Background search and related work - Plant disease detection using images

Igor Fontes and João Pedro Brito

April 28, 2022

Abstract

Agriculture is the basis of every economy worldwide. However, solving crop production problems related to plant diseases is one of the major factors affecting domestic market condition in any country. This report provides a general view of recent imaging techniques for plant disease classification and State of The Art (SOTA) proposals. Due to the large variability of crops and plant diseases, a lot of methods explore machine learning algorithms to solve problems related to specific types of fruit or vegetable and its possible diseases.

1 Journal papers

Due to recent advances in deep learning, traditional methods typically applied to image classification problems were substituted by neural network and support vector machine approaches. Different image representations and processing are also explored in the field of plant disease classification using leaf images. Systematical reviews and surveys give a general summary of advances and limitations in this area.

1. A review of imaging techniques for plant disease detection [SSS20]

   In recent time major work is being done for the identification of plant disease presents in varied parts of the world affection varied crops. Major work is being done in the domain of identification of causing factors of these diseases. Some of the diseases are marked by the presence of viruses while some are resultant of fungal infection. This becomes a major issue when the causing factor is not traceable before it has already spread to major production section. This paper brings a review on effective use of different imaging techniques and computer vision approaches for the identification and classification of plant diseases. Detection of Plant disease is initiated with image acquisition followed by pre-processing while using the process of segmentation. It is further accompanied by different techniques used for feature extraction along with classification. In this Paper we present the Current Trends and Challenges for detection of plant disease using computer vision and advance imaging technique.

2. Detection and classification of citrus diseases in agriculture based on optimized weighted segmentation and feature selection [SKI+18]

   This article proposes a hybrid method for detection and classification of diseases in citrus plants. The proposed method consists of two primary phases; (a) detection of lesion spot on the citrus fruits and leaves; (b) classification of citrus diseases. The citrus lesion spots are extracted by an optimized weighted segmentation method, which is performed on an enhanced input image. Then, color, texture, and geometric features are fused in a codebook. Furthermore, the best features are selected by implementing a hybrid feature selection method, which consists of PCA score, entropy, and skewness-based covariance vector. The selected features are fed to Multi-Class Support Vector Machine (M-SVM) for final citrus disease classification. The proposed technique is tested on Citrus Disease Image Gallery Dataset, Combined dataset (Plant Village and Citrus Images Database of Infested with Scale), and a private collected images database. The proposed technique outperforms the existing methods and achieves good classification accuracy. A good advance is the study of the fruits surface image instead of their leaves.

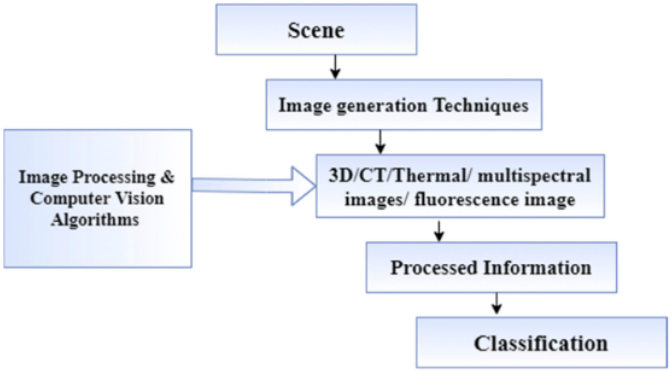

Figure 1: General view of a plant image classification

Figure 2: Sample image - Citrus disease identification

3. Review of the state of the art of deep learning for plant diseases: a broad analysis and discussion [HYA20]

   Recently, many DL architectures have been implemented accompanying visualisation techniques that are essential for determining symptoms and classifying plant diseases. This review investigates and analyses the most recent methods, developed over three years leading up to 2020, for training, augmentation, feature fusion and extraction, recognising and counting crops, and detecting plant diseases, including how these methods can be harnessed to feed deep classifiers and their effects on classifier accuracy.

2 Conference papers

1. Plant Disease Detection Using Machine Learning [RHN+18]

   This paper includes various phases of implementation namely dataset creation, feature extraction, training the classifier and classification. The created datasets of diseased and healthy leaves are collectively trained under Random Forest to classify the diseased and healthy images. For extracting features of an image we use Histogram of an Oriented Gradient (HOG). Overall, using machine learning to train the large data sets available publicly gives us a clear way to detect the disease present in plants in a colossal scale.

2. A color and texture based approach for the detection and classification of plant leaf disease using KNN classifier [HHR19]

   This paper proposed a technique for plant leaf disease detection and classification using K-nearest neighbor (KNN) classifier. The texture features are extracted from the leaf disease images for the classification. In this work, KNN classifier will classify the diseases like alternaria alternata, anthracnose, bacterial blight, leaf spot, and canker of various plant species. The proposed approach can successfully detect and recognize the selected diseases with 96.76 % accuracy.

3. Diseases Detection of Cotton Leaf Spot Using Image Processing and SVM Classifier [BT18]

   This proposed work presents a system using simple image processing approach for automatic diagnosis of cotton leaf diseases. Classification based on selecting appropriate features such as

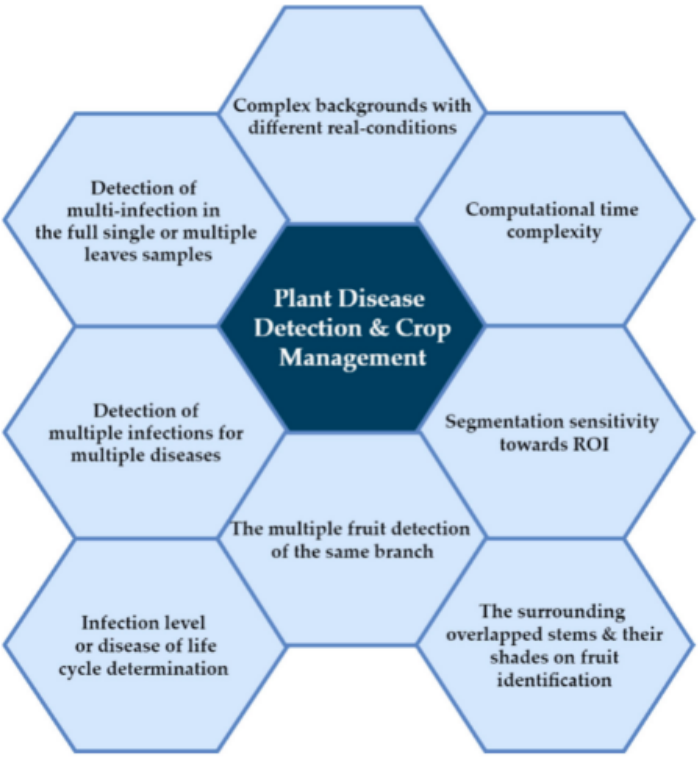

Figure 3: Main challenges and proposals - Plant disease detection

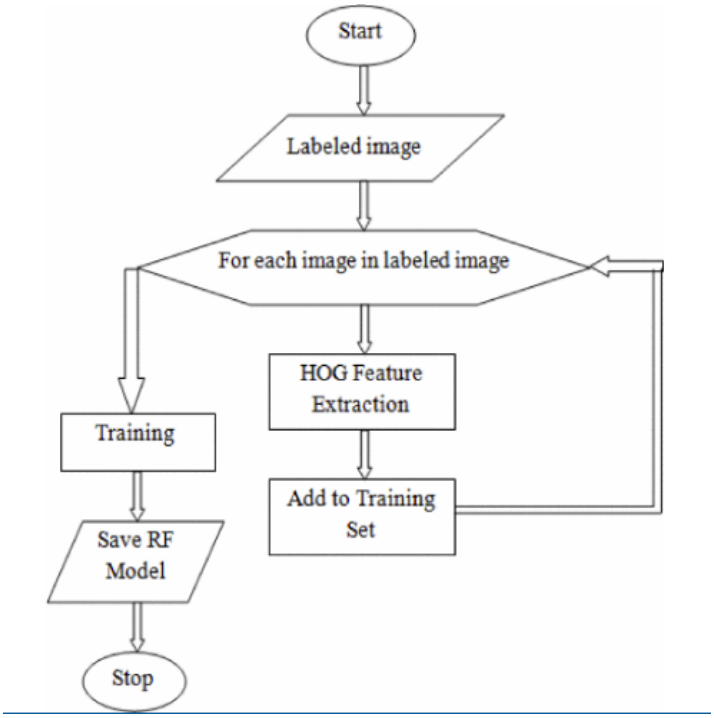

Figure 4: Flow chart for training

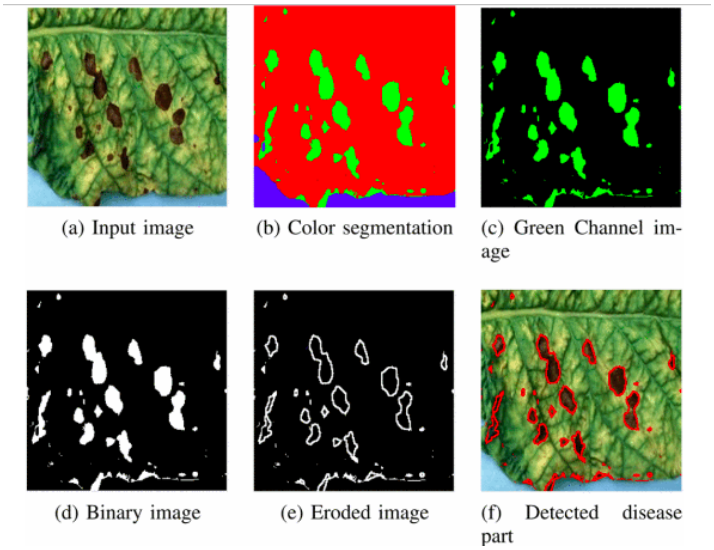

Figure 5: Steps of plant leaf disease detection

color, texture of images done by using SVM classifier. The images are acquired from cotton fields using a digital camera. Various preprocessing techniques as filtering, background removal, enhancement are done. Colour-based segmentation is done to obtain the diseased segmented part from the cotton leaf. Segmented image is used for feature extraction. However, the model is limited to cotton disease identification and it is not tested using other scenarios.

4. Image based Plant Disease Detection in Pomegranate Plant for Bacterial Blight [DAK+19]

   This paper focus on a particular disease that appears in Pomegranate plants. The disease detection process involves steps like image acquisition, image pre-processing, image segmentation, feature extraction, object recognition and classification. Based on the output obtained from the above mentioned criteria's, the disease with which the plant affected is observed. This paper discussed the method used for the detection of the plant diseases using their image.

5. Plant Disease Detection Using CNN [SDDD20]

   This study provides insights into an overview of the plant disease detection using different algorithms. A CNN based method for plant disease detection has been proposed to increase performance. Different from previous work, this paper attempts a more general approach with a restricted number of plant classes. Simulation study and analysis is done on sample images in terms of time complexity and the area of the infected region. It is done by image processing technique. A total of 15 cases have been fed to the model, out of which 12 cases are of diseased plant leaves namely, Bell Paper Bacterial Spot, Potato Early Blight, Potato Late Blight, Tomato Target Spot, Tomato Mosaic Virus, Tomato Yellow Leaf Curl Virus, Tomato Bacterial Spot, Tomato Early Blight, Tomato Late Blight, Tomato Leaf Mold, Tomato Septoria Leaf Spot and Tomato Spider Mites and 3 cases of healthy leaves namely, Bell Paper Healthy, Potato Healthy and Tomato Healthy. Test accuracy is obtained as 88.80%. Different performance matrices are derived for the same.

6. Unsupervised Convolutional Autoencoder-Based Feature Learning for Automatic Detection of Plant Diseases [PSSZ18]

   From the data, the work design discriminative features that are good for diseases classification. However, finding suitable features from the images are often challenging due to high intra-variability and inter-variability of the data. In this paper, the authors present an unsupervised feature learning algorithm using the convolutional autoencoder for detection of plant diseases. The approach focus on the classifier, but image processing and filtering are not explored.

7. Detection and classification of groundnut leaf diseases using KNN classifier [VDSJ19]

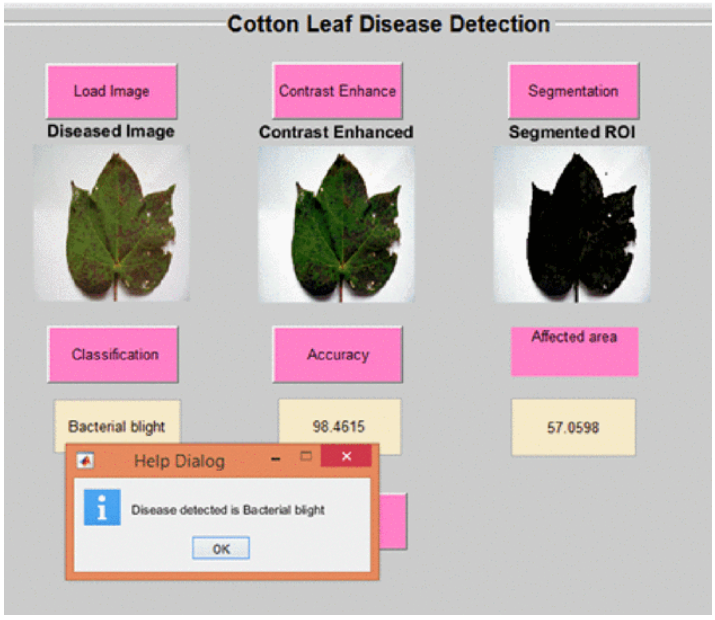

Figure 6: Toolbox showing result bacterial blight is detected in a cotton leaf

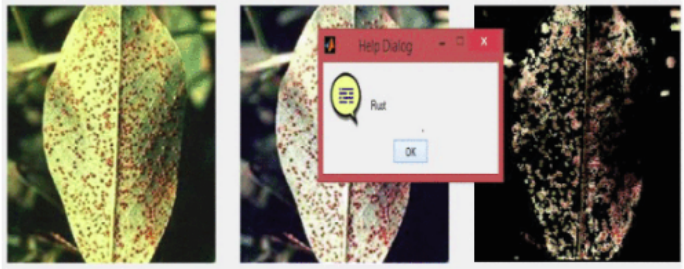

Figure 7: Rust

This paper discusses a technique for the early determination of disease such as in groundnut plant leaves. This method will improve production of crops. It comprises of number of steps viz. image acquisition, image pre-processing, segmentation, features extraction and classifier using K Nearest Neighbor (KNN).

8. Plant Disease Detection Using Hyperspectral Imaging [MWG+17]

   This paper proposes the use of hyperspectral imaging (VNIR and SWIR) and machine learning techniques for the detection of the Tomato Spotted Wilt Virus (TSWV) in capsicum plants. Discriminatory features are extracted using the full spectrum, a variety of vegetation indices, and probabilistic topic models. These features are used to train classifiers for discriminating between leaves obtained from healthy and inoculated plants. The results show excellent discrimination based on the full spectrum and comparable results based on data-driven probabilistic topic models and the domain vegetation indices. Additionally our results show increasing classification performance as the dimensionality of the features increase.

9. Plant Disease Detection and Diagnosis using Deep Learning [RSSV+22]

   This paper explores a more complex data analysis using a methodology that consists of using the Convolutional Neural Network (CNN) to identify and diagnose plant diseases such as Measles, Scabies, Earlyblight, Leafscorch and Bacterialspot.

10. Plant Disease Detector [Kam18]

    The objective of this paper is the development of a mobile application capable of automatically

detecting diseases in plants through image processing techniques with the objective of providing fast, accurate, easy-to-use and inexpensive solutions to farmers.

References

[BT18] Namrata R. Bhimte and V. R. Thool. Diseases detection of cotton leaf spot using image processing and svm classifier. In *2018 Second International Conference on Intelligent Computing and Control Systems (ICICCS)*, pages 340–344, 2018.

[DAK+19] Sharath D.M., Akhilesh, S. Arun Kumar, Rohan M.G., and Prathap C. Image based plant disease detection in pomegranate plant for bacterial blight. In *2019 International Conference on Communication and Signal Processing (ICCSP)*, pages 0645–0649, 2019.

[HHR19] Eftekhar Hossain, Md Farhad Hossain, and Mohammad Anisur Rahaman. A color and texture based approach for the detection and classification of plant leaf disease using knn classifier. In *2019 International Conference on Electrical, Computer and Communication Engineering (ECCE)*, pages 1–6. IEEE, 2019.

[HYA20] Reem Ibrahim Hasan, Suhaila Mohd Yusuf, and Laith Alzubaidi. Review of the state of the art of deep learning for plant diseases: a broad analysis and discussion. *Plants*, 9(10):1302, 2020.

[Kam18] Jagadish Kashinath Kamble. Plant disease detector. In *2018 International Conference On Advances in Communication and Computing Technology (ICACCT)*, pages 97–101, 2018.

[MWG+17] Peyman Moghadam, Daniel Ward, Ethan Goan, Srimal Jayawardena, Pavan Sikka, and Emili Hernandez. Plant disease detection using hyperspectral imaging. In *2017 International Conference on Digital Image Computing: Techniques and Applications (DICTA)*, pages 1–8, 2017.

[PSSZ18] Hilman F Pardede, Endang Suryawati, Rika Sustika, and Vicky Zilvan. Unsupervised convolutional autoencoder-based feature learning for automatic detection of plant diseases. In *2018 International Conference on Computer, Control, Informatics and its Applications (IC3INA)*, pages 158–162. IEEE, 2018.

[RHN+18] Shima Ramesh, Ramachandra Hebbar, M Niveditha, R Pooja, N Shashank, PV Vinod, et al. Plant disease detection using machine learning. In *2018 International conference on design innovations for 3Cs compute communicate control (ICDI3C)*, pages 41–45. IEEE, 2018.

[RSSV+22] R.Senthil Kumar R, Amarjeeth Singh, Hema Jaisree S V, Aishwarya D, and J S Jayasree. Plant disease detection and diagnosis using deep learning. In *2022 International Conference for Advancement in Technology (ICONAT)*, pages 1–6, 2022.

[SDDD20] Garima Shrestha, Deepsikha, Majolica Das, and Naiwrita Dey. Plant disease detection using cnn. In *2020 IEEE Applied Signal Processing Conference (ASPCON)*, pages 109–113, 2020.

[SKI+18] Muhammad Sharif, Muhammad Attique Khan, Zahid Iqbal, Muhammad Faisal Azam, M. Ikram Ullah Lali, and Muhammad Younus Javed. Detection and classification of citrus diseases in agriculture based on optimized weighted segmentation and feature selection. *Computers and Electronics in Agriculture*, 150:220–234, 2018.

[SSS20] Vijai Singh, Namita Sharma, and Shikha Singh. A review of imaging techniques for plant disease detection. *Artificial Intelligence in Agriculture*, 4:229–242, 2020.

[VDSJ19] MP Vaishnnave, K Suganya Devi, P Srinivasan, and G Arut Perum Jothi. Detection and classification of groundnut leaf diseases using knn classifier. In *2019 IEEE International Conference on System, Computation, Automation and Networking (ICSCAN)*, pages 1–5. IEEE, 2019.