PROXIMAL SENSING AND AUTOMATIC INFORMATION EXTRACTION FOR MONITORING THE ROLE OF BIOCHAR AS A BIOFERTILIZER FOR STRAWBERRIES

Politecnico di Torino 1859

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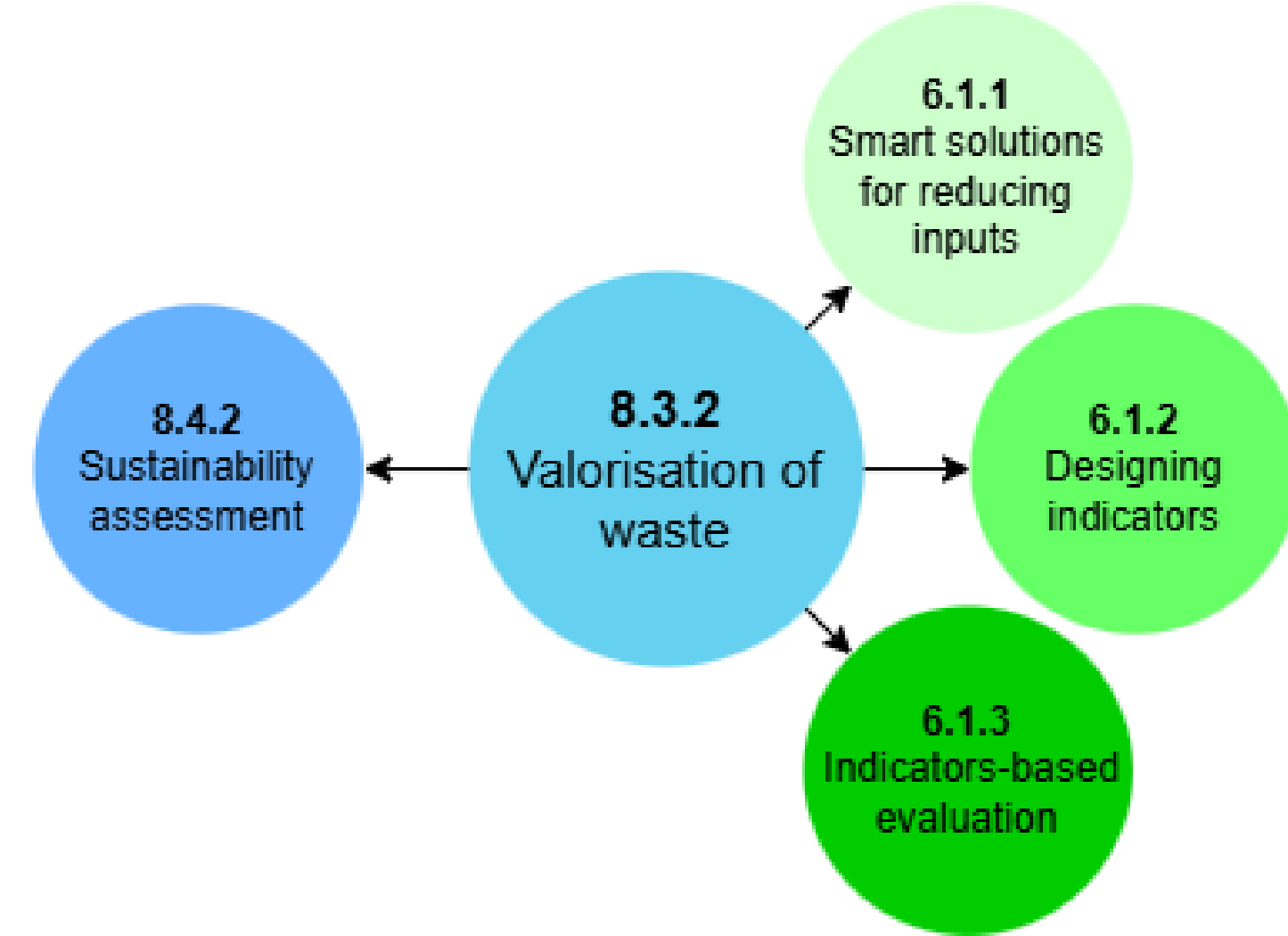
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ABSTRACT

The project aims to evaluate and compare the effects of organic fertilizers (biochar and digestate) on greenhouse crops. The first trial focused on the effect of biochar produced from woody biomass on strawberry (*Fragaria × ananassa*) plants. Two groups of plants were treated with different doses of biochar. The plants were housed in a greenhouse equipped with multiple sensors which automatically gathered and stored data. Ground truth data was manually gathered twice weekly. Multispectral (MS) images were acquired and processed using a target-free calibration workflow, permitting the eventual calculation of plant health indices (NDVI) and automatic detection of plant fitness indicators. Eventually, a fully-automated proximal sensing and information extraction pipeline will allow for the convenient, up-to-date monitoring of greenhouse crops and comparison of organic fertilizers on plant health and productivity. Future trials will be carried out using digestate and the experiment will be extended to include other greenhouse crops.

TASK CONNECTIONS

- 6.1.1 Smart solutions for reducing inputs
- 8.4.2 Sustainability assessment
- 8.3.2 Valorisation of waste
- 6.1.2 Designing indicators
- 6.1.3 Indicators-based evaluation

MATERIALS

1 greenhouse   **1** irrigation system   **15** plants   **15L** soil   **2** doses biochar

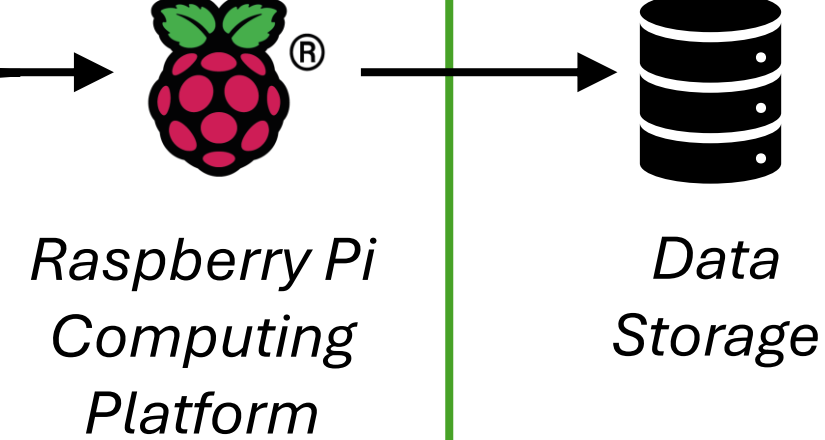**1** x proximal sensing system

SENSORS

MAPIR Survey3W Camera
Low-cost MS Camera
HFOV: 87°
Bands: Red-Green-NIR (RGN)
Output: RAW + JPG

DHT22
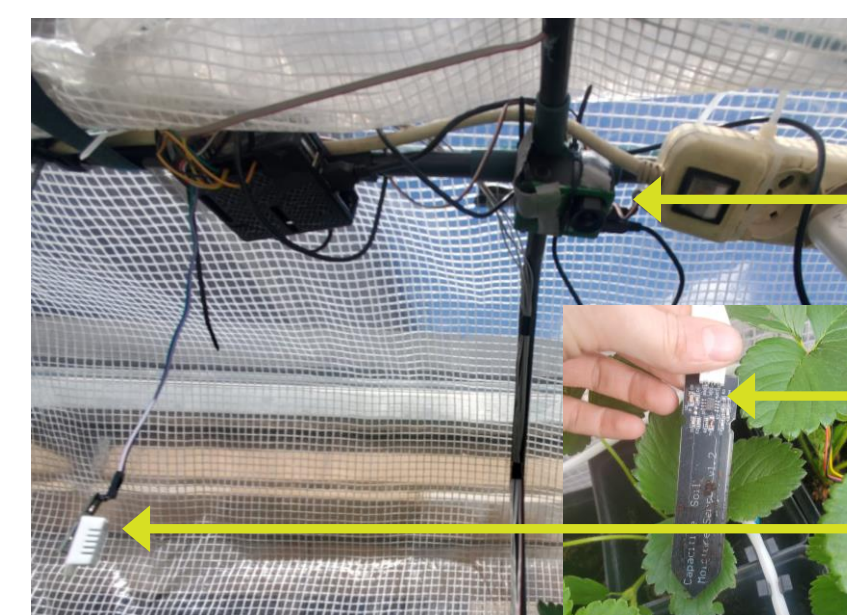Low-cost temperature + humidity sensor

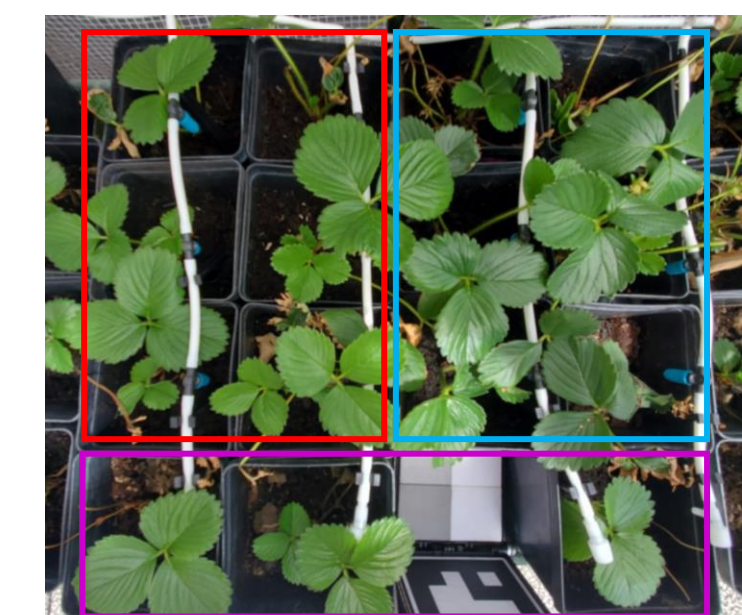*Capacitive Soil Moisture Sensor v1.2*
Low-cost soil moisture sensor

x 5

Raspberry Pi Computing Platform

Data Storage

METHODS

1. Set-Up

MAPIR
Soil Moisture Sensor
DHT22

2. Biochar Application

Biochar dose A (6 plants)
Biochar dose B (6 plants)
Control (3 plants)

3. Data Collection

| Data	Frequency
RGN images	Hourly
Air temperature (ºC)	
Air humidity (%)	Every 10 minutes
Soil moisture (raw)	
Root length (cm)	Start and End
Plant height (cm) no. of flowers and fruits	Twice weekly

4. Data Analysis

- Radiometric calibration of images
- NDVI calculation
- Automatic flower and fruit detection and counting using deep learning model
- Correlation of biochar treatment with plant fitness indicators

RESULTS

Automatic data collection and information extraction

Data	Quantity
RGN Images	2000+
Temperature + humidity	14591
Plant height (cm) no. of flowers and fruits	18
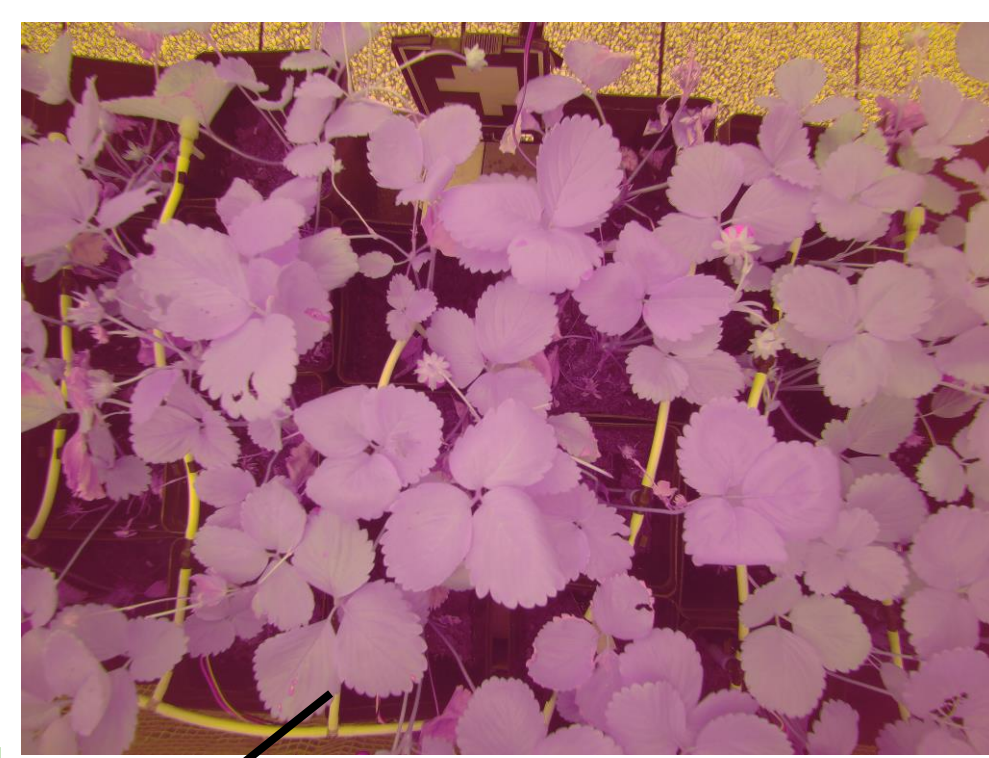
Next

NDVI calculation + Flower and fruit detection and counting

Example RGN image (23/06/2024)

Effect of biochar on strawberry plants

Plant Height from May to August
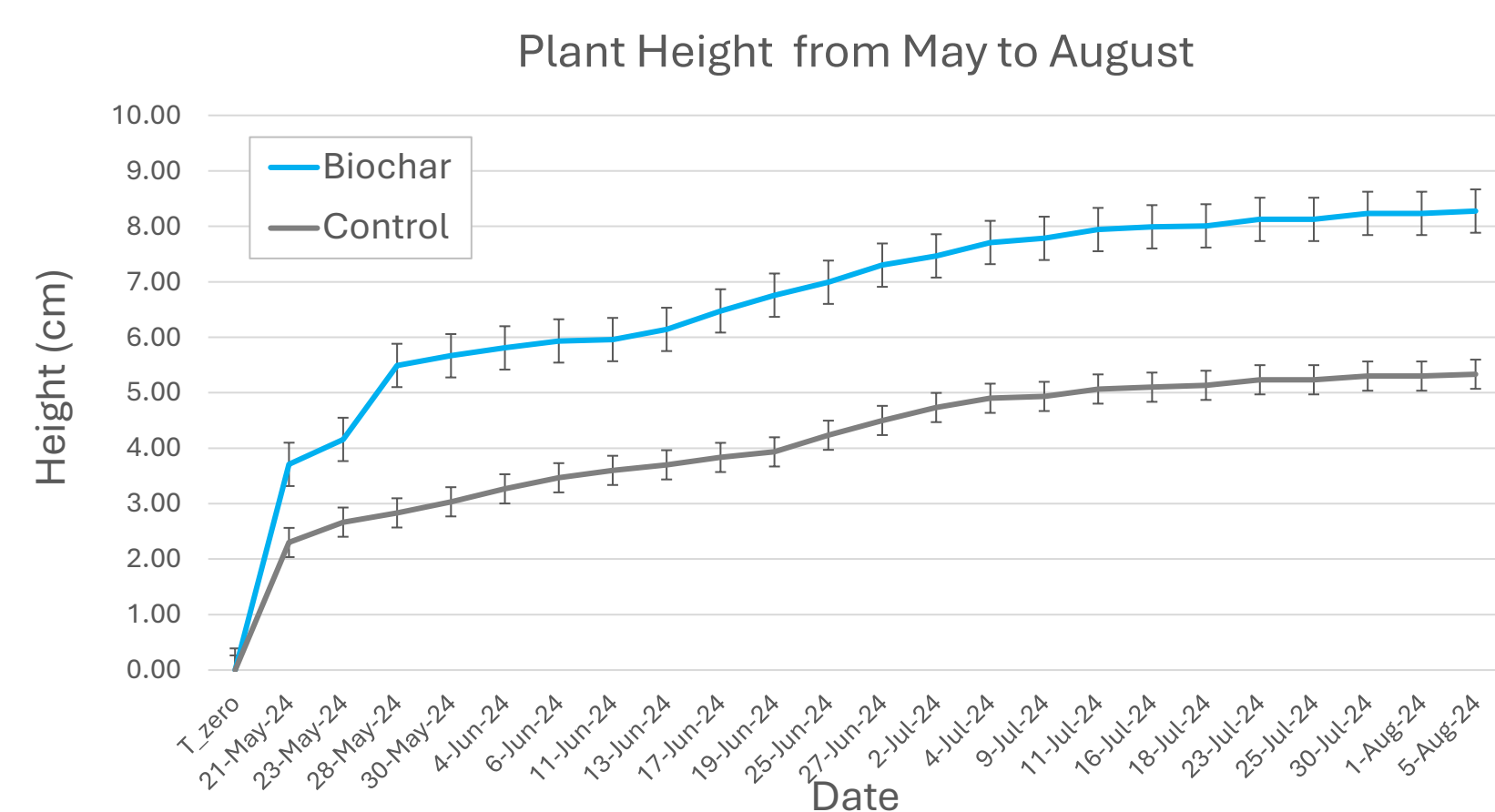
Compared to untreated plants, biochar-treated plants:

- Grew taller
- Flowered earlier and longer
- Did not produce significantly more fruits

Scientific production and dissemination