# Farm Beats

Goal & motivation: agriculture output needs to ↑ by 70% by 2050

challenge:
- less water
- less arable land
- worse environment

Data driven agriculture

Ex 1: measure soil moisture at every point

↳ to make precise irrigation

⇓

↑ improve yield of the farm! & ↓ cost

But...

Manual data collection is costly!

IoT system for agriculture

challenge 1: no internet connectivity

↳ can't tranfer data to Cloud!

challenge 2: no power

↳ solar power is weather dependent

challenge 3: physical limitations

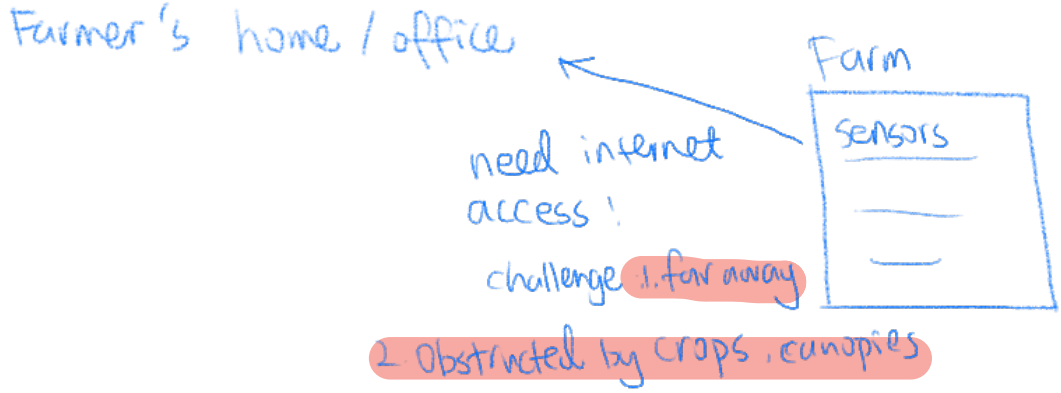
↳ tractor may run over sensors

↳ expensive to deploy and maintain

FarmBeats: E2E system that is at 2 orders of magnitude

lower cost

challenge 1: no internet connectivity




idea: TV white spaces

↳ unused TV channels

↳ high tput at long distances

↳ covers the farm

* lower frequency than Wi-Fi (2.4GHz)

challenge 2: physical limitation / limited resources

UAVs to enhance spatial coverage

↳ combine imagery from drone & farm data from sensor

↳ formulated as a learning problem

area w/ sensor data: training

area w/o sensor data: prediction

input is visual

↓

Gaussian Process Model — extrat feature similarity & location proximity

↓

output is moisture

Low-cost Aerial Imagery: (TYE)

UAVs has limitation in some countries

use balloon

↳ SLAM to localize the balloon

↳ canopy that covers the ground

↳ model can capture surface pattern

↳ RGB/NIR images

challenge 3: connectivity

idea: compute locally and send summaries

summarize sensor data & aggregates to a compact file

↳ 2-3 orders of magnitude smaller than raw data.

time sensitive info delivered locally

challenge 4: power avail is variable

flood monitoring is impossible → sensor is down

idea: use forecast to predict solar power

use drones to get high resolution image

↳ water puddle

Precision Map shows FB can ↑ accuracy by deploying small amount of sensors, achieving good coverage in the farm.