



# MOBILE APPLICATION FOR DETECTING SOME WHEAT PATHOGENS USING AI

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**Abstract:** The study aimed to develop an application for the recognition of five pathogens in wheat culture based on artificial intelligence (AI). Five pathogens in wheat cultivation were studied : *Blumeria graminis*, *Pyrenophora tritici repentis*, *Puccinia recondita*, *Puccinia striiformis* and *Puccinia graminis*. A data set of 323 images with pathogens studied in wheat culture was used. In order to train the ML model we have applied several methods on our dataset, such as data augmentation, optimizers and loss function. The model was evaluated in 2 different ways : Class Activation Map visualization and confusion matrix. The model correctly predicted in a percentage of 88.4% for *Puccinia striiformis*, 72.03% for *Puccinia recondita* and 94.67% for *Blumeria graminis*.

## • Introduction

Artificial intelligence is an area of computer science that highlights the creation of intelligent machines that work and react like humans (TECHOPEDIA).

Among the most important branches of Artificial Intelligence, Machine Learning (ML), Neural Network (NN), Natural language processing (NLP), Expert system (ES), Fuzzy Logic, Vision, Speech, Planning, Robotics, are considered with applications in different fields (MISHRA et al., 2016; RAI and CHATTERJEE, 2020; SCOLTIS et al., 2020).

Machine learning (ML) has already shown a special interest in agriculture, providing opportunities for the operationalization of large databases, in the development of intelligent and high-performance agro-technologies (LIAKOS et al., 2018). Machine learning was also used to study stress tolerance in wheat (MOGHIMI et al., 2018), the localization of compounds in plants (ZHANG et al., 2018), molecular plant biology (SILVA et al., 2019), biotechnology and plant breeding (NIAZIAN and NIEDBALA, 2020) etc.

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The present study aimed to develop an application for the recognition of five pathogens in wheat culture.

## • Material and method

In order to develop the application for the recognition of the symptoms of five foliar pathogens of cereals, a set of images taken in the experimental fields established on the territory of SDT of USAMVB Timisoara was used. The first step in building the data set to train the ML model was to augment the data. Data augmentation means increasing the number of data through known changes, which make sense in the context of training and help the model to be more robust.

Machines learn through a loss function. It is a method of evaluating the way in which specific algorithms model the given data. If the predictions deviate too much from the actual results, the train loss function would show a very large number. Gradually, with the help of an optimization function, the network learns to reduce the loss function that is the error in prediction, changing its parameters.

There is no "one-size-fits-all" data loss function for algorithms in ML. There are different factors involved in choosing a loss function for a specific problem, such as the type of ML algorithm chosen, the ease of calculating the derivatives and, to some extent, the percentage of exaggerated values in the data set. The default loss function used is FlattenedLoss of CrossEntropyLoss.

Data is at the heart of any Machine Learning problem. In recent years, steps taken using AI would not have been possible without access to relevant data. The data used for this study were accessed from the database of the discipline of phytopathology (COTUNA, 2017).

## • Results and discussions

The application for the recognition of some diseases from cereal crops was initially thought to be able to recognize five foliar diseases that occur in wheat crops. Of course, there is a possibility to develop this application in such a way that it can recognize all the diseases that occur in cereals and many more. The images used were made in the experimental fields of USAMVB Timisoara, Phytopathology discipline.

The results obtained are good, encouraging. As described in the Material and Method chapter, results were obtained based on the trained model, some of which are presented and discussed below.

Test image for *Puccinia striiformis*. As can be seen in the picture, the model predicts 88.4% that the disease present on the leaves is *Puccinia striiformis*.



Test image for *Puccinia recondita* is shown in the figure 7. It can be seen in the image that the model predicts with an accuracy of 72.03% that the disease on the leaves is *Puccinia recondita*.



Test image for *Blumeria graminis* is shown in the figure 8. As in previous situations, the model predicts with an accuracy of 94.67% that the disease on the leaves is *Blumeria graminis*



## • Conclusions

We can say that the developed application works well, being able to recognize with a fairly high accuracy the pathogens for which it was created. On the other hand, however, its testing was not carried out in field conditions, as it was in the prototype stage.

We are certainly just starting out, the application will be developed, but we believe that the use of artificial intelligence for this kind of problem should be encouraged, by facilitating access to various information such as some databases.

The model correctly predicted in a percentage of 88.4% for *Puccinia striiformis*, 72.03% for *Puccinia recondita* and 94.67% for *Blumeria graminis*. For the remaining 2 pathogens we are still developing our model.

Also, the application can be adapted for other studies at the level of the leaf surface of the plants, or at the level of agricultural crops.

