

# IoT in Agriculture - Soil Moisture

*And How sensors communicate with IoT Devices*

# Intro

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- Last class we talked about ambient temperature
  - used it to switch on/off LED
- Hard to control temperature (control environment using heaters etc)
- Moisture is another ambient property
  - Easier to control (either with watering can or large scale irrigation system)

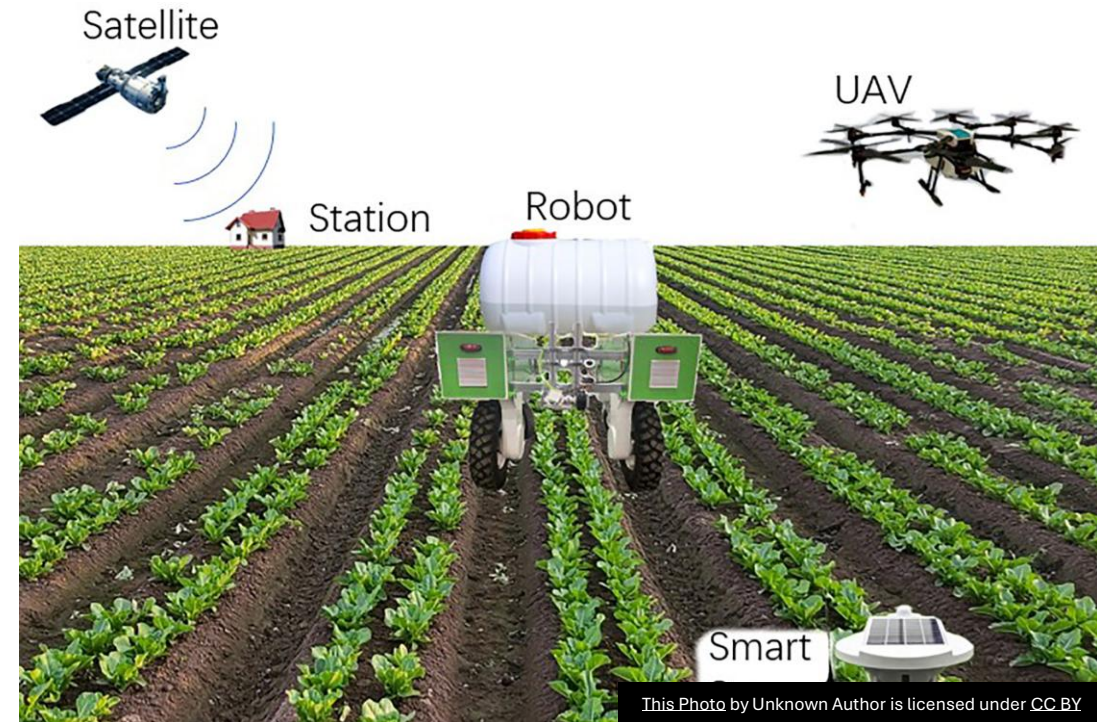
## Agenda

1. Soil Moisture
2. How do sensors communicate with IoT devices?



# Digital Agriculture (Agri 4.0)

- **Digital agriculture** uses tools to collect, store, and analyse farming data .
- It is also known as the '**Fourth Agricultural Revolution**' or 'Agriculture 4.0' .
- It encompasses the entire 'agriculture value chain', from farm to table . This includes tracking produce quality, warehouse systems, and even tractor rental apps .
- Digital agriculture allows farmers to increase yields, use less fertilizers and pesticides, and optimise water use .
- 'Precision Agriculture' is a technique that observes, measures, and responds to crops on a per-field basis .



# Agri 4.0 Use Cases

- Temperature measurement - to predict plant growth and maturity .
- Automated watering - using soil moisture sensors to water only when needed .
- Pest control - using cameras on robots or drones to apply pesticides only where needed .



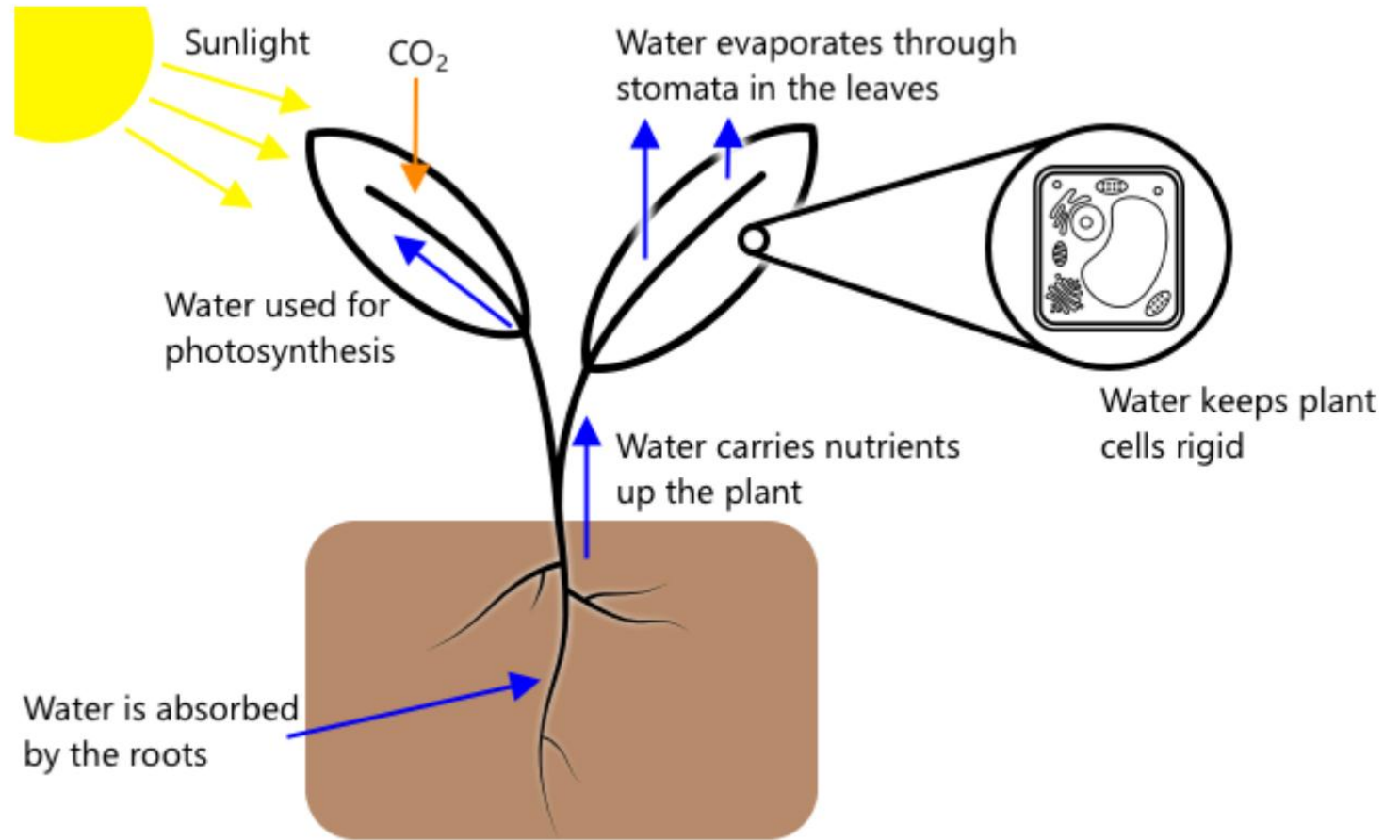
# Soil Moisture

## Water Uptake:

Plants absorb water through their roots, which is essential for growth.

### Key Functions:

- **Photosynthesis:** Combines water, carbon dioxide, and light to produce carbohydrates and oxygen.
- **Transpiration:** Water loss through leaf pores helps draw in  $\text{CO}_2$ , transports nutrients, and cools the plant. Approximately 90–98% of water absorbed can be lost through transpiration.
- **Structural Support:** With plants being about 90% water, moisture maintains cell rigidity and overall structure.





# Why monitor Soil Moisture

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- Optimal Conditions:
  - Ideal soil moisture levels are crucial; too little water restricts nutrient absorption, while too much leads to root oxygen deficiency and decay.
- Impact on Plant Health:
  - Balanced moisture ensures healthy root function and supports overall plant vitality.

***IoT devices help farmers monitor soil moisture in real time, ensuring watering only when necessary.***



# Soil Moisture Sensors

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- **Resistive Sensors:**

- Use two metal probes to measure electrical resistance in the soil.
- Higher water content lowers resistance, providing an indicator of moisture levels.
- Can be built simply (e.g., using two nails and a multimeter).

- **Capacitive Sensors:**

- Measure changes in capacitance between electrical plates due to varying soil moisture.
- Convert these changes into a measurable voltage for IoT devices.

- **Common Output:**

- Both sensor types produce an **analog** voltage that reflects soil moisture levels for further digital processing.

