WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Improve Plant Health Using Machine Learning for Image-Based Plant Disease Detection

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ABSTRACT

Plant disease detection is a critical task in agriculture aimed at ensuring food security and sustainable crop production. This review provides an overview of recent advancements in techniques for plant disease detection, along with the challenges faced and future research directions. Here we have our newly developed "Improving Plant Health Using Machine Learning for Image Based Plant Disease Detection" System. The plant disease detection project aims to develop a system for identifying various plant diseases using image processing techniques and machine learning models, specifically Convolutional Neural Networks (CNNs). The project utilizes the New Plant Diseases Dataset available on Kaggle. By leveraging Django for the web framework and SQLite for the database, the system is designed to be both accessible and efficient for end-users, such as farmers and agricultural experts. The System aims to advance precision agriculture with a scalable and scalable solution to reduce the impact of plant diseases on crops.

Keywords: Machine Learning, Image Processing, Leaf Disease, Disease Identification, Food security.

1. INTRODUCTION

Plant diseases pose a significant threat to global food security and agricultural sustainability, leading to substantial crop losses worldwide. Traditional methods of disease diagnosis, relying on visual inspection by human experts or laboratory-based assays, are often labour intensive, time-consuming, and may lack accuracy, especially in large-scale agricultural settings. However, recent advancements in technology, particularly in the fields of computer vision, machine learning, spectroscopy, and sensor technology, have revolutionized the way plant diseases are detected and diagnosed. This introduction provides an overview of the importance of plant disease detection, the challenges associated with traditional methods, and the potential of modern techniques to address these challenges. We discuss the impact of plant diseases on agricultural productivity, the role of early detection in disease management strategies, and the need for automated, non-destructive, and scalable detection solutions. Furthermore, we highlight the growing interest in interdisciplinary research collaborations between agriculture, computer science, and engineering disciplines to develop innovative approaches for plant disease detection. Through this review, we aim to explore the current state-of-the-art techniques, identify challenges and limitations, and discuss future research directions in the field of plant disease detection.

2. LITERATURE REVIEW

1. Automated Image Capturing System for Deep Learning-based Tomato Plant Leaf Disease Detection and Recognition [1].

Publication Year: 2023

Author: Robert G. de Luna, Elmer P. Dadios, Argel A. Bandala [1].

Journal Name: International Conference on Advances in Big Data, Computing and Data Communication Systems Summary: Smart farming system using necessary infrastructure is an innovative technology that helps improve the quality and quantity of agricultural production in the country including tomato. Since tomato plant farming take considerations from various variables such as environment, soil, and amount of sunlight, existence of diseases cannot be avoided. The current advance computer system innovation made possible by deep learning that have cover the way for camera captured tomato leaf disease. This study developed the innovative solution that provides efficient disease detection in tomato plants. A motor-controlled image capturing box was made to capture four sides of every tomato plant to detect and recognize leaf diseases.

2. CNN based Leaf Disease Identification and Remedy Recommendation System[2].
Publication Year: 2023
Author: Sunku Rohan, Triveni S Pujar, Suma VR Amog Shetty, Rishabh F Tated [2].
Journal Name: IEEE conference paper Summary: Agriculture field has a high impact on our life. Agriculture is the most important sector of our Economy. Farmers are difficult to identify the leaf disease so they produce less production. Though, videos and images of leaves provide better view for agricultural scientists can provide a better solution. So that can solve the problem of related to crop disease [2]. It is required to note that if the productivity of the crop is diseased then, it has high risk of providing good nutrition [2]. Due to the improvement and development in technology where devices are smart enough to recognize and detect plant diseases.

3. Real-Time Detection of Apple Leaf Diseases Using Deep Learning Approach Based on Improved Convolution Neural Networks [3].
Publication Year: 2023
Author: Bin Liu, Peng Jiang, Yuehan Chen, Dongjian He, Chunquan Liang [3].
Journal Name: IEEE ACCESS
Summary: This paper contains five types of apple leaf disease that are, aria leaf spot, Brown spot, Mosaic, Grey spot, and Rust. That is affected in apple [3]. This paper used deep learning techniques to improved convolution neural networks (CNNs) for detection in apple leaf diseases [3]. In this paper, the apple leaf disease dataset (ALDD) is used, which consist complex images and laboratory images, and rest constructed via data augmentation and image annotation technologies to create new apple leaf disease detection model that uses deep-CNNs is by using Rainbow concatenation and Google Net Inception structure [3]. In testing dataset used 26,377 images of apple leaves disease, the proposed INAR- model is trained and then detect five common apple leaf diseases [3]. In the experimental results show that the INAR- SSD model realizes 78.80% detection performance, with a high-detection speed of 23.13 FPS [3].

4. Identification of plant leaf diseases using a nine-layer deep convolution neural network [4] Publication Year: 2023
Author: Geetharamani G., Arun Pandian J.
Journal Name: Computers and Electrical Engineering 76 (20)
Summary: In this paper, plant leaf disease identification using deep learning technique in convolution neural network (CNN). The Convolutional neural network model is trained using an than 39 different classes of open dataset of plant leaves diseases, and background images [4]. That contain six types of data augmentation methods and that are used for gamma correction, image flipping, principal component analysis (PCA) color augmentation, rotation, noise injection, and scaling [4]. Whole are notice that using data augmentation. That can increase the performance of the model. The model was trained using different training range of epochs, batch sizes and dropouts [4]. Then CNN is compared with transfer learning approaches, the proposed model achieves better result. When using the validation data [4]. Though simulation proposed model achieves 96.46% classification accuracy [4].

3. METHODOLOGY

BLOCK DIAGRAM

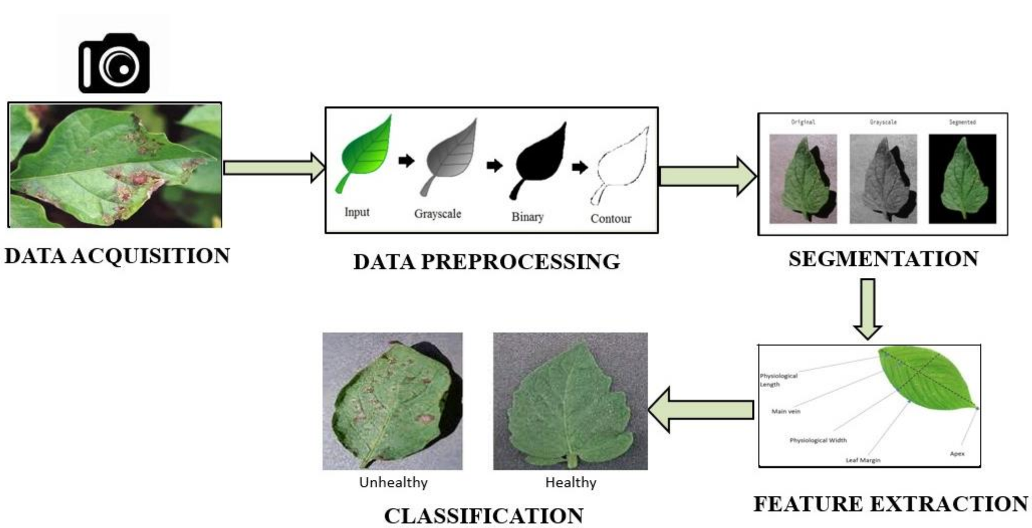

Fig 3.1: Block Diagram

1. **Problem Definition and Dataset Collection:**

• Define the problem scope, including the types of plant diseases to be detected and the target plant species.
• Collect a diverse dataset of images depicting healthy plants and various diseases affecting the target plant species.

2. **Data Preprocessing:**

• Preprocess the dataset by resizing images to a uniform size, normalizing pixel values, and augmenting data to increase diversity.
• Implement preprocessing techniques like rotation, flipping, and zooming to augment the dataset and enhance model generalization.

3. **Model Selection and Development:**

• Choose a suitable deep learning architecture, such as convolutional neural networks (CNNs), for image classification.
• Design the CNN model architecture with appropriate layers for feature extraction, including convolutional, pooling, and fully connected layers.

4. **Dataset Splitting:**

• Split the pre-processed dataset into training, and test sets, typically using an 80- 20 ratio.

5. **Model Training:**

• Train the CNN model on the training set using the training pipeline, including mechanisms for batch processing, data augmentation, and early stopping.
• Monitor the model's performance on the validation set to prevent overfitting and fine-tune hyperparameters as needed.

6. **Evaluation and Validation:**

• Evaluate the trained model's performance on the test set using metrics like accuracy, precision, recall, and F1-score.

Use Case Diagram

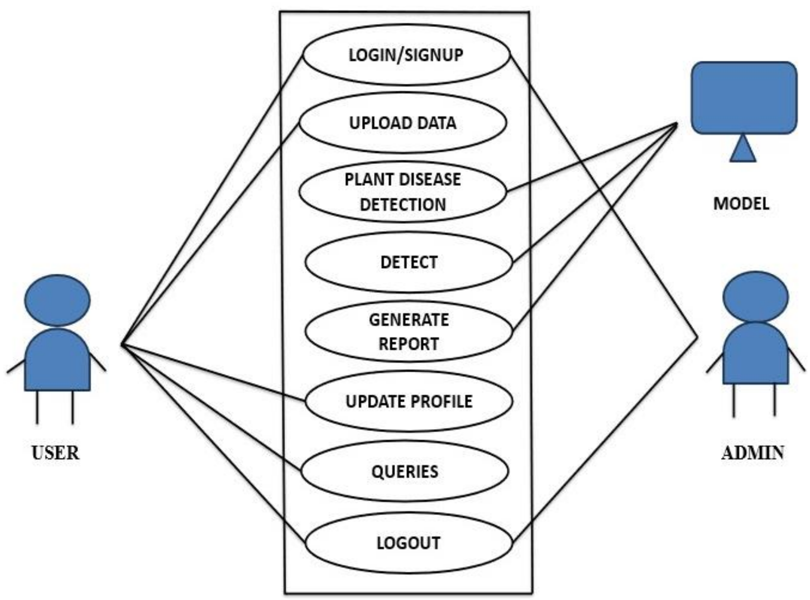

Fig 3.2: Use Case Diagram

Fig 3.2 shows A use case diagram for image-based plant disease detection using Convolutional Neural Networks (CNNs) illustrates the interaction between various actors and the system, highlighting the key functionalities and processes involved. In this scenario, the primary actors include the Farmer, Agricultural Expert, and System Administrator. The Farmer interacts with the system by capturing and uploading images of plants suspected to have diseases.

4. ALGORITHMS USED

Convolutional Networks (CNNs):

Convolutional Neural Network (CNN) is a type of deep learning algorithm that is especially suitable for image recognition and task processing. It consists of various parts, including assembly parts, connecting parts and complete parts. The architecture of CNNs is inspired by the processing of images in the human brain and is well-suited to capturing the texture and structure of images. The main components of the stable emotions network include:

• Solids: These layers apply a validation function to the input image using a filter (also known as a kernel) to detect features such as edges, shapes, and complexities. Validation functions help preserve the relationship between pixels. Maximum addition is a general combination operation that selects the maximum value in a group of adjacent pixels.

Support Vector Machines (SVM):

Support Vector Machine or SVM is one of the most popular learning control methods used in classification and regression problems. But it is mainly used in classification problems in Machine Learning. The purpose of the SVM algorithm is to create a thin line or decision boundary that can separate domain and class levels so that we can easily classify new data points into better classes in the future. The optimum decision boundary is called the hyperplane. SVM selects endpoints/partitions to help create a hyperplane. These edge cases are called supports, and the algorithm is called the support machine. See the diagram below where two different classes are implemented using a boundary layer or hyperplane.

Random Forest:

Random Forest is a popular machine learning algorithm for supervised learning. It can be used in both classification and regression problems in ML. It is based on the concept of ensemble learning, which is a method of combining multiple layers to solve a complex problem and improve model performance. As the name suggests, "A normal forest is a classifier that contains multiple decision trees for different parts of the dataset and takes an average of steps to refine the data." Rather than relying on a single decision tree, certainty forest takes predictions from each tree and predicts the final output based on multiple guessing games.

5 CONCLUSION

In this paper, survey on various techniques for Leaf Disease Detection is done. Image-based detection of plant diseases is a promising and innovative approach to revolutionize agriculture and improve crop management. This method uses advanced technologies such as computer vision and machine learning and offers several advantages such as early and accurate disease detection, rapid response to outbreaks and efficient use of resources. The ability to analyse vast amounts of visual data enables a comprehensive understanding of plant health, allowing growers to make informed decisions and implement targeted actions.

REFERENCES

[1] Robert G.de Luna, Elmer P. Dadios, Argel A. Bandala, "Automated Image Capturing System for Deep Learning-based Tomato Plant Leaf Disease Detection and Recognition," International Conference on Advances in Big Data, Computing and Data Communication Systems 2023.

[2] Suma VR Amog Shetty, Rishab F Tated, Sunku Rohan, Triveni S Pujar, "CNN based Leaf Disease Identification and Remedy Recommendation System," IEEE conference paper 2023.

[3] Peng Jiang, Yuehan Chen, Bin Liu, Dongjian He, Chunquan Liang, "Real-Time Detection of Apple Leaf Diseases Using Deep Learning Approach Based on Improved Convolution Neural Networks," IEEE ACCESS 2023.

[4] Geetharamani, Arun Pandian, "Identification of plant leaf diseases using a nine- layer deep convolution neural network," Computers and Electric Engineering 76 (2023).

[5] Md. Mafiul Hasan Matin, Mst. Arifa Anjum Ava, Md. Golam Moazzam khokan, Mohammad Shorif Uddin.A Dataset for Accurately Identifying Eggplant Diseases.SSRN,17 Nov 2023.

[6] M. Dhana Lakshmi, Bidush Kumar Sahoo, Rajendra Kumar Ganiya. Analysis of Cotton Leaf Curl Diseases Using Advanced Learning Model.

IJISAE, Vol. 12 No. (2023).

[7] Truong Quang Vinh, Tran Ba Thanh, Dang Hoang Viet. Tomato Disease Detection Using Quaternion Convolutional Neural Network. IEEE Xplore (2023).

[8] Drasko Radovanovic, Slobodan Đukanovic. Image-Based Plant Disease Detection: A Comparison of Deep Learning and Classical Machine Learning Algorithms. IEEE Xplore (2023).