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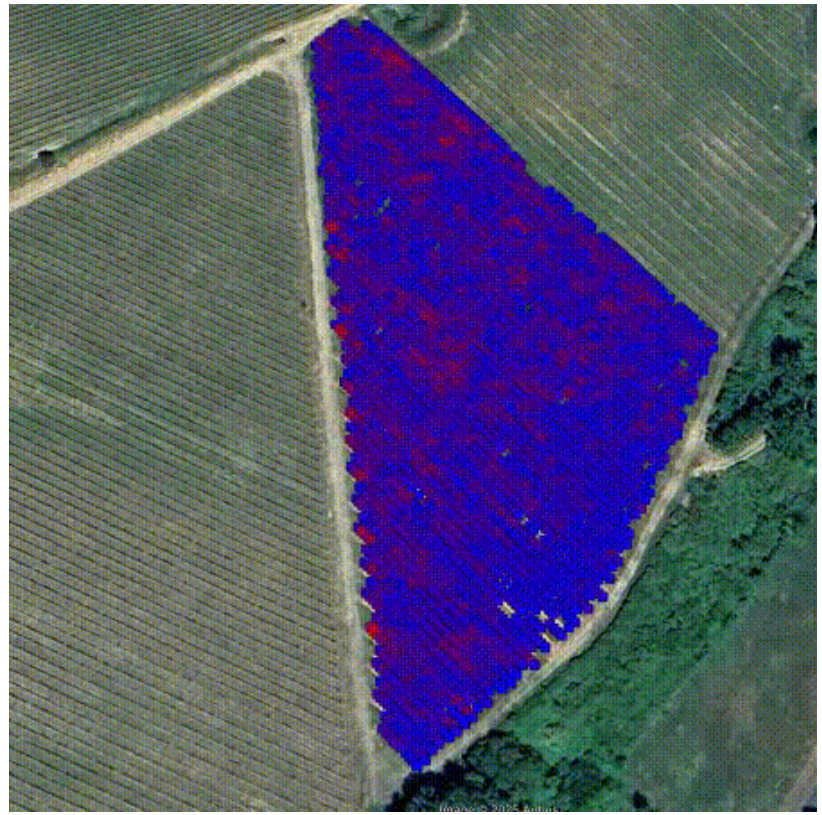
НИИ микроэлектронной аппаратуры

AG Digital Mapping

Based on Computer Vision and AI Algorithms



2025

Main Stages of Digital Mapping

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1. Data Collection

A video camera integrated with a GNSS navigation receiver is mounted on a drone or ground vehicle. Video data is collected, with each frame tagged with precise geodetic coordinates indicating its location.

2. Data Processing

The collected data is processed using computer vision algorithms and artificial intelligence (neural networks). This enables the identification of fruits, trellis supports, and signs of plant diseases (e.g., defects in fruits or leaves).

3. Mapping

Based on the processed data, the following maps can be created:

- Yield density map
- Yield map
- Problem area map for diseased plants
- Field inventory map for multiple plant varieties
- Early growth stage yield prediction
- Monitoring of trellis support structures in orchards and vineyards

Examples of Information Collection Systems

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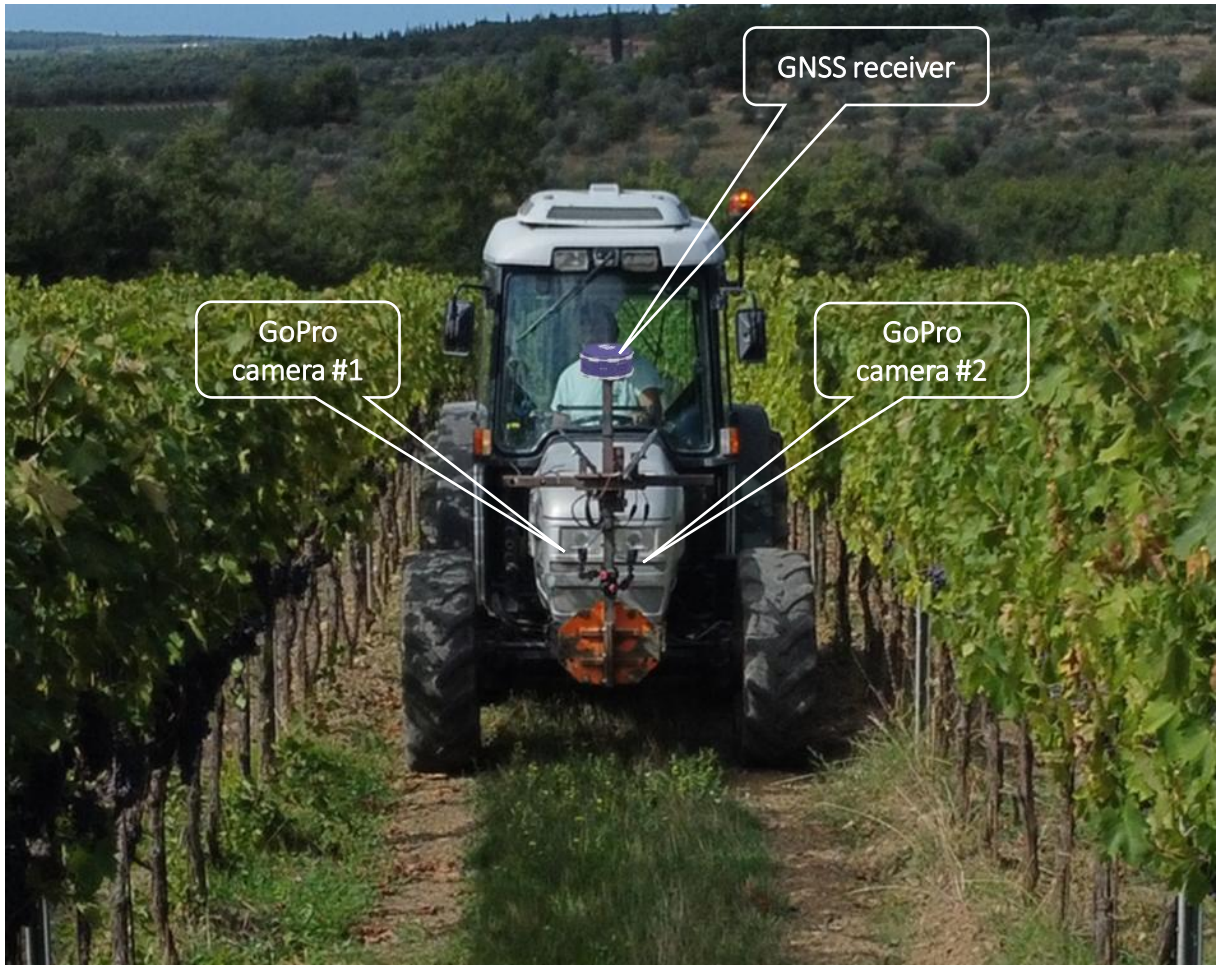

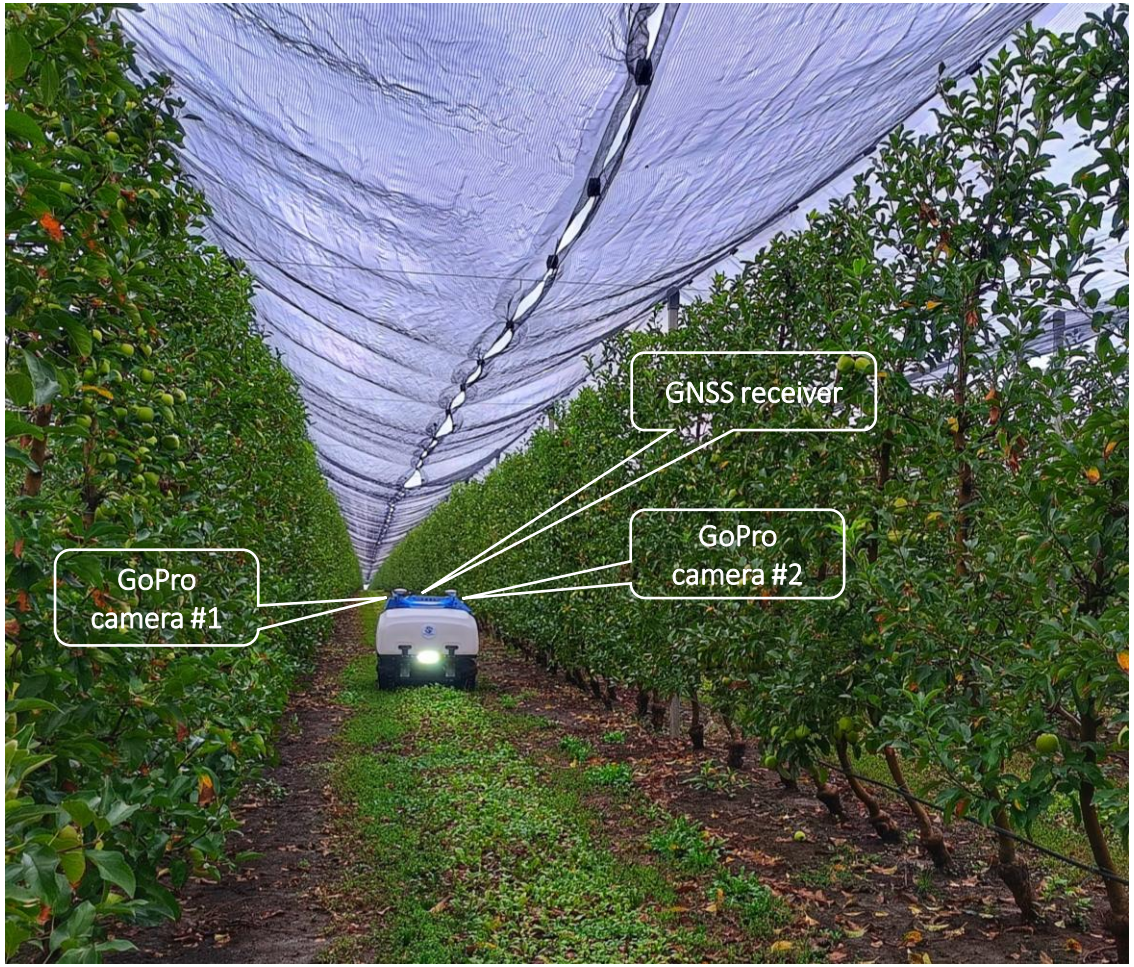

GoPro cameras are used to collect visual information.
A GNSS receiver is used as a source of geodetic position and vehicle orientation.

Processing Video Information Using Neural Networks
Examples of Fruit Detection and Segmentation

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Example of Neural Network Operation for Detection, Segmentation and Classification of Fruits

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Sorting grapes into healthy and defective

Determining apple varieties

Detection of a Sick or Defective Grape Bush by Leaves (Neural Network Analysis)

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Examples of a neural network used to identify diseased grape bushes and determine their geolocation.
Problem areas in the frame are marked with yellow squares.

Localization of Trellis Pillars
Assessment of Their Deviation from Vertical

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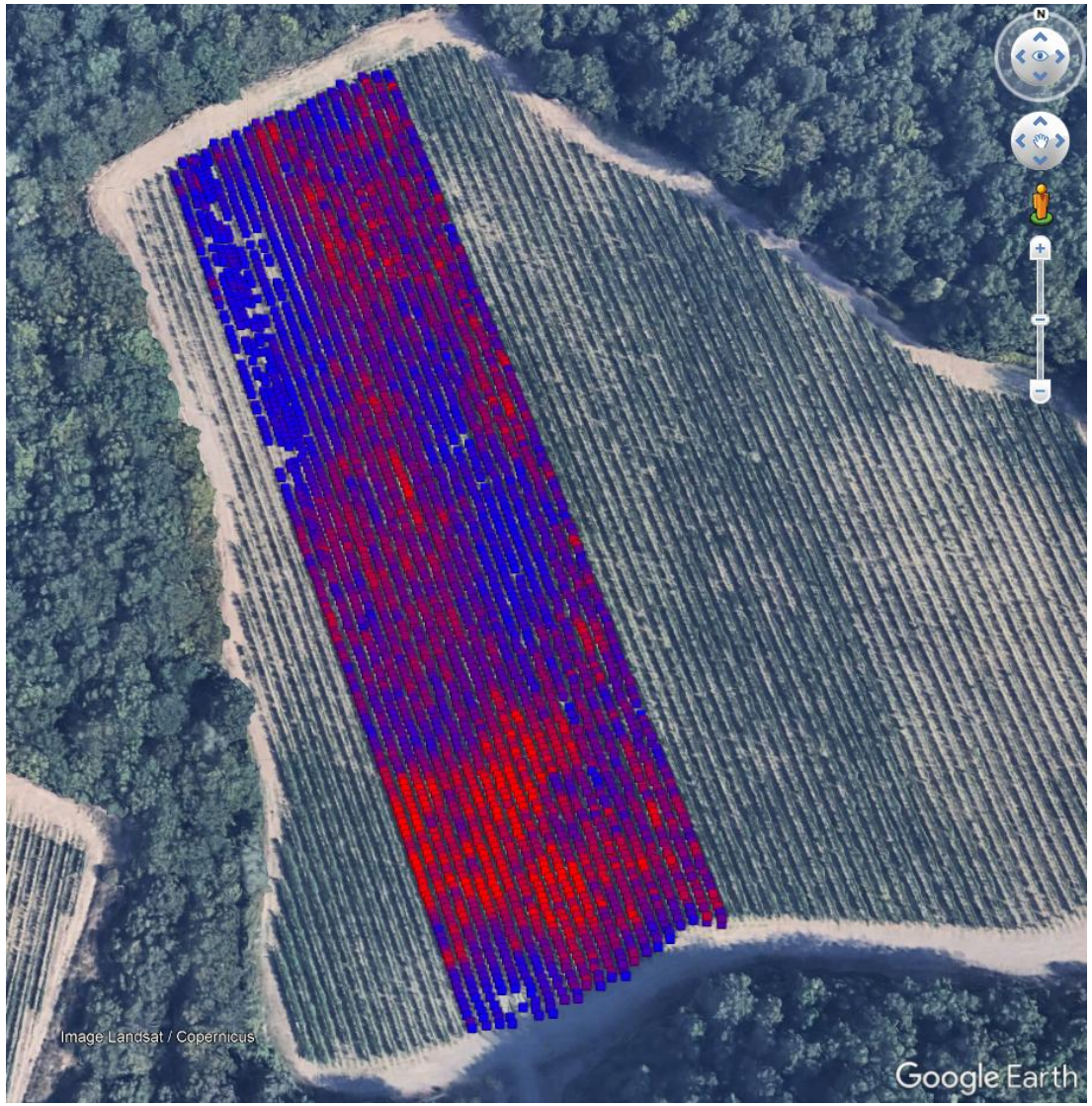
Deviation of a trellis support from the vertical can lead to negative consequences. It is important to regularly check the condition and verticality of trellis posts and, if necessary, repair or replace them. A method for detecting severely tilted supports using a computer vision system has been proposed.

GRAPE YIELD MAP



Red color – high grape yield, blue – low yield.

Total number of measurements:	3669 positions
Average grape yield:	64.2 q/ha
Average share of defective grapes:	0.4 q/ha
Percentage of defective products:	0.61%
Maximum grape yield:	202 q/ha
Total area of the polygon:	0.97 ha
Perimeter of the polygon:	485.6 m

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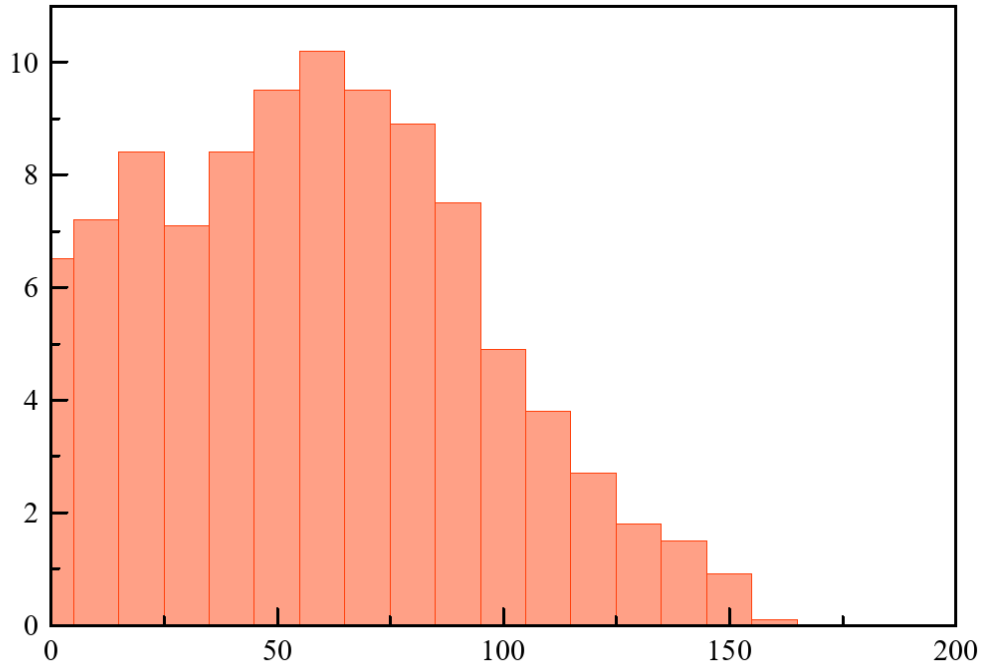
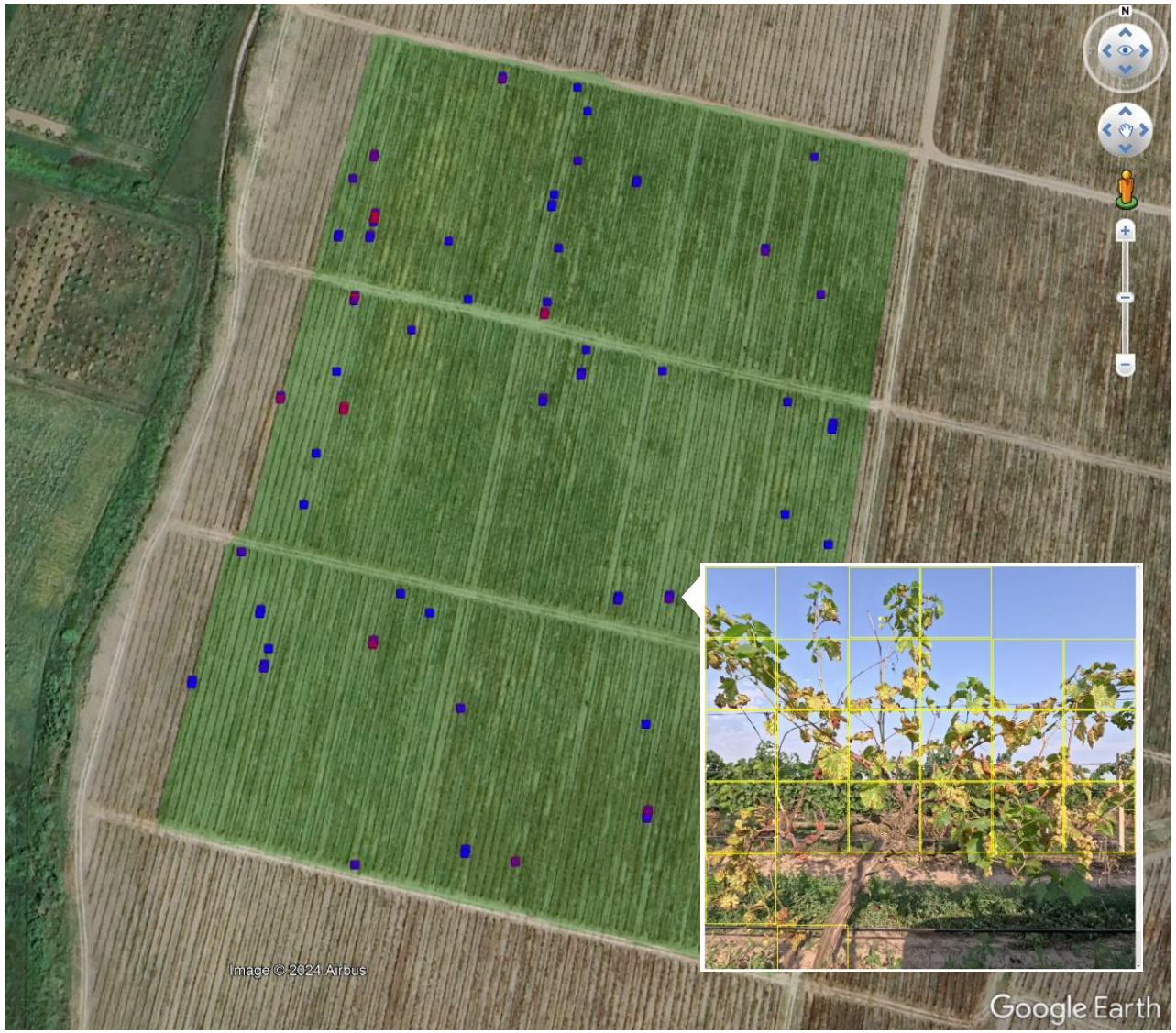
Grape yield histogram (q/ha)



VINEYARD DESIASES MAP



Map of diseased grape plant for three vineyard quarters (created based on the analysis of grape leaves using a neural network).

Map legend:
Red color - high degree of infestation,
blue - low degree of infestation,
unpainted areas - no bushes affected by the disease, or infestation is insignificant.
Photo confirmation is available for problem areas.

Total number of analyzed positions:	8779
Average intensity of diseased grapes:	0.83%
Maximum intensity of diseased grapes:	52.76%
Total area of the polygon:	6.95 ha
Perimeter of the polygon:	1079.9 m

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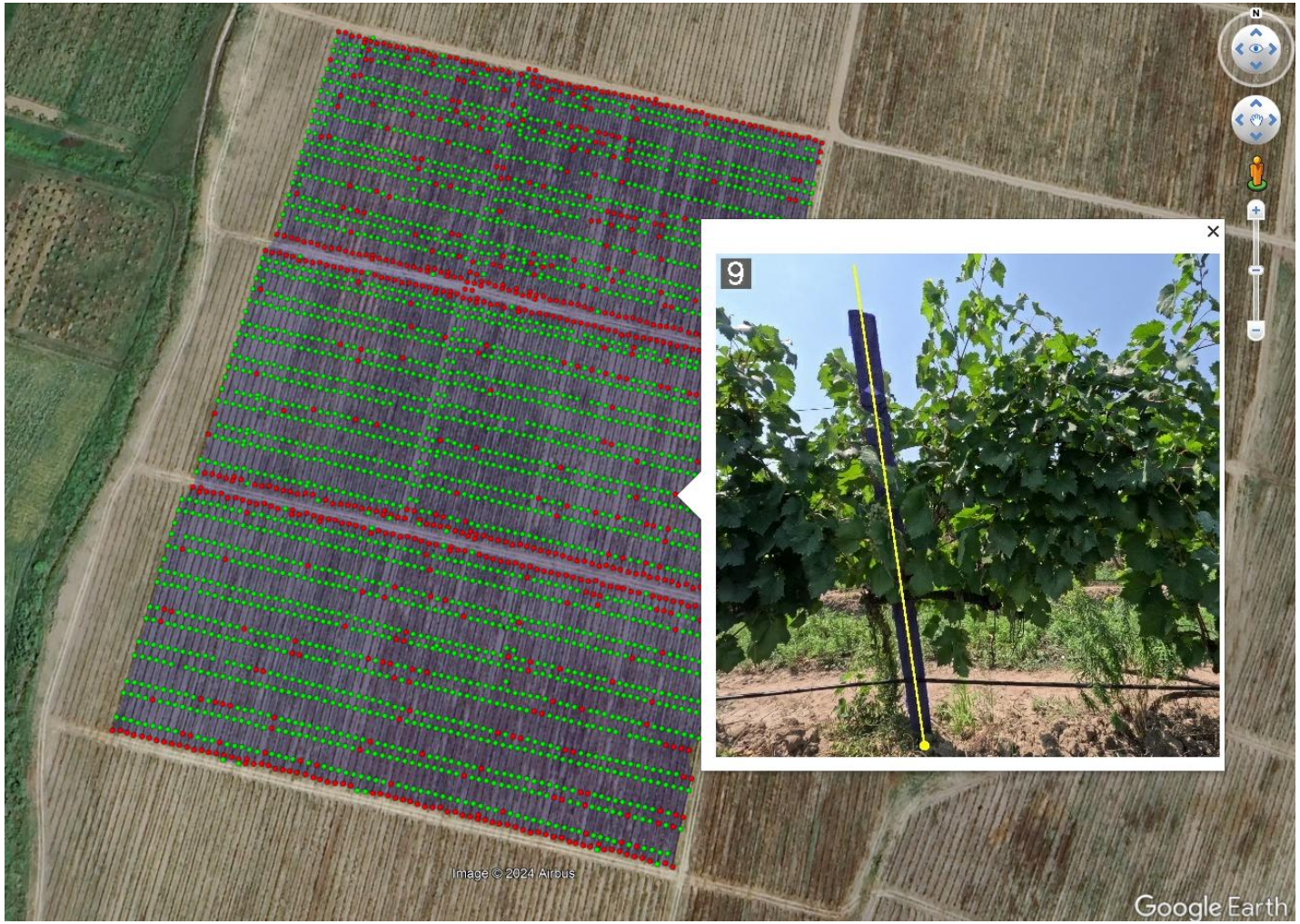
PILLARS MAP WITH THEIR INCLINATION INFORMATION



Map legend:
green color: vertical deviation of the pole is less than 5 degrees,
red color: vertical deviation of the pole is more than 5 degrees.

Each pillar marker contains information about its vertical deviation, for pillars with significant inclination – map data has photo confirmation.

Total number of trellis poles:	3449
Average deviation of a trellis pole:	5.7 degrees
Maximum deviation:	51.0 degrees
Total area of the polygon:	6.93 ha
Polygon perimeter:	1075.7 m

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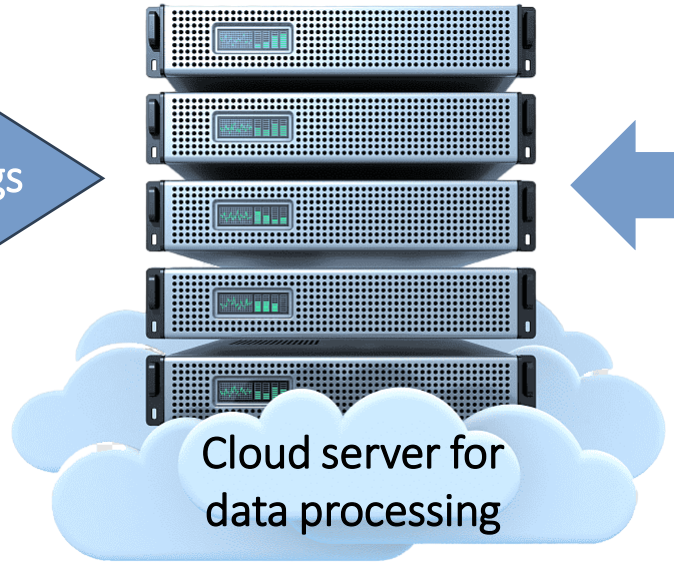
CLOUD SERVICE FOR DIGITAL MAPPING

Data collection for mapping

video & geotags



data

Data processing engineer

Agroholding Office

maps & tables

Implementation of cloud client/server interface (frontend) and data processing algorithms (backend)

MAPPING SYSTEM CAPABILITIES

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- Mapping trellis supports, crop density, and yield
- Crop volume forecasting for logistics and production planning
- Agricultural fruit quality assessment: determining the percentage of defective produce
- Early detection and localization of plant diseases to prevent their spread
- Flexibility in customizing the system for different classes of agricultural products: fruits, vegetables, and berries
- Generating reports, tables, and graphs in a format convenient for the customer

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