

Sustainable Revolution in Vineyard Management: MAIWY's Potential for Pests Detection and Disease Significant Pesticide Reduction



Name of the Organisations Involved

• MAIWY, Germany

Challenges Identified

Due to climate change and global warming, new variants of vine leaf diseases caused by bacteria, fungi, and insects have steadily been increasing in the last few years. This has led to a large-scale prophylactic usage of pesticides in vineyards and to pest control in case of infestation. 60% of all fungicides are applied in vineyards, despite the fact that vineyards cover only 3% of Europe's agricultural land. "Today, grapes are among the fruits most heavily contaminated with toxic pesticides," says chemical expert Manfred Krautter of Greenpeace. Or in other words: With a 750 ml bottle of wine, we consume one teaspoon of pesticide residues. Not only the wine but also grape juice, other grape products, and grapes themselves contain pesticide residues.

But why is the pesticide usage in the vineyard so immense?

Until a grapevine yields grapes, it needs to grow for at least 3 years, but protection against pest infestation starts with planting. Since grapevines are planted in short distances, pests can spread easily to neighboring plants.

Winegrowers want to minimize the risk and therefore regularly apply large quantities of pesticides in the vineyards as a prophylactic measure. However, in recent years, awareness of the need for more sustainability and the protection of our habitat has grown significantly and the pressure on agriculture is increasing: In June 2022, the EU Commission suggested that pesticide use would be reduced by 50% in 2030. Why? There are some scientists who have studied the distribution, quantitative detection, and effects of pesticides on various organisms and biodiversity in detail. Pesticide residues are related to the incidence of various human diseases. Scientific studies show a link between pesticides and Parkinson's disease, childhood leukemia, and an increased risk of liver and breast cancer, asthma, allergies, and damage to the nervous system.

What is the current analysis of a vine disease?

This is currently a complex, multi-stage process: After an infested leaf has been detected and the winegrower needs expert help for the pest analysis, they often have to send the leaf to specialized institutes to conduct an exact pest analysis. While the winegrower waits for the result of the institute, the

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infestation can spread, which results in additional use/need of pesticides to combat the pest. To facilitate, speed up, and optimize vine leaf infestation and vine leaf deficiencies detection, we developed MAIWY.

Goals and solution

Our goal is to enable a significant reduction in the enormous use of pesticides in vineyards and preserve our environment. The vision of the app/AI is to detect leaf diseases and nutrient deficiency symptoms before they are visible to the human eye. The MAIWY team has developed a high-quality digital technology for reliable detection of vine leaf diseases, aiming to reduce pesticide usage by differentiating between vine leaf diseases using machine learning and analyzing the regional degree of leaf infestation spread. Building trust in new technologies and possibilities is an important aspect of their work.

Short description of the technology and the beneficiaries

MAIWY detects vine-leaf diseases using an AI algorithm on images taken with a smartphone.



It's easy to use and doesn't require extensive knowledge of vine-plant infections. If a sick plant is identified, MAIWY automatically offers treatment options. For preventative farming, MAIWY also provides a live map of detected diseases at or near the user's location.





MAIWY is available as a smartphone application, free to download from the Google Play Store or the App Store. It is designed to support winegrowers throughout the growth phase of vine-plants, starting at BBCH 11.

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Picture 2. MAIWY app, © MAIWY

Here's how it works: First, the winegrower or their employee takes a picture with a smartphone of a potentially infected vine-leaf. MAIWY supports offline usage directly in the vine fields. Then, MAIWY's algorithm predicts the disease and offers the user one or more treatment options without an internet connection. Additionally, the app creates a current local spread map, which is provided to the users, allowing for appropriate measures. The live map is available when the device MAIWY is installed on is connected to the internet. When connected, the user can upload the taken pictures to supply more data points to the live map.

Creation of value:

- The custom dataset created by MAIWY for their machine learning model is a unique and valuable asset, providing a significant competitive advantage for the app. The annotation was done by different vine disease experts.
- MAIWY has developed a machine learning model using TensorFlow and MobileNet for transfer learning based on an RGB image dataset created by their own team. The AI model achieves an accuracy of 96% in classifying 7 different grape leaf diseases.
- The number of active users continuously expands MAIWY's GPS and disease database.
- The model has been deployed to the Google Play Store and Apple App Store, with over 2.5 thousand scans and 760 free app downloads to date.

Actions taken

First, the MAIWY team created an annotated dataset containing over 7,000 images capturing various vine leaf diseases using different mobile phones. However, to achieve high accuracy with the app, it became evident that the team needed to expand their data resources. To address this, they applied data augmentation algorithms to enrich their training dataset. With this database, the MAIWY team was able to construct, train, and validate a machine learning model that runs directly on the device and achieves a 96% accuracy rate. The decision to use edge computing is preliminary due to the limited mobile cellular coverage within vineyard areas.

Integrating the model seamlessly into an app interface facilitates real-time communication with their server. This integration allows them to collect location data and image data from scans. The MAIWY team provided this version of the MAIWY app to winegrowers, giving them the opportunity to test its

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functionality and enabling the team to gain valuable insights and identify potential challenges. In the meantime, the MAIWY team has also created an improved UI and diversified their dataset.

Benefits and Impact

MAIWY was created with all winegrowers in mind, also non-commercial and part-time winegrowers since no prior pest infestation knowledge is required to use MAIWY. Additionally, even without an internet connection, winegrowers can stay informed and can intervene promptly without losing time for analysis.

With the MAIWY app, winegrowers can take early and appropriate measures to prevent the large-scale spread of diseases or deficiencies by utilizing the provided MAIWY live map of infected plants, thereby safeguarding their yield.

Full-time farmers could potentially save money on plant treatment measures. By identifying infested plants, pesticides can be applied more precisely. Overall, this saves both, money and time, for farmers. Reduction of pesticide usage is beneficial for our whole environment since the residues spread via land, water and air and the grape products are healthier for their consumers.

The MAIWY app is used internationally, as seen on the local spread map.

MAIWY was developed and will be continuously trained in future for a very early detection of pest infestation – a detection method before the pests are perceptible to the human eye. Additionally, the MAIWY developer team plans to explore other disease tracking possibilities - such as via satellites.

User Feedback and Interviews: <u>https://www.maiwy.com/english/feedback</u>

Contact information

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Application area

Digital Technology in the Value Chain ⊠ Supply Chain Management

Digital Technologies ⊠ Artificial Intelligence

🗵 Big Data

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