Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 5, No.3, May : 2024

PEPPER LEAF DISEASE DETECTION USING RCNN IN DEEP LEARNING

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***Abstract*—-**
Pepper leaf disease using Region-based Convolutional Neural Networks (RCNN). RCNN model is an advanced deep learning framework that exhibits promising capabilities in object detection tasks as it effectively merges region proposal techniques with convolutional neural networks. With this study, we successfully adapt and optimize RCNN for the precise identification of pepper leaf disease. This paper works on detecting target objects within an image! It seamlessly combines selective search algorithms that propose potential object regions with convolutional neural networks, eventually enabling efficient and accurate identification. By utilizing this robust model, we increased accuracy score of 99% of the model's resilient performance in detecting disease in pepper leaf

***Keywords*—**
Pepper leaf blight disease, Real time detection, Region Based Convolutional Neural Network, Image Detection**.**

I. Introduction

Agriculture and farming are treated as a "waste of time" in the modern era. The major reason behind this is plant disease and natural calamities. Natural calamities can be considered as out of our box content whereas plant diseases can be determined and needed precautions can be taken for a better tomorrow. Here we are considering the case of Pepper plants. Most of the pepper plant disease can be detected by checking the plant leaves. [1] Usually seen diseases are Verticillium wilt, Damping off disease, Leaf spot, Mosaic virus etc. Manually analysing and detecting [2] will take time and is a difficult task. A deep learning algorithm is used to analyse the leaf and detect whether the leaf is defected or not and if defected, it determines which is the
disease. [3] With the advancements in technology, particularly in image processing and Deep learning, automated system for disease detection in pepper plants have gained traction. Traditional disease detection techniques are labour-intensive and prone to human error since they rely on visual inspection by agricultural specialists. Technological developments, especially in the fields of deep learning and image processing [4], have accelerated the creation of automated systems for the diagnosis of pepper plant diseases. Efficient disease detection and management strategies are essential for mitigating these detrimental effects. The output of traditional disease detection techniques, which mostly rely on visual inspection by agricultural specialists and can be labour-intensive and prone to human error. CNN simplifies the recognition problem and saves time because it is an end-to-end structure. The model can be implemented on a Farming sector and can easily monitor pepper plants there. The system collects and checks the matches with the training data to detect if defected. The final output is disease with remedies if defected.

II. Literature Survey

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Prior research in plant disease detection has predominantly focused on the application of deep learning techniques.
Singh, R et al. [5] Development of a Smartphone-Based Application for Pepper Plant Disease Diagnosis. 2021 IEEE Uttar Pradesh Section International Conference on Electrical, Computer and Electronics Engineering.
Lee, J., Kim et al. [6] Detection of Pepper Plant Diseases Using Convolutional Neural Networks and Learning.2022 IEEE International Conference on Consumer Electronics - Taiwan (ICCE).
Rathore et al. [7] Computer vision-based techniques for disease detection and classification in pepper plants A review. Computers and Electronics in Agriculture, 161, 280-292.
Singh et al. [8] This research focuses on the development of a smartphone-based application for diagnosing diseases in the pepper plants. The application utilizes image processing techniques and machine learning algorithms to analyze images captured by smartphones and provide real-time disease diagnosis and recommendations.
Kowsari et al. [9] Capsicum annuum L. diseases diagnosis based on ensemble deep learning approach. Plant Methods.
Das et al. [10] A review on deep learning applications in detecting and classifying diseases in pepper plants. Journal of Plant Diseases and Protection.Wang et al [11] Plant disease identification using deep learning: A review.

III. METHODOLOGY

This section will cover every step of the training, testing and developing the model from gathering data to employing most potent deep learning models to train our own data. The procedure begins with the input image, which stands in for the raw data that was sent into the system for analysis. Subsequently, the input data undergoes preprocessing, which includes operations like scaling, normalization, and augmentation, to prepare it for model training the data was divided into numerous subgroups for validation, testing and training after it had undergone preprocessing. Using the RCNN model, we input pictures of the pepper leaf. In order to avoid overfitting and modify hyperparameters, the model's performance is assessed simultaneously using the validation dataset.

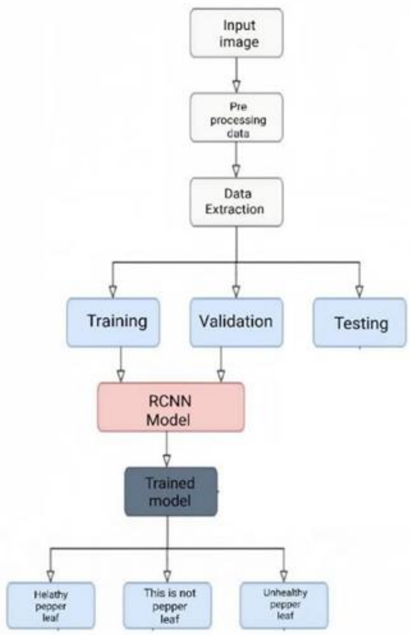

Fig. 1. Model Architecture

In order to make sure that the final deployed model is reliable and strong for classification tasks, validation is required to assess the model's performance and spot possible problems. In the fig.1 we can see the model architecture. In this diagram there are three outputs which leaf is healthy or unhealthy

Industrial Engineering Journal
ISSN: 0970-2555
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and final output is this is not pepper leaf image as the image given is random or not pepper leaf. If the image is either tomato or any other leaf then the output will be as this is not pepper leaf. By using this methodology, we can able to prove whether the leaf is healthy or unhealthy.

A. Dataset Analysis

The Plant Village dataset which contains 15000 images, is used with different leaves such as Pepper leaves, Potato leaves, Tomato leaves etc. This dataset provides images of different leaves healthy or unhealthy. Every image in the collection, it is evident, has a ground truth label describing the precise type of leaf it depicts. The table below shows types of leaves in the dataset.

S NO.	Leaf Name
1	Pepper leaf
2	Tomato leaf
3	Potato leaf

Table. 1 Types of leaves

B. Dataset Visualization

Graphical representation 06which is visual representation of dataset is made in order to get brief understanding and visualization of different types of leaves in training and testing as shown fig 2

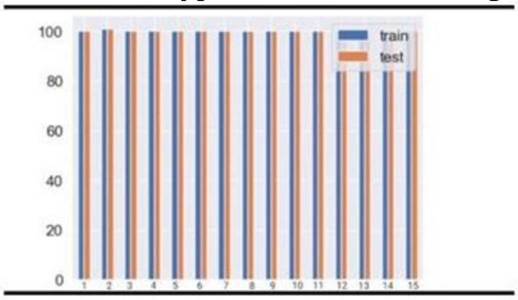

Fig. 2. Data visualization

C. Pre-Processing Technique

Pre-processing serves as a fundamental step in the pipeline of image analysis, particularly in the domain of plant disease detection. In the context of detecting pepper leaf diseases using image data, pre-processing is essential to improving the photos' quality and usefulness. This article elaborates on the significance of pre-processing in the detection of pepper leaf diseases

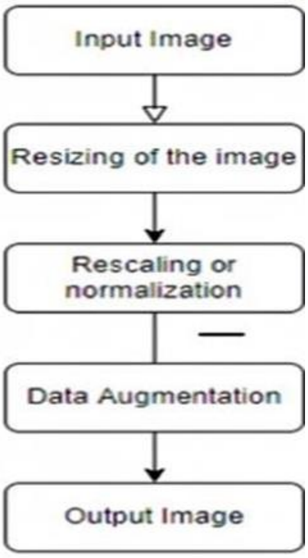

Fig.3.Preprocessing

D. Training the Model

Fine-tune the pre-trained RCNN model on the annotated dataset of pepper leaf images. During training, the model learns to localize and classify disease instances within the leaf images. Utilize techniques in order to boost the variety of training samples and strengthen the model's Dataset Visualization resilience to changes in disease appearance and leaf conditions. samples of such augmentations include rotation, flipping, and scaling of the data. Stochastic gradient descent (SGD) or Adam are two gradient-based optimization algorithms that can be used to train a model. The learning rate and other hyperparameters can then be adjusted to maximize performance.

E. Evaluating thr Model

To track the trained RCNN model's capacity for generalization and identify any overfitting, evaluate its performance on a different validation dataset. Assess the model's accuracy in disease identification and localization quantitatively by using common measures including precision, recall, F1-score, and mean Average Precision (map).

F. Model Deployment

Once satisfactory performance is achieved on the validation dataset, evaluate the trained RCNN model on a separate test dataset to assess its real-world performance. Deploy the trained model for inference on new, unseen pepper leaf images, providing accurate and efficient disease detection capabilities for agricultural applications.

G. Accuracy Detection

This RCNN model was tested using a dataset with 150,000 photos. This model identified PLBD pepper leaves with 99.59% accuracy. We also used real-time pepper images using Region-based Convolutional Neural Networks (RCNNs) with a focus on achieving high accuracy.

Table.2 shows the accuracy and loss values with Epoch iteration. Fig.4 and 5 shows the graph of accuracy, loss and validation values

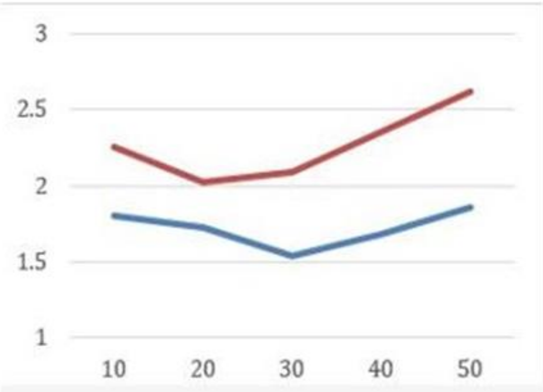

Fig.4. Validation graph

	E-poch	Loss	Accuracy
RCNN Model Values	1	0.4791	0.7898
	7	0.2192	0.8728
	10	0.1373	0.9177
	13	0.0571	0.9905
	15	0.0392	0.9959

Table.2. Loss and accuracy

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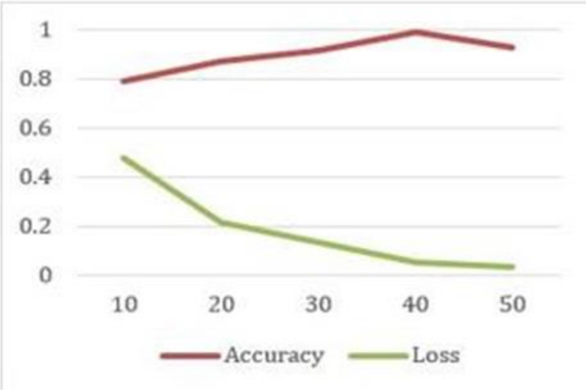

Fig.5 loss and Accuracy graph

IV. CONCLUSION

Finally, this article uses region-based convolutional neural networks to offer a robust solution for disease detection on pepper leaves. The system demonstrates high accuracy. By leveraging Deep learning techniques, this research contributes to advancements in disease management. The overall accuracy score of 99.58% reflects the model's resilient performance in detecting pepper leaf disease simultaneously, considering the class imbalance and complexity of the detection task. Overall, This RCNN model ensures food security in agriculture

V. RESULT

The methodology involves training the system on a diverse dataset comprising both healthy and diseased pepper leaves. To detect whether pepper leaves are healthy or unhealthy using the RCNN model using RCNN model. To detect random images and also real-time images using RCNN model. We also made a difference in the accuracy from the base paper and our paper. The accuracy in our paper increased by 0.59.

A. Image Upload

Fig.6. Upload the image

Users have opportunity to select from images and choosing an image and upload the image

B. *DISPLAY PREDICTED RESULT*

the Fig.8 shows the result that the pepper leaf is healthy or unhealthy. If the leaf is healthy, it shows "This is a Healthy Pepper leaf.". If the leaf is Un-healthy, it shows "This is an Un-healthy pepper leaf". If the image shows different image, then the output shows "This is not Pepper leaf image".

As the model goes through training iterations, the accuracy and loss graph show, with the accuracy gradually increasing and the loss decreasing. To improve performance and attain greater accuracy rates, it might be required to fine-tune the model architecture, modify hyperparameters, or add to the dataset. This would increase the overall efficacy of disease identification in pepper plants.

Fig.7. Healthy Pepper Leaf

Fig.8. Unhealthy Pepper Leaf

REFERENCES

[1] Chavan, A. P., Patil, S. P., & Bhosale, P. M. (2018). Automated Pepper Plant Disease Detection and Classification Using Image Processing Techniques. "In the proceedings of the 2018 International Conference on Communication, Computing, and Internet of Things (IC3IoT)"

[2] Rajput, V., Prasad, S., & Singh, R. K.(2019). Pepper Plant Disease Detection and Classification Using Deep Learning Techniques. "The 2019 3rd International Conference on Electronics and also in the Communication, Aerospace Tech (ICECA).

[3] Kumar, N.., Belhumeur, P. N., Biswas, A., & Jacobs, D. W. (2020). A Survey on Deep Learning Techniques for Plant Disease Detection and Diagnosis. Frontiers in Plant Science, 11, 572135.

[4] Patil, S. P., Chavan, A. P., & Bhosale, P. M. (2020). Detection and Classification of Pepper Plant Diseases Using Machine Learning Algorithms. 2020 International Using Convolutional Neural Networks. In: Shakya, S., Du, KL., Hoaxing, W. (eds).
Lvol 351. Springer, Singapore https://doi.org/10.1007/978-981-16-7657-4_3

[5] Singh, R., Mishra, P., Tripathi, A., & Srivastava, V. (2021). Development of a Smartphone-Based Application for Pepper Plant Disease Diagnosis. 2021 IEEE Uttar Pradesh Section International Conference on Electrical, Computer and Electronics Engineering (UPCON).

[6] Lee, J., Kim, J., Kang, J., & Park, D. S. (2022). Detection of Pepper Plant Diseases Using Convolutional Neural Networks and Transfer Learning.2022 IEEE International Conference on Consumer Electronics - Taiwan (ICCE).

[7] S. S. Chouhan, A. Kaul, U. P. Singh and S. Jain, "Bacterial foraging optimization based radial basis function neural network (brbfnn) for identification and classification of plant leaf diseases: An automatic approach towards plant pathology" DOI: 10.1109/ACCESS.2018.2800685

[8] Singh, R., & Saha, S. (2020). An intelligent approach for detection and classification of leaf diseases in pepper plants using convolutional neural networks. Computers and Electronics in

Agriculture, 169, 105183.
[9] Kowsari, K., Pourpanah, F., & Rahimian, M. H. (2021). Capsicum annuum L. diseases diagnosis based on ensemble deep learning approach. Plant Methods, 17(1), 1-20.
[10] Das, S., Das, A., & Samanta, A. K. (2022). A review on deep learning applications in detecting and classifying diseases in pepper plants. Journal of Plant Diseases and Protection, 129(1), 63-75.
[11] I. Haque, K. R. Md Ashiqul Islam, A. A. S. Md Mizanur Rahaman and M. S. Islam, "Classifying Pepper Disease based on Transfer Learning: A Deep Learning Approach", International Conference on Applied Artificial Intelligence and Computing,
pp. 620-629,2022. **DOI:** 10.1109/ICAAIC53929.2022.9793178
[12] Wang, L., Zhang, Y., & Gao, X. (2020). Plant disease identification using deep learning: A review.
[13] Raju, S., Kumar, R., & Bhatt, S. (2023). Detection of pepper plant diseases using machine learning techniques: A comparative study. Journal of Plant Pathology & Microbiology, 14(5), 1-8.
[14] Midhun P Mathew, Therese Yamuna Mahesh, Determining the Region of Apple Leaf Affected by Disease Using YOLO V3. In 2021 International Conference on Communication, Control and Information Sciences (ICCISc-2021)
[15] R. Sharma and V. Kukreja, "Segmentation and Multi-Layer Perceptron: An Intelligent Multi-classification model for Sugarcane Disease Detection", International Conference on Decision Aid Sciences and Applications (DASA), pp. 1265-1269, 2022.DOI**:** 10.1109/DASA54658.2022.9765191