FarmBeats: Empowering Farmers with Affordable Digital Agriculture Solutions

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## The Agricultural Challenge

**Global Access**
- 1 in 9 people are undernourished (UN)
- 65% reduce poverty for 65% of the world’s poor who live in rural areas and work in farming
- 70% more food is needed by 2050

**Sustainable Production**
- 70% of global water resources are needed for Agriculture
- 24% of global greenhouse emission comes from Agriculture
- 251T liters of water to be saved in 2030 from implementing Smart Agriculture

**Need for Economic Growth**
- 30% of global workers are employed by Agriculture
- 10-30% Agriculture contributes 10% of global GDP and up to 30% in low income countries
- $4.8T Global Agriculture revenue

Source: Sustainability development goals, UNITED NATIONS 2017
Data-driven agriculture

Precision agriculture has shown to:

- Improves yield
- Reduces cost
- Ensures sustainability
According to U.S. Department of Agriculture, high cost of manual data collection prevents farmers from using data-driven agriculture.
An end-to-end system that enables seamless data collection and insights for agriculture

FarmBeats
In this talk

FarmBeats: An end-to-end system that enables seamless data collection and insights for agriculture

Solves key challenges:

- No farm connectivity
- Precision Mapping
- Slow cloud connectivity
- Power on the Farm
Challenge: Farm connectivity

Cloud

Farmers home/office

Few miles away and obstructed by crops, canopies, etc.

Soil Moisture Sensors

Drone Video

Wind Speed/Direction Sensors

pH Sensors
Challenge: Farm connectivity

- Farmers home/office
- Base station
- Soil Moisture Sensors
- Drone Video
- Wind Speed/Direction Sensors
- pH Sensors

TV White Space frequencies used to carry data signals
In this talk

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Solves key challenges:

- Connectivity on the Farm
- Precision Mapping
- Slow cloud connectivity
- Power on the Farm
Challenge: Limited resources

Need to work with sparse sensor deployments

- Physical constraints due to farming practices
- Too expensive to deploy and maintain

How do we get coverage with a sparse sensor deployment?
Idea: Use drones to enhance spatial coverage

- Drones are ~1000 dollars and automatic
- Can cover large areas quickly
- Can collect visual data

Combine visual data from the drones with the sensor data from the farm
Drones have a few limitations:

- Limited battery life
- Regulatory concerns
- Cost

Low-cost aerial imagery: Tethered Eye (TYE)
Idea: Use Drones to Enhance Spatial Coverage

Drone Video → Panoramic Overview → Sparse Sensor Data → Precision Map
Precision Map: Moisture
Idea: use drones/balloons to enhance spatial coverage

FarmBeats can use drones to expand the sparse sensor data and create summaries for the farm.
In this talk

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Solves key challenges:

- Connectivity on the Farm
- Precision Mapping
- Slow cloud connectivity
- Power on the Farm
The Real World

Whitespace frequencies used to carry data signals

Cloud

Weak connectivity
Prone to outages

Farmers
home/office

Base station

Soil Moisture Sensors

Drone Video

Wind Speed/
Direction Sensors

pH Sensors
The Real World

Weather Data
(rain, wind, pollen)

Seed vendors / Argonomists / Farmers

Recommendations
(daily best practices)

Cloud

FarmBeats Gateway
(Azure IoT Edge)

Farmers home/office

Base station

Sensors

Whitespace frequencies used to carry data signals
Pilot Project Status

- Current Pilot
  - ESSEX FARM
    - Drones
    - Whitespace
    - Soil Sensors
  - Brunner Farms
    - Drones
    - Whitespace
    - Soil Sensors
  - Dancing Crow Farms
    - Drones
    - TVE
    - Whitespace
    - Soil Sensors
    - Gateway
  - Skylascopes
    - Drones
  - GEEK UNIVERSITY
    - Drones
    - Soil Sensors
    - TVE