitoring the soil moisture. Once the moisture drops below a preset threshold, irrigation will begin (Hunter Corporation, 2025). While these systems are efficient at reducing water usage, they still do not function at peak efficiency. They cannot analyze weather data, which can cause incidents in irrigation. For example, if it is expected to rain, the system will not know that and still water the plants if the soil moisture is below the preset threshold.

While some systems do integrate moisture sensors, these systems cannot also analyze multiple rows for the soil moisture sensors. These irrigation controllers only come with one soil moisture sensor and make the assumption that the soil measure is the same for the entire field. If you wanted to use multiple sensors, you would have to buy multiple systems that are not friendly to the environment or have a budget. This can lead to issues for farms that are on hillsides where different rows of crops would have different soil moisture (S. Assouline et al, 2007). For example, if the soil moisture was placed at the tip of the hill, it might cause excessive irrigation for the plants at the bottom, and if the sensor was at the tip, it would not provide ample irrigation for the plants at the top. To solve this, the system could use multiple moisture sensors corresponding to multiple control valves.

Lots of automatic irrigation systems also lack the ability to interpret weather data. The ability to interpret weather data can help reduce waste as it is the ability to tell what the current weather conditions are as well as what the coming weather conditions are. This will allow the system to smartly decide if irrigation is carried out at any given moment by examining weather data and holding out on irrigation if precipitation is predicted. This can significantly reduce the amount of water consumed.

Problem Statement

Farms waste fresh water through excessive irrigation every day. This can be extremely wasteful and lead to excessive humidity.

Objective

Objective 1: Create a device that can reduce the amount of freshwater waste on farm through smart irrigation

Objective 2: Be scalable for something as small as a garden to something as large as a large agricultural operations