Revolutionizing Precision Farming For Smallholders Using Sensory Mesh Networks

Spero Analytics

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What is your idea?

We are Spero Analytics, an AgTech startup based in Toronto, Canada. **Our moonshot idea is to collect key agronomic data – primarily soil moisture – in underdeveloped agricultural regions on a massive scale, in real-time, and at a high spatial resolution using structured, sensory mesh networks. We will then work with our CGIAR partners to couple this data with other soil and meteorological variables in order to provide farmers with customized, actionable insights over SMS on (a) water management, (b) optimal planting and harvesting times (crop calendar), and (c) the best crop diversity for their land holding**. In short, we want to enable precision agriculture among smallholder farmers by overcoming important data deficiencies.

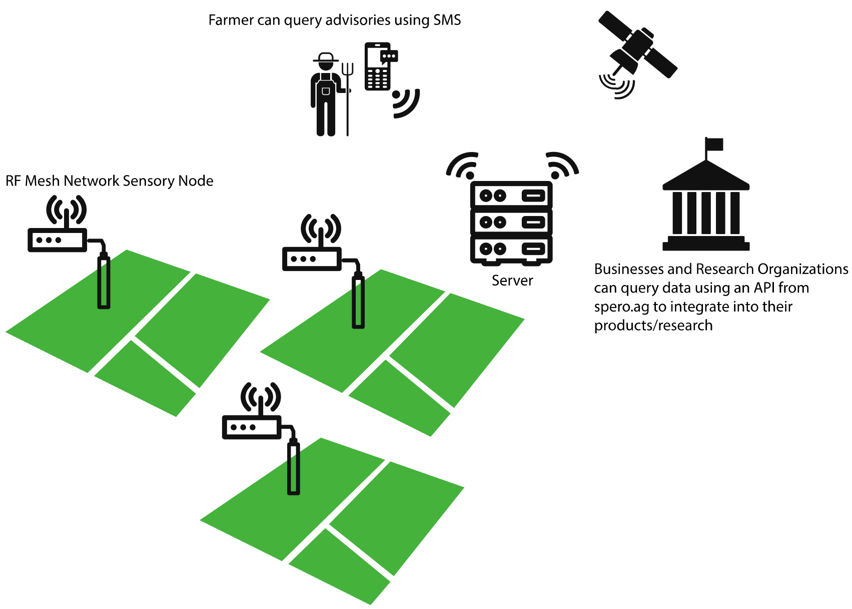

Figure 1: Diagram of the Proposed Solution

The idea of sending SMS farming advisories to farmers is not novel, but the use of mesh networks to gather and transmit key agronomic data is a potential game changer. Here's why: (1) Mesh networks are decentralized, insofar as data is transmitted from one sensory node to the next rather than directly to the server; this means that a singular network with one server can have a very wide reach; (2) The networks transmit data over license-free radio frequency waves and do not require cellular connectivity, lending them suitable for implementation in remote agricultural communities; (3) Even if a node is damaged or loses power, the network can algorithmically heal itself so long as two nodes are within range of one another; (4) Radio frequency antennas have a very long range – up to 4 km; and (5) the sensory nodes can be made affordable through economies of scale and modular, allowing users to customize the data they collect from each node.

High-resolution, real-time soil and environmental data is largely absent from low-income countries, and this has hampered development initiatives and intervention policies. We are certain that having a robust, self-powered, self-healing network of low-maintenance modular nodes which can selectively sense agronomic variables can be of immense value to CGIAR centers – who can use this data to probe for correlations that can enable us to forecast droughts and water balance requirements for specialized crops such as coffee and cocoa, pest outbreaks and diseases, and better advise farmers on cropping practices – as well established data-driven agriculture platform developers and local governments – who can access our data easily over API and integrate it into their advisory apps and services.

Pilot Testing

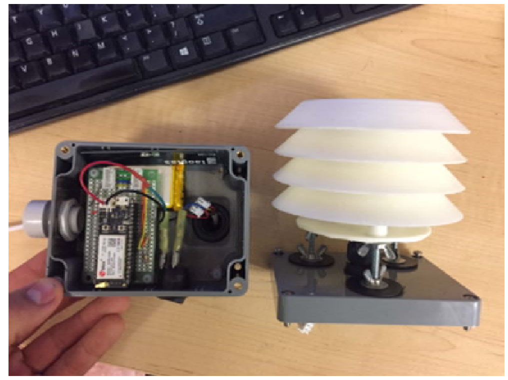

Figure 2: Prototype of Mesh Sensory Node

Through the USAID Data Driven Farming Challenge – for which we are currently a finalist – we have shown that we can build inexpensive, waterproof sensory nodes which measure soil moisture, air temperature, and humidity. These readings are transmitted over radio frequency to a cloud-connected server which uploads the data to a website with a map interface and temporal charts of sensory measurements (spero.ag), and makes the data available via SMS to farmers. At this point, however, we have not yet (1) programmed the self-healing mesh functionality, (2) integrated self-power functionality into the nodes, (3) constructed the API for data access, (4) delved into the complexities of forecast advisories, and (5) tested our network at scale. For the next 3 months, using a portion of the $100,000 Inspire award, we are confident we can address points (1), (2) and (3). This will be done partly in conjunction with research students at The Water and Energy Lab at the University of Toronto (UofT), which specializes in tackling global engineering challenges.

On points (4) and (5), we plan to work closely with Dr. David Guerena at CIMMYT and Dr. Steven Prager at CIAT in order to test out small-scale implementations of our network (~100 nodes in each location) starting in the early summer of 2018 in Nepal and Colombia respectively. Once we are satisfied with the fidelity of the data and the reliability of the network, we will proceed to draw down the remainder of the $100,000 to progressively add more nodes to the network, as well as different environment sensors to each node. In Nepal, we will work with partners – CIAT, CIMMYT, and ICIMOD – to couple our data with their repository of geotagged agronomic information in order to fill-in their environmental data gaps and identify optimal cropping practices and to provide farmers with accurate water management advisories in order to mitigate the effects of climatic shocks on their yields.

Next, we will aim to capitalize on our partners' vast network of farming co-ops and local government contacts to ensure the relevant ministries refer to our data when studying new intervention policies such as irrigation initiatives, and to gather feedback from farmers on the value and intuitiveness of the advisories we will be providing them. At the same time, we will seek out partnerships with existing AgTech data-driven farming platform developers, such as PEAT GmbH, who can integrate our network data into their apps and advisory systems.

As we are undergoing the above activities, we will constantly be looking for opportunities to achieve greater cost savings and economies of scale on our network. Perhaps one of the biggest benefits of the proposed system is its inherent scalability: Scale is both a requirement and a feature of the network, therefore, the $100,000 can go a long way to ensuring the viability of our proposed solution.