Development of a digital monitoring system for pear rust and fire blight in fruit orchards (MONIQUA)

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Phenotyping…

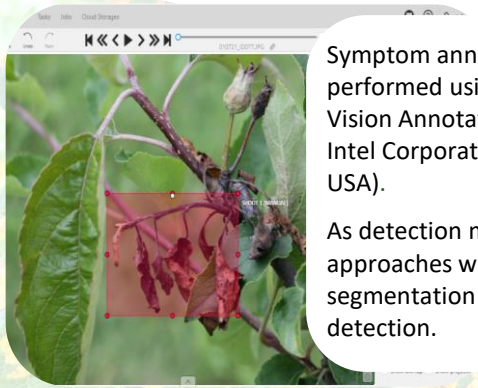
…is very labor- and cost-intensive

…is only possible for a selected number of fruit trees in a limited period of time

…varies often depending on the person

The **aim of the MONIQUA project** is the establishment of a digital monitoring system for the detection and localization of pathogens in fruit orchards.
For this, *Erwinia amylovora* (fire blight) and *Gymnosporangium sabinae* (European pear rust) are used as model pathogens.

Symptom annotation and detection model



Symptom annotation is performed using Computer Vision Annotation Tool (CVAT, Intel Corporation, California, USA).

As detection model two approaches will be tested: image segmentation and object detection.

GIS-assisted disease symptom localization

A digital elevation model (DEM) and an orthomosaic (DOP) is created using Agisoft Metashape Professional (Agisoft, St. Petersburg, Russia). Then, single symptoms will be localized to single specific trees.

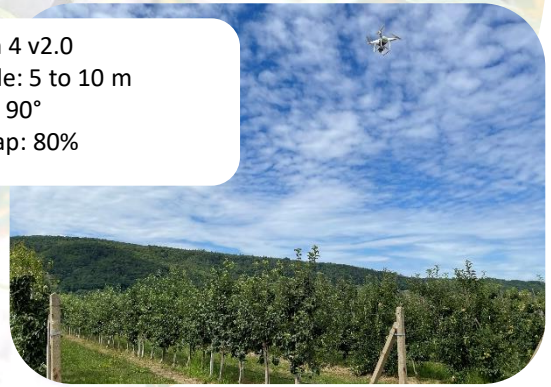
Generation of training and test image data

RGB images of fire blight symptoms were captured after artificial inoculation in the experimental orchard and in the greenhouse.

RGB images of different stages of European pear rust symptoms were captured after natural infection in the field.

UAV platform and flight parameters

DJI Phantom 4 v2.0
Flight altitude: 5 to 10 m
Gimbal: 45°- 90°
Image overlap: 80%



Preliminary results

Over 800 training images with fire blight and pear rust symptoms were captured and over 84,000 annotations were made. Different image qualities of different camera devices support the robustness of the detection model.

Using ResNet segmentation detection, the overall accuracy was highest for a CropSize of 100x100 px (recall = 0.89).

For GIS-based localization of disease symptoms, 3D point clouds were created and real coordinates were assigned to the symptoms.

Outlook

A TensorFlow-based object detection with a pre-trained YOLO ver.3 and ver.5 algorithm should be adapted, which allows the clear identification of each symptom in an image and the subsequent quantification of disease symptoms.

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