

Objective

Develop a wireless subterranean **sensor package** to enable remote **soil monitoring** throughout the growing season **without** surface penetration, eliminating the need for **intra-seasonal intervention**

Value Proposition

- Providing **real-time** data on **soil parameters** will help farmers make **data-driven** decisions, leading to an improvement in **crop quality** and **yield**
- With frequent accurate data, farmers can **optimize** resource usage to **reduce waste** and support increasing demand for **sustainable agriculture**

Background

- Current products employ antenna that penetrate the surface soil
- Industry devices must be removed before equipment can operate
- Increased cost associated with extra labor
- Signals are heavily attenuated in soil when buried

Key Requirements

- Measure soil parameters of **NPK, Moisture, Temperature, Electrical Conductivity, and PH**
- **3-Month** battery life, data sampling at **15-minute** intervals
- Buried to **1 ft** depth, **IP65** rated, robust, serviceable, low cost
- Transmit data using **915MHz LoRa** to a web user interface

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Sponsor: UI – CALS, Dr. Johnny Li

Design

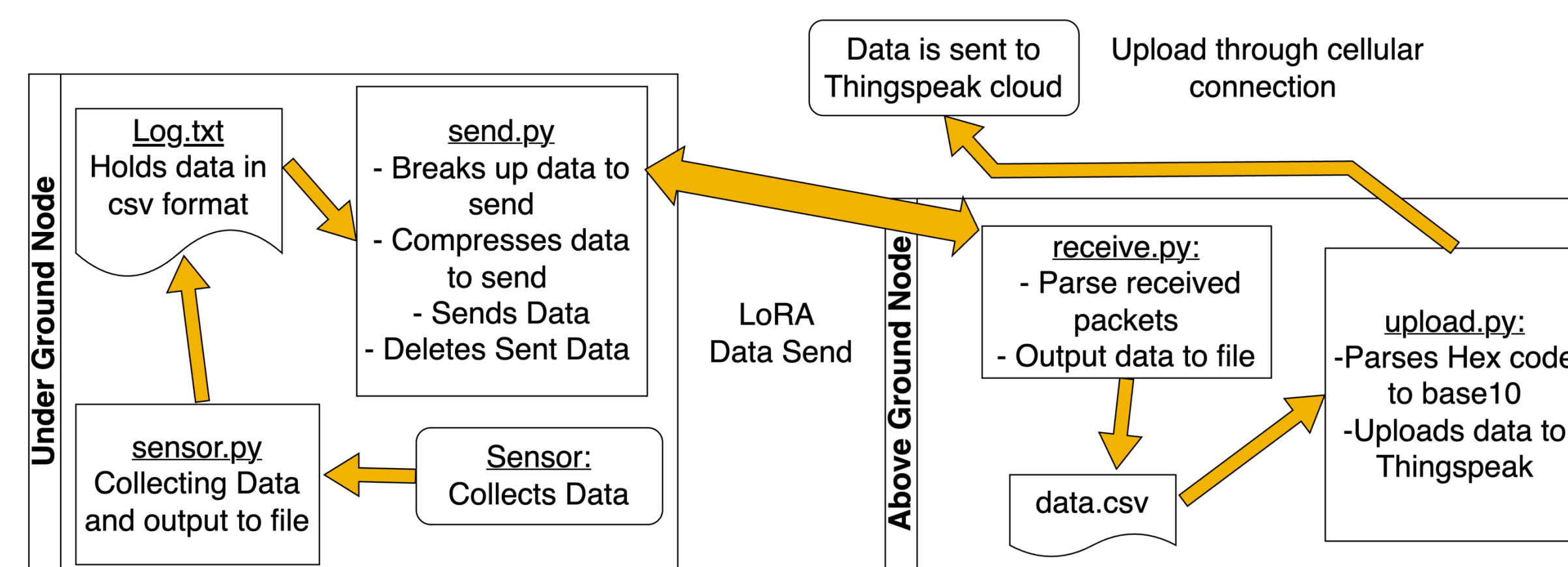


Figure 1: Data Flow Diagram



Figure 2: CAD enclosure design UG (left), AG (right)

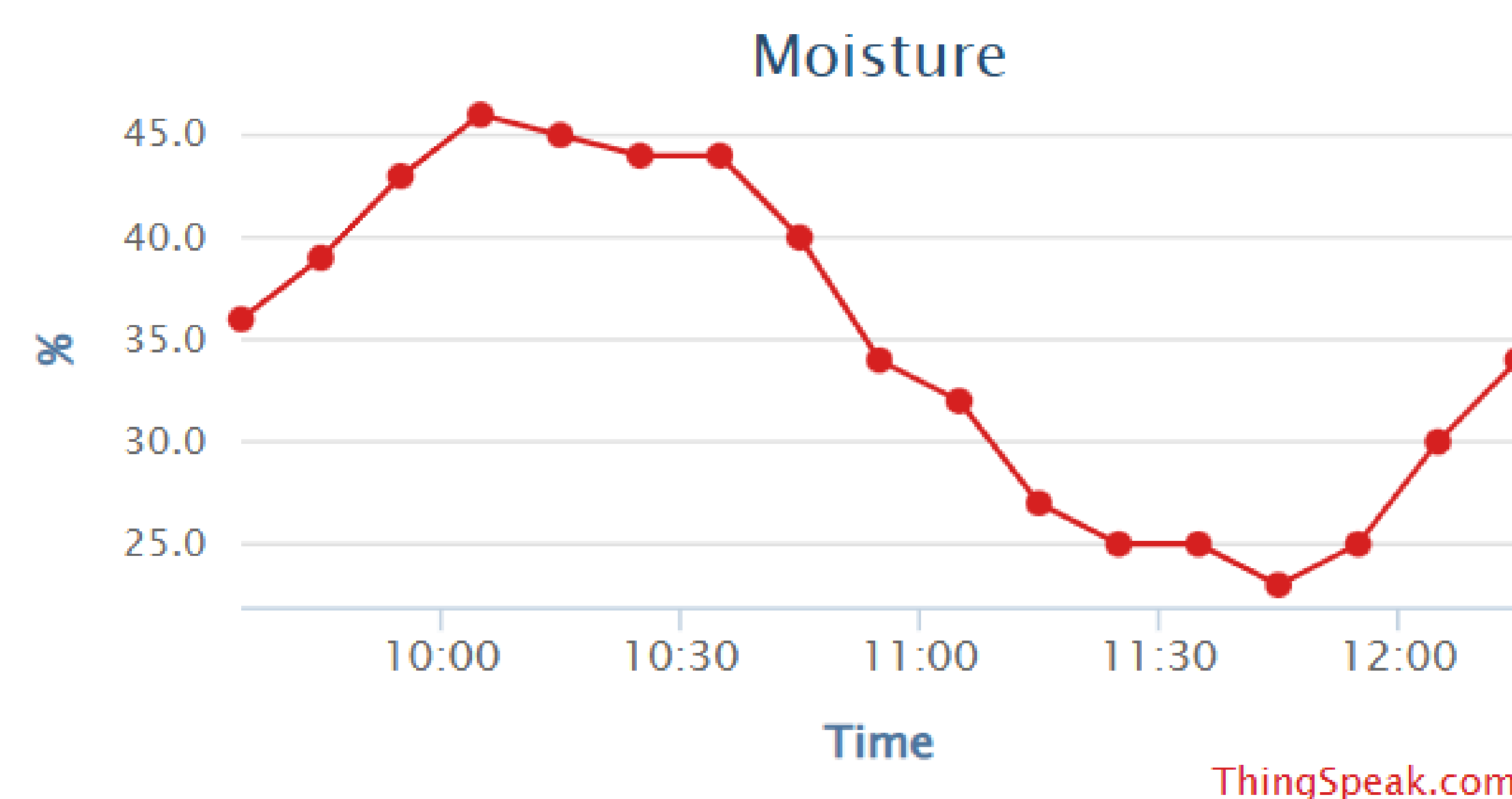


Figure 3: ThingSpeak data chart (1 of 7 total parameters)



Validation

- Signal retained while buried at 1ft depth, > 1km range
- Sensor accuracy verified for moisture, temperature, and electrical conductivity
- Modified enclosure tested against liquid and dirt
- Power consumption measured to adequately size battery
- Packet integrity maintained through signal disturbance

Results

- **Above Ground node (AG)** capable of being mounted/transported in various ways (i.e. drone, carried)
- **Underground Node (UG)** remotely collects data and wirelessly transmits to AG at specified time interval
- AG uploads data to **ThingSpeak** cloud for remote viewing
- Using data compression and a "handshake" system, we mitigated data corruption present in 10% of instances

Future Work

- Using custom components will optimize for efficiency, cost and size. This would create a scalable product that may appeal to the general market
- Lower frequency ranges paired with more powerful hardware may provide more reliable, longer-range transmissions
- Receiver AG node may be paired with sprayer devices to autonomously correct soil in real time

