

# Hydration Automation

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Agricultural systems are dependent on water to cultivate plants and raise livestock. These systems are equipped with irrigation systems that store water in reserves or tanks for later use or manage the distribution of the water to the rest of the system. Modern irrigation systems are equipped with many sensors and actuators to manage and monitor the flow and distribution of water throughout the system. However, the industrial level systems on the market are expensive, complex, energy inefficient, and are often manually operated making them inaccessible to smaller farms or ranches. Therefore, we have designed and are building a low cost, small factor, smart, and more sustainable system called Hydration Automation (HA) to monitor and manage water level and distribution in water tanks.

The system is comprised of Sensing Units (SUs), Relay Units (RUs) and an Actuating Unit (AU) with a wireless communication subsystem between the units to transport data. The SUs are attached to water tanks and use an ultrasonic sensor and micro controller to gather and send the water tank level data over the wireless subsystem to the AU. The AU collects and analyses the data from all the tank sensors and controls valves or pumps to distribute the correct amount of water to the different locations in the system when needed. The RUs are used as relay nodes in the system to transport the water level data over longer distances or around large objects. The wireless communications subsystem uses a custom routing protocol atop a transport layer such as LoRa and a wireless physical layer utilizing RFM95 Radio Modules in the 915/916 MHz frequency band. The system is energy efficient and allows for easy removal and addition of units to the system.

We designed each unit in the system to be modular and components easily replaceable in case of damage or failure of a component. Each unit in the system is powered by a solar panel and battery to provide a more sustainable solution. To conserve power, the SUs spend most of their time in a low power (sleep) mode and only awake periodically to measure and send the water tank level to the AU. The units are encased in custom designed 3D printed cases to provide a water proofed, less expensive and more sustainable option. This enables the system to be smaller and modular in design allowing for it to meet specific design choices and protect against many environmental threats, installation demands and quality standards.

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