SmartFarm – Hybrid Cloud IoT Systems for Simplifying and Automating Agriculture Analytics

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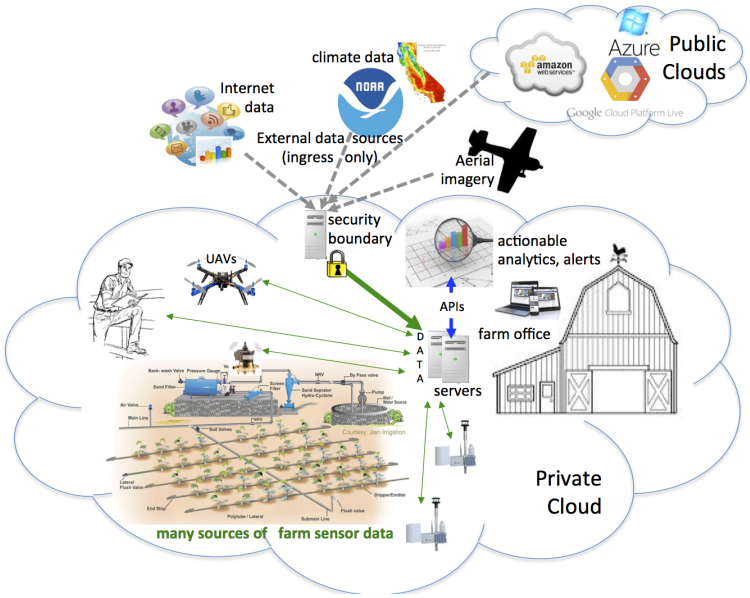
The agriculture industry faces tremendous pressure to increase crop production and yields to meet future consumer demand for food. This problem is compounded by the population growth of the planet, severely limited natural resources (arable land and water), unpredictable weather patterns, the requirement of sustainability, and climate change, among other variables. In an effort to make farms more productive, farmers are increasingly turning to environmental measurement and data analysis. Computing systems can automate this process to facilitate faster problem diagnosis, more accurate outcome prediction, and proactive decision making. Unfortunately, such systems to date have received little attention from the computer science research community and extant solutions are proprietary, complex, costly, or not widely available.

The goal of our work is to investigate a novel, unifying, and open source approach to agriculture analytics and precision farming called SmartFarm. As depicted in the figure below, SmartFarm integrates disparate environmental sensor technologies into an on-premise, private cloud software infrastructure that provides farmers with a secure, easy to use, low-cost data analysis system. SmartFarm couples data from external sources with farm-local statistics, provides an interface into which custom analytics tools can be plugged and automatically deployed, and ensures that all data and analyses remain under the control of farmers. SmartFarm enables farmers to extract actionable insights from their data, to quantify the impact of their decisions and environmental changes, and to identify opportunities for increasing farm productivity.



Our research agenda for enabling this vision consists of investigations into

- A software architecture that links data sources with data aggregation, processing, and analytics algorithms using 1 or more servers in a way that is self-managed and fault tolerant (cloud-based),
- Data collection (ingress) support for different, geographically distributed sensor systems (local and remote), each potentially with their own data formats, time scales, etc.,
- A new data model based on document referentiality and eventual consistency to facilitate large scale data aggregation, automated analytics, and simplified extraction,
- Application programming interfaces (APIs) for easy and automatic integration of modeling, analysis, alerting, auditing/reporting, and visualization technologies, and
- Privacy and security mechanisms that restrict access to data (collected or produced) and the system to only farm-authorized parties.

The result, we believe will be an open source, freely available software system that is easy to run and manage locally (on-premise), that ensures privacy and security of data, while providing aggregation of disparate sensor data for effective and agile agriculture analytics throughout every stage and component of the crop lifecycle.